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## Opening address

Distinguished Guests,  
Ladies and gentlemen,  
Good morning.

On behalf of the Korean Federation of Fisheries Science and Technology (KOFFST) Presidents, I sincerely welcome you to the KOFFST International Conference 2023. First of all, I would like to express my gratitude to Deputy Mayor Lee Seong-kweun of Busan City for his generous support for KOFFST's international conference and his welcome greetings today. I am very grateful to the president No Dong-jin of the Korean federation of Fisheries industries Associations(KFA), and the president Tadashi Tokai of the Japanese Society of Fisheries Science for coming to congratulate this event and giving congratulatory remarks.

In addition, Dr. Yoshiaki KAI(Kyoto University), Bertrand Collet(INRAE), Olafur Arnar Ingolfsson(IMR) and Dr. Rayan Carnegie(Virginia Institute of Marine Science), who will give keynote lectures, and guest lecturers from each fishery-related society, distinguished guests and all participants of this conference, and graduate students who will lead the future of Korean fisheries science, thank you very much.

Distinguished guests and members.

The theme of this conference is 'Fisheries Science in the Era of the Fourth Industrial Revolution'. Over the past three years, COVID-19 has had a huge impact on diverse industries as well as our health and life styles in worldwide. In the fisheries sector, the decrease in foreign human resources has led to a sharp drop in productivity due to suspension of operations resulted from the pandemic.

We are starting to break away from the influence of COVID-19 and to re-start normal activities. Although the stage of the pandemic would be the end, we are facing new difficulties because of population decline and aging issues.

With the recent development of computer technology, we are trying to overcome many difficult issues with automation and smart technology in combination in big data, AI platform, ICT, and IoT technologies, in particular, in the primary industrial sector such as agriculture. In addition, we are focusing a lot of investment and efforts on the development of new renewable energy such as offshore wind power generation and carbon-neutral technology. We have to adapt those new trend and technologies in the fisheries sector. I think the fourth industrial

revolution of big data and AI platforms should be urgently occurred in the fisheries.

My colleagues, senior and junior researchers! We will have to pass on the rich and beautiful sea to our descendants. To this end, we should make more efforts to open an era of fisheries research based on science and new technology in the 21st century.

In response to these social demands of the times, I will strive to lead the future fisheries by gathering various opinions to solve problems in the fisheries based on mutual expertise in the field of fisheries science among members.

Finally, I am very happy to meet you like this despite your busy schedule. I hope that you will enjoy the autumn of Busan in your spare time during this international conference and achieve meaningful results. Thank you very much, everyone.

**Hwang Doo-Jin**

**President of Korean Federation of Fisheries Science and Technology Societies**

# Welcoming address

**2023 International Academic Conference of KOFFST**  
**(Theme: Fisheries Science in the Era of the Fourth Industrial Revolution)**

10:00 AM, November 3<sup>rd</sup> (Fri) at BEXCO

Nice to meet you all.

I am LEE Seong-kweun, Vice Mayor for Economic Affairs of Busan Metropolitan City.

To begin, I wish to extend my warmest welcome to the International Academic Conference of KOFFST (the Korean Federation of Fisheries Science and Technology Societies), being held here in the city of Busan.

In addition, I would like to express my sincere gratitude to Chairman Hwang Doo-Jin of the Korean Federation of Fisheries Science Societies for opening the doors to further elevate this conference, which is focused on the theme, "Fisheries Science in the Era of the Fourth Industrial Revolution."

I am deeply grateful for the participation of Chairman No Dong-jin of the National Federation of Fisheries Cooperatives, and Chairman Tadashi Tokai of JSFS (the Japanese Society of Fisheries Science), among all the other esteemed society presidents and experts who have taken time out of their busy schedules to be here with us today.

As we head into the 21<sup>st</sup> century, this conference, under the theme of "Fisheries Science in the Era of the Fourth Industrial Revolution", will be a stepping stone to bring continual innovation to the fisheries industry overall, including seafood production, processing, distribution, and the marine environment, through the convergence of cutting-edge technology and fisheries science.

Busan has been actively pursuing various projects centered on key areas that will be of importance in the Fourth Industrial Revolution era. For example, the city has steadily been developing a Smart Aquaculture Cluster Test-bed, establishing an Intelligent Aquaculture Big Data Center, modernizing the Busan Cooperative Fish Market, creating a platform for seafood products, and forming a seafood product cluster. We have also implemented projects such as a system to predict and address issues emerging from the seafood distribution process by using big data analysis, and are building a platform through the collection, analysis, and standardization of big data from aquaculture facilities to enhance production efficiencies and ensure optimal breeding conditions within the Smart Aquaculture Cluster.

I truly hope that this international academic conference will serve as a strong foundation for contributing to the future industrialization of the fisheries sector. As for Busan, the city is fully committed to pursuing projects focused on continuous research and innovation in order to play a greater role in the growth and development of fisheries science.

Furthermore, it is just a matter of weeks until the selection of the host country for the 2030 World Expo, which holds the potential to be a groundbreaking opportunity for, not only the Republic of Korea, but also our friends around the world, to take a giant leap forward in terms of industrial and economic progress. As such, I earnestly request your generous support and cooperation to ensure that the 2030 Busan World Expo becomes a reality.

In closing, I sincerely hope that the International Academic Conference of KOFFST, a venue for the world's most esteemed experts in this field to present their latest research accomplishments, will continue to grow and flourish alongside the Busan International Seafood & Fisheries Expo, which is being held here at BEXCO at the same time.

In closing, I offer my best wishes for the good health of all the participants joining us today.

Thank you

**LEE Seong-kweun**  
**Vice Mayor for Economic Affairs of the Busan Metropolitan City**

## Congratulatory address

Hello, everyone!

I am delighted to extend my sincere congratulations on the convening of an international conference in the field of fisheries science in the era of the Fourth Industrial Revolution.

President Hwang Doo-jin of the Korean Federation of Fisheries Science and Technology Societies and heads of organizations that are the member of the KOFFST who have been playing a leading role in the advancement of our fisheries science and host this meaningful event today!

Deputy Mayor Lee Seong-kwon of Busan Metropolitan City who is here with us out of his busy municipal schedule! I would like to thank all of you for attending today's event.

Currently, we are entering a new era known as the Fourth Industrial Revolution, driven by innovative technological advancements not only in Korea but all over the world.

Key technologies such as data, networks, and what is commonly referred to as artificial intelligence are reshaping traditional industrial structures.

Our fisheries industry, too, stands at the forefront of this transformation.

Various Information and Communication Technologies (ICT) are being integrated into the production, distribution, and processing of fisheries products. This transition is aimed at transforming the industry from a simple catch-and-grow model into one that creates new value-added opportunities.

It is undeniably a matter of great satisfaction that our government is actively promoting the advancement of the fisheries industry to drive future growth and industrialization in line with the Fourth Industrial Revolution.

If our fisheries industry and the scientific community actively participate in these changes, I am confident that South Korea will make a new leap, emerging as a leading global maritime power.

At this juncture, it is with great delight that we see some of the most distinguished fisheries science experts from both domestic and international spheres coming together to explore the direction in which the marine industry should progress.

I sincerely hope that our fisheries sector will leap forward as a key industry leading the way in the Fourth Industrial Revolution through active collaboration between the marine industry and the field of science in the future.

Thank you very much.

**No Dong-jin**  
**President of National Federation of Fisheries Cooperatives**



## Congratulatory address

Honorable members of the Korean Federation of Fisheries Science and Technology Societies, distinguished guests, colleagues, and friends,

It is my great honor to address this esteemed gathering at the international conference of the Korean Federation of Fisheries Science and Technology Societies, KOFFST, as the President of the Japanese Society of Fisheries Science.

I would also like to extend my sincere congratulations to President Doo-Jin HWANG and all the staff of the Korean Federation of Fisheries Science and Technology Societies for successfully organizing the 2023 International Conference entitled "Fisheries Science in the Era of the Fourth Industrial Revolution".

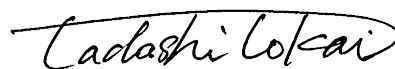
The field of fisheries and aquatic science faces many challenges, from ensuring sustainable fisheries management to addressing the impacts of climate change and some other environmental issues on aquatic ecosystems. The two societies, the Korean Federation of Fisheries Science and Technology Societies and the Japanese Society of Fisheries Science, share the common goal of developing fisheries and aquatic sciences for the betterment of our respective countries and the international community. In the spirit of cooperation and knowledge sharing, we can come together, share experiences, and jointly find innovative solutions to these pressing issues.

I would like to express our sincere appreciation to the Korean Federation of Fisheries Science and Technology Societies for the opportunity provided to our Society, and in particular for allowing our Society's postdoctoral members to share their expertise and research at this prestigious conference. This collaborative spirit exemplifies the strength that emerges when the two societies come together to support the advancement of fisheries and aquatic science.

The next spring meeting of the Japanese Society of Fisheries Science will be held March 27-30, 2024, in the vibrant city of Tokyo, so please be sure to join us. This will be an excellent opportunity for further collaboration and exchange of ideas.

Finally, I wish the Korean Federation of Fisheries Science and Technology Societies every success and further development.

Thank you very much, gamsahabnida.



**Tadashi Tokai**

**President of The Japanese Society of Fisheries Science**

## Board Members in 2023

### ◎ Officers and Board Members in 2023 KOFFST

President : Hwang, Doo-Jin (Chonnam National University)

Vice-Presidents : Lee, Jung-Suck (Gyeongsang National University)

Im, Yang-Jae (National Institute of Fisheries Science)

Jung, Sung-Ju (Chonnam National University)

Lee, Yong Seok (Soonchunhyang University)

### ◎ Planning committee chair and members

Members : Lee, Yoo-Won (Pukyong National University)

Eom, Sung-Hwan (Dong-Eui University)

Park, Jeong-Ho (National Institute of Fisheries Science)

Hong, Suhee (Gangneung-Wonju National University)

Sang, Min Kyu (Soonchunhyang University)

\* KOFFST, Korean Federation of Fisheries Science and Technology Societies. KOSFAS, The Korean Society of Fisheries and Aquatic Science. ISK, The Ichthyological Society of Korea. KSFP, The Korean Society of Fish Pathology. KSFOT, The Korean Society of Fisheries and Ocean Technology. MSK, The Malacological Society of Korea.

### ◎ Society Contact

#### **KOSFAS**

(Tel: 051-629-7363 / E-mail: kosfas@kosfas.or.kr / Homepage: <http://www.kosfas.or.kr> )

#### **ISK**

(Tel: 061-690-8931 / E-mail: fish-korea@naver.com / Homepage: <http://www.fishkorea.or.kr> )

#### **KSFP**

(Tel: 033-640-2852 / E-mail: ksfp1988@naver.com / Homepage: <http://www.ksfp.org> )

#### **KSFOT**

(Tel: 051-629-5994 / E-mail: ksft7@daum.net / Homepage: <http://www.fishtech.or.kr> )

#### **MSK**

(Tel: 041-530-3040 / E-mail : malacol@naver.com / Homepage: <http://www.malacol.or.kr> )

## Program Schedule

### “Fisheries Science in the Era of the Fourth Industrial Revolution”

#### ○ November 2<sup>nd</sup>, 2023 (Thursday)

TIME	PROGRAM
11:30 -	Registration
13:00 - 18:00	Oral presentation, Symposium & Workshop

#### ○ November 3<sup>rd</sup>, 2023 (Friday)

TIME	PROGRAM
09:00 -	Registration
10:00 - 10:40	<b>Opening ceremony:</b> Chairperson Kyounghoon Lee (Pukyong National University)
	Opening address: Doo-Jin Hwang (President, KOFFST)
	Welcoming address: Seong-Kweun Lee (Vice Mayor for Economic Affairs, Busan Metropolitan City)
	Congratulatory address: Dong-jin No (Chairman, National Federation of Fisheries Cooperatives) Tadashi Tokai (President, The Japanese Society of Fisheries Science) Cecil A. Jennings (President, The American Fisheries Society)
	<b>Group photo</b>
10:40 - 12:00	<b>Plenary session:</b> Chairperson Young-Mog Kim (Pukyong National University) Heui Chun An (Korea Institute of Fisheries and Ocean Engineering)
10:40 - 11:20	I: Tadashi Tokai (Professor, Tokyo University of Marine Science and Technology, Japan)
11:20 - 12:00	II: Olafur Arnar Ingolfsson (Researcher, Institute of Marine Research, Norway)
12:00 - 12:10	<b>Prize draw</b>
12:10 - 13:00	<b>Break time</b>
13:00 - 17:30	<b>Annual meeting and Conference</b> Invited presentation, Oral and Poster presentation
17:40 - 18:00	<b>KOFFST General meeting</b>
18:30 -	<b>Reception</b>

## 각 학회별 일정표

November 2<sup>nd</sup>, 2023 (Thursday)

### (1) 한국수산과학회(KOSFAS) #211~#214

시간 Time	내용 및 사회자/좌장 Program & Chair			
	수산이용가공 (211호) Fisheries Processing · Uses	양식·생물공학 (212호) Aquaculture	자원·해양·환경 (213호) Fisheries Resources · Ocean · Environment	양식·생물공학 (214호) Aquaculture
13:00-18:00	Part I 구두발표 Oral presentation part I  좌장: 엄성환 (동의대학교) Sung-Hwan Eom	Part I 구두발표 Oral presentation part I  좌장: 이봉주 (공주대학교) Bong-Joo Lee	Methodology for fishery menagement I  좌장: 신동훈 (국립수산과학원) Donghoon Shin	[유수식 디지털양식 혁신기술개발사업] 기술워크숍
	Part II 구두발표 Oral presentation part II  좌장: 엄성환 (동의대학교) Sung-Hwan Eom	Part II 구두발표 Oral presentation part II  좌장: 허성표 (제주대학교) Sung-Pyo Hur	Methodology for fishery menagement II  좌장: 최정화 (국립수산과학원) Jung Hwa Choi	
	Part III 구두발표 Oral presentation part III  좌장: 김경태 (동의대학교) Kyung Tae Kim		Feeding ecology of fish  좌장: 백근욱 (경상국립대학교) Geun-Wook Baek	
		Part III 구두발표 Oral presentation part III  좌장: 현지연 (한국해양과학 기술원) Ji Yeon Hyeon	KOICA program  좌장: 박원규 (부경대학교) Won-Gyu Park	

November 3<sup>rd</sup>, 2023 (Friday)

## (1) 한국수산과학회(KOSFAS) #211~#213

시간 Time	내용 및 사회자/좌장 Program & Chair		
13:00-14:00	<b>평의회 및 총회(214호)</b> Annual & council meeting 이은우(동의대학교) Eun-Woo Lee		
14:00-17:30	수산이용가공 (211호) Fisheries Processing · Uses	양식·생물공학 (212호) Aquaculture	자원·해양·환경 (213호) Fisheries Resources · Ocean · Environment
	<b>신진과학자</b> Young scientist presentation  <b>좌장:</b> 이상길 (부경대학교) Sang Gil Lee	<b>Part IV 구두발표</b> Oral presentation part IV  <b>좌장:</b> 변준환 (부경대학교) Jun-Hwan Byun	<b>Ecology of fishery resources I</b>  <b>좌장:</b> 이충일 (강릉원주대학교) Chung Il Lee
	<b>Marine biotechnology for Food Processing</b>  <b>좌장:</b> 심길보 (부경대학교) Kil Bo Shim	<b>Part V 구두발표</b> Oral presentation part V  <b>좌장:</b> 이승형 (부경대학교) Seunghyung Lee	<b>Ecology of fishery resources II</b>  <b>좌장:</b> 이경훈 (부경대학교) Kyounghoon Lee
		<b>Part VI 구두발표</b> Oral presentation part VI  <b>좌장:</b> 박영진 (선문대학교) Youngjin Park	

November 3<sup>rd</sup>, 2023 (Friday)

(2) 한국어류학회(ISK) #314

시간 TIME	내용 PROGRAM	사회자/좌장 CHAIR
13:40-14:00	총회 General assembly	박정호(국립수산과학원) Jeong-Ho Park
14:00-14:50	초청특강 Invited Speaker	김진구(국립부경대학교) Jin-Koo Kim
14:50-15:00	Coffee break	
15:00-15:50	Part I 구두발표(특별) Oral presentation part I	이완옥(순천향대학교) Wan-Ok Lee
15:50-16:00	Coffee break	
16:00-17:15	Part II 구두발표 Oral presentation part II	백근욱(경상국립대학교) Gun Wook Baek

November 2<sup>nd</sup>, 2023 (Thursday)

(3) 한국어병학회(KSFP) 부경대학교 대연캠퍼스 향파관(A15) 409호

시간 TIME	내용 PROGRAM	사회자/좌장 CHAIR
13:50-14:00	등록 Registration	
14:00-15:00	Session 1 새우 급성간췌장괴사병(AHPND)	김도형(부경대학교) Do-Hyung Kim
15:00-16:00	Session 2 무지개송어와 뱀장어 증례	조미영(국립수산과학원) Miyoung Cho
16:00-17:00	Session 3 강도다리와 넙치 증례	신상필(공주대학교) Sang Phil Shin

November 3<sup>rd</sup>, 2023 (Friday)

(3) 한국어병학회(KSFP) #315

시간 TIME	내용 PROGRAM	사회자/좌장 CHAIR
13:20-13:50	정기총회 General assembly	홍수희(강릉원주대학교) Suhee Hong
13:50-14:00	휴식 Break time	
14:00-15:00	초청특강 Invited Speaker	김도형(부경대학교) Do-Hyung Kim
15:00-15:10	Coffee break	
15:10-16:10	Part I 구두발표 Oral presentation part I	김영철(강릉원주대학교) Young-Chul KIM
16:10-16:20	Coffee break	
16:20-17:20	Part II 구두발표 Oral presentation part II	김형준(국립수산과학원) Hyoung Jun Kim
17:20-17:30	Coffee break	
17:30-18:30	Part III 구두발표 Oral presentation part III	정명화(한서대학교) Myung-Hwa Jung



November 3<sup>rd</sup>, 2023 (Friday)

(4) 한국수산해양기술학회(KSFOT) #316

시간 TIME	내용 PROGRAM	사회자/좌장 CHAIR
13:00-13:30	총회 General assembly	이유원(부경대학교) Yoo-Won Lee
13:30-14:30	Part I 구두발표 Oral presentation part I	차봉진(국립수산과학원) Bong-Jin Cha
14:30-14:40	Coffee break	
14:40-15:55	Part II 구두발표 Oral presentation part II	이성일(부경대학교) Sung-Il Lee
15:55-16:05	Coffee break	
16:05-17:20	Part III 구두발표 Oral presentation part III	김민선(군산대학교) Min-Son Kim

November 3<sup>rd</sup>, 2023 (Friday)

(5) 한국패류학회(MSK) #317

시간 TIME	내용 PROGRAM	사회자/좌장 CHAIR
13:00-13:20	총회 General assembly	상민규 (한국자생동물자원활용 융복합연구소) Min Kyu Sang
13:20-13:50	초청 강연 Invited speaker session	최광식(제주대학교) Kwang-Sik Choi
13:50-14:50	Part I 구두발표 Oral presentation part I	조상만(군산대학교) Sang-Man Cho
14:50-15:00	Coffee break	
15:00-16:00	Part II 구두발표 Oral presentation part II	이희중(국립수산과학원) Hee Jung Lee
16:00-16:10	Coffee break	
16:10-17:30	Part III 구두발표 Oral presentation part III	정희도(국립수산과학원) Hee-Do Jeung

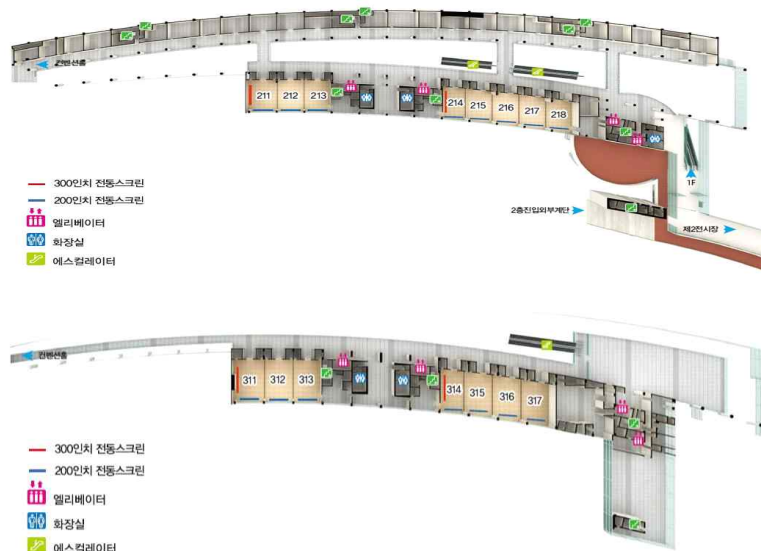
## Venue info. (학술대회 장소안내)

### BEXCO 제1전시장 2F, 3F

- 개회식, 공동초청특강 : 벅스코 제1전시장 2층, 214호
- 학회별 총회 및 구두 발표 : 벅스코 제1전시장 2층,  
211호~214호 및 3층,  
314호~317호
- 포스터 발표 : 벅스코 제1전시장 2층, 217호~218호
  - 포스터 규격 : 80cm x 110cm (가로 x 세로)
  - 부착 및 철거시간 : 11월 3일(금) 10시까지 부착,  
11월 3일(금) 17시 이후 철거
  - 발표자 본인께서 부착 및 회수하셔야 합니다.
  - 포스터 게시는 부착 시간에 반드시 부착 유지하여  
포스터가 누락되는 일이 없도록 협조 바랍니다.  
포스터 발표상 심사에 반영됩니다.  
(해당 기간 내 미부착으로 인한 불이익이 발생할 수  
있습니다.)

### ○ 11 월 3 일 행사장 안내 : BEXCO 제 1 전시장

- (1) 개회식, 공동초청특강 : 214호
- (2) 한국수산과학총연합회 총회 : 214호
- (3) 구두발표 학술대회장 : 211호~213호 및 314호~317호
- (4) 포스터발표 : 217호~218호



- \* KOSFAS, The Korean Society of Fisheries and Aquatic Science. ISK, The Ichthyological Society of Korea. KSFP, The Korean Society of Fish Pathology. KSFOT, The Korean Society of Fisheries and Ocean Technology. MSK, The Malacological Society of Korea.

분야별 구두발표회장 Venue of oral presentation		학회별 총회장 Venue of annual meeting	
수산이용가공 Fisheries Processing • Uses	211호	한국수산과학회 KOSFAS	214호
양식 • 생물공학 Aquaculture	212호		
자원 • 해양 • 환경 Fisheries Resources • Ocean • Environment	213호		
어류분류 • 생태 • 유전 Fish Taxonomy • Ecology • Genetics	314호	한국어류학회 ISK	314호
어병 Fish Diseases	315호	한국어병학회 KSFP	315호
어업기술 Fisheries and Ocean Technology	316호	한국수산해양기술학회 KSFOT	316호
패류 Malacology	317호	한국패류학회 MSK	317호
* 개회식 Opening ceremony * 공동초청특강 Plenary session (Invited presentation)		214호	
* 한국수산과학총연합회 총회 KOFFST General meeting		214호	
* 포스터 전시 Poster presentation		217호~218호	

## Registration info.

등록장소 Registration venue		벅스코 제1전시장 2층 로비 등록데스크
등록비 Registration fee	일반 Regular	₩150,000
	학생 Student	₩50,000

## Traffic info.

- 버스 : 5-1, 31, 39, 40, 63, 100, 107, 100-1, 115, 115-1, 139, 141, 155, 181, 200, 1001, 1002, 1006 번 이용 – 센텀시티역(벅스코) 하차
  - 지하철 : 2 호선 센텀시티(벅스코)역 하차
  - 주차안내
    - 주차비는 한국수산과학총연합회에서 지원하지 않습니다.
    - 주차권 발급을 받으실 때, 1일용으로 받으셔야 편리합니다. (소형: 1일 15,000원, 대형: 1일 30,000원)
- 단, 수시로 출입하면 매번 주차비는 별도로 지불하셔야 합니다. (10분마다 소형: 400원, 대형: 800원)

November 3<sup>rd</sup>, 2023 (Friday)

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∴ Opening ceremony

#214

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*Chairperson: Kyoungsoon Lee (Pukyong National University)*

10:00-10:40

Opening address

Doo-Jin Hwang

President of the Korean Federation of Fisheries Science and Technology Societies

Welcoming address

Seong-Kweun Lee

Vice Mayor for Economic Affairs of the Busan Metropolitan City

Congratulatory address

Dong-jin No

Chairman of the National Federation of Fisheries Cooperatives

Tadashi Tokai

President of the Japanese Society of Fisheries Science

Cecil A. Jennings

President of the American Fisheries Society

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**∴ Plenary session (PS-1 ~ PS-2)**

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#214

*Chairperson: Young-Mog Kim (Pukyong National University)*

10:40-11:20 PS-1 Research on marine plastic pollution and countermeasures in the fishing industry in Japan

Tadashi Tokai

Tokyo University of Marine Science and Technology

*Chairperson: Heui Chun An (Korea Institute of Fisheries and Ocean Engineering)*

11:20-12:00 PS-2 Norwegian smart fishing technology in the era of the fourth industrial revolution

Olafur Arnar Ingolfsson

Fish Capture Research Group, Institute of Marine Research, Bergen NO-5817, Norway

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∴ **Invited speaker session (IS-1 ~ IS-4)**

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#314, Exhibition center 1, BEXCO

*Chairperson: Jin-Koo Kim (Pukyong National University)*

14:00-14:50 IS-1 Comparative phylogeography of the North Pacific marine fishes

Yoshiaki Kai

Maizuru Fisheries Research Station, Field Science Education and Research Center, Kyoto University

#315, Exhibition center 1, BEXCO

*Chairperson: Do-Hyung Kim (Pukyong National University)*

14:00-14:30 IS-2 Genome editing in fish cells – from basic research to applications in disease control

Bertrand Collet

Université Paris-Saclay, INRAE, UVSQ, VIM, 78350, Jouy-en-Josas, France

14:30-15:00 IS-3 Fish vaccination by needle-free innovation nano-vaccines

Channarong Rodkhum<sup>1,2</sup>

<sup>1</sup>Department of Veterinary Microbiology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, 10330, Thailand.

<sup>2</sup>Center of Excellence in Fish Infectious Diseases, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, 10330, Thailand

#317, Exhibition center 1, BEXCO

*Chairperson: Kwang-Sik Choi (Jeju National University)*

13:20-13:50 IS-4 Evolutionary ecological insight into an oyster-pathogen system is key to effective management of an important marine resource species, the eastern oyster in the USA

Ryan Carnegie

Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, Virginia 23062, USA



## Fisheries Processing · Uses (OU-1 ~ OU-18)

November 2<sup>nd</sup>, 2023 (Thursday)

∴ Oral presentation part I

#211

*Chairperson: Sung-Hwan Eom (Dong-Eui University)*

13:00-13:15    OU-1    The ability of long arm octopus (*Octopus minor*) extract in preventing eye injury of zebrafish (*Danio rerio*) embryos by Particulate Matter

R.P.T.I. Ranasinghe and Seon-Heui Cha<sup>\*</sup>

Department of Marine Bio and Medical Sciences, Hanseo University,  
Seosan-si, 31962, Korea

13:15-13:30    OU-2    Potential utilization of *Bacillus* spp. isolated from *Jeotgal* as a microbial starter decomposing marine biomass

Min-Ung Kim<sup>1\*</sup>, Kyong-Jin Cho<sup>1</sup> and Young-Mog Kim<sup>1</sup>

<sup>1</sup>Department of Food Science and Technology, Pukyong National University,  
Korea

13:30-13:45    OU-3    Anti-inflammatory activity of dioxinodehydroeckol from *Ecklonia cava* in *Cutibacterium acnes*-induced inflammatory signaling by regulation of NF-κB activity

Eun-Song Kim<sup>1\*</sup>, Ju-Won Ryu<sup>1</sup>, Hyo-Bin Kim<sup>1</sup>, Kyung Tae Kim<sup>1</sup> and  
Sung-Hwan Eom<sup>1</sup>

<sup>1</sup>Department of Food Science & Technology, Dong-Eui University, Busan  
47340, Korea

13:45-14:00    OU-4    Toxic effects of hull cleaning wastewater on two marine diatoms  
*Skeletonema costatum* and *Navicula* sp.

TaeSoo Kim<sup>1</sup>, YunJi An<sup>1</sup>, HuiJeong Byeon<sup>1</sup>, Ho Rim Song<sup>3</sup>, Sang Mok Jung<sup>2</sup>, In Sun Kim<sup>3</sup> and Hyun Woung Shin<sup>1\*</sup>

<sup>1</sup>Department of Biology, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>2</sup>Research Institute for Basic Science, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>3</sup>AlgaeBio Co., Asan 31459, Republic of Korea

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∴ **Oral presentation part II**

#211

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*Chairperson: Sung-Hwan Eom (Dong-Eui University)*

14:10-14:25    OU-5    Comparison of antioxidant and physiological activities of  
different solvent extracts from *Sargassum thunbergii*

Da-Bin Park<sup>\*</sup>, Yeon-Ji Lee and Yong-Tae Kim

Dept of Food Science and Biotechnology, Kunsan National University, Gunsan 54150, Korea

14:25-14:40    OU-6    Maximizing phenolic potential: Subcritical water extraction  
optimization from *Ecklonia stolonifera*

Ye-Seul Park, Jin-Seok Park, Ji-Min Han, Yu-Na Shin, Ye-Ryeon Shin  
and Byung-Soo Chun<sup>\*</sup>

Department of Food Science and Technology, Pukyong National University, 45  
Yongso-ro, Namgu, Busan 48513, Republic of Korea

- 14:40-14:55    OU-7    Development of seasoning materials and water-soluble calcium processing technology using fish sauce by-product
- Seung Ah Son, Yeon Joo Bae, Jong Bong Lee, Ga Yeon Kwon and Kil Bo Shim  
Department of Food Science and Technology, Pukyong National University, Busan 48513, Republic of Korea
- 14:55-15:10    OU-8    Valorization of skipjack tuna (*Katsuwonus pelamis*) by-products: lipids extraction using supercritical CO<sub>2</sub>, protein recovery by subcritical water hydrolysis
- Ye-Ryeon Shin<sup>1</sup>, Jin-Seok Park<sup>1</sup>, Ji-Min Han<sup>1</sup>, Ye-Seul Park<sup>1</sup>, Yu-Na Shin<sup>1</sup> and Byung-Soo Chun<sup>1\*</sup>  
<sup>1</sup>Department of Food Science and Technology, Pukyong National University, 45, Nam-Gu, Busan 48513, Republic of Korea
- 15:10-15:25    OU-9    Exploring *Ecklonia cava* extracts for antioxidant and antidiabetic potential: A subcritical water extraction approach
- Yu-Na Shin<sup>1</sup>, Jin-Seok Park<sup>1</sup>, Ji-Min Han<sup>1</sup>, Ye-Seul Park<sup>1</sup>, Ye-Ryeon Shin<sup>1</sup> and Byung-Soo Chun<sup>1\*</sup>  
<sup>1</sup>Department of Food Science and Technology, Pukyong National University, 45 Yongso-ro, Nam-Gu, Busan 48513, Republic of Korea

*Chairperson: Kyung Tae Kim (Dong-Eui University)*

15:40-15:55    OU-10    Fisheries processing in Malawi

Hermis Chagoma

Department of Fisheries, Senga-bay Fisheries Research Centre, Salima. Malawi

15:55-16:10    OU-11    Comparison of nutritional and sensory properties of frozen dumplings made with red-banded lobster hot water extract and mealworm powder

Ga Yeon Kwon, Hyo Rim Lee, Do Hwi Kim, Ji Na Shin, Min Jae Kim, Yeon Joo Bae, Jong Bong Lee, Seung Ah Son, Suk kyung Sohn and Kil Bo Shim

Department of Food Science and Technology, Pukyong National University

16:10-16:25    OU-12    SWIR (shortwave infrared) hyperspectral imaging coupled with multivariate analysis for quality evaluation in dried laver

Jong Bong Lee, Suk Kyung Sohn, Seung Ah Son, Yeon Joo Bae, Ga Yeon Kwon and Kil Bo Shim\*

Division of Food Science and Biotechnology, Pukyong National University, Busan 48513, Republic of Korea

November 3<sup>rd</sup>, 2023 (Friday)

∴ Young scientist presentation

#211

*Chairperson: Sang Gil Lee (Pukyong National University)*

14:00-14:30 OU-13 PCL/Gelatin nanofibrous membrane integrated with polydeoxyribonucleotides extracted from unused marine organisms for skin regeneration

Tae-Hee Kim<sup>1,2\*</sup>, Se-Chang Kim<sup>2,3</sup>, Won Sun Park<sup>4</sup>, Il-Whan Choi<sup>5</sup>, Hyun-Woo Kim<sup>1,2,6</sup>, Hyun Wook Kang<sup>1,2,3</sup>, Young-Mog Kim<sup>1,2,7</sup> and Won-Kyo Jung<sup>1,2,3</sup>

<sup>1</sup>Research Center for Marine-Integrated Bionics Technology, Pukyong National University, Busan 48513, Republic of Korea; <sup>2</sup>Marine Integrated Biomedical Technology Center, The National Key Research Institutes in Universities, Pukyong National University, Busan 48513, Republic of Korea; <sup>3</sup>Major of Biomedical Engineering, Division of Smart Healthcare, College of Information Technology and Convergence and New-senior Healthcare Innovation Center (BK21 Plus), Pukyong National University, Busan 48513, Republic of Korea; <sup>4</sup>Department of Physiology, Kangwon National University School of Medicine, Chuncheon 24341, Republic of Korea; <sup>5</sup>Department of Microbiology and Immunology, College of Medicine, Inje University, Busan 47392, Republic of Korea; <sup>6</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea; <sup>7</sup>Department of Food Science and Technology, Pukyong National University, Busan 48513, Republic of Korea

14:30-15:00 OU-14 Controlling mono- and polymicrobial species biofilms by fucoidan-gold nanoparticles

Fazlurrahman Khan<sup>1,2,3</sup>, Nazia Tabassum<sup>2,3</sup>, Kyung-Jin Cho<sup>4</sup>, DoKyung Oh<sup>4</sup> and Young-Mog Kim<sup>2,3,4</sup>

<sup>1</sup>Institute of Fisheries Sciences, Pukyong National University, Busan 48513, South Korea

<sup>2</sup>Marine Integrated Biomedical Technology Center, The National Key Research Institutes in Universities, Pukyong National University, Busan 48513, Republic of Korea.

<sup>3</sup>Research Center for Marine Integrated Bionics Technology, Pukyong National University, Busan 48513, Republic of Korea

<sup>4</sup>Department of Food Science and Technology, Pukyong National University, Busan 48513, South Korea

15:00-15:30 OU-15 Alginic acid, a functional dietary ingredient derived from *Ecklonia maxima* stipe, attenuates the pro-inflammatory responses on particulate matter-induced lung macrophages

Hyun-Soo Kim

Department of Seafood Science and Technology, The Institute of Marine Industry, Gyeongsang National University, 2-9, Tongyeonghaean-ro, Tongyeong-si, Gyeongsangnam-do, 53064, Republic of Korea

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∴ **Marine biotechnology for Food Processing**

#211

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*Chairperson: Kil Bo Shim (Pukyong National University)*

15:40-16:15 OU-16 Determination of 11 residual organophosphate flame retardants in aquatic products across South Korea using modified QuEChERS and LC-MRM

Jin Hwan Kim, Min Kyeong Kwon, Young Min Kim, Ye Bin Shin and Yong Seok Choi<sup>\*</sup>

College of Pharmacy, Dankook University, Cheonan, South Korea

- 16:15-16:50 OU-17 Exploring the structural characteristics and potential health benefits of fucoidan: A study on gut microbiota modulation

Bomi Ryu<sup>1\*</sup>

<sup>1</sup>Major of Food Science and Nutrition, Pukyong National University, Busan 48513, Republic of Korea

- 16:50-17:25 OU-18 Big data analysis on muscle atrophy inhibition by *Sargassum serratifolium*

Bonggi Lee<sup>1,2\*</sup>, Heeyeon Ryu<sup>2</sup>, Hyeon Hak Jeong<sup>2</sup>, Myeong-Jin Kim<sup>1</sup> and Jae-II Kim<sup>1</sup>

<sup>1</sup>Major of Food and Nutrition, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>Department of Smart Green Technology Engineering, Pukyong National University, Busan 48513, Republic of Korea

## Aquaculture (OA-1 ~ OA-34)

November 2<sup>nd</sup>, 2023 (Thursday)

∴ Oral presentation part I

#212

*Chairperson: Bong-Joo Lee (Kongju National University)*

13:00-13:20   OA-1   Comparison of haematological and morphological characteristics of the starry flounder (*Platichthys stellatus*) triploid and hybrid (*P. stellatus*♀ × *Kareius bicoloratus*♂) triploid

Jung-Yeol Park<sup>1\*</sup>, Suk-Bin Moon<sup>1</sup>, Da-Bin Jin<sup>1</sup>, Jun-Wook Hur<sup>1</sup> and Han-Kyu Lim<sup>2</sup>

<sup>1</sup>Department of Aquaculture and Aquatic Science, Kunsan National University, Gunsan 54150, Korea

<sup>2</sup>Department of Marine and Fisheries Resources, Mokpo National University, Republic of Korea

13:20-13:40   OA-2   Development of cultivated seafood using aquatic animal cells

Hwa Jin Lee<sup>1,2</sup>, Hye Min Lee<sup>1,3</sup>, Sang-Yup Lee<sup>1</sup> and Sang Yoon Lee<sup>1</sup>

<sup>1</sup>CellQua, Inc, Seongnam 13595, South Korea

<sup>2</sup>Department of Biological Sciences, Kongju National University, Gongju 32588, South Korea

<sup>3</sup>Division of Fisheries Life Science, Pukyong National University, Busan 48513, South Korea

13:40-14:00   OA-3   A study on the symptoms of Byeokoreum (climbing a wall) of the juvenile abalone

Jong-Ak Lim<sup>1\*</sup>, Chun-Cheol Kim<sup>1</sup>, Yun-Seol Kim<sup>1</sup>, Yong-bin Park<sup>1</sup>, Hye-Ri Nam<sup>1</sup>, Mi-Ran Kim<sup>1</sup>, Kyeong-Woo Lee<sup>1</sup> and Young-Hun Kim<sup>2</sup>

<sup>1</sup>Fisheries seed Research Institute, Jeollanam-do Oceans&Fisheries Science Institute, Wando 59146, Republic of Korea

<sup>2</sup>Freshwater Fish Research Institute, Jeollanam-do Oceans&Fisheries Science Institute, Jangseong 57211, Republic of Korea



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**Break time**


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14:10-14:30   OA-4   *Vibrio atlantiscus* isolated from sea-farmed rainbow trout in winter of Japan

Maki Otani<sup>1</sup>, Fumio Takizawa<sup>1</sup> and Hiroaki Suetake<sup>1</sup>

<sup>1</sup>Faculty of Marine Science and Technology, Fukui Prefectural University, Obama 917-0003, Japan

14:30-14:50   OA-5   Introduction to anti-parasite functional feed

Meseguer Hernandez Eloy

Edificio Dibaq Cl La Cruz,3 40260 Fuentepelayo (segovia) Spain

14:50-15:10   OA-6   Application cases of 4Tress, an anti-parasitic substance in Dibaq feeds, on turbot

Sang-Hyun Jeong

Kumhomarine Technology Co.,Ltd, 50,Jigegol-ro, Namgu, Busan 48466, Republic of Korea

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**∴ Oral presentation part II**
**#212**


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*Chairperson: Sung-Pyo Hur (Jeju National University)*

15:20-15:35   OA-7   Aquaculture sector of Bangladesh

Md. Shafaet Alam

Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh

15:35-15:50   OA-8   Sustaining ocean wealth: A comprehensive analysis of Fiji's fisheries and aquaculture sector

Isileli Naqovudradra Veilomani Odrovakavula

Ministry of Fisheries, Suva, Fiji Islands

15:50-16:05 OA-9 Aquaculture sector of Nepal

Bikram Syangtan

Department of Livestock service, Ministry of Agriculture and Livestock Development, Nepal

16:05-16:20 OA-10 Status of fisheries and aquaculture in Rwanda

Placide Nkundimana

Division of Standards Compliance and Enforcement, Rwanda Inspectorate and Competition Authority,  
Kigali, Rwanda

16:20-16:35 OA-11 Integrated aquaculture system and climate change adaptations in Tanzania

Deborah Makuli Nyamhanga

Fisheries Extension Services, Ministry of Livestock and Fisheries, Njombe District Council, Republic of Tanzania

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∴ **Oral presentation part III**

#212

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*Chairperson: Ji Yeon Hyeon (Korea Institute of Ocean Science & Technology)*

16:45-17:00 OA-12 Current status of aquaculture in Timor-Leste

Delio Da Costa

National Institute of Fisheries and Aquaculture, Ministry of Agriculture and Fisheries, Dili, Timor-Leste

17:00-17:15 OA-13 Expanding ornamental fish cultivation for economic growth in Uganda: Opportunities, challenges, and the ways forward

Oguta Job Francis

Aquaculture Extension Services Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Aquaculture Extension, Karenga DLG

- 17:15-17:30 OA-14 Molecular characterization and evolution of ficolin in a primitive chondrosteian sturgeon, *Acipenser baerii*

Paschaline Udoka Ferdinand<sup>1,2,3\*</sup>, WSP Madhuranga<sup>3</sup>, CWR Gunasekara<sup>3</sup>, Jiye Lee<sup>3</sup>, Young Gil Shin<sup>3</sup> and Chan-Hee Kim<sup>3</sup>

<sup>1</sup>National Biotechnology Development Agency, Federal Ministry of Science and Technology, Abuja, 900109, Nigeria

<sup>2</sup>KOICA-PKNU International Graduate Program of Fisheries Science, Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Division of Fisheries Life Science, Pukyong National University, Busan 48513, Republic of Korea

- 17:30-17:45 OA-15 Establishing the optimal conditions to support the propagation of red seabream iridovirus (RSIV) in GF and DGF cells

Juma Aisha Khamis<sup>1</sup> and Kwang Il Kim<sup>2</sup>

<sup>1</sup>Department of Fisheries Development and Aquaculture, Ministry of Blue Economy and Fisheries, Tanzania

<sup>2</sup>Department of Aquatic Life Medicine, Pukyong National University, Busan 48516, Republic of Korea

- 17:45-18:00 OA-16 The current status and future aspects of shrimp aquaculture in Indonesia

Ramadhan Febri

Head of the Environmental Health Section and Fisheries Quality Assurance, Marine and Fisheries Service, Bengkulu, Indonesia

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○ **Session schedule** : November 2<sup>nd</sup> 2023 (Thursday) 13:00 - 18:00

○ **Venue** : #214, Exhibition Center 1, BEXCO

*Chairperson:*

Time	Activities	Speaker
13:00 - 13:20	참가자 등록	
13:20 - 16:00	연구개발 추진내용 발표(논문)	
16:00 - 16:10	<b>Break time</b>	
16:10 - 16:50	아쿠아노르 방문 결과 공유	
16:50 - 18:00	농업 경영정보지원시스템 전문가 발표 1. 2. 3.	

November 3<sup>rd</sup>, 2023 (Friday)

∴ Oral presentation part IV

#212

*Chairperson: Jun-Hwan Byun (Pukyong National University)*

- 14:00-14:10 OA-17 Effects of replacing fish meal with a blend of corn gluten meal and meat meal on the growth, biochemical profile, digestive enzyme activity, antioxidant status, and innate immunity of juvenile black rockfish (*Sebastes schlegelii*)

Tae Hoon Lee, Hwa Yong Oh, Gyu Jin Lee, Seo Young Park and Hee Sung Kim\*

Department of Marine Biology and Aquaculture, Gyeongsang National University, Tongyeong 53064, Korea

- 14:10-14:20 OA-18 Substitution effects of fish meal with corn gluten meal in the diets on growth, feed utilization, biochemical composition, and hematological chemistry of red sea bream (*Pagrus major*)

Tae Woong Kwon<sup>1\*</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence on Marine Bioscience, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

- 14:20-14:30 OA-19 Relationship between water quality environment and mortality rate of olive flounder (*Paralichthys olivaceus*) farmed in Wando and Jeju area using big data analysis

Sae-Hwi Jang<sup>1</sup>, Young-Hoon Jin<sup>1</sup>, Inyeong Kwon<sup>2</sup> and Taeho Kim<sup>2\*</sup>

<sup>1</sup>Interdisciplinary Program of Smart Aquafarm, Graduate School, Chonnam National University, Yeosu 59626, Republic of Korea;

<sup>2</sup>Smart Aquaculture Research Center, Chonnam National University, Yeosu 59626, Republic of Korea

- 14:30-14:40 OA-20 Gene expression and fluorescence *in situ* hybridization (FISH) revealed a comparative role for the IGF system in Pacific oysters (*Crassostrea gigas*) gonad (from Geoje Island, South Korea)

Eun-Seo Lee<sup>1\*</sup>, Josel Cadangin<sup>1</sup>, Su-Jin Park<sup>2</sup>, Ji-Sung Moon<sup>1</sup>, Taek-Jeong Nam<sup>3</sup> and Youn Hee Choi<sup>1,3,4</sup>

<sup>1</sup>Department of Fisheries Biology, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Southeast Marine Fisheries Research Institute, National Institute of Fisheries Science, Tongyeong, 53085

<sup>3</sup>The Future Fisheries Food Research Center, Institute of Fisheries Sciences, Pukyong National University

<sup>4</sup>Department of Fisheries Life Sciences, Pukyong National University, Busan 48513, Republic of Korea

- 14:40-14:50 OA-21 Effect of partial and complete substitution of fish meal by tuna by-product meal in the diets of juvenile rockfish (*Sebastes schlegelii*) on growth performance

Yu Jin Sim<sup>1\*</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence on Marine Science, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

- 14:50-15:00 OA-22 Evaluation of different levels of dietary protein and lipid on acute temperature stress responses in juvenile northern snakehead (*Channa argus*)

Suhyun Lee<sup>1</sup>, Haham Kim<sup>1</sup>, Sooa Yoon<sup>1</sup>, Hyuncheol Jeon<sup>1</sup>, Abayomi Ogun<sup>1</sup>, Tugce Kilic<sup>1</sup>, Seonghun Won<sup>2</sup> and Seunghyung Lee<sup>1</sup>

<sup>1</sup>Division of Fisheries Life Sciences, Pukyong National University, Busan 48513, Rep. of Korea

<sup>2</sup>Aqua Solution Team, CJ Feed & Care, Seoul 04584, Rep. of Korea

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**∴ Oral presentation part V**

#212

*Chairperson: Seunghyung Lee (Pukyong National University)*

- 15:10-15:20 OA-23 Can dietary supplementation of host-associated probiotics along with a prebiotic enhance temperature stress tolerance in juvenile olive flounder (*Paralichthys olivaceus*)?

Hyuncheol Jeon<sup>1\*</sup>, Haham Kim<sup>1</sup>, Sooa Yoon<sup>1</sup>, Suhyun Lee<sup>1</sup>, Abayomi O. Ogun<sup>1</sup>, Aulia Deni<sup>1</sup>, Tugce Kilic<sup>1</sup>, Wonsuk Choi<sup>2</sup>, Eun-Woo Lee<sup>3</sup>, Sungchul C. Bai<sup>1</sup> and Seunghyung Lee<sup>1</sup>

<sup>1</sup>Major of Aquaculture and Applied Life Sciences, Division of Fisheries Life Sciences, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>CJ Feed & Care, Anseong 152, Korea

<sup>3</sup>Division of Biopharmaceutical Engineering, Dong-Eui University, Busan 47340, Republic of Korea

- 15:20-15:30 OA-24 Comparative study on growth characteristics of *Haematococcus pluvialis* using organic carbon sources

Huijeong Byeon<sup>1</sup>, Yunji An<sup>1</sup>, Taesoo Kim<sup>1</sup>, Sung Taek Cho<sup>3</sup>, Minjeong Kang<sup>3</sup>, Hyun Woung Shin<sup>1</sup> and Sang Mok Jung<sup>2\*</sup>

<sup>1</sup>Department of Biology, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>2</sup>Research Institute for Basic Science, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>3</sup>AlgaeBio Co., Asan 31459, Republic of Korea

- 15:30-15:40 OA-25 Screening salinity tolerance in green macroalga *Haematococcus pluvialis*

Yunji An<sup>1</sup>, Huijeong Byeon<sup>1</sup>, Taesoo Kim<sup>1</sup>, Min Suk Kim<sup>3</sup>, Sang Mok Jung<sup>2</sup> and Hyun Woung Shin<sup>1\*</sup>

<sup>1</sup>Department of Biology, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>2</sup>Research Institute for Basic Science, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>3</sup>AlgaeBio Co., Asan 31459, Republic of Korea

- 15:40-15:50 OA-26 Dietary inclusion of gamma amino butyric acid and sodium butyrate in diets containing graded level of duck byproduct meal for juvenile red seabream *Pagrus major*

Buddhi E. Gunathilaka<sup>1</sup>, Seong-Mok Jeong<sup>2</sup>, Kang-Woong Kim<sup>2</sup>, Seunghan Lee<sup>2</sup>, Sang-Woo Hur<sup>2</sup> and Sang-Min Lee<sup>1\*</sup>

<sup>1</sup>Department of Aquatic Life Medicine, Gangneung-Wonju National University, Gangneung, 25457, Korea

<sup>2</sup>Aquafeed Research Center, National Institute of Fisheries Science, Pohang, 37517, Korea

- 15:50-16:00 OA-27 Effect of wide range pH on early larval development of Pacific abalone (*Haliotis discus hannai*)

Dian Yuni Pratiwi<sup>1,3</sup>, Irfan Zidni<sup>1,3</sup>, Mi-Jin Choi<sup>2</sup>, Hyun-Seok Jang<sup>1</sup>, Tae-Min Kim<sup>1</sup>, Kang-Won Kim<sup>1</sup>, Youn-Su Cho<sup>2</sup> and Han-Kyu Lim<sup>1,2\*</sup>

<sup>1</sup>Department of Biomedicine, Health & Life Convergence Sciences, BK21 Four, Mokpo National University, Muan 58554, Republic of Korea

<sup>2</sup>Department of Marine and Fisheries Resources, Mokpo National University, Muan 58554, Republic of Korea

<sup>3</sup>Department of Fisheries, The Faculty of Fisheries and Marine Science, Universitas Padjadjaran, Sumedang 45363, Indonesia

- 16:00-16:10 OA-28 The effect of physiological and growth performance of mirror carp *Cyprinus carpio nudus* under starvation stress

Chang-huen Cho<sup>1</sup>, Da-Bin Jin<sup>1</sup>, Suk-Bin Mun<sup>1</sup>, Huirong Lyu<sup>1</sup>, Jung-Yul Park<sup>1</sup> and Jun-wook Hur<sup>1\*</sup>

<sup>1</sup>Department of Aquaculture and Aquatic Science, Kunsan National University, Gunsan 573-701, Korea



- 16:10-16:20 OA-29 Adsorption technology using a modified zeolite with alginate-hydrogel coating method for ammonium adsorption in the aquaculture effluent

Hyunsoo Choi<sup>1</sup> and Taeho Kim<sup>2,3\*</sup>

<sup>1</sup>Interdisciplinary Program of Smart Aquafarm, Graduate School, Chonnam National University, Yeosu 550-749, Republic of Korea

<sup>2</sup>Department of Marine Production Management, Chonnam National University, Yeosu 550-749, Republic of Korea

<sup>3</sup>Smart Aquaculture Research Center, Chonnam National University, Yeosu 550-749, Republic of Korea

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∴ Oral presentation part VI

#212

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*Chairperson: Youngjin Park (Sunmoon University)*

- 16:30-16:40 OA-30 Developing a modified flow-through aquaculture system for culturing olive flounder (*Paralichthys olivaceus*)

Young-Hoon Jin<sup>1</sup>, Inyeong Kwon<sup>2</sup> and Taeho Kim<sup>2\*</sup>

<sup>1</sup>Interdisciplinary Program of Smart Aquafarm, Graduate School, Chonnam National University, Yeosu 550-749, Republic of Korea

<sup>2</sup>Smart Aquaculture Research Center, Chonnam National University, Yeosu 550-749, Republic of Korea

- 16:40-16:50 OA-31 Incorporated jack mackerel meal in diets replacing fish meal with various animal protein sources on the growth, feed availability, and biochemical composition of red sea bream (*Pagrus major*) and economic analysis

Seong Il Baek<sup>1\*</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence on Marine Science, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

- 16:50-17:00   OA-32   Inclusion effect of jack mackerel meal as a feed enhancer in rockfish (*Sebastes schlegeli*) diets replacing 20% fish meal with chicken by-product meal on growth and feed availability

Ran Li<sup>1\*</sup>, Yu Jin Sim<sup>1</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence of Marine Science, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

- 17:00-17:10   OA-33   Inclusion impact of jack mackerel meal in the olive flounder (*Paralichthys olivaceus*) feeds substituting 50% fish meal with tuna by-product meal on growth, feed availability, and economic efficiency

Md. Rabiul Islam<sup>1\*</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Education of Maritime and Ocean Culture-Contents, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence on Marine Science, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

- 17:10-17:20   OA-34   Replacement effect of fish meal with corn protein concentrate in diets on growth performance, feed utilization, biochemical composition, and hematological parameters of rockfish (*Sebastes schlegeli*)

Md. Farid Uz Zaman<sup>1\*</sup>, Tae Woong Kwon<sup>1</sup> and Sung Hwoan Cho<sup>2</sup>

<sup>1</sup>Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

<sup>2</sup>Division of Convergence on Marine Science, Korea Maritime and Ocean University, Busan 49112, Republic of Korea

## Fisheries Resources · Ocean · Environment (OR-1 ~ OR-26)

November 2<sup>nd</sup>, 2023 (Thursday)

∴ Methodology for fishery management I

#213

*Chairperson: Donghoon Shin (National Institute of Fisheries Science)*

13:10-13:25 OR-1 Estimation density of euphausiids and Copepoda in the East-South Sea using by multi-frequency

Hyungtae Kim<sup>1\*</sup>, Wooseok Oh<sup>2</sup>, Euna Yoon<sup>3</sup>, Hyoungbeen Lee<sup>3</sup>, Sunyoung Oh<sup>1</sup>, Sara Lee<sup>1</sup> and Kyounghoon Lee<sup>4</sup>

<sup>1</sup>Department of Fisheries Physics, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Institute of Low-Carbon Marine Production Technology Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Republic of Korea

<sup>4</sup>Division of marine production system management, Pukyong National University, Busan 48513, Republic of Korea

13:25-13:40 OR-2 Target strength measurements and distribution characteristics of herring (*Clupea pallasii*) using multi-frequency

Wooseok Oh<sup>1</sup>, Euna Yoon<sup>2</sup>, Hyoung Been Lee<sup>2</sup>, Sara Lee<sup>3</sup> and Kyounghoon Lee<sup>4</sup>

<sup>1</sup>Institute of Low-Carbon Marine Production Technology, Pukyong National University, Busan 48513, Korea

<sup>2</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Korea

<sup>3</sup>Department of Fisheries Physics, Pukyong National University, Busan 48513, Korea

<sup>4</sup>Division of marine production system management, Pukyong National University, Busan 48513, Korea

13:40-13:55 OR-3 A framework for short-term forecasting *Todarodes pacificus* distribution

Seokjin Yoon<sup>1\*</sup>, Changsin Kim<sup>1</sup>, Jung Jin Kim<sup>1</sup>, Moo-Jin Kim<sup>1</sup>, Minkyung Bang<sup>2</sup>, Chan Joo Jang<sup>2</sup>, Dongwha Sohn<sup>3</sup>, Sangil Kim<sup>3</sup>, Hyun Woo Kim<sup>1</sup> and Sukyung Kang<sup>1</sup>

<sup>1</sup>National Institute of Fisheries Science, Busan, Republic of Korea

<sup>2</sup>Korea Institute of Ocean Science and Technology, Busan, Republic of Korea

<sup>3</sup>Pusan National University, Busan, Republic of Korea

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∴ **Methodology for fishery management II**

#213

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*Chairperson: Jung Hwa Choi (National Institute of Fisheries Science)*

14:00-14:15 OR-4 Mitochondrial genomics illuminates the discrete population of the common octopus, *Octopus vulgaris* (Cephalopoda: Octopodidae) in Western Pacific Ocean

Ah Ran Kim<sup>1\*</sup>, Shantanu Kundu<sup>2</sup>, Soo Rin Lee<sup>1</sup>, Jae-Hyeong Yang<sup>3</sup>, Se-Hyun Song<sup>3</sup> and Hyun-Woo Kim<sup>1,2</sup>

<sup>1</sup>Research Center for Marine Integrated Bionics Technology, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Fisheries Resources Management Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

14:15-14:30 OR-5 Dynamics of fish and phytoplankton communities in Ilgwang's coastal waters: Insights from environmental DNA metabarcoding

Yunji Go<sup>1\*</sup>, Soo Rin Lee<sup>2</sup>, Ah Ran Kim<sup>2</sup>, Chang-Keun Kang<sup>3</sup> and Hyun-Woo Kim<sup>2,4</sup>

<sup>1</sup>Industry 4.0 Convergence Bionics Engineering, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Marine Integrated Biomedical Technology Center, National Key Research Institutes in Universities, Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>School of Earth Sciences and Environmental Engineering, Gwangju Institute of Science and Technology, Gwangju 61005, Republic of Korea

<sup>4</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

14:30-14:45 OR-6 Modified plumb staff beam trawl for the Korean coastal habitats

Jeong Ho Park<sup>1</sup>, Bob McConnaughey<sup>2</sup>, Steve Intelmann<sup>2</sup> and Jung Hwa Choi<sup>3</sup>

<sup>1</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu 59780, Republic of Korea

<sup>2</sup>Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 7600 Sand Point Way NE, Seattle, Washington 98115, USA

<sup>3</sup>Dokdo Fisheries Science Center, East Sea Fisheries Research Institute, National Institute of Fisheries Science, Pohang 37709, Republic of Korea

∴ **Feeding ecology of fish**

#213

*Chairperson: Geun-Wook Baek (Gyeongsang National University)*

15:00-15:15 OR-7 Food item of the anchovy *Engraulis japonicus* in EEZ, Korea

Hyeon Ji Kim<sup>1\*</sup>, Jeong Hoon Lee<sup>1</sup>, Hawsun Sohn<sup>1</sup>, Gun Wook Baek<sup>2</sup> and Seung Hyun Son<sup>1</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries

<sup>2</sup>Department of Marine Biology and Aquaculture Science, College of Marine Science, Gyeongsang National University

15:15-15:30 OR-8 Feeding ecology of Antarctic toothfish, *Dissostichus mawsoni* in area 58.4, Southern Ocean

Gi Chang Seong<sup>1</sup>, Sangdeok Chung<sup>2</sup>, Jaebong Lee<sup>2</sup>, Do-Gyun Kim<sup>1</sup>, Da Yeon Kang<sup>1</sup>, Suyeon Jin<sup>1</sup> and Gun Wook Baek<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology and Aquaculture / Department of Aquaculture Science / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong, 53064, Korea

<sup>2</sup>Distant Water Fisheries Resources Division, National Institute of Fisheries Science, Busan, 46083, Korea

15:30-15:45 OR-9 Stomach contents analysis of red seabream, *Pagrus major* (Sparidae) in the South Sea of Korea using DNA metabarcoding

Hye-Eun Kang<sup>1\*</sup>, Se-Hyun Song<sup>2</sup>, Jae-Hyeong Yang<sup>2</sup> and Hyun-Woo Kim<sup>3</sup>

<sup>1</sup>Institute of Marine Life Science, Fisheries Science Research Center, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>Fisheries Resources Management Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

<sup>3</sup>Department of Marine Biology, Pukyong National University, Busan 48516, Republic of Korea

15:45-16:00 OR-10 Feeding habits of anchovy, *Engraulis japonicus* in the coastal waters of Tongyeong, Korea

Jae-Ik Cho<sup>1</sup>, Do-Gyun Kim<sup>1</sup>, Gi Chang Seong<sup>1</sup>, Da Yeon Kang<sup>1</sup>, Suyeon Jin<sup>1</sup>, Hoyoung Soh<sup>2</sup> and Gun Wook Baek<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology & Aquaculture / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong 53064, Republic of Korea

<sup>2</sup>Department of Ocean Integrated Science, Chonnam National University, Yeosu, Korea

16:00-16:15 OR-11 Role of the feeding environment during the spawning season of *Engraulis japonicus* in the southern coast of Korea

Jin Ho Jung<sup>1</sup>, Heeyong Kim<sup>2</sup>, Jeong-Ho Park<sup>1</sup>, Mi Song<sup>1</sup> and Seong Yong Moon<sup>1\*</sup>

<sup>1</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu 59780, Republic of Korea

<sup>2</sup>Research and Development Planning Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

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∴ KOICA program

#213

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*Chairperson: Won-Gyu Park (Pukyong National University)*

16:30-16:45 OR-12 Policy implications for stock recovery based on stock assessment of trawl fisheries in Cameroon

Marie Therese Viviane Omgba<sup>1\*</sup>, Jong oh Nam<sup>2</sup> and Mu hui Lee<sup>3</sup>

<sup>1</sup>Ministry of Livestock, Fisheries and Animal Industries, Yaounde, Republic of Cameroon

<sup>2</sup>Division of Marine & Fisheries Business and Economics, College of Fisheries Sciences, Pukyong National University

<sup>3</sup>Department of Resource and Environmental Economics, Graduate School, Pukyong National University

16:45-17:00 OR-13 Complete mitogenome of spottail spiny turbot, *Psettodes belcheri* (Pleuronectiformes: Psettodidae): Characterization and phylogeny

Flandrianto Sih Palimirmo<sup>1</sup>, Shantanu Kundu<sup>2</sup>, Hye-Eun Kang<sup>3</sup>, Ah-Ran Kim<sup>4</sup>, Soo Rin Lee<sup>4</sup> and Hyun-Woo Kim<sup>2,4</sup>

<sup>1</sup>National Research and Innovation Agency, Cibinong 16915, Indonesia

<sup>2</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Institute of Marine Life Science, Pukyong National University, Busan 48513, Republic of Korea

<sup>4</sup>Marine Integrated Biomedical Technology Center, National Key Research Institutes in Universities, Pukyong National University, Busan 48513, Republic of Korea

17:00-17:15 OR-14 Status of fisheries in Malawi

Dellings Rodrick Kamenya

Department of Fisheries, Ministry of Natural Resources and Climate Change, Lilongwe, Malawi

17:15-17:30 OR-15 Current status of fisheries in Timor-Leste

Artur Maria Pereira

Ministry of Agriculture and Fisheries of Timor-Leste General Directorate of Fisheries, Aquaculture and Marine Resources National Directorate for Spatial Planning of the Sea, Capture and Management of Aquatic Resources



November 3<sup>rd</sup>, 2023 (Friday)

∴ Ecology of fishery resources I

#213

*Chairperson: Chung Il Lee (Gangneung-Wonju National University)*

- 14:00-14:15 OR-16 Carbon and nitrogen isotopic compositions of particulate organic matter and biogeochemical processes during the pre- and post-monsoon season in a temperate estuary, western coast of Korea

Dongyoung Kim<sup>1</sup>, Dong Young Lee<sup>1</sup>, Tae-Hoon Kim<sup>2</sup>, Hyung-Mi Cho<sup>3</sup>, Jeonghyun Kim<sup>4</sup> and Hyun Je Park<sup>1\*</sup>

<sup>1</sup>Department of Marine Bioscience, Gangneung-Wonju National University, Gangneung 25457, Republic of Korea

<sup>1</sup>Department of Oceanography, Chonnam National University, Gwangju 61186, Republic of Korea

<sup>1</sup>Department of Ocean Sciences, Inha University, Incheon 22212, Republic of Korea

<sup>1</sup>Department of Earth and Marine Sciences, Jeju National University, Jeju 63243, Republic of Korea

- 14:15-14:30 OR-17 Assessing the risk of microplastics on gill and GI tract health in a goldfish model

Yongjoon Yoon<sup>1</sup>, Jeong Woo Park<sup>2</sup>, Sun Park<sup>3</sup>, Jin-Young Yang<sup>3</sup> and Ki Hwan Moon<sup>1,2\*</sup>

<sup>1</sup>Dept. of Marine Bioscience and Environment, Korea Maritime & Ocean University, Busan 49112, South Korea

<sup>2</sup>Ocean Science & Technology School, Korea Maritime & Ocean University, Busan 49112, South Korea

<sup>3</sup>Dept. of Biological Sciences, Pusan National University, Busan 46241, South Korea

14:30-14:45 OR-18 Morphological and molecular variation in *Platichthys bicoloratus* (Pleuronectidae) from Korea

Soo Been Kim<sup>1</sup>, Maeng Jin Kim<sup>2</sup> and Jin-Koo Kim<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>Fisheries Resources and Environment Division, East Sea Fisheries Research Institute, Gangneung 25435, Gangwon-do

14:45-15:00 OR-19 Change in the density of Pacific cod (*Gadus macrocephalus*) egg and larvae

Jong-Won Park<sup>1</sup>, Chul-Jung Ann<sup>1</sup>, Pyo-II Han<sup>1</sup> and Chung Il Lee<sup>1\*</sup>

<sup>1</sup>Department of Marine Ecology and Environment Gangneung-Wonju National University, Gangneung 25457, Republic of Korea

15:00-15:15 OR-20 Spawning migration strategies of chum salmon (*Oncorhynchus keta*) with physical environment change in the coastal water of Korea

Beom-sik Kim<sup>1</sup>, Ju Kyoung Kim<sup>2</sup>, Na Ri Kim<sup>3</sup>, Se Un Ki<sup>4</sup>, Jong Won Park<sup>1</sup>, Pyo Il Han<sup>1</sup> and Chung Il Lee<sup>1\*</sup>

<sup>1</sup>Department of Marine Ecology and Environment, Gangneung-Wonju National University, Gangneung 25457, Korea

<sup>2</sup>Aquatic Living Resources Center of West Sea, FIRA, Korea

<sup>3</sup>Livestock and Marine Industry, Ulju-gun, Korea

<sup>4</sup>Institute of Ocean & Fisheries Science, Jeollanam-do, Korea

15:15-15:30 OR-21 Comparison of reproductive ecology of *Amphioctopus fangsiao* in Yellow Sea and South Sea of Korea

Suyeon Jin<sup>1</sup>, Dae hyeon Kwon<sup>2</sup>, Seong Yong Moon<sup>3</sup>, Maeng Jin Kim<sup>4</sup>,  
Seung Hwan Lee<sup>2</sup>, Jin Ho Jung<sup>3</sup> and Gun Wook Baeck<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology and Aquaculture / Department of Aquaculture Science / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong, Korea

<sup>2</sup>Fisheries Resources and Environment Division, West Sea Fisheries Research Institute, National Institute of Fisheries Science, Incheon, Korea

<sup>3</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu, Korea

<sup>4</sup>East Sea Fisheries Research Institute, National Institute of Fisheries Science, Gangneung, Korea

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∴ Ecology of fishery resources II

#213

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*Chairperson: Kyounghoon Lee (Pukyong National University)*

15:45-16:00 OR-22 Vertical distribution of eggs and larvae of *Glyptocephalus stelleri* in the East Sea of Korea

Hwan-Sung Ji<sup>1\*</sup>, Bo-Ram Lee<sup>1</sup>, Hyo-Jae Yu<sup>1</sup>, Jeong-Hoon Lee<sup>1</sup> and  
Sukyoung Kang<sup>2</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Republic of Korea

<sup>2</sup>Coastal Waters Fisheries Resources Research Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

16:00-16:15 OR-23 Ichthyoplankton assemblage structure in Yeongil Bay, Korea

Se Hun Myoung<sup>1</sup>, Hwan-Sung Ji<sup>1\*</sup>, Hyo-Jae Yu<sup>1</sup>, Bo-Ram Lee<sup>1</sup>, Si-Won Choi<sup>1</sup>, Jung Nyun Kim<sup>1</sup>, Jin-Koo Kim<sup>2</sup> and Haw Sun Sohn<sup>1</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Republic of Korea

<sup>2</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Korea

16:15-16:30 OR-24 Age and growth of largehead hairtail *Trichiurus japonicus* near Jeju Island, Korea

Han Ju Kim, Jeonghoon Kee, Jung Nyun Kim and Hawsun Sohn  
Fisheries Resources Research Center, National Institute of Fisheries Science(NIFS), Tongyeong 53064, Republic of Korea

16:30-16:45 OR-25 Age and growth biology of seabass, *Lateolabrax japonicus* in the coastal waters of South Sea, Korea

Da Yeon Kang<sup>1</sup>, Heeyong Kim<sup>2</sup>, Seong Yong Moon<sup>3</sup>, Jin Ho Jung<sup>3</sup> and Gun Wook Baeck<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology & Aquaculture / Department of Aquaculture Science / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong, Korea

<sup>2</sup>Coastal Water Fisheries Resources Research Division, National Institute of Fisheries Science, Busan, Korea

<sup>3</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu, Korea

16:45-17:00 OR-26 Age and growth of the chub mackerel, *Scomber japonicus* in the South Sea of Korea

Do-Gyun Kim<sup>1</sup>, Ho Young Soh<sup>2</sup> and Gun Wook Baeck<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology & Aquaculture / Department of Aquaculture Science / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong, Korea

<sup>2</sup>Department of Ocean Integrated Science, Chonnam National University, Yeosu, Korea

## Fish Taxonomy · Ecology · Genetics (OF-1 ~ OF-6)

November 3<sup>rd</sup>, 2023 (Friday)

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### ∴ Oral presentation part I

#314

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*Chairperson: Wan-Ok Lee (Sonnchunhyang University)*

15:00-15:50    OF-1    Phenotypic variation and reproductive success of a keystone stream fish, bluehead chub: an application of PIT antenna and genetic parentage methods

Seoghyun Kim

Department of Biological Sciences, Kangwon National University

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### ∴ Oral presentation part II

#314

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*Chairperson: Geun-Wook Baek (Gyeongsang National University)*

16:00-16:15    OF-2    Analysis of stomach contents of rainbow trout (*Oncorhynchus mykiss*) captured in natural water system in Korea

Yun Jeong Cho, Young Jun Park, Jong Won Song and Su Hwan Kim<sup>\*</sup>  
National Institute of Ecology

16:15-16:30    OF-3    Molecular phylogeny and taxonomic review of the family Pomacentridae from Korea

Ju-Won Jin and Jin-Koo Kim

Department of Marine Biology, Pukyong National University

16:30-16:45 OF-4 New insights into early life history of the family Triglidae: focusing on wide-range captured larvae and juveniles

Jae-Hoon Jang<sup>1</sup>, Se-Hun Myoung<sup>2</sup>, Hwan-Sung Ji<sup>2</sup>, Hawsun Sohn<sup>2</sup> and Jin-Koo Kim<sup>1\*</sup>

<sup>1</sup>Department of Marine biology, Pukyong University

<sup>2</sup>Fisheries Resources Research Center, National Institute of Fisheries Science

16:45-17:00 OF-5 Maturity and spawning of the chub mackerel, *Scomber japonicus* in the South Sea of Korea

Do-Gyun Kim<sup>1</sup>, Ho Young Soh<sup>2</sup> and Gun Wook Baeck<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology & Aquaculture / Department of Aquaculture Science/ Institute of Marine Industry, College of Marine Science, Gyeongsang National University

<sup>2</sup>Department of Ocean Integrated Science, Chonnam National University

17:00-17:15 OF-6 Diet composition of bluefin searobin, *Chelidonichthys spinosus* in the South Sea of Korea

Chan-Hee Choi<sup>1</sup>, Hyeon Ji Kim<sup>2</sup>, Jeong Hoon Lee<sup>2</sup> and Gun Wook Baeck<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology & Aquaculture / Department of Aquaculture Science/ Institute of Marine Industry, College of Marine Science, Gyeongsang National University

<sup>2</sup>Fisheries Resources Research Center, National Institute of Fisheries Science

## Fish Diseases (OD-1 ~ OD-9)

November 2<sup>nd</sup>, 2023 (Thursday)

### ∴ Session 1

부경대학교 대연캠퍼스 향파관(A15) 409호

*Chairperson: Do-Hyung Kim (Pukyong National University)*

- |             |   |
|-------------|---|
| 14:00-14:10 | <p>국내 양식 대하의 급성간체장괴사병(AHPND) 병원성 분석</p> <p>계현정<br/>국립수산과학원</p>          |
| 14:10-14:20 | <p>2023년 새우 급성간체장괴사병(AHPND) 발생 현황 및 역학조사 결과</p> <p>장광일<br/>수산물품질관리원</p> |
| 14:20-14:30 | <p>새우 급성간체장괴사병(AHPND) 발생양식장 방역조치 사례</p> <p>김영재<br/>(주)한국수산방역기술</p>      |

### ∴ Session 2

부경대학교 대연캠퍼스 향파관(A15) 409호

*Chairperson: Miyoung Cho (National Institute of Fisheries Science)*

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|-------------|--|
| 15:00-15:10 | <p>양식 무지개송어에서 분리된 IHNV의 두 계통의 한 병원성 비교 실험</p> <p>김형준<br/>국립수산과학원</p> |
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15:10-15:20 양식 뱀장어의 발생 질병 (인천/경기권)

한상윤  
아쿠아메드 수산질병관리원

15:20-15:30 양식 뱀장어의 발생 질병 (전라권)

정성주  
전남대학교

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**∴ Session 3**

부경대학교 대연캠퍼스 향파관(A15) 409호

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*Chairperson: Sang Phil Shin (Kongju National University)*

16:00-16:10 강도다리 질병 임상 사례

우수지  
국립수산과학원

16:10-16:20 넙치 점액포자충과 연쇄구균병 임상 사례

김아란  
국립수산과학원

16:20-16:30 *Photobacterium damsellae* 감염 넙치의 임상증례

신수미  
전남대학교

16:30-16:40 넙치의 백신 및 항생제 사용법

최윤재  
완도수산질병관리원



November 3<sup>rd</sup>, 2023 (Friday)

∴ Oral presentation part I

#315

*Chairperson: Young-Chul KIM (Gangneung-wonju National University)*

15:10-15:30 OD-1 Horizontal transmission of the white spot syndrome virus under various conditions

Min-Jae Kim<sup>1</sup>, Jae-Ok Kim<sup>2</sup>, Gwang-Il Jang<sup>3</sup>, Mun-Gyeong Kwon<sup>3</sup> and Kwang-Il Kim<sup>1\*</sup>

<sup>1</sup>Department of Aquatic Life Medicine, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Tongyeong Regional Office, National Fishery Products Quality Management Service (NFQS), Tongyeong 53019, Republic of Korea

<sup>3</sup>Aquatic Disease Control Division, National Fishery Products Quality Management Service (NFQS), Busan 49111, Republic of Korea

15:30-15:50 OD-2 Establishment of primary cell derived from giant river prawn (*Macrobrachium rosenbergii*) and culture of susceptible virus

Da-Yeon Choi\*, Hee-Jae Choi, and Yue Jai Kang

Department of Aquatic Life Medicine, Kunsan National University, Gunsan, Republic of Korea.

15:50-16:10 OD-3 Generation of recombinant snakehead rhabdovirus (SHRV) expressing artificial microRNA targeting spring viremia of carp virus (SVCV) P gene and *in vivo* therapeutic use against SVCV infection

Mariem Bessaid<sup>1</sup>, Jun Soung Kwak<sup>2</sup>, Ki Hong Kim<sup>1\*</sup>

<sup>1</sup>Department of Aquatic Life Medicine, Pukyong National University, Busan 48513, South Korea

<sup>2</sup>Centre for Integrative Genetics (CIGENE), Faculty of Biosciences, Norwegian University of Life Sciences, Norway

*Chairperson: Hyoung Jun Kim (National Institute of Fisheries Science)*

16:20-16:40 OD-4 Viperin ablation interferes with immune cell recruitment and fish metabolism under VHSV infection

K.A.S.N Shanaka<sup>1,2</sup>, K.P Madushani<sup>1,2</sup>, Sumi Jung<sup>1,2</sup>, Myoung-Jin Kim<sup>3</sup> and Jehee Lee<sup>1,2</sup>

<sup>1</sup>Department of Marine Life Sciences & Center for Genomic Selection in Korean Aquaculture, Jeju National University, Jeju, 63243, Republic of Korea

<sup>2</sup>Marine Science Institute, Jeju National University, Jeju, 63333, Republic of Korea

<sup>3</sup>Nakdonggang National Institute of Biological Resources, Sangju, 37242, Republic of Korea

16:40-17:00 OD-5 Molecular insights into immune responses in olive flounder against VHSV infection

Yoonhang Lee\* and Do-Hung Kim

Department of Aquatic Life Medicine, Pukyong National University, Busan, Korea

17:00-17:20 OD-6 MyD88 ablation attenuates immune cell responses and immune gene expression under VHSV infection in zebrafish

K.P Madushani<sup>1,2</sup>, K.A.S.N Shanaka<sup>1,2</sup>, U.P.E.Arachchi<sup>1,2</sup>, Sumi Jung<sup>1,2</sup>, Myoung-Jin Kim<sup>3</sup> and Jehee Lee<sup>1,2</sup>

<sup>1</sup> Department of Marine Life Sciences & Center for Genomic Selection in Korean Aquaculture, Jeju National University, Jeju, 63243, Republic of Korea

<sup>2</sup>Marine Science Institute, Jeju National University, Jeju, 63333, Republic of Korea

<sup>3</sup>Nakdonggang National Institute of Biological Resources, Sangju, 37242, Republic of Korea

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 ∴ Oral presentation part III
 

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#315

*Chairperson: Myung-Hwa Jung (Hanseu University)*

- 17:30-17:50 OD-7 Prophylactic efficacy of bacteriophage cocktail against multiple-antibiotic-resistant and single-phage-resistant *Vibrio coralliilyticus* infection in Pacific oyster (*Crassostrea gigas*) larvae

Hyouun Joong Kim<sup>\*</sup>, Kyung-II Park

Department of Aquatic Life Medicine, Kunsan National University, Kunsan 54150, Republic of Korea

- 17:50-18:10 OD-8 Involvement of Galectin 9 from redlip mullet (*Planiliza haematocheilus*) in the regulation of antibacterial and antiviral immunity in teleost fish

W.A.D.L.R. Warnakula<sup>1,2\*</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, E.M.T. Tharanga<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, R.I. Sandeepani<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

<sup>1</sup>Department of Marine Life Sciences & Center for Genomic Selection in Korean Aquaculture, Jeju National University, Jeju 63243, Republic of Korea

<sup>2</sup>Marine Science Institute, Jeju National University, Jeju 63333, Republic of Korea

- 18:10-18:30 OD-9 Optimizing LAMP assay to identify the endangered eel species, *Anguilla japonica*

Eun-II Lee<sup>1\*</sup>, Hari Won<sup>3</sup>, Hyung-Bae Jeon<sup>1,2</sup> and Kyung-II Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>3</sup>Honam National Institute Biological Resources, 99 Gohadoan-gil, Mokpo 58762, Republic of Korea

## Fisheries and Ocean Technology (OT-1 ~ OT-14)

November 3<sup>rd</sup>, 2023 (Friday)

∴ Oral presentation part I

#316

*Chairperson: Bong-Jin Cha (National Institute of Fisheries Science)*

- |             |      |   |
|-------------|------|---|
| 13:30-13:45 | OT-1 | <p>Development of automatic assembling system of gillnet</p> <p>Heui-Chun An<sup>*</sup>, Yong-Beam Pyeon, Min-Ah Heo and Kuk-Jin Cho<br/>Korea Institute of Fisheries and Ocean Engineering, Busan 48508, Republic of Korea</p>  |
| 13:45-14:00 | OT-2 | <p>Study of computational fluid dynamics characteristics according to the nozzle shape of shellfish dredge fishery</p> <p>Jae-hyun Bae<sup>1*</sup>, Hyun-Su Jo<sup>2</sup> and Hyung-Seop Kim<sup>3</sup><br/> <sup>1</sup>Fisheries Engineering Division, National Institute of Fisheries Science, Republic of Korea<br/> <sup>2</sup>Dept. of School of Marine Industrial Transportation Science and Technology, Kunsan National University, Republic of Korea<br/> <sup>3</sup>Dept. of Marine Biological Resource and Aquaculture, Kunsan National University, Republic of Korea</p> |
| 14:00-14:15 | OT-3 | <p>A study for the fishing effect using a gill net on a cube-type reef with eight inner blades in Oeyeondo</p> <p>Eun-Bi Min<sup>1*</sup>, Tae-Jong Kang<sup>1</sup> and Doo-Jin Hwang<sup>2</sup><br/> <sup>1</sup>Department of Fisheries Science, Chonnam National University, Yeosu 59626, Korea<br/> <sup>2</sup>Department of Marine Production Management, Chonnam National University, Yeosu 59626, Korea</p>   |

14:15-14:30 OT-4 A study on the resistance reduction for a coastal stow net using the simulations and the model experiments

Sua Park<sup>1</sup>, Jihoon Lee<sup>2\*</sup>, Minseo Park<sup>1</sup> and Daeyeon Cho<sup>1</sup>

<sup>1</sup>Department of Fisheries Sciences, Chonnam National University, Yeosu 59626, Republic of Korea

<sup>2</sup>Department of Marine Production Management, Chonnam National University, Yeosu 59626, Republic of Korea

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∴ Oral presentation part II

#316

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*Chairperson: Sung-Il Lee (Pukyong national university)*

14:40-14:55 OT-5 Species composition and community structure of aquatic organisms caught by the coastal beam trawl in Gomso Bay, Jeollabuk-do

Young-Hwan Joo<sup>1\*</sup>, Sang-Chul Yoon<sup>2</sup>, Ji-Hoon Choi<sup>2</sup> and Hyun-Su Jo<sup>3</sup>

<sup>1</sup>Department of Fisheries Science, Kunsan National University, Gunsan 54150, Korea

<sup>2</sup>Fisheries Resources Research Division, National Institute of Fisheries Science, Busan 46083, Korea

<sup>3</sup>Division of Marine Industry-Transportation Science and Technology, Kunsan National University, Gunsan 54150, Korea

14:55-15:10 OT-6 CPUE standardization of sailfin sandfish (*Arctoscopus japonicus*) caught by the East Sea Mid-sized Danish seine fishery in Korean waters

Na-Young Jung<sup>1\*</sup> and Sung-Il Lee<sup>2</sup>

<sup>1</sup>Division of Fisheries Physics, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>Division of Marine Production System Management, Pukyong National University, Busan 48516, Republic of Korea

15:10-15:25 OT-7 Species identification and tempo-spatial distribution of anchovy using by multi-frequeuncy

Geunchang Park<sup>1\*</sup>, Wooseok Oh<sup>2</sup>, Sunyoung Oh<sup>1</sup>, Sa-La Lee<sup>1</sup>, Eu-Na Yoon<sup>3</sup>, Hyoungbeen Lee<sup>3</sup> and Kyounghoon Lee<sup>4</sup>

<sup>1</sup>Department of Fisheries Physics, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Institute of Low-Carbon Marine Production Technology Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Republic of Korea

<sup>4</sup>Division of marine production system management, Pukyong National University, Busan 48513, Republic of Korea

15:25-15:40 OT-8 Density estimating comparison of Antarctic krill (*Euphausia superba*) in South Shetland island by using 2 post-processing analysis methods

Sara Lee<sup>1\*</sup>, Inwoo Han<sup>2</sup>, Sangdeok Chung<sup>3</sup>, Wooseok Oh<sup>4</sup> and Kyounghoon Lee<sup>5</sup>

<sup>1</sup>Department of Fisheries Physics, Pukyong National University, Busan 48513, Korea

<sup>2</sup>Cetacean Research Institute, National Institute of Fisheries Science, Ulsan 44780, Korea

<sup>3</sup>Division of Distant Water Fisheries Resources, National Institute of Fisheries Science, Busan 46083, Korea

<sup>4</sup>Institute of Low-Carbon Marine Production Technology, Pukyong National University, Busan 48513, Korea

<sup>5</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Korea

15:40-15:55 OT-9 Real-time monitoring system for marine life in the vicinity of nuclear power plants

Tae-Jong Kang<sup>1\*</sup>, Eun-Bi Min<sup>1</sup> and Doo-Jin Hwang<sup>2</sup>

<sup>1</sup>Department of Fisheries Sciences, Chonnam National University, Yeosu 55024, Republic of Korea

<sup>2</sup>Department of Marine Production Management, Chonnam National University, Yeosu 55024, Republic of Korea

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∴ Oral presentation part III

#316

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*Chairperson: Min-Son Kim (Kunsan national university)*

16:05-16:20 OT-10 Towards safer fishing vessels: Utilization of digital technologies for safe fishing vessel design and operation

Kwi-Yeon Koo<sup>1\*</sup>, Hyung-Ju Kim<sup>2</sup> and Soo-Yeon Kwon<sup>3</sup>

<sup>1</sup>Department of Microsystems, University of South-eastern Norway, Borre 3184, Norway

<sup>2</sup>Department of Mechanical and Industrial Engineering, Norwegian University of Science and Technology, Trondheim 7034, Norway

<sup>3</sup>Safety Research Department, Korea Maritime Transportation Safety Authority, Sejong-City 30100, Republic of Korea

16:20-16:35 OT-11 A study on the co-existence of offshore wind and fishing activities

Yu-Jeong Mun<sup>1\*</sup> and Cho-Young Jung<sup>2</sup>

<sup>1</sup>Department of Fisheries Science, Kunsan National University, Kunsan 54150, Republic of Korea

<sup>2</sup>Division of Marine Industry-Transportation Science and Technology, Kunsan National University, Kunsan 54150, Republic of Korea

- 16:35-16:50 OT-12 Analyzing fatalities in commercial trap fishing boats: Estimating reduction rates based on accident analysis and preventive guidelines

Su-Hyung Kim<sup>1</sup>, Kyung-Jin Ryu<sup>1</sup>, Seung-Hyun Lee<sup>1</sup>, Kyoung-Hoon Lee<sup>2</sup>, Seong-Hun Kim<sup>2</sup> and Yoo-Won Lee<sup>2\*</sup>

<sup>1</sup>Training ship, Pukyong National University, Busan 48513, Korea

<sup>2</sup>Division of of Marine Production System Management, Pukyong National University, Busan 48513, Korea

- 16:50-17:05 OT-13 A study on the improve to required competences for fishing vessel officers through improvement of the standards of recognized education and training institutes

Kyung-Jin Ryu<sup>1\*</sup>, Su-Hyung Kim<sup>1</sup>, Yoo-Won Lee<sup>2</sup> and Hyung-Seok Kim<sup>2</sup>

<sup>1</sup>Training ship, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>Division of Marine Production System Management, Pukyong National University, Busan 48516, Republic of Korea

- 17:05-17:20 OT-14 A study on fishing ship accident analysis using Bayesian networks

Sang-A Park<sup>1</sup>, Deuk-Jin Park<sup>2\*</sup>, Hee-Jin Lee<sup>2</sup> and Su-Hyung Kim<sup>3</sup>

<sup>1</sup>Department of Fishery of Physics, Graduated School, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Republic of Korea

<sup>3</sup>Training Ship, Pukyong National University, Busan 48513, Republic of Korea



## Malacology (OM-1 ~ OM-10)

November 3<sup>rd</sup>, 2023 (Friday)

∴ Oral presentation part I

#317

*Chairperson: Sang-Man Cho (Kunsan National University)*

13:50-14:10 OM-1 Finding normal states of the microbiome for the pathobiome study

Hyung-Bae Jeon<sup>1,2\*</sup>, Hari Won<sup>3</sup> and Kyung-II Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>3</sup>Honam National Institute Biological Resources, 99 Gohadoan-gil, Mokpo 58762, Republic of Korea

14:10-14:30 OM-2 Isolation and characterization of sympatric isolate of *Sphaeroforma* sp. belong to Mesomycetozoea class from Pacific oyster, *Crassostrea gigas*

Dong-Hyun Lee<sup>1\*</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-II Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

14:30-14:50 OM-3 First Report of *Bonamia ostreae* Infection in Native Flat Oysters (*Ostrea denselamellosa*) from the West Coast of Korea

Woon-Chul Kang<sup>1\*</sup>, Seung-Hyeon Kim<sup>1</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-II Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

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**∴ Oral presentation part II**


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#317

**Chairperson: Hee Jung Lee (National Institute of Fisheries Science)**

- 15:00-15:20 OM-4 First isolation of protist *Thraustochytrium* sp. from Undulated Surf Clam (*Paratapes undulatus*) in southern area of Taiwan

Yu Chen<sup>1\*</sup>, Jin-Xia Long<sup>1</sup>, Seung-Hyeon Kim<sup>1</sup>, Eun-Il Lee<sup>1</sup>, Woon-Chul Kang<sup>1</sup>, Dong-Hyun Lee<sup>1</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-Il Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

- 15:20-15:40 OM-5 Distribution patterns of the chemosynthetic marine bivalve *Pillusina pisidium* (Family: Lucinidae) in seagrass beds in Korean waters

Jong-Seop Shin<sup>1\*</sup>, Kae Kyoung Kwon<sup>2</sup>, Sung Hyun Yang<sup>2</sup>, Soonhong Kwon<sup>1</sup>, Taehun Noh<sup>1</sup>, and Kwang-Sik Choi<sup>1</sup>

<sup>1</sup>Department of Marine Life Science (BK21 FOUR), Jeju National University, Jeju 63243, Republic of Korea

<sup>2</sup>Marine Biotechnology & Bioresource Research Department, Korea Institute of Ocean Science and Technology, Busan 49111, Republic of Korea

- 15:40-16:00 OM-6 Prevalence and infection intensity of *Perkinsus olseni* in venerid clams *Protothaca jedomensis* occurring on the south coast of Korea

Thatchaneshkanth Subramaniam\* and Kwang-Sik Choi

Department of Marine Life Science (BK21 FOUR) and Marine Science Institute, Jeju National University, Jeju 63243, Republic of Korea

*Chairperson: Hee-Do Jeung (National Institute of Fisheries Science)*

- 16:10-16:30 OM-7 First report of *Perkinsus marinus* parasite in native Pacific oyster, *Crassostrea gigas* from west coast Korea

Seung-Hyeon Kim<sup>1\*</sup>, Yu Chen<sup>1</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-Il Park<sup>1,2</sup>

<sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

- 16:30-16:50 OM-8 Changes in the species composition of mollusca according to changes in the environment of Gyeongpo Lake

Hyeon Jun Shin<sup>1,2\*</sup>, Jun Yang Jeong<sup>1,2</sup>, Chan Eui Hong<sup>1,2</sup>, Yong Tae Kim<sup>1,2</sup>, Hyeok Lee<sup>1</sup>, Yiseon Jang<sup>1</sup>, Min Kyu Sang<sup>2,3</sup>, Jie Eun Park<sup>2,3</sup>, Dae Kwon Song<sup>2,3</sup>, Jun Sang Lee<sup>2</sup>, and Yong Seok Lee<sup>1,2,3</sup>

<sup>1</sup>Department of Biology, College of Natural Sciences, Soonchunhyang University, Asan,, Chungnam, 31538, South Korea

<sup>2</sup>Korea Native Animal Resources Utilization Convergence Research Institute (KNAR), Soonchunhyang University, Asan, Chungnam, South Korea

<sup>3</sup>Research Support Center for Bio-Bigdata Analysis and Utilization of Biological Resources, Soonchunhyang University, Asan, Chungnam, South Korea

- 16:50-17:10 OM-9 Transcriptomics and Flow Cytometry Analysis of the Pacific oyster (*Crassostrea gigas*) Hemocytes in Response to Hypoxia and Elevated Water Temperature

Jeong-Hwa Kim\*, Kwang-Sik Choi, Yuna Song, and Hyun-Ki Hong  
Department of Marine Life Science (BK21 FOUR) and Marine Science Institute, Jeju National University, Jeju 63243, Republic of Korea

17:10-17:30 OM-10 A review of the endangered mollusks transcriptome under the threatened species initiative of Korea

Min Kyu Sang<sup>1,2\*</sup>, Hongray Howrelia Patnaik<sup>1</sup>, Jie Eun Park<sup>1,2</sup>, Dae Kwon Song<sup>1,2</sup>, Jun Yang Jeong<sup>1,3</sup>, Chan Eui Hong<sup>1,3</sup>, Yong Tae Kim<sup>1,3</sup>, Hyeon Jun Shin<sup>1,3</sup>, Liu Ziwei<sup>1,3</sup>, Hee Ju Hwang<sup>3</sup>, So Young Park<sup>4</sup>, Se Won Kang<sup>5</sup>, Jung Ho Ko<sup>6</sup>, Jun Sang Lee<sup>1</sup>, Hong Seog Park<sup>7</sup>, Yong Hun Jo<sup>1,3</sup>, Yeon Soo Han<sup>8</sup>, Bharat Bhusan Patnaik<sup>1,9</sup> and Yong Seok Lee<sup>1,2,3</sup>

<sup>1</sup>Korea Native Animal Resources Utilization Convergence Research Institute (KNAR), Soonchunhyang University, Asan, Chungnam, South Korea

<sup>2</sup>Research Support Center for Bio-Bigdata Analysis and Utilization of Biological Resources, Soonchunhyang University, Asan, Chungnam, South Korea

<sup>3</sup>Department of Biology, College of Natural Sciences, Soonchunhyang University, Asan,, Chungnam, 31538, South Korea

<sup>4</sup>Biodiversity Research Team, Animal & Plant Research Department, Nakdonggang National Institute of Biological Resources, Sangju, Gyeongbuk, 37242, South Korea

<sup>5</sup>Biological Resource Center (BRC), Korea Research Institute of Bioscience and Biotechnology (KRIBB), Jeongeup, Jeonbuk, 56212, South Korea

<sup>6</sup>Police Science Institute, Korean National Police University, Asan, Chungnam, 31539, South Korea

<sup>7</sup>Research Institute, GnC BIO Co., LTD., 621-6 Banseok-dong, Yuseong-gu, Daejeon, 34069, South Korea

<sup>8</sup>College of Agriculture and Life Science, Chonnam National University, 77 Yongbong-ro, Buk-gu, Gwangju, 61186, South Korea

<sup>9</sup>P.G Department of Biosciences and Biotechnology, Fakir Mohan University, Odisha, 756089, Nuapadhi, Balasore, India

## Poster presentation (PU-1 ~ PM-7)

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### ■ Fisheries Processing · Uses (PU-1 ~ PU-47)

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#### PU-1

Astaxanthin in *Haematococcus pluvialis* as a promising therapeutic for neurodegeneration caused by Parkinson's disease - A scientific mini review

R.P.T.I. Ranasinghe and Seon-Heui Cha\*

Department of Marine Bio and Medical Sciences, Hanseo University, Seosan-si, 31962, Korea

#### PU-2

Elemental composition and content ranges for artificial sea salt manufacturing

Jae-Ho Woon<sup>1</sup> and Hee-Sun Kim<sup>2\*</sup>

<sup>1</sup>Industry Academy Cooperation Group Department of Marine Food Science Technology, Gangneung-Wonju National University, Gangneung 25457, Republic of Korea

<sup>2</sup>Chemistry & Environment Group Radiation & Decommissioning Lab., KHNP Central Research Institute, Daejeon 34101, Republic of Korea

#### PU-3

Manufacturing of functional low-salt seasoned Gim (김) using marine microalgae spirulina

Kyumin Kim, San-A Han and Seon-Heui Cha

Department of Marine Bio and Medical Sciences, Hanseo University, Seosan 31962, Republic of Korea

#### PU-4

Comparison of antioxidant changes of algae with different extraction Technologies

Seungmin Moon<sup>1</sup>, Changheon Lee<sup>1</sup>, Eunsong Cha<sup>1</sup>, Gyeong-tae Jeong<sup>1</sup> and Daeung Yu<sup>1,2</sup>

<sup>1</sup>Interdisciplinary Program in Senior Human-Ecology, Major in Food and Nutrition, Changwon National University

<sup>2</sup>Department of Food and Nutrition, Changwon National University

**PU-5**

Determination of optimal processing conditions of high protein laver chip using reaction flavor technology

Gyeong-tae Jeong<sup>1</sup>, Changheon Lee<sup>1</sup>, Eunsong Cha<sup>1</sup>, Seungmin Moon<sup>1</sup>, Yong-jun Cha<sup>2</sup> and Daeung Yu<sup>1,2</sup>

<sup>1</sup>Interdisciplinary Program in Senior Human-Ecology, Major in food and Nutrition, Changwon National University

<sup>2</sup>Department of Food and Nutrition, Changwon National University

**PU-6**

The inhibition of benign prostatic hyperplasia by *Ecklonia stolonifera* extract is related to the inactivation of 5- $\alpha$  reductase

Min Yeong Kim<sup>1,2</sup> and Yung Hyun Choi<sup>1,2</sup>

<sup>1</sup>Anti-Aging Research Center, Dong-eui University, Busan 47340, Republic of Korea

<sup>2</sup>Department of Biochemistry, Dong-eui University Collage of Korean Medicine, Busan 47227, Republic of Korea

**PU-7**

Anti-inflammatory effect of *Capsosiphon fulvescens* extract in LPS-treated RAW 264.7 macrophages through inhibition of NF- $\kappa$ B signaling pathway

Seon Yeong Ji<sup>1,2</sup> and Yung Hyun Choi<sup>1,2</sup>

<sup>1</sup>Anti-Aging Research Center, Dong-eui University, Busan 47340, Republic of Korea

<sup>2</sup>Department of Biochemistry, Dong-eui University Collage of Korean Medicine, Busan 47227, Republic of Korea

**PU-8**

Purification, identification, and function analysis of ACE inhibitory peptide from *Gigantidas vrijenhoeki*

Seong-Yeong Heo, Junseong Kim, Nalae Kang, Eun-A Kim and Soo-Jin Heo<sup>\*</sup>

Jeju Bio Research Center, Korea Institute of Ocean Science and Technology, Jeju 63349, Republic of Korea

### **PU-9**

5-Bromoprotocatechualdehyde inhibits colon cancer growth by inducing the ROS-inhibiting AKT signaling pathway

Junseong Kim<sup>1\*</sup>, Seong-Yeong Heo<sup>1</sup> and Soo-Jin heo<sup>1</sup>

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### **PU-10**

Volatile flavor compounds of anchovy sauce derived through reaction flavor technology

Eunsong Cha<sup>1</sup>, Changheon Lee<sup>1</sup>, Seungmin Moon<sup>1</sup>, Gyeongtae Jeong<sup>1</sup>, Yong-Jun Cha<sup>2</sup> and Daeung Yu<sup>1,2</sup>

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### **PU-11**

Identification and characterization of potential probiotic strains in sea cucumber gut microbiota

A Won Kim<sup>1,†</sup>, JuHyeon Lee<sup>1,†</sup>, Yerin Choi<sup>1,2</sup>, Beom-Cheol Kim<sup>3</sup>, Sam Woong Kim<sup>4</sup> and Ki Hwan Moon<sup>1\*</sup>

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<sup>4</sup>Agri-Food Bio Convergence Institute, Gyeongsang National University, Jinju 52725, South Korea

### **PU-12**

Eel byproduct upcycling: Subcritical water extraction for enhanced flavor and nutrition in snack production

Jin-Seok Park<sup>1</sup>, Ji-Min Han<sup>1</sup>, Min-Seo Choi<sup>1</sup>, Jang-Woo Kim<sup>1</sup>, Sin-Won Park<sup>1</sup>, Myung-Hun Noh<sup>1</sup> and Byung-Soo Chun<sup>1\*</sup>

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<sup>2</sup>WOW SEAFOOD INC., 190-1, Seonsuchon-ro, Haeundae-gu, Busan, Korea



**PU-13****Utilizing functional substances from eel by-products for premium fish snacks**

Ji-Min Han<sup>1</sup>, Min-Seo Choi<sup>1</sup>, So-Young Park<sup>2</sup> and Byung-Soo chun<sup>1\*</sup>

<sup>1</sup>Department of Food Science and Technology, Pukyong National University, 45 Yongso-ro Namgu, Busan, Republic of Korea

<sup>2</sup>Department of Biotechnology, Pukyong National University, 45 Yongso-ro Namgu, Busan, Republic of Korea

**PU-14****Preparation and nutritional characteristics of oyster (*Crassostrea gigas*) concentrated powder as a food processing material**

Min Kyo Kim, Jae-Hee An, Ga-Eun Kim, Jong-Hoon Kim, Sue-Sung Jung, Jeong-Hyun Lim, Yeon-Gyeong Go, In Seong Yoon<sup>1</sup> and Min Soo Heu<sup>\*</sup>

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**PU-15****Comparison of *Codium fragile* treated with different desalination processes**

Sohong Park<sup>\*</sup>, Seonghui Kim, Hodeung Yoo, Serim Park, Seonmi Ji, Huiwon Oh and Suengmok Cho

Department of Food Science and Technology, Institute of Food Science, Pukyong National University, Busan 48513, Korea

**PU-16****Comparison of sleep-promoting effects of optimized *Gracilaria verrucosa* extracts by different drying methods**

Hodeung Yoo<sup>\*</sup>, Seonghui Kim, Sohong Park, Serim Park, Seonmi Ji, Huiwon Oh and Suengmok Cho

Department of Food Science and Technology, Institute of Food Science, Pukyong National University, Busan 48513, Korea

### **PU-17**

Optimization of combinational treatment using lactic acid bacteria and rosemary extraction to prevent tuna discoloration

Ji-Hwan Choi<sup>1</sup>, Mi-Ru Song<sup>1</sup>, Du-Min Jo<sup>1</sup>, Ji-Sun Choi<sup>1</sup> and Young-Mog Kim<sup>1\*</sup>

<sup>1</sup>Department of Food Science and Technology, Pukyong National University, Busan 48513, Republic of Korea

### **PU-18**

Quality changes of Pacific oyster *Crassostrea gigas* according to storage period and temperature

Yeon-Ju Sim<sup>1</sup>, Du-Min Jo<sup>1</sup>, So-Yeon Noh<sup>1</sup>, Ye-Bin Jang<sup>1</sup>, Jeong-Bin Jo<sup>1</sup> and Young-Mog Kim<sup>1\*</sup>

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### **PU-19**

Development of pet churro feed through upcycling of discarded fish cakes

Inhwan Lee<sup>1</sup>, Gyeong-Seop Yun<sup>1</sup>, Jin-Hwa Lee<sup>1</sup>, Khawaja Muhammad Imran Bashir<sup>1,2</sup>, Do Youb kim<sup>3</sup>, Ye Youl Kim<sup>3</sup>, Seon Yeong Kang<sup>3</sup> and Jae-Suk Choi<sup>1</sup>

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<sup>3</sup>Samjin Food Co. Ltd, 36, Taejong-ro 99 beon-gil, Yeongdo-gu, Busan 49036, Korea

### **PU-20**

Development of elderly-friendly HMR soup using conger eel (*Conger myriaster*)

Inhwan Lee<sup>1</sup>, Gyeong Seop Yun<sup>1</sup>, Jin-Hwa Lee<sup>1</sup>, Khawaja Muhammad Imran Bashir<sup>1,2</sup>, Dong Wook Kang<sup>3</sup>, Woo Young Jung<sup>3</sup>, In Ha Yoo<sup>3</sup> and Jae-Suk Choi<sup>1</sup>

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<sup>3</sup>Seawell Co. Ltd., 508-7 Byeoksan E-centumclass one 99, Centumdong-ro, Haeundae-Gu, Busan, Korea

**PU-21**

Optimization of surimi powder manufacturing process for development of seafood protein beverages

Inhwan Lee<sup>1</sup>, Gyeong Seop Yun<sup>1</sup>, Jin-Hwa Lee<sup>1</sup>, Khawaja Muhammad Imran Bashir<sup>1,2</sup>,  
In Kyung Kim<sup>3</sup>, Hye Joo Kang<sup>3</sup>, Jung Min Seo<sup>3</sup> and Jae-Suk Choi<sup>1</sup>

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<sup>3</sup>Full-JungSung Co., Ltd., UN Peonghwa-ro 3beon-gil, Nam-gu, Busan, Korea

**PU-22**

Physicochemical properties and physiological activity effects of various solvent extracts from *Enteromorpha compressa*

Sun-A Park, Da-Bin Park, Min-Gyeom Kim, Min-Sun Kim and Yong-Tae Kim

<sup>1</sup>Dept of Food Science and Biotechnology, Kunsan National University, Gunsan 54150, Korea

**PU-23**

Comparison of antioxidant and physiological activities of different solvent extracts from *Dictyota dichotoma*

Sun-A Park, Yeon-Ji Lee and Yong-Tae Kim

<sup>1</sup>Dept of Food Science and Biotechnology, Kunsan National University, Gunsan 54150, Korea

**PU-24**

Effect of storage period and temperature on freshness changes of yellow croaker *Larimichthys polyactis*

Jeong-Bin Jo<sup>1</sup>, Ye-Bin Jang<sup>1</sup>, So-Yeon Noh<sup>1</sup>, Du-Min Jo<sup>1</sup>, Yeon-Ju Sim<sup>1</sup> and Young-Mog Kim<sup>1</sup>

<sup>1</sup>Department of Food Science and Technology, Pukyong National University, Busan 48513, Republic of Korea

### PU-25

Characterization of EB-AuNPs and analysis of anti-biofilm and mechanism against biofilm-forming pathogens

DoKyung Oh<sup>1\*</sup>, Ji-Hwan Choi<sup>1</sup>, Ji-Sun Choi<sup>1</sup>, Fazlurrahman Khan<sup>2</sup> and Young-Mog Kim<sup>1</sup>

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<sup>2</sup>Institute of Fisheries Sciences, Pukyong National University, Busan 48513, Republic of Korea

### PU-26

Aminoglycosides as a key antibiofilm and antivirulence agents against *Pseudomonas aeruginosa*

Nazia Tabassum<sup>1,2</sup>, Fazlurrahman Khan<sup>1,2,3</sup>, Min-Ung Kim<sup>4</sup>, Jeong-Bin Jo<sup>4</sup>, Ji-Hwan Choi<sup>4</sup> and Young-Mog Kim<sup>1,2,4</sup>

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<sup>4</sup>Department of Food Science and Technology, Pukyong National University, Busan 48513, South Korea

### PU-27

Distribution and Identification in *Enterococcus* spp. Strains Isolated from *Venerupis philippinarum* in the West Coast of Korea

Shin-Hye Lee, Jung-Kil Seo, Seung-Yong Lim, Na-Young Lee and Kwon-Sam Park

Department of Food Science and Biotechnology, Kunsan National University, Gunsan 54150, Republic of Korea

### PU-28

Toxin genes and antimicrobial resistance of *Clostridium perfringens* strains isolated from commercial Jeotgals

Shin-Hye Lee, Sung-Chul Hong, Yong-Tae Kim and Kwon-Sam Park

Department of Food Science and Biotechnology, Kunsan National University, Gunsan 54150, Republic of Korea

**PU-29****Effects of barley starch on properties of fish surimi mixture for 3D printing**

Ha-Young Lee<sup>1</sup>, Hyun-Sik Na<sup>1</sup>, Dong-Hyeon Kim<sup>1</sup>, Sang-Min Lee<sup>1</sup>, Hyeon-Ji Yu<sup>1</sup>, Go-Wun Seo<sup>1</sup>, Chang-Hyeon Ko<sup>1</sup>, Seon-Woo Park<sup>1</sup>, Hyung-Wook Choi<sup>1</sup>, Ye-Jin Choi<sup>1</sup>, Mi Jeong Jo<sup>2</sup> and Dong-Hyun Ahn<sup>1</sup>

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<sup>2</sup>Department of Microbiology, Pukyong National University, Busan 48513, Republic of Korea

**PU-30****Evaluation of quality in surimi mixtures coagulated with calcium lactate after addition of different concentrations of alginic acid for 3D printing**

Dong-Hyeon Kim<sup>1</sup>, Hyun-Sik Na<sup>1</sup>, Ha-Young Lee<sup>1</sup>, Sang-Min Lee<sup>1</sup>, Hyeon-Ji Yu<sup>1</sup>, Go-wun Seo<sup>1</sup>, Chang-Hyeon Ko<sup>1</sup>, Seon-Woo Park<sup>1</sup>, Hyung-Wook Choi<sup>1</sup>, Ye-Jin Choi<sup>1</sup>, Mi Jeong Jo<sup>2</sup> and Dong-Hyun Ahn<sup>1</sup>

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<sup>2</sup>Department of Microbiology, Pukyong National University, Busan 48513, Republic of Korea

**PU-31****Effects of adding guar gum for optimal properties of fish surimi mixture for 3D printing**

Hyun-Sik Na<sup>1</sup>, Dong-Hyeon Kim<sup>1</sup>, Ha-Young Lee<sup>1</sup>, Sang-Min Lee<sup>1</sup>, Hyeon-Ji Yu<sup>1</sup>, Go-wun Seo<sup>1</sup>, Chang-Hyeon Ko<sup>1</sup>, Seon-Woo Park<sup>1</sup>, Hyung-Wook Choi<sup>1</sup>, Ye-Jin Choi<sup>1</sup>, Mi Jeong Jo<sup>2</sup> and Dong-Hyun Ahn<sup>1</sup>

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<sup>2</sup>Department of Microbiology, Pukyong National University, Busan 48513, Republic of Korea

### **PU-32**

Quality characteristics of fish meat patties according to the proportion of swordfish (*Xiphias gladius*) white meat and tuna (*Thunnus albacares*) red meat

Sang-Min Lee<sup>1</sup>, Hyeon-Ji Yu<sup>1</sup>, Ha-Young Lee<sup>1</sup>, Hyun-Sik Na<sup>1</sup>, Dong-Hyeon Kim<sup>1</sup>, Go-Wun Seo<sup>1</sup>, Chang-Hyeon Ko<sup>1</sup>, Seon-Woo Park<sup>1</sup>, Hyung-Wook Choi<sup>1</sup>, Ye-Jin Choi<sup>1</sup>, Mi Jeong Jo<sup>2</sup> and Dong-Hyun Ahn<sup>1</sup>

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<sup>2</sup>Department of Microbiology, Pukyong National University, Busan 48513, Republic of Korea

### **PU-33**

Antibacterial activity of potentially probiotic acetic acid bacteria isolated from homemade grape vinegar

Eun-Seo Lim

Department of Nutrition & Food Science, Tongmyong University

### **PU-34**

Prebiotic and antioxidant activities of exopolysaccharide producing *Lactobacillus paraplantarum* PV48 isolated from pickled vegetables

Eun-Seo Lim

Department of Nutrition & Food Science, Tongmyong University

### **PU-35**

Purification and identification of  $\beta$ -secretase inhibitory peptides from freshwater fish muscle hydrolysates

Dae-Sung Han<sup>1</sup>, Sung-Gon Moon<sup>1</sup> and Hee-Guk Byun<sup>1\*</sup>

<sup>1</sup>Department of Aquatic Life Medicine, Gangneung-Wonju National University, Gangneung 25457, Republic of Korea

**PU-36**

Antibacterial and anti-inflammatory effects of dioxinodehydroeckol from *Ecklonia cava*

Eun-Song Kim<sup>1\*</sup>, Ju-Won Ryu<sup>1</sup>, Hyo-Bin Kim<sup>1</sup>, Ju-Hyeon Song<sup>1</sup>, Chae-Hyun Seo<sup>1</sup>,  
Chan-Woo Kim<sup>1</sup>, Kyung Tae Kim<sup>1</sup>, Poong Ho Kim<sup>2</sup> and Sung-Hwan Eom<sup>1</sup>

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<sup>2</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu 59780, Republic of Korea

**PU-37**

Physicochemical analysis and antioxidant potential of *Artina pectinata* (comb pen shell) edible components *via* subcritical water hydrolysis

Ye-Seul Park<sup>1</sup>, Jin-Seok Park<sup>1</sup>, Byung-Soo Chun<sup>1</sup> and Hee-Jeong Lee<sup>2\*</sup>

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**PU-38**

Individual identification of minke whale using 18 STR markers

Seung-Woo Noh<sup>\*</sup>, Yu-Li Oh, Jeong-Ok Park, Hyeon-Kyeong Yoon and Min-Kyu Choo  
Korea Coast Guard Research Center, Korea Coast Guard, Cheonan 31254, Republic of Korea

**PU-39**

Biological efficacy of fucoidan isolated from five species of brown algae

Ji-Won Jeong<sup>1,2</sup> and Won-Kyo Jung<sup>1,2,3\*</sup>

<sup>1</sup>Major of Biomedical Engineering, Division of Smart Healthcare, College of Information Technology and Convergence and New-senior Healthcare Innovation Center (BK21 Plus), Pukyong National University, Busan 48513, Korea

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<sup>3</sup>Research Center for Integrated Bionics Technology, Pukyong National University

## **PU-40**

Photocrosslinked hydrogel with gallic acid-grafted CSMA and FGelMA for accelerated diabetic wound healing

Dong-Joo Park<sup>1,2</sup> and Won-Kyo Jung<sup>1,2,3\*</sup>

<sup>1</sup>Major of Biomedical Engineering, Division of Smart Healthcare Major of Biomedical Engineering and New-senior Healthcare Innovation Center (BK21 Plus), Pukyong National University, Busan 48513, Republic of Korea

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<sup>3</sup>Research Center for Marine Integrated Bionics Technology, Pukyong National University, Busan 48513, Republic of Korea

## **PU-41**

Isophloroglucin A-reinforced oxidized alginate/gelatin hydrogel with multifunctionality for accelerating wound healing

Nam-Gyun Kim<sup>1,2</sup>, Se-Chang Kim<sup>1,2</sup>, Tae-Hee Kim<sup>2,3</sup>, Jae-Young Je<sup>4</sup>, Bonggi Lee<sup>5</sup>, SangGil Lee<sup>5,6</sup>, Young-Mog Kim<sup>2,3,7</sup>, Hyun-Wook Kang<sup>1,2,3</sup> and Won-Kyo Jung<sup>1,2,3\*</sup>

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**PU-42**

Extraction and characterization of biocompatible elastin from *Thunnini* heart as fishery processing by-products

Seung-Hee Moon<sup>1</sup> and Won-Kyo Jung<sup>2\*</sup>

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**PU-43**

$\epsilon$ -Veniferin loaded fish GelMA based 3d scaffold with anti-inflammatory, antioxidant and antimicrobial activity for chronic wound healing

Jin-Bok Jang<sup>1,2</sup> and Won-Kyo Jung<sup>1,2,3</sup>

<sup>1</sup>Major of Biomedical Engineering, Division of Smart Healthcare, College of Information Technology and Convergence and New-senior Healthcare Innovation Center (BK21 Plus), Pukyong National University, Busan 48513, Korea

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**PU-44**

Effect of rock bream extracts on production of glutathione (GSH) and reactive oxygen species (ROS)

Sun Young Lim\*, Young Do Shin, Jeong Woo Lee and Myungwon Choi

Division of Convergence on Marine Science, Korea Maritime & Ocean University, Busan, Korea

**PU-45**

Effect of freezing method and frozen storage temperature on the storability of mackerel

Ji-Su Hong<sup>1\*</sup>, Soo-Won Kim<sup>1</sup>, Yeon-Su Yeo<sup>1</sup>, Seung-Hyeon Lee<sup>1</sup>, Jong-Lak Cho<sup>2</sup>,  
Kyung-Hee Park<sup>3</sup>, Myoung-Choo Cho<sup>3</sup> and Jeong-Mok Kim<sup>1,2</sup>

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<sup>3</sup>HAENONG Co., Ltd., Naju 58275, Republic of Korea

**PU-46**

Isolation and characterization of *E. coli* and *Salmonella* spp. specific bacteriophage isolated from sewage disposal plant

Yong-Chae Oh<sup>1\*</sup>, Jong-Lak Cho<sup>2</sup> and Jeong-Mok Kim<sup>1,2</sup>

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**PU-47**

Study on antimicrobial activity and action mechanism of the antimicrobial peptides identified from the octopus (*Octopus minor*) against piglet diarrhea-causing bacteria

Ho Sung Moon<sup>1</sup>, Mahanama De zoysa<sup>2</sup>, Ilson Whang<sup>3</sup> and Jung-Kil Seo<sup>1</sup>

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<sup>2</sup>College of Veterinary Medicine and Research Institute of Veterinary Medicine, Chungnam National University, Daejeon 34134, Republic of Korea

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**■ Aquaculture (PA-1 ~ PA-45)**

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**PA-1**

Effect of garlic powder added feed on improving river puffer (*Takifugu obscurus*) growth

Dong-Hoon Lee\*, Tae-Young Ahn, Jung-Jo Han and Bong-Hyeon Kim

Gyeonggi Province Maritime and Fisheries Research Institute, Yangpyeong 12513, Republic of Korea

**PA-2**

Dual-infection of white spot syndrome virus and decapod hepanhamaparvovirus in *Penaeus vannamei* shrimp cultured in Korea

Jee Eun Han<sup>1\*</sup>

<sup>1</sup>Department of Veterinary medicine, Kyungpook National University, Daegu 41566, Republic of Korea

**PA-3**

Microplastic as a potential risk for white spot syndrome virus infection in Pacific white leg shrimp

Hye Jin Jeon<sup>1\*</sup> and Jee Eun Han<sup>1</sup>

<sup>1</sup>Department of Veterinary medicine, Kyungpook National University, Daegu 41566, Republic of Korea

**PA-4**

Experiment on artificial seed production of *Cyclina sinensis*

Byung-Kwon Kim<sup>1\*</sup>, Jae-Yong Bae<sup>1</sup>, Seong-Min Kim<sup>1</sup>, Dal-Young Kim<sup>1</sup>, Seong-Ryul Lim<sup>1</sup> and Bong-Hyeon Kim<sup>1</sup>

<sup>1</sup>The Gyeonggi Province Maritime and Fisheries Research Institute; Korea

#### PA-5

Effects of replacing fish meal with a mixture of corn protein concentrate and poultry by-product meal on growth performance of juvenile black rockfish (*Sebastes schlegelii*)

Hwa Yong Oh, Tae Hoon Lee, Gyu Jin Lee, Seo Young Park and Hee Sung Kim\*

Department of Marine Biology and Aquaculture, Gyeongsang National University, Tongyeong 53064, Korea

#### PA-6

Growth and reproduction of rotifer, *Brachionus* spp., collected from the *Hwajinpo* lake on the different temperature

Buom-Sup Shim<sup>1\*</sup>, Hae-Min Yoon<sup>1</sup>, Min-Min Jung<sup>2</sup>, Jae-Seong Lee<sup>3</sup>, Jin-Chul Park<sup>4</sup>, Young-Hwan Lee<sup>1</sup> and Heum-Gi Park<sup>1</sup>

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<sup>4</sup>Gangwon State Cold water Fisheries Research Center, Gangneung, 24747, Republic of Korea

#### PA-7

Antimicrobial and biofilm inhibitory properties of hemocyanin from edible gastropod *Hemifusus pugilinus* (Born, 1778)

Kiyun Park<sup>1\*</sup>, Sivakamavalli Jeyachandran<sup>2</sup> and Ihn-Sil Kwak<sup>1,3</sup>

<sup>1</sup>Fisheries Science Institute, Chonnam National University, Yeosu 59626, South Korea

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<sup>3</sup>Department of Ocean Integrated science, Chonnam National University, Yeosu 59626, South Korea

**PA-8**

Characterization of extracellular matrix protein EFEMP2 in olive flounder *Paralichthys olivaceus*

Hee Jeong Kong<sup>1\*</sup>, Ja Young Cho<sup>1</sup>, Ju-Won Kim<sup>1</sup>, Dong-Gyun Kim<sup>1</sup>, Young-Sam Kim<sup>1</sup>,  
Woo Jin Kim<sup>1</sup>, Sang-Yeob Yeo<sup>2</sup> and Young-Ok Kim<sup>1</sup>

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<sup>2</sup>Department of Applied Chemistry and Biotechnology, Hanbat National University, Daejeon 34158, Republic of Korea

**PA-9**

Development and genetic diversity analysis of microsatellite markers using next-generation sequencing in *Crassostrea gigas*

Woo-Jin Kim, Chun Mae Dong, Mi Nan Lee, Hee Jeong Park, Su Young Kim, Young-Ok Kim,  
Eun Soo Noh and Eun-Mi Kim

Biotechnology Research Division, National Institute of Fisheries Science, Busan 46083, Korea

**PA-10**

Comparison of hatching rates of cuttlefish (*Sepia esculenta*) fertilized eggs by hatching method

Seong-Min Kim<sup>1\*</sup>, Dal-Young Kim<sup>1</sup>, Jae-Yong Bae<sup>1</sup>, Seong-Ryul Lim<sup>1</sup>, Bong-Hyun Kim<sup>1</sup>  
and Byung-Kwon Kim<sup>1</sup>

<sup>1</sup>The Gyeonggi Province Maritime and Fisheries Research Institute; Korea

**PA-11**

First description of type I suppressor of cytokine signaling genes SOCS6 and SOCS7 in the whiteleg shrimp, *Litopenaeus vannamei*

CWR Gunasekara<sup>1</sup>, WSP Madhuranga<sup>1</sup>, Jiye Lee<sup>1</sup>, Hye-Jin Go<sup>1</sup>, Young-Gil Shin<sup>1</sup>, Tae-Su Kim<sup>1</sup>,  
Hyun-Woo Jang<sup>1</sup>, Ji-Eun Myung<sup>1</sup>, Suyeong Son<sup>1</sup>, Paschaline U. Ferdinand<sup>2</sup> and Chan-Hee Kim<sup>1\*</sup>

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<sup>2</sup>KOICA-PKNU International Graduate Program of Fisheries Science, Pukyong National University, Busan 48513, Korea

## PA-12

Fish farm monitoring report for outdoor aquaculture of eastern catfish *Silurus asotus* in Korea

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<sup>3</sup>Fisheries Resources Research Institute, Gyeongsangnam-do, Tongyeong 53080, Republic of Korea

## PA-13

Effect of dietary vitamin C supplementation on growth performance and biochemical parameters in grower walleye pollock, *Gadus chalcogrammus*

Ki Wook Lee<sup>1\*</sup>, Gyeong Sik Han<sup>1</sup>, So Sun Kim<sup>1</sup> and Jin Woo Park<sup>2</sup>

<sup>1</sup>Aquaculture Industry Research Division, East sea Fisheries Research Institute, National Institute of Fisheries Science, Gangneung 25435, Republic of Korea

<sup>2</sup>Subtropical Fisheries Research Institute, National Institute of Fisheries Science, Jeju-do 63610, Republic of Korea

## PA-14

Identification of a prototype fish ficolin-2 from *Acipenser baerii*: Molecular characterization and phylogenetic analysis

WSP Madhuranga<sup>1</sup>, Paschaline U. Ferdinand<sup>2</sup>, CWR Gunasekara<sup>1</sup>, Jiye Lee<sup>1</sup>, Hye-Jin Go<sup>1</sup>, Young-Gil Shin<sup>1</sup> and Chan-Hee Kim<sup>1</sup>

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<sup>2</sup>KOICA-PKNU International Graduate Program of Fisheries Science, Pukyong National University, Busan 48513, Korea

**PA-15**

Analysis of growth and movement characteristics of juvenile *Haliotis discus hannai* by the stocking density and individual size

Hyun Seok Jang<sup>1</sup>, Mi Jin Choi<sup>2</sup>, Young Dae Oh<sup>2</sup>, Dian Yuni Pratiwi<sup>1</sup> and Han Kyu Lim<sup>1,2</sup>

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<sup>2</sup>Department of Marine and Fisheries Resources, Mokpo National University, Muan 58554, Republic of Korea

**PA-16**

Estimation of olive flounder growth through genomic prediction

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<sup>4</sup>Centre for Sustainable Tropical Fisheries and Aquaculture, James Cook University

**PA-17**

Analysis of bacterial isolates and resistance patterns of tetracyclines in olive flounder (*Paralichthys olivaceus*) after administration of oxytetracycline

Ye Ji Kim<sup>1\*</sup>, Lyu Jin Jun<sup>1</sup>, Myoung Sug Kim<sup>2</sup> and Joon Bum Jeong<sup>1</sup>

<sup>1</sup>Department of Marine Life Science, Jeju National University

<sup>2</sup>Pathology Research Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

### PA-18

The effect of salinity on indoor tank acclimation of Korean pomfret (*Pampus echinogaster*)

Seok-Jun Hong\*, Seung-Hun Han, Chung-Yeol Park, Hyun-Gu Park, Young-Jun Kim  
and Myung-Bae Seo

Marine&Fisheries Science Museum of Jeollanam-Do Ocean&Fisheries Science Institute, Yeosu 59771  
Republic of Korea

### PA-19

A study on the appropriate temperature for finding the optimal transportation method for juvenile sea cucumber, *Stichopus japonicus*

Seon-Sik Lee

Incheon Fisheries Resources Research Institute, Incheon, 23121, Republic of Korea

### PA-20

Zebrafish CCR2 mutant suffer from ataxia and atrophy of developing CNS

Hee-Jeong Kong<sup>1</sup>, Jae-Ung Jeong<sup>2</sup>, Ji Hyeon Noh<sup>2</sup>, Yeon Su Kim<sup>2</sup>, So Hee Park<sup>2</sup>, Ju-Won Kim<sup>1</sup>  
and Sang-YeobYeo<sup>2</sup>

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### PA-21

Evaluation of formulated feeds for the Atlantic salmon parr (*Salmo salar* L.)

Byoungyoon Lee<sup>1</sup>, Saeyeon Lim<sup>1</sup>, Seunghan Lee<sup>2</sup>, Kang-Woong Kim<sup>2</sup>, Mun Chang Park<sup>3</sup>,  
Woo Seok Hong<sup>3</sup>, Seok Ju Hong<sup>3</sup>, Se Ryun Kwon<sup>1</sup> and Youngjin Park<sup>1\*</sup>

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<sup>3</sup>Gangwon state Inland Water Resource Center, Chuncheon 24210, Republic of Korea



**PA-22**

Antioxidant and lipase inhibition activities of glycoprotein isolated from edible seaweeds

Jong Min Lee<sup>1\*</sup> and Jui Chakma<sup>1</sup>

<sup>1</sup>Department of Biotechnology, College of Fisheries Science, Pukyong National University, Busan, 48513, Republic of Korea

**PA-23**

Immersion challenge with *Enterocytozoon hepatopenaei* (EHP) in black porgy (*Acanthopagrus schlegelii*)

Ji-Min-Ryu<sup>1</sup>, Eul-Bit-Noh<sup>1</sup>, Beom-Hee-Lee<sup>1</sup> and Bo-Seong-Kim<sup>1\*</sup>

<sup>1</sup>Department of Aquatic life medicine, Kunsan National University, Gunsan 54150, Republic of Korea

**PA-24**

Isolation and characterization of chum salmon (*Oncorhynchus keta*) primary cells for cell line establishment

Hye Min Lee<sup>1,2</sup>, Hwa Jin Lee<sup>1,3</sup>, Jeong-Hyeon Cho<sup>4</sup> and Sang Yoon Lee<sup>1</sup>

<sup>1</sup>CellQua, Inc, Seongnam 13595, South Korea

<sup>2</sup>Division of Fisheries Life Science, Pukyong National University, Busan 48513, South Korea

<sup>3</sup>Department of Biological Sciences, Kongju National University, Gongju 32588, South Korea

<sup>4</sup>Jeju Fisheries Research Institute, National Institute of Fisheries Science, Jeju 63610, South Korea

**PA-25**

Characterization of caudal fin cell line from a novel fish experimental model, the silvertip tetra (*Hasemanian nana*)

Hwa Jin Lee<sup>1,2</sup> and Sang Yoon Lee<sup>1</sup>

<sup>1</sup>CellQua, Inc, Seongnam 13595, South Korea

<sup>2</sup>Department of Biological Sciences, Kongju National University, Gongju 32588, South Korea

## PA-26

Primary cell isolation and cellular characterization for the establishment of cell lines from eel, *Anguilla japonica*

Hwa Jin Lee<sup>1,2</sup>, Hye Min Lee<sup>1,3</sup>, Mi-Gi Lee<sup>4</sup> and Sang Yoon Lee<sup>1</sup>

<sup>1</sup>CellQua, Inc, Seongnam 13595, South Korea

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<sup>3</sup>Division of Fisheries Life Science, Pukyong National University, Busan 48513, South Korea

<sup>4</sup>Gyeonggido Business and Science Accelerator, Suwon, South Korea

## PA-27

Effect of water temperature on post-surgical recovery following bio-logger implantation in olive flounder

Wonjun Son<sup>1\*</sup>, Gyeonghun Kim<sup>1</sup>, Hyejeong Han<sup>1</sup>, Taeho Kim<sup>2</sup> and Inyeong Kwon<sup>1</sup>

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<sup>2</sup>Department of Marine Production Management, Chonnam National University, Yeosu 59626, Republic of Korea

## PA-28

Toxicity evaluation of bio-Based microplastic polyhydroxybutyrate on adult white leg shrimp (*Litopenaeus vannamei*)

Hui-rong Lyu<sup>1</sup>, Jung-Yeol Park<sup>1</sup>, Chang-huen Cho<sup>1</sup>, Suk-Bin Mun<sup>1</sup>, Da-Bin Jin<sup>1</sup>,

Hyeong-Jun Yoon<sup>1</sup>, Tae-Yang Kang<sup>1</sup> and Jun-wook Hur<sup>1\*</sup>

<sup>1</sup>Department of Aquaculture and Aquatic Science, Kunsan National University, Gunsan 54150, Republic of Korea

**PA-29**

Ghrelin expression and gastrointestinal transit time under starvation in starry flounder (*Platichthys stellatus*)

Youn Su Cho<sup>1</sup>, Hyun Seok Jang<sup>2</sup>, Tae Min Kim<sup>2</sup>, Gang Won Kim<sup>2</sup>, Hye Min Oh<sup>1</sup>,  
Ju Seong Kim<sup>1</sup> and Han-Kyu Lim<sup>1,2\*</sup>

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Republic of Korea

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Muan 58554, Republic of Korea

**PA-30**

Nutritional enrichment with glucose in the yolk-sac larvae stage of freshwater eel (*Anguilla japonica*)

Min Gyu Shin\*, Hyeon-Min Lee, Jin Choi and Shin-Kwon Kim

Aquaculture Research Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PA-31**

Nutritional enrichment method to improve the effect of artificial maturation in freshwater eel (*Anguilla japonica*)

Hyeon-Min Lee\*, Min Gyu Shin, Bo-Hye Nam and Shin-Kwon Kim

Aquaculture Research Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PA-32**

Review of zebrafish (*Danio rerio*) disease

San-A Han, Kyumin Kim and Seon-Heui Cha\*

Department of Marine Bio and Medical Sciences, Hanseo University, Seosan-si 31962, Republic of Korea

### PA-33

Understanding the impact of *Pseudomonas aeruginosa* infection on the transcriptome of *Urechis unicinctus* Nephridia

Hye Young Oh<sup>1</sup> and Nam Gyu Park<sup>2\*</sup>

<sup>1</sup>Institute of Marine Life Science, Pukyong National University 45, Busan 48513, Republic of Korea

<sup>2</sup>Department of Biotechnology, Pukyong National University 45, Busan 48513, Republic of Korea

### PA-34

Long-term usability evaluation of the low-fish meal extruded pellet diet for juvenile olive flounder *Paralichthys olivaceus* at Jeju fish farm

Hyunwoon Lim<sup>1</sup>, Wonhoon Kim<sup>1</sup>, Jaesik Kim<sup>1</sup>, Jin-Woo Song<sup>2</sup>, Seunghan Lee<sup>3</sup>, Sang-Woo Hur<sup>3</sup>, Kang-Woong Kim<sup>3</sup> and Kyeong-Jun Lee<sup>4\*</sup>

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<sup>4</sup>Marine Science Institute, Jeju National University, Jeju Self-Governing Province 63333, Korea

### PA-35

Evaluation of the low-fish meal extruded pellet diet for growing olive flounder *Paralichthys olivaceus* at Jeju fish farm

Hyunwoon Lim<sup>1</sup>, SangHyun Song<sup>1</sup>, Jaesik Kim<sup>1</sup>, Jin-Woo Song<sup>2</sup>, Seunghan Lee<sup>3</sup>, Sang-Woo Hur<sup>3</sup>, Kang-Woong Kim<sup>3</sup> and Kyeong-Jun Lee<sup>4\*</sup>

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### PA-36

Effect of improving growth using water temperature and intestinal microorganisms in red-spotted grouper *Epinephelus akkara*

Byeong-Hoon Kim<sup>1</sup>, Song-Hee Choi<sup>2</sup>, Kang-Hee Im<sup>2</sup> and Sung-Pyo Hur<sup>2\*</sup>

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**PA-37**

Effects of graded levels of dietary  $\gamma$ -aminobutyric acid supplementation on temperature stress responses in juvenile olive flounder (*Paralichthys olivaceus*)

Abayomi O. Ogun\*, Haham Kim, Sooa Yoon, Suhyun Lee, Hyuncheol Jeon, Deni Aulia, Junhyeok Hur and Seunghyung Lee

Division of Fisheries Life Sciences, Pukyong National University, Busan 48513, Rep. of Korea

**PA-38**

Design and characterization of antimicrobial peptide analogs driven from sea urchin, *Heliocidaris crassispina*

Soohyun Park<sup>1</sup>, Hye Young Oh<sup>2</sup>, Hye-jin Go<sup>2</sup>, Anastasia Kubarova<sup>2</sup> and Nam Gyu Park<sup>1\*</sup>

<sup>1</sup>School of Marine and Fisheries Life Science (Major in Biotechnology),

<sup>2</sup>Institute of Marine Life Science, Pukyong National University, Busan, 48513, Korea

**PA-39**

Experiment on the effect of nitrate nitrogen on acute mortality in rainbow trout (*Oncorhynchus mykiss*) fries

JIn-Seo Choi<sup>1</sup>, Seung-Ri Kim<sup>1</sup>, Ji-Yoon Lee<sup>1</sup>, Soo-in Hwang<sup>1</sup>, Gun-Woo Park<sup>1</sup> and Jeong-Hwan Park<sup>2\*</sup>

<sup>1</sup>Department of Aquaculture and Applied Life Sciences, Pukyong National University, Busan 48513, Republic of Korea

<sup>2</sup>Department of Fisheries Biology, Pukyong National University, Busan 48513, Republic of Korea

**PA-40**

Developing a microsatellites PCR system for small yellow croaker (*Larimichthys polyactis*) and their application in parentage assignment

Eun Soo Noh<sup>1\*</sup>, Eun-Ha Shin<sup>1</sup>, Woo-Jin Kim<sup>1</sup>, Young-Ok Kim<sup>1</sup> and Yongwoon Ryu<sup>2</sup>

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<sup>2</sup>Subtropical Fisheries Research Institute, National Institute of Fisheries Science, Jeju 63610, Republic of Korea

**PA-41**

Recombinant production of perlucin-like protein from starfish (*Patiria pectinifera*) and its antibacterial activity

Seongeon Kim<sup>1†</sup>, Jun Hui Kang<sup>1†</sup>, Hye Young Oh<sup>2</sup> and Nam Gyu Park<sup>1\*</sup>

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**PA-42**

Identification and recombinant production of macin from starfish, *Patiria pectinifera*

Junseong Choi<sup>1</sup>, Hye Young Oh<sup>2</sup>, Yeon Su Ham<sup>3</sup>, Jung Min Cha<sup>3</sup> and Nam Gyu Park<sup>1\*</sup>

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<sup>3</sup>Department of Biotechnology, Pukyong National University, Busan 48513, Korea

**PA-43**

Characterization of an antimicrobial peptide purified from starfish, *Patiria pectinifera*

Jae Young Lim<sup>1</sup>, Soohyun Park<sup>1</sup>, Hye Young Oh<sup>2</sup> and Nam Gyu Park<sup>1\*</sup>

<sup>1</sup>School of Marine and Fisheries Life Science (Major in Biotechnology)

<sup>2</sup>Institute of Marine Life Science, Pukyong National University, Busan, 48513, Republic of Korea

**PA-44**

Production of anti-pancreatic cancer compound isolated from marine sediments *Streptomyces* sp. A21a

Jong Min Lee<sup>1\*</sup> and Ga Yeong Kim<sup>1</sup>

<sup>1</sup>Department of Biotechnology, College of Fisheries Science, Pukyong National University, Busan 48516, Republic of Korea

**PA-45**

*amhy* knockout induces ovarian development in XY gonads of pejerrey *Odontesthes bonariensis*

Larissa M. de Vasconcelos<sup>1</sup>, Ricardo Shohei Hattori<sup>1</sup>, Juan Ignacio Fernandino<sup>2</sup>, Yoji Yamamoto<sup>1</sup> and Carlos Augusto Strüssmann<sup>1</sup>

<sup>1</sup>Department of Marine Biosciences, Tokyo University of Marine Science and Technology, Tokyo, Japan

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■ **Fisheries Resources · Ocean · Environment (PR-1 ~ PR-22)**

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**PR-1**

Using multiple benthic indices to evaluate the ecological quality in the sand beach of Anmyeondo in Chungcheongnamdo, South Korea

Jian Liang<sup>1</sup>, Meng-Yuan Shu<sup>2</sup> and Chae-Woo Ma<sup>1</sup>

<sup>1</sup>Department of Biology, Soonchunhyang University, Asan 31538, Republic of Korea

<sup>2</sup>Department of Sports Medicine, Soonchunhyang University, Asan 31538, Republic of Korea

**PR-2**

Distribution characteristic of benthic foraminiferal assemblage in the continental shelf of the East China Sea

Da-Un Jeong<sup>1,2</sup>, Yeon-Gyu Lee<sup>2</sup> and Ihn-Sil Kwak<sup>1,2\*</sup>

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<sup>2</sup>Department of Ocean Integrated Science, Chonnam National University, Yeosu 59626, Republic of Korea

**PR-3**

Vertical distribution and density of giant jellyfish (*Nemopilema nomurai*) using acoustics

Sunyoung Oh<sup>1\*</sup>, Kyoung-Yeon Kim<sup>2</sup>, Sara Lee<sup>1</sup>, Geunchang Park<sup>1</sup>, Wooseok Oh<sup>3</sup> and Kyounghoon Lee<sup>4</sup>

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<sup>4</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Republic of Korea



**PR-4**

Reproductive ecology of yellowback seabream (*Dentex tumifrons*) in the South Sea of Korea

Yu-Jeong Choi<sup>1</sup>, Gun-wook Baek<sup>2</sup>, Hyeon-Ji Kim<sup>1</sup> and Jeong-Hoon Lee<sup>1\*</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong, Korea

<sup>2</sup>Department of Marine Biology & Aquaculture / Institute of Marine Industry, College of Marine Science, Gyeongsang National University, Tongyeong, Korea

**PR-5**

Stock assessment of Small yellow croaker (*Larimichthys polyactis*) in the Northwest Pacific region using CMSY and BSS models

Yun-Je Kim<sup>1</sup>, Do-Hoon Kim<sup>1</sup>, Piao Zhenying<sup>2</sup>, Ji-Min Oh<sup>2</sup> and Na-Kyung Yoon<sup>2</sup>

<sup>1</sup>Department of Marine & Fisheries Business and Economics, Pukyong National University

**PR-6**

Reproductive ecology of pen shell *Atrina pectinata* (Bivalvia: Pinnidae) in the coastal waters of Jinhae, Korea

Hyeon Gyu Lee<sup>1</sup>, Bok Soon Jeon<sup>1</sup>, Eun A Yoon<sup>1</sup> and Jeong-Hoon Lee<sup>1</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 56034, Korea

**PR-7**

Variation and diversity of fish resources in the Jinhae Bay during winter season, assessed by combining eDNA, Trammel net, and acoustic surveys

Yong-Deuk Lee<sup>1</sup>, Eunna Yoon<sup>1</sup>, Cheol Park<sup>1</sup>, Woo-Seok Gwak<sup>2</sup> and Hyungbeen Lee<sup>1\*</sup>

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<sup>2</sup>Marine Bio-Education and Research Center, Gyeongsang National University, Tongyeong 53064, Republic of Korea

**PR-8**

Whale DNA barcoding system for forensic science

Jeong-Ok Park, Yu-Li Oh, Seung-Woo Noh, Hyeon-Kyeong Yoon and Min-Kyu Choo  
Korea Coast Guard Research Center, Cheonan 31254, Republic of Korea

**PR-9**

Bacteriological affects of land pollutants on shellfish production area in southern sea area of Gangneung-si, Gangwon-do, Korea at rainfall time

Hyeon-Uk Park, Seung-Ho Choi and Il-Shik Shin  
Department of Marine Food Science and Technology, Gangneung-Wonju National University, Gangneung-si, Korea

**PR-10**

Morphological development of larvae and juveniles in cultured three line grunt, *Parapristipoma trilineatum* (Perciformes: Haemulidae)

Si-Yeong Jeong<sup>1\*</sup>, Jeong-Hyeon Cho<sup>2</sup>, Jin-Woo Park<sup>2</sup> and Jin-Koo Kim<sup>1</sup>  
<sup>1</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Korea  
<sup>2</sup>Subtropical Fisheries Research Institute, Jeju 63610, Republic of Korea

**PR-11**

Impact of marine aggregate extraction on the catch of primary fisheries resources

Jae-Hoon Cha, Woo-Jung Kim, Ji-Bin Im and Seung-Ho Lee  
Korea Environmental Technology Consulting Hotline, Ansan 15459, Rep. of Korea

**PR-12**

Current status and key insights of environmental impact assessment for floating offshore wind power development projects

Geunchang Park, Hyojun Lee and Hyuntaik Oh  
Center for marine environmental impact assessment, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PR-13**

Spatio-temporal study of sardine *Sardubios melanostictus* from the Southern Waters of Korea using set net and hydroacoustic method

Hyungbeen Lee<sup>1\*</sup>, Euna Yoon<sup>1</sup>, Han Ju Kim<sup>1</sup>, Jeong-Hoon Lee<sup>1</sup>, Jung Nun Kim<sup>1</sup>  
and Hawsun Sohn<sup>1</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Korea

**PR-14**

Target strength and swimbladder morphology of chub mackerel *Scomber japonicus* in the Northwest Pacific Ocean

Euna Yoon<sup>1\*</sup>, Hyungbeen Lee<sup>1</sup>, Jeong-Hoon Lee<sup>1</sup> and Jung-Nun Kim<sup>1</sup>

<sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries Science, Tongyeong 53064, Korea

**PR-15**

Spatio-temporal distribution of antarctic silverfish (*Pleuragramma antarcticum*) in the Ross Sea

Sara Lee<sup>1\*</sup>, Wooseok Oh<sup>2</sup>, Hyungsul La<sup>3</sup>, Wuju Son<sup>4</sup>, Hyung tae Kim<sup>1</sup>, Jiyeon Kim<sup>1</sup>,  
Jeong-Hoon Kim<sup>5</sup> and Kyoungsoon Lee<sup>6</sup>

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<sup>5</sup>Division of Life Sciences, Korea Polar Research Institute, Incheon, Republic of Korea

<sup>6</sup>Division of Marine Production System Management, Pukyong National University, Busan 608-737, Korea

**PR-16**

Molecular identification and morphological description for larvae and juvenile of *Neosalanx anderssoni* (Salangidae, Pisces) collected from southwestern sea of Korea

Seo-Yeon Koo<sup>1</sup> and Jin-Koo Kim<sup>1</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

**PR-17**

First description of *Thryssa kammalensis* (Engraulidae, Clupeiformes) larvae and juveniles collected from the southwestern sea of Korea

Hyeon-Jun Ryu<sup>1</sup> and Jin-Koo Kim<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

**PR-18**

Change of fish species around Dokdo and Ulleungdo by trammel net

Ui-Cheol Shin<sup>1</sup>, Young-Sun Song<sup>1</sup>, Eun-Ho Kim<sup>1</sup>, Seok-Jin Yoon<sup>1</sup> and Jung-Hwa Choi<sup>1\*</sup>

<sup>1</sup>Dokdo Fisheries Research Center, National Institute of Fisheries Science, Pohang 37709, Republic of Korea

**PR-19**

Newly discovered eight-gilled hagfish (Agnatha, Myxinidae) based on imported fish specimens

Young-Sun Song<sup>1\*</sup> and Jin-Koo Kim<sup>2</sup>

<sup>1</sup>Dokdo Fisheries Research Center, National Institute of Fisheries Science, Pohang 37709, Republic of Korea

<sup>2</sup>Department of Marine Biology, Pukyong National University, Busan, 48513, Republic of Korea

**PR-20**

Maturity and spawning of Spanish mackerel, *Scomberomorus niphonius* in the southwestern waters of Korea

Seong Yong Moon<sup>1\*</sup>, Suyeon Jin<sup>2</sup>, Gun Wook Baek<sup>2</sup> and Heeyong Kim<sup>3</sup>

<sup>1</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, Yeosu 59780, Republic of Korea

<sup>2</sup>Department of Marine Biology and Aquaculture, College of Marine Science, Gyeongsang National University, Tongyoung 53064, Republic of Korea

<sup>3</sup>Research and Development Planning Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PR-21**

Distribution characteristics of sailfin sandfish (*Arctoscopus japonicus*) using scientific echosounder in Dokdo, Korea

Eunho KIM<sup>\*</sup>, Seokjin Yoon, Young Sun Song, Ui Cheol Shin and Junghwa Choi  
Dokdo Fisheries Research Center, NIFS, Pohang 37709, Republic of Korea

**PR-22**

A length-based assessment model with environmental conditions being incorporated: illustration with Korea chub mackerel (*Scomber japonicus*) population

So-Yeon Nam<sup>1\*</sup>, Jin-Woo Gim<sup>2</sup> and Saang-Yoon Hyun<sup>1</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, Busan 48516, Republic of Korea

<sup>2</sup>National Institute of Fisheries Science, Busan 46083, Republic of Korea

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■ **Fish Taxonomy · Ecology · Genetics (PF-1 ~ PF-33)**

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**PF-1**

Sexual dimorphism of the olfactory lamellae of *Rhodeus uyekii*

Hyun-Tae Kim

Department of Science Education, Jeonju National University of Education

**PF-2**

Morphology and morphometry of the olfactory organ of *Rhodeus notatus*

Hyun-Tae Kim

Department of Science Education, Jeonju National University of Education

**PF-3**

Osteological study of *Misgurnus* (Pisces, Cobitidae) in South Korea

Se-Yeon Park and Jong-Yeong Park\*

Division of Biological Science, College of Life Sciences, Jeonbuk National University

**PF-4**

A Taxonomical review of differences in body color and measuring characters between geuns *Oryzias* from Korea

Myong-Hak Lee and Jong-Young Park,

Division of Biological Science, College of Life Sciences, Jeonbuk National University

**PF-5**

Morphological study of *Rhinogobius similis* (Gobiidae, Gobionellinae) in Jeju Island and Korean peninsula

In-Jae Mun and Jong-Young Park\*

Division of Biological Science, College of Life Sciences, Jeonbuk National University

**PF-6**

Ecological characteristics of Korean dark dleeper, *Odontobutis platycephala* in Jaho stream, Korea

Hwa-Keun Byeon

Deptatment of Biology Education, Seowon Uinversity, Chungju 28674

**PF-7**

A study on the fish biological survey in the mid- and downstream of Naeseongcheon stream

Hyun-Ju Lim, Jung-Yeon Kim, Han-Ki Nam and Jae-Min Park\*

Gyeongbuk Native Fish Business Center, Province of Gyeongsangbuk-do

**PF-8**

Egg development and morphology of larva and juvenile of *Hyphessobrycon eques*

Na-Young Jeon<sup>1</sup>, Jae-Min Park<sup>2</sup>, Na-Ri Kim<sup>3</sup> Sung-Hun Lee<sup>4</sup> and Kyeong-Ho Han<sup>1\*</sup>

<sup>1</sup>Department of Fisheries Sciences, Chonnam National University; <sup>2</sup>Gyeongsangbuk-Do Native Fish Business Center; <sup>3</sup>Ulju-gun Metropolitan City Livestock and Marine Industry Division; <sup>4</sup>Department of Fishery, Marine, Industry, Tourism, and Leisure, Chonnam National University

**PF-9**

Effects of non-native species removal and connectivity on fish community structure in a wetland ecosystem

Jeong-Soo Gim<sup>1\*</sup>, Donghyun Hong<sup>1</sup>, Dong-Kyun Kim<sup>2</sup>, Erik Jeppesen<sup>3</sup>, Kwang-Seuk Jeong<sup>4</sup>, Gwangmuk Lim<sup>5</sup>, SeungBeen Heo<sup>1</sup>, Gea-Jae Joo<sup>1</sup> and Hyunbin Jo<sup>1,6</sup>

<sup>1</sup>Department of Integrated Biological Science, Pusan National University, <sup>2</sup>K-water Research Institute, <sup>3</sup>Department of Ecoscience, Aarhus University, <sup>4</sup>Department of Nursing Science, Busan Health University, <sup>5</sup>Department of Life Science and Environmental Biochemistry, Pusan National University, <sup>6</sup>Institute for Environment and Energy, Pusan National University

### PF-10

#### Effects of estuary re-opening management on fish community in the Nakdong River Estuary

Donghyun Hong<sup>1\*</sup>, Jeong-Soo Gim<sup>1</sup>, Gea-Jae Joo<sup>2</sup>, Dong-Kyun Kim<sup>3</sup>, Daehyun Choi<sup>4</sup>, Hak-Young Lee<sup>5</sup> and Hyunbin Jo<sup>1,6\*</sup>

<sup>1</sup>Department of Integrated Biological Science, Pusan National University, <sup>2</sup>Department of Biological Sciences, Pusan National University, <sup>3</sup>K-water Research Institute, Yuseong-gu, <sup>4</sup>Nakdong-River Estuary Water Ecosystem Restoration Council, <sup>5</sup>Department of Biological Sciences, Chonnam National University, <sup>6</sup>Institute for Environment and Energy, Pusan National University

### PF-11

#### Fish assemblage of Docheon and Myogok reservoir in Yeongdeok-gun, Kyeongsangbuk-do

Dong-Jae Yoo<sup>1</sup>, Woo-Sung Choi<sup>2</sup>, Seong-Hoon Lee<sup>3</sup> and Kyeong-Ho Han<sup>2\*</sup>

<sup>1</sup>Department of Production, Fisheries Resource Development Research Institute, <sup>2</sup>Department of Fishery Sciences, Chonnam National University, <sup>3</sup>Department of Fishery, Marine, Industry, Tourism and Leisure, Chonnam National University

### PF-12

#### Fish community characteristics and distribution aspect of *Rhodeus pseudosericeus* (Cyprinidae) in the Geumdang Stream, a tributary of the Han River Drainage System of Korea

Mee-Sook Han and Myeong-Hun Ko\*

Kosoo Biology institute

### PF-13

#### Fish community characteristics and distribution aspect of endangered Fish Species in the Downstream of Yongdam-dam, a tributary of the Geum River Drainage System of Korea

Jae-Woo Joo<sup>1</sup>, Hany Chang<sup>2</sup> and Myeong-Hun Ko<sup>1\*</sup>

<sup>1</sup>Kosoo Biology institute, <sup>2</sup>National Institute of Ecology



**PF-14**

Ichthyofauna in the Geumho River, Nakdong River System, Korea

Sung Mu Sung<sup>1</sup> and Chae Byung Sook<sup>2,\*</sup>

<sup>1</sup>Muldeuli Research, <sup>2</sup>Institute of Freshwater Ecology

**PF-15**

Anatomical and histological study of the olfactory organ of the grass puffer *Takifugu niphobles* (Tetraodontiformes, Tetraodontidae) in the Jeju Island

Min-Jeong Choi<sup>1\*</sup> and Jong-Young Park<sup>1\*</sup>

<sup>1\*</sup>Division of Biological Science, College of Life Sciences, Jeonbuk National University

**PF-16**

Isotopic niche and competition between *Pennahia argentata* and *Larimichthys polyactis* using bulk and amino acid stable isotopes

Tae-Sik Yu<sup>1</sup>, Won-Seok Kim<sup>2</sup>, Bohyung Choi<sup>3</sup> and Ihn-Sil Kwak<sup>12\*</sup>

<sup>1</sup>Fisheries Science Institute, Chonnam National University, <sup>2</sup>Department of Ocean Integrated Science, Chonnam National University, <sup>3</sup>Inland Fisheries Research Institute, National Institute of Fisheries Science

**PF-17**

Morphological and morphometric characteristics of leptocephalus collected from the waters around Heuksan Island in Dadohaehaesang National Park, Korea

Dong-Min Park<sup>1,3\*</sup>, Yu-Cheol Lee<sup>1</sup>, In-Young Choi<sup>1</sup>, Tae-Sik Yu<sup>2</sup>, Woo-Sung Choi<sup>3</sup>, and Kyeong-Ho Han<sup>3</sup>

<sup>1</sup>Marine Research Center, National Park Research Institute, <sup>2</sup>Fisheries Science Institute, Chonnam National University, <sup>3</sup>Department of Fisheries Science, Chonnam National University

**PF-18**

Embryonic and larvae development of hybrid pufferfish, *Takifugu rubripes*(♀) X *T. obscurus*(♂)

Jin Lee<sup>1</sup>, Sung-Hun Lee<sup>2</sup>, Hyeong-Seon Kim<sup>3</sup>, and Kyeong-Ho Han<sup>1\*</sup>

<sup>1</sup>Department of Fisheries Sciences, Chonnam National University, <sup>2</sup>Department of Fishery, Marine, Industry, Tourism, and Leisure, Chonnam National University, <sup>3</sup>Aquatopia International Inc.

### PF-19

Types of *Gymnogobius taranetzi* and genetical classification of 11 species of Gobiidae

In-Ho Yeon<sup>1</sup>, Ha-Rin-Yi Kim<sup>2</sup>, Sung-Hun Lee<sup>3</sup> and Kyeong-Ho Han<sup>2\*</sup>

<sup>1</sup>Korea Fisheries Resources Agency, Southern sea office; <sup>2</sup>Department of Fisheries and Sciences, Chonnam National University; <sup>3</sup>Chonnam National University Department of Fishery, Marine, Industry, Tourism, and Leisure, Chonnam National University

### PF-20

First record of *Bathyraja griseocauda* (Rajiformes: Arhynchobatidae) with morphological abnormality in the southwest Atlantic Ocean

Min-Gyoon Park<sup>1</sup>, Eunjung Kim<sup>2</sup> and Jin-Koo Kim<sup>1\*</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, <sup>2</sup>Distant Water Fisheries Resources Division, National Institute of Fisheries Science

### PF-21

First record of Bellybarred pipefish, *Hippichthys spicifer* (Rüppell, 1838) (Gasterosteiformes: Syngnathidae), from Jeju Island, Korea

Yu-Jin Lee and Jin-Koo Kim\*

Department of Marine Biology, Pukyong National University, Busan 48513, Republic of Korea

### PF-22

Morphological description of an unrecorded earthworm goby *Luciogobius martellii* Di caporiacco, 1948 (Perciformes: Gobiidae) from Seochon, Korea

Min-Soo Sohn<sup>1</sup>, Hyuck Joon Kwun<sup>1</sup> and Jin-Koo Kim<sup>2\*</sup>,

<sup>1</sup>National Marine Biodiversity Institute of Korea, <sup>2</sup>Department of Marine biology, Pukyong National University

### PF-23

First occurrence of longarm mullet *Moolgarda cunnesius* (Mugiliformes: Mugilidae) from Jeju Island, Korea

Yeon-Ju Seo<sup>1</sup> and Jin-Koo Kim\*

Department of Marine Biology, Pukyong National University

**PF-24**

A new record of snubnose pompano, *Trachinotus blochii* (Carangidae) from Korea

Hyeon-Jeong Kim and Jin-Koo Kim\*

Department of Marine Biology, Pukyong National University

**PF-25**

First occurrence of the dana pearleye, *Scopelarchoides danae* (Aulopiformes: Scopelarchidae) in the Southern Sea of Korea

Jin-Koo Kim<sup>1\*</sup>, Jung-Hwa Ryu<sup>2</sup> and Se-Hyun Song<sup>3</sup>

<sup>1</sup>Department of Marine Biology, Pukyong National University, <sup>2</sup>Ryujunghwa Marine Research Institute, Busan 47266, <sup>3</sup>National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PF-26**

First reliable record of the *Scolecenchelys fuscogularis* (Anguilliformes: Ophichthidae) from Daesambudo Island, Korea

Hyun-Geun Cho<sup>1\*</sup>, Dong-Min Park<sup>2</sup> and Ji-Hwa Jung<sup>1</sup>

<sup>1</sup>Division of Zoology, Honam National Institute of Biological Resources, <sup>2</sup>Marine Research Center, National Park Research Institute

**PF-27**

Changes in fish community structure by a gape net in the coast of Nangdo Island, Korea

Seung-Jo Han<sup>1</sup>, Jin-Ho Jung<sup>1</sup>, Hae-young Choi<sup>1</sup>, Jeong-Ho Park<sup>1</sup> and Seong-Yong Moon<sup>1\*</sup>

<sup>1</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science

**PF-28**

Changes in fish community structure near the Yeosu Coast, Korea: A study based on the daily set-net catch data from the last 15 years

Seong Yong Moon<sup>1</sup>, Mi Hee Lee<sup>1</sup>, Jeong-Ho Park<sup>1</sup>, Heayoung Choi<sup>1</sup>, Kyung-Mi Jung<sup>2</sup> and Myung Sung Koo<sup>3,\*</sup>

<sup>1</sup>South Sea Fisheries Research Institute, National Institute of Fisheries Science, <sup>2</sup>Coastal Water Fisheries Resources Research Division, National Institute of Fisheries Science, Fisheries Engineering Research Division, National Institute of Fisheries Science

**PF-29**

Species composition of fish collected by gill net at the coastal waters of Goseong in Gangwon-do, Korea

Ha-Young Seong<sup>1</sup>, Sun-Kil Lee<sup>1</sup>, Maeng-Jin Kim<sup>1</sup>, Jeong-Min Shim<sup>1</sup>, Jae-Hyeong Yang<sup>2</sup> and Jeong-Ik Baek<sup>1\*</sup>

<sup>1</sup>East Sea Fisheries Research Institute, National Institute of Fisheries Science, <sup>2</sup>Coastal Water Fisheries Resources Research Division, National Institute of Fisheries Science

**PF-30**

Species composition of fish collected by gill net in Donghae, East Sea of Korea

Jeong-Kyu Lee<sup>1</sup>, Sun-Kil Lee<sup>1</sup>, Maeng-Jin Kim<sup>1</sup>, Jeong-Min Shim<sup>1</sup>, Jae-Hyeong Yang<sup>2</sup> and Jeong-Ik Baek<sup>1\*</sup>

<sup>1</sup>East Sea Fisheries Research Institute, National Institute of Fisheries Science, <sup>2</sup>Coastal Water Fisheries Resources Research Division, National Institute of Fisheries Science

**PF-31**

Species composition and seasonal variation of fish collected in coastal waters off Jindo-myeon, Sinan-gun, Korea

Ae-Ri Jung<sup>1</sup>, Sung-Hun Lee<sup>2</sup> and Kyeong-Ho Han<sup>1\*</sup>

<sup>1</sup>Department of Fisheries Sciences, Chonnam National University, <sup>2</sup>Department of Fishery, Marine, Industry, Tourism, and Leisure, Chonnam National University

**PF-32**

Comparative analysis of fish assemblage characteristics between closed and opened estuaries

Gun Hee Oh<sup>1</sup>, Tae-Sik Yu<sup>2</sup>, Chang Woo Ji<sup>2</sup> and Ihn-Sil Kwak<sup>1,2\*</sup>

<sup>1</sup>Department of Ocean Integrated Science, Chonnam National University, <sup>2</sup>Fisheries Science Institute, Chonnam National University

**PF-33**

First report of morphology of a oneknife unicornfish *Naso thynnoides* (Acanthuridae, Perciformes) identified based on COI sequences

Hae-Young Choi<sup>1</sup>, Sung Kim<sup>2</sup>, Hee-Chan Choi<sup>3</sup> and Seok-Hyun Yoon<sup>4\*</sup>

Fisheries Resources and Environment Division, South Sea Fisheries Research Institute, <sup>2</sup>Ocean Climate Response & Ecosystem Research Department, Korea Institute of Ocean Science & Technology, <sup>3</sup>Marine Environment Impact Assessment Center, National Institute of Fisheries Science, <sup>4</sup>Oceanic Climate & Ecology Research Division, National Institute of Fisheries Science

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■ **Fish Diseases (PD-1 ~ PD-66)**

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**PD-1**

Toxic effects on growth performance and hematological parameters of Korean bullhead, *Pelteobagrus fulvidraco* exposed to Phenthoate

Su-bin Jeong<sup>1</sup>, Jae-Ho Choi<sup>1</sup>, Ju-Hyeong Lee<sup>1</sup>, Jun-Ho Hwang<sup>1</sup>, Jae-rin Lim<sup>1</sup>, Young-Bin Yu<sup>2</sup>, Hyeok-Chan Jung<sup>2</sup>, Min-Jae Kim<sup>2</sup>, Se-hyeong Lee<sup>2</sup>, Ji-Yeon Ko<sup>2</sup>, Na-Yeong Kwon<sup>2</sup> and Ju-Chan Kang<sup>2,\*</sup>

<sup>1</sup>Department of Smart Green Technology Engineering, Pukyong National University

<sup>2</sup>Department of Aquatic Life Medicine, Pukyong National University

**PD-2**

Toxic effects on growth performance and hematological parameters in starry flounder, *Platichthys stellatus* exposed to Bisphenol A

Jun-Ho Hwang<sup>1</sup>, Jae-Ho Choi<sup>1</sup>, Ju-Hyeong Lee<sup>1</sup>, Su-Bin Jeong<sup>1</sup>, Jae-Rin Im<sup>1</sup>, Young-Bin Yu<sup>2</sup>, Hyeok-Chan Jung<sup>2</sup>, Min-Jae Kim<sup>2</sup>, Ji-Yeon Ko<sup>2</sup>, Se-Hyeong Lee<sup>2</sup>, Na-Yeong Kwon<sup>2</sup>, and Ju-Chan Kang<sup>2\*</sup>

<sup>1</sup>Department of Smart Green Technology Engineering, Pukyong National University

<sup>2</sup>Department of Aquatic Life Medicine, Pukyong National University,

**PD-3**

Toxic effects on growth performance and hematological parameters of Korean Rockfish, *Sebastes schlegelii* exposed to polyethylene microplastic

Jae-Rin Im<sup>1</sup>, Jae-Ho Choi<sup>1</sup>, Ju-Hyeong Lee<sup>1</sup>, Jun-Ho Hwang<sup>1</sup>, Su-bin Jeong<sup>1</sup>, Young-Bin Yu<sup>2</sup>, Hyeok-Chan Jung<sup>2</sup>, Min-Jae Kim<sup>2</sup>, Ji-Yeon Ko<sup>2</sup>, Na-Yeong Kwon<sup>2</sup>, Se-Hyeong Lee<sup>2</sup>, and Ju-Chan Kang<sup>2,\*</sup>

<sup>1</sup>Department of Smart Green Technology Engineering, Pukyong National University

<sup>2</sup>Department of Aquatic Life Medicine, Pukyong National University

**PD-4**

Toxic effects of combined exposure to microplastics and cadmium on antioxidant and immunity in *Platichthys stellatus*

Ju-Hyeong Lee<sup>1\*</sup>, Young-Bin Yu<sup>2</sup>, Heok-Chan Jung<sup>2</sup>, Jae-Ho Choi<sup>1</sup>, Na-Yeong Kwon<sup>2</sup>, Ji-Yeon Ko<sup>2</sup>, Min-Jae Kim<sup>2</sup>, Se-Hyeong Lee<sup>2</sup>, Jun-Ho Hwang<sup>1</sup>, Su-Bin Jeong<sup>1</sup>, Jae-Rin Im<sup>1</sup> and Ju-Chan Kang<sup>2</sup>

<sup>1</sup>Department of Smart Green Technology Engineering, Pukyong National University

<sup>2</sup>Department of Aquatic Life Medicine, Pukyong National University

**PD-5**

Red sea bream iridovirus (RSIV) infection in rock bream (*Oplegnathus Fasciatus*) according to stocking density

Chae-Yeong Ji and Chan-Il Park

Department of Marine Biology & Aquaculture, Institute of Marine Industry, College of Marine Science, Gyeongsang National University, 2, Tongyeonghaean-ro, Tongyeong 53064, Republic of Korea

**PD-6**

Development and validation of a multiplex quantitative polymerase chain reaction assay for detecting and genotyping red sea bream iridoviral disease

In-Gu Kim and Chan-Il Park

Department of Marine Biology and Aquaculture, Gyeongsang National University, Tongyeong 53064, Gyeongsangnam-do, Republic of Korea

**PD-7**

Molecular characterization and expression analysis of the zinc finger protein 703 (ZNF703) gene from starry flounder (*Platichthys stellatus*)

Sei-Rin Jang and Chan-Il Park

Department of Marine Biology and Aquaculture, Gyeongsang National University, Tongyeong 53064, Gyeongsangnam-do, Republic of Korea

### PD-8

Insights of the molecular mechanisms of the antioxidant effector glutaredoxin1 from yellowtail clownfish (*Amphiprion clarkii*)

Cheong Uk Park<sup>1,2\*</sup>, J.D.H.E.Jayasinghe<sup>1,2</sup>, E.M.T.Tharanga<sup>1,2</sup>, D.M.K.P.Sirisena<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, W.A.D.L.R.Warnakula<sup>1,2</sup>, R.I.Sandeepani<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

<sup>1</sup>Department of Marine Life Sciences & Center for Genomic Selection in Korean Aquaculture, Jeju National University, Jeju 63243, Republic of Korea

<sup>2</sup>Marine Science Institute, Jeju National University, Jeju 63333, Republic of Korea

### PD-9

Serotype and mitochondrial cytochrome c oxidase subunit 1 gene analysis of the scuticociliate *Miamiensis avidus* in cultured olive flounder (*Paralichthys olivaceus*) in Jeju island

Ye-Jin Ko, Lyu-Jin Jun and Joon-Bum Jung

Department of Marine Life Science & Marine Science Institute, Jeju National University, Jeju Self-Governing Province, 63243, Republic of Korea

### PD-10

Molecular characterization and immune response of a *suppressor of cytokine signaling 3a* gene from *Scomber japonicus*

Yuhwan Jo<sup>1,2\*</sup>, H.M.V. Udayantha<sup>2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, E.M.T. Tharanga<sup>1,2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Cheong Uk Park<sup>1,2</sup>, R. I. Sandeepani<sup>1,2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-11**

Galectin-8-like isoform X1 from redlip mullet (*Planiliza haematocheilus*) exhibits protective effects against oxidative damage and cell death

W.A.D.L.R. Warnakula<sup>1,2\*</sup>, E.M.T. Tharanga<sup>1,2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, R.I. Sandeepani<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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<sup>2</sup>Marine Science Institute, Jeju National University, Jeju 63333, Republic of Korea

**PD-12**

Molecular and functional characterization of a ladderlectin-like molecule from red-spotted grouper (*Epinephelus akaara*)

Jeganathan Tharshan Jeyakanesh<sup>1,2\*</sup>, Kishanthini Nadarajapillai<sup>1,2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, E.M.T. Tharanga<sup>1,2</sup>, Cheong Uk Park<sup>1,2</sup>, R.I. Sandeepani<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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<sup>2</sup>Marine Science Institute, Jeju National University, Jeju 63333, Republic of Korea

**PD-13**

Interferon regulatory factor 2 in red-spotted grouper (*Epinephelus akaara*): Structural and functional investigation for its immunological properties

D.M.K.P. Sirisena<sup>1,2\*</sup>, R.I. Sandeepani<sup>1,2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Cheong Uk Park<sup>1,2</sup>, E.M.T. Tharanga<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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#### PD-14

Molecular identification and characterization of interferon-stimulated gene 20-kDa protein in red-spotted grouper (*Epinephelus akaara*)

D.M.K.P. Sirisena<sup>1,2\*</sup>, R.I. Sandeepani<sup>1,2</sup>, Yasara Kavindi Kodagoda<sup>1,2</sup>, J.D.H.E. Jayasinghe<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, B.P.M. Vileka Jayamali<sup>1,2</sup>, Cheong Uk Park<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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#### PD-15

Characterizaation of yellowtail clownfish (*Amphiprion clarkii*)  
cc chemokine ligand 4 (ccl4): expression profiles and biofunction in innate immunity

J.D.H.E. Jayasinghe<sup>1,2\*</sup>, Hanchang Sohn<sup>2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, E.M.T. Tharanga<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, R. I. Sandeepani<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup> Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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#### PD-16

Insights into metal tolerance, immune response, and oxidative stress of metallothionein from disk abalone (*Haliotis discus discus*)

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**PD-17**

Correlation of rock bream iridovirus (RBIV) replication and hematological indicators in rock bream (*Oplegnathus fasciatus*)

Jayeon Cheon and Myung-Hwa Jung

Department of Marine Bio and Medical Sciences, Hanseo University, Korea

**PD-18**

Effect of rock bream iridovirus (RBIV) infected tissue intake on mortality in rock bream (*Oplegnathus fasciatus*)

Seok Ju Lee and Myung-Hwa Jung

Department of Marine Bio and Medical Sciences, Hanseo University, Korea

**PD-19**

Virulence shift of rock bream iridovirus (RBIV) during serial passage in rock bream (*Oplegnathus fasciatus*)

Da-Seul Lee, Yeon-Gyoung Lee and Myung-Hwa Jung

Department of Marine Bio and Medical Sciences, Hanseo University, Korea

**PD-20**

Systemic infection of rock bream iridovirus (RBIV) through blood vessels

Dong Jin Lim and Myung-Hwa Jung

Department of Marine Bio and Medical Sciences, Hanseo University, Korea

**PD-21**

Oral transmission as a route of infection for rock bream iridovirus (RBIV) in rock bream (*Oplegnathus fasciatus*)

Hyeon Seo Yoon and Myung-Hwa Jung

Department of Marine Bio and Medical Sciences, Hanseo University, Korea

## PD-22

Role of tumor necrosis factor receptor-associated factor 6 in regulating antiviral immunity in red-spotted grouper (*Epinephelus akaara*)

E.M.T. Tharanga<sup>1,2\*</sup>, Kishanthini Nadarajapillai<sup>1,2</sup>, D.M.K.P.Sirisena<sup>1,2</sup>, J.D.H.E.Jayasinghe<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Jeganathan Tharshan Jeyakanesh<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Hanchang Sohn<sup>2</sup>, Qiang Wan<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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## PD-23

TRAF2 of red-spotted grouper (*Epinephelus akaara*) promotes the polarization of M2 macrophages and antiviral defence.

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## PD-24

Thioredoxin-interacting protein links oxidative stress and immune functions in yellowtail clownfish (*Amphiprion clarkii*)

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**PD-25**

Genome Wide Association Study (GWAS) and Genomic Prediction for resistance to *Entreomyxum leei* in olive flounder (*Paralichthys olivaceus*)

Gaeun Kim<sup>1,2</sup>, W.K.M. Omeke<sup>2</sup>, Sukkyoung Lee<sup>2</sup>, Chang-Nam Jin<sup>2</sup>, Hanchang Sohn<sup>2</sup>, D.S. Liyanage<sup>2</sup>, H.M.V. Udayantha<sup>2</sup>, Jeongeun Kim<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, Taehyug Jeong<sup>2</sup>, Qiang Wan<sup>2</sup>, Cecile Massault<sup>3</sup>, Dean R. Jerry<sup>3</sup> and Jehee Lee<sup>1,2</sup>

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**PD-26**

Molecular characterization and detoxification of a Glutathione S-transferase omega 1 from redlip mullet (*Liza hematocheilus*)

Jeongeun Kim<sup>1,2</sup>, W.K.M. Omeke<sup>2</sup>, W.P.S.N. Wiljeweera<sup>1,2</sup>, D.M.U.M. Dissanayaka<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-27**

Molecular Delineation, Expression Profiling and Antiviral Immune Response of AclFI44L from *Amphiprion clarkii*

Y.K. Kodagoda<sup>1,2</sup>, W.K.M. Omeke<sup>2</sup>, D.S. Liyanage<sup>2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, K. Arthika<sup>1,2</sup>, Taehyug Jeong<sup>2</sup>, Sukkyoung Lee<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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### PD-28

Identification of MAP kinase-interacting kinase 2 (*MKNK2*) from yellowtail clownfish (*Amphiprion clarkii*): insights into its molecular, transcriptional, functional properties and immune regulatory functions

H.A.C.R. Hanchapola<sup>1,2</sup>, D.S. Liyanage<sup>2</sup>, W.K.M. Omeke<sup>2</sup>, H.M.V. Udayantha<sup>2</sup>, Jeongeun Kim<sup>1,2</sup>, Gaeun Kim<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, M.A.H. Dilshan<sup>1,2</sup>, D.C.G. Rodrigo<sup>1,2</sup>, B.P.M. Vileka Jayamali<sup>1,2</sup>, G.A.N.P. Ganepola<sup>1,2</sup>, Arthika Kalaichelvan<sup>1,2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup>, and Jehee Lee<sup>1,2</sup>

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### PD-29

Insight into the molecular characteristics, antioxidant properties, and immunological expression of thioredoxin-domain containing protein 12 (TXNDC12) from yellowtail clownfish (*Amphiprion clarkii*)

M.A.H. Dilshan<sup>1,2</sup>, W.K.M. Omeke<sup>2</sup>, H.M.V. Udayantha<sup>2</sup>, D.S. Liyanage<sup>2</sup>, D.C.G. Rodrigo<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup>, and Jehee Lee<sup>1,2</sup>

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### PD-30

Molecular characterization, antioxidant, and DNA protective functions of peroxiredoxin1 from yellowtail clownfish (*Amphiprion clarkii*)

D.C.G. Rodrigo<sup>1,2</sup>, H.M.V. Udayantha<sup>2</sup>, W.K.M. Omeke<sup>2</sup>, D.S. Liyanage<sup>2</sup>, Gaeun Kim<sup>1,2</sup>, Jeongeun Kim<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, M.A.H. Dilshan<sup>1,2</sup>, G.A.N.P. Ganepola<sup>1,2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup>, Qiang Wan<sup>2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-31**

Assessing the prediction accuracy for resistance to viral hemorrhagic septicemia virus in olive flounders

D.S. Liyanage<sup>2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup>, Mun-kwan Kim<sup>2</sup>, W.K.M. Omeke<sup>2</sup>, H.M.V. Udayantha<sup>2</sup>, Jeongeun Kim<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Gaeum Kim<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, M.A.H. Dilshan<sup>1,2</sup>, D.C.G. Rodrigo<sup>1,2</sup>, Cheong-Uk Park<sup>1,2</sup>, Jaemin Hyun<sup>3</sup>, Seong-Rip Oh<sup>3</sup>, Aejeon Park<sup>3</sup>, Po Gong<sup>3</sup>, Dean R Jerry<sup>4</sup> and Jehee Lee<sup>1,2</sup>

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**PD-32**

Molecular characterization and *In silico* analysis of isoform of thioredoxin domain containing protein 9 (*TXNDC9*) from chub mackerel (*Scomber japonicus*)

G.A.N.P. Ganepola<sup>1,2</sup>, H.M.V. Udayantha<sup>2</sup>, W.K.M. Omeke<sup>2</sup>, D.S. Liyanage<sup>2</sup>, Jeongeun Kim<sup>1,2</sup>, Gaeun Kim<sup>1,2</sup>, Jihun Lee<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, M.A.H. Dilshan<sup>1,2</sup>, D.C.G. Rodrigo<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, Arthika Kalaichelvan<sup>1,2</sup>, Sukkyoung Lee<sup>2</sup>, Taehyug Jeong<sup>2</sup>, and Jehee Lee<sup>1,2</sup>

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**PD-33**

Quantitative evaluation of the viability of *Miamiensis avidus*

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**PD-34**

Analysis of serotype and antibiotic resistance gene of *Streptococcus parauberis* isolated from cultured olive flounder (*Paralichthys olivaceus*) in Jeju in 2023

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**PD-35**

CRISPR/Cas9-induced knockout of Tlr5a enhances the resistance of zebrafish larvae against *Edwardsiella piscicida* infection while attenuating over inflammation

H.M.S.M.Wijerathna<sup>1,2</sup>, Sumi Jung<sup>1,2</sup>, Sarithaa Sellaththurai<sup>1,2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-36**

CRISPR/Cas9-mediated tumor necrosis factor-alpha-type I in zebrafish leads to susceptibility to *Edwardsiella piscicida* infection

Kishanthini Nadarajapillai<sup>1,2</sup>, Sumi Jung<sup>1,2</sup>, Sarithaa Sellaththurai<sup>1,2</sup>, Subothini Ganeshalingam<sup>1,2</sup>

Myoung-Jin Kim<sup>3</sup> and Jehee Lee<sup>1,2</sup>

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**PD-37**

Molecular characterization and transcriptional expression profiling of E3 ubiquitin/ISG15 ligase TRIM25-like isoform X1 from *Amphiprion clarkii*

Subothini Ganeshalingam<sup>1,2</sup>, Kishanthini Nadarajapillai<sup>1,2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-38**

Molecular characterization and expression profiling of *trim59* in red-spotted grouper (*Epinephelus akaara*)

U.P.E. Arachchi<sup>1,2</sup>, K.P. Madushani<sup>1,2</sup>, K.A.S.N. Shanaka<sup>1,2</sup>, Sumi Jung<sup>1,2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-39**

Molecular characterization, immune responses, and functional delineation of E3 ubiquitin ligase March5 from yellowtail clownfish (*Amphiprion clarkii*)

B.P.M. Vileka Jayamali<sup>1,2</sup>, H.M.S.M. Wijerathna<sup>1,2</sup>, D.M.K.P. Sirisena<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, W.A.D.L.R. Warnakula<sup>1,2</sup>, Sumi Jung<sup>1,2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-40**

Thioredoxin domain-containing protein 17 (TXNDC17) in Chub mackerel (*Scomber japonicus*): Molecular characteristics and immune response

Arthika Kalaichelvan<sup>1,2\*</sup>, H.M.V. Udayantha<sup>1,2</sup>, W.K.M. Omeke<sup>1,2</sup>, G.A.N.P. Ganepola<sup>1,2</sup>, Yuhwan Jo<sup>1,2</sup>, Y.K. Kodagoda<sup>1,2</sup>, H.A.C.R. Hanchapola<sup>1,2</sup>, Sumi Jung<sup>1,2</sup> and Jehee Lee<sup>1,2</sup>

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**PD-41**

Bacterial Extracellular Vesicles Isolated from *Edwardsiella piscicida*: Isolation, Characterisation, and Immunomodulatory Activities

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College of Veterinary Medicine and Research Institute of Veterinary Medicine,  
Chungnam National University, Daejeon 34134

**PD-42**

Isolation, Characterization and Immune Modulatory Properties of Extracellular Vesicles Derived from *Streptococcus parauberis*

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**PD-43**

Immune Modulatory Properties and Proteomic Analysis of Extracellular Vesicles (EVs) Isolated from *Streptococcus parauberis* Challenged Olive Flounder (*Paralichthys olivaceus*) Plasma

E. H. T. Thulshan Jayathilaka\*<sup>1</sup>, Amirah Hani Ramli<sup>2</sup>, Mahanama De Zoysa<sup>1</sup>, and Chamilani Nikapitiya<sup>1</sup>

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**PD-44**

Molecular Profiling of *Edwardsiella piscicida* Infected Olive Flounder (*Paralichthys olivaceus*) Plasma Derived Extracellular Vesicles

Chamilani Nikapitiya\*, Withanage Prasadini Wasana, E.H.T.T. Jayathilaka, and Mahanama De Zoysa  
College of Veterinary Medicine, Chungnam National University, Daejeon 34134

**PD-45**

Development and validation of cross-priming amplification combined with lateral flow assay (CPA-LFA) for the detection Koi herpesvirus (KHV)

Guk Hyun Kim<sup>1</sup>, Hye Won Kim<sup>1</sup>, Ji Yeong Choi<sup>1</sup>, Hyun Deok Choi<sup>1</sup>, and Kwang Il Kim<sup>1\*</sup>

<sup>1</sup>Department of Aquatic Life Medicine; Pukyong National University; Busan; Republic of Korea

**PD-46**

Diagnostic biomarkers and models for assessing obesity in rainbow trout (*Oncorhynchus mykiss*)

Jiyeon Park and Do-Hyung Kim\*

Department of aquatic life medicine, Pukyong National University, Busan 48516, Republic of Korea

**PD-47**

Dynamics of VHSV infection in olive flounder (*Paralichthys olivaceus*): size-dependent viral loads and temperature-mediated decay rates in seawater

Hyo-Young Kang<sup>1</sup>, Yoonhang Lee<sup>1</sup>, Young Ung Heo<sup>1</sup>, Fortunitawanli Cahyani<sup>1</sup>, Ju-Hyeong Lee<sup>2</sup>, Jae-Ok Kim<sup>3</sup>, Gwang Il Jang<sup>4</sup>, Sungyoul Hong<sup>4</sup>, Mun-Gyeong Kwon<sup>4</sup> and Do-Hyung Kim<sup>1\*</sup>

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**PD-48**

Screening for antibacterial activity of medicinal plants and chemicals against fish pathogen

Seung-Hoon Lee<sup>1</sup>, Hyun-Ji Byun<sup>1</sup>, Dong-Hwi Kim<sup>1</sup>, Min-Soo Joo<sup>1</sup>, So-Sun Kim<sup>1</sup>, Jung-Jun Park<sup>1</sup>, Kyoung-Duck Kim<sup>1</sup>, Kwang Tae Son<sup>1</sup>, and Soo-Ji Woo<sup>1\*</sup>

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**PD-49**

Changes in vitamin D binding protein (DBP) expression in rainbow trout (*Oncorhynchus mykiss*) according to LED light

Sang-Baek Lee, Hyun-Seung Jo, Tae-Hee Hwang, Chang-Han Kim and Yi-Kyung Kim

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**PD-50**

Expression analysis of biorhythm genes of rainbow trout, *Oncorhynchus mykiss* in response to the length of day

Se-Jin Kim, Dong-Pyo Kim, Seong-Il Kim, Seung-Hoon Back, Sang-hyup Park and Yi Kyung Kim

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Gangneung 25457, Republic of Korea

**PD-51**

Rainbow trout AKT1 (RAC-alpha Serine/Threonine-Protein Kinase) Expression Analysis in Response to Photoperiods

Yang-Sub Lee<sup>1</sup>, Tae-Min Um<sup>1</sup>, Chan-Young Lee<sup>1</sup>, Min-Seok Jin<sup>1</sup> Gi-Bbum Lee<sup>2</sup> and Yi-Kyung Kim<sup>2</sup>

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**PD-52**

Natural killer cell activity of splenocytes from olive flounder injected by a novel toltrazuril derivative, PK08

Jung-Eui Kim<sup>1\*</sup>, Jung-Waun Do<sup>2</sup>, A-Ran Kim<sup>2</sup> and Yi-Kyung Kim<sup>1</sup>

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<sup>2</sup>National Institute of Fisheries Science, Busan, Korea

**PD-53**

Verification of protective efficacy against different viral hemorrhagic septicemia virus (VHSV) isolates belonging to genotype IVa depending on various dose-boosting immunization of rVHSV-GΔTM in olive flounder

So Yeon Kim<sup>\*1</sup> and Min Sun Kim<sup>1</sup>

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**PD-54**

Effect of viral hemorrhagic septicemia virus genotype II on gene expression in  $\Delta$ TRAF6- *Epithelioma papulosum cyprini* (EPC) cells

Najib Abdellaoui<sup>1\*</sup>, Seon Young Kim<sup>1</sup>, Hyoung Jun Kim<sup>2</sup> and Min Sun Kim<sup>1</sup>

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**PD-55**

Antiviral effect of miR-155 on infectious hematopoietic necrosis virus (IHNV) and infectious pancreatic necrosis virus (IPNV) in *Epithelioma papulosum cyprini* (EPC) cells

Ik-Jun Park<sup>1\*</sup>, Najib Abdellaoui<sup>1</sup> and Min Sun Kim<sup>1</sup>

<sup>1</sup>Department of Biological Sciences, Kongju National University, Gongju 32588, Republic of Korea

**PD-56**

Optimization of viral hemorrhagic septicemia virus (VHSV) detection based on CRISPR-Cas13a system

Hwa-jin Lee<sup>1\*</sup>, Najib Abdellaoui<sup>1</sup>, Ha-Eun Kim and Min-sun Kim<sup>1</sup>

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**PD-57**

The complete mitochondrial genome of *Megalobenedenia derzhavini* (Monogenea: Capsalidae) infecting cultured black rockfish (*Sebastes schlegelii*) in Korea

Han-Seul Cho<sup>1\*</sup> and Jeong-Ho Kim<sup>1</sup>

<sup>1</sup>Department of Aquatic Life Medicine, Gangneung-Wonju National University, Gangneung, Korea

**PD-58**

Structural identification of TNFSF15 receptors (death receptor 3 and decoy receptor 3) in rock bream (*Oplegnathus fasciatus*)

Sungjae Ko\* and Suhee Hong

Department of Aquatic Life Medicine, Gangneung-Wonju National University, Gangneung 210-702, Republic of Korea

**PD-59**

Evaluation of its protective immune potency in olive flounder (*Paralichthys olivaceus*) of chitosan microsphere-based oral vaccine against the scuticociliate parasite *Miamiensis avidus* (Ciliophora: Scuticociliatida)

Su-mi Shin and Sung-Ju Jung

Department of Aqualife Medicine, Chonnam National University, Republic of Korea

**PD-60**

Comprehensive characterization of a tandem-repeat Galectin-9 gene from sevenband grouper (*Hyporthodus septemfasciatus*)

Kyung-Min Kang<sup>1</sup>, Yong-Jun Park<sup>1</sup>, Han-Gyeol Kim<sup>1</sup>, Jae-Young Pe<sup>1</sup>, Myung-Joo Oh<sup>2</sup> and Jong-Oh Kim<sup>1,3\*</sup>

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<sup>2</sup>Department of Aqualife Medicine, Chonnam National University, Busan, Korea.

<sup>3</sup>Department of Microbiology, Pukyong National University, Busan 48513, Republic of Korea.

**PD-61**

Effects of *Lactobacillus* fermented brewing by-product on innate immunity, growth performance and antibacterial activity in Carp, *Cyprinus carpio*

Eun Chong Yang<sup>1\*</sup>, Jae Hyeok Choi<sup>1</sup>, Sang Mok Jung<sup>1</sup>, Tae Won Jang<sup>1</sup>, Jae Hoon Kim<sup>1</sup>, Yu Jin Hwang<sup>1</sup>, Hae In Jung<sup>1</sup>, Chan Heun Lee<sup>2</sup> and Sang Hoon Choi<sup>1</sup>

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<sup>2</sup>Geum Sung Sang Gong co., Ltd., 102, 2-gil Bong Hwanggongdan Gimje-si, Jeonbuk, Korea

**PD-62**

Development and application of quantitative detection method against *Miamiensis avidus* (Ciliophora: Scuticociliatida)

Jin-Young Kim and Sung-Ju Jung

Department of Aqualife Medicine, Chonnam National University, Republic of Korea

**PD-63**

Anti-VHSV activity of *Cirsium japonicum* aerial parts: determination of the optimized extract and its efficacy in olive flounder *Paralichthys olivaceus*

Walimuni Randika Harshan Mendis\*, Jae-Woong Lim, Ga-Won Kim and So Young Kang<sup>†</sup>

Department of Aqualife Medicine, Chonnam National University, Yeosu 59626, Republic of Korea

**PD-64**

Effects of serotonin and melatonin on the expression of reproduction-related genes in the pituitary cells of eels (*Anguilla japonica*)

Jeong Hee Yoon, Ji Eun Ha, Dong Woo Kim, Jeong Hee Min, Bo Ryung Park and Joon Yeong Kwon\*

Department of Applied Biological Science, Sunmoon University, Asan 31460, Republic of Korea

**PD-65**

Elucidation of molecular and cellular mechanisms against formalin-inactivated infectious hematopoietic necrosis virus vaccine in rainbow trout (*Oncorhynchus mykiss*)

Jongwon Lim and Suhee Hong

Department of Aqualife Medicine, Gangneung-Wonju National University, Gangneung 25457, Republic of Korea

**PD-66**

Development of an early detection PCR assay for infectious haematopoietic necrosis (IHN) in salmonids

Ju Young Seo<sup>1</sup>, Seyi Shin<sup>1</sup>, Yudam Kim<sup>1</sup>, Seung Ly Choi<sup>1</sup>, Jiyeong Lee<sup>1</sup>,

Yeon Bin Chung<sup>1</sup>, Dong Geun Choi<sup>1</sup>, Jin Bae Jeon<sup>1</sup>, Dong Wan Kim<sup>1</sup> and Young Chul Kim<sup>1</sup>

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**■ Fisheries and Ocean Technology (PT-1 ~ PT-18)**

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**PT-1**

A study on the effect of additional resistance on engine power in towing fishing gear of a bottom trawl ship

Woo-Gyeong Wang

Department of Power System Engineering, Chonnam National University, Chonnam 59626, Korea

**PT-2**

Development of a safety system for Haenyeo (Korean traditional fisher women diver) using a wireless network and smart working tool

Taesik Kim<sup>1</sup>, Young-Woon Song<sup>1</sup>, Juhwan Kim<sup>2</sup>, Meungsuk Lee<sup>3</sup> and Son-Cheol Yu<sup>1\*</sup>

<sup>1</sup>Department of convergence IT Engineering, POSTECH, Pohang 37673, Republic of Korea

<sup>2</sup>Robot Center, Samsung Research, Samsung Electronics, Seoul 06765, Republic of Korea

<sup>3</sup>Interactive Robotics R&D Division Human-centered Mechatronics Research Center, KIRO, Pohang 37666, Republic of Korea

**PT-3**

Basic study on the sinking material improvement for offshore small yellow croaker drift gill net fishing gear

Keun-Hyoung Kim<sup>1\*</sup>, Kyoung-Bum Kang<sup>2</sup>, Myung-Sung Koo<sup>3</sup>, Jong-Bum Kim<sup>4</sup>, Nam-Hee Heo<sup>1</sup> and Suk-Jong Kim<sup>1</sup>

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<sup>3</sup>Fisheries Engineering Research Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

<sup>4</sup>Center leader, Korea Fisheries Infrastructure Promotion Association, Incheon 22348, Korea

#### **PT-4**

Analysis of risk factors for gillnet fishing in floating offshore wind farms using AHP technique

Jong-Kap Ahn<sup>1</sup>, You-Jin Park<sup>2</sup>, Yu-Jin Jeong<sup>2</sup> and Young-Su Ahn<sup>1\*</sup>

<sup>1</sup>Institute of Marine Industry, Gyeongsang National University, Tongyeong 53064, Republic of Korea

<sup>2</sup>Department of Business Administration, Yonsei University, Wonju 26493, Republic of Korea

#### **PT-5**

Density distribution of giant jellyfish (*Nemopilema nomurai*) using acoustic and sighting survey

Sunyoung Oh<sup>1\*</sup>, Kyoung-Yeon Kim<sup>2</sup>, Sara Lee<sup>1</sup>, Geunchang Park<sup>1</sup>, Wooseok Oh<sup>3</sup> and Kyounghoon Lee<sup>4</sup>

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<sup>4</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Republic of Korea

#### **PT-6**

Species composition and community structure of aquatic organisms caught by the shrimp dredge in Gomso Bay, Jeollabuk-do

Young-Hwan Joo<sup>1\*</sup>, Sang-Chul Yoon<sup>2</sup>, Ji-Hoon Choi<sup>2</sup> and Hyun-Su Jo<sup>3</sup>

<sup>1</sup>Department of Fisheries Science, Gunsan National University, Gunsan 54150, Korea

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<sup>3</sup>Division of Marine Industry-Transportation Science and Technology, Gunsan National University, Gunsan 54150, Korea

#### **PT-7**

Domestic market and assembly status of gillnet fishing gear

Min-Hee Park, Yong-Beam Pyeon, Min-Ah Heo, Min-Su Park and Heui-Chun An\*

Korea Institute of Fisheries and Ocean Engineering, Busan 48508, Republic of Korea

**PT-8**

Test survey using a broadband echo sounder and bottom trawl to examine acoustical species identification technique

Seung-Mi Lee<sup>1</sup>, Min-Sook Han<sup>1</sup>, Ho-Young Jang<sup>2</sup>, Min-Seon Kim<sup>2</sup> and Bo-Kyu Hwang<sup>2</sup>

<sup>1</sup>Department of Fisheries Science at Kunsan National University, Republic of Korea

<sup>2</sup>Marine and Fisheries Management Major at Kunsan National University, Republic of Korea

**PT-9**

Understanding the seasonal status of fisheries resource in the East China Sea by using bottom trawl

Jung-Kwan Lee<sup>1\*</sup>, Geun-Chang Park<sup>2</sup>, Byeong-Gwon Lim<sup>3</sup>, Dae-Jin Kim<sup>4</sup>, Hyoung-Ho Shin<sup>4</sup>, Doo-Jin Hwang<sup>4</sup> and Kyounghoon Lee<sup>5</sup>

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<sup>5</sup>Division of Marine production management system Management, Pukyong National University, Busan 48513, Republic of Korea

**PT-10**

Development of poly (butylene adipate-co-butylene succinate-co-ethylene adipate-co-ethylene succinate) (PBEAS) net twine as biodegradable fishing gear

Subong Park<sup>1\*</sup>, Bongseong Bae<sup>2</sup>, Bong-Jin Cha<sup>2</sup>, YunJin Kim<sup>3</sup> and HyoWon Kwak<sup>3</sup>

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<sup>3</sup>Department of Agriculture, Forestry and Bioresources, College of Agriculture & Life Sciences, Seoul National University, Seoul 08826, Republic of Korea

**PT-11**

The comparison of catch performance of available fish species with different net height for trawl net

Jung-Mo Jung\*, Hyun-Young Kim and Kyu-Suk Choi

Fisheries Engineering Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PT-12**

Fishing operation characteristics of coastal composite fishing vessels exclusive to long arm octopus (*Octopus minor*) fishing in Korea

Min-Son Kim<sup>1</sup>, Bo-Kyu Hwang<sup>1</sup>, Ho-Young Chang<sup>1</sup>, Min-Suk Han<sup>2</sup> and Seung-Mi Lee<sup>2</sup>

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<sup>2</sup>Department of Fisheries Science Graduate School, Kunsan National University, Gunsan 54150, Republic of Korea

**PT-13**

A study on the marine mammal bycatch reduction based on buoy material in coastal trap fishery

Kyu-Suk Choi<sup>1</sup>, Bong-Jin Cha<sup>1</sup>, Sam-Gwang Cho<sup>2</sup>, Hyun-Young Kim<sup>1</sup>, Pyeon-Kwan Kim<sup>1</sup>, Gyeom Heo<sup>1</sup> and Jung-Mo Jung<sup>1</sup>

<sup>1</sup>Fisheries Engineering Division, National Institute of Fisheries Science, Republic of Korea

<sup>2</sup>Advanced Aquaculture Research Center, National Institute of Fisheries Science, Republic of Korea

**PT-14**

Stock assessment of small yellow croaker caught by multiple fisheries in Korean waters

Eun-Gyu Kim<sup>1\*</sup> and Sung-Il Lee<sup>2</sup>

<sup>1</sup>Division of Fisheries Physics, Pukyong National University, Busan 48516, Republic of Korea

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**PT-15**

Underwater stability according to the shape of giant octopus pots on the east coastal sea in Korea

Seonghun Kim<sup>1\*</sup>, Hyungseok Kim<sup>1</sup>, Pyungkwan Kim<sup>2</sup>, Sena Baek<sup>3</sup> and Taekyun Kim<sup>3</sup>

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**PT-16**

A study on the conger eel (*Conger myriaster*) catching mechanism according to the shape of the hook in longline shapes and sizes

Sena Baek<sup>1\*</sup>, Namgu Kim<sup>1</sup>, Taekyun Kim<sup>1</sup>, Seung-Hyun Lee<sup>1</sup> and Seonghun Kim<sup>2</sup>

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<sup>2</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Korea

**PT-17**

Characterization of seawater sterilizers using carbon nanotube fiber UV lamps

Jae-hyun Bae

Fisheries Engineering Division, National Institute of Fisheries Science, Busan 46083, Republic of Korea

**PT-18**

A study on the estimation of the catch of large purse seine boat by combining AIS data and TAC catch data

Eun-A Song<sup>1</sup>, Solomon Amoah Owiredu<sup>1</sup>, Byeong-Yeob Kim<sup>2</sup>, Kyoung-Hoon Lee<sup>3</sup> and Kwang-II Kim<sup>2\*</sup>

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<sup>3</sup>Division of marine production system management, Pukyong National University, Busan 48513, Korea

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■ **Malacology (PM-1 ~ PM-7)**

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**PM-1**

Changes in the cultural environment after the introduction of the rack oyster farms in tidal flat

Sang-Man Cho<sup>1\*</sup>, Seo-Hyun Lee<sup>1</sup>, and Joo-Hyun Kang<sup>2</sup>

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<sup>2</sup>Korea Ocean Research Inc., Tongyeong 53003, Republic of Korea

**PM-2**

Two unrecorded species of the family Assimineidae (Mollusca: Gastropoda) from the Korean Peninsula

Cho Rong Shin<sup>1,2\*</sup>, Eun Hwa Choi<sup>2,4</sup>, and Ui Wook Hwang<sup>1,2,3,4</sup>

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<sup>4</sup>Phylomics Inc., Daegu 41910, Republic of Korea

**PM-3**

Characterization of a novel protist belonging to the Mesomycetozoea class isolated from Manila clam, *Ruditapes philippinarum*

W.A.A.H. Kalhari<sup>1\*</sup>, Seung-Hyeon Kim<sup>1</sup>, Yu Chen<sup>1</sup>, Woon-Chul Kang<sup>1</sup>, Eun-Il Lee<sup>1</sup>, Dong-Hyun Lee<sup>1</sup>, Si-Eun Noh<sup>1</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-Il Park<sup>1,2</sup>

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**PM-4**

Expression of biomarker genes related to health and immunity for health assessment in *Haliotis discus hannai*

Chul-Won Kim<sup>1</sup>, Ha-Jeong Jeon<sup>2</sup>, Geon-Tak Kim<sup>2</sup> and Han-Seung Kang<sup>2\*</sup>

<sup>1</sup>Department of Aquaculture, Korea National College of Agriculture and Fisheries, Jeonju 54874, Republic of Korea

<sup>2</sup>Department of Marine Environment, MS BioLab, Daejeon 34576, Republic of Korea

**PM-5**

The complete mitochondrial genome of a chiton *Acanthochitona defilippii* (Mollusca: Polyplacophora) from South Korea

I Hyang Kim<sup>1\*</sup>, Cho Rong Shin<sup>1,2</sup>, Eun Hwa Choi<sup>2,4</sup>, and Ui Wook Hwang<sup>1,2,3,4</sup>

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<sup>4</sup>Phylomics Inc., Daegu 41910, Republic of Korea

**PM-6**

The complete mitochondrial genome of *Melampus sincaporensis* (Gastropoda: Ellobiidae) from South Korea

Hye-Jeong Yu<sup>1\*</sup>, Cho Rong Shin<sup>1,2</sup>, Eun Hwa Choi<sup>1,4</sup>, and Ui Wook Hwang<sup>1,2,3,4</sup>

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<sup>4</sup>Phylomics Inc., Daegu 41910, Republic of Korea

**PM-7**

The complete mitochondrial genome of a worm snail *Thylacodes adamsii* (Littorinimorpha: Vermetidae) from South Korea

Yu-Min Lee<sup>1\*</sup>, Eun-Hwa Choi<sup>1,4</sup>, Ki-Beom Kim<sup>3,4</sup> and Ui-Wook Hwang<sup>1,2,3,4</sup>

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KOFFST International Conference 2023  
“Fisheries Science in the Era of the Fourth Industrial Revolution”

# Abstracts



KOFFST International Conference 2023

**Plenary session &  
Invited speaker session**

◎ PS-1 ~ PS-2

◎ IS-1 ~ IS-4



PS-1

## Research on Marine Plastic Pollution and Countermeasures in the Fishing Industry in Japan

Tadashi Tokai

Tokyo University of Marine Science and Technology

Marine plastic pollution is an issue of global concern. The first half of the presentation will provide an overview of the results of a survey of marine plastic debris in the waters surrounding Japan. The survey was conducted using training vessels from fisheries-related universities and faculties in Japan. In the second half of the presentation, we will discuss the use of gear recycling as a solution to ALDFG (abandoned, lost, or otherwise discarded fishing gear), which is considered a marine plastic problem. In addition, we will consider the feasibility of fishermen's activities to collect marine plastic debris, particularly seafloor debris, and research studies to support this activity.

Research on marine macro- and microplastic debris in the surrounding waters of Japan has been conducted since 2014, using training vessels affiliated with fisheries-related universities and faculties, as part of a project funded by the Ministry of Environment in Japan. To estimate the density of macroplastic debris floating on the sea surface, a line transect method, as previously used for cetacean resource surveys, is used based on visual observations. Floating microplastics will be collected using Newton nets, originally designed to catch fish eggs and larvae, and their density will be estimated. The density of plastic debris on the seafloor has been estimated using trawl surveys. Unfortunately, the density of microplastics in the waters around East Asia exceeds both the global and North Pacific averages. Significant amounts of plastic debris have been found on the seafloor during trawl surveys in the East China Sea, where both Korea and Japan are expected to undertake conservation efforts. The seafloor debris appears to have originated close to where it was collected.

Abandoned, lost or discarded fishing gear (ALDFG) is often found on the seabed as well as on the shore. Measures are needed to prevent plastic waste from fishing gear from entering the ocean. Recycling technologies for fishing gear waste should be developed and fishing gear should be designed to be easily recyclable. According to the OECD's Global Plastics Outlook report, approximately 6.1 million tons of plastic will enter aquatic environments, including rivers, lakes and oceans, in 2019. In addition, it is estimated that approximately 30 million tons of plastic accumulated on the ocean floor from 1970 to 2019. Fishermen can potentially help collect plastic debris on the seafloor and in the ocean. More research and studies are needed to validate this initiative. As the ocean provides not only food but also other invaluable resources, it is crucial to mitigate the impact of plastic pollution on this environment.

PS-2

## Norwegian smart fishing technology in the Era of the Fourth Industrial Revolution

Olafur Arnar Ingolfsson

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Challenges in fisheries have intensified over the years, affecting both vessels and fishing gears. Sustainability has many facets. Ecolabeling, market power and investment leverage with potential negative ramifications tends to set pressure on fisheries management and fishing practices. One of the foremost concerns regarding responsible fish capture, revolves around the capture of juvenile fish, leading to overexploitation and population imbalances. In addition, catches in excess of the vessels holding capacity imposes safety hazards and induces fish discarding.

In most trawl fisheries, a single selection device – usually a codend or a grid, is regulated by authorities to avoid catches of juveniles. These are rarely sufficient to meet the criteria set by fisheries management. An intriguing revelation arises when multiple selective solutions are integrated into fishing gear design. In the Northern shrimp fisheries, modifying trawl design has proven to greatly improve size selection. Adding artificial light to the trawl further improves size selection. In combination with a size-selective codend, these modifications can result in significantly sharper selection than can be achieved by a single device.

In the pelagic fisheries for blue whiting, individual catches of several hundreds of tonnes have resulted in codends bursting, spillage of fish and dangerous situations onboard the vessels. A catch limitation device, in combination with automation of codend expansion has yielded promising results for controlling catch size and avoiding bursting codends. As a part of our work on catch limitation in fisheries, automatic codend releasers has been developed. Such releasers have proven to be useful in other contexts as well, and have been used for e.g. estimating surface selection in fisheries, underwater film projects and fishing with pots where surface ice pose challenges.

Techniques for species detection from underwater video, using artificial intelligence, have been escalating in recent years. The “Deep vision” technology has been utilised on surveys by IMR for identifying species composition at depth as the fish pass the trawl. There is an ongoing work to develop the technology for applications in commercial fisheries, for receiving instant information on species- and size composition in trawl fisheries. In the experimental purse seine fisheries for bluefin tuna, similar technology has been utilised for estimating the size of individual fish. Advancements in technology also allow for e.g. image analysis from towed underwater vehicles, reducing the need for trawl surveys.

IS-1

## Comparative phylogeography of the North Pacific marine fishes

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The North Pacific Ocean includes several marginal seas and a complex current system, shaping the present biogeographic regions. Together with the various historical factors, such as glacial sea-level changes, marine fishes of the North Pacific exhibit extensive population structures within species, sometimes resulting a cryptic speciation. I herein review the recent phylogeographic studies of ground fishes widely distributed in the North Pacific. The sequence variations of mitochondrial DNA have provided an insight for divergences among the local populations, and have revealed several phylogeographic breaks among and within the marginal seas in the North Pacific. More recently, the application of high-throughput sequencing methods, such as RAD-seq, MIG-seq, and GRAS-Di, highlights the incipient genetic divergence, the demographic histories, including rapid population expansions and/or bottle neck events, and the past and present gene flows. In addition, because some trends in phenotypic divergence in a specific region have been evident, the advent of high-throughput sequencing technologies will enhance our understanding of mechanisms underlying phenotypic diversification among marginal seas in the near future.



IS-2

## Genome editing in fish cells – from basic research to applications in disease control

Bertrand Collet

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In fish, a number of cell lines have been isolated for the purpose of viral diagnostic, vaccine production or as a material for basic research in fish immunology. Some of them have functional signaling pathways related to the antiviral mechanisms driven by type 1 interferon (IFN1) or to inflammation and became, as such, valuable tools to understand innate immune regulations. We have recently developed a genome editing method to invalidate genes involved in the IFN1 signalling pathways, in particular those belonging to the Interferon Stimulated Genes (ISGs).

Over the last five years we have isolated a number of clonal cell lines derived from a salmonid fish, Chinook salmon *Oncorhynchus tshawytscha* or from a cyprinid fish, the fathead minnow *Pimephales promelas*, with one, two or three genes invalidated. These include *stat1a*, *stat2*, *mx1*, *mx2*, *mx3*, *irf3*, *irf7*, *viperin*, *mda5*, *myd88*, *pkc*, *ch25hb1-5*, *rig-I*, *dhx58a* or *crfb2*. Gene invalidation allows the rigorous identification of the function of ISGs in both group of fish and can help to evaluate the effect of the salmonid-specific genome duplication when several paralogues have been retained.

A number of fish viruses responsible for serious diseases cannot replicate in any of the currently available fish cell lines. We hypothesize that the invalidation of key genes involved in the antiviral immune response would reduce the capacity of the cell lines to resist to a viral infection. As a direct consequence, we expect an increased rate of viral replication and associated amount of virus produced, improving the viral diagnostic and the viral production methods. In term, the availability of such highly permissive cell lines would enhance the control strategies that can be implemented to fight viral diseases in aquaculture.

## Fish vaccination by needle-free innovation nano-vaccines

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Infectious diseases are the major diseases which now devastating the cultured fish worldwide. Among those diseases, bacterial disease is the major disease destroying the wide range of economical cultured fish species e.g., Tilapia (*Oreochromis* spp.), Lates calcarifer (Asian sea bass), etc. To reducing fish production loss from infectious diseases, the diseases prevention strategies should be implemented. Vaccine is one of most effective solution using for infectious diseases prevention in fish. Fish can exhibit specific immune responses against infections by vaccination with effective vaccines. Most of the licensed fish vaccines are vaccines for injection. Although injection vaccination in cultured fish can provide many advantages, however, this method still has many disadvantages such as 1.) it is not appropriate for the early stage and small size of fish, 2.) fish required sedation or anesthesia before vaccination, 3.) fish may get infection by surrounding pathogens at the injection site, 4.) fish may get severe stress from injection, 5.) laborious method, 6.) many equipment needed, 7.) time-consuming, etc. Therefore, needle-free vaccination is a novel solution in fish vaccination which provide many benefits for the prevention of infectious diseases in cultured fish. Our current research was mainly focused on the development of novel mucoadhesive nano-vaccines for immersion against fish bacterial infections such as *Flavobacterium oreochromis*, *Franciscella orientalis*, *Aeromonas veronii*. and *Streptococcus agalactiae*. The cationic nano-polymers were combined with the antigens preparing from sonicated formalin-killed bacterial cells. Various parameters of the nano-vaccines including transmission electron microscopy (TEM), physiochemical properties; zeta potential, and polydispersity index (PDI) were comprehensively characterized. The immunological and protective effects of the needle-free vaccination by the nano-vaccines were determined from *in vivo* study in the experimental fish species such as the relative percent survival (RPS) after challenging with pathogens, expression of immune-related genes by qPCR, histopathological changing, and antibody production by ELISA. The results revealed promising immunological and protective effects of the nano-vaccines which immersion vaccinated to the experimental fish species. Additionally, the nano-vaccine candidates have higher efficacies when compared to killed-whole cell by immersion vaccination. We also provide promising efficacy and feasibility of our nano-vaccines after immersion vaccinate to mass fish production at the commercial farming scale. Our research can be summarized that needle-free vaccination by nano-vaccines can create significant immunological and protective efficacies to culture-fish species against major fish bacterial diseases. Moreover, it can be easily and efficiently used in the mass fish production of the commercial scale-farming for prevention of harmful fish infectious diseases.

## IS-4

Evolutionary ecological insight into an oyster-pathogen system is key to effective management of an important marine resource species, the eastern oyster in the USA

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The collapse of eastern oyster *Crassostrea virginica* populations in the Mid-Atlantic region of the USA in the second half of the twentieth century, and of the fisheries and aquaculture industries dependent on this species, caused unparalleled ecological and economic disruption in the region. It was caused by major oyster disease outbreaks compounding a century of overharvesting, and the prospects for recovery were so bleak that dramatic solutions such as a non-native oyster introduction or 'genetic rehabilitation' with domesticated oyster lines were considered as responses. We now recognize the collapse as due to a cascade of events that began with introduction of the exotic *Haplosporidium nelsoni* in the 1950s, causing a great reduction in oyster abundance; which was followed by a great increase in pathogenicity of the directly transmissible native pathogen *Perkinsus marinus* in response to the *H. nelsoni*-caused decrease in both oyster abundance and longevity. This evolutionary ecological lens through which we view the trajectories of diseases and the decline of oysters in the US Mid-Atlantic also helps us understand the recovery of *C. virginica* populations in the last twenty years. Because of extensive long-term monitoring of oyster populations and their diseases, we can see the oyster recovery as not entirely (or at all) due to innovations in oyster restoration strategies and in resistance breeding for aquaculture. Rather, the recovery is due to the evolution of disease resistance and tolerance by the oysters themselves. We are using this knowledge to promote enlightened strategies for oyster restoration and fishery resource management, and to build stronger foundations for aquaculture breeding of oysters, all of which must be based on conservation of broad natural genetic diversity to support future responses of oysters to emerging diseases, and to changing and more stressful and challenging marine environments.



## KOFFST International Conference 2023

### Oral presentation

- ◎ KOSFAS : OU-1 ~ OU-18  
OA-1 ~ OA-34  
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- ◎ ISK : OF-1 ~ OF-6
- ◎ KSFP : OD-1 ~ OD-9
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- ◎ MSK : OM-1 ~ OM-10



OU-1

## The ability of long arm octopus (*Octopus minor*) extract in preventing eye injury of zebrafish (*Danio rerio*) embryos by Particulate Matter

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Worldwide, particulate matter (PM) causes acute to chronic lung and cardiac problems, as well as premature deaths. PM is a combination of microscopic, solid, inhalable airborne particles, including liquid droplets. Construction sites and fires may produce direct emissions of PM. But emissions are mostly from sources that involve complicated biochemical reactions, including nitrogen oxides and sulfur dioxide from industrial and automobile effluents. It therefore has a detrimental effect on eye make-up and vision. There are very few treatment options for PM induced eye injury available at the moment, emphasizing the importance of innovative pharmaceuticals. The present study has identified the protective effect of *Octopus minor* extract (OME) against PM (300  $\mu\text{gml}^{-1}$ ) induced eye damage in zebrafish (*Danio rerio*) by screening a library of invertebrate extracts. Current research was conducted using *in vivo* zebrafish vertebrate model which is an important animal model due to the conserved genes between human and zebrafish. In the present study, significant reduction in PM induced embryo toxicity in zebrafish cotreated with OME and significant protection of OME cotreatment over PM induced reduction in the eye size and lens fluorescence of *Tg(mito:eGFP)* zebrafish embryos were identified. And, photoreceptor cell development, eye pigmentation, lens development and eye embryogenesis disruption due to PM was reduced at the level of mRNA expressions in a striking manner. This study also gives insights of possible antioxidant and anti-inflammatory properties of OME.

## OU-2

## Potential utilization of *Bacillus* spp. isolated from *Jeotgal* as a microbial starter decomposing marine biomass

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Recently marine biomass has been in the spotlight as a future resource that produces less greenhouse gases and has rich nutrients. Therefore, many researches are conducting to extract useful components from marine biomass using hot water, organic solvents, and microorganisms. Among them, microbial fermentation has the advantage of being eco-friendly and easy to extract nutritional components with less denaturation. The genus of *Bacillus* produces various hydrolytic enzymes with high activity, and some *Bacillus* spp. is known to possess functionality such as antibacterial activity. In this study, 38 strains of *Bacillus* sp. were isolated from three types of *Jeotgal* (flounder, squid, anchovy). The experiment was progressed in the following order; 1) analysis of protease and cellulase activity, 2) analysis of hemolysis activity and production of biogenic amines. Based on these analyses, 5 strains of *Bacillus* sp. were selected and assessed on the hydrolase activity to marine biomass. Among of them, *Bacillus amyloliquefaeciens* MU2 strain exhibited the highest hydrolase efficacy of marine biomass. The fermentation using this strain results in the increase yield on protein extraction (31.45% after 24 h fermentation, w/v) compared to control sample (2.81% of yield, w/v). Thus, this study provides a novel approach on the utilization of marine biomass using microbial fermentation to extract useful ingredients from marine biomass.



OU-3

### Anti-inflammatory activity of dioxinodehydroeckol from *Ecklonia cava* in *Cutibacterium acnes*-induced inflammatory signaling by regulation of NF- $\kappa$ B activity

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Acne vulgaris is one of the most common inflammatory skin disorders, which are reported to be caused by *Cutibacterium acnes* (*C. acnes*) among a variety of factors. In this study, Dioxinodehydroeckol isolated from an edible brown seaweed *Ecklonia cava* was shown to be a potent anti-inflammatory agents. we examined the antibacterial and anti-inflammatory activities of dioxinodehydroeckol on *C. acnes*-stimulated inflammatory responses. The antimicrobial activity of dioxinodehydroeckol was evaluated by the determination of minimum inhibitory concentrations (MICs). The results showed that dioxinodehydroeckol inhibited the growth of skin bacteria, including *C. acnes*, *Staphylococcus aureus*, and *S. epidermidis*. To explore anti-inflammatory effects, HaCaT cells were stimulated with *C. acnes* after treatment with dioxinodehydroeckol. The concentration-dependent inhibition of dioxinodehydroeckol reduced the levels of IL-6 and IL-8 cytokines, which are pro-inflammatory cytokines. Dioxinodehydroeckol also inhibited *C. acnes*-induced phosphorylation of the extracellular signal-regulated kinase (ERK), and protein kinase B (AKT), and inhibited nuclear factor-kappa B (NF- $\kappa$ B) signaling. These results suggest that dioxinodehydroeckol from *E. cava* could be a potential therapeutic agent to effectively treat the inflammatory skin disease induced by *C. acnes*.

## OU-4

### Toxic effects of hull cleaning wastewater on two marine diatoms *Skeletonema costatum* and *Navicula* sp.

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To remove biofouling on the surface of vessels, underwater vessel cleaning is increasing as well as robot cleaning systems. After the cleaning process, there is a high possibility that wastewater will have a negative impact not only on marine life living on the bottom of the ship, but also on adjacent living organisms. It is reported that as the demand for ships increases the amount of wastewater also naturally increases. Microalgae are the primary producers in the marine environment and play an important role as a food resource. These microalgae are the first to be affected by hull cleaning wastewater and may subsequently affect organisms that feed on them. Although toxicological assessment of microalgae using antifouling agents is being conducted, actual hull cleaning wastewater is insufficient. This study used the marine diatom *Skeletonema costatum* and *Navicula* sp. to conduct a toxicity evaluation on the conventional hull cleaning and robot cleaning wastewater for two ships. As a result of cleaning wastewater from two types of ships, *S. costatum*, its concentration of 38.75% and 17.61% showed EC<sub>50</sub> values, respectively. *Navicula* sp. was 31.7% and 23.28%. Before and after filtering using a robot cleaning device, the EC<sub>50</sub> of *S. costatum* was 9.34% and 12.38%, and that of *Navicula* sp. was 11.27% and 13.72%. Based on this study, it can be used as basic data to conveniently evaluate and predict the impact of hull cleaning wastewater on the marine environment.

OU-5

## Comparison of antioxidant and physiological activities of different solvent extracts from *Sargassum thunbergii*

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This study was conducted to investigate the ingredients of antioxidant and physiological activities of the Korean marine algae, *Sargassum thunbergii*. In the analysis of general composition, contents of moisture, crude protein, crude lipid, crude ash, and carbohydrate were 14.25%, 20.17%, 0.17%, 12.60%, and 52.80%, respectively. The main minerals were potassium, calcium, magnesium and sodium. The solvent extracts from *S. thunbergii* were prepared using 70% ethanol, 80% methanol, and distilled water. The extraction yields range of various solvent extracts were 7.90-26.19%. The total polyphenol and flavonoid content range of the extracts were about 94.90-117.56 mg/g and 17.37-20.23 mg/g, respectively. Ethanol extract displayed the highest in total polyphenol. However, flavonoid content was the strongest in water extract. In all antioxidant experiments, the ethanol extract showed the highest activity. While the tyrosinase ( $IC_{50}$ , 0.50 mg/mL), elastase ( $IC_{50}$ , 0.30 mg/mL) and ACE inhibitory activity ( $IC_{50}$ , 37.52  $\mu$ g/mL) of the methanol extract were higher than those of the other extracts. On the other hand, the ethanol extract was the highest AChE inhibitory activity ( $IC_{50}$ , 0.55 mg/mL). In BACE1 inhibitory activity ( $IC_{50}$ , 9.42  $\mu$ g/mL), the water extract was the highest. These results indicate that *S. thunbergii* maybe useful as an antioxidant and functional substance in food and medical material. Therefore, it is thought that additional research is needed.

OU-6

## Maximizing Phenolic Potential: Subcritical Water Extraction Optimization from *Ecklonia stolonifera*

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Functional foods have garnered significant public interest recently due to their potential to enhance overall health and reduce disease risk. *Ecklonia stolonifera*, a brown seaweed variety, stands out as a promising source of polyphenols for the development of functional foods. This is primarily due to its remarkable anti-diabetic, anti-arteriosclerosis, and exceptional liver-protective properties against toxins. The study aimed to identify the optimal subcritical water extraction (SWE) conditions for polyphenols from *E. stolonifera*. Using response surface methodology (RSM), the study determined these conditions to be 198.5°C, 36.21 min, and 12.23 g/mL. Furthermore, the investigation involved a comprehensive analysis of bioactive compounds extracted from *E. stolonifera*. High-performance liquid chromatography (HPLC) was employed to discern the individual phenolic compounds within the extract. Simultaneously, the physicochemical properties, potential antioxidant and antihypertensive activities, and antimicrobial properties of the hydrolysates derived from *E. stolonifera* were evaluated. Notably, the findings revealed that the *E. stolonifera* extract displayed substantial antioxidant activities, demonstrated by high values for ABTS<sup>+</sup>, DPPH radical scavenging, and FRAP (70.94±0.15, 60.03±0.35, and 29.45±0.39 mg Trolox equivalent/dried sample, respectively). Moreover, the total phenolic content (TPC) measured at 50.01±0.12 mg Phloroglucinol/dried sample exceeded that of other commonly studied seaweed varieties. In addition to its impressive antioxidant properties, the *E. stolonifera* extract, when processed under optimal conditions, exhibited potent antihypertensive activity (≤95.87±0.01%) and demonstrated activity against various pathogens. In conclusion, this study underscores the immense potential of *E. stolonifera* as a valuable nutraceutical material when treated using the SWE method, paving the way for the development of functional foods that can significantly contribute to improved health and disease prevention.

OU-7

## Development of seasoning materials and water-soluble calcium processing technology using fish sauce by-product

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The seafood processing industry produces over 60% of by-products, including bycatch and other secondary products derived from the manufacturing process, such as heads, gills, skin, trimmings, fins, frames, bones, viscera, blood, and roes of commercial fish species.

Fish sauce by-product is a valuable source of seasoning ingredients, minerals, and ash that can be recycled.

This study determined the optimal conditions for extracting seasoning components by decomposing the fish sauce by-product into acid and neutralizing it. The objective was to develop a plan for recycling neutralized sediments into calcium materials. The process involved decomposing the sediments into acid, neutralization, and developing seasoning components for fish sauce by-products. The acid concentration was adjusted to 9% and 18%, and the solutions were analyzed after being allowed to decompose for 1-24 hours at pH 4-6. It was intended to analyze the nitrogen content of amino acids, calcium, and various chemical components to determine their potential use as seasoning ingredients. Optimal processing conditions were derived by confirming safety with 3-MCPD.

Based on the experiments conducted, it was determined that the most effective extraction conditions were a concentration of 9%, a duration of 4 hours, and a pH level of 5. After analysis, the resulting chemical composition was found to be  $77.78 \pm 0.09$  g/100 g of moisture, with AN content of  $443.80 \pm 5.44$  mg/100 g and Ca content of  $519.15 \pm 41.96$  mg/kg. It is worth noting that the final product did not contain any 3-MCPD.

It was concluded that seasoning ingredients created in ideal conditions can be safely extracted to the fullest extent possible. The precipitate was neutralized and then burned at 800°C and 1000°C. The chemical composition and calcium content were analyzed using inorganic, X-ray diffraction (XRD), and Fourier-transform infrared spectroscopy (FT-IR).

The mineral analysis revealed that the Ca content was  $209,114.51 \pm 2,982.43$  mg/kg. Chloroapatite, merrillite, and sodium calcium phosphate were found to be the common compounds at both temperatures, all of which contained calcium. Based on this, it was concluded that these compounds could be used as a source of calcium.

It is suggested that seasoning materials and calcium products using fish sauce by-products can be an effective utilization plan under optimal conditions.

OU-8

## Valorization of Skipjack tuna (*Katsuwonus pelamis*) by-products: lipids extraction using supercritical CO<sub>2</sub>, protein recovery by subcritical water hydrolysis

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Skipjack tuna (*Katsuwonus pelamis*) is utilized in canned food production, with a significant portion (30-50%) of its raw materials currently being discarded, leading to environmental pollution. In response to this issue, the physiological substances were extracted using a supercritical carbon dioxide (SC-CO<sub>2</sub>) and subcritical water hydrolysis (SWH) process, which is a safe and environmentally friendly technology. In this study, *K. pelamis* was classified head, viscera and skin sections to compare their constituents. Various properties were evaluated, including phospholipids (PLs) purity, PLs composition using <sup>31</sup>P nuclear magnetic resonance (NMR), thermal properties, fatty acid (FA) composition, and fat-soluble vitamins. Furthermore, using de-oiled residue, SWE was conducted with extraction temperatures from 160°C to 240°C degrees. the study included an assessment of antioxidant activity (ABTS<sup>+</sup>, DPPH, FRAP), total protein content (TP), total sugar content (TS), reducing sugar content (RS), and Maillard reaction products (MRPs), antidiabetic properties and amino acid analysis in the obtained *K. pelamis* hydrolysate. Results indicate that the skin has the highest oil content at 31.18±0.59, while the head offers the highest PLs yield at 5.53±0.56. The major fatty acids include palmitic acid, oleic acid, DHA, and EPA. For omega-3 fatty acids, the skin oil showed the highest content at 30.0% in skin oil and the skin PLs showed 19.91%. Furthermore, TGA shows the polar nature of PLs, characterized by more intricate compounds compared to oils. Furthermore, the SWE efficiency of *K. pelamis* hydrolysate was highest for all parts at 160°C, and it exhibited a decreasing trend as the temperature increased. The ABTS<sup>+</sup>, DPPH radical scavenging, and FRAP assay results all showed the highest activity at 240°C. TP content was highest at 200°C, reaching 219.86±2.26, 297.36±2.17, and 265.88±0.85 for the respective parts. Among the different parts, viscera exhibited the highest activity and content. Therefore, the results of this study, obtained through the comparison of different parts of *K. pelamis* by-products using eco-friendly technology, are of significance value for the food and pharmaceutical industries. This research contributes to enhancing the value of by-products value and introducing a range of potential uses.

OU-9

## Exploring Ecklonia cava Extracts for Antioxidant and Antidiabetic Potential: A Subcritical Water Extraction Approach

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Diabetes is a significant global public health concern, affecting over 1 in 10 adults and projected to rise to 783.2 million by 2045. Therefore, this study aims to explore the potential of *Ecklonia cava* as a source of hypoglycemic agents. *E. cava*, a type of brown algae, is renowned for its a wide range of properties, including antibacterial, antioxidant, antiviral, and anticancer activities. An eco-freindly extraction method, subcritical water extraction, was utilized to extract functional substances from *E. cava*. This extraction process involved subjecting *E. cava* to subcritical water conditions at a solid:liquid ratio of 1:20 for 30 min in a temperature range of 110-230°C and a pressure of 3 MPa. For comparison, a methanol extraction was conducted at room temperature for a duration of 48 h. Antioxidant activity was highest at 110°C ESE for ABTS<sup>+</sup> and DPPH radical scavenging with 91.07±0.15 and 36.22±0.30 mg trolox/g dried mass, respectively, and at 140°C ESE for FRAP with 12.01±0.15 mg trolox/g. The antidiabetic properties of *E. cava* extracts were evaluated using  $\alpha$ -amylase and  $\alpha$ -glucosidase inhibition assays. The IC<sub>50</sub> value for  $\alpha$ -amylase inhibition was 0.13±0.00 mg/ml for acarbose, with the *E. cava* methanol extract (EME) showing the best activity at 2.18±0.01 mg/ml, followed by 8.19±0.35 for 110°C *E. cava* subcritical water extract (ESE) and 18.29±2.67 mg/ml for 140°C ESE. In terms of  $\alpha$ -glucosidase inhibition, the IC<sub>50</sub> value were 0.21±0.01 µg/ml for acarbose, 26.58±0.48 µg/ml for ESE at 110°C, 41.36±0.88 µg/ml for ESE at 140°C, and 75.86±0.05 µg/ml for EME. The kinetics of  $\alpha$ -glucosidase inhibition by these extracts were investigated through Michaelis-Menten and Lineweaver-Burk plots. The results show that 110 and 140°C ESE were mixed competitive inhibitory, whereas 170, 200°C ESE and EME were noncompetitive inhibitory characteristics. And 230°C ESE showed uncompetitive inhibitory characteristics. In conclusion, these results emphasize the potential ESE, particularly at 110°C, as a strong contender for the development of functional foods and nutraceuticals aimed at postprandial glycemic control.

OU-10

## Fisheries processing in Malawi

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With 20% of Malawi's surface area (118,484km<sup>2</sup>) composed of water, fishing is an important sector that contributes to livelihoods of the rural population and economic growth of the country. Fish contributes substantially to the food security and livelihood of millions of people in Malawi. The sector contributes about 4% to the Gross Domestic Product. Fish provides 70% of the animal protein intake of the Malawian population and 40% of total protein supply for the country (Government of Malawi, 2021).

However, fish quality and value addition are of major concern in Malawi as it is estimated that 40 percent of the annual catch is lost through post-harvest-losses. (Government of Malawi, 2016)

As the country's key strategies to reduce fish post-harvest-losses from 40 percent to 20 percent. An estimated 90% of the fish caught in Malawi is processed into various products and various fish processing methods are being employed by fish processors (Mkoko, 1988). Several methods are employed for fish processing which include Sun-drying, smoking, para-boiling and pan-roasting. Small-size fish are traditionally sun-dried, while large-size fish are mostly smoked (Kapute, 2008). In rare case, some fish is iced and sold fresh in towns, especially in the supermarkets, particularly from the industrial fishery. There is very little value adding in the fisheries industry (Government of Malawi, 2016).

Fish processing and quality control in Malawi are still poorly developed. Currently, the available fish standards do not cover all fish products and fish is landed in areas where there are no proper fish landing and handling facilities. In addition, there is no competent authority to monitor controls on fish quality aspects and guarantee safety to consumption. There is a very limited number of adequately trained personnel (Kapute, 2008). Information on fish processing in Malawi is scanty and almost unavailable.

Therefore, there is an urgent need to address public services and infrastructure issues along the whole fish value chain.



OU-11

## Comparison of nutritional and sensory properties of frozen dumplings made with Red-banded lobster hot water extract and Mealworm powder

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As global warming and abnormal climate change continue to pose significant food security challenges worldwide, the issue of ensuring future food has become increasingly urgent. One of the causes of climate change is environmental pollution, which ocean warming, overfishing, and fishing by-products can cause. Fishery by-products have value as they are a rich source of minerals (such as calcium, sodium, potassium, phosphorus, and iron) and high-quality ingredients that can be recycled. Edible insects are a sustainable and eco-friendly source of nutrition that is also cost-effective. In addition, they are an excellent source of nutrients and minerals essential for a healthy diet.

This study aimed to develop frozen dumplings using red-banded lobster by-products and mealworms and analyzed their nutritional and sensory characteristics to assess their potential as alternative food sources.

The manufacturing technology and conditions were optimized to ensure that the taste and aroma of shrimp are present, even when shrimp is not included.

Red-banded lobster by-products were processed through hot water extraction, drying, and molded into meatballs to improve edible insect chewiness.

The composition of dumplings made by this process was tested for its proximate composition, including fatty acids, minerals, free amino acids, and aroma components.

The results indicated that the crude protein content was  $8.88 \pm 0.06$  g, and the crude lipid content was  $2.73 \pm 0.22$  g, indicating a higher quantity of crude protein than crude lipids. The analysis of fatty acids showed that 80.88% of them were unsaturated, and EPA and DHA were also detected. In terms of minerals, the contents of Fe, Mg, Zn, Mo, and Mn were found to have increased compared to the control. The free amino acid test detected components such as proline and glycine, which are known to give a shrimp flavor, and the aroma component test confirmed the presence of the shrimp flavor from the two raw materials. Sensory evaluation using the Duncan post hoc analysis method showed no significant difference in color, texture, shrimp taste and, aroma, etc., between the two products. The product's marketability was confirmed, and it can be developed as a future substitute food due to its nutritional, economic, and environmental value, as well as its excellent texture and taste.

OU-12

## SWIR (Shortwave infrared) hyperspectral imaging coupled with multivariate analysis for quality evaluation in dried laver

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Laver is a red seaweed species commonly used in processed foods or as a source of health-promoting compounds. Traditionally, lavers were staple foods in limited regions of Asia, but increased awareness of their health benefits and the globalization of processed food products have led to dramatic increases in consumption across the world. Especially, the demand and exports of processed Korean laver products to East Asia, the European Union, and the United States have increased globally. The Republic of Korea's laver exports are valued at US\$700 million.

Traditionally, the quality of Korean dried laver has been evaluated based on moisture content and sensory factors such as color and crispy texture because of various product types and regional raw materials. There is no comprehensive analysis of the nutritional/functional characteristics of laver and the technological basis for its quality control.

This study identified the correlation between the HSI (hyperspectral imaging) data cube and each quality factor (proximate composition, taste compounds, and sensory factors) for quality evaluation using the non-destructive test.

The study used the ANOVA and Duncan multiple range tests to identify the correlation between quality factors and HSI data. HSI data cube was collected from the SWIR range (980-2500 nm) and averaged for wavelength, with the pore area excluded after setting the region of interest (ROI). The calculated wavelength and quality factors underwent analysis using PLS-DA, a linear and non-linear classification model.

According to the data, AMP, and stress, the classification results obtained from PLS-DA were 100% accurate for all classes, with  $R^2$  ranging from 66.1 to 99.9%. Meanwhile, the classification by ANN-DA using AMP and protein yielded 100% accuracy, with  $R^2$  ranging from 99.8 to 100%. These findings confirm that quality factors, such as AMP and protein, suit quality standards. In addition, it was discovered that the classification performance of ANN-DA is more appropriate than PLS-DA.

The data suggests that using protein-based quality factors is effective for non-destructive quality evaluation.

OU-13

## PCL/Gelatin nanofibrous membrane integrated with polydeoxyribonucleotides extracted from unused marine organisms for skin regeneration

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Conventional wound dressings have several shortcomings because they are unspecific and partially effective for wound healing. To enhance the therapeutic efficiency of wound dressings, we extracted polydeoxyribonucleotides (PDRN) from *Patiria pectinifera*, and characterized using absorbance-based analysis, chemical composition analysis, and electrophoresis. We evaluated their cytotoxicity and wound healing activity on human dermal fibroblast (HDF) and human keratinocytes (HaCaT). Next, we used electrospinning to fabricate polycaprolactone (PCL)/gelatin (Gel)/PDRN nanofibers for wound dressing application. The average fiber diameters of PCL (P), PCL/Gel (PG), and PCL/Gel/PDRN (PGP) nanofibers were  $582.88 \pm 202.65$ ,  $435.65 \pm 149.87$ , and  $334.63 \pm 98.09$  nm, respectively. The biocompatibility of the nanofibers was assessed using MTT assay and FDA/PI staining on HDF and HaCaT, no cytotoxicity was observed. In vivo experiments with full-thickness skin defect mouse models confirmed that the PGP nanofiber accelerated the initial wound healing process, as shown by wound closure analysis and histological analysis. Our results suggest that the PGP nanofiber has potential as a biomaterial for wound dressing applications and skin tissue engineering.

OU-14

## Controlling mono- and polymicrobial species biofilms by fucoidan-gold nanoparticles

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Evidence from *in vitro* and *in vivo* investigations, as well as co-isolation of *Staphylococcus aureus* and *Candida albicans* from human tissues and organs, points to a synergistic link in the formation of polymicrobial biofilms. A major cause of antimicrobial resistance that contributes to the high death rate is the polymicrobial biofilm produced by these pathogens. This study looked at inhibiting polymicrobial biofilm using nanoparticles as an alternative method. In this study, a marine-derived natural substance called fucoidan (Fu) was used to synthesize gold nanoparticles (AuNPs). UV-visible absorption spectrophotometer, FTIR, DLS, FE-TEM, zeta potential, EDS, and energy-dispersive X-ray diffraction were all used to characterize the naturally produced Fu-AuNPs. Biofilms formed by *S. aureus* and *C. albicans* are inhibited by Fu-AuNPs in their early phases, and Fu-AuNPs eradicate mature, single- and multi-species biofilms. Fu-AuNPs were also effective at the >MIC, MIC, and sub-MIC value in eradicating mature single and multi-species biofilms of *S. aureus* and *C. albicans*. Future researchers will look at this discovery as an innovative strategy for combating polymicrobial biofilms brought on by bacterial and fungal pathogens.

OU-15

## Alginate acid, a functional dietary ingredient derived from *Ecklonia maxima* stipe, attenuates the pro-inflammatory responses on particulate matter-induced lung macrophages

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Alginate is a prominent food component extensively employed in developing functional food items and a dietary supplement with significant anti-inflammatory potential. Globally, rising air pollution by particulate matter (PM) has become a significant threat to humans, causing collateral lung tissue damage by inflammation. Therefore, the present study aimed to evaluate the anti-inflammatory potential of alginate isolated from *Ecklonia maxima* stipes (EMSA) against lung inflammation due to PM exposure. Initial results from cell viability, nitric oxide, prostaglandin E-2, and pro-inflammatory cytokine production assays showed that EMSA has potential anti-inflammatory activity against PM-induced inflammation. Western blot and qPCR results revealed the anti-inflammatory potential of EMSA through inflammatory signaling pathways, further confirmed by in vivo results and inductively coupled plasma-optical emission spectrometry. Therefore, EMSA can produce low-cost and high-quality alginate for several fields, such as functional foods using *E. maxima* stipes, a natural source such as functional foods, pharmaceuticals, and nutraceuticals.

OU-16

## Determination of 11 residual organophosphate flame retardants in aquatic products across South Korea using modified QuEChERS and LC-MRM

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The consumption of organophosphate flame retardants (OPFRs) increases, and it has raised concerns about their presence in food, particularly aquatic products, and their potential implications for human health. To address these concerns, we devised a novel approach to simultaneously determine 11 commonly used OPFRs (2-ethylhexyl diphenyl phosphate, tri-n-butyl phosphate, tris(2-ethylhexyl) phosphate, tricresyl phosphate, triphenyl phosphate, tris-2-chloroethyl phosphate, tris(1,3-dichloropropyl) phosphate, tris(1-chloro-2-propyl) phosphate, triethyl phosphate, 2,2-bis(chloromethyl)trimethylenebis[bis(2-chloroethyl) phosphate, tri(2-butoxyethyl) phosphate) in various aquatic products. The method involved modified QuEChERS and LC-MRM techniques for purification/extraction and instrumental analyses, respectively. We also conducted a comprehensive validation of the method, which included assessing specificity, linearity ( $r^2 \geq 0.993$ ), sensitivity (lower limit of quantitation: 0.05-2.00 ppb), accuracy (recovery: 67.3-118.8%), and precision (relative standard deviation of recovery: 3.4-16.7%). Subsequently, we applied the validated method to 259 aquatic product samples from seven regions in South Korea and confirmed the OPFRs up to 40.332  $\mu\text{g/kg}$ . This is the first systematic study to monitor OPFRs in various aquatic products and holds potential for enhancing South Korea's food safety management system.

**Keywords:** organophosphate flame retardant; OPFRs; aquatic products; QuEChERS; LC-MRM; monitoring

OU-17

## Exploring the Structural Characteristics and Potential Health Benefits of Fucooidan: A Study on Gut Microbiota Modulation

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In recent years, there has been a growing fascination with algal polysaccharides, particularly fucoidan, derived from brown algae, within both the scientific community and various industries. Fucoidan belongs to a diverse class of polysaccharides known for their high molecular weight, abundant fucose content, and sulfated nature, primarily sourced from brown seaweeds. The pharmaceutical sector, in particular, has shown substantial interest in exploring the physicochemical attributes and potential bioactive properties of fucoidan over the past few decades.

Fucoidans are characterized by the presence of sulfate ester groups, giving rise to negatively charged surfaces, variable molecular weights, and water solubility. Furthermore, fucoidans exhibit a wide range of promising bioactivities, including antitumor, immunomodulatory, and antiviral effects. These bioactivities are closely linked to their unique chemical properties, such as molecular weight, sulfation pattern, and degree of sulfation.

Of particular note is the ability of fucoidan to form ionic complexes with oppositely charged molecules due to the inclusion of sulfate residues bearing negative charges in its structural framework. This property enables fucoidan to form structures in conjunction with other polymers, adding to its intrigue in both scientific and industrial circles, driven by its potential contributions to human health.

Despite the growing interest, a significant challenge remains in accurately identifying and quantifying the complex nature of fucoidan. To address this, our study aimed to offer a comprehensive overview of the essential structural features of fucoidan. We extracted fucoidan from five distinct species of *Sargassum*, which are found along the coastline of Jeju Island, South Korea. Based on their unique structural characteristics, we went on to investigate their impact on the gut microbiota using a zebrafish model with imbalanced gut health induced by lipopolysaccharide (LPS).

The findings from our study suggest that the structural attributes of fucoidan hold promise as a prebiotic agent, potentially promoting gut health.

OU-18

## Big Data Analysis on Muscle Atrophy Inhibition by *Sargassum Serratifolium*

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Recent research has highlighted the significant impact of macrophage-secreted factors on skeletal muscle metabolism. In this study, we investigated the potential of Meroterpenoid-Rich Extract of *Sargassum Serratifolium* (MES) to counteract alterations in the macrophage transcriptome induced by lipopolysaccharide (LPS) treatment and their subsequent effects on skeletal muscle. We employed macrophage-conditioned medium (MCM) obtained from LPS-treated macrophages (LPS-MCM) and MES-treated macrophages (MES-MCM) to assess their impact on differentiated C2C12 myotube cells. LPS-MCM treatment upregulated muscle atrophy-related genes and reduced glucose uptake, while MES-MCM treatment reversed these effects. Our RNA sequencing analysis revealed various changes in the expression patterns of immune system pathways and cytokine transport pathways in macrophages treated with MES. Additionally, protein array analysis showed that proteins such as GDF-15, IL-1 $\alpha$ , and RAGE, which exhibited high expression levels in LPS-MCM, had significantly reduced expression in MES-MCM. These proteins are closely associated with muscle atrophy and muscle glucose homeostasis. These findings underscore the complex interplay between the macrophage transcriptome and secreted factors from macrophages that can either impair or enhance skeletal muscle function. Of particular note is the potential of MES treatment to reduce macrophage-derived cytokines, suggesting a pivotal role in preserving skeletal muscle function.



OA-1

## Comparison of haematological and morphological characteristics of the Starry Flounder (*Platichthys stellatus*) triploid and hybrid (*P. stellatus*♀×*Kareius bicoloratus*♂) triploid

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This study aimed to determine the appropriate treatment methods for 3n starry flounder (*Platichthys stellatus*) and to confirm the induction rate of 3n starry flounder under heat and chemical treatment. Additionally, we compared the morphological and hematological characteristics of 3n starry flounder and its hybrid (Starry flounder, *P. stellatus* ♀ × Stone flounder, *K. bicoloratus* ♂) with 2n starry flounder, including their chromosome size and number. For the induction of triploidy in the starry flounder, the use of cold shock, heat shock and chemical shock was investigated. The results showed that the highest triploidy induction rate of 98.3±2.9% was achieved under the condition of a processing temperature of -1.9~-1.8°C during cold shock, a processing interval of 9 minutes after modification, and a low-temperature treatment time of 60 minutes. Comparing the forms of the 2n starry flounder, the hybrid and the stone flounder, the stone flounder had a wider and rounder body shape with a short tail fin compared to the 2n starry flounder. In addition, the stone flounder had a higher eye size and inter-eye distance ratio on the head. The stone flounder 2n had the highest number of fin rays with DF (Dorsal fin) 68.30±0.79, AF (Anal fin) 48.80±0.90, CF (Caudal fin) 19.20±0.29, PF (Pelvic fin) 12.00±0.30, while the diploid starry flounder had the lowest number of fin rays. The hybrid 2n had a body shape that was intermediate between the starry flounder and the stone flounder, but was closer in shape to the stone flounder and maintained an intermediate number of fin rays. There were differences in head and eye ratios between 2n and 3n forms of the starry flounder, but there were no significant differences in body shape and fin ray number. Compared to the hybrid 2n, the hybrid 3n had a shorter body length and a higher ratio of head organs to overall length, as well as fewer fin rays or a similar number. Hematological analysis showed that the erythrocyte count of the 3n starry flounder was lower than that of the 2n starry flounder, while the hematocrit and hemoglobin levels showed no significant differences. The mean corpuscular volume and mean corpuscular hemoglobin, which are related to erythrocyte size, were significantly higher in the 3n fish than in the 2n fish. The erythrocytes of the 3n fish were more than 50% larger than those of the 2n fish and were elliptical in shape.

## Development of cultivated seafood using aquatic animal cells

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As an alternative solution to address climate change and food security concerns, the field of food technology has gained prominence, particularly in the realm of alternative food sources. Among these alternatives, plant-based and animal-based ingredients are used for alternative proteins. Recently, animal-based alternative proteins, specifically cultivated meat and seafood, have garnered attention for utilizing animal cells as their primary source. Cultivated meat is produced from terrestrial animals such as cattle, pigs, and chickens, while cultivated seafood involves the use of aquatic animal cells, including fish and crustaceans.

Globally, there are about 160 companies involved in the production of cultivated meat and seafood, with cultivated seafood accounting for about 20%, with globally representative species including tuna, salmon, sea bass, eel, and shrimp. There are currently three domestic companies developing farmed seafood in South Korea.

The methods for producing cultivated meat or seafood vary widely, with a critical differentiator being the use of scaffolds. Presently, our focus is on developing cultivated seafood using scaffolds; however, our ultimate goal is to create cultivated seafood without the use of scaffolds. This is driven by the desire to minimize the addition of artificial materials to the final product.

Essential ingredients include cells, scaffolds, basal media, and additives to produce cultivated seafood. Cells can be obtained from muscle, fat, liver, and other relevant tissues, while scaffolds, basal media, and additives must meet food-grade standards. We aim to secure and establish cell lines from ten different aquatic animal species annually. Currently, we have obtained cells from eel, salmon, tilapia, squid, and shrimp, and we are in the process of establishing cell lines. Additionally, we have developed food-grade basal media and scaffolds. Furthermore, we are developing substitutes for fetal bovine serum and antibiotics. To contribute to environmental conservation and human progress, we aim to produce various products using aquatic animal cells, including cultivated seafood.

OA-3

## A Study on the Symptoms of Byeokoreum (Climbing a wall) of the Juvenile Abalone

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This study studied the causes of disease and immune gene expression with the aim of resolving the symptoms of Byeokoreum, which is a major cause of mortality during the abalone seed production period.

For this purpose, Juvenile Abalone that showed symptoms of wall climbing was selected as a test zone and normal individuals were comparison zone, 15 individual were sampled in each section. Then, three each and analyzed for pathogens and immune-related genes.

In order to analyze the pathogen gene, it was confirmed through the diagnosis of breeding water and disease causes, and immune-related gene analysis was measured using PCR primersets.

As a result, symptoms caused by tubercle mycosis caused by *Halioticida noduliformes* are presumed to be the cause of the test test, and it is believed that further research is needed due to the occurrence of Byeokoreum symptoms depending on the amount detected.

Immunization-related genes such as TLRs and Lysozyme showed low expression due to a decrease in all physiological functions, including the immune system, when the disease occurs.

In addition, individuals with active mobility are closely related to the pulmonary angular muscle, and when attached without moving, mucous cells in the foot epithelial layer that secrete attached mucus develop, and it is expected that mobility and adhesion can be analyzed.

OA-4

## *Vibrio atlanticus* isolated from sea-farmed rainbow trout in winter of Japan

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Wakasa Bay is surrounded by a type of ria coast, which protects it from rough waves in winter, and therefore provides the best condition for placing aquaculture netpens. In our aquaculture system, juvenile rainbow trout are reared in freshwater ponds, transferred to seawater netpens, and cultivated there from December to May. For some years, a certain amount of mortality has been observed a month after seawater acclimatization, in which the diseased fish showed typical symptoms of vibriosis such as bleeding and ulcers on the skin surface. Although bacteria isolated from the ulcers and kidney were identified as *Vibrio* sp. by 16S rRNA sequencing analysis, the percentage identities were very close (~98%) and determining the exact species was difficult. In this study, multilocus sequence analysis with eight genes (*ftsZ*, *gapA*, *gyrB*, *pyrH*, *recA*, *rpoA*, *topA*, and 16S rRNA) was used to conduct phylogenetic analysis with other major Vibrionae species. Furthermore, complete genome sequence was determined using PacBio Sequel II and used for further analyses. These data indicate that the *Vibrio* sp. isolate is *V. atlanticus*, the genome of which consists of two chromosomes (Chr1: 3.44 Mb, Chr2: 1.60 Mb) encoding 4502 genes (CDS, rRNA and tRNA). The virulence against rainbow trout was examined by conducting a challenge experiment, in which the bacterial suspension was intraperitoneally injected into 7-days-post seawater acclimatized fish. A few days after the challenge, the challenged fish showed bleeding and ulcers on the skin surfaces. This research was supported by the research program on development of innovative technology grants (JPJ007097) from the Project of the Bio-oriented Technology Research Advancement Institution (BRAIN).

OA-5

## Introduction to anti-parasite functional feed

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As a result of innovation and continuous improvement, Dibaq Aquaculture is introducing a new product line called Dibaq AquaSafe.

### Feature

1. Addition of functionality: Adding products derived from natural extracts helps maintain the balance of intestinal microorganisms and ultimately has a positive effect on the health and immunity of fish and increases yield.

Dibaq feed takes this very seriously and gives priority to these compounds, available in various formats and combinations.

2. Anti-parasite function: In addition to enhancing immunity, this product has anti-parasite properties against internal and external parasites, providing protection against various pathogens. The combination of the two functions is effective against parasites such as intestinal *Myxoplasma gondii*(E.leei) and monogenes.

3. Improvement and expansion of fry fish feed: Production of perfectly standardized micropellets physically and nutritionally through extrusion of 0.6mm and 0.8mm micropellets, a highly technological process. The individual particle size of the granules and the resulting degree of grinding of the feed have a significant impact on the digestibility of feed raw materials, and increase digestibility, resulting in increased production. The new line of Microbaq AquaSafe can be segmented and adapted to different species, making it especially beneficial for carnivorous fish and fry fish with short digestive tracts.

4. Digestive and functional activity: Improves the nutritional quality of feed through special natural additives that optimize its use in the digestive tract, saving customers money and improving production through improving proper gut health.

OA-6

## Application Cases of 4Tress, an Anti-Parasitic substance in Dibaq Feeds, on Turbot

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The major parasite affecting turbot is gill flukes known as monogenea, which parasitize various aquaculture fish, including turbot, sea bass, and other seawater fish. These parasites lead to direct mortality and secondary bacterial infections, causing significant damage.

To address gill fluke infections, anthelmintics are commonly used, but they do not provide a fundamental cure.

At an aquaculture fish farm located in Sanyang-eup, Tongyeong, which was using E.P. feeds, we introduced DIBAQ MAXPRO with the anti-parasitic substance 4Tress. We carefully observed and focused on confirming the significant effects against gill fluke infections, as suggested by the fish farm owner's opinion.

Our observations, particularly focused on turbot, indicated that the anti-parasitic effect of 4Tress, a functional ingredient, was indeed significant. We conducted observations over two months in August and September 2023, assessing the gill fluke population, gill coloration, and mortality rates.

The results are as follows:

	Infected population (Based on 10)	Number of parasites per fish	Gill Color	Number of dead fish (Daily)	Fish farm size
Tongyeong D fish farm	4/10	1~4	Red	1~2	0.2ha
Fish farms around Tongyeong	7/10	10~50	Light pink	100~1000	0.5~1.0ha

Furthermore, we have initiated a request for specialized information regarding the effectiveness of anti-parasitic substances from the feed manufacturer, DIBAQ Group in Spain. We present this summary of the case from the two-month observation period to explain the advantages of such functional feeds.

OA-7

## Aquaculture sector of Bangladesh

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The aquaculture sector in Bangladesh has emerged as a major contributor to the country's economy and food security. With abundant water resources and favorable climatic conditions, Bangladesh has become one of the world's leading fish-producing nations. In the fiscal year 2021-22, the country achieved a remarkable total fish production of 4.71 million metric ton (m MT), surpassing its projected target. Aquaculture accounted for 58.03% of this production, highlighting the significant role of fish farming in the industry's growth. Bangladesh has achieved self-sufficiency in fish production, providing approximately 60% of the total daily animal protein intake for its population. The industry also contributes substantially to the nation's foreign currency earnings, with fish and fishery product exports making up 1.05% of the total national export earnings in 2021-22. The country's achievements are recognized on a global scale, with Bangladesh ranking 3rd in inland open water capture production and 5th in global aquaculture production. The fisheries sector plays a vital role in the national economy, contributing 2.43% to the GDP and 22.14% to the agricultural GDP. More than 12% of the population is directly or indirectly engaged in fisheries-related activities for their livelihood. The growth of aquaculture, particularly in shrimp and fish hatcheries, driven by private entrepreneurs, has spurred expansion but also raised concerns about seed quality. Challenges such as inbreeding and brood management issues have been addressed through government programs, including the establishment of major carp brood banks and the promotion of Specific Pathogen Free (SPF) shrimp hatcheries. Coastal aquaculture, encompassing shrimp/prawn and finfish farming, is expanding, with an emphasis on eco-friendly practices and quality standards. Bangladesh's aquaculture sector has made significant strides in recent years, contributing to economic growth, food security, and global recognition. To realize its full potential, collaboration among government departments, development partners, researchers, and NGOs is essential, with a focus on sustainability.

OA-8

## Sustaining ocean wealth: A comprehensive analysis of Fiji's fisheries and aquaculture sector

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This country report delves into the dynamic and pivotal realm of Fiji's Fisheries and Aquaculture Division, offering a comprehensive assessment of its current status, challenges, and opportunities. The report begins by providing an overview of Fiji, political landscape, summary of the fisheries industry and its contribution towards the government as a whole. Geographically, Fiji comprises over 330 islands, each offering a distinct blend of lush rainforests, pristine beaches, and azure waters. In conclusion, "Sustaining Ocean Wealth: A Comprehensive Analysis of Fiji's Fisheries and Aquaculture Sector" offers a holistic perspective on the vital role played by fisheries and aquaculture in Fiji's development. It sheds light on the challenges and opportunities that lie ahead, serving as a valuable resource for policymakers, researchers, and stakeholders committed to preserving Fiji's marine heritage and harnessing the potential of its aquatic resources for sustainable growth.



OA-9

## Aquaculture sector of Nepal

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Aquaculture is one of the fastest growing agriculture subsectors in Nepal contributing for food security and poverty alleviation. In Nepal, aquaculture development was institutionalized in 1947 AD by establishing fisheries unit under Agricultural Council. The country has magnificent potential for the development of aquaculture. Nepal is rich in aquaculture resources in terms water resources and fish diversity. There are more than 6000 rivers flowing from the High Himalayas towards the southern plains 12500ha lakes and 500ha reservoirs. Major aquaculture systems of Nepal are pond aquaculture, case culture and flow through aquaculture system. Culture specious of Nepal are rainbow trout in the mountains; Carps, tilapia and pangasius in the southern plains. The total fish production of the country is 104,623Mt in 2021 of which 20% is contributed by capture fisheries while 80% is from aquaculture. Fisheries and aquaculture sector contributes about 1.83% in Agricultural Gross Domestic Production and 0.44% in Gross Domestic Production. At present, the availability of fish in least developed country is 11kg but in Nepal, it has very low 3.43kg. However, fish as a protein-rich food is acceptable to every level of the population. The total number of farmer family involved in the aquaculture sector is 150000 providing 395,000 jobs opportunities. There are 126 hatcheries and 222 fish nurseries producing 51 million fish fry each year. The government organizations are providing substantial support in terms of research, extension and financial assistance. However, there are challenges and opportunities that need to be addressed to sustain and further expand this sector. Additionally, there is a need for further investment in research and development, disease control, and nutrition enhancement to boost the aquaculture production in Nepal.

OA-10

## Status of fisheries and aquaculture in Rwanda

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Rwanda is a land locked country with an estimated population of 13.6 million and a surface area of 26,338 km<sup>2</sup> of which 5.3% is water surface. Fishes are generally grown in fresh water of lakes, rivers and ponds. Around 40 species are reported in Rwandan water bodies, of which only four (*Limnothrissa miodon*, *Oreochromis niloticus*, *Clarias gariepinus* and *Haplochromis* species) are of economic importance. Fishing activities are carried out in 17 lakes and 4 rivers with the yield of 32,094 MT in 2021; and fish culture is practiced in ponds (324 ha), floating cages (59,390 m<sup>3</sup>), and 41 dams with a total capacity of 31,360,000 m<sup>3</sup>. In the development of aquaculture, different production systems are used and their capacity is increasing every year. Most of fish farmers are adopting floating cage aquaculture system as the way of increasing productivity. Based on the report of year 2022, the national fish production was estimated to 43,560 MT, with a target to produce 112,000 MT annually by 2024 according to the fourth Strategic Plan for Agriculture Transformation (PSTA4), which runs from 2018 to 2024. However, Rwanda still imports an estimated 15,000 MT of fish every year in order to cater for the rising demand. Aquaculture and fisheries in Rwanda face several challenges among others 1) limited water resources, 2) climate change and water quality concerns, 3) insufficient infrastructure / technology, 4) limited technical expertise, 5) limited access to finance for small-scale farmers. Rwanda is making efforts to develop aquaculture and fisheries sectors despite its landlocked geography, in order to reduce its dependency on imported fish. The government has supported various initiatives to encourage fish farming in ponds, cages, and tanks. In addition, the country has invested in research and training programs to improve fish farming techniques and the quality of fish products by building partnership with international organizations and universities to enhance knowledge and skills in aquaculture and fisheries.

OA-11

## Integrated aquaculture system and climate change adaptations in Tanzania

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Integrated aquaculture systems (IAS) is a sustainable farming method that synergistically combines various aquaculture activities with complementary agricultural practices. It aims to minimize environmental impact while maximizing resource utilization and enhancing farm productivity, and sustainability. The research explores how IAS can provide creative solutions for resilience-building in the face of environmental uncertainties, as climate change poses significant challenges to conventional farming practices. It begins by exploring the specific effects of climate change on Tanzania, including altered precipitation patterns, protracted droughts, and rising temperatures. These modifications put food security and livelihoods at risk by threatening the sustainability of aquaculture farming practices. The study carefully examines the idea of IAS, which entails growing fish concurrently with other agricultural pursuits in order to foster synergistic relationships and diversify sources of income. Resilience building, resource efficiency, and climate-smart practices are important elements. The research in the policy area assesses the effectiveness of current regulations and makes recommendations for changes and incentives to encourage the adoption of IAS widely. It also emphasizes the importance of training and capacity-building initiatives that will provide Tanzanian fish farmers with the information and expertise they need to successfully implement climate-resilient practices. Food security, income, and poverty reduction are all topics that are thoroughly covered in the research on the socioeconomic effects of IAS. In addition, it highlights the advantages for the environment by demonstrating how IAS can help promote environmentally friendly fish farming methods and minimize environmental footprints. Basically, this study identifies an exciting opportunity for IAS as a means of climate adaptation in Tanzania's aquaculture industry. It aims to empower fish farmers, improve their capacity for adaptation, and promote sustainability in aquaculture by outlining the potential advantages, difficulties, and policy implications of adopting IAS.

OA-12

## Current Status of Aquaculture in Timor-Leste

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Aquaculture activities are focused on freshwater fish farming. The government promotes small-scale, “backyard” farming of carp and tilapia to increase fish consumption in inland areas. A third species that is promoted by the government is milkfish. In Timor-Leste, around 75 percent of the country’s 1.2 million people live in rural areas where livelihoods depend on the farming of crops and livestock, largely of a subsistence or semi-subsistence nature. Recent years have witnessed notable progress in aquaculture participation, with approximately 2,000 households engaged in small-scale fish farming. These operations typically involve fishponds of modest sizes, averaging below 200 m<sup>2</sup>, indicative of the prevalence of small-scale subsistence farming. In 2008, freshwater aquaculture production was a modest 45.6 metric tons. However, recent aquaculture development initiatives led by WorldFish and its partners have significantly increased, reaching over 3,500 metric tons in 2021. In 2018, Timor-Leste produced around 44.50 tons of seaweed for export and increase in 2022 about 498.05 tons, and a significantly larger quantity was available for the local market. The country has potential areas for aquaculture divided into three categories; brackish water covering 234.6 hectares, freshwater spanning 198.1 hectares, and marine encompassing 266.6 hectares, the government of Timor-Leste also owns its own hatcheries that provide seed production, the Gleno hatchery specializes in monosex, the Vemase hatchery focuses on milkfish and crabs, the Manufahi hatchery concentrates on Common carp, and the Viqueque and NIFA hatcheries are dedicated to tilapia seed production. From 2018 to 2022, the National Institute of Fisheries and Aquaculture produced and distributed a total of 225,467 tilapia seeds to fish farmers. The estimated production over these five years amounted to 76,640 tons. This distribution benefited a total of 464 beneficiaries from 12 municipalities who managed a combined total of 643 fishponds. The most crucial issues related to the aquaculture sector in Timor-Leste can be summarized as the absence of a feed factory and proximate analysis, along with a shortage of aquaculture equipment.

OA-13

## Expanding Ornamental Fish Cultivation for Economic Growth in Uganda: Opportunities, Challenges, and the Ways Forward

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This abstract presents preliminary findings on the availability of ornamental fish species in Uganda's natural water systems, with a focus on the Kyoga and Victoria Lake system. Several studies reveal a substantial abundance of vibrant coloured fishes that exhibit the potential for successful breeding in captivity and adaptation to artificial diets in controlled environments. These species are aesthetically appealing and possess a high market demand, highlighting a promising avenue for diversifying aquaculture species and enhancing economic prospects in Uganda.

There are several opportunities including but not limited to; abundance of Coloured *Haplochromine Cichlids*. Previous studies affirm the presence of an abundant population of coloured *H. cichlids* in Uganda's freshwater bodies. Despite this, their utilization for ornamental or aquarium trade remains largely untapped. The technology required for breeding and sustaining ornamental fish in captivity is accessible, providing a solid foundation for large-scale production.

However, several challenges are still hampering the establishment of ornamental fisheries development in Uganda, including, absence of systematic policies. The absence of structured policies pertaining to ornamental fish trade, coupled with a dearth of specific research on ornamental fish culture, presents a significant challenge to the industry's development.

**Insufficient Infrastructure and Inputs:** Inadequate infrastructure and key inputs act as barriers to producing in-demand varieties required by the fast-growing domestic and international market.

OA-14

## Molecular characterization and evolution of ficolin in a primitive chondrosteian sturgeon, *Acipenser baerii*

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Ficolins are structurally and functionally homologous to MBL and can activate the lectin pathway of the complement cascade in mammals, however, nothing is known about the molecular identity of ficolins in teleosts. Here, we report the first identification of a ficolin gene in a primitive chondrosteian sturgeon, *Acipenser baerii*, enabling investigation of its molecular characterization, evolutionary dynamics, and functional attributes. Nucleotide sequence of the identified *A. baerii* ficolin (AbFCN) comprised 3,439 bp with open reading frame (ORF) 951, encoding 320 amino acid residues protein, consisting of a signal peptide (Met<sup>1</sup>Cys<sup>25</sup>), a collagen-like domain (Leu<sup>47</sup>Asn<sup>104</sup>) and two cysteine residues (Cys<sup>269</sup>Cys<sup>282</sup>) within a fibrinogen binding domain (Asn<sup>112</sup>Phe<sup>320</sup>). Multiple sequence alignment and phylogenetic analysis revealed that AbFCN had high sequence similarity (>50%) with mammalian ficolins and shared ancestor within human FCN-3 with specific fish lineages. Collectively, this study provides the first molecular identity of the prototype of ficolin-3 in teleost and our better understanding of ficolin's roles in teleost. Further research will explore the gene expression analysis and functional study.

OA-15

## Establishing the optimal conditions to support the propagation of red seabream iridovirus (RSIV) in GF and DGF cells

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Red sea bream iridovirus (RSIV), a Megalocytivirus, harms diverse fish species and causes major aquaculture losses. This study investigates optimal RSIV replication conditions in two cell lines, namely grunt fin (GF) and dwarf gourami fin (DGF) cells. The effects of various incubation temperatures (23°C, 25°C, and 28°C) and fetal bovine serum concentrations (0%, 2%, 5%, and 10%) on RSIV replication were explored. Both cell types maintained consistent morphological integrity throughout the 10-day observation period under all conditions. The most favorable conditions were identified at 28°C with a 10% FBS-supplemented medium. In the comparison of cytopathic effects following RSIV inoculation at different temperatures, clear differences were observed. In the RSIV-inoculated DGF cells, an apparent CPE was observed from 5 days post-inoculation (dpi) at 28 °C, and all CPE was identified in all experimental conditions at 7 and 10 dpi. In contrast, RSIV-inoculated GF cells slightly displayed CPE at 25°C and 28°C. Notably, RSIV replication started at 28C in both cell types. Moreover, at the different initial concentrations of RSIV inoculations (high dose as 10<sup>6</sup> genome copies/mL and low dose as 10<sup>4</sup> genome copies/mL), despite this, DGF cells showed clear CPE in both conditions, GF showed CPE when exposed to the high dose of RSIV inoculation. Notably, RSIVs from GF and DGF cells of varying FBS concentrations displayed a marked difference in viral copy numbers. In all conditions, RSIV from GF cells had approximately 10<sup>4</sup> copies/mL, while DGF cells showed significantly higher counts, reaching 10<sup>7-8</sup> copies/mL at 10 dpi. From the disparity in viral replication, the optimal FBS concentrations for RSIV propagation on DGF cells were determined to be 5%, respectively. Furthermore, the correlation between TCID<sub>50</sub> and viral copies determined the minimum infectious dose for RSIV in DGF cells is over 100 times higher compared to GF cells (10<sup>4</sup> genome copies/mL in DGF cells compared to 10<sup>6</sup> genome copies/mL in GF cells). These findings highlight the need to optimize cell culture conditions for RSIV replication and emphasize DGF cells' high permissiveness to the virus.

OA-16

## The Current Status and Future Aspects of Shrimp Aquaculture in Indonesia

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Indonesia being one of the leading producers of aquaculture products has been steadily expanding to meet both demand and export opportunities. Shrimps, among the aquaculture products in Indonesia, are indeed one of the important aquaculture products in Indonesia. According to the FAOs report in 2020 global aquatic product value is categorized into finfish (66.5%) crustaceans (22.8%) and molluscs and other aquatic invertebrates (10.7%). In terms of crustaceans, shrimps and prawns account for 16% of the export volume. Therefore shrimp aquaculture plays a role in Indonesias growth strategy. This study examines the state and future prospects of shrimp aquaculture in Indonesia using data from the Ministry of Maritime Affairs and Fisheries Republic of Indonesia (MMAF) as well as data from the Food Agriculture Organization (FAO). The analytical method uses a qualitative descriptive approach considering variables such as shrimp production growth, export volume, product value and strategy mapping through SWOT analysis to evaluate strengths, weaknesses, opportunities and threats, within the shrimp aquaculture sector. The findings indicate that aquaculture significantly contributes to achieving development objectives. However based on what we have observed it is clear that there are areas of concern and potential risks that need to be addressed. That is why we have developed a plan to effectively tackle these weaknesses and mitigate the associated threats.



OA-17

## Effects of replacing fish meal with a blend of corn gluten meal and meat meal on the growth, biochemical profile, digestive enzyme activity, antioxidant status, and innate immunity of juvenile black rockfish (*Sebastes schlegelii*)

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This study assessed the impact of replacing fish meal (FM) with a blend of corn gluten meal and meat meal (BCM) on the growth performance, digestive enzyme activity, and nonspecific immune response of juvenile black rockfish (*Sebastes schlegelii*). Seven diets were formulated to replace 0% (BCM0), 10% (BCM10), 20% (BCM20), 30% (BCM30), 40% (BCM40), 50% (BCM50), and 60% (BCM60) FM protein with a blend of CGM and MM (BCM) at a ratio of 1:2. Each diet was randomly assigned to triplicate groups of 30 rockfish (initial body weight: 3.6 g) for 8 weeks. The BCM0–BCM50 diets resulted in no significant differences in final body weight (FBW), weight gain (WG), and specific growth rate (SGR), whereas the BCM60 diet led to the lowest FBW, WG, and SGR. The feed consumption and feed efficiency of rockfish fed BCM10–BCM50 diets did not differ significantly from those of rockfish fed the BCM0 diet. Intestinal trypsin and lipase activities showed a linear decrease with increasing substitution levels of BCM in the experimental diets. Moisture levels increased with elevated BCM replacement in diets, whereas crude protein and lipid levels decreased with increased BCM replacement. Whole-body amino acid profiles of rockfish, except for glycine and proline content, were not significantly affected by diet. However, lysozyme and catalase activities exhibited quadratic responses to increasing dietary BCM levels, and superoxide dismutase activity and glutathione content showed a negative linear responses. Overall, these results show that a mixture of corn gluten meal and meat meal can replace up to 50% of dietary FM without adversely affecting the growth performance of juvenile rockfish.

OA-18

Substitution effects of fish meal with corn gluten meal in the diets on growth, feed utilization, biochemical composition, and hematological chemistry of red sea bream (*Pagrus major*)

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Looking for an alternative protein source for fish meal (FM) is an essential issue in aquafeed nutrition research. Corn gluten meal (CGM) is a plant protein source commonly used in aquafeed and it can be regarded as a replacement for FM. This study aims to evaluate the substitution effect of FM with CGM in diets on growth, feed consumption, feed utilization, biochemical composition, and hematological chemistry of red sea bream. A total of 600 fish averaging 8.6 g were randomly distributed into 12, 300 L flow-through tanks (50 fish per tank) in triplicate. Four isonitrogenous (52.0%) and isolipidic (14.6%) experimental diets were formulated. The control (Con) diet contained 55% FM and 17% fermented soybean meal as the protein sources and 4% fish oil and 4% soybean oil as the lipid sources, respectively. In the Con diet, 20%, 40%, and 60% FM were substituted with CGM, designated as the CGM20, CGM40, and CGM60 diets, respectively. Fish were hand-fed to apparent satiation twice a day for 8 weeks. Weight gain and specific growth rate of fish fed the Con and CGM20 diets were superior ( $P < 0.0001$ ) to fish fed the CGM40 and CGM60 diets. Feed consumption of fish fed the Con diet was significantly ( $P < 0.03$ ) higher than that of fish fed the CGM40 and CGM60 diets, but not significantly different from that of fish fed the CGM20 diet. Protein retention of fish fed the Con and CGM20 diets was significantly ( $P < 0.007$ ) higher than that of fish fed the CGM40 and CGM60 diets. However, none of the feed efficiency, protein efficiency ratio, biochemical composition, and hematological parameters of fish were significantly affected by dietary treatments. In conclusion, FM up to 20% could be substituted with CGM without causing detrimental effects on growth performance, feed availability, and hematological chemistry of red sea bream.

OA-19

Relationship between water quality environment and mortality rate of olive flounder (*Paralichthys olivaceus*) farmed in Wando and Jeju area using big data analysis

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Olive flounder (*Paralichthys olivaceus*) is a major aquaculture fish species in Korea and is mainly farmed in land based flow-through aquaculture systems on Wando and Jeju Island. However, farmed olive flounder are dying due to various causes, and the mortality rate is high at approximately 45.5% in Jeju and 22.4% in Wando, which has a significant negative impact on farm management.

Previous studies on the relationship between the mortality of olive flounder and water environment have shown that rapid fluctuations in water temperature (WT), dissolved oxygen (DO), salinity (Sal), and pH cause stress in olive flounder. However, in order to more accurately analyze the relationship between the water quality environment of fish farms and the mortality, various studies using big data analysis techniques are needed.

Therefore, in this study, the relationship between WT, DO, Sal, and pH and the mortality using big data analysis techniques for olive flounder farmed in Wando and Jeju Island was investigated. Water quality environment sensor data (WT, DO, Sal, and pH) measured in real time in the aquaculture tank from January 2020 to April 2023 and the survival and mortality rates of olive flounder recorded at regular intervals by field workers were used. First, we used the interquartile range (IQR) method to remove outliers and performed data analysis through correlation analysis, pair plots, decision trees, and time series methods.

As a result decision tree analysis revealed the feature importance of water quality data that effects the mortality of olive flounder is as follows; DO: 0.092, Sal: 0.0039, pH: 0.0895, WT: 0.0023 for Wando and DO: 0.0005, Sal: 0.0012, pH: 0.0001, WT: 0.0003 for Jeju.

These findings indicate that WT, DO, Sal, and pH parameters have minimal effects on olive flounder mortality in both Wando and Jeju area and that olive flounder mortality is not suddenly triggered by gradual changes of water environment in the fish farms. The next step is to conduct a comprehensive analysis of water environmental data and fish disease data to identify factors affecting olive flounder mortality in aquaculture environments.

OA-20

Gene expression and fluorescence *in situ* hybridization (FISH) revealed a comparative role for the IGF system in Pacific oysters (*Crassostrea gigas*) gonad (from Geoje Island, South Korea)

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The IGF system is known to be involved in the reproduction of vertebrates and more recently, in invertebrates. In this study, the role played by the members of the IGF system namely, *Crassostrea gigas* insulin receptor-related receptor (CIR), IGF binding protein complex acid labile subunit (IGFBP\_ALS), and molluscan insulin-related peptide (MIP) were investigated in relation to the annual reproductive cycle of male and female Pacific oysters (*Crassostrea gigas*). A total of 35 samples were collected from the natural growing ground of oysters on Geoje Island monthly for one year (March 2021 to February 2022). These samples were subjected to morphological measurements including the calculation of the body condition index. CIR, IGFBP\_ALS, and MIP were detected in the gonads of oysters following gene expression (RT-PCR) and visualized localization (FISH) analysis. The oyster had, on average, a shell length of  $66.71 \pm 1.64$  mm, shell height of  $119.93 \pm 3.08$  mm, shell width of  $39.62 \pm 1.05$  mm, total weight of  $158.58 \pm 5.61$  and soft tissue weight of mean,  $23.90 \pm 0.86$  g. The condition index was calculated from the body morphometrics and was highest in May and lowest in October, regardless of sex. During the months of March to September, gonads revealed gonochorism (either male or female) and undifferentiated for the rest of the year. RT-PCR analysis revealed that MIP had a higher expression in these months compared to CIR and IGFBP\_ALS and was the highest in May and August for females and in April and August for male oysters. Meanwhile, CIR and IGFBP\_ALS in both sexes showed a monthly complementary tendency in their expression. Visualization of gonad fluorescence in the gonad showed a similar pattern as the MIP expression during the differentiated months. Taken together, key members of the IGF system were involved in the reproductive maturation of both male and female oysters as demonstrated by gene expression patterns and the fluorescence *in situ* hybridization.

OA-21

## Effect of partial and complete substitution of fish meal by tuna by-product meal in the diets of juvenile rockfish (*Sebastes schlegeli*) on growth performance

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To achieve the goal of sustainable aquaculture, fish meal (FM) substitution with an alternative source that is inexpensive and year-round available in aquafeeds is highly needed. Animal protein sources including terrestrial and fishery by-products could be more proper alternative to FM in carnivorous fish feeds because of their substantial quantities of protein and lipid, excellent palatability, and favorable essential amino acid (AA) profiles. However, some developed countries have restrictions on using terrestrial animal by-products in animal feeds because of safety issues. Therefore, this study was conducted to assess the substitution effect of the graded levels (20% increment) of FM with tuna by-product meal (TBM) in the diets of rockfish (*S. schlegeli*) on growth performance. Fifty-five percent FM was included in the control (Con) diet. In the Con diet, 20%, 40%, 60%, 80%, and 100% FM were replaced with TBM, named as the TBM20, TBM40, TBM60, TBM80, and TBM100 diets, respectively. A total of 540 early-stage of juvenile rockfish averaging 2.4 g was randomly divided into 18, 50-L flow-through tanks (30 fish per tank). All experimental diets were fed to triplicate groups of fish twice a day for 8 weeks. At the end of the 8-week feeding trial, weight gain and feed consumption of rockfish fed the TBM20 and TBM40 diets were comparable to rockfish fed the Con diet, but superior to rockfish fed all other diets. Rockfish fed the TBM20 diet achieved superior specific growth rate (SGR) to fish fed the TBM60, TBM80, and TBM100 diets, but comparable to fish fed the Con and TBM40 diets. Feed efficiency, protein retention, biometric indices, biochemical composition (proximate composition and AA profiles), and hematological parameters of fish were not altered by dietary FM substitution with TBM. Dietary optimum levels of FM substitution with TBM were estimated to be 16.7%, 18.0%, and 11.6% based on the regression analysis. The economic profit index (EPI) of the Con, TBM20, and TBM40 diets were superior compared to that of all other diets. In conclusion, the TBM40 diet producing the highest EPI, but relatively low economic efficiency ratio, was the most recommendable to farmers in terms of economic return.

OA-22

## Evaluation of different levels of dietary protein and lipid on acute temperature stress responses in juvenile northern snakehead (*Channa argus*)

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Due to the importance of major nutrients such as protein and lipid for optimal growth and physiological performances of fishes, many studies have been conducted to determine its requirement for cultured fishes. However, little is known about interactive effects of dietary protein and lipid levels on temperature stress responses in cultured fishes. Northern snakehead is a commercially important fish species in Asia but has faced with continuously increasing water temperature associated with climate change. Thus, a 3 × 3 factorial experiment was designed to evaluate the relationship between interaction of dietary protein and lipid levels and physiological performance of juvenile northern snakehead responding to acute temperature stress. Four hundred five juveniles (initial body weight: 19.3 ± 0.03 g; mean ± SEM) were randomly distributed into each of 27 tanks (15 fish per tank; *N* = 3 tanks per treatment). Nine diets were prepared to contain three levels of crude protein (41, 44 and 47%) in combination with three levels of crude lipid (6, 9 and 12%). Following the 60-days of feeding trial, the juveniles from each of the nine treatments were abruptly exposed to higher water temperature at 35 °C for 2 h and were recovered at ambient water temperature for 2 h. Results showed that a significant interactive effect of dietary protein and lipid levels on weight gain (WG), feed efficiency (FE) and condition factor (CF), showing the improved values as the protein increased but the lipid level decreased (*P* < 0.05). There was a main effect of both protein and lipid levels on WG, FE and CF. Based on results of the three-way (3 protein levels × 3 lipid level × 2 stress condition) ANOVA test, there was neither the interactive effects between the dietary nutrient levels and stress condition nor the interactive effect between the protein and lipid levels on plasma metabolites. However, a significant main effect of temperature stress was detected in plasma glutamic oxaloacetic transaminase, glutamic pyruvate transaminase, total protein and triglyceride. There was a significant main effect of dietary protein levels on the relative gene expression of HSP70 in head kidney, whereas no change in HSP60 and HSP70 in other tissues, including gill, liver, and spleen was observed. In summary, the tested dietary protein and lipid levels resulted in significant alteration of the growth responses; however, those did not induce dramatic changes in plasma metabolites and the expression of the key stress markers (HSP60 and HSP70) in gill, liver, and spleen with the exception in the head kidney when exposed to the acute temperature stress.

OA-23

Can dietary supplementation of host-associated probiotics along with a prebiotic enhance temperature stress tolerance in juvenile olive flounder (*Paralichthys olivaceus*)?

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It is known that the gut microbiota-brain axis plays a role in feeding behavior, digestive/absorptive processes, metabolism, and immune responses. Little is known about effects of dietary supplementation of synbiotics in the regulation of host physiology in response to temperature stress. Therefore, the current study was conducted to evaluate effects of synbiotics, consisting of a single or mixture of host-associated probiotics isolated from olive flounder and fructo-oligosaccharides (FOS) as a prebiotic on lethal and acute temperature stress responses in juvenile olive flounder. Four hundred eighty-six juveniles (initial body weight:  $7.26 \pm 0.04$  g) were randomly distributed into 27 rectangular tanks (18 fish per tank;  $N=3$  tanks per treatment). Three HAPs, including *Bacillus sonorensis*, *Bacillus subtilis*, and *Bacillus velezensis* and one prebiotic, FOS were supplemented in a basal diet to prepare for nine experimental diets as follows: no addition of probiotic and prebiotic as a control diet; prebiotic only; three different synbiotics with single addition of each probiotics with FOS; four different synbiotics with mixed addition of two or three probiotics with FOS. The concentration of each probiotic and FOS was  $1 \times 10^7$  CFU/g and 5g/kg basal diet, respectively. Following the 8-week growth trial, the juveniles were subjected to temperature stress exposures: 1) lethal test: gradual increase in water temperature (0.5 °C increment every 30 m) until reaching 30.5 °C and 2) acute test: 2-h heat shock at 30 °C followed by 2-h recovery at 19.5 °C. The lethal exposure test result demonstrated that the relatively higher survival rate (16.4 %) of the juveniles fed the synbiotics diets (FOS+*B. sonorensis*+*B. velezensis*, FOS+*B. sonorensis*+*B. subtilis*+*B. velezensis*) than that (4.2 %) of those fed the other diets although no significant difference was detected among the diets. In the acute temperature stress test, there was no significant effect of dietary supplementation of the synbiotics on the plasma metabolites (GOT, GPT, glucose, total protein, total cholesterol, and triglyceride) as well as on the relative gene expression levels of heat shock proteins 60, 70, and 90, glucose 6-phosphatase, and activated protein kinase- $\beta$  in brain, gill, kidney, and liver tissues. These preliminary results can be used in future studies to elucidate interaction between microbiota and temperature stress responses in fishes.

OA-24

## Comparative study on growth characteristics of *Haematococcus pluvialis* using organic carbon sources

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*Haematococcus pluvialis* can be artificially converted to the aplanospore stage for astaxanthin accumulation. Since this is not a vegetative stage, cell growth is limited. Organic and inorganic carbon sources, strong light, and high salt stress are mainly used. In the overall mass culture process, it is not only important to quickly convert to the astaxanthin stage, but also increasing biomass is also an important factor. However, even though organic carbon sources increase growth rate, research on growth promotion is lacking because the focus is only on promoting astaxanthin accumulation. Therefore, this study used organic carbon sources such as ribose, glycerol, and sodium gluconate to verify the growth rate in the green vegetative stage by exposing them to the same concentration. The culture conditions were under JM medium (Jaworski's medium), LD for 12 hours each, 20°C, and light intensity was 40  $\mu\text{mol}/\text{m}^2/\text{s}$ . The concentration of each carbon source was to 1.33 g/L and then the growth rate was compared. As a result, the sodium acetate as control was converted to the aplanospore stage first, but the final cell density was the lowest at  $3.556 \times 10^4 \pm 0.206 \times 10^4$  cells  $\text{mL}^{-1}$ . The glycerol had the highest growth rate at  $17.711 \times 10^4 \pm 8.261 \times 10^4$  cells  $\text{mL}^{-1}$ , but conversion to aplanospore took the longest. The sodium gluconate and ribose were  $9.6 \times 10^4 \pm 0.662 \times 10^4$  cells  $\text{mL}^{-1}$  and  $13.689 \times 10^4 \pm 1.852 \times 10^4$  cells  $\text{mL}^{-1}$ , respectively. During the same period, ribose continued to increase in cell density. Therefore, sodium acetate and sodium gluconate may have the potential to accumulate astaxanthin, and glycerol and ribose may promote cell growth.



OA-25

Screening salinity tolerance in green macroalga *Haematococcus pluvialis*Yunji An<sup>1</sup>, Huijeong Byeon<sup>1</sup>, Taesoo Kim<sup>1</sup>, Min Suk Kim<sup>3</sup>,Sang Mok Jung<sup>2</sup> and Hyun Woung Shin<sup>1\*</sup><sup>1</sup>Department of Biology, Soonchunhyang University, Asan 31538, Republic of Korea<sup>2</sup>Research Institute for Basic Science, Soonchunhyang University, Asan 31538, Republic of Korea<sup>3</sup>AlgaeBio Co., Asan 31459, Republic of Korea

*Haematococcus pluvialis* is a microalgae that lives in freshwater and accumulates a high amount of carotenoid, especially astaxanthin. The biggest hurdle for mass production is biological contamination. During the growth stage of them, various undesired organisms such as *Paraphysoderma sedebokerense*, rotifer and amoeba, etc. occur, resulting in biomass decreases. Most of these freshwater-based biological contaminants die or are unable to grow under high salinity conditions. In fact, *H. pluvialis* converts polysaccharide into astaxanthin, by a specific enzyme under a saline environment. These methods are very useful industrially. Although *H. pluvialis* stops growing under high salinity conditions, there is a lack of research on controlling biological contamination using the salt tolerance during the growth stage. This study screened the *H. pluvialis* growth rate at various salinity concentrations, and defined salinity tolerance. The initial inoculated cell number was  $2 \times 10^4 \pm 0.2 \times 10^4$  cells mL<sup>-1</sup>. The culture conditions were under JM medium (Jaworski's medium), LD for 12 hours each, 20°C and light intensity was 40  $\mu$  mol/m<sup>2</sup>/s. The salinity was adjusted using natural sea salt. As a result, *H. pluvialis* in the growth stage did not grow the salinity at above 1 psu. Between the salinity concentrations of 0.5 and 1 psu, the growth rate was 50% lower than that of the control group, and below 0.5 psu, there was no significance. Based on this study, additional research is needed on the correlation between salt tolerance of their growth stages, and it can be applied to biological control during mass culture.

OA-26

Dietary inclusion of gamma amino butyric acid and sodium butyrate in diets containing graded level of duck byproduct meal for juvenile red seabream  
*Pagrus major*

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The experiment was conducted to evaluate the effects of gamma amino butyric acid (GABA) and sodium butyrate (SB) when fish meal (FM) was replaced with duck byproduct meal (DM) in diets for red seabream (*Pagrus major*). A control diet was designed to contain 60% FM (FM60). Two other diets were formulated by replacing 20% and 40% FM with 40% or 20% DM (DM20 and DM40). Six more diets were formulated by adding 0.02% GABA or 0.2% SB to each FM60, DM20 and DM40 diets (FM60+G, FM60+S, DM20+G, DM20+S, DM40+G and DM40+S). Triplicate groups of fish ( $5.52 \pm 0.02$ ) were fed for eight weeks. Growth of fish fed FM60+G, FM60+S diets was significantly higher than other groups except for DM20+S. Feed efficiency was higher in DM20+S group compared to DM20+G and diets containing 40% DM. Serum lysozyme activity of FM60+G and FM60+S groups was higher than that of fish fed DM20, DM40 and DM40+S groups. Therefore, GABA and SB enhanced growth, feed utilization and innate immunity of red seabream when FM in diets was replaced with DM. It also seems like both fish and diet performances can be effectively improved by SB when diets contain high DM levels.

OA-27

## Effect of Wide Range pH on Early Larval Development of Pacific abalone (*Haliotis discus hannai*)

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The Pacific abalone (*Haliotis discus hannai*), a marine herbivore gastropod, is the main species contributing marginal revenue for South Korean economies. Despite of the continuous increase in the productivity of domestic abalone aquaculture, the rising concentration of carbon dioxide in the atmosphere is causing pH changes. The changes in pH can negatively affect the normal development of larvae. Several studies have been conducted on the effects of small-range pH changes on Pacific abalone's larval development, but research on the effects of wide-range pH changes on the early development of abalone has not been conducted. This research aims to examine the effect of wide-range pH changes on the early development of the Pacific abalone. Abalone eggs and larvae were exposed to six pH levels (5, 6, 7, 8, 9, and 10). The hatching rate, malformation rate, larval length, DNA damage, oxygen consumption rate, and expression levels of two biomineralization genes (calmodulin and carbonic anhydrase) were analyzed. The hatching rate at acidified or alkaline conditions was significantly lower than that at control conditions (pH 8). Similarly, larval lengths at both 20 and 30 hpf were smaller under low or high pH conditions than those in normal pH conditions. Larval development was also delayed and an increase in the proportion of malformed larvae under low and high pH conditions. At pH 6, 7, 9, and 10, veliger larvae can still form normal shells, but all larvae at pH 5 were unable to form shells. The percentage of DNA damage in larvae under acidified or alkaline conditions was also significantly higher than in controls. The oxygen consumption rate of larvae decreased under low or high pH. Calmodulin expression at 20 hpf was not significantly different between pHs but was significantly different at 30 hpf larvae. Carbonic anhydrase gene expression at 20 hpf and 30 hpf under low or high pH was significantly different from the control.

## The Effect of Physiological and Growth Performance of Mirror Carp *Cyprinus carpio nudus* under starvation stress

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In this study, the effect of starvation on the growth performance, physiological change, and enzyme activity of Mirror Carp (27.21±5.08 g, 12.17±0.74 cm) was investigated. Fish in different experimental groups were deprived of feed for 0(S0), 10(S10), 20(S20), and 30(S30) days, respectively. At the end of each group, growth parameters and blood samples were collected for starvation-inducing responses.

The growth rate in length (GRL), the growth rate in weight (GRW), and the specific growth rate (SGR) were examined as indicators of growth performance. Results revealed a significant decline in these parameters during the starvation period. Specifically, after thirty days of starvation, GRL decreased to -2.61±0.02%, GRW decreased to -20.57±1.30%, and SGR decreased to -0.71±0.02% in mirror carp. Furthermore, the condition factor (CF) index exhibited a significant decrease ( $P<0.05$ ) after 10, 20, and 30 days of starvation in Mirror Carp. Additionally, the hepatosomatic index (HSI) showed a significant reduction after 20 days of starvation compared to the control group.

The results indicate that organic plasma components, including glucose, lactic acid, AST, ALT, and TP levels, were significantly lower after 30 days of starvation compared to both the control and the 10-day starved group. However, compared with a control group with S30, no significant change was observed in cortisol levels. The inorganic plasma component Na<sup>+</sup> was decreased in the S30 group than in the control group ( $P<0.05$ ). On the other hand, K<sup>+</sup> levels were significantly increased. In the hematological parameter, the RBC and HCT did not present significant differences in all groups, whereas HGB decreased under starvation stress. The activity of SOD and CAT increased at 10 days from the control group. However, under starvation stress from S10 groups, SOD significantly increased, but CAT was significantly suppressed.

In this study, it demonstrates that starvation stress has adverse effects on the growth performance and physiological changes of mirror carp. These findings may provide fundamental data for understanding starvation-induced responses in fish.

OA-29

## Adsorption technology using a modified zeolite with alginate-hydrogel coating method for ammonium adsorption in the aquaculture effluent

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Management of ammonium concentration needs to be performed essentially and controlled less than the hazardous levels in fish farms. There are diverse technologies of ammonium removal which have been developed such as, coagulant, filtration, chlorination, ion exchange membrane bioreactor, and bio-floc treatment. However, these conventional methods in wastewater treatment were not enough to be considered as advanced methods for ammonium removal in terms of cost and operation method. Thus, more effective method for ammonium removal was found as adsorption method. A series of materials have been applied in the adsorption process using traditional adsorption materials, for instance, activated carbon, hydrogel, and zeolites. The wide application of zeolites in wastewater treatment has been developed with adsorption technology for the ammonium ions removal. Zeolites have diverse porous crystalline structures which composed of aluminate ( $\text{AlO}_4^-$ ) and silicate ( $\text{SiO}_4^{4-}$ ), tetrahedral aluminosilicates connecting with O atoms, these characters play a key role in cation exchange equilibrium and adsorption techniques due to the porous structures.

In this research, enhanced physicochemical characters and additional metals ( $\text{Na}^+$ ,  $\text{Ca}^{2+}$ , and  $\text{Mg}^{2+}$ ) that were considered to modify a zeolite for the improvement of ammonium adsorption. That provides physicochemical modifications and structural advantages for synthesizing a novel hybrid-zeolite structure which has high surface area and smaller pore diameter. The novel structural design with the addition of the certain alkaline metals was practicable due to the inspired of Faujasite zeolite alkaline metal molecular ratio ( $\text{Ca}^{2+} : \text{Na}^+ : \text{Mg}^{2+} = 1 : 2 : 1$ ).

For actual application of ammonium removal, the synthesized zeolite and the natural zeolite were compared in the actual aquaculture effluent from a local fish farm. After the wastewater treatment by the alginate-hydrogel-metal-zeolite (Al-H-M-Z) and zeolite (Z), the residual ammonium concentrations were found as  $1.97 \text{ mg L}^{-1}$  and  $2.02 \text{ mg L}^{-1}$ , respectively. In the ammonium removal percentages, 7.94% and 5.61% of the Al-H-M-Z and Z were measured resulting in 1.41-fold higher adsorption efficiency after the coating process. These results demonstrated that the modified zeolite could be more effective than the bare zeolite for the aquaculture wastewater even in the seawater.

## Developing a modified flow-through aquaculture system for culturing olive flounder (*Paralichthys olivaceus*)

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Olive flounder (*Paralichthys olivaceus*) is a major aquaculture fish species in Korea and is primarily cultivated in land based flow-through aquaculture systems. However, these systems undergo continuous water temperature changes due to environmental variations, and abrupt changes in water temperature can lead to physiological stress. In addition, flow-through aquaculture systems place great demands on water resources because they require large volumes of high quality source water to grow fish and they also discharge their wastewaters into lead the aquatic environment. Especially, discharge of untreated aquaculture wastewaters can lead to physicochemical and biological degradation of receiving waters. Despite advances in feed quality and feeding practices, the treatment of wastewaters from flow-through aquaculture facilities is a necessary practice.

In this study, a novel and modified flow-through aquaculture system was developed to reduce the excessive water exchange rate and solve uncontrollable water quality problems in the traditional flow-through aquaculture systems. The new flow-through aquaculture system was designed to become less the water exchange rate from 24 to 9 cycles per day by equipping with CO<sub>2</sub> degassing towers with biological media. This system is also designed to reuse approximately 70% of the wastewaters and discharge the remaining 30% into the sea. By discharging wastewaters, the heat source can be recovered and the water temperature in the aquaculture tank can be increased. The system consists of water treatment devices, CO<sub>2</sub> degassing towers, silver nanoparticles (Ag-NPs) contained filter, heat exchange device, cooling and heating device, and medium-pressure UV lamp.

The flow-through aquaculture system developed in this study was established using mass balance relations. The aquaculture system can be operated with only 60% of the flow rates used in traditional flow-through systems. The system also saves energy and keeps total ammonia nitrogen (TAN) and CO<sub>2</sub> concentrations in each aquaculture tank below 2 mg/L and 7 mg/L, respectively. It is expected that this system will reduce the mortality rate of farmed fish by improving the efficiency of water treatment devices. The next step would be to evaluate the maximum load of TAN and CO<sub>2</sub> generated when cultivating olive flounder (*Paralichthys olivaceus*) in the traditional and a modified flow-through aquaculture system and perform experimental and numerical analysis to investigate whether a system like this could be incorporated effectively in the aquaculture industry.

OA-31

## Incorporated jack mackerel meal in diets replacing fish meal with various animal protein sources on the growth, feed availability, and biochemical composition of red sea bream (*Pagrus major*) and economic analysis

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Incorporation of 24% jack mackerel meal (JMM) as feed stimulants at the expense of fish meal (FM) in diet achieved superior growth performance and feed utilization of red sea bream to fish fed a 60% FM-based diet. This study aims to evaluate substitution effect of FM with various animal protein sources in diets with JMM inclusion on growth performance of red sea bream (*P. major*). A two-way {3 substitution sources [tuna by-product meal (TBM), chicken by-product meal (CBM), and meat meal (MM)]  $\times$  2 FM substitution levels (25% and 50%)} ANOVA experimental design was applied. The control (Con) diet contained 60% FM. In the Con diet, 25% and 50% of FM were replaced with TBM, CBM, and MM, respectively, and then 24% JMM was supplemented at the expense of FM, named as the TBM25, TBM50, CBM25, CBM50, MM25, and MM50 diets. Four hundred and twenty fish averaging 11.8 g were randomly distributed into 21, 50-L tanks (20 fish/tank) with triplicate. Fish were hand-fed to apparent satiation twice daily for 8 weeks. At the end of 8-week feeding trial, the TBM-substituted diets achieved significantly greater weight gain, SGR, and feed consumption of fish than the CBM- and MM-substituted diets. In addition, dietary substitution of 25% of FM achieved significantly greater weight gain, SGR, and feed consumption than dietary substitution of 50% FM. Weight gain and SGR of fish fed the TBM25, TBM50, CBM25, MM25, and MM50 diets were comparable to fish fed the Con diet, but superior to fish fed the CBM50 diet. Fish fed the TBM-substituted diets achieved superior feed efficiency to fish fed the CBM-substituted diets. Protein retention, hematological parameters, and biochemical composition of fish were not significantly influenced by dietary treatments. The TBM-substituted diets achieved superior economic profit index (EPI) to fish fed the CBM- and MM-substituted diets. The TBM50 diet exhibited the greatest EPI. Conclusively, TBM and MM, and CBM could replace 50%, and 25% FM in red sea bream diets with 24% JMM inclusion, respectively, without compromising growth, feed utilization, hematological parameters, biochemical composition. The TBM50 diet was the most desirable treatment in terms of the greatest growth performance of red sea bream and economic return to farmers.

OA-32

## Inclusion effect of jack mackerel meal as a feed enhancer in rockfish (*Sebastes schlegeli*) diets replacing 20% fish meal with chicken by-product meal on growth and feed availability

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An 8-week feeding trial was conducted to assess the effect of feed enhancer, jack mackerel meal (JMM), in diets replacing 20% fish meal (FM) with chicken by-product meal (CBM) on the growth and feed availability of rockfish (*S. schlegeli*). Six experimental diets were prepared to be isonitrogenous (50.0%) and isolipidic (15.0%). Specifically, 55% FM was included in the control (Con) diet. In the Con diet, 20% FM was replaced by CBM, and then included with the graded (0%, 20%, 40%, 60%, and 80%) levels of JMM as a feed enhancer at the expense of FM, named as the C20J0, C20J20, C20J40, C20J60, and C20J80 diets, respectively. A total of 540 juvenile rockfish (initial weight of 11.2 g) was randomly distributed into 18, 50-L flow-through tanks (30 rockfish/tank). All experimental diets were fed to triplicate groups of rockfish twice a day for 8 weeks. At the end of the 8-week feeding trial, the weight gain, specific growth rate (SGR), and feed consumption of rockfish fed the C20J60 and C20J80 diets were ( $P < 0.003$ ,  $P < 0.003$ , and  $P < 0.03$ , respectively) superior to rockfish fed the Con and C20J0 diets, but not significantly ( $P > 0.05$ ) different from those of rockfish fed the C20J20 and C20J40 diets. In terms of the orthogonal polynomial contrast, the weight gain, SGR, and feed consumption of rockfish exhibited remarkable linear ( $P = 0.001$  for all) relationships with dietary inclusion levels of JMM. The best-fitting models between dietary inclusion levels of JMM and weight gain ( $Y = 0.0793 + 18.2467X$ ,  $P < 0.001$ , adjusted  $R^2=0.6435$ ), SGR ( $Y = 0.0043 + 1.7256X$ ,  $P < 0.001$ , adjusted  $R^2=0.6391$ ), and feed consumption ( $Y = 0.0793 + 21.2533X$ ,  $P < 0.001$ , adjusted  $R^2=0.6551$ ) were observed. However, feed efficiency ratio, protein efficiency ratio, and protein retention, biological indices, proximate composition, amino acid profiles, and hematological parameters of rockfish were not significantly ( $P > 0.05$ ) influenced by dietary treatments. The economic profit index (EPI) of the C20J60 and C20J80 diets were significantly ( $P < 0.02$ ) higher than that of the C20J0 diet, but not significantly ( $P > 0.05$ ) different from that of the Con, C20J20, and C20J40 diets. In conclusion, inclusion of 60% JMM in the diet replacing 20% FM with CBM is the most recommendable feeding strategy in considering the growth performance and feed consumption of rockfish and the economic return to farmers.



OA-33

Inclusion impact of jack mackerel meal in the olive flounder (*Paralichthys olivaceus*) feeds substituting 50% fish meal with tuna by-product meal on growth, feed availability, and economic efficiency

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The goal of this study was to determine inclusion effect of graded levels of jack mackerel meal (JMM) as feed attractant in the olive flounder (*P. olivaceus*) feeds substituting 50% FM with tuna by-product meal (TBM) on the growth, feed availability, biochemical composition, plasma measurements, and economic efficiency. Six isonitrogenous (55.5%) and isolipidic (10.0%) diets were developed. Sixty percent FM was included in the control (Con) diet. Fifty percent of FM in the Con diet was replaced with TBM, and then 10, 20, 30, 40, and 50% JMM were included at the expense of FM, referred to as the TJ10, TJ20, TJ30, TJ40, and TJ50 diets, respectively. Three hundred and sixty juvenile fish averaging 18.0 g were randomly distributed into 18, 50 L flow-through tanks (20 fish/tank). All diets were randomly assigned to triplicate group of fish. Fish were hand-fed to apparent satiation twice a day for 8 weeks. At the end of the 8-week feeding trial, weight gain, specific growth rate, and feed consumption of fish fed the TJ30, TJ40, and TJ50 diets were significantly ( $P < 0.001$ ,  $P < 0.001$ , and  $P < 0.002$ , respectively) greater than those of fish fed the Con and TJ10 diets, but not significantly ( $P > 0.05$ ) different from those of fish fed the TJ20 diet. Feed utilization, proximate composition, amino acid (AA) profiles, and haematological chemistry of fish were not significantly ( $P > 0.05$ ) altered by dietary treatments. However, the TJ30 diet was the most recommendable to farmers in considering economic conversion ratio (ECR) and economic profit index (EPI). In conclusion, the TBM20 diet appeared to be the most recommendable based on growth performance and feed consumption, but the TBM30 diet led to the highest return to farmers in terms of ECR and EPI.

## Replacement effect of fish meal with corn protein concentrate in diets on growth performance, feed utilization, biochemical composition, and hematological parameters of rockfish (*Sebastes schlegeli*)

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Searching for an alternative source for fish meal (FM) in aquafeeds always receives scientist's interest. This study investigates to evaluate dietary substitution effect of corn protein concentrate (CPC) for fish meal (FM) on growth, feed utilization, biochemical composition, and hematology of rockfish (*Sebastes schlegeli*). A total of 540 juvenile (initial weight of 2.3 g) fish were randomly distributed into 18, 50 L flow-through tanks (30 fish/tank). Six experimental diets were formulated to be isonitrogenous (51.0%) and isolipidic (12.5%). The control (Con) diet contained 55% FM. In the Con diet, 10%, 20%, 30%, 40%, and 50% of FM were substituted with CPC, referred to as the CPC10, CPC20, CPC30, CPC40, and CPC50 diets, respectively. All experimental diets were assigned to triplicate groups of fish and hand-fed to apparent satiation twice daily for 8 weeks. Weight gain of fish fed the Con and CPC10 diets were superior ( $P < 0.0001$ ) to fish fed the CPC20, CPC30, CPC40, and CPC50 diets. Specific growth rate (SGR) of fish fed the Con and CPC10 diets were significantly ( $P < 0.0001$ ) higher than that of fish fed the CPC30, CPC40, and CPC50 diets, but not significantly ( $P > 0.05$ ) different from that of fish fed the CPC20 diet. Feed consumption of fish fed the Con diet was significantly ( $P < 0.0001$ ) higher than that of fish fed all other diets, except for the CPC10 diet. Feed efficiency ratio of fish fed the Con, CPC10, and CPC20 diets were significantly ( $P < 0.0001$ ) higher than that of fish fed the CPC30, CPC40, and CPC50 diets. Protein efficiency ratio of fish fed the Con diet was significantly ( $P < 0.001$ ) higher than that of fish fed the CPC40 and CPC50 diet, but not significantly different from that of fish fed the CPC10, CPC20, and CPC30 diets. However, biological indices except for hepatosomatic index, biochemical composition, and hematological parameters of rockfish were not significantly ( $P > 0.05$ ) influenced by dietary FM replacement with CPC. The economic profit index (EPI) of the Con and CPC10 diets were significantly ( $P < 0.0001$ ) higher than that of all other diets. In conclusion, FM up to 10% and 20% could be replaceable with CPC in the diets of rockfish without retarding weight gain and feed consumption, and SGR, respectively. However, substituting 10% FM with CPC appeared to be the most recommendable to farmers in considering weight gain of rockfish and economic analysis.

OR-1

## Estimation density of euphausiids and copepoda in the East-South Sea using by Multi-Frequency

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After identifying the acoustic backscattering strength on the euphausiid and copepod analysis frequencies, the frequency difference, as  $\Delta\text{MVBS}$ , from multi-frequencies can be obtained as a positive value by subtracting the frequency with the largest and smallest TS of the target species. The results of the euphausiid dB differences were 11.0-17.8, 3.3-8.8, -0.9 to 2.9, 11.9-14.9, 4.2-5.9, and 7.8-9.0 dB at 200-38, 200-70, 200-120, 120-38, 120-70 and 70-38 kHz, respectively. For copepods, they were 25.3-28.7, 15.1-18.1, 6.7-8.8, 18.7-19.9, 8.4-9.3, and 10.2-10.6 dB at 200-38, 200-70, 200-120, 120-38, 120-70 and 70-38 kHz, respectively. The acoustic scattering character of euphausiids and copepods using the DWBA model showed that the TS of euphausiids increased as body length and frequency increased. At 200 kHz, the TS decreased in correspondence of approximately a body length of 20 mm before increasing again. This was similar to 70 kHz but lower than 120 kHz. Moreover, the difference in the TS values for each frequency decreased as body length increased. The TS of copepods also increased as body length and frequency increased. At 200 kHz their body length decreased at approximately 15 mm before increasing again, so the TS value was lower than that at 70 or 120 kHz. Currently, South Korea is implementing a fishing quota system centering on TAC fish species. Therefore, as in this study, a distribution survey of food organisms can form the basis for fishery resource management. In addition, there is a lack of research on species identification using more than three frequencies, so this paper can be used as a basis for research on species identification using more than three frequencies

OR-2

## Target strength measurements and distribution characteristics of Herring(*Clupea pallasii*) using multi-frequency

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The Pacific herring (*Clupea pallasii*) is a fish in the herring family (Clupeidae) of the order (Clupeiformes), widely distributed in the southeastern coastal waters of Korea, Japan, the Bering Sea, Alaska, the North Pacific, and the Western Pacific ocean. Fishery production amount of herring was low at around 5,000 tons in the 1970s, but increased to 20,000 tons in the 2000s before decreasing to around 1,000 tons in 2002. However, there have been significant fluctuations with a peak at around 45,000 tons in 2008, a decline to around 25,000 tons in 2011, its catch amount tends to gradually decrease. As fluctuations in herring fishery production are unstable, so the it needs to manage and assess the fisheries resource and biomass estimation in order to ensure its continued utilization. In this study, we measured the Target strength of herring using multi-frequency method and characterized its spatio-temporal distribution. While volume backscattering strength (SV) of target organisms can be easily obtained in the field with acoustic surveys, it requires clear target strength (TS) data in order to convert to its biomass estimation. The Target strength of herring was measured using the suspension method and the Kirchhoff-ray mode (KRM) model. The hydro-acoustic survey data were collected in February and May 2022 during Expedition 23 in the East and South Seas. The acoustic data analysis method set the size of the fish group [2 m(L) × 1 m(H)] to detect the smallest fish school, and the dB-difference was set to separate only the echo signal of herring. It shows that  $TS=20\log_{10}(FL)-69.14$  at frequency 38 kHz,  $TS=20\log_{10}(FL)-66.79$  at frequency 70 kHz, and  $TS=20\log_{10}(FL)-69.45$  at frequency 120 kHz with according to changing its swimming angle. The TS of the herring measured using the KRM model was found to be  $TS=20\log_{10}(FL)-63.52$  at frequency 38 kHz,  $TS=20\log_{10}(FL)-64.46$  at frequency 70 kHz, and  $TS=20\log_{10}(FL)-64.72$  at frequency 120 kHz. In addition, the depth distribution of herring schools was detected in the range between 40 m and 150 m depth. The horizontal distribution of herring showed that relatively more fish school were detected in the coastal waters of Ulsan and the waters near Busan, and more fish school were detected in the eastern waters than in the southern waters.

OR-3

### A framework for short-term forecasting *Todarodes pacificus* distribution

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*Todarodes pacificus* is widely distributed in the East Sea, the East China Sea and the Northwest Pacific Ocean, and is a commercially important species in Korea. However, since the 2000s, the fishing competitiveness has been declining significantly due to continuous decreases in production and increases in costs such as labor cost and oil price. In order to improve the fishing competitiveness, it is essential to forecast fishing conditions such as fishing ground and production. In this study, therefore, we developed a framework for short-term forecasting *T. pacificus* distribution using a maximum entropy model (Maxent) and a generalized additive model (GAM). The Maxent uses techniques developed from machine learning, allowing empirical data to be used to predict the probability of finding something under certain conditions distributed in space. The GAM is a statistical modeling technique that extends the generalized linear model concept by allowing for more flexible and non-linear relationships between the predictor and response variables. We will discuss the applicability of our model for short-term forecasting fishing conditions of *T. pacificus*.

OR-4

## Mitochondrial genomics illuminates the discrete population of the Common Octopus, *Octopus vulgaris*(Cephalopoda:Octopodidae) in Western Pacific Ocean

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The common octopus (*Octopus vulgaris*), belonging to the order Octopoda and family Octopodidae, is globally distributed and plays a vital role in regional fisheries. Traditionally found in Jeju Island and the south sea, its habitat has expanded to the east sea due to marine environmental changes. Despite this expansion, catch rates are declining and the significant lack of genetic evaluations complicates the establishment of effective conservation strategies. Despite this range expansion, there has been a decline in catch rates, and particularly, the shortage of genetic resource assessments impedes the formulation of effective conservation strategies.

To address this, our research aimed to secure and contrast the full mitochondrial genomes of both imported and domestic octopuses, considering geographical changes. Using next-generation sequencing techniques, we obtained the full mitochondrial genomes and targeted two mitochondrial regions(Cytochrome oxidase subunit 1 and Cytochrome B) for population analysis. In the dataset of the complete mitochondrial genomes secured in this study, the genetic distance for *Octopus vulgaris* was determined to be 1.1%. Notably, the genetic divergence between octopuses from Korea and Japan was exceptionally low, ranging from 0 to 0.2%. In contrast, the genetic distance between octopuses from Korea/Japan and those from Mediterranean was found to be between 2.7% to 2.8%. Phylogenetic analysis of 89 specimens spanning four regions in Korea and Greece distinctly identifying population groups in the North Atlantic/Mediterranean, West Pacific, and Gulf of Mexico/East Pacific. Our findings underscore the complex genetic insight of the common octopus across varied regions. Understanding these genetic characteristics forms the foundation for devising sustainable management and conservation strategies for this essential marine species.

OR-5

## Dynamics of fish and phytoplankton communities in Ilgwang's coastal waters: Insights from environmental DNA metabarcoding

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The coastal waters of Ilgwang in Gijang-gun, influenced by the Tsushima Warm Current, nuclear plant effluents, seasonal inland water influx, and anthropogenic influences, offer a unique setting for studying the environmental responses of marine life. This study, spanning June 2020 to November 2022, utilized environmental DNA metabarcoding to analyze fish and phytoplankton communities. Fish analysis revealed 490 Amplicon Sequence Variants (ASVs) and 184 species, categorized into autumn 2021, autumn 2022, and other groups. *Engraulis japonicus* predominated in most seasons, with notable roles for *Gadus macrocephalus*, *Chelidonichthys spinosus*, and *Scomberomorus niphonius*, especially in 2022 autumn. *Hirundichthys oxycephalus* and *Platichthys stellatus* showed significant temperature correlations. Phytoplankton analysis yielded 702 ASVs representing 18 phyla and 73 species, grouped into winter-spring, spring-summer, and summer-autumn transitions, highlighting *Micromonas bravo* - *Eunotia* sp. - *Synechococcus* sp. Spearman correlation tests identified temperature-sensitive ASVs within *Synechococcus* sp., showcasing seasonal fluctuations. The station-specific community analysis indicated differences in phytoplankton communities between upper and lower stations, suggesting a potential influence from nuclear effluents. This study provides concise insights into dynamic coastal ecosystem responses, crucial for understanding marine biodiversity in changing environments.

OR-6

## Modified plumb staff beam trawl for the Korean coastal habitats

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A modified small (5.1m footrope) plumb staff beam trawl was designed by Aookire and Rose (2005) to sample demersal fauna in uneven, complex habitats in Alaska. The plumb staff beam trawl system developed by Gunderson and Ellis (1986) is highly effective for stock assessment sampling of demersal fauna, especially Dungeness crab and flatfishes that burrow into the substrate. The modified net was introduced for coastal fisheries resources surveys in Korea. Net performance test was followed by field collections at one station in which 27 species of fish and invertebrate were captured. The modified beam trawl appears to be an effective tool for sampling demersal fisheries resources in a variety of Korean coastal habitats including those with emergent biotic structure.



OR-7

Food item of the anchovy *Engraulis japonicus* in EEZ, KoreaHyeon Ji Kim<sup>1\*</sup>, Jeong Hoon Lee<sup>1</sup>, Hawsun Sohn<sup>1</sup>, Gun Wook Baeck<sup>2</sup> and Seung Hyun Son<sup>1</sup><sup>1</sup>Fisheries Resources Research Center, National Institute of Fisheries<sup>2</sup>Department of Marine Biology and Aquaculture Science, College of Marine Science, Gyeongsang National University

The anchovy(*Engraulis japonicus*) is classified Clupeiformes(Herrings), Engraulidae(Anchovies). They are a wide spread species in the world, such as coasts of Pacific included Korea, Japan and China. The anchovy appears as a food organism for various species, from pelagic to ground species such as mackerel and yellow goosfish, which are major commercial species. The anchovy is important role in connecting the low and high niche food web. Previous research on anchovies involved fish collected from nearby coasts, but we've research at all area of Korea. The anchovy used in this study were investigated using individuals collected with bottom trawl in vessel of Tamgu 21, 22, 23 from 2017 to 2022, and were collected from all EEZ areas in Korea. The anchovy mainly consumed Euphausiids and copepods, and other Amphipods, Macrura and Chaetognaths. The trend of the anchovy of main food items by year and area was identified, and as a result, it was confirmed that the types and ratios of food organism by area and by year were different. This trend is identified, and furthermore, the relationship with zooplankton, a food organism, is identified, and ecological information of anchovies that connectors of higher ecosystems in low ecosystems will provided.

OR-8

## Feeding ecology of Antarctic toothfish, *Dissostichus mawsoni* in area 58.4, Southern Ocean

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Morphological analysis of the stomach contents of 549 *Dissostichus mawsoni* specimens collected at depths of 682-1,730 m in area 58.4 during Antarctic summer fishing seasons from 2014 to 2015 was used to assess dietary composition according to depth and size class. Larger individuals tend to be distributed in deeper water. *D. mawsoni* consumed mainly a piscivore, such as Macrouridae. The dietary composition of *D. mawsoni* did show significant differences by depth and size class. As the body size of *D. mawsoni* increased, the mean weight of prey per stomach (*mW/ST*) tended to increase.

OR-9

## Stomach Contents Analysis of Red Seabream, *Pagrus major* (Sparidae) in the South Sea of Korea using DNA metabarcoding

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The red seabream, *Pagrus major*, belonging to the family Sparidae, is widely distributed in coastal waters ranging from the South China Sea to northern Japan. Generally, they inhabit rocky reefs on the continental shelf at a depth of 30 m to 150 m and sandy bottoms at a depth of 30 m to 70 m during the spawning season. Due to its status as a generalist predator with a broad prey spectrum, especially favoring abundant and easily accessible resources, analyzing the diet components of *P. major* can provide valuable ecological insights into its habitat. Previous studies have investigated the feeding habits of *P. major* in the Korea Strait and the coastal waters off Busan using visual identification. However, there are potential limitations of morphological analysis in stomach content studies. DNA metabarcoding enables species identification of rare or fragmented prey items at a low taxonomic level with high sensitivity and reduced dependence on taxonomic expertise. Furthermore, it allows the identification of a diverse range of prey taxa by simultaneously generating large quantities of DNA sequences at a relatively low cost and effort, which is especially advantageous for analyzing large sample sizes. A total of 598 individuals of *P. major* were collected from the South Sea of Korea between 2021 to 2023. To identify the prey items of *P. major*, DNA metabarcoding analysis was conducted on stomach contents using 18S rRNA universal primer set. After processing, 12,360,594 merged reads of eukaryotic taxa were obtained and further clustered at 98 % cut-off sequence identity. Finally, 464 Amplicon Sequence Variants (ASVs) were generated, which were assigned to 139 orders. The twelve most dominant orders included Actiniaria, Amphipoda, Decapoda, Dendrochirotida, Eunicida, Euphausiacea, Octopoda, Perciformes, Phlebobranchia, Phyllodocida, Spirularia, Stolidobranchia. Based on the similarity of prey items, sample groups with a similarity of more than 60 % were identified and divided into four groups. As a result of the stomach contents analysis using DNA metabarcoding, it was determined that red seabream are generalized feeders, primarily consuming a diverse array of benthic organisms within their habitat.

OR-10

### Feeding habits of anchovy, *Engraulis japonicus* in the coastal waters of Tongyeong, Korea

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The feeding habits of anchovy, *Engraulis japonicus* were studied using 1,087 specimens collected by set net fisheries in the coastal waters of Tongyeong, Korea. The size of the specimens ranged from 1.9 to 14.7 cm in fork length. *E. japonicus* was fed mainly on copepods, which constituted 50.4% of *IRI*, followed by euphausiids, which constituted 47.3% of *IRI*. Graphical analysis of the diet composition showed that *E. japonicus* was specialist predator. The result of analysis in ontogenetic changes significantly exhibited among size classes (<8.0 cm, 8.0-10.0 cm, 10.0-12.0 cm,  $\geq 12.0$  cm). The proportion of euphausiids increased, as body size of *E. japonicus* increased whereas the consumption of copepods decreased. As the body size of *E. japonicus* increased, the mean number of prey per stomach (*mN/ST*) and the mean weight of prey per stomach (*mW/ST*) was significantly different among size classes (one-way ANOVA,  $P < 0.05$ ). In the Spring, Autumn and Winter, the diet was dominated by copepods. In the Summer, the diet was dominated by euphausiids. As the seasonal change of *E. japonicus* diet, the mean number of prey per stomach (*mN/ST*) and the mean weight of prey per stomach (*mW/ST*) was significantly different among seasons (one-way ANOVA,  $P < 0.05$ ). Seasonal and size-related shifts in dietary composition were investigated by PERMANOVA analysis, there are significant variations among size classes and seasons.

OR-11

## Role of the feeding environment during the spawning season of *Engraulis japonicus* in the southern coast of Korea

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The study conducted from April to November 2022 in the southern coast of Korea focused on the Pacific anchovy, *Engraulis japonicus*, a commercially significant small pelagic fish species in Korean waters. This research aimed to gain insights into the ecological dynamics of *E. japonicus* by analyzing its stomach contents and community structure of zooplankton during the spawning season. A total of 210 *E. japonicus* individuals were examined, with a fork length range of 8.7-14.4 cm. Gonadosomatic index (GSI) value show peaks from April to July. The dominant species were *Paracalanus* copepodite (29.7%), *Paracalanus orientalis* (13.3%), *Oikopleura diocia* (6.2%), *Adianosagitta crassa* (4.0%), *Ditrichocorycaeus affinis* (3.7%), and *Oithona similis* (2.8%). During the study period, phytoplankton constituted the most significant portion (56.9%) of the diet, with *Coscinodiscus* spp being the most substantial prey item. Copepods remained a secondary component of the diet, comprising 21.9 in %IRI. According to the %IRI, the most important were the copepods, *D. affinis*, *C. sinicus*, and *Oncaea venusta*. This study provides insights into the ecological interactions of anchovies in the surrounding feeding environment during the spawning season.

OR-12

## Policy implications for stock recovery based on stock assessment of trawl fisheries in Cameroon

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The fishing industry in Cameroon plays a pivotal role in the nation's economy, providing employment, income, and vital protein sources. This industry encompasses both artisanal and industrial sectors. Cameroon has a coastline of around 402 kilometers where industrial fishing extends from 3 nautical miles up to the boundary of the Exclusive Economic Zone (EEZ) shared with neighboring coastal states. Given that trawlers are the predominant fishing equipment employed in industrial fishing, the Cameroonian industrial fishing fleet has transformed over the past century, characterized by phases of growth, decline, and production stabilization. Until 11 years ago, the industry has encountered a series of challenges, including overexploitation, bycatch of non-target species, and illegal fishing practices. These issues have been exacerbated by an outdated fisheries law that no longer aligns with the sector's present realities, and the insufficient implementation of management measures, further exacerbating the situation. A previous bioeconomic assessment conducted in 2012 revealed alarming findings – fisheries were operating significantly beyond their economic capacity during the period from 1990 to 2010, signaling an unsustainable trajectory. Therefore, this study delves deep into the multifaceted challenges surrounding trawl fishing in Cameroon, focusing on the sustainability and viability of this sector from 1998 to 2022. As a result, this study shows that the Cameroon government's efforts to reduce fishing efforts in trawl fishing since 2011 have had a positive effect on fish stocks and catches from these fisheries. However, to maintain sustainable trawl fishing, a policy is needed to reduce the fishing effort to somewhat less than now, that is, within the FMSY level. Additionally, this study highlights the pressing need for updated regulations and enhanced management practices to address the challenges faced by Cameroon's fishing industry and ensure the responsible utilization and conservation of marine resources for generations to come.

OR-13

## Complete mitogenome of spottail spiny turbot, *Psettodes belcheri* (Pleuronectiformes: Psettodidae): Characterization and Phylogeny

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*Psettodes belcheri* (Bennett, 1831) is known as the primitive flatfish distributed in Eastern Atlantic, starting from Western Sahara and Mauritania to Angola. In this study, we provide the complete mitogenome of *P. belcheri* from Cameroon using the next-generation sequencing. The mitogenome was 16,747 bp long and encoded with 37 genes (13 PCGs, two rRNA genes, 22 tRNA genes, and a control region). The mitogenome of *P. belcheri* is AT-biased (54.15%), as exhibited in its congener, *Psettodes erumei* (53.07% and 53.61%). The majority of PCGs start with an ATG initiation codon, except Cytochrome c oxidase I (COI), which starts with a GTG codon and four PCGs and ends with the TAA termination codon and except seven PCGs with an incomplete termination codon and two PCGs (NAD1 and NAD6) terminated with AGG and TAG stop codons, respectively. In *P. belcheri* mitogenome, most tRNAs showed classical cloverleaf secondary structures, except tRNA-serine with a lack of DHU stem. Comparative analyses of the conserved blocks of two Psettodidae species control regions revealed that the CSB-II block was more extended (51 bp) than other blocks and contained highly variable sites. A comprehensive phylogenetic analysis using mitochondrial genomes (13 concatenated PCGs) categorized various Pleuronectiformes species, highlighting the basal position of the Psettodidae family and showed monophyletic clustering of *Psettodes* species. The divergence time (20.56 MYA) between *P. belcheri* and *P. erumei* was estimated, providing insights into their separation and colonization during the early Miocene. The TimeTree analysis also estimated the divergence of two suborders Psettodoidei and Pleuronectoidei during the late Paleocene to early Eocene (56.87 MYA).

OR-14

## Status of fisheries in Malawi

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In Malawi Fisheries sector is composed of capture fisheries, aquaculture, and aquarium trade sub-sectors. The capture fisheries comprise small-scale fishery, large-scale fishery, and subsistence fishery. The fisheries sector plays a crucial role in the country's economy (Contributes 4 to 7% of the national GDP), contributing to employment, food security, income generation, and biodiversity conservation. The focus of this country report is primarily on small-scale fisheries operating in various water bodies in Malawi. The report provides insights into fishing effort indicators, such as the number of fishers, fishing vessels, and fishing gears used in Malawi. Malawi fisheries are exploited by a total of 74,222 fishers, of which 13,823 are gear owners and 60,399 are crew members representing 18.62% and 81.38%, respectively. The trends show that there is an increase in the number of fishers and boats with engines, which is partly attributed to human population growth and increased demand for fish resources. In terms of annual fish production in Malawi, annual fish catches increased from 95,724 Mt in 2010 to 173,480 Mtin 2021. A substantial contribution comes from Lake Malawi, with artisanal fisheries being the primary driver. There is shift in catch composition toward economically less valued species like *Engraulicypris sardella* which contributes more than 60% of the total fish catch in Malawi. The shift is attributed to the overfishing of more valuable species. There has been an increase in Per capita fish consumption over the last 10 years, reaching 12.6kg/person/year in 2018, from 5.4kg/person/year in 2009, but the consumption is lower than the World Health Organization's recommended consumption levels. Fisheries sector in Malawi faces challenges in fisheries management, including overexploitation, illegal fishing, weak law enforcement, habitat degradation, pollution, climate change impacts, political interference, inadequate funding, and capacity limitations. Sustainable management practices, strengthened enforcement, increased funding, and enhanced capacity building are crucial for safeguarding the future of the country's fisheries and ensuring the well-being of its people.



OR-15

## Current status of fisheries in Timor-Leste

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Timor-Leste, a small half-island nation with a population of approximately 1.34 million and a land area of 15,410km<sup>2</sup> is situated between Indonesia (to the north) and Australia (to the south). Its coastline stretches for about 740km, and it boasts an extensive exclusive economic zone (EEZ) covering roughly 79,000km<sup>2</sup>. The Strategic Development Plan (SDP) for the years 2011-2030 designates the Ministry of Agriculture and Fisheries (MAF) as the governing body responsible for overseeing all fisheries programs in the country. The importance of a thriving agricultural and capture fisheries sectors cannot be understated in Timor-Leste. It plays a pivotal role in poverty reduction, ensuring food security, and stimulating economic growth-especially within rural communities. Timor-Leste's fisheries industry primarily consists of two components aquaculture and capture fisheries. Currently, capture fisheries yield approximately 2,714 tons annually, with an estimated 99.72% of unexplored fisheries potential, amounting to approximately 637,069 tons. This statistic reveals that Timor-Leste's fisheries remain underdeveloped and underutilized. Surprisingly, for an island nation, fish consumption in Timor-Leste is significantly lower than neighboring countries, with an estimated average of only 6.1kg per capita (17kg in coastal areas and 5.2kg in inland areas). This is well below the global average of 20.2 per capita. The historical challenges that Timor-Leste has faced in the fisheries sector such as lack of fisheries data, technology capacity, infrastructure and financial assistance. To address these core challenges and unlock the potential of Timor-Leste's fisheries sector the government should prioritize the enhanced technical Capacity, separation of fisheries department from the Ministry of Agriculture and Fisheries ministry to ensure focused and dedicated attention to the unique needs of the fisheries sector.

OR-16

## Carbon and nitrogen isotopic compositions of particulate organic matter and biogeochemical processes during the pre- and post-monsoon season in a temperate estuary, western coast of Korea

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Estuarine dams discharge the large volumes of freshwater into coastal areas during the summer monsoon in northeast Asia. Estuaries play a pivotal role as transitional zones in the land-sea continuum, governing the production, removal, and transformation of particulate organic matter (POM). To evaluate the impact of freshwater discharge on the composition of POM and the production of autochthonous POM, we investigated the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in POM and the primary production of phytoplankton in the upstream and downstream regions of major rivers (the Han River, the Geum River, and the Yeongsan River) on the western coast of Korea. The range of  $\delta^{15}\text{N}$  in POM were relatively wide during post-monsoon (-0.2~23.6) compared to post-monsoon period (4.1~18.9) during the study period, indicating variability in biogeochemical processing during the monsoon period. The negative relationship between salinity and  $\delta^{15}\text{N}$  value of POM during the study period revealed the  $\delta^{15}\text{N}$  can be considered as indicator of freshwater impact on western coast of Korea. The C:N ratios of POM were negatively correlated with the  $\delta^{15}\text{N}$  in the study area, displaying the spatial variability with significantly higher value in dammed estuaries than in natural estuary. Spatial variation of primary production showed the relatively high value in the Yeongsan River end, resembling the spatial variation of chlorophyll a concentration. Primary production in the natural river-estuary continuum (the Han River) exhibited seasonally consistent values, in contrast to increased primary production after monsoonal events in the dammed areas (the Geum and Yeongsan River). Overall, our results demonstrate the influences of dam discharge on the composition and source of POM due to increased concentration of autochthonous POM after summer monsoon season.

OR-17

## Assessing the risk of microplastics on gill and GI tract health in a goldfish model

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Microplastics (MPs), a representative water pollutant, are not easily degraded in the environment, so they can affect the aquatic ecosystem. Previous studies have shown that accumulation of MPs in body causes physical damage to the gastrointestinal (GI) tract. In addition, MPs can be induced transcriptional changes, immune response in fishes. However, direct studies on host-pathogen susceptibility to MPs are still limited. Herein, we designed the experiments to confirm the effect of MPs accumulation by exposing fluorescent MPs to goldfish. After 14 days exposure, histological observation by H&E staining performed. The effects of MPs on fish immune/stress-related genes expression levels confirmed by qRT-PCR. The accumulation of MPs in tissues will be observed by a confocal microscope. To determine the immune/stress-related responses in goldfish, several enzymes activity will be analyzed by ELISA. Metagenomics approach will be performed to define the alteration of fish gut and gill microbiome. To test the pathogen susceptibility, LD<sub>50</sub> analysis will be conducted with *Vibrio vulnificus*. To determine the impact of microplastics exposure on goldfish behavioral change, behavior analysis will be performed using Ethovision XT. Our study can provide insight of MPs accumulation in aquatic organisms, and its impacts on pathogen sensitivity.

OR-18

## Morphological and molecular variation in *Platichthys bicoloratus* (Pleuronectidae) from Korea

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The stone flounder, *Platichthys bicoloratus*, is a fish species belonging to the family Pleuronectidae that is widely distributed in the entire coast of Korea, Japan, China, and Taiwan. *P. bicoloratus* is a species of high commercial value in coastal fisheries, but its population is gradually decreasing. Although development of Eggs, spawning, and feeding habits have been reported for *P. bicoloratus*, no studies have examined its population structure to species conservation and management units establishment. Therefore, This study performed morphological and molecular analyses of 140 specimens collected from five localities in Korea to identify the population structure and demographic history of *P. bicoloratus*. As a result of morphological analysis using 7 meristic characters and 28 measuring character, Kruskal-Wallis test of meristic characters showed that the Yeosu differed from the Daecheongdo in the number of anal fins and the Goseong, Yeosu, and Daecheongdo are different from each other in the number of vertebrae. Similarly, Canonical discriminant analysis (CDA) of measuring character showed that the Yeosu differed from the Daecheongdo and Goseong slightly differed from the Daecheongdo. Pairwise  $\Phi_{ST}$  for 720 base pairs of cytochrome *b* sequence showed that the Goseong was well distinguished from the remaining 4 regions(Pohang, Yeosu, Seocheon, Daecheongdo), and was particularly well distinguished from Daecheongdo( $\Phi_{ST}=0.187$ ,  $p<0.001$ ). In addition, Bayesian skyline plot suggests that *P. bicoloratus* had a low effective population size during the Pleistocene, and rapid population expansion occurred during interglacial periods. As a result of this study, morphological analysis and molecular analysis showed similar but slightly different results, so additional research using more sensitive molecular markers such as microsatellites is needed.

OR-19

## Change in the density of Pacific cod (*Gadus macrocephalus*) egg and larvae

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The Pacific cod (*Gadus macrocephalus*) eggs are considered demersal egg, stenothermal, and euryhaline. They remain in a bottom environment until pre-hatching. After hatching, larvae are sometimes found in the surface layer due to differences in density, and they are transported to nearby nursery grounds by currents, so the early life stage of Pacific cod (egg/larvae) is likely to be exposed to various water masses. This study analyzes the change in density of fertilized egg and larvae with water temperature in the laboratory.

In the experiment, the density of fertilized eggs and larvae in the culture tank maintained at 3°C and 10°C was measured daily. For fertilized eggs, the density was measured from 1 days post-fertilization to pre-hatching. For larvae, the density was measured from 1 days post-hatch to 50% mortality. No feed was supplied between the experiments. As a result of the experiment, all fertilized eggs hatched after approximately 25 days in a 3°C tank, and all hatched after approximately 10 days in a 10°C tank. The timing of the density change in the larvae was observed starting from the 12 days post-hatch in a 3°C tank, and it revealed the density range of the lower layers (100 m) off the East/Japan Sea coast. In contrast, in a 10°C tank, it began on the 6 days post-hatch and exhibited a density range of medium layers (50 m) off the east coast. This study can serve as foundational data for ecosystem models, providing density values during the early life stage of Pacific cod based on water temperature. It can be used to investigate the continuous response of marine life to climate change.

OR-20

## Spawning migration strategies of Chum salmon (*Oncorhynchus keta*) with physical environment change in the coastal water of Korea

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The eastern coastal water of Korea, southern limit of Chum salmon (*Oncorhynchus keta*) distribution in the north Pacific Ocean, has the largest density of salmon migrating to Korean rivers. The coastal water forms the boundary between a low saline, cold water mass flowing from the north to the south and a high saline, warm water mass flowing from the south to the north. Spawning migration strategies of salmon in the coastal water is important for spawning success with energy reserve. We analyzed the relationship between marine environment change (sea water temperature, tidal elevations) and spawning migration of salmon in the coastal water. In the coastal water, the salmon actively moved between upper and lower layer and migrates into the river at night when sea level rose during high tide. Salmon migrated into the river when sea surface water temperature was between 12-20°C, and actively migrated into the river when sea surface water temperature decreased below 18°C. The number of salmon ascending the river peaked when the water column was vertically mixed by spring tides. The latitudinal distribution of salmon from northern part to the southern part in the coastal water was changed according to the distribution of sea surface water temperature along the coastal water, and timing of migrate into river from the coast was highly related with tides. In conclusion, in the process of reaching the spawning grounds, salmon chooses strategies to reduce energy expenditure by using optimal environmental conditions. This study provides important information in understanding of the mechanisms that regulate the distribution of salmon in coastal and river during spawning migration.

OR-21

## Comparison of reproductive ecology of *Amphioctopus fangsiao* in Yellow Sea and South Sea of Korea

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The reproductive ecology of *Amphioctopus fangsiao* was studied using respectively 1,413 and 3,691 samples collected monthly from January to December 2021 in Yellow Sea and South Sea of Korea. We analyzed monthly changes in sex ratio, gonadosomatic index (GSI), histological maturity stage, fecundity, size distribution of oocytes, and size at maturity. The sex ratio was significantly different in each of the two regions. Based on monthly histological observation of the gonad development and GSI, the spawning period was found to take place from March to June for both region. The *A. fangsiao* specimens in Yellow Sea had more fecundity and smaller oocyte size than in South Sea. The size at maturity in Yellow Sea was 50% at 46.1 g BW (38.7 mm ML), 75% at 78.7 g BW (46.1 mm ML), and 97.5% at 154.1 g BW (63.3 mm ML), and in South Sea was 50% at 60.8 g BW (48.9 mm ML), 75% at 81.1 g BW (53.5 mm ML), and 97.5% at 127.2 g BW (64.1 mm ML).

OR-22

## Vertical distribution of eggs and larvae of *Glyptocephalus stelleri* in the East Sea of Korea

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Blackfin flounder (*Glyptocephalus stelleri*) is an important demersal fish found in North Pacific, but its catch amount has declined in recent years. Thus, to understand the reasons for this declining trend, the vertical distribution and abundance of ichthyoplankton of the Blackfin flounder in the East Sea of Korea were investigated during April 2021. Fish eggs and larvae were sampled using a multiple opening/closing net and environmental sensing system, and identified by their mitochondrial DNA cytochrome oxidase subunit I sequences. We collected 107 *G. stelleri* eggs (diameter: 1.03–1.30 mm) and three larvae (total length: 6.3–8.6 mm) from a depth range of 0–110 m where temperature ranged from 15 to 6 °C. *G. stelleri* eggs and larvae were mostly found at water columns depths of 30–60 m and 20–60 m, respectively. Vertical distribution of eggs and larvae of *G. stelleri* were influenced by oceanographic conditions, such as temperature, salinity, and thermocline depth. This is the first study reporting the vertical distribution of *G. stelleri* eggs and larvae off the East Sea of Korea. The study increases our understanding of renewal of *G. stelleri* populations to facilitate fishery resource management and species conservation.



OR-23

## Ichthyoplankton assemblage structure in Yeongil Bay, Korea

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The species composition and distribution patterns of ichthyoplankton collected from January to December 2022 from Yeongil Bay, East Sea of Korea, were investigated. An oblique tow was collected from the bottom to the surface using a bongo net (80cm, 330  $\mu$ m) herein, from seven stations. The collected samples were identified using morphological analysis and mtDNA cytochrome oxidase subunit I (COI) and 16S rRNA sequencing. A total of  $6,603 \pm 11,051$  eggs/1000 m<sup>3</sup> (mean  $\pm$  standard deviation, SD) belonging to 30 species and 18 families, and  $239 \pm 533$  larvae/1000 m<sup>3</sup> from 29 species and 18 families, were collected from Yeongil Bay. The dominant egg species were *Engraulis japonicus* (69.8%), *Sardinops sagax* (9.0%), and *Scomber japonicus* (7.4%). *E. japonicus* (54.1%), *Repomucenus valenciennae* (10.9%), and *Sebastiscus marmoratus* (9.4%) were the dominant larval species.

OR-24

## Age and growth of Largehead Hairtail *Trichiurus japonicus* near Jeju Island, Korea

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Largehead Hairtail *Trichiurus japonicus* is important ecological and commercial species in waters of Korea. Samples were collected monthly from March 2019 to February 2020. we analyzed age and growth of Largehead Hairtail using 448 otoliths. Total lengths of Largehead Hairtail ranged from 17.8 to 53.0 cm, which is sufficient length range for analyzing age structure and growth parameters. Translucent zone was counted as annual mark, formed during the spawning season in October. Estimated ages were 1-7 years, and 53.0 cm individual was age 7. Age 1-2 years in this study had highest proportion (80.0%). von Bertalanffy growth model was obtained as  $L_t = 60.2(1 - \exp^{-0.15(t + 1.69)})$ .

OR-25

Age and growth biology of seabass, *Lateolabrax japonicus*  
in the coastal waters of South Sea, Korea

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The age and growth of the seabass, *Lateolabrax japonicus* was investigated based on samples captured in the coastal waters of South Sea, Korea from January to December, 2020. The spawning period was extrapolated from January to March based on monthly changes in the gonadosomatic index and histological observation of gonads. Annual periodicity of the otolith opaque zones formed in spring after spawning was validated by the edge-type analysis. The examination of the sectioned sagittal otolith indicated the maximum age of *L. japonicus* as 11 years in both sexes. The relationship between total length and otolith radius was analyzed separately for each sex with  $TL=41.661R-7.5749$  for females and  $TL=32.285R-1.0516$  for males. From the parameters calculated using average total length and weight when the year ring was formed, the growth of *L. japonicus* was expressed by von Bertalanffy growth equations as  $L_t=117.36(1-e^{-0.10(t+1.74)})$  for females,  $L_t=109.58(1-e^{-0.08(t+2.53)})$  for males, and  $L_t=112.05(1-e^{-0.09(t+2.03)})$  for combined sexes, where  $L$  is total length at age  $t$ . Both sexes of *L. japonicus* grew rapidly with females attaining larger total length than males of the same age class.

OR-26

## Age and growth of the chub mackerel, *Scomber japonicus* in the South Sea of Korea

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Age and growth of chub mackerel, *Scomber japonicus*, were estimated based on vertebral centrum belonging to 1,131 fish collected by purse seine and set net in the South Sea of Korea from March 2019 to February 2022. The size of *S. japonicus* ranged from 5.9 to 46.6 cm in fork length (FL). Ages were determined from annuli in vertebral centrum and annuli were formed between April and June once a year. Also, the main spawning period was estimated to be between April and June, thus rings were considered to be annual marks. Ages of sampled individuals ranged from 0 to 6 years. Fish growth was expressed by the von Bertalanffy growth equation, as follows:  $FL_t = 48.03(1 - e^{-0.34(t+0.23)})$  for females and  $FL_t = 48.06(1 - e^{-0.34(t+0.22)})$  for males, where  $FL_t$  is the Fork length in cm and  $t$  is age in years. The growth rates of males and females were not significantly different ( $P > 0.05$ ). The growth equation for females and males combined was  $FL_t = 48.86(1 - e^{-0.33(t+0.23)})$ .

OF-1

## Phenotypic variation and reproductive success of a keystone stream fish, bluehead chub: an application of PIT antenna and genetic parentage methods

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A key topic and challenge in behavioral ecology are to quantify individual variation and its impact on fitness consequences. However, studying reproduction in the wild is notoriously difficult for small-bodied aquatic species due to their cryptic spawning. Here, reproductive ecology of bluehead chub (*Nocomis leptoccephalus*), a nest-building freshwater fish, was studied to characterize phenotypic variation and its effect on fitness consequences. Direct field observations throughout a spawning season revealed that temporal variation and spatial synchrony in spawning activities were linked to stream temperature and flow conditions, and there was much variation in nest size, shape, and construction behavior. In addition, an automated tracking (PIT tag) and genetic parentage techniques (microsatellite loci) were used to investigate how individual difference led to variation in reproductive success using a field experiment and tracking individuals in a natural stream. Contrary to prevalent patterns observed in many animals, larger body size was not always a factor leading to more successful reproduction, particularly in males. Instead, reproductive success depended more heavily on nest size and behavior. Furthermore, behavioral tactics that increased reproductive success differed by sex, in which nest sharing was advantageous for males and visiting more nests for spawning was advantageous for females. These findings illustrate that reproductive success was affected by a complex interplay of environmental conditions, phenotypic variation and behavior in this keystone species, whose nests are also used by other fish species in the Southeast USA.

OF-2

## Analysis of stomach contents of rainbow trout (*Oncorhynchus mykiss*) captured in natural water system in Korea

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Rainbow trout, *Oncorhynchus mykiss*, is a Salmonidae fish that lives in North America and eastern Russia. However, rainbow trout is a popular farmed fish species that has been introduced all over the world, and has been cultivated in Korea since it was introduced in 1965. Rainbow trout is a cold-water fish species that lives mainly in the upper reaches of rivers where the water is clear and rich in dissolved oxygen. The water temperature in which rainbow trout lives is maintained below 24°C throughout the year, and the optimal water temperature is known to be 16~18°C. In Korea, it is mainly farmed in the Gangwon-do region, and some are also farmed in Chungcheongbuk-do and Gyeongsangbuk-do. Rainbow trout has been designated as one of the world's top 100 invasive alien species by IUCN, and is causing damage due to genetic pollution and competition with native salmonid fish for spawning and habitat. Rainbow trout farmed in Korea are infertile and triploid due to their increased meat quality and rapid growth. However, it has been confirmed that rainbow trout have leaked into the natural ecosystem due to floods and neglect of management. As in cases reported overseas, rainbow trout may cause competition with domestic native fish species for habitat and spawning, and direct predation may cause damage. Therefore, in this study, we aim to identify the food source of rainbow trout and indirectly infer the resulting damage to the ecosystem by analyzing the stomach contents of rainbow trout found in the natural aquatic ecosystem.

OF-3

## Molecular phylogeny and taxonomic review of the family Pomacentridae from Korea

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Damselfishes (Perciformes, Pomacentridae) mainly inhabit tropical and temperate oceans, with 29 genera and 387 species in the world. Among them, 8 genera and 21 species have been reported in Korea. Many studies have been conducted on the taxonomy of damselfishes, but the classification on their subfamilies is confusing. Therefore, in this study, molecular phylogeny of 8 genera and 17 species of the family Pomacentridae are analyzed based on mtDNA 16S rRNA 473bp and nDNA RAG1 812bp sequences. Also the external morphological traits of 64 specimens collected from Korea investigated to determine if there are diagnostic features distinguishing subfamilies or genera. Molecular phylogenetic trees (NJ, ML, and BI) showed that four groups (Chrominae, Glyphisodontinae, Pomacentrinae, and Microspathodontinae) were largely formed, and each group was supported by high bootstrap values. Each subfamily is divided by number of spiniform procurent caudal rays, the morphology and rows of the teeth, and the margin of suborbital and preopercle. Each genus is divided by the number of dorsal fin spines and anal fin soft rays, the morphology and rows of the teeth, and body coloration. Of the 21 damselfishes reported in Korea, *Neopomacentrus violascens* and *Chromis analis* may not inhabit Korea according to their previous known distribution. Also *Dascyllus melanurus* and *Chromis tingting* (formerly *Chromis mirationis*) have never been collected since their first reports. However, it needs careful monitoring because the Korean peninsula shows the most rapid increase in seawater temperature.

OF-4

## New insights into early life history of the family Triglidae: focusing on wide-range captured larvae and juveniles

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Gunnard (Scorpaeniformes: Triglidae) comprises 132 species in 9 genera in the world, 19 species in 3 genera in Japan, and 11 species in 3 genera in Korea. They inhabit up to 500 m deep on continental shelves in tropical and temperate seas. Abrupt increase in the Korean population of *Chelidonichthys spinosus* during 2020-2022 may be affected by biological and/or environmental variables. Therefore, we assumed that the spawning or nursery grounds of Triglidae including *C. spinosus* were largely formed in Korean waters. In order to prove this, we investigated a total of 85 specimens of larvae and juveniles of Triglidae collected from Korean waters (East Sea, Yellow Sea, Korean Strait and East China Sea) between 2016 and 2023 using Bongo net. A total of 11 adult tissues were used for molecular comparison, which were provided by Marine Fish Resource Bank of Korea (MFRBK), Kagoshima University (KAUM) and Kyoto University (FAKU). As a result, 3 genera and 9 species were identified as follows: *C. spinosus* larva (13.03 mm TL, n=1), *Lepidotrigla guentheri* larvae (4.99-17.69 mm TL, n=11), *L. microptera* larvae (7.48-12.39 mm TL, n=2), *L. abyssalis* larvae (3.43-12.24 mm TL, n=53), *L. kishinouyei* larvae (5.30-15.40 mm TL, n=3), *L. alata* larvae (5.42-8.97 mm TL, n=5), *L. hime* larvae (4.50-13.41 mm TL, n=5), *L. longifaciata* larva (5.14 mm TL, n=1), *Pterygotrigla hemisticta* larva (9.75 mm TL, n=1). Larvae and juveniles of Triglidae are very similar in having a large mouth, a long snout and large pectoral fin, but they significantly differed in the shape and distribution of melanophores in the pectoral fin. Our findings are the first in the world and can help to understand the early life history of Triglidae.



OF-5

## Maturity and spawning of the chub mackerel, *Scomber japonicus* in the South Sea of Korea

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The maturity and spawning of chub mackerel, *Scomber japonicus*, was investigated using 1,131 samples collected by purse seine and set net in the South Sea of Korea from March 2019 to February 2022. The size of *S. japonicus* ranged from 5.9 to 46.6 cm in fork length (FL). We analyzed annual and monthly changes in maturity stage, gonadosomatic index (GSI), fork length (FL) at 50%, 75%, and 97.5% group maturity, egg diameter and fecundity. The spawning period was from March to July, with the peak from April to June based on monthly changes in maturity stages and GSI. The percentage of sexually mature females estimated from a logistic function was over 50% at 28.1 cm FL, 75% at 30.8 cm FL, 97.5% at 36.7 cm FL. The size of eggs spawned was between 0.41 to 1.13 mm. *S. japonicus* were a multiple spawner species, spawning several times during the spawning season. Fecundity varied between 92,173 and 612,640 eggs. The relationship between the fecundity and FL of the fish was expressed in the fecundity equation as  $F=1.1675FL^{3.4899}$  ( $R^2=0.8523$ ).

OF-6

## Diet composition of Bluefin searobin, *Chelidonichthys spinosus* in the South Sea of Korea

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The diet composition of Bluefin searobin, *Chelidonichthys spinosus* was studied using 356 specimens collected by fisheries resources survey vessels bottom trawls of national institute of fisheries science in 2022 the South Sea of Korea. The species ranged from 9.7 cm to 42.0 cm in total length (TL). *C. spinosus* was bottom-feeding carnivore that fed mainly on *Macrura*, which constituted 85.7% of *IRI*, especially *Leptochela sydniensis*. Its diet also included small quantities of polychaetes, crabs and fishes. Further analyzed the data by dividing the specimens into five classes (<15.0 cm, 15.0-20.0 cm, 20.0-25.0 cm, 25.0-30.0 cm,  $\geq$ 30.0 cm). As increasing body size, the proportion of *Macrura* decreased, whereas the consumption of crabs, stomatopods increased gradually. As the body size of *C. spinosus* increased, the mean weight of prey per the stomach (*mW/ST*) tended to increase significantly (one-way ANOVA,  $P<0.05$ ).

OD-1

## Horizontal transmission of the white spot syndrome virus under various conditions

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White spot syndrome virus (WSSV) is the most problematic pathogen in crustaceans. However, its waterborne transmission based on the correlation between disease severity grade and viral shedding rate has not yet been explored. In this study, we investigated the horizontal transmission model of white spot syndrome virus based on the correlation between disease severity grade and viral shedding rate. We also determined the minimum infective doses of white spot syndrome virus via the waterborne route. From the intramuscular injection challenges at varying doses and water temperatures, the histopathological severity grade of experimentally infected shrimps showed a significant correlation with the viral genome copies in the pleopod, as determined by real-time PCR. In brief, the severity grades of G1, G2, G3, and G4 corresponded to  $10^2$  -  $10^4$ ,  $10^4$  -  $10^5$ ,  $10^5$  -  $10^7$ , and  $10^7$  -  $10^8$  WSSV genome copies/mg, respectively. Based on the correlation between the severity grades and the viral genome copies in shrimp, viral shedding was observed at G1 ( $3.1 \times 10^3$  copies/mg), and mortality was observed at G2 ( $8.5 \times 10^4$  copies/mg). Furthermore, a positive linear correlation was observed between viral copies of pleopods and viral shedding rate ( $y = 0.7076x + 1.414$ ;  $p < 0.001$ ). Minimum infective doses of WSSV were determined via an immersion challenge. Infection was observed within 1, 3, and 7 d in  $10^5$ -,  $10^3$ -, and  $10^1$  copies/mL of seawater, respectively. In the cohabitation challenge, infection was observed within six days with viral loads of  $10^1$  to  $10^2$  copies/mL of seawater, which further increased in the recipient group. Our results indicate a positive correlation between disease severity grade and viral shedding rate of infected shrimp and suggest that the waterborne transmission of WSSV depends on the viral load and exposure period. Furthermore, these results can aid in understanding the dynamics of white spot syndrome virus in pond culture systems and facilitate further studies on the interactions between species during outbreaks and the spread of white spot disease in pond culture systems.

OD-2

## Establishment of primary cell derived from giant river prawn (*Macrobrachium rosenbergii*) and culture of susceptible virus

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The aquaculture of aquatic invertebrates has grown rapidly, but viral disease outbreaks have seriously negative impacted the sustainability and economy in the aquatic invertebrates farm worldwide. Therefore we need a primary cell culture method or cell line to diagnose, and research aquatic invertebrate viruses. However, most of aquatic animal derived cell lines are based on fish. We studied establish a sustainable primary cell culture environment and methods derived aquatic invertebrates. And we researched the passage and culture of a virus that is susceptible to a primary cell derived from giant river prawn (*Macrobrachium rosenbergii*) egg. In this study, a primary cell culture method of *M. rosenbergii* as aquatic invertebrates established and WSSV were tried to subculture *in vitro* using M cell. As a result, the culture environment of M cell showed higher maintenance rate in L-15 medium, temperature 25°C, pH 7.2, fetal bovine serum content 20%, and salinity 20ppt than other conditions. In addition, as a result of confirming the number of virus copies in qPCR of WSSV passaged 3 times into M cell, it was verified that the WSSV was amplified more than the control group (non-passage WSSV). In conclusion, we collected primary cell derived from *M. rosenbergii* eggs, established various culture conditions, and confirmed the possibility of subculture *in vitro* of WSSV, a susceptible virus. The results of this study will be useful for future studies of cytopathology, genetics, and infectious virus epidemiology related to aquatic invertebrates.

OD-3

## Generation of recombinant snakehead rhabdovirus (SHRV) expressing artificial microRNA targeting spring viremia of carp virus (SVCV) P gene and in vivo therapeutic use against SVCV infection

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Spring viremia of carp virus (SVCV) is one of the major viral agent causing lethal damages in common carp (*Cyprinus carpio*) and other cyprinid fish species. In the present study, an in vivo therapeutic measure against SVCV was developed using artificial microRNA (AmiRNA) targeting SVCV P gene transcript. synthesized AmiRNA mimics and AmiRNA-expressing vector system were used to determine the downregulation ability of the three candidates of AmiRNAs (AmiR-P1, -P2, and -P3) against SVCV P gene transcript, among which AmiR-P3 was chosen since it showed a higher inhibitory activity.

Based on the *in vitro* results, we rescued recombinant snakehead rhabdoviruses (SHRVs) expressing the chosen SVCV P gene-targeting AmiRNA (rSHRV-AmiR-P3) or control AmiRNA (rSHRV-AmiR-C) using reverse genetic technology in order to overcome any limitation of AmiRNA mimics or the AmiRNA-expressing systems in in vivo. After verifying *in vitro* that the expression of AmiR-P3 and AmiR-C was successful through rSHRVs, we evaluated the availability of rSHRV-AmiR-P3 for in vivo control of SVCV. For that, zebrafish were infected with either rSHRV-AmiR-C or rSHRV-AmiR-P3 followed by SVCV infection or infected with SVCV followed by either rSHRV-AmiR-C or rSHRV-AmiR-P3 infection. as a result, there was no significant difference in survival rates between groups of fish infected with rSHRV-AmiR-C or rSHRV-AmiR-P3 before SVCV infection, however, the survival rate in the group of fish infected with SVCV followed by infection with rSHRV-AmiR-P3 was significantly higher than in the group of fish infected with rSHRV-AmiR-C. These results suggest that both SHRVs infection before SVCV provided somehow a prophylactic effect, on the other hand, the therapeutic effect of AmiR-P3 comparing to AmiR-C could be noticed through the survival rate of both fish groups. Based on the present study results, we could verify that recombinant SHRV could be a suitable system for a successful expression of artificial microRNA, and rSHRV expressing artificial microRNA targeting the SVCV P gene could be used as an alternative to control SVCV infection in fish for therapeutic purpose.

OD-4

## Viperin ablation interferes with immune cell recruitment and fish metabolism under VHSV infection

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Host metabolism and immune cells are closely entangled to bring the optimum antiviral defense. Immune cells, such as neutrophils, predominantly undergo glycolysis at their resting state; when activated, they shift glycolysis into pentose phosphate pathway, producing ROS. Viperin was suggested as a candidate for this metabolic shift. However, to date, this hypothesis has not been tested in teleost. A *viperin* deficient model was generated using CRISPR/Cas9 mutagenesis. Adult and larvae zebrafish were injected with VHSV, and time-dependent samples were collected for gene expression analysis. A *viperin*-overexpressed stable-cell line was generated for the lipid and ROS analysis. *Viperin*-deficient transgenic models, including *viperin*<sup>-/-</sup>*Tg(mpx:mCherry)* and *viperin*<sup>-/-</sup>*Tg(mpeg1.1:Dendra)* lines, were used for immune cell analysis. When infected with VHSV, *viperin*<sup>-/-</sup> fish showed considerably higher mortality rates. VHSV copy number and expression of the *NP* gene were significantly increased in *viperin*<sup>-/-</sup> fish. Metabolic gene analysis revealed significant differences in *soda*, *hif1a*, *fasn*, and *acc* expression, indicating their impact on metabolism. Cholesterol analysis in zebrafish larvae during VHSV infection indicated significant upregulation of cholesterol production without Viperin. *In vitro* analysis of ZF4 cells suggested a considerable reduction in lipid production and a significant upregulation of ROS generation with the over-expression of *viperin*. Neutrophil and macrophage recruitment were significantly modulated in *viperin*<sup>-/-</sup> fish compared to the WT fish. Thus, we have demonstrated that Viperin plays a role in interfering with metabolic alterations during VHSV infection.

OD-5

## Molecular insights into immune responses in olive flounder against VHSV infection

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The interplay between host and pathogen elicits a myriad of molecular interactions that dictate the course of infection and disease progression. This study aims to explore the detailed transcriptomic landscape and identify pivotal genes and pathways implicated in the immune responses and pathogenesis of olive flounder during VHSV infection. Despite the presence of several previous studies, it has not been explored with sufficient depth. Briefly, on the third-day post-infection with VHSV at 15 °C, head kidney was collected from both infected and control fish and subjected to RNA-seq. The results showed that out of 23,126 CDS in the olive flounder genome, 3,864 (16.7%) and 5,275 (22.8%) genes were significantly up- and down-regulated, respectively. Intriguingly, our focus on immune-related genes could unveil a profound array of key elements involved in the host defense mechanism and VHSV pathogenesis. Firstly, we found elevated transcription of TLR7 and the cGAS-STING pathway, indicating recognition of VHSV by the intracellular pattern recognition receptors. Notably, increased expression of type I and II interferons and their respective receptors, as well as interferon regulatory factors and interferon stimulated genes including MX1. In this study, increased MHC-II expression was observed, demonstrating antigen presenting (AP) from AP cells to helper T (Th) cells. Transcription of both pro-inflammatory (e.g., IL-1b), regulatory cytokines (e.g., IL-10) along with various chemokines (e.g., CCL-20, CXCL-10) were significantly up-regulated, indicating the presence of different subsets of Th cells and their feedbacks to maintain the balance of immune system. Moreover, increased expression of perforin-granzyme, fas-fas ligand, and CD8 were observed, suggesting a robust involvement of cytotoxic T cells against VHSV infection. However, the expression of MHC-I was significantly down-regulated, proposing possible immune evasion strategy of VHSV, as described in several other viral pathogens. This viral immune evasion might be associated with the significantly increased viral titer and mortality in fish observed in later infection periods in this study. Differential expression of apoptosis-related genes including caspases, CytC, and BCL-2 family genes was also observed, indicating the removal of infected and/or damaged cells. Hepcidin, haptoglobin, and ferritin, the integral players in iron homeostasis, exhibited highly induced expression patterns, implying their role in immune system against VHSV in fish.

OD-6

## MyD88 ablation attenuates immune cell responses and immune gene expression under VHSV infection in zebrafish

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Myeloid differentiating factor-88 (Myd88) is a major adaptor protein in Toll-like receptor (TLR) pathway. Main TLR receptors for virus recognition utilize MyD88, and the lack of MyD88 could severely dysfunctional the virus recognition process. The Viral Hemorrhagic Septicemia Virus (VHSV) is a negative-sense RNA virus that causes substantial economic losses to the fish industry worldwide. We show the importance of MyD88 in antiviral defense by generating *myd88*<sup>-/-</sup> zebrafish. The caudal fin injury infection experiment in *myd88* ablated larvae indicated a substantial spread of VHSV at the injury site. Neutrophils and macrophage recruitment to the infected area were significantly reduced in *myd88*<sup>-/-</sup> fish. This KO model was challenged with VHSV, and gene expression was analysed. The VHSV *NP* gene expression was significantly upregulated in *myd88*<sup>-/-</sup> fish compared to the WT. A significant gene expression and immune cell marker modulation were observed in the mutant model compared to the WT. Our observations suggested that the lack of a significant adaptor protein for immune signal transduction severely disrupts immune cell development, migration, and immune-related gene expression, leading to enhanced VHSV replication. To the best of our knowledge, this is the first study conducted on zebrafish lacking MyD88 against VHSV infections.



OD-7

Prophylactic efficacy of bacteriophage cocktail against multiple-antibiotic-resistant and single-phage-resistant *Vibrio coralliilyticus* infection in Pacific oyster (*Crassostrea gigas*) larvae

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*Vibrio coralliilyticus* (*V. coralliilyticus*) poses a significant threat to marine bivalve hatcheries worldwide, leading to widespread mass mortality. This study examines the application of a bacteriophage (phage) cocktail to assess its prophylactic efficacy against both multiple-antibiotic-resistant (MAR) and single-phage-resistant (SPR) *V. coralliilyticus* infections in Pacific oyster larvae.

To prevent the emergence of SPR strains and maximize treatment impact, we developed a phage cocktail comprising three distinct *V. coralliilyticus*-specific phages. This study evaluated the preventive capacity of this phage cocktail against MAR and SPR *V. coralliilyticus* variants.

Results from cell lysis tests indicated the strong bactericidal effectiveness of the phage cocktail, when compared to the group treated with two individual phages (pVco-5 and pVco-7), especially against MAR and SPR variants. Furthermore, *in vivo* experiments involving Pacific oyster larvae validated the prophylactic potential of the phage cocktail against both MAR and SPR variants.

The application of this phage cocktail has the potential to mitigate the mass mortality caused by *V. coralliilyticus* infections in the production of marine bivalve seedlings. These results suggest promise for reducing the detrimental impacts of MAR and SPR *V. coralliilyticus* on the aquaculture industry, highlighting the versatile utility of phage cocktails in managing various bacterial diseases.

OD-8

## Involvement of Galectin 9 from redlip mullet (*Planiliza haematocheilus*) in the regulation of antibacterial and antiviral immunity in teleost fish

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Galectin 9 (Gal9) is a tandem repeat type  $\beta$ -galactoside-binding lectin that have a wide range of biological roles in cell adhesion, cell growth, cellular signaling, and innate and adaptive immunity. Many studies have investigated the functional properties of Gal9 in mammals; however, knowledge of fish Gal9 is limited. Therefore, in this study we aimed to clone *Gal9* from *Planiliza haematocheilus* (*PhGal9*) and investigate its structural and functional characteristics. We identified a 969 bp long open reading frame of *PhGal9* encoding a protein of 322 amino acids. The predicted molecular weight of *PhGal9* was 35.385 kDa, and it lacked a signal peptide sequence. The mature protein was localized in the cytosol (probability=0.58) and was secreted to extracellular space through unconventional protein secretory pathways (threshold score=0.55). *PhGal9* was ubiquitously expressed in all tissues investigated while predominantly present in the intestine, spleen, and brain. When the fish were stimulated with Poly I:C, LPS, and *L. garvieae*, the expression of *PhGal9* in the blood tissue was significantly ( $p < 0.001$ ) elevated by 15-fold, 10-fold, and 9.5-fold for Poly I:C, LPS and *L. garvieae* at 6 h post infection, respectively. In the functional assay, r*PhGal9* exhibited dose-dependent agglutination potential towards gram-positive and gram-negative marine bacteria at a minimum concentration of 50  $\mu\text{g/mL}$ . In the antiviral assay, the expression levels of Viral Hemorrhagic Septicemia Virus (VHSV) glycoproteins, phosphoproteins, nucleoproteins, non-virion proteins, matrix proteins, and RNA polymerase were significantly reduced in *PhGal9-overexpressed* cells. Furthermore, the mRNA expression of autophagic genes (*sqstm1*, *tax1bp1b*, *rnf13*, *lc3*, and *atg5*) and antiviral genes (*viperin*) were upregulated in *PhGal9* overexpressed cells. For the first time in teleost fish, the function of exogenous and endogenous Gal9 in preventing virus attachment and replication by neutralizing virion and autophagy has been demonstrated. Conclusively, our findings suggest that *PhGal9* could be a potent modulator in antibacterial and antiviral immune responses in redlip mullet.

OD-9

## Optimizing LAMP assay to identify the endangered eel species, *Anguilla japonica*

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Identifying morphologically similar species on-site is getting more important to manage the wild populations especially endangered species. Conventional identification using morphological characters has inherent limitations with the cryptic species complex such as eel species, genus *Anguilla*. Alternatively, DNA barcoding offers an advantage in identifying species that are morphologically indistinguishable by providing reproducible and reliable genetic data. However, there are still limitations of DNA barcoding regarding the space and time required for carrying out lab procedures. The limitations can be overcome by utilising the loop mediated isothermal amplification (LAMP) method, due to its short running time and the capability to identify samples with a simple portable heating block. Here, we developed the novel LAMP assay to identify critically endangered Pacific eel, *Anguilla japonica*, which is morphologically indistinguishable to other species. We designed a species-specific LAMP primer based on the mitochondrial control region of all anguillid species from GenBank. We synthesized the mitochondrial control region sequences to test the specificity. Then, we performed *in silico* PCR with the actinopterygii species from Korea (610 species in total) to avoid the false positive amplification. We used WarmStart LAMP kit on the Real-Time PCR system, and the WarmStart colorimetric LAMP kit on the thermocycler to optimize and test the sensitivity of DNA samples at varying concentrations. Since our preliminary results showed the high frequency of false positive for both kits, we added Dimethyl sulfoxide (DMSO) and *Tte* UvrD Helicase to avoid non-target amplification for the control group. Our results indicate that no false positive reactions were observed in WarmStart LAMP kit with *Tte* UvrD Helicase, while decreased frequency of false positive reactions in WarmStart colorimetric LAMP kit with 5% of DMSO. We highlight that the optimization process for the LAMP assays is inevitable to avoid false positives

OT-1

## Development of automatic assembling system of gillnet

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The National Institute of Fisheries Science developed biodegradable gillnet fishing gear to reduce damage caused by abandoned fishing gear, but it is facing limited supply due to reasons such as high price and durability. In order to reduce the unit cost of biodegradable gillnet fishing gear, the expansion of automated production facilities is necessary. In this study, we developed a technology that can automatically assemble gillnet gear into one system by integrating the four-step gillnet fishing gear assembly process that relies on manual work. The automatic gillnet fishing gear assembly system consists of a float assembly line and a sinker assembly line. It is a structure that allows the float and sinker to be assembled simultaneously on both sides by placing a net between these two lines. The floats and sinkers are transported through a conveyor belt, and the rope is transported to a certain length through a rotary clamping discharge unit equipped with a servo motor. The rope supply section has a detection sensor to prevent rope twisting and a tension sensor to adjust tension. A slide module equipped with an optical sensor counts the number of mesh and transports the net. The rope supply section has a detection sensor to prevent rope twisting and a tension sensor to adjust tension. The connection between the net rope and the float rope or sinker rope is done automatically using a sewing machine. As a result of measuring the float connection gap of manually assembled and automatically assembled nets, the accuracy of float connection gap of the automatically assembled net was 99.6%, which was 2.4% higher than that of the manually assembled net. The time required for manual assembly and automatic assembly were measured, and the productivity improvement rate of automatic assembly was 203% compared to manual assembly. Utilizing this automatic gillnet fishing gear assembly system is expected to reduce fishing gear production costs and expand the supply of biodegradable gillnet fishing gear.

## OT-2

## Study of computational fluid dynamics characteristics according to the nozzle shape of shellfish dredge fishery

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Generally, shellfish dredge is used to catch shellfish at shellfish farms. Shellfish dredge fishing gear has a rectangular frame attached to the front of the bag net. There are several rakes below the frame of this fishing gear. Shellfish are caught by towing this fishing gear with a fishing boat.

In this study, when this shape net fishing gear was equipped with a nozzle that sprays water at high pressure using a pump, we attempted to analyze the hydrodynamic characteristics such as flow field and pressure field according to the pump capacity and nozzle specifications.

The impact of water sprayed from the nozzle installed on the net fishing gear directly affects the seafloor and marine life. Therefore, there is a need to increase fishing efficiency while minimizing the impact on the marine environment.

Therefore, in order to investigate the hydrodynamic characteristics when using a nozzle for dredge fishing gear, the currently proposed shellfish dredge fishing gear was analyzed through computational hydrodynamic numerical analysis according to actual use conditions.

## OT-3

## A study for the fishing effect using a gill net on a cube-type reef with eight inner blades in Oeyeondo

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In the ocean, fish reefs provide a variety of habitats. Thus, artificial reefs are being developed for the characteristics of the seas and inhabit species, creating habitats artificially to promote the preservation and management of fishery organisms. In this study, it conducted a fishing survey using gill nets to understand the fishing effects on a cube-type reef with eight inner blades (CTREB) by fish and marine forests in Oeyeondo, in terms of species composition, CPUE, species diversity, and dominance. The CTREB by fish and marine forests was set up in 2022, and it conducted fishing surveys using gill nets six times in August, October, and November 2022 and March, May, and August 2023. The survey vessel (F/V) is 3.20 tons, and the gill net is composed of four widths, each being 500 m. For the fishing effect survey of the CTREB were conducted at a total of four sites: Areas where CTREB by fish and marine forests are installed and areas where they are not installed. The CPUE of reef area and control area where the CTREB by fish has increased since May 2023. The CPUE based on the number of individuals was higher in the CTREB by fish area than in the control area. The CPUE of reef area and control area where the CTREB by marine forests has increased since May 2023. The CPUE based on the number of individuals was similar in both the CTREB by marine forests area and control areas, but the CPUE based on weight was higher in the CTREB by marine forests area. Species diversity was highest in the CTREB by marine forests area in October 2023, as it exhibited the highest index due to the uniform capture of a multitude of species, totaling 9 species and 42 individuals. Conversely, in the CTREB by fish control area in May 2023, although the number of species and individuals was the highest in this study, totaling 10 species and 94 individuals, the species diversity index was 0.41. Based on the results of this study, there was the catch to increase from the second year after the installation of the CTREB by fish and marine forests, primarily the appearance of benthic organisms such as *Raja pulchra*, *Paralichthys olivaceus* and *Pleuronectes yokohamae*.

## OT-4

## A study on the resistance reduction for a coastal stow net using the simulations and the model experiments

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Recently, safety accidents in coastal stow net fishery have occurred frequently. the safety accidents in coastal stow net fishery due to the use of heavy anchors can reduce the anchor weight by reducing the resistance force of the entire fishing gear. In order to design a low-resistance force fishing gear, it is necessary to evaluate the resistance force on the whole gear and part of the gear. Furthermore, it is necessary to identify the part of the fishing gear that generates the most resistance force, reduce the mesh diameter in that part, and apply the high tenacity yarn to analyze the effect of reducing resistance force generated from the fishing gear.

Therefore, the current coastal stow nets (A, B type) were modified the diameter in that part, and the resistance forces and shape variations were calculated and measured through the numerical simulations and scale-down model experiments.

Based on the analysis of the results of the current fishing gear (A, B type), simulation and model fishing gear experiments were conducted using the proposed low-resistance force fishing gear that changed the diameter of section 1 to half.

First, as a result of analyzing the resistance force according to the current speeds, the resistance force tended to increase as the current speed increased. In this case, regardless of the change in the diameter of the section, the resistance force increased with the current speeds.

Next, the resistance force according to the change in the diameter of Section 1 tended to decrease as the diameter decreased.

Finally, when comparing the shape variation of the section, the net width increased and the height decreased as the current speed increased regardless of the change in diameter, showing a relatively similar trend without much difference.

This study is believed to be able to secure operational stability and provide basic data for future research on the coastal stow net fishing by improving and changing fishing gear currently used in fishing sites.

OT-5

## Species composition and community structure of aquatic organisms caught by the coastal beam trawl in Gomso Bay, Jeollabuk-do

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The southwestern and western coasts of Korea have developed intertidal zones due to complex coastlines and abundant sediments supplied from the land. In addition, the bay waters have a high basic productivity, are abundant in prey organisms, and provide a place to hide from predators, so they serve as a spawning and breeding ground for many aquatic organisms. However, in the waters of Gomso Bay, located between Buan-gun and Gochang-gun in Jeollabuk-do, the area of the intertidal zone has decreased by about 20% due to continuous land reclamation due to recent industrialization and urbanization, and about 90% of the coastline has been converted into an artificial coastline. These changes have a direct impact on existing benthic organisms because they reduce the amount of sediment supplied from land, and ultimately affect the entire coastal ecosystem through the food chain. However, recent research on fisheries biological resources in Gomso Bay waters is very lacking. Therefore, the purpose of this study is to understand the environmental characteristics of Gomso Bay waters for aquatic organisms by analyzing the species composition and community structure of aquatic organisms living in Gomso Bay. This study conducted a total of 12 surveys in the waters of Gomso Bay, once a month from January to December 2022. The fishing gear used in the survey was the beam trawl, and was towed for 30 minutes at each of five stations in the Gomso Bay. A total of 94 species, 20,246 individuals, and 602,828g of aquatic organisms were caught during the survey period. Among them, fish were the most numerous with 56 species, followed by 21 species of crustaceans, 8 species of shellfish, and 5 species of cephalopods. As for the catch population ratio by fish species, *Leiognathus nuchalis* accounted for 14.0% of the total population, followed by *Portunus trituberculatus* (12.1%), *Oratosquilla oratoria* (10.4%), *Crangon hakodatei* (9.9%). As a result of community structure analysis, the species diversity index was in the range of 1.72-2.56, the highest in January and the lowest in August. The evenness index was in the range of 0.52-0.90, the highest in January and the lowest in May. The richness index ranged from 2.39-5.20, the highest in June and the lowest in March. The dominance index was in the range of 0.32-0.67, the highest in August and the lowest in January.



## OT-6

CPUE standardization of sailfin sandfish (*Arctoscopus japonicus*) caught by the East Sea Mid-sized Danish seine fishery in Korean watersNa-Young Jung<sup>1\*</sup> and Sung-II Lee<sup>2</sup><sup>1</sup>Division of Fisheries Physics, Pukyong National University, Busan 48516, Republic of Korea<sup>2</sup>Division of Marine Production System Management, Pukyong National University, Busan 48516, Republic of Korea

CPUE is used for stock assessment as an index of stock quantity, but for more accurate stock assessment, standardization of CPUE is needed to remove spatial, temporal, and environmental factors that affect CPUE. In this study, CPUE standardization of sailfin sandfish caught by the East Sea Mid-sized Danish seine fishery was conducted using the data of radio station from 2004 to 2022. The data used for the CPUE standardization include fishing date and location (30'x30' in latitude and longitude), catch (in weight) of sailfin sandfish, and effort (fishing days). The CPUE standardization was carried out using Generalized Linear Model (GLM). The explanatory variables used in the GLM were year, quarter, and area. The results of the GLM showed that the quarter was the most influential factor, followed by area. When comparing the nominal CPUE with the standardized CPUE, there was a little difference in trend, but a significant difference between the two values. Both CPUEs increased from 2004 to 2017 and have decreased since 2018, but recently the standardized CPUE is showing a stable trend at a low level. The highest values for both CPUEs were shown in 2017, with values of 1.7 ton/day and 0.9 ton/day, respectively, but these two values have a large difference. This difference is due to the effect of quarter that largely affects the CPUE.

OT-7

## Species identification and tempo-spatial distribution of anchovy using by multi-frequeuncy

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This study utilized the dB-difference method to identify the echo signals of anchovies in the echogram, and identified the day and night distribution characteristics of anchovies based on this. Using the difference in frequency characteristics of 18, 38, 70, 120, and 200 kHz, the dB-difference intervals of  $-2.1 \text{ dB} \leq \Delta \text{MVBS}_{18-38} \leq 4.4 \text{ dB}$ ,  $-9.7 \text{ dB} \leq \Delta \text{MVBS}_{70-38} \leq 1.3 \text{ dB}$ ,  $-10.2 \text{ dB} \leq \Delta \text{MVBS}_{120-38} \leq 2.3 \text{ dB}$ , and  $-10.7 \text{ dB} \leq \Delta \text{MVBS}_{200-38} \leq 0.3 \text{ dB}$  were set to extract the echo signals of anchovies. The echo signals of anchovies extracted by the frequency difference method were integrated at EDSU intervals of 1.0 n.mile and expressed as an extracted area scattering coefficient value per nautical mile to understand the distribution characteristics of anchovies. The results showed that in the East and South Seas, anchovies had a relatively higher distribution inshore than offshore, and a higher distribution density in May when the water temperature was high than in February when was low. Furthermore, anchovies were found to be mainly distributed in the water level at depths of 30–70 m during the daytime; whereas they were found at depths of 30–50 m and up to 150 m at night. The results of this study are expected to serve as a basis for further research on species identification of anchovies using acoustics.

## OT-8

Density estimating comparison of Antarctic krill (*Euphausia superba*) in South Shetland island by using 2 post-processing analysis methodsSara Lee<sup>1\*</sup>, Inwoo Han<sup>2</sup>, Sangdeok Chung<sup>3</sup>, Wooseok Oh<sup>4</sup> and Kyoungsoon Lee<sup>5</sup><sup>1</sup>Department of Fisheries Physics, Pukyong National University, Busan 48513, Korea<sup>2</sup>Cetacean Research Institute, National Institute of Fisheries Science, Ulsan 44780, Korea<sup>3</sup>Division of Distant Water Fisheries Resources, National Institute of Fisheries Science, Busan 46083, Korea<sup>4</sup>Institute of Low-Carbon Marine Production Technology, Pukyong National University, Busan 48513, Korea<sup>5</sup>Division of Marine Production System Management, Pukyong National University, Busan 48513, Korea

In this study, the acoustic data collected using the scientific echosounder installed on commercial fishing vessels were used to estimate the density and biomass of Antarctic krill in the waters surrounding South Shetland island (Subarea 48.1) using acoustic analysis methods proposed by CCAMLR. The catch amount of Antarctic krill by a mid-water trawl gear was found to be higher in the coastal waters of Elephant Island than in South Shetland Island, and the distributed density was particularly high near the coast of Elephant Island. The length of A. krill caught using the midwater trawl fishing gear ranged between 22.0 and 67.0 mm (Avg.±SD: 49.06±4.15 mm). Two methods, swarm-based method and dB-difference method, were used to compare and estimate the density values of A. krill. The swarm-based method is a data processing method proposed by Cox in SG-ASAM-17/02 in 2017 that uses the detect schools function of acoustic data analysis software to extract krill schools. The dB-difference method utilizes the characteristic that the target strength of krill varies with frequency to estimate density. The average density of krill analyzed by the swarm-based method was 48.15 g/m<sup>2</sup>, while the average density of krill analyzed by the dB-difference method was 36.50 g/m<sup>2</sup>. As a result of determining the correlation between transects through T-test, the Pearson correlation coefficient was 0.99, showing no significant difference ( $p>0.05$ ).

OT-9

## Real-time monitoring system for marine life in the vicinity of nuclear power plants

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Recently, the number of jellyfish has been increasing on the coast of Korea due to the influence of climate change, and in particular, the number of cases of damage has been reported due to a rapid increase in the number of jellyfish. In particular, power plants take in and use nearby seawater for cooling the generator, and when jellyfish enter the intake, the intake is blocked, resulting in damage such as a decrease in power output or power generation suspension. The blockage of the power plant intake is caused not only by jellyfish but also by small marine organisms such as shrimp and salpa, so it is urgent to come up with various measures to prevent the inflow of these marine organisms. In 2021, cases of damage to nuclear power plants due to the influx of domestic marine life were recently reported. There are various cases of the inflow of marine life from abroad, and in major countries such as the United Kingdom, the United States, and Japan, jellyfish flowed into the cooling intake, causing damage such as shutdown of power plants. Nuclear power plants installed disaster prevention facilities (screen, blocking net, etc.) around the intake port to block the inflow of marine life, and as a result, the damage was significantly reduced compared to before, but large and small damage still occurred. Currently, most of the monitoring of marine life around the intake is conducted by humans, and it is difficult to determine the exact number of people because these monitoring ranges are limited to sea level. In addition, manpower monitoring is carried out around the intake port, but there are many difficulties in efficient disaster prevention activities because organisms have already flowed into the intake port in large quantities. As a result, various methods and technologies are applied to prevent the inflow of marine life into the intake port and reduce damage, but due to many limitations, efficient monitoring technology is needed than the current method. In this study, a basic water tank experiment was conducted using a Biosonics DT-X 120 kHz scientific fish group detector, and a sea buoy was installed around the intake of a nuclear power plant, and acoustic data was collected using a two-way communication system between sea and land. Through this study, we developed a buoy-type monitoring system for the appearance of harmful organisms around the water intake of nuclear power plants using sound to prepare countermeasures against the inflow of marine life into the water intake of nuclear power plants, and prepared basic data to prepare prevention measures from marine life. did.

OT-10

## Towards safer fishing vessels: Utilization of digital technologies for safe fishing vessel design and operation

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Fishing is considered one of the most hazardous occupations worldwide, and fishing vessels, in particular, face several challenges that make them more vulnerable to accidents. These challenges include harsh operating condition, complex operations, economic pressures, aging fleet, equipment entanglements, lack of safety culture, etc. Consequently, 65.7% of all maritime accidents in South Korea were fishing vessel accidents in 2021. Therefore, it is necessary to improve the safety of fishing vessels.

To address this, several strategies are available. One approach involves administrative measures that benchmark European regulations and policies to improve those in South Korea. Another strategy is to utilize advanced digital technologies like AI and IoT. This study introduces two methods to enhance the safety of fishing vessels using such advanced digital technologies. Firstly, we can employ AI technology for design of safer fishing vessels. By developing standard safety modules for fishing vessels – encompassing hull shape, propulsion system, and fishing system - it is possible to establish a safety design data platform that utilizes AI technology to combine and validate these modules in various configurations. Secondly, the development of IT and IoT technologies enables real-time risk assessment and alert systems for fishing vessels. Based on real-time data, like vessel status, weather condition, nearby traffic, and seabed topography, we can instantly and continually evaluate the potential risk that a fishing vessel might face at each moment. As situations change, the system can send timely alerts that are tailored to the specific conditions and needs of fishermen, ensuring they have the best possible information to make safe decisions.

Technologies from the Fourth Industrial Revolution present a significant opportunity for enhancing fishing vessel safety. Therefore, continuous efforts are needed to improve the safety of fishing vessels by employing AI, IoT, and various digital technologies.

OT-11

## A study on the co-existence of offshore wind and fishing activities

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This study examined the coexistence of offshore wind power and fishing activities through domestic and international literature data and coexistence cases, and analyzed the difference in perception of offshore wind and fishing activities by region and fishing method to suggest ways to coexist with offshore wind and fishing activities at a time when domestic fishermen have been delayed for several years. as a result of analyzing a total of 84 questionnaires, the perception of the co-existence of offshore wind and fishing activities was 50% the same, and there was a significant difference in the cross-analysis of the co-existence of offshore wind and fishing activities by region ( $p<0.05$ ), and there was no significant difference by fishing method. In Gochang, the denial of the co-existence of the two parts was higher at 62.1%, and the reason for the denial was high because the fishing resources are expected to decrease due to the effects of noise, vibration, and current from offshore wind complex facilities, and Gunsan also showed 57.7% of the irregularities, and the reason for this was that it was not possible to operate in the offshore wind complex due to the nature of the fishery. on the contrary, in the case of Buan, 69.0% of the respondents answered positively to the co-existence of the two parts, and for that reason, 'because they are dissatisfied with the current co-existence plan (policy).

OT-12

## Analyzing fatalities in commercial trap fishing boats: Estimating reduction rates based on accident analysis and preventive guidelines

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Starting from January 27, 2024, the Severe Accident Punishment Act will apply to workplaces with 5 or more permanent employees but fewer than 50, including those in the fishing industry. Currently, there is a lack of readiness in these fishing vessels to comply with this law. To avoid punishments resulting from severe accidents like fatalities, captains and shipowners need to consistently record safety efforts made for the seafarers. These preventive measures are also expected to play a vital role in preventing accidents on fishing vessels. In this study, the authors analyzed fatal accidents on trap fishing boats over a 5-year period, provided preventive guidelines, and used Bayesian network inference to estimate the reduction rates in accidents when following these guidelines. In the trap fishery, there were 1,790 recorded accidents in the past five years. The major causes of these accidents, in order of frequency, were trip/slip, bump/hit, and stuck. Through Bayesian network inference, the authors discovered that the adoption of safety checklists and the correct usage of protective equipment have the potential to decrease fatality rates caused by trip/slip by 25.0%, bump/hit by 23.3%, and stuck by 26.2%.

OT-13

## A study on the improve to required competences for fishing vessel officers through improvement of the standards of recognized education and training institutes

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According to the recognized education and training institute on the Ship Officers Act on means a university, junior college, high school that administers education for persons intending to be seafarers or for seafarers (including any other school corresponding thereto), Korea Coast Guard Academy, Korea Institute of Maritime and Fisheries Technology established under the Korea Institute of Maritime and Fisheries Technology Act, or any other educational institution, as prescribed by Ordinance of the Ministry of Oceans and Fisheries.

All recognized education and training institutes have to do the standards required by ship officers act and A person get ship officer licenses who has undergone education and training required for licenses according to the classes. in addition, in order to reduce marine accidents caused by human error, improve the required competences for fishing vessel officers is required.

The standards of recognized education and training institutes stipulate how to educate ship officers for each course, but revision is required according to changes in the fishing vessel operation conditions. Recently, domestic laws and international conventions applied to fishing vessel have changed, and regulation for fishery are also being strengthened, so changes in the content of education are needed.

Therefore, in this study checked the contents of curriculum for fishing vessel officers and propose a revised plan and an educational improvement method to required competence for fishing vessel officers.



OT-14

## A study on fishing ship accident analysis using Bayesian networks

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Since Korea is surrounded by the sea on three sides, it is possible to capture a variety of aquatic life, and the industry is diverse, so the risk of marine accidents is relatively high. Fishing ships have different operating methods and navigation areas depending on the industry, and the causes of accidents and work environment factors are somewhat complex, so research on various analysis methods is necessary. In this study, data on two fishing ship maritime accidents were collected and quantified. The two types of data are the Marine Safety Tribunal's marine safety judgment decision and the Ministry of Oceans and Fisheries' situation transmission data. Among the two types of data, the Ministry of Oceans and Fisheries marine accident situation transmission data, which provided the fishing ship industry and accident location, which are considered important in fishing ship marine accidents, was selected as appropriate data for analysis. In order to determine the cause of the accident, the causes of each accident type were investigated through the opinions of subject matter experts(SMEs). The causal relationships of each accident factor were analyzed using a Bayesian network using classified data and expert opinions. Approximately 70% of most fishing ship accidents are caused by human factors, and in the future, we plan to classify them by industry and conduct cause and risk assessment for each type of accident.

## OM-1

## Finding normal states of the microbiome for the pathobiome study

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In contemporary disease aetiology, the conventional paradigm of one pathogen-one disease has encountered challenges. Empirical evidence suggests that the mortality events are often caused by multiple symbionts, host, and environment interactions. Thus, the concept of pathobiome (i.e., dysbiotic communities) has emerged to explain the status of assemblage that results in deleterious effects on the host's fitness. In order to identify pathobiome, it is essential to comprehend the microbiome in the 'normal' state of hosts across a wide range of environmental axes and geographical regions. The metabarcoding approach has revolutionised microbiome studies over the last decade with NGS technology, and the method offers numerous advantages, including improved reproducibility, decreased batch effects, and higher data productivity within a reasonable budget. Here, we try to build a database for the microbiome using eDNA and gill tissue of oyster species from Northwestern Pacific Ocean encompassing Korea (N = 8), Taiwan (N = 2), and Philippines (N = 1). All individuals were collected from their natural habitats, and no obvious mortality events were observed across the sampling sites. eDNA samples were extracted after collecting 2 L of surface water from Korean coast. In total, 2,307 OTUs identified from both eDNA and hosts. Our result indicates that the microbiome diversity differs in different geographic regions but is similar in different environmental conditions, and hosts. The PCA results showed differences in community composition by region, with the west coast of the Korean Peninsula forming a cluster with Taiwan and the Philippines, and the south coast and Gangneung on the east coast forming distinct cluster despite being geographically related to the west coast. On the other hand, the bacterial diversity within the hosts showed lower alpha diversity compared to the diversity in seawater, implying that certain species can be strongly correlated with the hosts. The study identified the community composition of the various microorganisms present in the host, which is expected to provide fundamental resources for assessing and managing the oysters.

## OM-2

Isolation and characterization of sympatric isolate of *Sphaeroforma* sp. belong to Mesomycetozoea class from Pacific oyster, *Crassostrea gigas*Dong-Hyun Lee<sup>1\*</sup>, Hyoun-Joong Kim<sup>2</sup>, Hyung-Bae Jeon<sup>1,2</sup>, S.D.N.K. Bathige<sup>2</sup> and Kyung-Il Park<sup>1,2</sup><sup>1</sup>Department of Aquatic Life Medicine, College of Ocean, Sciences and Engineering, Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea<sup>2</sup>Research Institute for Fisheries in Offshore Wind Farm (RIFO), Kunsan National University, 558 Daehakro, Gunsan 54150, Republic of Korea

The domestic oyster industry in South Korea accounted for 10.9% of the global production in 2020, making it a significant marine resource. The global aquaculture industry is rapidly growing, leading to increased concerns about oyster diseases. A significant portion of domestic oyster production, primarily Pacific oysters (*Crassostrea gigas*), is concentrated along the southern coast, particularly in the Tongyeong region. Consequently, research on oyster pathogens is of vital importance.

In this study, we aimed to morphologically classify cells isolated from the gill tissues of Pacific oysters along the southern coast of South Korea and establish a classification system based on the results of PCR products. A partial sequence of 18S rDNA sequence (1,191 bp) was retrieved from basic molecular biology techniques, and characterized bioinformatically. The sequence exhibited 100% identity with the highly homologous DNA sequence of *Sphaeroforma nootkatensis* available in the NCBI. Phylogenetic analysis was performed using the Geneious Prime 2023.1.2 software, revealed a close relationship with *Pseudoperkinsus tapetis* in the Mesomycetozoea family. Morphological features were examined under a light microscope and scanning electron microscope, showing striking resemblance to features observed in other members of this family.

However, there is limited research on this species in South Korea and globally, specifically in Pacific oysters. Therefore, further research on the isolated *S. nootkatensis* species is essential. This research will help elucidate its pathological characteristics and specific features, contributing to a better understanding of oyster health disease management.

## OM-3

## First Report of *Bonamia ostreae* Infection in Native Flat Oysters (*Ostrea denselamellosa*) from the West Coast of Korea

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*Bonamia ostreae*, a haplosporidian parasite causing bonamiosis, has been associated with the decline of oyster population particularly in Europe, eastern and western regions of North America, and New Zealand. However, it has not been reported in South Korea. Due to its rapid infectivity and high pathogenicity, *B. ostreae* is classified by the World Organization for Animal Health (WOAH) as a notifiable disease. Identifying this parasite is essential as it could support for disease management in oyster farms in South Korea.

In this study, we aimed to identify the presence of *B. ostreae* in native oysters. Flat oysters (*Ostrea denselamellosa*) were collected from the west coast region, and hemolymph and gill tissues were collected. Total DNA was extracted from gill tissues, and the conventional PCR, recommended by WOAH as the gold standard method, was conducted to amplify the 18S rDNA gene using species-specific primers. Subsequently, the PCR products were sequenced to confirm the amplification.

The DNA sequencing results revealed that the amplified PCR product is completely matched with the existing sequence of the *B. ostreae* (AF262995) at the NCBI database with 100% identity. Further, it was confirmed by phylogenetic analysis. Thus, these results confirmed the presence of *B. ostreae* parasites in Korean flat oysters for the first time. Additional studies are ongoing to confirm the prevalence and the infection intensity of this species. However, ongoing monitoring practices are required to prevent potential future outbreaks.

## OM-4

First isolation of protist *Thraustochytrium* sp. from Undulated Surf Clam  
(*Paratapes undulatus*) in southern area of Taiwan

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With globalization and international ship trades, as well as the activity of ocean currents, the transportation of aquatic animal pathogens such as parasites, bacteria and viruses has significantly increased worldwide. In Korea, the Tsushima Warm Current, a branch of the Kuroshio Warm Current originating from the North Pacific Ocean, plays a crucial role in the spread of tropical and subtropical aquatic pathogens to South Korean waters, affecting aquatic animals. During this process, some marine organisms can evade the pathogens by changing habitats, while other benthonic animals with low swimming capacities can be easily affected by these transported pathogens. Shellfish, being economically significant in the Korean aquaculture industry, require vigilant disease surveillance and prevention. Given the limited understanding of the influence of tropical and subtropical pathogens on domestic shellfish, our aim is to isolate warm-water pathogens from tropical areas and verify their pathogenic effects on Korean shellfish.

In this study, we randomly collected 30 undulate surf clams (*Paratapes undulatus*) from Kaohsiung city, Taiwan. Gill tissue fragments were individually cultured in Dulbecco's Modified Eagle Medium (DMEM) and Ham's F-12, supplemented with nystatin and penicillin-streptomycin to suppress bacterial and fungal growth. Subsequently, the protists were isolated through gradual dilution with DMEM in a 96-well plate until only a single protist remained. Finally, we successfully isolated a particular kind of protist and sub-cultured it in a new 6-well plate. Following this, DNA was extracted from the monocultured cells, and conventional PCR was performed using universal protozoan primers. The PCR products were sequenced, and the isolated protists were characterized as *Thraustochytrium* sp. based on the NCBI BLAST results. Different stages of the life cycle of this species were morphologically characterized using microscopes. Further studies are required to evaluate the pathogenicity of newly isolated protist against mollusks, including manila clam and oysters in Korean waters. This will provide useful information for the aquaculture industries in Korea for disease management.

## OM-5

Distribution patterns of the chemosynthetic marine bivalve *Pillusina pisidium*  
(Family: Lucinidae) in seagrass beds in Korean waters

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Members of the family Lucinidae are known to have a mutualistic relationship with chemosynthetic bacteria, as the host bivalves supply sulfides to chemosymbiotic bacteria residing in their gills, and the bacteria furnish the host with organic compounds produced through sulfide oxidation. Numerous species in the family Lucinidae are found in the subsurface of seagrass beds, where the sediments are anoxic or hypoxic and enriched with sulfides. In this unique environment, the symbiotic bacteria convert highly toxic sulfide into less harmful sulfate, fostering an amenable environment for seagrass growth. Despite Lucinidae's ecological significance, scant information about lucinid bivalves is available in Korean waters. A recent discovery of the lucinid clam *Pillusina pisidium* and their association with chemosynthetic bacteria in a seagrass bed on Jeju Island suggested a high possibility of the presence of the symbiotic lucinid clams in other seagrass beds in Korean waters. This study surveyed *P. pisidium* in various seagrass beds in Korean waters, including *Zostera marina*, *Z. japonica*, and *Phyllosapdix iwatensis* on the south and east coasts. The survey indicated that *P. pisidium* occurs in *Z. marina* beds in Ulleungdo, Geoje, Pohang, and Jeju Island exclusively, as they thrived in the subsurface of sandy-silt sediments, reaching the densities of up to 372 individuals/m<sup>2</sup>. In contrast, no *P. pisidium* populations were found in *Z. marina* beds in Seocheon, Jindo, Yeosu, and Goheung, where *Z. marina* was distributed on muddy sediment. Accordingly, it was believed that the sediment type in seagrass beds plays a pivotal role in *P. pisidium* colonization, as the clams favor the sandy silt environment to create channels for oxygen and sulfur uptake. The sandy-silt sediment in *Z. marina* seagrass beds seemed to play a vital role in the post-settlement *P. pisidium* larvae, as the newly settled larvae uptake the symbiotic bacteria from the sediments enriched with the sulfur-oxidizing bacteria.

OM-6

Prevalence and infection intensity of *Perkinsus olseni* in venerid clams  
*Protothaca jedoensis* occurring on the south coast of Korea

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Perkinsosis is a protozoan disease eliciting lethal and sublethal impacts on some commercially important marine mollusks, including oysters, clams, and abalones. In Korean waters, *Perkinsus olseni* has been identified as a perkinsosis agent impacting venerid clam *Protothaca jedoensis*. We examined *Perkinsus olseni* infection in *P. jedoensis* clams collected from a subtidal area in Yeosu on the south coast. A total of 200 clams were collected and examined *P. olseni* infection using RFTM assay and histology. The RFTM results indicated that 4.5% of the examined clams were infected with *P. olseni*, with an average infection intensity of  $1.1 \times 10^4$  cells/g gill, highlighting the presence of *Perkinsus olseni* in the area. Furthermore, 1% of the clams exhibited metacercaria infection, suggesting potential interactions with other parasites. Histology revealed the digestive gland atrophy (DGA) level was a favorable overall condition, with an average DGA score of 1.58 out of 4, suggesting that the clams in this region are in good condition. This report provides valuable insights into the prevalence and characteristics of *P. olseni* infection in *P. jedoensis* on the south coast, contributing to our understanding of the health and ecology of this economically and ecologically important species in Korean coastal waters.

## OM-7

## First report of *Perkinsus marinus* parasite in native Pacific oyster, *Crassostrea gigas* from west coast Korea

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*Perkinsus marinus* is a well-known pathogen associated with severe infections and economic losses in oyster aquaculture industries worldwide. Owing to its profound pathogenic and economic implications, this pathogen has been classified as notifiable by the World Organization for Animal Health (WOAH). Surprisingly, there have been no reported isolations of *P. marinus* from South Korea, a major oyster exporter. Given the country's position as the second-largest exporter, monitoring critical pathogens becomes essential.

In this study, we conducted a comprehensive investigation to assess the presence of *P. marinus* in native Pacific oysters (*Crassostrea gigas*) collected from the West Coast area of South Korea. Hemolymph and gill tissues were collected from oysters as possible tissues for further studies. Total DNA was extracted from gill tissues and the conventional PCR was performed using WOAH-recommended primers. Subsequently, the PCR products were sequenced. Fragments of gill tissue and hemolymph were cultured in the DMEM: Ham's F-12, a standard culture medium for *Perkinsus* sp. cells for further characterization. Morphological evaluations of cultured cells were performed using a light microscope, and additional tests, such as the culture of parasites in Ray's Fluid Thioglycollate Medium (RFTM) followed by Lugol staining were conducted.

Results from sequencing of the PCR product and RFTM confirmed the presence of *P. marinus* in *C. gigas*, albeit with a low infection density. The morphological features of cultured cells further corroborated the presence of *P. marinus* pathogens. This pioneering discovery holds significant implications for the management and health monitoring of oyster populations in Korea. Continued research is vital to comprehensively understand the prevalence, impacts, and potential mitigation strategies associated with *P. marinus* in this region, ensuring a sustainable and thriving oyster aquaculture industry.



## OM-8

## Changes in the species composition of mollusca according to changes in the environment of Gyeongpo Lake

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Gyeongpo Lake is known as a natural lagoon, known as have high biodiversity cause of characteristics of brackish water (salty ocean mixes with a freshwater river). Recently, mass media reported that the rapid environmental changes in Gyeongpo Lake, according to climate change and human activities. These current natural phenomenon can cause of serious changes in biodiversity. In this study, a list of mollusks species was constructed through precedent research review from 1997 to 2018. Also, The survey to Gyeongpo Lake has executed in May 2023, to find out the changes in the composition of mollusca species according to environmental changes. Precedent research were reviewed using databases such as ScienceOn (Web based DB) and NTIS, from 1997 to 2018. We confirmed that 19 species of 16 families of 11 orders have been reported. Based on precedent research, we selected two collection sites in Gyeongpo Lake. As a result of collection, 5 species of 4 families were found ; *Crassostrea gigas* (Bivalvia: Ostreidae), *Mytilus galloprovincialis* (Bivalvia: Mytilidae), *Arcuatula senhousia* (Bivalvia: Mytilidae), *Potamocorbula amurensis* (Bivalvia: Corbulidae), and *Batillaria cumingii* (Gastropoda: Batillariidae). According to previous studies, there were records of freshwater shellfish such as *Physa acuta* (Gastropoda: Physidae) and *Hippeutis cantori* (Gastropoda: Planorbidae), but in this survey, we only confirmed saltwater shellfish's inhabit. Based on these results, it was confirmed that the species living in the brackish water lake are changing due to environmental changes. Our results could be used as basic data to evaluate environmental changes.

OM-9

## Transcriptomics and Flow Cytometry Analysis of the Pacific oyster (*Crassostrea gigas*) Hemocytes in Response to Hypoxia and Elevated Water Temperature

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Hypoxia, accompanied by high water temperatures in summer, often results in catastrophic consequences to aquatic animals. This study used transcriptome profiles and flow cytometry to investigate the effects of hypoxia and elevated water temperature on cellular immune responses in the Pacific oyster *Crassostrea gigas*. In the experiment, oysters were exposed to a single stress condition of hypoxia (water temperature of 22.8°C and DO level of 1.02mg O<sub>2</sub>/L), and combined stress conditions of hypoxia and high water temperature (water temperature of 28.2°C and DO level 1.01mg O<sub>2</sub>/L) for ten days. To monitor the hypoxia and the thermal stresses on oysters, we measured the total hemocyte count (THC), hemocyte mortality, nitric oxide (NO) production, phagocytosis, and oxidative capacities of oyster hemocytes using flow cytometry. The transcriptome sequence of oyster hemocytes was also analyzed, and we adapted the Gene Ontology (GO), and the Kyoto Encyclopedia of Genes and Genomes (KEGG) to identify all immune-related differentially expressed genes (DEGs). The RNA-Seq results indicated that hypoxia and high water temperature altered the expression of hemocyte immune-related genes. Compared to the control oysters, the treated oysters showed up-regulated DEGs in cellular DNA replication involved in repairing damaged cells. In contrast, the DEGs engaged in cell movement, reactive oxygen species (ROS) metabolic process, lysosome, L-phenylalanine metabolic process, phagosome, and Wnt signaling pathway were down-regulated. Flow cytometry indicated that THC, hemocyte mortality, NO production in the oysters exposed to single stress and combined stresses were increased, whereas the phagocytosis and oxidative capacities of the hemocytes were decreased. Based on the transcriptome analysis and flow cytometry obtained in this study, it was concluded that hypoxic high thermal stresses substantially alter immune-related genes and cellular responses of oysters, which may lead oysters in lethal or sublethal condition.

## OM-10

## A review of the endangered mollusks transcriptome under the threatened species initiative of Korea

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Transcriptome studies for conservation of endangered mollusks is a proactive approach towards managing threats and uncertainties facing these species in natural environments. The population of these species is declining due to habitat destruction, illicit wildlife trade, and global climate change. These activities risk the free movement of species across the wild landscape, loss of breeding grounds, and restrictions in displaying the physiological attributes so crucial for faunal welfare. Gastropods face the most negative ecological effects and have been enlisted under Korea's protective species consortium based on their population dynamics in the last few years. Moreover, with the genetic resources restricted for such species, conservation by informed planning is not possible. This review provides insights into the activities under the threatened species initiative of Korea with special reference to the transcriptome assemblies of endangered mollusks. The gastropods such as *Ellobium chinense*, *Aegista chejuensis*, *Aegista quelpartensis*, *Incilaria fruhstorferi*, *Koreanohadra kurodana*, *Satsuma myomphala*, and *Clithon retropictus* have been represented. Moreover, the transcriptome summary of bivalve *Cristaria plicata* and Caenogastropoda *Charonia lampas sauliae* is also discussed. Sequencing, *de novo* assembly, and annotation identified transcripts or homologs for the species and, based on an understanding of the biochemical and molecular pathways, were ascribed to predictive gene function. Mining for simple sequence repeats from the transcriptome have successfully assisted genetic polymorphism studies. A comparison of the transcriptome scheme of Korean endangered mollusks with the genomic resources of other endangered mollusks have been discussed with homologies and analogies for dictating future research.



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## Poster Presentations

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- ◎ ISK : PF-1 ~ PF-33
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- ◎ MSK : PM-1 ~ PM-7



PU-1

## Astaxanthin in *Haematococcus pluvialis* as a promising therapeutic for neurodegeneration caused by Parkinson's disease - A scientific mini review

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Parkinson's disease (PD) is a neurodegenerative disorder characterized by the loss of dopaminergic neurons in the substantia nigra. The cause is unclear but linked to factors like lifestyle, age, endoplasmic reticulum and mitochondrial dysfunction, gender, environment, and external factors. According to the World Health Organization (WHO), disability and death due to PD are increasing faster than for any other neurological disorder in the world. Also, prevalence of PD has doubled in the past 25 years. Current treatments for PD mainly alleviate motor symptoms, while debilitating non-motor symptoms impairing the life quality of PD patients. The main consequences of PD are oxidative stress and mitochondrial impairment, with free radicals and oxidative stress causing dopamine cell degeneration.

Astaxanthin, a natural carotenoid with super antioxidant properties, has been reported to show protective effect on brain content from oxidative stress, neuronal cell death, and brain aging. *Haematococcus pluvialis*, a commercially important marine microalga, accumulates the highest reported red ketocarotenoid astaxanthin (3,3'-dihydroxy- $\beta,\beta$  carotene-4,4'-dione) content for any microorganism achieving up to 4–5% of dry weight. Also, it has crossed the blood-brain barrier in mammals, suggesting it could be a potential brain pharmaceutical. AST has been found to prevent apoptosis caused by MPTP and MPP<sup>+</sup> in substantia nigra neurons in mouse models of PD and human neuroblastoma cells. Moreover, astaxanthin has abolished cell viability inhibition and apoptosis promotion in SH-SY5Y cells by inhibiting ER stress and targeting the miR-7/SNCA axis. Astaxanthin may be a potent candidate for an anti-cell death compound that modifies PD progression.

Currently, no effective therapeutic measures exist to conquer neurodegeneration or restore dopaminergic neuron loss in Substantia Nigra. Scrutinizing more effective agents is crucial to achieve this goal. This scientific mini review carefully reviews the currently available scientific research articles that bring out clues for exploring the therapeutic potential of astaxanthin for treating PD.

PU-2

## Elemental composition and content ranges for artificial sea salt manufacturing

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Sea salt is the hexagonal, translucent crystals that remain after seawater is evaporated by sunlight and wind in salt flats. It is composed primarily of sodium chloride and contains many minerals. Depending on the mineral composition of the seawater and how it is made, sea salt has different mineral types and content. After the explosion at the Fukushima nuclear power plant in Japan, the release of stored contaminated water into the ocean began. The release of radioactive contaminated water into the ocean has resulted in contamination of marine fisheries and exposure to the food chain. Sea salt, a concentrate of seawater, is an essential food for making and storing food, including kimchi. It can be a mixture of various minerals present in seawater, mainly elements of the first and second groups of the periodic table. Radioactive materials released into the ocean by the Fukushima Daiichi nuclear power plant in Japan are traveling in ocean currents and reaching the South and East Seas of Korea within two years. The altered elemental concentrations in the seawater can be expressed in sea salt, a seawater concentrate. In this study, sea salt was collected from salt fields located in the South and West coasts of Korea from August to October. The elements in the sea salt were measured by ICP-MS and ICP-AES, and the content ratios were investigated. The content ranges of major 12 elements including Na, Ca, Mg, K and S were identified. The data can be used as a basis for the production of clean artificial sea salt that is not contaminated with radioactive substances or heavy metals.



PU-3

## Manufacturing of functional low-salt seasoned Gim (김) using marine microalgae spirulina

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Domestic consumption of seasoned seaweed has been increasing by 2% every year in recent years, and overseas exports are also increasing by 10-18% every year. However, there have recently been concerns that salt used in seasoning may affect metabolic diseases, so spirulina was used as a sweetener to produce low-salt Gim that meets consumer demand. To achieve this, spirulina seasoning conditions were adjusted to conditions suitable for the seasoned Gim manufacturing process. As the result, the salt content was 5% lower in spirulina-seasoned Gim than the pre-existing seasoned Gim. And ROS (reactive oxygen species) scavenging activity of the final product, spirulina-seasoned Gim, was also evaluated. To investigate this, zebrafish embryos were pretreated with spirulina according to the concentrations (0, 0.25, 0.5, 1 mg/mL) and then treated with 10 mM  $H_2O_2$ . In the result, the elevated ROS caused by  $H_2O_2$  was reduced by spirulina treatment in a dose-dependant manner ( $p < 0.005$ ). And also, NO (nitro oxygen) overexpression also reduced by spirulina pretreatment, In addition, sensory evaluation including taste, scent, texture and salty were recorded the average seven point with blind test. In conclusion, we produced functional spirulina-seasoned Gim that is lower in salt than pre-existing seasoned Gim with favorable. These result suggesting that the use of spirulina can be potential sweetener for seasoning Gim.

PU-4

## Comparison of antioxidant changes of algae with different extraction technologies

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Algae are classified as green, brown, and red algae according to their composition and pigment and also considered as an excellent source of antioxidant. The aim of this study was to investigate the comparison of antioxidant changes of algae depending on extraction technologies with conventional (CE, hot water and 95% ethanol), green (microwave assistant extraction, MAE), and combined green (microwave assistant extraction + ultrasound assistant extraction, MAE+UAE and microwave assistant extraction + high pressure processing, MAE+HPP) extractions. DPPH radical scavenging activity (%) and total phenolic content (TPC, mg/g) of algae extract with CE were ranged from 11.56 to 66.43% and 7.93 to 88.25 mg/g, respectively. DPPH and TPC of algae extract with optimum MAE condition through response surface methodology were ranged from 19.25 to 55.01% and 31.80 to 127.99 mg GAE/g, respectively. These with optimum MAE+UAE and MAE+HPP conditions were found to be higher than these of CE and MAE. Therefore, green extraction technology can be used as an eco-friendly extraction technology that can complement and replace existing extraction methods, and combining green extraction technologies will be more efficient and useful.

PU-5

## Determination of Optimal Processing Conditions of High Protein Laver Chip using Reaction Flavor Technology

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This study aimed to develop a high-protein and gluten-free laver chip with air-frying using reaction flavor technology by response surface methodology. To optimize the manufacturing process, we applied a central composite design with independent (X) and dependent (Y) variables, specifically methionine ( $X_1$ ), threonine ( $X_2$ ), and glycine ( $X_3$ ) and baked potato ( $Y_1$ ) and savory ( $Y_2$ ) odors. The optimal processing condition were determined with 0.54% of  $X_1$ , 3.30% of  $X_2$ , and 0.90 of  $X_3$ . Based on the optimal processing condition, predicted and measured  $Y_1$  and  $Y_2$  values were 6.5321 and 4.6537 and  $6.00 \pm 0.78$  and  $4.00 \pm 0.91$ , respectively. The difference between the predicted and measured Y values within 10% so, the predicted model for the optimal processing condition was validated. The laver chips exhibited high protein content(24.26%) and low-calorie content(371.56 kcal) compared to the commercial laver snack with oil frying. Further research into the physical characteristics of laver chips based on air-frying conditions was considered.

PU-6

## The inhibition of benign prostatic hyperplasia by *Ecklonia stolonifera* extract is related to the inactivation of 5- $\alpha$ reductase

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Benign prostatic hyperplasia (BPH) is highly related to sexual hormone metabolism and aging. In particular, dihydrotestosterone (DHT), to which testosterone is modified by 5 $\alpha$ -reductase (5AR), has a significant effect on BPH development. *Ecklonia stolonifera* is a brown alga that was shown to have antioxidant, anti-inflammatory, and chemopreventive activities. In this study, we examined whether potentials for improvement of DHT-induced BPH model using LNCaP prostate cells with *Ecklonia stolonifera* Extracts (ESE). Therefore, we confirmed the expression of androgen signaling-related factors, such as AR and PSA in LNCaP. Furthermore, we confirmed the androgen signaling inhibitory effect of DHT using the testosterone propionate (TP)-induced BPH rat model. *In vivo*, the BPH group showed an increase in prostate size compared with the control group. The ESE gavaged group showed a decrease in prostate size compared with the BPH group. In addition, the protein expressions of AR, 5AR2, and PSA were significantly lower in the ESE gavaged group than BPH group in prostate tissue. These results suggest the beneficial effects of ESE on BPH *via* the modulation of AR signaling pathway.

PU-7

## Anti-inflammatory effect of *Capsosiphon fulvescens* extract in LPS-treated RAW 264.7 macrophages through inhibition of NF- $\kappa$ B signaling pathway

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*Capsosiphon fulvescens* (CF) is a green alga that is known to be a nutrient-plentiful food as it contains a lot of minerals, vitamins and various functional polysaccharides. Although recent studies have reported various pharmacological properties of CF, the efficacy on inflammatory response remain unclear. This study was aimed to investigating the anti-inflammatory effect of CF on the lipopolysaccharide (LPS)-induced RAW 264.7 macrophages. CF attenuated NO and PGE<sub>2</sub> production by decreasing iNOS and COX-2 expression. CF also suppressed release of pro-inflammatory cytokines. Moreover, CF significantly attenuated activity and mRNA expression of metalloproteinases. Additionally, CF inhibited LPS-induced ROS levels, which was accompanied by markedly increased HO-1 in macrophages. CF inhibited FITC-LPS bound cells and TLR4 as well as protein levels of JNK, p38, ERK phosphorylation after LPS simulation. Furthermore, CF decreased the levels of pro-inflammatory cytokines associated with NF- $\kappa$ B activation similar to NF- $\kappa$ B inhibitor BAY7085. Our findings identify CF as a candidate NF- $\kappa$ B inactivator for the treatment and prevention of inflammatory disease.

PU-8

## Purification, Identification, and Function Analysis of ACE Inhibitory Peptide from *Gigantidas vrijenhoeki*

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The objective of this study was to prepare an angiotensin I-converting enzyme (ACE)-inhibitory peptide from the hydrothermal vent mussel, *Gigantidas vrijenhoeki*. The *G. vrijenhoeki* protein was hydrolyzed by various hydrolytic enzymes. The peptic hydrolysate exhibited the highest ACE-inhibitory activity and was fractionated into four molecular weight ranges by ultrafiltration. The <1 kDa fraction exhibited the highest ACE inhibitory activity and was found to have 11 peptide sequences. Among the analyzed peptides, KLLWNGKM exhibited stronger ACE inhibitory activity and an IC<sub>50</sub> value of 0.007 M. To investigate the ACE-inhibitory activity of the analyzed peptides, a molecular docking study was performed. KLLWNGKM exhibited the highest binding energy (-1,317.01 kcal/mol), which was mainly attributed to the formation of hydrogen bonds with the ACE active pockets, zinc-binding motif, and zinc ion. These results indicate that *G. vrijenhoeki*-derived peptides can serve as nutritional and pharmacological candidates for controlling blood pressure.

PU-9

## 5-Bromoprotocatechualdehyde inhibits colon cancer growth by inducing the ROS-inhibiting AKT signaling pathway

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Early asymptomatic lung cancer has the highest mortality rate in cancer. Therefore, we investigated anti-cancer activity of 5-bromoprotocatechualdehyde (BPCA) from polysiphonia morrowii Harvey (*P. morrowii*) in lung cancer H460 lung cancer cells. Dried *P. morrowii* powder was extracted thrice with 80% aqueous methanol at room temperature. The extract was separated using HPLC and the chemical structure was confirmed <sup>1</sup>H and <sup>13</sup>C NMR data. BPCA identified the anti-cancer activity by cell viability, apoptotic assay, ROS generation and protein expression. BPCA showed inhibition of tumor cell growth and induced decreased ROS generation which is associated with the induction of apoptosis through mitogen-activated protein kinase (MAPK) pathway and AKT signaling in lung cancer cells. The combination of BPCA and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), increased ROS production and apoptosis compared with non-treated group via regulation of AKT signaling and JNK MAPKs pathway. The result of the present study demonstrated that BPCA induced lung cancer cell death through ROS-mediated phosphorylation of AKT/MAPK signaling. Therefore, BPCA could be a beneficial and useful for treating lung cancer.

PU-10

## Volatile Flavor Compounds of Anchovy Sauce Derived through Reaction Flavor Technology

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Aim of this study was to develop a reaction flavor induced sauce (RFIS) using a commercial anchovy sauce (control) by reaction flavor technology and to identify and compare key aroma compounds. RFIS was produced by adding 1% (w/v) glucose and amino acids (threonine 0.5707%, glycine 0.8008%, and proline 0.5354%, w/v), which obtained by previous study, to control, and heating at 92 °C for 2 h in water bath. The volatile flavor compounds were identified using a solid-phase microextraction/gas chromatography/mass spectrometry (SPME/GC/MS). A total of 45 volatile flavor compounds were detected. Each group consisted of 10 aldehydes, 4 ketones, 5 alcohols, 14 nitrogen-containing compounds, 3 esters, 6 acids, and 3 other compounds. Among them, the content of nitrogen-containing compounds was the highest at 2,465.20 ng/g (RFIS). It was higher than the control (1,890 ng/g). Key flavor compounds of RFIS were dimethyl trisulfide, 3-methylbutanal, 2-ethyl-3,5-dimethylpyrazine, 3-ethyl-2,5-dimethylpyrazine, trimethylpyrazine, and 2-methylbutanal. These compounds were 2.41, 3.32, 1.17, 1.39, 1.16 and 3.44 times higher than these in the control, respectively. The developed RFIS has been enhanced backed potato, dark chocolate, nutty, and roasted flavor compounds compared to these in the control.



PU-11

## Identification and characterization of potential probiotic strains in sea cucumber gut microbiota

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Probiotics are living bacteria beneficial to the health of the host and have been studied to promote nutrient absorption, inhibit the growth of pathogens, and increase immunity. With the recent increase in research on probiotics, the discovery of marine-derived probiotics has become active. Herein, we focus on sea cucumbers as a potential resource for probiotics. Most sea cucumbers live in the deep sea, feeding on plankton and decaying organic matter, which is expected to create a diverse gut microbiome. The microflora distributed in the intestines of sea cucumbers were identified to isolate potential probiotic strains. The bacteria isolated from the intestines of sea cucumbers were tested on MRS agar containing  $\text{CaCO}_3$  to confirm lactic acid production. In order to determine their potential as probiotics, tests including the hemolysis, antibacterial activity, acid and bile salt resistance will be performed to identify the characteristics of the isolates. The probiotic strain candidates selected through these tests will be identified using 16S rDNA sequencing. Although this research is in a very early stage, we expect to obtain a new resource for probiotics that will enhance the value of sea creatures.

PU-12

## Eel byproduct Upcycling: Subcritical Water Extraction for Enhanced Flavor and Nutrition in Snack Production

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Eel heads, often disregarded in food processing due to their unappealing appearance and odor, represent a substantial portion, constituting 30%, of the eel body and offer exceptional nutritional value. This study explores the untapped potential of eel head by-products as a valuable protein resource for the food industry using subcritical water treatment, a method harnessing the unique properties of water at elevated temperatures and pressures. Subcritical water treatment is not only environmentally friendly but also safe for human consumption, making it an ideal solvent for processing underutilized eel parts rich in protein. We have obtained eel head subcritical water extracts under optimal conditions previously determined for flavor enhancement. These extracts were then employed in the production of fried snacks. Our analysis encompassed various physical and chemical characteristics, including color, oil content, expansion rate, thickness, texture, and microscopic appearance (Scanning Electron Microscope). Additionally, we conducted a flavor component analysis using GC-MS and evaluated taste components. Our findings demonstrate that snacks produced from these often-overlooked eel parts, using this clean processing method, offer significant nutritional benefits and enhanced flavor profiles. This research holds the promise of introducing high-value food products suitable for consumers of all ages and genders, while reducing waste and environmental impact in the food industry.

PU-13

## Utilizing functional substances from eel by-products for premium fish snacks

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In general, eels are rich in protein, vitamins, minerals, and polyunsaturated fatty acids, making them valuable marine resources. Among these, polyunsaturated fatty acids have significant physiological benefits, such as reducing blood cholesterol levels, promoting brain growth, and preventing heart disease, arteriosclerosis, and high blood pressure. They are widely utilized as ingredients for health-oriented food products. Eels are gaining attention as an excellent source of nutrition. However, by-products, such as heads and bones generated during processing, are often discarded or used as feed. To address this issue, our study aims to extract various functional ingredients from eel by-products and create premium snacks by incorporating these extracted elements. We used subcritical water to extract these functional materials and evaluated the physical properties, including color, MRPs, viscosity, and pH, of the extracted eel extract. Additionally, physiological antioxidant activity (ABTS, DPPH, FRAP, and Reducing Power), molecular weight, and amino acid composition were evaluated, and flavor components were evaluated using GC-MS. Through this analysis, we selected the optimal temperature conditions, the eel extract (EE) extracted under these conditions was applied to fish snacks to produce premium eel snacks. Through this study, it is expected to make a positive contribution to waste reduction by employing eco-friendly extraction methods, including high-value materials and subcritical water, for eel by-products, while also fostering the development of locally specialized eel snack products.

PU-14

## Preparation and nutritional characteristics of oyster (*Crassostrea gigas*) concentrated powder as a food processing material

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Oysters (*Crassostrea gigas*) are one of the major marine shellfish resources, with 306,029 M/T produced in 2021, accounting for more than 70% of total shellfish production. In Korea, raw oysters are mainly consumed, or they are processed into individually quick frozen (IQF) or steamed oysters (S) and used as ingredients for cooking and processing.

In this study, freeze-dried concentrate (FDC), steamed-freeze dried concentrate (SFDC) and steamed-hot air dried concentrate (SDC) were prepared from IQF and S through vacuum freeze-drying and hot air-drying, respectively. The nutritional properties of these concentrated powders were analyzed, and their storage stability and nutritional enhancement effects as food processing materials were investigated. Among oyster concentrates (OCs), the yield of FDC was 15.8%, and that of SFDC and SDC was 31.8 and 33.4%, respectively. The proximate compositions of OCs ranged from 0.1 to 2.8% moisture, 41.0 to 45.1% crude protein, 8.6 to 10.3% lipid, 4.0 to 6.3% ash, and 37.1 to 45.3 carbohydrate. The major amino acids in OCs were essential amino acids Lys, Leu, Arg, and Phe, and the non-essential amino acids were Glu, Asp, Gly, and Pro. The macro mineral components of OCs were Na, K, P, and S, and the trace mineral components were Zn, Cu, Fe, and Mn. Hunter's color values show that the L value and whiteness of FDC and SFDC are significantly higher than those of SDC (55.3 and 51.0), while the a value (3.11) and b value (19.8) of SDC are significantly different compared to FDC and SFDC. The volatile component intensity (VCI) and ammonia content of OCs were the highest in FDC at 973.2 level and 1,852.9 mg/100 g, respectively, followed by SFDC and SDC. Protein molecular weight distribution by electrophoresis was observed to be no different between OCs depending on the drying method. From the above results, the concentrated powder (OCs) manufactured from IQF and steamed oysters according to the drying method was confirmed to have a concentration effect on food nutrients and storage stability due to powdering, suggesting the possibility of use as a food material for nutritional enhancement. Therefore, oyster concentrate powder (OCs), as a material for food processing, can be applied to the development of new seafood fusion foods and can help in the sustainable production/consumption of oysters.

PU-15

## Comparison of *Codium fragile* treated with different desalination processes

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Excessive salt consumption is associated with an increased risk of cardiovascular diseases, prompting global recommendations to reduce salt intake. *Codium fragile* (CF), a type of green seaweed, contains polyphenols with antioxidant, anti-inflammatory, and anticancer properties. Despite its various beneficial properties, CF has been not yet industrially utilized as a functional food due to its high salt content of 60.0%. In previous studies, we optimized the soaking conditions employing response surface methodology (RSM) for minimizing total salt content (TSC) and preserving total phenolic content (TPC). However, ethanol extraction of the optimized soaking conditions yielded a high TSC. Therefore, in this study, post-desalination procedures were conducted after immersion. These procedures included centrifugal dehydration, sonication, vacuum purging, and soaking in a CaCl solution. As a result, centrifugal dehydration significantly reduced TSC, and notably preserved TPC compared to other processes. This study successfully identified an efficient desalination process. These conclusions mark a pivotal step towards utilizing high-salinity CF, which contains polyphenols in the development of functional food ingredients.

PU-16

## Comparison of sleep-promoting effects of optimized *Gracilaria verrucosa* extracts by different drying methods

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*Gracilaria verrucosa* (GV), a type of red seaweed found along the entire coastline of Korea, is a significant species as a source of food for humans and marine animals, as well as for the production of agar and thickeners. Many of compound including polyphenols, fatty acids, polysaccharides, and phycobiliproteins have been studied for various their bioactive properties, such as antioxidant, anti-inflammatory, anticancer, antibacterial, antiviral, and anxiolytic effects. In previous research, it was reported that GV extract increased sleep duration and optimized the extraction process employing response surface methodology (RSM) for enhanced sleep-promoting effects, total phenolic content (TPC), and yields. To utilize GV extract as mass production, it is necessary to compare tests according to drying methods. The aim of this study was to investigate processes using freeze drying (FD) and spray drying (SD) to produce GV extract that could be mass-produced while maintaining sleep-promoting effects, TPC, and yields. We found similar results between the drying methods for hypnotic activity, TPC, and yields. This experiment allowed us to confirm differences in GV extract based on drying methods and assess the feasibility of its commercial production.

PU-17

## Optimization of Combinational Treatment using Lactic Acid Bacteria and Rosemary Extraction to Prevent Tuna Discoloration

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Tuna, a globally consumed high-quality protein source, is prone to discoloration due to myoglobin (Mb) oxidation during distribution. In response, this study aims to suggest a novel approach to prevent discoloration in red tuna meat using lactic acid bacteria cell-free supernatant (LCFS) and rosemary extract (RE). Optimal conditions were determined using the Box-Behnken design (BBD), with independent variables including RE concentration ( $X_1$ ), LCFS to RE ratio ( $X_2$ ), immersion time ( $X_3$ ), and immersion ratio ( $X_4$ ). Dependent variables included tuna surface  $a^*$  value ( $Y_1$ ), crude extract  $a^*$  value ( $Y_2$ ), oxy-Mb ratio ( $Y_3$ ), sensory evaluation (redness) score ( $Y_4$ ), and overall acceptability score ( $Y_5$ ). The optimized conditions were as follows: a RE concentration of 0.0266 mg/mL, an LCFS to RE ratio of 1.19:1, an immersion time of 13.45 sec, and an immersion ratio of 1:3.31, respectively. Subsequently, a validation experiment was performed under the optimized conditions, showing statistically significant results. This study demonstrates the efficacy of the LCFS and RE mixture in preventing oxidation and discoloration in tuna, offering a novel method to preserve tuna quality and enhance its value.

PU-18

## Quality changes of Pacific oyster *Crassostrea gigas* according to storage period and temperature

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Pacific oyster *Crassostrea gigas* is distributed in various products, including raw, frozen, dried, salted, and canned oysters. Among these, raw oyster is a major product in the domestic market. Raw oysters are a product causing rapid quality deterioration in response to temperature fluctuations during the distribution process. Thus, this study aimed to assess the quality changes in microbiological, physicochemical, and sensory attributes in oysters and packaging water during the storage. Oyster samples purchased from the *Tongyeong* were stored at 4°C and 10°C, and analyzed with 12 h intervals. The result of microbiological analysis showed a gradual increase at all temperatures as the storage period increased. Initially, the viable cell count and coliforms were 3.38 log CFU/g and 1.89 log CFU/g, respectively, with final values reaching 4.58-5.01 log CFU/g and 3.06-3.93 log CFU/g, respectively. Regarding the physicochemical analysis, the initial pH value, starting at 6.47, gradually decreased to 5.53-5.57 as the storage period increased. Likewise, the glycogen content, which is initially at 862 mg/100g, decreased to 722.19-722.29 mg/100g at the endpoint. The packaging water turbidity showed increasing from 109.90 NTU to 1290.00-3003.33 NTU. Soluble protein concentrations started at 802.41 mg/100mL and rose to 1124.63-1946.85 mg/100mL. This study provides valuable insights into the quality changes of oysters depending on different temperature conditions (4°C and 10°C), and also suggests an essential data for assessing oyster freshness.



PU-19

## Development of pet churro feed through upcycling of discarded fish cakes

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In fish cake production line, some fish cakes are often discarded due to poor marketability. With the goal of upcycling these fish cakes into pet churros, a churro prototype was developed. The hot water extract of salmon by-product was added to fish cakes after removing salt and D-sorbitol which are normally preferred for human consumption. One kilogram of each type-A and type-B fish cakes was cut into pieces and pretreated with 4 L of water and incubated at room temperature for 3 hours. Afterwards, the samples were sonicated at 40, 60, and 80°C for 10, 20, 30, 40, 50, and 60 min at each temperature, respectively. Sonication for 60 min at 40, 60, and 80°C reduced the salt content present in type-A fish cake by 95.91%, 96.49%, and 97.08%, respectively. Whereas, a reduction of 95.87% in salt content present in type-B fish cake was observed at all tested temperatures (40, 60, and 80°C). Sonication for 60 min was helpful in reducing D-sorbitol content in type-A fish cake up to 92.3%, 94.2%, and 96.4%, respectively at 40, 60, and 80°C. Whereas, removal rate of 92.5%, 92.6%, and 95.3% in D-sorbitol content was observed in type-B fish cake sonicated at 40, 60, and 80°C for 60 min, respectively. Salmon head (360 g) and bones (360 g) were hydrolyzed at 80°C by enzyme mixture [Protamex (3.3 g) and Neutrase (6.6 g /1 L DW); pH 7.0] for 2 h and used for further experiments. Salt and D-sorbitol reduced fish cakes were ground and mixed with salmon byproduct hydrolysate at concentrations of 0, 10, and 20%, respectively. A preference evaluation test on dogs and cats using these churro products, the churro prototype containing 20% of salmon by-product hydrolysate showed the highest preference. This study shows that the fish cake with salt and sorbitol removed through hot water and ultrasonic treatment can be used as a pet feed material.

PU-20

## Development of elderly-friendly HMR soup using conger eel (*Conger myriaster*)

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Due to increase in aging society and single-person households, the demand for easily consumable HMR products is rising. We developed an easily consumable and elderly-friendly HMR retort soup using conger eel (*Conger myriaster*), which is a nutritionally excellent source of protein among marine products caught in large quantities in Korea. Conger eel bones (600 g), head (600 g), soybean paste (100 g), bay leaf (3 g), and ginger (30 g), were added in 6 L water and heated at 100°C for 2h. The supernatant was collected and used as broth. Conger eel fillet (30 g), radish siraegi (30 g), kappa cabbage (35 g), shiitake mushroom (10 g), perilla seed powder (5 g), garlic (10 g), cheongyang pepper (5 g), red pepper (5 g), green onion (20 g), Korean traditional soybean paste (15 g), salt (1 g), and 650 g of prepared broth were placed in a retort pouch, degassed, and sealed. The sealed retort pouches were heated at 90°C for 10 min, at 121°C for 20 min, and then cooled for 10 min. After retort processing, the small eel bones softened and no foreign body sensation was felt. In addition, the auxiliary ingredients had a soft texture and ease of swallowing. Therefore, it was confirmed that the conger eel HMR soup prototype prepared in this study has the potential to be used as a convenient meal for elderly.

PU-21

## Optimization of surimi powder manufacturing process for development of seafood protein beverages

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Recently, interest in consuming fish protein containing beverages is increasing. Thus, to develop a nutritionally excellent and safe surimi protein drink using Alaska pollock (*Gadus chalcogrammus*) and sea bream (*Nemipterus virgatus*) surimi, we manufactured a surimi powder that is highly palatable and has no fish odor. After thawing frozen surimi for 2 h using a high-frequency thawing machine, surimi was cut into pieces of 5 x 5 x 0.5 cm. These surimi pieces were heated by either steaming at 100°C for 15 min, microwaved at 700 W for 4 min, air fried at 180°C for 4 min, superheated steam grilled at 180°C for 10 min, or electric oven roasted at 180°C for 20 min. Afterwards, the heated surimi pieces were dried using three methods: freeze-drying at -35°C for 2 days, hot-air drying at 70°C for 2 days, and cold-air drying at 20°C for 4 days, respectively. The odor intensity, overall color difference ( $\Delta E$ ), pH, and VBN of the dried surimi powdered (80  $\mu$ m-mesh size) samples was measured, and overall acceptance was evaluated through sensory evaluation (9 point scale). The optimal processing conditions for Alaska pollock surimi were electric oven roasting and hot air drying, showing the odor intensity,  $\Delta E$ , pH, VBN and overall acceptance values of 153, 9.35, 7.62, 17.50 mg/%, and 8.20, respectively. The optimal processing conditions for sea bream surimi were superheated steam roasting and hot air drying, with odor intensity,  $\Delta E$ , pH, VBN, and overall acceptance of 383, 19.50, 7.36, 4.55 mg/%, and 7.20, respectively. Surimi powder prepared under the optimal conditions not only had no side effects, such as lactose intolerance or allergies, but also showed high protein content and excellent sensory quality characteristics. Thus, the prepared surimi powder can be used as a main ingredient in the seafood-based protein beverages.

PU-22

## Physicochemical properties and physiological activity effects of various solvent extracts from *Enteromorpha compressa*

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This study was conducted to investigate the antioxidant components and physiological activity of *Enteromorpha compressa*, a type of green algae. As a result of the general component analysis, the contents of moisture, crude protein, crude lipid, crude ash, and carbohydrate were 16.87%, 20.73%, 0.05%, 12.79%, and 49.56%, respectively. The main minerals were potassium, sodium and magnesium. The extraction solvents of *E. compressa* were 70% ethanol, 80% methanol and distilled water. Distilled water had the highest extraction yield at 25.67%, followed by methanol and ethanol. Methanol extract had the highest total polyphenol content, while distilled water extract had the highest total flavonoid content. In ethanol extract, ABTS and DPPH radical scavenging activity and nitrite scavenging activity were the highest. On the other hand, reducing power was the highest in methanol extract, and FRAP was the highest in ethanol extract. Methanol extract ( $IC_{50}$ , 0.70 mg/mL) was the highest in tyrosinase inhibitory activity, and distilled water extract ( $IC_{50}$ , 2.55 mg/mL) was the highest in elastase inhibitory activity. In addition, ethanol extract was the highest in ADH and ALDH activity. Ethanol extracts ( $IC_{50}$ , 0.17  $\mu$ g/mL) showed the highest BACE1 inhibitory activity. These results indicate that *E. compressa* can be useful as a raw material for food, medicine, and cosmetics that have antioxidant and physiological functionality. Therefore, the *E. compressa* is thought that additional research is needed.

PU-23

## Comparison of antioxidant and physiological activities of different solvent extracts from *Dictyota dichotoma*

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The antioxidant component analysis and physiological activity of *Dictyota dichotoma*, a type of brown algae containing a lot of fucosterol, were tested. As a result of the general component analysis, the contents of carbohydrate, moisture, crude protein, crude lipid, and crude ash were 54.08%, 9.96%, 5.53%, 1.46%, and 28.97%, respectively. The main minerals were potassium, calcium, magnesium and sodium. 70% EtOH, 80% MeOH, and distilled water were used as solvents to extract *D. dichotoma*, and the yields of the extract were 19.40%, 18.85%, and 24.17%, respectively. The total polyphenol content was the highest in distilled water extract, and the total flavonoid content was the highest in ethanol extract. DPPH radical scavenging activity and FRAP value were also the highest in ethanol extract. ABTS radical scavenging showed the highest methanol extract. On the other hand, distilled water extracts showed high activity in reducing power and nitrite scavenging activity. Methanol extract (IC<sub>50</sub>, 1.18 mg/mL) had the highest activity for tyrosinase inhibitory activity, and ethanol extract (IC<sub>50</sub>, 0.44 mg/mL) was the highest for elastase inhibitory activity. In AChE, an experiment related to dementia, methanol extract (IC<sub>50</sub>, 0.25 mg/mL) was the most inhibitory. Based on these results, the *Dictyota dichotoma* extract is effective in anti-aging and anti-dementia, confirming its potential as a material for food, cosmetics, and pharmaceuticals.

PU-24

## Effect of storage period and temperature on freshness changes of yellow croaker *Larimichthys polyactis*

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The yellow croaker *Larimichthys polyactis* is a finfish of the order of *Perciformes*. With the production of 41,000 MT in 2020, this fish is one of favored fishery products in Korea. In general, fishery products are easy to spoilage due to its high moisture content and soft tissue during storage and distribution. However, few study is only available on the freshness changes for fresh-distributed yellow croaker in the distribution stages. Therefore, this study aimed to analyze the changes in microbiological, physicochemical, and sensory aspects of yellow croaker according to storage periods and temperatures. Samples were purchased at a Mokpo fishery auction market and then stored at 4°C and 10°C, respectively, after transportation into laboratory. Viable cell count, coliforms, *Escherichia coli*, volatile basic nitrogen (VBN), pH, trimethylamine (TMA), and sensory evaluations were then conducted to assess the freshness. The viable cell count increased from an initial 3.98 log CFU/g to 6.50 log CFU/g and coliforms from 1.80 log CFU/g to 4.28 log CFU/g when stored at 4°C for 11 days. In the same conditions, VBN and TMA levels reached 44.97 mg/100 g and 18.781 mg/L, respectively. In contrary, when stored at 10°C for 9 days, the viable cell count increased from 3.98 log CFU/g to 7.07 log CFU/g and coliforms from 1.80 log CFU/g to 5.04 log CFU/g. VBN and TMA levels reached 64.19 mg/100 g and 13.571 mg/L, respectively, at the same conditions. These findings indicate that the freshness of yellow croaker products closely relate with temperature and storage period, even though these issues is very well known in fishery products. Thus, this study provides an valuable information on proper storage temperature and period to keep the freshness of fresh-distributed yellow croaker.

PU-25

## Characterization of EB-AuNPs and analysis of anti-biofilm and mechanism against biofilm-forming pathogens

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*Eisenia bicyclis* is known as a brown algae with antioxidant, anti-inflammatory, anti-cancer, and antibacterial activity since it contains various physiologically active substances such as fucoidan and phlorotannins. Gold nanoparticles (AuNPs) have been widely used to treat infections and diseases because of their excellent antibacterial activity. Also, the AuNPs are one of the metal nanoparticles approved by the FDA. Recently, research on anti-biofilm effects of AuNPs is also being conducted. Therefore, the aim of this study is evaluate the anti-biofilm activity of *Eisenia bicyclis* extract (EB)-AuNPs conjugates (EB-AuNPs). The physicochemical properties of conjugated EB-AuNPs were characterized by the analyses of zeta potential, field emission transmission electron microscope (FE-TEM), fourier transform infrared spectroscopy (FT-IR), and energy dispersive spectroscopy (EDS). The antibacterial and anti-biofilm activity were then evaluated by the assay of minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), biofilm inhibition and biofilm eradication against pathogenic bacteria. It was further conducted the analyses on a biofilm inhibitory mechanism of the EB-AuNPs. The experimental results revealed that the EB-AuNPs exhibited strong anti-biofilm activity against *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Listeria monocytogenes*, and *Staphylococcus aureus*. In addition, the result of inhibitory mechanism analysis revealed that swimming, swarming and twitching, which are known to be virulence factors, were inhibited by the treatment of EB-AuNPs in *P. aeruginosa*. The conjugates also inhibited the activity of protease and rhamnolipid related with pathogenicity. In *S. aureus*, the inhibition of staphyloxanthin, a virulence factor, was also confirmed. The results obtained in this study strongly suggest that the EB-AuNPs conjugate will be an attractive candidate to control biofilm causing severe problems in food industry, hospital and many other industrial area.

PU-26

## Aminoglycosides as a key antibiofilm and antivirulence agents against *Pseudomonas aeruginosa*

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Aminoglycosides were formerly widely utilized but have since been phased out because of the rise of multidrug-resistant bacteria. *Pseudomonas aeruginosa* PAO1 is an opportunistic foodborne pathogen, and in this work, we evaluated the subinhibitory concentrations (sub-MIC) of different aminoglycosides and tested them as an antibiofilm and for their anti-virulence capabilities. *P. aeruginosa* PAO1 is resistant to aminoglycoside antibiotics through numerous mechanisms, including biofilm formation and the development of multiple virulence factors. *P. aeruginosa* biofilm was inhibited by the sub-MIC concentrations of these antibiotics in alkaline TSB (pH 7.9). *P. aeruginosa* biofilms, after they have reached maturity, are likewise killed by these aminoglycosides at a variety of doses. When exposed to sub-MIC levels of aminoglycosides, *P. aeruginosa* underwent morphological alterations from rod-shaped to filamentous, elongated, and streptococcal forms. Multiple virulence factors of *P. aeruginosa* PAO1 were shown to be suppressed by the same growing conditions and sub-MIC of aminoglycosides. The aminoglycosides are shown to have high binding capabilities with the LasR protein, a well-characterized quorum-sensing receptor of *P. aeruginosa*, as shown by molecular docking experiments. This research provides a fresh rationale for using aminoglycosides as antibiofilm and antivirulence medicines against bacterial illnesses.



PU-27

## Distribution and Identification in *Enterococcus* spp. Strains Isolated from *Venerupis philippinarum* in the West Coast of Korea

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*Enterococcus* species are Gram-positive, catalase-negative, facultatively anaerobic oval cocci and are part of the natural microbiota of the gastrointestinal tract in humans. This study aimed to detect *Enterococcus* spp. strain, a fecal contamination indicator, by PCR assay from short neck clams *Venerupis philippinarum* in Cheonsu Bay area, Chu Island area and Wonsan Island area, the west coast of Korea, from November 2022 to February 2023 of *Enterococcus* spp. strain was 19 (79.2%) among 24 samples, and its concentration ranged from <18 to 33,000 MPN (most probable number)/100g.

The 269 isolated *Enterococcus* spp. strains were identified by PCR assay, and *Enterococcus* spp. distribution in short neck clams were *E. faecium* (39.8%), *E. faecalis* (23.0%), *E. hirae* (21.9%), *E. gallinarum* (10.4%), *E. casseliflavus* (1.5%), *E. durans* (1.5%) and unidentified strains (1.9%). Thus, *E. faecium* was the most dominant strain followed by *E. faecalis*.

Overall, these results provide novel insight into the necessity for shellfish sanitation in the sea area and could help reduce the fecal contamination risk.

PU-28

## Toxin Genes and Antimicrobial Resistance of *Clostridium perfringens* Strains Isolated from Commercial Jeotgals

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*Clostridium perfringens* causes diarrhea and other diseases in humans and animals. We investigated the prevalence, toxin gene profiles, and antimicrobial resistance of *C. perfringens* isolated from commercial jeotgals. *C. perfringens* was isolated from 11 of 22 commercial jeotgals. All *C. perfringens* strains were positive for the alpha toxin gene, but not for the beta, epsilon, iota, CPE or NetB toxin genes; therefore, all strains were identified as type A *C. perfringens*. Whereas the beta2 toxin gene was identified in 54.5% of isolates.

According to a disk diffusion susceptibility test, most isolates were resistant to kanamycin (90.9%), nalidixic acid (72.7%), oxacillin (54.5), erythromycin (27.3%), ciprofloxacin (9.1%) and clindamycin (9.1%). However, all of the strains were susceptible to 14 other antimicrobial including amoxicillin, ampicillin, and chloramphenicol. The average minimum inhibitory concentrations (MICs) against *C. perfringens* of clindamycin, kanamycin, and nalidixic acid were 128.0, 128.0, and 54.0 µg/mL, respectively. These results provide new insight into the necessity for sanitation of commercial jeotgals, and provide evidence to help reduce the risk of contamination of antimicrobial-resistant bacteria.

PU-29

## Effects of barley starch on properties of fish surimi mixture for 3D printing

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Starch is usually used for increasing some of physical properties of foods like chewiness, hardness, etc. Also those things usually have no bad reaction for human except some people (who have allergy about specific starch). In this study, we investigated the physical properties, color values of surimi mixtures with addition of various barley starch contents (0, 0.67, 1.34, 2.0, 2.67%) in preparing a cartridge for 3D printing as raw material. The results show that the firmness at unheated surimi mixture decreased as the amount of starch added increases, but after heating the hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience increased compared to the negative control (no added starch). Especially, the highest values were recorded in surimi mixture with 1.34% of starch added. This means that when heating the surimi mixture containing starch, the starch makes the texture of surimi harder than the negative control. In the case of color values, L\*, a\* and b\* value were all decreased after heating. The shearing force has no significant changes according to starch contents. In sensory evaluation, the smell, texture, hardness, elasticity and preference increased compared to the negative control. Considering the overall physical properties, the higher the barley starch content, the harder it was, making it most suitable for 3D printing. However, since the difference in content above 1.34% is not significant, the most appropriate addition condition is 1.34% rice barley starch. From these results, it is suggested that the barley starch increases overall physical strength and has little effect on smell and preference, and it can be useful as an additive for fish surimi.

PU-30

## Evaluation of quality in surimi mixtures coagulated with calcium lactate after addition of different concentrations of alginic acid for 3D printing

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Alginic acid is known to help discharge waste from the body as a cell wall component of brown algae, and is also used as a thickener or stabilizer in food manufacturing. When calcium, a divalent metal ion, is added to the alginic acid aqueous solution, the metal salt of the alginate is deposited in a gel phase. In this study, for 3D printing, different concentrations (0, 1, 1.5, 2.0 and 2.5%) of alginic acid were added to the surimi mixture, solidified with the same amount of calcium lactate, pH, color value, and physical properties were measured and sensory evaluation was conducted. The results show that the pH tends to decrease in a dose-dependent manner of alginic acid. In the heated surimi, when the concentration of alginic acid increased, the L and a values increased, and the delta E value decreased, resulting in a color close to white. The firmness score of the unheated surimi increased following the concentration of alginic acid increased. In the case of heated surimi, the highest value of hardness, gumminess, and chewiness were shown in the surimi mixture with 2% of alginic acid, and springiness and cohesiveness were shown similarly. Meanwhile, when the concentration of alginic acid is higher, the value of resilience is decreased. The work of shear in the heated surimi decreased as the concentration of alginic acid increased. In the sensory evaluation, the highest score of smell and fishy smell were shown in the surimi mixture with 2% alginic acid, and significantly similar levels of taste, abnormal, texture, hardness, elasticity, and preference were shown depending on the alginic acid concentration. From these results, it is determined that the overall acceptability as a 3D printing cartridge increased when 2% alginic acid was added to the surimi mixture and then coagulated with calcium lactate.

PU-31

## Effects of adding guar gum for optimal properties of fish surimi mixture for 3D printing

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Guar gum is an edible starch extracted from *Cyamopsis tetragonolobus* and is used as an auxiliary ingredient to enhance the viscosity and adhesiveness, improve emulsification stability of food. In this study, fish surimi mixture with fish 60% and water 40% was prepared by adding various content (0, 1.36, 2.68, 4 and 5.36 g) of guar gum and some of it was heated. And the possibility of use as a 3D printing cartridge was investigated by measuring the physical properties of heated and unheated surimi mixture, respectively. As a result, in the case of unheated surimi with guar gum, pH decreased as the content increased, and only the b (referred by yellowness) increased depending on the guar gum added in color values analysis. The firmness increased as the guar gum content increased, and there was no significant difference in adhesiveness. In color values comparison, the heated surimi has decreased both a (referred by redness) and b in a content-dependent manner, and the L (means lightness) value was higher than that of unheated surimi. Also, among physical properties, the highest values of hardness, gumminess and chewiness were observed in the heated surimi with 4g of guar gum added. However, no significant change was observed in springness and cohesiveness. The work of shear following the guar gum when content increased. As a result of sensory evaluation, the higher the guar gum content, only the hardness increased slightly, and there was no significant difference in the rest. In summary, surimi with 4g of guar gum is considered to be the optimal condition for 3D printing.

PU-32

## Quality characteristics of fish meat patties according to the proportion of swordfish (*Xiphias gladius*) white meat and tuna (*Thunnus albacares*) red meat

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Swordfish (*Xiphias gladius*) and tuna (*Thunnus albacares*) contain high protein, essential vitamins, and minerals, so they are suitable for use as the main material of fish patties by helping the human body in various aspects such as strengthening immunity and supplying nutrients. White meat smells like beef patties sold on the market, but various contents of red meat are added in consideration of economic feasibility. In this study, we investigated the physical properties, color values and sensory evaluation to optimize fish patties production according to the mixing ratio of tuna red meat and swordfish white meat (60:40, 40:60, 20:80 and 0:100). As a result in color values, compared to the non-heated fish patty, the brightness L value was similar in heated fish meat patty, but the redness a value and the yellowness b value increased. In physical properties, heated fish patty scored higher overall in hardness, springiness, gumminess, and chewiness than non-heated fish patty. In the heated patty, when the ratio of swordfish white meat is higher than that of tuna red meat, the hardness, springiness, cohesiveness, gumminess, and chewiness were measured with a low score, especially in red meat 40% with white meat 60%, resulting in a soft texture. According to the texture comparison analysis, it is helpful to increase the texture by using soft physical properties when eating fish meat patty after actual heating. In the sensory evaluation, compared to fish meat patty using only red meat, the score increased in smell, beef taste, texture, and elasticity as white meat was added. From these results, it is suggested that swordfish white meat, which improves overall quality such as physical properties and smell, can be used as a raw material for fish meat patty. Also, our results show that 20% tuna red meat and 80% swordfish white meat are most suitable for fish patties.

PU-33

## Antibacterial Activity of Potentially Probiotic Acetic Acid Bacteria Isolated from Homemade Grape Vinegar

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Probiotics, living microorganisms that contribute to the host's well-being by rebalancing the intestinal microbiota, possess specific traits including survival in gastrointestinal conditions, adhesion to intestinal surfaces, and diverse functions that yield numerous health benefits. With this regards, this study was conducted to isolate and identify dominant acetic acid bacteria (AAB) from homemade grape vinegar and to evaluate their potential probiotic functions. Among the 35 AAB isolates obtained from five samples, four strains (HG05, HG29, HG31, HG35) exhibited high survival rates in harsh intestinal environments such as acid or bile. Additionally, thes strains were confirmed to posses excellent adhesive capabilities to intestinal epithelial cells. The four selected strains were identified as *Acetobacter aceti*, *Acetobacter pasteurianus*, *Acetobacter intermedius*, and *Acetobacter tropicalis*, based upon 16 rRNA gene sequencing and Neighbor Joining phylogenetic analysis. In particular, *A. pasteurianus* HG29 exhibited remarkable broad antimicrobial spectrum due to the production of large amounts of acetic acid.

PU-34

## Prebiotic and Antioxidant Activities of Exopolysaccharide Producing *Lactobacillus paraplantarum* PV48 Isolated from Pickled Vegetables

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Probiotic bacteria play a crucial role in the synthesis of extracellular polysaccharides (EPSs), which possess commercially significant physiological and therapeutic activities. The present was aimed to investigate the prebiotic and antioxidant capabilities of EPSs derived from probiotic *Lactobacillus paraplantarum*. Among 29 strains of LAB isolated from Kimchi, *L. paraplantarum* PV48 strain exhibited the highest survival in the simulated gastrointestinal system and the best adhesion ability. The PV48 strain did not show any virulence factors, including hemolysin, gelatinase, DNase, biofilm production, and biogenic amines. The EPSs generated by the probiotic PV48 exhibited superior prebiotic properties, stimulating the growth of beneficial lactic acid bacteria and inhibiting the development of pathogenic bacteria, such as *Escherichia coli* O157 and *Salmonella typhimurium*. Moreover, the EPSs displayed effective radical scavenging and antioxidant activity, which can be utilized in the food and health industry as functional ingredients.



PU-35

## Purification and identification of $\beta$ -secretase inhibitory peptides from freshwater fish muscle hydrolysates

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Alzheimer's Disease(AD), which mainly causes dementia symptoms, is a neurodegenerative disease that increases rapidly in an aging society and mainly affects the elderly population.  $\beta$ -amyloid peptide aggregates, called amyloid plaques or senile plaque, are induced through an amyloid pathway involving  $\beta$ -secretase, and are mainly found in the brains of patients with Alzheimer's disease. Therefore, in this study, muscles of 10 species of freshwater fish used for food and undeveloped were hydrolyzed using 7 enzymes, and  $\beta$ -secretase inhibitory activity was measured with these hydrolysates. Among them, smelt, loach, yellowhead catfish and carp neutrase hydrolysates showed high activity, and the  $IC_{50}$  of each hydrolysates was  $0.74 \pm 0.24$ ,  $0.86 \pm 0.34$ ,  $1.66 \pm 0.04$  and  $1.91 \pm 0.12$  mg/ml. The YMC-Pack Diol 60 column was used to exclude these hydrolysates, and the  $IC_{50}$  of each hydrolysates fraction with maximum  $\beta$ -secretase inhibitory activity was  $1.21 \pm 0.09$ ,  $1.50 \pm 0.13$ ,  $2.40 \pm 0.05$  and  $2.47 \pm 0.08$  mg/ml. In future studies, the C18 column will be used to refine, and identify amino acid sequence of purified peptides.

PU-36

## Antibacterial and anti-inflammatory effects of dioxinodehydroeckol from *Ecklonia cava*

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*Cutibacterium acnes* (*C. acnes*) is one of the most common skin pathogens, and it plays an important role in the stimulation of inflammatory lesions. A variety of antibiotics such as tetracycline, erythromycin, and clindamycin commonly used as a treatment for acne, but many of them may lead to resistant pathogens and side effects. In this study, dioxinodehydroeckol isolated from an edible brown seaweed *Ecklonia cava* was shown to have a higher therapeutic efficacy and better safety profiles. we examined the antibacterial and anti-inflammatory activities of dioxinodehydroeckol from *E. cava*. we investigated the antibacterial effect of *Ecklonia cava* methanol extract and its solvent-soluble extract against *C. acnes*. The ethyl acetate (EtOAc) fraction showed the strongest antibacterial activity against *C. acnes*, *Staphylococcus aureus*, and *S. epidermidis* among the five solvent fractions. The dioxinodehydroeckol of the EtOAc-soluble extract also inhibited the growth of skin bacteria. To examine anti-inflammatory effects, the levels of IL-6 and IL-8 which are pro-inflammatory cytokines were assessed by enzyme-linked immunosorbent assay. The result showed that dioxinodehydroeckol reduced anti-inflammatory cytokines. These results suggest that dioxinodehydroeckol from *E. cava* could be a potential agent with antimicrobial and anti-inflammatory effects.

PU-37

## Physicochemical Analysis and Antioxidant Potential of *Artina pectinata* (Comb Pen Shell) Edible Components via Subcritical Water Hydrolysis

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*Artina pectinata*, commonly referred to as the Comb pen shell or CPS, served as the central subject of investigation. Three edible components, the Posterior Adductor Muscle (PAM), Anterior Adductor Muscle (ADM), and Mantle, underwent evaluation for their physicochemical properties through subcritical water hydrolysis. The extraction process involved conditions of 200 degrees Celsius for 30 minutes, 3 MPa pressure, and a 1:30 (g/mL) ratio. Notably, *A. pectinata* demonstrated significant antioxidant potential, with ABTS<sup>+</sup> values of  $47.07 \pm 0.13$  mg Trolox/g dry powder in PAM,  $39.71 \pm 0.17$  mg Trolox/g in ADM, and  $41.21 \pm 0.17$  mg Trolox/g in Mantle. Additionally, DPPH values further substantiated this potential, with readings of  $51.12 \pm 0.04$  mg Trolox/g in PAM,  $49.73 \pm 0.13$  mg Trolox/g in ADM, and  $49.97 \pm 0.04$  mg Trolox/g in Mantle. In addition, the total phenolic content (TPC) results showed that each part was  $21.77 \pm 0.23$ mg Tannic acid/g in PAM,  $31.97 \pm 0.31$ mg Tannic acid/g in ADM, and  $25.27 \pm 0.23$ mg Tannic acid/g in Mantle. Alongside these findings, comprehensive cytotoxicity assessments using HepG2 cells were performed and showed no cytotoxicity. Analysis for bioactive compounds using high-performance liquid chromatography (HPLC) detected gallic acid, Phloroglucinol, and Protocatechuic acid. These results underscore the versatile applications of *A. pectinata* hydrolysates, encompassing food production, energy beverages, and nutraceuticals.

PU-38

## Individual identification of Minke whale using 18 STR markers

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The International Whaling Commission(IWC) was established to preserve whale resources and promote the orderly development of the whaling industry. In 1986, the Commercial Whaling Moratorium went into effect, banning international trade in whale meat and products. In Korea, trade is permitted only as an exception when bycatch is inevitable during legal fishing. Whales are sold at high prices, ranging from 30 million to up to 60 million won, depending on their species, size, and condition. Approximately 240 minke whales are estimated to be consumed annually in 120 whale restaurants across the country, with an estimated 70% of them being believed to have been caught illegally. In particular, the Coast Guard conducts special crackdowns during periods of high whale activity to protect whale resources and continues these efforts by utilizing its patrol ships and aviation power. In addition, the Coast Guard Research Center and the Cetacean Research Institute are supporting illegal whaling cases through DNA analysis to identify whale species and individual minke whales. The Cetacean Research Institute analyzes DNA samples from minke whales in accordance with the 「Notice on conservation and management of whale resources」, and stores the data in a database. They utilize 18 markers to enhance the individual identification of minke whales. However, due to the need for quick case resolution, the analysis for individual identification of minke whales currently takes a significant amount of time. This study aims to solve the problem by utilizing multiplex PCR of 18 markers from the minke whale database, in order to shorten the individual identification analysis time.

PU-39

## Biological efficacy of fucoidan isolated from five species of brown algae

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Fucoidan, a sulfated polysaccharide abundantly found in various brown algae species, has received considerable attention in recent years due to its diverse biological activities and potential therapeutic uses. Featuring a complex and heterogeneous structure, fucoidan offers numerous bioactive properties that are associated with numerous health benefits, including anti-inflammatory, antioxidant, anticoagulant, and anticancer effects. In this study, we isolated fucoidan from 5 Korean brown algae (*Undaria pinnatifida*, *Saccharina japonica*, *Ecklonia cava*, *Ishige okamurae*, and *sargassum thunbergii*) and compared biological activity such as antioxidant and anti-inflammatory properties. Fucoidan was isolated by extraction using McIlvaine buffer. The antioxidant efficacy was confirmed 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2'-azobis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) scavenging activities. Also NO and pro-inflammatory cytokine such as tumor necrosis factor alpha (TNF- $\alpha$ ) and interleukin 1 beta (IL-1 $\beta$ ) production were measured to evaluate the inflammation control efficacy.

PU-40

## Photocrosslinked hydrogel with gallic acid-grafted CSMA and FGeIMA for accelerated diabetic wound healing

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Excessive inflammation and oxidative stress induced by trauma, burns, infections, and diseases are major contributors to chronic wounds. Thus, the development of materials capable of locally controlling the adverse effects due to excessive ROS production and persistent inflammatory responses is of paramount importance. This study presents a novel hydrogel with enhanced healing properties, designed from fish gelatin methacryloyl (FGeIMA), which has recently emerged as a substitute for gelatin derived from land animals, and gallic acid-modified chitosan methacryloyl (GA-CSMA) polymers. The hydrogel was fabricated via a straightforward UV photocrosslinking method and its morphology, rheological properties, swelling behavior, and degradation potential were evaluated. The GM/G-CM hydrogels effectively scavenged the ABTS and DPPH radicals, and *In vitro* investigations demonstrated the cytocompatibility of hydrogels with human dermal fibroblasts (HDF) and RAW264.7 macrophages, substantially suppressed oxidative damage in ROS microenvironments. Furthermore, it inhibited the production of nitric oxide (NO), tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), and Interleukin-1 $\beta$  (IL-1 $\beta$ ) while enhancing the production of Interleukin-10 (IL-10) in lipopolysaccharide (LPS)-stimulated RAW264.7 macrophages. Finally, in a diabetic mouse model with chronic wound conditions, the hydrogel exhibited anti-inflammatory and angiogenic effects. These results suggest that the GM/G-CM hydrogel, with its enhanced anti-inflammatory and antioxidant properties, can potentially be utilized as a wound dressing to improve hard-to-heal chronic wounds.

PU-41

## Isophloroglucin A-reinforced oxidized alginate/gelatin hydrogel with multifunctionality for accelerating wound healing

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This study investigated the potential applicability of wound dressing hydrogels for tissue engineering, focusing on their ability to deliver pharmacological agents and absorb exudates. Specifically, we explored the use of polyphenols, as they have shown promise as bioactive and cross-linking agents in hydrogel fabrication. Isophloroglucin A (IPA), a polyphenol not previously utilized in tissue engineering, was incorporated as both a drug and cross-linking agent within the hydrogel. We integrated the extracted IPA, obtained through the utilization of separation and purification techniques such as high-performance liquid chromatography (HPLC), liquid chromatography-mass spectrometry (LC-MS), and nuclear magnetic resonance (NMR) into oxidized alginate (OA) and gelatin (GEL) hydrogels. Our findings revealed that the mechanical properties, thermal stability, swelling, and degradation of the multifunctional hydrogel can be modulated via intermolecular interactions between the natural polymer and IPA. Moreover, the controlled release of IPA endows the hydrogel with antioxidant and antimicrobial characteristics. Overall, the wound healing efficacy, based on intermolecular interactions and drug potency, has been substantiated through accelerated wound closure and collagen deposition in an ICR mouse full-thickness wound model. These results suggest that incorporating IPA into natural polymers as both a drug and cross-linking agent has significant implications for tissue engineering applications.

PU-42

## Extraction and Characterization of Biocompatible Elastin from *Thunnini* heart as Fishery Processing by-Products

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Elastin is an elastic and stretchable protein that makes up the extracellular matrix and plays an important role in maintaining the structure and function of tissues and organs in the body. It has a strong non-polar, hydrophobic structure and is characterized by high elasticity, long-term stability, stretchability, and thermal stability. Due to these advantages, elastin-based biomaterials are increasingly being studied for application in tissue engineering. Currently, the consumption of aquatic products is increasing worldwide, and the discarded aquatic by-products during processing cause environmental, social, and economic problems. In this study, we extracted and characterized elastin from tuna heart. Elastin was extracted by alkaline method and characterized by amino acid composition analysis, Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), and differential scanning calorimetry (DSC). The results showed similar physicochemical properties to conventional elastin, with high non-polar amino acid content and thermal stability. The biocompatibility of the elastin was evaluated using CCK-8 assay and FDA/PI staining for human dermal fibroblasts (HDF), and non cytotoxicity was observed. The results suggested that tuna heart elastin has the potential to be utilized as a novel biomaterial.



PU-43

## $\epsilon$ -Veniferin loaded fish GelMA based 3d scaffold with anti-inflammatory, antioxidant and antimicrobial activity for chronic wound healing

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The 2% of population will experience a chronic wound in their life time. Chronic wound need a lot of time and effort to treat so it is a huge problem to have a burden of a medical and financial. In this study, we report a 3d scaffold that successfully accelerated wound healing with multi functions like antioxidant, anti-inflammatory, and anti-microbial. The 3d scaffolds based on fish gelatin methacryloyl loaded  $\epsilon$ -veniferin were fabricated. The fish gelatin was extracted from *Salmo salar* skin using hot water extraction and SDS-PAGE, FT-IR, and UV-VIS spectroscopy were performed to characterize the extracted fish gelatin. The  $\epsilon$ -veniferin was synthesis using resveratrol oxidative dimerization reaction. The biological activity of  $\epsilon$ -veniferin was evaluated including antioxidant, anti-inflammatory, and anti-microbial activities. The fabricated 3d scaffolds were observed morphological property and evaluated mechanical, swelling property and drug release profile. *In vitro* studies were conducted on human dermal fibroblasts, keratinocytes, and RAW 264.7 macrophages to evaluate the cytotoxicity as well as the antioxidant and anti-inflammatory activities of the fabricated scaffolds. This study provide the potential of  $\epsilon$ -veniferin loaded scaffold for chronic wound healing.

PU-44

## Effect of rock bream extracts on production of glutathione (GSH) and reactive oxygen species (ROS)

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We investigated heavy metal contents and chemical composition including proximate, fatty acid and amino acid composition of rock bream (*Oplegnathus fasciatus*). The effect of rock bream extracts on antioxidant was also carried out. Mercury and lead contents of rock bream were  $0.06 \pm 0.01$  and  $0.01 \pm 0.00$ , respectively. Rock bream had 73.6% moisture, 5.52% crude fat, 19.6% crude protein and 1.23% ash. Fatty acid composition showed that rock bream contained 12.1% eicosapentaenoic acid (EPA) and 12.3% docosahexaenoic acid (DHA). Main amino acid compositions were glutamic acid, aspartic acid, lysine and leucine. The treatments with both acetone/methylene chloride (A+M) and methanol (MeOH) extracts dose-dependently decreased  $H_2O_2$  induced reactive oxygen species (ROS) production in HT-1080 cells compared to the control without the extracts. MeOH extract showed a higher effect in reducing ROS production compared to A+M extract. The production of glutathione (GSH) showed that A+M extract increased the GSH levels compared to MeOH extract. These results indicate that the heavy metal contents of rock bream were below the limit of the Food Code of Korea. The present study suggests that the rock bream extracts might possess antioxidant effect.

PU-45

## Effect of freezing method and frozen storage temperature on the storability of mackerel

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Mackerel treated with quick-freezing and slow-freezing methods was frozen and stored to evaluate storability. Mackerel fillet was quick frozen using hybrid ice and stored at  $-20\text{ }^{\circ}\text{C}$ , and slow frozen at  $-20\text{ }^{\circ}\text{C}$  and  $-70\text{ }^{\circ}\text{C}$  and stored for 90 days to compare quality. Quality evaluation according to freezing method and frozen storage temperature was analyzed for drip, pH, volatile basic nitrogen(VBN), shearing force, general microorganisms, and pathogenic microorganisms. The amount of drip increased as the frozen storage period increased, and hybrid ice occurred most frequently in the order of quick freezing,  $-70\text{ }^{\circ}\text{C}$  slow freezing, and  $-20\text{ }^{\circ}\text{C}$  slow freezing. The pH was confirmed to be  $5.6\pm0.35$  before freezing, and in the experimental group stored for 30 days, only the hybrid ice quick freezing experimental group showed  $5.7\pm0.07$ , similar to before freezing, while the other experimental groups increased to  $6.0\sim6.5$ . VBN was found to be  $10.3\text{ mg}\%$  before freezing, and the 30 day stored samples increased by  $0.2$  to  $0.8\text{ mg}\%$  in all experimental groups depending on the storage period, with similar increases depending on the storage period. General microorganisms were detected at  $3.1\text{ log CFU/g}$  before freezing, and depending on the storage period, in the experimental groups gently frozen at  $-20\text{ }^{\circ}\text{C}$  and  $-70\text{ }^{\circ}\text{C}$ , they were detected in the range of  $2.0\sim2.5\text{ log CFU/g}$  and  $1.7\sim2.1\text{ log CFU/g}$ , respectively. It has been done. Hybrid ice was quickly frozen and stored at  $-20\text{ }^{\circ}\text{C}$  in the experimental group, and a range of  $1.6$  to  $1.7\text{ log CFU/g}$  was detected.

PU-46

## Isolation and characterization of *E. coli* and *Salmonella* spp. specific bacteriophage isolated from sewage disposal plant

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Bacteriophage, a type of virus that infects bacteria, is a biological disinfectant. It is harmless to humans and has the potential to replace chemical disinfectants. Extensive research on bacteriophage is currently underway. Six highly active bacteriophages were separated from the local sewage treatment plant using *Escherichia coli* and *Salmonella* Typhimurium. They showed a latent time of about 10~20 minutes and a burst size of 1.9~2.9 log PFU/mL. It was stable in the pH range of 4.0~11.3, and stable in the temperature range of 45~60 °C. As a result of confirming the reactivity of chlorine compounds, phase suspension containing organic materials was significantly less reactive, chlorine dioxide was completely deactivated in the range of 15 ppm or more when phase suspension directly dissolved in PBS was used. Transmission electron microcopy was used to confirm that they belonged to *Caudovirales Myoviridaceae*. The head diameter was 73~80 nm, and the tail length was 115~170 nm, all different. This result is a measure of chemical resistance to bacteriophages and can be used to utilize the hurdle technology of low-concentration chemical disinfectants.

PU-47

## Study on antimicrobial activity and action mechanism of the antimicrobial peptides identified from the Octopus (*Octopus minor*) against Piglet diarrhea-causing bacteria

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Three antimicrobial peptides (Octominin, Octopromycin, Octoprohibitin) consisting of 23, 38, and 26 amino acid residues were identified from the Octopus transcriptome data. In previously published papers, these three peptides showed potent antibacterial and antifungal activity. To investigate the possibility of biomedical applications of these peptides against piglet diarrhea-causing bacteria such as *E. coli*, *Salmonella*, and *Clostridium*, biological activities and action mechanisms of these peptides were studied. The tertiary structures of three peptides were predicted by Alphafold2 server and revealed these peptides adopted the helical structures containing partial amphipathic properties. Three peptides showed potent antimicrobial activity against piglet diarrhea-causing bacteria without significant cytotoxicity. To investigate the physicochemical stabilities of these peptides, effect of protease, pH, salinity, and temperature on their antimicrobial activities were tested. According to our results, temperature did not effect on their antimicrobial abilities, but protease, pH, and salinity affected peptides` activities. In addition, to investigate action mechanisms of these peptides, bactericidal activity and membrane permeabilizing ability were studied. According to our results, these peptides did not show bactericidal activity and membrane permeabilizing ability. These results suggested that these peptides might have bacteriostatic properties and not directly act on the bacterial membrane but target intracellular compounds such as DNA or proteins for antimicrobial function.

PA-1

## Effect of garlic powder added feed on improving river puffer (*Takifugu obscurus*) growth

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It takes about 2 to 3 years to raise river puffer (*Takifugu obscurus*) to selling size of 300g, so it is necessary to develop aquaculture management methods and special feeds that can shorten this. To date, yellow puffer artificial seed production and fish growing technology can be considered established, but research to reduce production costs is still needed. Therefore, the GMFRRI (Gyeonggi-do maritime fisheries resources research Institute) attempted to improve the growth of river puffer fish by adding garlic powder to the feed to shorten the growth period. The crude protein of the three types of feed (GP 0%, GP 1.5%, and GP 2.5%) to which garlic powder was added was 58% and the crude fat was 17%, and were produced as EP diet at the Kyungwon Feed Factory. After purchasing 200 river puffer fish weighing around 200 g from a private fish farm located in Gyeonggi-province, they underwent an adaptation period of three weeks in fish tank (5 m). Afterwards, 6 fish tanks (2 × 0.85 × 1.2 m) were prepared within another round fish tank (5 m) where the nitrification process was completely completed for 4 weeks, and 30 river puffer fish individuals weighing an average of 207g were dispersed and accommodated. The feed experiment period lasted 9 weeks, and the feed was limited to 1% of daily body weight. During the 9-week experiment period, water quality was dissolved oxygen (DO) 7.3~8.1 mg/L, pH 6.7~7.3, salinity 3.0~3.3 psu, total ammonia (TAN) 0.00~1.95 mg/L, NO<sub>2</sub>-N 0.002~1.296 mg/L, NO<sub>3</sub>-N showed a value of 4.2~14.6 mg/L. The values of weight gain (WG, %), feed efficiency (FE, %), protein efficiency ratio (PER, %), and specific growth rate (SGR, %) were significantly higher in the GP 1.5% group than these of GP 0% and GP 2.5% groups, and the GP 2.5% experimental group was the lowest (P<0.05). There was no significant difference in condition factor (CF) and survival rate (%) among the three experimental groups (P>0.05), and overall feed intake (DM, g) was lowest in the GP 2.5% group (P<0.05). In this experiment, the addition of garlic powder in the feed was effective in improving the growth of river puffer fish, as reported for other fish, but the addition of 2.5% of garlic powder in the feed was found to have a negative effect. Therefore, it is considered that future garlic powder addition concentration tests between 1.5% and 2.5% will be necessary.

PA-2

## Dual-infection of white spot syndrome virus and decapod hepanhamaparvovirus in *Penaeus vannamei* shrimp cultured in Korea

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The rapid growth of shrimp aquaculture has led to emerging diseases globally. With viral diseases causing 60% of losses, white spot syndrome virus (WSSV) is a notable viral disease, primarily affecting marine shrimp. This virus is responsible for over 1 billion US dollars in Korea alone. Decapod hepanhamaparvovirus (DHPV) is also a viral disease infecting penaeid shrimp, and it poses challenges due to its non specific symptoms and often occurs in concurrent infections with other pathogens. Recently, a new type DHPV was reported in cultured *Penaeus vannamei* shrimp in several countries.

The present study was conducted in Korean shrimp farms, and detected dual pathogens, WSSV and DHPV. A novel genotype of DHPV in all the analyzed shrimp samples (83 of 83), and also detected in pond water, crab (*Helice tridens*), and live food samples (squid, polychaeta). Additionally, WSSV was concurrently detected in the samples, including 41 shrimp samples, pond water and crab samples. By qPCR analysis, WSSV was quantified in shrimp between  $2.58 \times 10^7$  copies/ $\mu$ l and  $1.27 \times 10^2$  copies/ $\mu$ l, respectively. In addition, dual-infection with both viruses (WSSV and DHPV) in shrimp could be demonstrated by histopathological analysis. Viral infection can result in a significant economic losses in shrimp production, and therefore, precise monitoring and management of WSSV and DHPV prevalence in pond water, live food, and habitats are essential to preventing the spread of these viral diseases in Korean shrimp culture industry.

PA-3

## Microplastic as a potential risk for white spot syndrome virus infection in pacific white leg shrimp

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Recently, there has been a noticeable surge in the utilization of plastic, and as a result, the amount of plastic waste has also increased. Unfortunately, a substantial amount of plastic wastes are being discharged into the marine environments, eventually accumulating in aquatic organisms in the form of microplastics (MPs). White spot syndrome virus (WSSV) is a viral pathogen that poses a significant threat to shrimp, environmental stress factors can accelerate viral replication and thus increase infection. This study was conducted under the assumption that MP could be a risk factor for infectious diseases.

In this study, we investigated the potential role of MP as a risk factor for WSSV. Experimental shrimp ( $N = 32$ , average weight per shrimp:  $1.5 \pm 0.05$  g) were divided into four groups, each with duplicates. The group 2 (exposed to MP only) and group 4 (not exposed to both WSSV and MP) were fed specific pathogen-free (SPF) shrimp tissue once, whereas group 1 (exposed to WSSV only) and group 3 (exposed to both WSSV and MP) were fed WSSV stock once to induce WSSV infection. Following this, group 1 and group 4 were injected with 100  $\mu$ L of 1X PBS, orally, whereas group 2 and group 3 were injected with 100  $\mu$ L of MP, orally, for MP exposure.

The result showed that group 3 (exposed to both WSSV and MP) experienced mortality within 24 hours of MP exposure, with a 50% accumulative mortality rate at the experience termination day. In contrast, no mortality was observed in group 1, 2, and 4. Histological examination showed that shrimp in group 1 showed basophilic inclusion body in hepatopancreas epithelial and gill tissue, along with many abnormally shaped nuclei in muscle fibers. Group 2 showed collapsed tubule structures, loss of B-cells in hepatopancreas, and many nuclei showing abnormal shape and slight lysis were observed in muscle fibers. Notably, in group 3 showed basophilic inclusion body and separation of basement membrane in hepatopancreas, along with numerous basophilic inclusion bodies in gill tissue. Also, many abnormal shaped nuclei along with infiltrated and dissolved muscle fibers were observed.

In conclusion, this study highlights the increased risk of disease infection that may result from exposure to MPs in shrimp, and It warns that exposure to MPs can potentially harm aquatic organisms.



PA-4

## Experiment on artificial seed production of *Cyclina sinensis*

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This study was investigated the effectiveness of *Cyclina sinensis* seed production using the Down-Welling System for stable seed supply. For seed production, we investigated the sexual maturity of clams living in the Gyeonggi tidal flats. In July 2023, it was confirmed that *Cyclina sinensis* had reached sufficient sexual maturity in the Gyeonggi-do flats.

The spawning stimulation method used the water temperature raising method and the exposure method, and as a result,  $10,000 \times 10^4$  inds fertilized eggs were produced. After 24 hours, they transformed into D-shaped larva, and the survival rate was 80% with  $8,000 \times 10^4$  inds. The D-shaped larva was swimming. After 6 days, as the foot developed and it became a pediveliger stage and began to settle. Early pediveliger stage larvae numbered  $6,000 \times 10^4$  inds, with a survival rate of 60%. The mortality rate of early pediveliger larvae increased rapidly during the first 7 days, and the final population of 14 days-old larvae was  $2,000 \times 10^4$  inds, with a survival rate of 20%. A comparative experiment on the production efficiency of the Down-Welling System and the Floor cultivation System was conducted using 14 days-old larvae. A breeding experiment was conducted for 90 days with  $1,000 \times 10^4$  pediveliger larvae in the Down-Welling System and  $1,000 \times 10^4$  pediveliger larvae in the Floor cultivation System. As a result of the experiment, seeds grew to 3mm in size over 90 days, a total of  $50 \times 10^4$  seeds were produced in the Down-Welling System, and 0 were produced in the Floor cultivation tank. The production density for the Down-Welling System was  $10 \times 10^4$  inds/m<sup>2</sup> (total production:  $50 \times 10^4$  inds).

This study was showed that the Down-Welling System can be used to produce more stable seeds than the Floor cultivation System when producing artificial seeds.

PA-5

## Effects of replacing fish meal with a mixture of corn protein concentrate and poultry by-product meal on growth performance of juvenile black rockfish (*Sebastes schlegelii*)

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This study evaluated the effect of fish meal substituted with a mixture of corn protein concentrate and poultry by-product meal (MCP) on the growth performance of juvenile black rockfish (*Sebastes schlegelii*). A total of 1,440 juvenile rockfish were randomly distributed into 300 L rectangular tanks (60 fish per tank). Each experimental diets were prepared in triplicate. Eight isonitrogenous and isolipidic experimental diets were formulated to replace 0% (MCP0), 10% (MCP10), 20% (MCP20), 30% (MCP30), 40% (MCP40), 50% (MCP50), 60% (MCP60) and 70% (MCP70) FM protein with a blend ratio of 1 (corn protein concentrate) : 2 (poultry by-product meal). At the end of 8 weeks feeding trial, the fish fed the MCP0, MCP10, MCP20, MCP30, and MCP40 diets showed no significant difference in final body weight, weight gain, specific growth rate, and feed consumption, whereas those fed the MCP50, MCP60, and MCP70 diets were significantly different from those of fish fed MCP0 diet. Survival, feed efficiency and protein efficiency ratio were not showed significant differences between the fish fed the MCP treatments. In short, these results showed that the MCP would be able to replace FM for up to 40% without adverse affect on the growth performance of juvenile black rockfish.

PA-6

## Growth and reproduction of rotifer, *Brachionus* spp., collected from the Hwajinpo lake on the different temperature

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Rotifera have a important role in the production of aquaculture fish larvae, serve as essential components in maintaining freshwater ecosystem balance as a source of food. Furthermore, they have recently been widely used as an experimental species to investigate the ecosystem environment.

In this study, we conducted an experiment to compare the growth and reproductive characteristics of two species of *Brachionus* sp. (H-SL and H-US), which were collected from a brackish water area in Hwajinpo, Goseong-gun, Gangwon-do, and tentatively identified as belonging to the genus *Brachionus*, with *Brachionus koreanus* under different temperature conditions. At 28°C, the biological minimum size amictic females of *B. koreanus*, H-SL, and H-US were  $97.9 \pm 2.94 \mu\text{m}$ ,  $121.9 \pm 2.98 \mu\text{m}$  and  $82.7 \pm 4.21 \mu\text{m}$ , respectively, and all of them showed a tendency for the size of amictic eggs to decrease with increasing water temperature. In the case of offspring, *B. koreanus* and H-US showed a significant increase in the number of eggs laid as the water temperature increased, but H-SL showed no significant difference. In all cases, the higher the water temperature, the shorter the lifespan, with *B. koreanus* having the shortest lifespan of  $6.8 \pm 1.03$  days at 32°C. In the individual culture experiment, the SGR of all species increased as the water temperature increased, and *B. koreanus* at 32°C showed the highest growth rate of  $1.24 \pm 0.005$  and the growth rate of H-SL at 16°C culture condition showed a higher of  $0.50 \pm 0.654$  than other species. The highest density was recorded for *B. koreanus* at 32°C, with  $2849.9 \pm 404.48 \text{ ind./ml}$ , the highest density among the species examined in the study.

Of the two species collected from the Hwajinpo brackish water area, the H-SL appears to have a higher growth rate than other species in the low temperature and is considered to be suitable as food for cold-water fish larvae. And the H-US ( $84.7 \pm 3.85 \mu\text{m}$ ) is judged to be a suitable prey organism for small fish larvae with small mouth size.

## Antimicrobial and biofilm inhibitory properties of hemocyanin from edible gastropod *Hemifusus pugilinus* (Born, 1778)

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Marine gastropod mollusc *Hemifusus pugilinus* are fashionable delicacies with high nutritional values. The seafood industry plays a huge role in the blue economy, exploiting the advantage of the enriched protein content of marine organisms. Diseases greatly affect these aquatic organisms in culture and, hence, there is need to study, in detail, their innate immune mechanisms. Hemocyanin is a non-specific innate defense molecule present in the blood cells of several invertebrates, especially molluscs, arthropods, and annelids. It is concerned with oxygen transport, blood clotting, and immune enhancement. In the present study, this macromolecular metalloprotein was isolated from the hemolymph of the marine snail *Hemifusus pugilinus* (Born, 1778) using Sephadex G-100 gel filtration column chromatography. It occurred as a single band (MW 80 kDa) on SDS-PAGE. High-performance liquid chromatography (HPLC) of the purified hemocyanin showed a single peak with a retention time of 4.3 min. The secondary structure and stability of the protein were detected using circular dichroism (CD), and the spectra demonstrated negative ellipticity bands close to 208 nm and 225 nm, indicating  $\beta$ -sheets. Further exploration of the purified hemocyanin revealed remarkable antimicrobial and antibiofilm activities against Grampositive (*Enterococcus faecalis* and *Staphylococcus aureus*) and Gram-negative bacteria (*Pseudomonas aeruginosa* and *Proteus vulgaris*) at a concentration of 1–5  $\mu\text{g/mL}$ . Spectrophotometric and in situ microscopic analyses (CLSM) unveiled the potential of the purified hemocyanin to inhibit biofilm formation in these bacteria with a minimal inhibitory concentration of 40  $\mu\text{g/mL}$ . Furthermore, *H. pugilinus* hemocyanin (10  $\mu\text{g/mL}$  concentration) displayed antifungal activity against *Aspergillus niger*. The purified hemocyanin was also assessed for cytotoxicity against human cancer cells using cell viability assays. Altogether, the present study shows that molluscan hemocyanin is a potential antimicrobial, antibiofilm, antifungal, anticancer, and immunomodulatory agent, with great scope for application in the enhancement of the immune system of molluscs, thereby facilitating their aquaculture.

PA-8

Characterization of extracellular matrix protein EFEMP2 in olive flounder  
*Paralichthys olivaceus*

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The EGF containing fibulin-like extracellular matrix protein 2 (EFEMP2) is a crucial component for elastic fiber assembly in extracellular matrix (ECM) and involved in connective tissue development, elastic fiber formation and tumor growth. However, the function of EFEMP2 in fish are unknown in spite of the multiple role of EFEMP2 in various of species. In this study, we isolated and characterized EFEMP2 cDNA, which belongs to the fibulin family of ECM proteins from the olive flounder *Paralichthys olivaceus*. PoEFEMP2 contained a 1,305-bp sequence encoding a 435 amino acid (aa), which in turn composed calcium-binding EGF-like (EGF-CA), complement C1r-like EGF-like (cEGF). Multiple alignment revealed that PoEFEMP2 showed 67.5-96.8% similarity with various orthologues of fish, and a phylogenetic tree was constructed of vertebrates. PoEFEMP2 mRNA was detected in all tissues examined; levels were highest in the heart, testis and ovary. PoEFEMP2-edited cells were generated using the clustered regularly interspaced short palindromic repeats/CRISPR-associated-9 (CRISPR/Cas9) system. We plan to conduct further studies to investigate the role of PoEFEMP2 in *P. olivaceus*.

PA-9

## Development and genetic diversity analysis of microsatellite markers using next-generation sequencing in *Crassostrea gigas*

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This study was conducted to develop microsatellite markers in *Crassostrea gigas* using next-generation sequencing. A total of 46,335,655,445 bp reads were generated on an Illumina HiSeqx ten system, yielding 600,863,377 bp sequences. The de novo assembly resulted in 30,636 contigs. A total of 261 contigs, including 56 microsatellite loci, were derived from 30,636 contigs longer than 518 bp. A total of 16 polymorphic nuclear microsatellite markers were chosen to evaluate population genetic parameters in the farm. The mean number of effective alleles was 10, ranging from 4 to 27. The observed heterozygosity ( $H_O$ ) and expected heterozygosity ( $H_E$ ) ranged between 0.188 and 0.896 with an average of 0.541 and from 0.232 to 0.944 with an average of 0.592, respectively. Linkage equilibrium was observed in all loci and five of them showed significant deviations from Hardy-Weinberg equilibrium. The results show that the 16 polymorphic nuclear microsatellite markers can be used to study the population and conservation genetics of *Crassostrea gigas* in Korea. The analysis of polymorphic SSR could provide an important experimental tool for examining a range of issues in *Crassostrea gigas* genetics

PA-10

## Comparison of hatching rates of cuttlefish(*Sepia esculenta*) fertilized eggs by hatching method

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Cuttlefish(*Sepia esculenta*) is mainly distributed in East Asian waters such as East China Sea, including S.Korea, and is caught along the coast in Gyeonggi Bay and Daecheon from May to June. However, due to climate change, the cuttlefish catch in Gyeonggi-do is decreasing from 6 tons in 2017 to 1 ton in 2022, and dependence on imports and its prices are increasing accordingly.

Therefore, Gyeonggi Province has been releasing cuttlefish seed in Gyeonggi Bay since 2021 to increase the amount of fisheries resources. And the key of increasing fisheries resource that cuttlefish is not only the fishing intensity but more releasing the cuttlefish seed which are made by proper hatching method.

The proper hatching method means that provide abundant oxygen to fertilized eggs, it depends on the agitation method of fertilized eggs.

So, the method of agitation the fertilized eggs is related to the oxygen supply required for hatching, and the fertilized eggs are evenly stirred is critical to hatching rate. Therefore, in this study, each hatching rate was compared by agitation of fertilized egg method(by hatchery, aeration and use of water wheel for stirring).

As a result, about 58% of fertilized eggs are hatched by using a hatchery, 66% of eggs were hatched by aeration in a circular FRP tank, and 71% were hatched in raceway tank by water wheel for stirring. Therefore, the highest hatching rate of cuttlefish fertilized eggs were found that agitation by water wheel in raceway-tank.

PA-11

## First description of type I suppressor of cytokine signaling genes SOCS6 and SOCS7 in the whiteleg shrimp, *Litopenaeus vannamei*

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Suppressor of cytokine signaling (SOCS) genes are pivotal negative regulators intricately involved in the modulation of cytokine signaling pathways, exerting significant influence over diverse biological processes, including immune responses. In this investigation, we conducted comprehensive analyses of two distinct SOCS genes, designated as *LvSOCS6* and *LvSOCS7*, isolated from *Litopenaeus vannamei*, the whiteleg shrimp. *LvSOCS6* encodes a polypeptide comprising 463 amino acid residues (aas) and spans a genomic sequence of 1392 base pairs (bps). Conversely, *LvSOCS7* encodes a substantially larger polypeptide encompassing 955 aas, corresponding to a genomic region spanning 2868 bps. Both *LvSOCS* proteins exhibited characteristic domains affiliated with the SOCS family, notably featuring a centrally located Src homology 2 (SH2) domain and a C-terminal SOCS box. Moreover, phylogenetic analysis unveiled the evolutionary relatedness of *LvSOCS6* and *LvSOCS7*, as their deduced amino acid sequences clustered within the invertebrate type I SOCS family. The tissue distribution profile of *LvSOCS6* and *LvSOCS7* indicated ubiquitous expression across all examined tissues, with *LvSOCS6* displaying heightened expression levels in the gills and *LvSOCS7* predominantly in the gills and stomach. Remarkably, examination of mRNA expression patterns following immune stimulations with lipopolysaccharide (LPS) and polyinosinic: polycytidylic acid (poly (I: C)) revealed significant upregulation of *LvSOCS* genes, underlining their active involvement in the immune response. In contrast, peptidoglycan (PGN) stimulation yielded comparatively lower expression levels across the examined tissues. Intriguingly, the diminished expression of *LvSOCS6* and *LvSOCS7* coincided with a substantial elevation in mRNA expression levels of *LvSTAT*, an essential component of the Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway. Collectively, this study provides compelling insights into the potential roles of the newly discovered type I SOCS genes in the orchestration of innate immune responses in *Litopenaeus vannamei*, underscoring their significance in regulating immune pathways.



PA-12

## Fish farm monitoring report for outdoor aquaculture of eastern catfish *Silurus asotus* in Korea

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This study aimed to investigate the growth performance of far eastern catfish (*Silurus asotus*) on outdoor fish farms to obtain basic data for the domestic eastern catfish aquaculture industry. An outdoor fish farm was directly monitored from June 2018 to October 2019 to determine the farming conditions, growth performance, and water quality. The growth performance in 2017 was analyzed using data from the same fish farm. Three years of monitoring showed that the fish farm required approximately 5–6 months between stocking, harvesting, and selling an *S. asotus* batch. The growth parameters, namely, the weight gain rate (WGR), specific growth rate (SGR) for culture periods, SGR for feeding periods, and feed coefficient rate (FCR), were 4,664.7%, 1.27%, 2.43%, and 1.25 in 2017; 6,452.0%, 1.52%, 2.79%, and 1.42 in 2018; and 3,270.0%, 1.11%, 2.12%, and 1.38 in 2019, respectively. Moreover, the WGR was two-fold higher in 2018 than 2019, whereas the FCR was more effective in 2019 than 2018, presumably because of the stocking density. No mass mortality was observed during the water quality analysis. The results of this study provide basic data for the development of the catfish industry.

PA-13

## Effect of dietary vitamin C supplementation on growth performance and biochemical parameters in grower walleye pollock, *Gadus chalcogrammus*

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The optimum dietary vitamin C (VC) levels of walleye pollock (*Gadus chalcogrammus*) has not been determined. The purpose of this study was to assess the effect of dietary VC level on growth performance and biochemical parameters of grower walleye pollock and determine the optimum VC level in its diet. Six kinds of experimental diets (VC0, VC1, VC3, VC5, VC7 and VC10) with different levels of VC (3.24, 21.92, 63.31, 101.42, 145.46 and 202.51 mg kg<sup>-1</sup> diet, respectively) were fed to fish (initial mean weight 173.5 ± 0.31 g) for 8-week. At the end of feeding trial, growth (final body weight, weight gain and specific growth rate) and feed utilization (feed efficiency and protein efficiency ratio) of fish fed the VC7 and VC10 diets were significantly higher than that of fish fed the VC0 diet ( $P < 0.05$ ). The VC3 to VC10 diets significantly decreased the plasma superoxide dismutase (SOD) activity ( $P < 0.05$ ). Compared with the VC0 group, fish fed the VC7 and VC10 diets showed significantly higher contents of growth hormone and insulin-like growth factor-1 in plasma ( $P < 0.05$ ). In conclusion, dietary supplementation of VC in walleye pollock diet improves growth performance and SOD activity. Also, broken-line analysis on weight gain proved that the optimum dietary VC level of grower walleye pollock was estimated to be 156.42 mg kg<sup>-1</sup> diet.

PA-14

## Identification of a prototype fish ficolin-2 from *Acipenser baerii*: Molecular characterization and phylogenetic analysis

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Ficolins (FCNs) play a crucial role with pattern recognition receptors (PRRs) and activate the lectin pathway of the complement cascade by binding to carbohydrate patterns on the surface of microbe. The majority of FCNs identified in vertebrates and invertebrates to date, however, nothing is known about molecular identity in fish species. In this study, we report the first identification of a fish FCN designated as *AbFCN2* from a primitive chondrosteian, *Acipenser baerii*, and its molecular characterization and phylogenetic analysis. The full-length cDNA sequence comprised 1,492 base pairs (bp), starting with a 5'-untranslated region (UTR, 72 bp), followed by an open reading frame (ORF, 996 bp), and a 3'-UTR (424 bp) containing a poly(A) signal (AATAAA) sequence located at 38-bp upstream of the poly(A) tail. The deduced ORF sequence encoded the *AbFCN2* protein comprising 331 amino acid residues with a signal peptide with two cysteine residues, a collagen-like domain, and a C-terminal fibrinogen-like. Multiple alignment and phylogenetic analysis revealed that the *AbFCN2* protein had the highest sequence homology with human FCN2 (51.5%) and the lowest homology with African clawed frog (47.2 %) and classified into a sister clade of mammals in the vertebrate lineage, suggesting an orthologous of FCN2 in other animals. Collectively, this study provides compelling insights into the evolutionary and functional aspects of the prototype teleost FCN2 gene, shedding light on their integral role in orchestrating immune responses and underscoring their significance in immune pathway regulation in fish.

PA-15

## Analysis of growth and movement characteristics of juvenile *Haliotis discus hannai* by the stocking density and individual size

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Behavior serves as an important indicator of the effects of environmental stressors on organisms. In this study, one year old abalone *Haliotis discus hannai* (15.1±0.8 mm) were used and each 0.34 m<sup>2</sup> tank was stocked with 100, 150, 200, 250, and 300 juvenile abalone. After 328 days, we found that the low stocking density treatment showed significantly higher growth, whereas the high stocking density treatment showed significantly lower growth. In addition, abalone showed a lower rate of movement, distance moved, and velocity at higher stocking densities, but only velocity differed significantly. In contrast, In the Supplied the feed tanks significant difference between the moving distance and velocity. When the two groups of different sizes were mixed in tank, the rate of movement, distance moved, and velocity showed significant differences between differently-sized individuals. Our study indicates that breeding abalone at high densities has a negative effect on their growth and survival, which is thought to primarily be caused by spatial competition, and secondarily by differences in body size, ultimately affecting growth and productivity.

PA-16

## Estimation of olive flounder growth through genomic prediction

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Fish selection for breeding is a decision that must be made by considering several factors. Selective breeding, which solely depends on pedigree information, has limitations that can negatively affect the desired traits in the long term. In this context, genomic prediction for fish selection is a promising advanced tool that can alleviate most of the drawbacks in selective breeding and provide information for better selection. In our study, we optimize genomic prediction methods using 5-fold cross-validation to predict the weight trait of olive flounder which was genotyped by 70 K SNP array. Optimization was carried out by changing different criteria such as prediction method, fixed effects, SNP number, population size, and phenotypic records at different ages of fish. In addition, we determined the predictive ability for the total length and width of fish. Out of eleven prediction methods used in this study, the highest predictive ability was given by Bayesian B (0.675), Elastic Net (0.679), Random Forest (0.698) methods, and GBLUP (0.637) was given the lowest predictive ability. The inclusion of fish sex/gender information to the model as a fixed effect significantly increases the predictive ability of GBLUP (0.835) and Bayesian B (0.83). Even at a lower number of SNP markers such as 4000, the predictive ability of selected methods and models ranged from 0.641 to 0.831. In the fixed effect included models, predictive ability was more than 80 % for weight traits even using 100 SNPs. Increasing the population size reduces the standard deviation of the predictive ability. Interestingly, phenotypic records of 1.8-year-old fish were given significantly higher prediction ability compared to other ages. In addition, selected models and methods provide higher predictive ability for the fish's length (0.655-0.852) and body depth (0.665-0.861). The findings of the study can be informative for the future genomic selection programs of olive flounder and as an insight into genomic prediction in aquaculture.

PA-17

## Analysis of bacterial isolates and resistance patterns of tetracyclines in olive flounder (*Paralichthys olivaceus*) after administration of oxytetracycline

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Amoxicillin, ampicillin, ceftiofur, florfenicol, tetracycline, doxycycline and oxytetracycline are common antibiotics used in aquaculture against bacterial pathogens in fish. The aim of this study was to investigate change in bacteria and bacterial resistance rate after the administration of oxytetracycline in the rearing water of olive flounder (*Paralichthys olivaceus*). For this purpose, olive flounder from two farms (farm A, farm B) were treated with oxytetracycline at a concentration of 25 ppm for 1 hour. Samples were taken to isolate bacteria from the rearing water, liver, intestine and kidney of olive flounder before treatment and on days 1 and 14 after treatment. For bacterial isolation, liver, intestines and kidneys were smeared on tryptic soy agar (TSA, Difco, USA), TSA supplemented with oxytetracycline (10 µg/ml), thiosulfate citrate bile salt sucrose (TCBS) agar (Difco, USA), and TCBS supplemented with oxytetracycline (10 µg/ml). Detailed identification of the bacteria was performed by 16S rRNA sequencing, and the disk diffusion method was used for antibiotic susceptibility testing. There was a decrease in the number of bacteria after the oxytetracycline treatment, followed by an increase on day 14 after the treatment, when the changes in the number of bacteria in the rearing water were examined. As a result of 16S rRNA sequencing, various bacteria such as *Vibrio owensii*, *V. alginolyticus*, *V. fortis*, *V. chagasii*, *V. harveyi*, and *Photobacterium damsela* were detected in the water samples. Bacteria isolated from olive flounder included *P. iliopiscarium*, *V. scopthalmi*, and *P. damsela*. As a result of the oxytetracycline disk, we observe that the percentage of isolates in farm A that did not inhibition zone on the disk increased from 14% before to 25% after treatment. However, farm B shows a similar trend with 60% and 63% before and after treatment, respectively.

PA-18

## The effect of salinity on indoor tank acclimation of Korean pomfret(*Pampus echinogaster*)

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*P. echinogaster* is attracting attention as a variety that requires mass production due to its high demand as a seafood, but it is very difficult to keep it alive in the process of capturing it in nature and acclimatizing it to an artificial environment. It is known that the body fluid osmotic pressure of many teleost fishes is 15 to 10 psu, and marine fish expend energy to regulate osmotic pressure. This study was conducted to obtain basic data to increase the initial survival rate of *P. echinogaster*, and based on the results of preliminary experiments conducted in 2022, the effect of salinity on indoor tank acclimation of *P. echinogaster* was investigated.

*P. echinogaster* (standard length  $12.1 \pm 1.8$  mm, standard weight  $41.6 \pm 8.3$  g) was selected among the creatures caught in a set net located in Dolsan, Yeosu on July 27 and August 18, 2023, and a total of 108 were captured. The salinity concentration at the start of the experiment was divided into LSW1 (Low Salinity Water, 10 psu), LSW2 (Low Salinity Water, 20 psu), and SW (Sea Water, 27 psu), and the experiment was repeated twice. In the first round, 15 fishes were used in each experimental group from July 27 to August 17, and in the second round, 15 fishes were used in each experimental group from August 18 to September 16.

As a result of investigating the survival rate of *P. echinogaster* according to salt concentration, the survival rate of LSW1 was the highest at 40% on the 30th, followed by the survival rate of LSW2 at 23%, and the survival rate of SW at 13%. In the case of SW, the mortality rate was high from the day the experiment began. In all experimental districts, oyster eating was confirmed on the third day, and eating activities gradually increased over the day, and krill were also actively eaten afterwards.

PA-19

## A study on the appropriate temperature for finding the optimal transportation method for juvenile sea cucumber, *Stichopus japonicus*

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It is most ideal to transport sea cucumbers, *Stichopus japonicus* by live-fish transportation vehicle for a long time, but it is often not possible. Using the characteristics of *S. japonicus* that have excellent recovery ability even when exposed to the air, we would like to identify the optimal transport method by comparing survival, recovery, activity, and external damage to air exposure time by various temperatures. Juvenile *S. japonicus* (1.1~1.5 g wet body weight) were randomly distributed of five individuals in a 100 mL beaker and exposed to the air, and the conditions were examined 5 times at temperature 0, 5, 10, 15, 20, and 25°C for 60 hours. When the transportation time was within 24 hours, there were no serious problems with survival, recovery, activity, and external damage of juvenile *S. japonicus* in a well-sealed state at temperatures between 0 and 20 °C. At temperature 25°C, only minor external damage occurred at 12 hours of exposure to the air, and there was no abnormality in survival and activity. After 36 hours, it showed a survival rate of 20% and severe external damage. However, if it exceeds 24 hours, it has been investigated that the optimum state can be maintained up to 60 hours only if it is maintained at 5-10°C in a well-sealed state.



PA-20

## Zebrafish CCR2 mutant suffer from ataxia and atrophy of developing CNS

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Chemokines and their receptors play an important role in the immune system. Human CCR5 is known as a G protein-coupled receptor that functions as a chemokine receptor in the CC chemokine group. However, the function of the human CCR5 homolog during zebrafish development is largely unknown. We isolated the CCR2 gene as a homolog of human CCR5 and generated a zebrafish mutant using CRISPR/Cas9 genome editing. The nonsense mutant of zebrafish CCR2 developed normally. To analyze the zebrafish CCR2 mutant, we performed RNA-Seq using 10-dpf zebrafish embryos. Transcriptome analysis provides a set of misregulated genes associated with a neurodegenerative disease characterized by progressive ataxia and atrophy of the cerebellum and brainstem. We confirmed the genes using volcano plot analysis, David analysis, and real-time PCR. Our results suggest that the novel function of the chemokine receptor might be associated with ataxia and atrophy of the cerebellum and brain stem.

PA-21

## Evaluation of formulated feeds for the Atlantic salmon parr (*Salmo salar* L.)

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As salmon consumption in Korea has been increasing yearly, Korean salmon industry goes big. There is a need to develop formulated feeds using domestic ingredients for cost-effective salmon farming. Lipid contents in fish diet can influence flavor and textures as well as lipid metabolism especially important for anadromous fish like salmon. However, understanding effect of dietary lipid in salmon during the freshwater phase (parr) remains unclear. Thus, this study aims to secure basic data for developing formulated feeds for Atlantic salmon. Six 1000L semi-circulating filtration type aquariums were used to culture 300 fish (13~17g, 10~17cm) per dietary group with freshwater environment (pH 6.7~6.8, DO 7~8mg/L, Temperature 15°C). Five commercially available feeds for salmonids were fed to experimental fish groups (C1, C2 and C3: domestic salmonoid feeds; C4 and C5: overseas salmonoid feeds) for 12 weeks. The lipid levels of the feeds used in this study vary (C1 and C2: low-lipid diet, 13-14%; C3 high-lipid diet, 25%; C4 and C5: medium-lipid diets, 17-18%). C6 groups were fed with C1 feeds for first 4 weeks and then fed with C5 for another 8 weeks to understand effects of changing lipid contents on growth and immune responses of salmon at parr-stage. After the feeding trial, the weight gain, feed efficiency, survival rate, hepatosomatic index (HSI), proximate composition for whole fish body, antioxidant enzymes (SOD, Catalase, GPx), immune-related enzymes (IgM, Lysozyme) and histology (liver and intestine) will be analyzed. This study attempts to provide basic knowledge for development of early stage of salmon feed.

PA-22

## Antioxidant and Lipase Inhibition Activities of Glycoprotein Isolated from Edible Seaweeds

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Useful ingredients derived from seaweed are attracting attention in the potential functional food, cosmetics, and pharmaceutical industries due to their physiological activity with almost no side effects. The aim of this study was to evaluate the antioxidative ability and lipase inhibition activity of edible seaweed glycoproteins with molecular weight of less than 10 kDa. Glycoproteins were purified using the same method from four different types of commercially available seaweed named *Ulva lactuca*, *Sargassum horneri*, *Undaria pinnatifida* and *Saccharina japonica*. All four glycoprotein samples proved to be antioxidant against three radical scavenging assays. The radical scavenging activity increased in concentration dependent manner. Strong lipase inhibition was also observed where *Ulva lactuca* showed the highest activity of 84% among four seaweeds.

PA-23

### Immersion challenge with *Enterocytozoon hepatopenaei* (EHP) in black porgy (*Acanthopagrus schlegelii*)

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*Enterocytozoon hepatopenaei* (EHP) is a causative agent of Hepatopancreatic microsporidiosis (HPM) leading to economical loss associated with growth retardation in white-leg shrimp. Since infection with EHP was first reported in *Litopenaeus monodon* in Thailand in 2004, Following EHP infection at shrimp farms in Korea were reported in *Litopenaeus vannamei* and *Macrobrachium rosenbergii* in 2021 and 2022, respectively. EHP was also detected in live feeds (*Artemia*, polychaetes, squids), harbor organisms (molluscs and other animals), and dragonfly acting as mechanical carriers in shrimp. Recently, pilot research on potential carrier or host evaluated in crab or fish which no detection of EHP was observed. In this study, black porgy (*Acanthopagrus schlegelii*), major cultured fish in Korea, was evaluated for EHP potential carrier using immersion challenge. 9 black porgy ( $14.00 \pm 8.36\text{g}$ ) were treated with immersion challenge with  $7.89 \times 10^4$  EHP cells/L isolated from naturally infected white-leg shrimp in farm, and 9 black porgy ( $17.96 \pm 8.42\text{g}$ ) were treated with only sea-water as control. 3 fishes in each groups were dissected at 1, 3, and 7 days post-immersion (dpi), and intestine and stomach were isolated for PCR analysis (SWP-PCR method). As a result, EHP detection rate in the stomach were observed with 33.3% (1/3) in 1 dpi, and with 66.6% (2/3) in 3 and 7 dpi whereas EHP was not detected in intestine all times. It is meaning migrating EHP in environment was ingested by black porgy, and digesting EHP procedure was occurred in fish stomach. This outcome took into insight the fact that black porgy does not function as a mechanical transporter or reservoir, but it still requires additional research with a comprehensive assessment of histopathological observation utilizing *in situ* hybridization.

PA-24

## Isolation and characterization of chum salmon (*Oncorhynchus keta*) primary cells for cell line establishment

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In recent years, there has been a growing trend in the research community to replace animal experiments in the pursuit of animal welfare and ethics. In South Korea, the mandatory pre-approval of experimental protocols by the Institutional Animal Care and Use Committee (IACUC) is required prior to animal experiments. A prominent approach to replace animal experiments is the use of cell culture. When animal experiments are inevitable, the trend is to initiate with cell-based models in the initial stages and progress to animal models in later stages.

To facilitate the transition to cell-based models, it is imperative to have access to primary cells of the organisms under study. In particular, when research focuses on specific tissues, access to cells from those tissues is essential. Worldwide, access to cell lines from various species and tissues of mammals is seamless. However, institutions providing and maintaining cell lines from aquatic animals are rare. Consequently, there is a compelling need to obtain primary cells from aquatic animals, establish cell lines, and distribute them to researchers.

Chum salmon (*Oncorhynchus keta*) represents a prominent species among the Salmonidae family, including species native to South Korea. Salmonidae species are globally accessible and widely studied. While cell lines are available for rainbow trout and Atlantic salmon among Salmonidae species, access to cell lines from other species is limited. Notably, there are no reported instances of establishing or distributing Salmonidae cell lines in South Korea.

Hence, we are engaged in developing and banking cell lines from aquatic animals. As part of our efforts, we have successfully obtained primary cells from chum salmon, including muscle, liver, and adipose tissues. We have used the pCELL™ kit (CellQua, South Korea), developed by CellQua for the isolation of primary cells. We are continuously working to convert these primary cells into natural immortalized cell lines. We believe that the availability of chum salmon cell lines will open new avenues for research in marine biotechnology.

PA-25

## Characterization of caudal fin cell line from a novel fish experimental model, the silvertip tetra (*Hasemanian nana*)

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The silvertip tetra (*Hasemanian nana*) is a freshwater fish species native to South America, specifically the Sao Francisco region of Brazil. This species is known for its small size (3 cm) and thrives in water temperatures ranging from 23-28°C. It is known for its ease of rearing, with a short maturation period and the advantage of obtaining numerous clear eggs that hatch within 24 to 36 hours. The transparent eggs facilitate the observation of developmental stages. Notably, the females are silvery while the males are orange, making it easy to distinguish the sexes based on coloration. These characteristics make the silvertip tetra a promising new experimental fish model suitable for associations between sex determination and phenotype research.

Fish cell lines are essential for several research areas, including fish growth, disease, production, genetics, and biotechnology. However, the availability of fish cell lines is very limited and often restricted to foreign sources. As a result, domestic researchers often undertake the development of fish cell lines to support their experiments.

Caudal fin cell lines have been developed from several fish species. Caudal fins play a critical role in their survival and are characterized by rapid regenerative capacity and ease of manipulation.

In this study, we focused on developing and characterizing cell lines derived from the caudal fin of the silvertip tetra. Male silver tip tetras were subjected to ice anesthesia, and caudal fins were extracted. Primary cells were obtained using the pCELL™ kit (CellQua, South Korea), and cell lines were established by serial passaging using CQ-F™ medium (CellQua, South Korea). We determined the optimal conditions for fetal bovine serum (FBS) concentration and temperature at passage number 60. This cell line holds great promise for applications in various aquaculture and fisheries research fields.

PA-26

## Primary cell isolation and cellular characterization for the establishment of cell lines from eel, *Anguilla japonica*

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Worldwide, the eel (*Anguilla japonica*) is a very popular species, with successful aquaculture limited to the laboratory. Illegal harvesting of eels, particularly in the form of 'glass eels', remains a pressing problem worldwide, and the eel is currently listed as an endangered species. While research into various aspects of eel biology and aquaculture has provided valuable insights, many challenges remain, including disease management and nutritional considerations.

To accelerate research, it is imperative to minimize reliance on live animals for experimentation, as such methods raise ethical concerns and require significant resources in terms of personnel, space, time, and cost. Cellular experiment using eel cells offers a viable alternative with the potential to address animal welfare concerns while streamlining research efforts. Particularly in areas such as vaccine development, eel cell cultures have become indispensable.

Unfortunately, domestic access to eel cell lines in South Korea remains non-existent, and global availability is also extremely rare. Prominent eel cell lines such as EK-1 (eel kidney) and EO-1 (eel ovary) have been used by a select group of international researchers, resulting in published studies. However, the use of eel cells for research in South Korea is virtually uncharted territory, and obtaining eel cells is a formidable challenge.

We have obtained primary cells from eel muscle, fin and liver tissues. For primary cell isolation, we used our proprietary cell culture kit, pCELL™ kit (CellQua, South Korea), and our proprietary basal medium, CQ-F™ medium (CellQua, South Korea), for cell culture. Cell proliferation rates were assessed by doubling time measurements and tissue-specific cell characteristics were analyzed by fluorescence-activated cell sorting (FACS).

The procurement of diverse eel tissue cells has significant potential for a range of applications within South Korea's marine bio-industry. This research is essential in addressing the challenges facing eel research and aquaculture.

PA-27

## Effect of water temperature on post-surgical recovery following bio-logger implantation in olive flounder

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Bio-loggers are used in many studies to obtain behavioral and biological information of swimming fish. However, when these devices are implanted into the body, surgical procedures that cause stress and physiological side effects are often required. This study was conducted to determine the recovery of flounder after bio-logger implantation. In particular, the water temperature was set at 24°C and 28°C under the assumption that the degree of recovery of flounder would vary depending on water temperature changes.

A total of 10 live flounders (*Paralichthys olivaceus*) from a local farm were used in this study. The experiments were conducted under a 12 (6:00–18:00):12 (19:00–5:00) h light:dark photoperiod. A bio-logger (DST milli-HRT, Star-Oddi) was inserted near the heart of olive flounder to observe heart rate changes in response to water temperature. The bio-logger measured heart rates every 10 min in Experiment 1 (24°C) and Experiment 2 (28°C) for 8 days. ECG data were collected every 2 h considering the capacity of the data logger. Accordingly, an ECG sampling frequency of 100 Hz was set in all experimental groups. All logged heart rate measurements were graded with a data verification quality index (QI) to calibrate the electrocardiogram data.

The heart rate of the flounder ranged from 79.66 ± 17.38 bpm on the day of surgery to 43.83 ± 19.97 bpm at the end of the experiment. The heart rate increased and decreased repeatedly over time and was maintained at 40 bpm after 3 days. In experiment 2, the heart rate of the flounder was highest at 69.38±29.82 bpm on the day of surgery. At the end of the experiment, it was found to be 59.82 ± 24.47 bpm, but 60 bpm was continuously maintained throughout the experiment.



PA-28

## Toxicity evaluation of bio-Based microplastic polyhydroxybutyrate on adult White leg shrimp (*Litopenaeus vannamei*)

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The experiment was conducted to evaluate the oral subchronic toxicity of microplastic PHB (polyhydroxybutyrate) on adult *Litopenaeus vannamei*. 600 shrimps (initial mean weight:  $12.3 \pm 0.2$ g) were randomly allocated to 12 300L PVC tanks and reared for 4 weeks. Four diets containing 0, 0.1, 0.5 and 1g PHB/kg feed were fed to triplicate groups of shrimp respectively. At the end of the experiment, hepatopancreas samples from each group were taken for antioxidant and immune enzyme activities analysis. Gill, hepatopancreas and intestine samples from 1g PHB/kg group was taken for detection of distribution and composition of microplastics. Intestinal tissues from control and 1g PHB/kg group were sampled for intestinal microflora and metabolomics analysis. There were no obvious differences in growth parameters, including final average weight, specific growth rate (SGR), weight gain (WG), and survival rate between the control and experimental groups. The antioxidant and immune enzyme activities were not significantly affected, except lysozyme (LZM) activity increased with increasing of PHB concentration. According to the qualitative results of LDIR, most of microplastics in gill, hepatopancreas and intestine cannot be qualitatively identified. The number of microplastics with a matching degree  $>0.65$  in gills, hepatopancreas and intestine was 10, 10, 104 respectively. Following 16S rRNA sequencing, 3124 operational taxonomic units were identified across the control and PHB group. Alpha diversity analysis showed that species richness and diversity was higher in PHB group. PHB supplementation increased the abundance of *Firmicutes*, while decreasing the abundance of *Bacteroidota*. The significantly different species in PHB group were *Enterobacterales*, *Gammaproteobacteria*, *Vibrionaceae*, *Vibrio*, *Xanthomarina*, *Motilimonas* and *Psychromonadaceae*, while in control group, the most different species were *Rhodobacteraceae*, *Alphaproteobacteria*, *Rhodobacterales*, *Ruegeria*, *Halocynthiibacter*, *Flavobacteriaceae*, *Cyclobacteriaceae*, *Algoriphagus* and *Cytophagales*.

PA-29

## Ghrelin expression and gastrointestinal transit time under starvation in starry flounder (*Platichthys stellatus*)

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Ghrelin, a potent stimulator of growth hormone secretion and a significant regulator of food intake and energy homeostasis in mammals, is also present in non-mammalian vertebrates, including fish. While the systemic impact of ghrelin has been thoroughly explored in mammals, its functions and associated effects in fish species remain relatively underexplored. As a key component of the endocrine system, understanding the role of ghrelin in fish could provide crucial insights into metabolic regulation, growth patterns, feeding behavior, and overall health of aquatic life. Unniappan et al. (2002) conducted a study examining the effect of ghrelin on feeding behavior in goldfish. The experiment involved intraperitoneal injections of ghrelin at varying dosages. The researchers discovered that ghrelin injections significantly increase food intake in the ghrelin-treated goldfish, suggesting that ghrelin stimulates appetite in fish similar to its effects in mammals. However, studies with other species, such as rainbow trout, have indicated that the delivery of synthetic ghrelin has no effect on food intake or even decreases voluntary food intake. These varied findings suggest that the behavioral response to ghrelin overload may differ depending on the species and fish conditions. Hence, it is crucial to empirically assess the expression pattern of ghrelin in response to different biological and environmental conditions in the specific target species in order to gain deeper insights into the specific roles of ghrelin. To confirm the correlation between the gastrointestinal transit time of the feed and the change in ghrelin expression, the time for the feed to completely pass through the stomach was checked. As a result, 24 hours after feeding, the feed completely passed through the stomach and into the intestines. As confirmed by photographs, the contents were completely discharged from the intestines between 40 and 48 hours after feeding. Ghrelin expression was highest 48 hours after fasting, and ghrelin expression was consistent with feed intestinal transit time. Based on these results, the gastrointestinal transit time must be considered in order to maintain ghrelin expression.

PA-30

## Nutritional enrichment with glucose in the yolk-sac larvae stage of Freshwater eel (*Anguilla japonica*)

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Freshwater eel are commercially important in Northeast Asia, but mass seed production has not been successful, in part because of their very unique life history. Brood stock are known to spawn at a depth of about 200 m near the Mariana Trench. And, the hatched larvae feed on marine snow and are known to migrate along the currents for about 150 days after hatching (DAH) before metamorphosing into juvenile eels (glass eel). These unique ecological characteristics are impossible to adapt to aquaculture, resulting in low quality of artificial seed. Therefore, this study aimed to provide a new method to enrich nutrition of seeds before the first feeding, and to confirm the effect of glucose as a nutrient source for eel larvae. As new nutritional enrichment method, larvae were housed in 300 L cylindrical tanks immediately after hatching and reared on the rotation system in glucose-add seawater (0%, 0.5%, 1%, 2%) from 1 to 6 DAH. Morphological changes were measured for total length (TL) and body depth (BD), and biochemical changes were determined by ELISA analysis of hyaluronic acid (the main substance that makes up the eel larval body and of which precursor is glucose) concentration. Histological changes were confirmed by ab-PAS staining the accumulation of glycogen in the liver. In result, at 6 DAH, Glucose-0% group had 6.85 mm TL, Glucose-0.5% group had 6.83 mm TL, Glucose-1% group had 6.65 mm TL, and Glucose-2% group had total mortality. There was no significant difference between Glucose-0% and -0.5% group ( $p>0.05$ ), but Glucose-0% and -0.5% group had significantly larger TL than Glucose-1% group ( $p<0.05$ ). In body depth, No significant differences were observed between Glucose-0% (0.60 mm BD) and -1% group (0.59 mm BD) ( $p>0.05$ ), but Glucose-0.5% group (0.64 mm BD) was significantly larger than Glucose-0% and -1% group ( $p<0.05$ ). Meanwhile, the amount of hyaluronic acid was about 60% higher in Glucose-0.5% group (10.67 ng/ml) than in Glucose-0% (6.47 ng/ml) and -1% group (6.70 ng/ml), and a significant difference was observed ( $p<0.05$ ), while no significant difference was observed between Glucose-0% and -1% group ( $p>0.05$ ). Histological analysis showed that Glucose-0.5% and -1% group had relatively more glycogen accumulation in the liver at 6 DAH than Glucose-0% group. Thus, this study suggests a novel approach to nutritional enrichment using 0.5% glucose in seawater during the yolk-sac larvae stage, and further shows that the glucose supplementation can enhance their growth, hyaluronic acid synthesis, and glycogen accumulation in the body.

PA-31

## Nutritional enrichment method to improve the effect of artificial maturation in Freshwater eel (*Anguilla japonica*)

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Eel is one of the valuable species in Northeast Asia, but the maturation and spawning mechanism of eel are not clearly understood. After 5-10 years of growth in freshwater, eels migrate for spawning to near of the Mariana Trench without food during about 6 months. Eels mature during the spawning migration, but these conditions are not adapt in reproduction, so they are currently injected with hormones to induce artificial maturation. On the other hand, aquacultured species usually induce nutritional enhancement by providing adequate food sources during spawning season, but eels do not eat for about 15-20 weeks when hormones are administered, resulting in body surface inflammation and poor of egg quality. Therefore, this study aimed to suggest a nutritional enhancement method during hormone administration and to confirm its effect. Eel females were injected with the salmon pituitary extracts (50 mg/kg) once weekly for maturation. The eels were checked weekly for changes in body weight, abdomen, and genital pore to determine maturity. This experiment was designed to determine the effect of nutrient injections on maturation and egg production. Control group consisted of 11 females (average weight  $483 \pm 32$  g) treated with hormone for 15 weeks and Experimental group consisted of 11 females (average weight  $483 \pm 31$  g) treated with a combination of hormone and the complex nutrients (0.5 ml/kg) for 15 weeks. In this study, the number of deaths during the maturation was 8 in Control group and 4 in Experimental group. Also, inflammation occurred less frequently Experimental group (3 individuals) then Control group (6 individuals). And, the number of deaths within 5 weeks was lower in Experimental group (2 individuals) compared to Control group (6 individuals). Meanwhile, the number of mature tended to be higher in Experimental group (5 individuals) compared to Control group (2 individuals), and the number that reached spawning was the same at 2 individuals. The time to spawning was shorter in Experimental group (8.5 weeks) compared to Control group (9.5 weeks). The average initial weight of spawned females was relatively similar in Control ( $478 \pm 12$  g) and Experimental ( $482 \pm 5$  g) group, but the weight of eggs produced was higher Experimental group (215.5 g) than Control group (163 g). This study provided a new method for nutritional enhancement during artificial maturation and showed that nutrient injection was effective in inducing artificial maturation and increasing eggs production. In the future, we will study for finding active ingredients and comparing wild and farmed eels.

PA-32

## Review of zebrafish (*Danio rerio*) disease

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Zebrafish (*Danio rerio*) are widely used in vertebrate development, genetic research, and compound screening for pharmaceutical development, and are raised in an recirculating aquaculture system (RAS) in many research facilities. Because the RAS continuously reuses water, it is difficult to avoid the creation of pathogenic microorganisms as secretions from experimental animals and nitrate substances eluted from feed accumulate in the system. Additionally, most zebrafish users obtaining eggs from adults to conduct research. At this time, during the mating process to get eggs, not only are there a high probability of skin injuries after mating due to rubbing between individuals, but their immunity is also reduced. Therefore, it is essential to maintain and manage individuals that return to the system immediately after mating as disease-free and healthy individuals, as they can be easily exposed to diseases and affect research results. Therefore, we would like to summarize the factors affecting zebrafish health in RAS.

PA-33

## Understanding the impact of *Pseudomonas aeruginosa* infection on the transcriptome of *Urechis unicinctus* Nephridia

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Marine invertebrates, such as the spoon worm (*Urechis unicinctus*), are essential sources for the development of novel antibiotics to address the emerging antibiotic-resistant bacteria crisis. Currently, numerous research efforts are underway to identify lead compounds with antimicrobial and other activities derived from diverse marine and terrestrial resources. Spoon worms, which inhabit subtidal and intertidal zones, are robust animals capable of surviving in harsh environments. They are expected to possess potent immune substances that can deter pathogen invasion in aquatic environments teeming with microorganisms. Therefore, the construction of a transcriptome database for spoon worms' immune responses, induced by *Pseudomonas aeruginosa*, is essential. Such a database can potentially serve as a library for identifying effective antimicrobial peptide (AMP) sequences against antibiotic-resistant bacteria. In this study, *P. aeruginosa* was injected into spoon worms, and transcriptome analysis was performed using the animals' nephridia sixteen hours after injection. A total of 43,043 contigs were obtained through *de novo* assembly. In total, 4,004 differentially expressed genes (DEGs) were identified in the infected spoon worms compared to the control group, with 2,297 up-regulated and 1,707 down-regulated DEGs. KEGG classification revealed that the up-regulated genes in the infected spoon worms were related to pathways associated with antioxidant and antimicrobial activities, while the down-regulated genes were involved in pathways related to various cancers. Additional investigations are currently underway to identify candidate AMPs using the *U. unicinctus* transcriptome database through applying several filters, and the validation of these candidates will be conducted through a high-throughput antimicrobial activity screening system.

PA-34

## Long-term usability evaluation of the low-fish meal extruded pellet diet for juvenile olive flounder *Paralichthys olivaceus* at Jeju fish farm

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This study was conducted to evaluate the utilization of the low-fish meal (LFM) diet, and the effect of black soldier fly (BSF) *Hermetia illucens* meal and oil as a fish meal (FM) substitute or functional additive for juvenile olive flounder *Paralichthys olivaceus* at the fish farm. The control diet (FM70) contained 70% of fish meal (anchovy and sardine). Two types of experimental diets replaced FM using animal (tankage, poultry byproduct and tuna byproduct meal) and plant (wheat gluten and soy protein concentrate) protein sources, and contained 45 and 35% of FM, respectively (designated as FM45 and FM35). One experimental diet replaced the FM with animal, plant and BSF meal, and fish oil additionally using insect meal and oil (FM35+). At the end of the feeding trial, there was no significant difference in growth performance, feed utilization, survival rate and biological indices among all experimental groups. Aspartate aminotransferase and cholesterol levels in the FM35 and FM35+ groups were significantly higher than that in the FM70 group. The linoleic acid level in the muscle was significantly higher in fish fed FM70 diet than those of fish fed the FM45, FM35 and FM35+ diets. We suggested that there is no negative effect of using the LFM diet for juvenile olive flounder at fish farm during 6 month.

Table 1. Growth performance, feed utilization and survival of juvenile olive flounder (initial mean body weight: 19.3g) fed the experimental diets for 6 months.

Diets	FBW (g)	WG (%)	SGR (%)	FI (g)	FCR	PER	Survival (%)
FM70	259±23.3	1239±121	1.58±0.06	251±14.1	1.05±0.04	1.62±0.07	57.0±0.62
FM45	256±5.66	1226±29.3	1.58±0.01	260±4.95	1.10±0.01	1.54±0.01	54.7±1.80
FM35	252±29.7	1206±154	1.58±0.07	255±1.41	1.10±0.13	1.54±0.19	51.9±2.71
FM35+	240±6.36	1141±33.0	1.56±0.02	240±14.9	1.09±0.10	1.58±0.14	45.6±5.59

Values are mean of triplicates and presented as mean ± SD.

PA-35

## Evaluation of the low-fish meal extruded pellet diet for growing olive flounder *Paralichthys olivaceus* at Jeju fish farm

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This study was conducted to evaluate the utilization of the low fish meal extruded pellet diet for growing olive flounder *Paralichthys olivaceus* at Jeju fish farm. The control diet (FM70) contained 70% of fish meal (anchovy and sardine). Two types of experimental diets replaced fish meal in the control diet using animal and plant protein sources (tankage meal, poultry byproduct meal, tuna byproduct meal, wheat gluten, and soy protein concentrate), and contained 45 and 35% of fish meal, respectively (designated as FM45 and FM35). One of the experimental diets were adjusted for the content of animal and plant protein substitutes, with black soldier fly (*Hermetia illucens*, BSF) meal added 3.5% and BSF oil at 0.5% and the content of fish meal controlled at 35% (FM35+). At the end of the feeding trial, there was no significant difference in growth performance, feed utilization, survival rate and biological indices among all experimental groups. Glucose level in the FM45 and FM35 groups were significantly higher than that in the FM70 group. We suggested that there is no negative effect of using the LFM diet for growing olive flounder at fish farm during 6 month.

Table 1. Growth performance, feed utilization and survival of growing olive flounder (initial mean body weight: 392g) fed the experimental diets for 6 months.

Diets	FBW (g)	WG (%)	FI (g)	FCR	Survival (%)
FM70	1100±10.4	179±2.64	754±691	1.43±0.03	71.7±0.04
FM45	1045±27.0	165±6.86	754±9.70	1.53±0.02	70.7±2.25
FM35	1020±33.3	170±8.82	690±21.1	1.47±0.11	71.8±1.79
FM35+	1096±63.9	179±6.52	781±2.32	1.43±0.06	73.7±0.31

Values are mean of triplicates and presented as mean ± SD.



PA-36

## Effect of improving growth using water temperature and intestinal microorganisms in red-spotted grouper *Epinephelus akkara*

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This study was conducted to enhance the growth of farmed red-spotted grouper using the identified intestinal microbiota and appropriate water temperature conditions from previous research. The experimental group maintained water temperatures in the range of 26-27°C, while the control group was kept at natural water conditions. The experimental group was fed with commercial feed supplemented with a microbiota (3 species) at a rate of 3% per feed weight (1% for each microbiota species), while the control group was fed with commercial feed only. The experiment lasted for a total of 54 weeks, during which the growth performance of the experimental fish was investigated. To observe the histological characteristics of the intestine, sampling were performed at 3-week intervals from the beginning of the experiment until 12 weeks.

The results of the experiment showed that the body weight and total length began to increase significantly ( $P < 0.05$ ) in the experimental group ( $42.8 \pm 0.5$  g) compared to the control group ( $34.7 \pm 0.63$  g) from the 3 weeks. At the end of the experiment, the total weight gain was 53,350 g for the control group and 136,239g for the experimental group. During the experimental period, the average growth rate and feed efficiency were 11.6% and 46.1% for the control group, and 19.4% and 73.0% for the experimental group, respectively. The average survival rate for the control group and experimental group was 99.8% and 99.9%, respectively. Measurement of the number of goblet cells in the intestinal mucosa showed that the experimental group ( $47.9 \pm 3.8$ ) had a significantly ( $P < 0.05$ ) many number of goblet cells compared to the control group ( $42.6 \pm 4.8$ ) from the 3 weeks of the experiment.

Based on our research results, it is suggested that the appropriate water temperature and the supply of feed with added intestinal microbiota played a role in the digestive activity, and effectively promoting their growth. Our study may provide insights into the potential of intestinal microbiota as probiotics and optimal rearing conditions for the cultivation of red-spotted grouper.

PA-37

## Effects of graded levels of dietary $\gamma$ -aminobutyric acid supplementation on temperature stress responses in juvenile olive flounder (*Paralichthys olivaceus*)

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Increasing water temperature associated with global warming directly or indirectly influences survival, growth, physiological activity, and immunity of cultured fish, and this environmental change can be a stressor for olive flounder, one of the important cultured fish species in Rep. of Korea. Gamma-aminobutyric acid (GABA) is one of the free amino acids, classified as a non-essential amino acid, playing an important role as a neurotransmitter inhibitor in the nervous system. In mammals, stress-relieving and sleep-enhancing effects of GABA have been demonstrated, and a growth-promoting effect of this free amino acid has been shown in cultured fishes. Thus, the current study was conducted to evaluate effects of graded levels of dietary GABA supplementation on temperature stress responses in juvenile olive flounder. Three hundred juveniles (initial body weight:  $12.97 \pm 0.1$  g) were distributed randomly across 15 rectangular tanks, with each tank accommodating 20 fish ( $N=3$  tanks per treatment). Addition of 0, 100, 200, 300, 400, and 500 ppm GABA in a basal diet was made to prepare for the six experimental diets. Following the 8-week growth trial, the juveniles were subjected to two temperature stress exposure: 1) lethal test: gradual increase in water temperature ( $1^\circ\text{C}$  increment every 30 m) until reaching  $32^\circ\text{C}$  and survival rate was measured for 48 h and 2) acute test: 6-h heat shock at  $29^\circ\text{C}$ . In the lethal exposure test, there was no significant difference in survival rate among the test diets. In the acute exposure test, there was a significant main effect of temperature stress on plasma metabolites, including glutamic oxaloacetate transaminase (GOT), glutamic pyruvic transaminase (GPT), and glucose, showing that those were elevated in response to the temperature stress. However, no significant main effect of the GABA supplementation on the plasma metabolites, including GOT, GPT, glucose, total protein, total cholesterol, and triglyceride was observed. A significant main effect of the temperature stress on the super oxide dismutase (SOD) and cortisol levels in plasma, showing that the SOD level was reduced but cortisol level was increased in response to the temperature stress. However, no significant main effect of the GABA supplementation on the SOD, glutathione peroxidase, immunoglobulin M, lysozyme, and cortisol levels was detected. Results of relative gene expression levels of key genes (heat shock proteins 60, 70, and 90) in various tissues will be discussed later.

PA-38

## Design and characterization of antimicrobial peptide analogs driven from sea urchin, *Heliocidaris crassispina*

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Humankind has discovered and developed various antibiotics to control pathogens. However, the indiscriminate use of these drugs has led to the emergence of multidrug-resistant (MDR) bacteria. MDR bacteria, such as ESKAPE strains, pose a major threat to public health. Additionally, despite the increasing prevalence of MDR bacteria, the development of new antibiotics has been declining. Antimicrobial peptides (AMPs) are promising candidates for the development of new antibiotics. AMPs are short peptides, typically composed of 10-100 amino acids (AAs). The positively charged or hydrophobic AAs are considered crucial components enabling the electrostatic and hydrophobic interactions between the AMPs and the negatively charged bacterial cytoplasmic membrane. One approach to enhance the antimicrobial activity of AMPs is to design analogs by adding, truncating, or substituting AAs. In the previous study, we have isolated an AMP from sea urchin, *Heliocidaris crassispina*. The isolated peptide is composed of 17 AAs and had amidated C-terminus. Based on the AA sequence, two series of analogs were designed to enhance the antimicrobial activity. In the first series, Gly residues were substituted with Ala residues to promote a helical structure known for its advantages in antimicrobial activity. In the second series, certain residues from the most potent Ala-substituted analog were substituted with Lys, which led the peptide to have more positive charges and amphipathicity. Most analogs showed enhanced antimicrobial activity, except for one analog in which Gly was substituted with Ala near the N-terminus. Furthermore, the membrane permeability of Lys-substituted analogs increased compared to that of the native peptide. In summary, these results demonstrate that the designed analogs show increased antimicrobial activity. Additional investigations examining potential side effects (hemolysis or cytotoxicity) and Research into the immune regulatory effects of these designed analogs are necessary to evaluate their potential as novel antibiotics.

PA-39

## Experiment on the effect of nitrate nitrogen on acute mortality in Rainbow Trout(*Oncorhynchus mykiss*) fries

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In the aquaculture system, ammonia, a byproduct of the metabolic activity of fish, is discharged through their gills. When nitrate nitrogen is concentrated at high levels, it adversely affects the structure and function of tissues. This, in turn, impacts blood properties, breathing, survival, and growth, ultimately leading to a decrease in productivity. Therefore, the goal of this study was to identify a safe concentration that does not affect the productivity of rainbow trout.

The study conducted an experiment to determine the safe concentration of nitrate in rainbow trout. To assess the acute toxicity of nitric acid nitrogen on rainbow trout, 15g of rainbow trout were placed in a 50L square water tank, and this setup was repeated three times to check the survival rate and semi-lethal concentration according to exposure time based on nitric acid nitrogen concentration. Throughout the entire experiment, the water temperature was maintained at 17°C, and the nitric acid nitrogen concentration was set at 0 (control), 250, 500, 1000, and 2000 mg NO<sub>3</sub>-N/L, respectively. No food was provided during the experiment period, and 40% of the total daily quantity of water was replaced twice (at 9:00 and 21:00). The experiment was conducted over a total of 4 days(96 hours).

Fish in the 2000 mg NO<sub>3</sub>-N/L range began to die rapidly after 36 hours, and all were deceased within 60 hours of exposure to nitric acid nitrogen. When the final survival rate was assessed at 96 hours, the survival rates of fish in the 0, 250, and 500 mg NO<sub>3</sub>-N/L ranges did not show a significant difference, all being above 95%. However, the survival rate of fish in the 1000 mg NO<sub>3</sub>-N/L range was 84.5%, showing a slight difference. Furthermore, fish in the 1000 mg NO<sub>3</sub>-N/L range gradually exhibited abnormal swimming behavior over time. This indicates that the lethal concentration of nitric acid nitrogen for rainbow trout is considered to be between 1000 and 2000 mg NO<sub>3</sub>-N/L.

PA-40

## Developing a microsatellites PCR system for small yellow croaker (*Larimichthys polyactis*) and their application in parentage assignment

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The small yellow croaker, *Larimichthys polyactis*, holds significant economic importance in Korea, China, and Japan, making it one of the most renowned fish species in the region. In this study, microsatellite markers were screened based on the reference genome sequence of *L. polyactis*. The genome of *L. polyactis* was sequenced using the PacBio Sequel II system and Illumina NovaSeq system, resulting in the successful decoding of the genome, with a total genome size of 700.58 Mb. From the reference genome sequence, we selected 96 microsatellite markers with stable amplification using Krait software. After optimizing primer sequences, concentrations, and product sizes, we obtained a set of 9 microsatellite markers. The evaluation of these selected genetic markers involved parentage assignment of *L. polyactis*, based on pedigrees generated from randomly bred groups, using CERVUS 3.0 software. The analysis of 150 offspring produced from 90 parents with unknown genders resulted in a 97.3% parentage assignment rate, using a 95% accuracy threshold. These microsatellite markers exhibited a high degree of polymorphism and met the requirements for parentage assignment. Therefore, the application of these specific genetic markers not only provides precise pedigree data but also reduces the burden of labor and cost. Additionally, the multiplex PCR system developed in this research for microsatellite markers offers a practical and valuable approach to facilitate the artificial breeding and pedigree management of *L. polyactis*.

PA-41

## Recombinant production of perlucin-like protein from starfish (*Patiria pectinifera*) and its antibacterial activity

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The innate immune system plays a vital role in invertebrate animals like starfish, *Patiria pectinifera*. This is, in part, due to the lack of operating adaptive immunity in these animals. Be that as it may, the invertebrates successfully defend themselves against various pathogens, in which defense, the recognition of pathogen-associated molecular patterns (PAMPs) plays an important role. Lectins like perlucins and perlucin-like proteins are known to take part in the innate immunity through the PAMP recognition and possibly moonlight as antimicrobial proteins. In this study, a candidate perlucin-like protein from *P. pectinifera* (PpPlp) was produced through a heterologous expression system and its antimicrobial activity against broad spectrum microbial strains was investigated. The expression vector with the nucleotide sequence of the mature PpPlp (pET-28a-PpPlp) was transformed into *Escherichia coli* BL21(DE3). Six induction conditions were considered, among which one with 0.1mM IPTG and 3hr induction at 37°C was the optimal induction condition. The over-expressed recombinant PpPlp (rPpPlp) was retrieved through affinity purification using His-tag. The purified rPpPlp was dialyzed in 1XPBS and isolated further through a reversed-phase column in high pressure liquid chromatography (HPLC), in which steps protein losses were observed. Moreover, the antibacterial activity of rPpPlp at this stage was negligible. Thus, the refolding of rPpPlp and its isolation through HPLC were carried out, which improved rPpPlp's antibacterial activity marginally. The antimicrobial activity of the refolded rPpPlp was investigated against various microbial strains. To confirm its involvement in the defense system of *P.pectinifera*, the transcriptional expression levels of PpPlp would be investigated.

PA-42

Identification and recombinant production of macin from starfish,  
*Patiria pectinifera*

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Antimicrobial peptides (AMPs) are essential defense molecules that play a vital role in the innate immune system of invertebrates lacking adaptive immunity. Macin is an AMP with antimicrobial and neuroregenerative properties, but it has never been reported in starfish. This study aims to identify and characterize macin from the starfish *Patiria pectinifera* (PpMacin) and investigate its antimicrobial activity. The nucleotide sequence of PpMacin was obtained using local tBLASTn with Hydra's Hydramacin-1 and leech's Neuromacin as queries. The sequence was verified by cDNA cloning. PpMacin was found to be 1527 bp long (5' UTR: 140 bp, ORF: 264 bp, 3' UTR: 1123 bp). The ORF encoded a mature peptide of 63 amino acids (AAs) and a signal peptide of 24 AAs. This cationic peptide had a molecular weight (MW) of approximately 7.3 kDa. The nucleotide sequence of the mature PpMacin was then inserted into the pET28a-TrxA vector and transformed into *Escherichia coli* BL21(DE3). The recombinant TrxA-PpMacin was purified using Ni-NTA beads, and PpMacin was separated from TrxA by CNBr treatment and HPLC purification. The MW and antibacterial activity of PpMacin were confirmed using LC/MS and URDA, respectively. Refolding of recombinant PpMacin was conducted to improve the peptide's antibacterial activity. The antimicrobial activity of the recombinant PpMacin before refolding, after refolding, and of the reduced PpMacin will be investigated against a broad spectrum of microbial strains, and the importance of proper folding with disulfide bond formation will be studied. Additionally, the transcriptional expression levels of PpMacin in different *P. pectinifera* tissues and post-immune challenge will be examined to establish its role in the innate immune system of the starfish.

PA-43

### Characterization of An antimicrobial peptide purified from starfish, *Patiria pectinifera*

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Marine animals are equipped with a potent defense system, possibly due to the microbe-rich environment of their surroundings. These animals, particularly marine invertebrates like the starfish *Patiria pectinifera*, lack adaptive immunity and primarily rely on innate immunity. Nevertheless, they successfully protect themselves against pathogenic infections by effectively utilizing antimicrobial peptides (AMPs). These peptides play an essential role in the defense system of marine invertebrates and have gained significant attention as potential antimicrobial agents. The objective of this work is to isolate AMPs from the shells of *P. pectinifera*. Shells from 60 starfish were collected and subjected to extraction by boiling and 5% acetic acid solution (v/v). Then, the extract was fractionated into four groups based on the hydrophobicity of the materials, using a Sep-Pak C18 cartridge. Among these fractions, the one eluted with 60% MeOH exhibited the most notable antibacterial activity against *Bacillus subtilis*. This particular fraction underwent a series of high-performance liquid chromatography (HPLC) steps to isolate a peptide showing antimicrobial activity against *B. subtilis*. The molecular weight (M.W) of the purified peptide was 4,121.925 Da when measured as [M+H]<sup>+</sup>. The amino acid (AA) sequence, determined using Edman degradation, comprised 44 AAs. Currently, cDNA cloning of the purified peptide is in progress to confirm the complete AA sequence, which has yielded multiple isotype AA sequences and a candidate AA sequence matching the observed M.W. Further research is required to validate these findings, assess the purified peptide's antimicrobial activity against various microbes, and explore its role in the innate immune defense of *P. pectinifera*.



PA-44

Production of anti-pancreatic cancer compound isolated from marine sediments  
*Streptomyces* sp. A21a

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The purpose of this study to research anti-pancreatic cancer effect of secondary metabolite from *Streptomyces* sp. A21a. It isolated from marine sediments, Busan, Republic of Korea. Marine sediment is known as rich in marine microbial diversity. Marine *Actinomycete* secondary metabolite is known to have pharmacological compounds such as anticancer, antimicrobial, and antiviral effect. Pancreatic cancer has a high anticancer failure rate due to difficulty in early detection. Pancreatic cancer therapy is in combination with anti-cancer drugs, even though development of next-generation anticancer drug. Therefore, chemotherapy is needed for pancreatic cancer. Actinomycete isolated from marine sediments, which has an anti-pancreatic cancer effect. *Streptomyces* sp. A21a was selected from isolated marine sediment derived actinomycete. It identified through 16S rRNA and confirmed to be 99.72% similar to *Streptomyces alboverticillatus*. After culturing in GSS broth for 7 days at 28°C, Mycelium cake and Supernatant were separated and extracted. Viability and proliferation tests were conducted on pancreatic cancer cell lines MIA PaCa-2, PANC-1, and Capan-2 in Mycelium cake for 24, 48, and 72 hours. As a result, both mycelium cake extraction and supernatant were confirmed to have a dose-dependent anti-pancreatic cancer effect.

PA-45

*amhy* knockout induces ovarian development in XY gonads of pejerrey  
*Odontesthes bonariensis*

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Sex determination in vertebrates displays a great diversity ranging from genetic sex determination (GSD) to environmental sex determination (ESD), in which environmental signals modulate gender development. The pejerrey *Odontesthes bonariensis* is a gonochoristic fish that has an XX/XY genetic sex determination system in coexistence with temperature-dependent sex determination (TSD). In the TSD system, all-female and all-male progenies can be obtained when fish are exposed to environmentally realistic temperatures of 17°C and 29°C respectively, during the critical period of sex determination (CPSD) (1-5 weeks after hatching). At intermediate temperatures (around 25°C), gonadal development generally follows a genotypically-dictated male- or female pathway associated with the presence or absence, respectively, of a Y chromosome-linked copy of the anti Müllerian hormone gene (*amhy*). However, the details of this process are still largely unknown. In this species, *amhy* expression starts shortly after hatching but decreases during the CPSD, when expression of its autosomal form, *amha*, begins. *amha* levels, in turn, are maintained high during the testicular differentiation. This intriguing expression pattern casts doubt if *amhy* is indeed necessary for masculinization at intermediate, sexually neutral temperatures. In this study, we produced *amhy* mutant pejerrey using the CRISPR/Cas9 platform to evaluate through loss-of-function if *amhy* is necessary for masculinization of XY pejerrey gonads. For this purpose, pejerrey eggs from an all XY-progeny were co-injected with two gRNAs (250ng/μl) targeting exons I and II of the *amhy* gene and the Cas9 enzyme (500ng/ μl) immediately after fertilization. By using two gRNAs, we aimed to induce wide deletions to increase the possibility of phenotypic knockout in the F0 generation. Larvae were reared at 25°C until gonadal sex could be asserted by light histology. Knockout efficiency was estimated by sequencing using an Illumina MiSeq platform and compared to non-injected controls. Paired-end clean reads after the barcode and primer sequence removed from raw data of amplicon sequencing were analyzed with CRIS.py. Treated fish showed overall high rates of mutation (>90%) except for two fish with only 49% and 62% of reads containing indels. Seven out of 26 individuals from the injected group developed ovaries morphologically identical to those found in normal females, whereas in the control group all fish (n=28) developed testis. The fact that several mutant individuals underwent male-to-female sex reversal and the results of expression patterns of sex-differentiation related genes of mutants support the notion that *amhy* has an important role in the development of testis in this species.

PR-1

## Using multiple benthic indices to evaluate the ecological quality in the sand beach of Anmyeondo in Chungcheongnamdo, South Korea

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Sandy beaches are frequently chosen for leisure activities and vacations, making them vulnerable to the pressures of growing urban development and coastal construction. Therefore, it is necessary to accurately evaluate the marine ecological quality of sand beaches. In this study, we first used six benthic indices namely the AZTI marine biotic index (AMBI), benthic index (BENTIX), benthic polychaetes amphipods index (BPA), multivariate AZTI marine biotic index (M-AMBI), MEDiterranean OCCidental index (MEDOCC), and abundance biomass comparison (W-value) to assess the ecological quality in the sand beach of Anmyeondo, Chungcheongnamdo. In the ecological quality assessment of the study area, the average values of the six indices (AMBI, BENTIX, BPA, M-AMBI, MEDOCC, W-value) were 0.92, 4.67, 0.11, 0.65, 0.05099, 1.23 and 0.15, respectively; the average of all benthic indices met the high standards. In the Spearman correlation coefficient analysis, AMBI index showed the best correlation with environmental parameters and others benthic indices. But the results of Kappa analysis, only the BENTIX and MEDOCC had the good level of agreement. Overall, our study evaluated the ecological quality and provided valuable information for the conservation in the sand beach of Anmyeondo.

PR-2

## Distribution characteristic of benthic foraminiferal assemblage in the continental shelf of the East China Sea

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A study was conducted to understand the distribution and formation mechanism of benthic foraminiferal assemblages in the East China Sea. Grain size analysis, <sup>14</sup>C radiocarbon dating, and benthic foraminifera analysis were carried out on thirty-two surface sediments collected from the continental shelf. The sedimentary facies were composed of sandy mud to muddy sand facies, with an average of 52.04% sand, 13.72% silt, and 34.20% clay. These sedimentary facies are palimpsest sediment. Benthic foraminifera was classified into a total of 48 genera and 104 species, including agglutinated foraminifera (8 genera, 18 species), calcareous-hyaline foraminifera (36 genera, 77 species), and calcareous-porcelaneous foraminifera (4 genera, 9 species). The average number of individuals and species diversity of benthic foraminifera was 46,760 individuals/20ml and 2.5, respectively. The production rate of agglutinated foraminifera increased towards the Yangtze River area, while that of planktonic foraminifera increased towards Jeju Island. The dominant species were *Ammonia ketienziensis*, *Bolivina robusta*, *Eggella advena*, *Eilohedra nipponica*, *Pseudorotalia gamardii*, and *Pseudoparrella naraensis*. The <sup>14</sup>C radiocarbon dating of *Bolivina robusta* and *Pseudorotalia gamardii* with the highest production rate were 2,360±40 yr B.P. and 2,450±40 yr B.P., respectively. In the results of cluster analysis, three assemblages were composed of *P. gaimardii*, *B. robusta*, and *A. ketienziensis*-*P. naraensis* were broadly classified. The *P. gaimardii* assemblage is thought to have formed from about 2.5 yr B.P. in the sea area of the Yangtze River to 50 m in water depth, affected by freshwater. The *B. robusta* assemblage is thought to have formed from about 2.4 yr B.P. in the sea area of Jeju Island to 50~100 m, affected by offshore water. Finally, the *A. ketienziensis*-*P. naraensis* assemblage was formed in the northwest sea area (Central Yellow Sea Mud). These distributions and compositions of benthic foraminiferal assemblages formed from about 2.5 yr B.P. in the northern East China Sea are thought to be due to changes in benthic ecological environments that occurred as a result of the sea level increase during the late Holocene

PR-3

## Vertical distribution and density of giant jellyfish (*Nemopilema nomurai*) using acoustics

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In this study, the hydro-acoustic data were analyzed to determine the distribution of giant jellyfish entering into the Korean coastal waters during the summer of 2023, and the distribution and density of giant jellyfish by water layer.

The hydro-acoustic survey was conducted from May 24 to June 1 in the East China Sea, and was conducted from July 4 to July 14, 2023. The acoustic data were collected by a split-beam scientific echosounder (EK-80, Kongsberg Maritime, Norway) with frequencies of 38, 70, 120, 200, and 333 kHz, attached to the bottom of the research vessel Tamgu 21<sup>st</sup>, which belongs to the National Institute of Fisheries Science. They were analyzed by the echo integration method, and the signals were presumed to be a jellyfish signal using the dB-difference method and giant jellyfish were counted using a single target detection method to represent their distribution and density by water column.

In 2023, a total of 754 giant jellyfish were detected in May, swimming in the 30-60 m range, with the highest concentration near 30 m with a total of 211 individuals. The distribution density of giant jellyfish detected within the scientific echosounder beam width (7 deg.) showed the highest distribution density in the southwestern part of the survey area, with a value of 445.993 ( $10^{-6}$ ind./m<sup>3</sup>) and a average of 103.569 ( $10^{-6}$ ind./m<sup>3</sup>). The total number of giant jellyfish detected in July was 317 inds, mostly distributing in the depth range between 30-80 meters. The distribution density of giant jellyfish was highest near to Shinan waters, with 134.358 ( $10^{-6}$ ind./m<sup>3</sup>), and the average distribution density was 29.059 ( $10^{-6}$ ind./m<sup>3</sup>).

PR-4

## Reproductive ecology of yellowback seabream (*Dentex tumifrons*) in the South Sea of Korea

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The reproductive ecology of the yellowback seabream *Dentex tumifrons* using samples collected by monthly bottom trawling in Korean coastal waters from January to December 2018. We analyzed monthly changes in gonadosomatic index (GSI), fecundity, total length (TL) at 50% group maturity, histology and maturity stage. Spawning occurred in May and October. Fecundity varied with total length as  $F=1.3754TL^{3.2664}$ , with a range of 1,220 to 155,625 eggs per female. At 50% group maturity estimates of female total length were 18.4 cm, respectively. To determine the spawning season and reproductive cycle of the yellow sea bream, *Dentex tumifrons*, seasonal change in the gonadosomatic index (GSI) was examined histological observations of both ovaries and testes were conducted.

PR-5

## Stock assessment of Small yellow croaker (*Larimichthys polyactis*) in the Northwest Pacific region using CMSY and BSS models

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This study aimed to evaluate the stock status of Small yellow croaker (*Larimichthys polyactis*) caught in the Northwest Pacific region and to seek strategies for management. In this study, the following three points were considered as differences from previous stock assessment studies. First, data of fishing types targeting Small yellow croaker in Korea was maximally utilized. Second, in addition to the GLM (Generalized Linear Model) method, which is widely used as a standardization for fishing efforts, as an alternative, the total amount of horsepower by fishing type was used to standardize fishing efforts. Third, since Small yellow croaker migrates the North Pacific region, the stock assessment was conducted by including all catch data of China, Japan, and Taiwan, which are neighboring countries that jointly catch.

For these research objectives, CMSY (Catch-Maximum Sustainable Yield) model and BSS (Bayesian state-space) model, which are based on catch and resilience data were used. In addition, the scenario analysis was conducted according to the fishing type, period, and fishing effort standardization method. Result showed that the current biomass of the Small yellow croaker was predicted to be generally on the decline and be lower than the biomass of maximum sustainable yield (BMSY) level.

PR-6

## Reproductive ecology of Pen shell *Atrina pectinata* (Bivalvia: Pinnidae) in the coastal waters of Jinhae, Korea

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The histological study of Pen shell *Atrina pectinata* were investigated in the coastal waters of Jinhae, Korea in 2021. Sea surface temperature was the lowest in January and the highest in August. The sex ratio of pen shell in the study area was 1:1.3, with no significant difference found. Shell height range was 18.0–29.5 mm for males and 18.7–31.0 mm for females. In the result of allometric equations, no significant differences were found between sexes. The GSI between sexes ranged from 7.4 to 27.1 for males and 8.1 to 25.7 for females, with a peak in June for all sexes. In addition, it is determined that the increase in GSI is affected by the water temperature. AMI showed a maximum in September with a range of 28.4–41.2 for males and a maximum in February for females with a range of 29.5–37.4. Histological analysis showed that the gonads of females were divided into 4 developmental stages (immature, maturing, mature, and ripe) that suggested summer breeders (spawning in summer).

Keywords: Histological study, Pen shell, GSI, AMI, Gonad



PR-7

## Variation and diversity of fish resources in the Jinhae Bay during winter season, assessed by combining eDNA, Trammel net, and acoustic surveys

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We compared the species identified by eDNA (environmental DNA) metabarcoding with those captured by the Trammel net, and evaluated the correlation between eDNA copies of Pacific cod and herring, which are winter-spawning species in the Jinhae Bay, and the results of acoustic surveys. The survey was conducted twice a month from December 2021 to March 2022 in the Jinhae Bay, where seawater was collected, eDNA metabarcoding, and qPCR (*Gadus macrocephalus*, *Clupea pallasii*) analyses. For the acoustic survey, we deployed a mooring equipped with an autonomous echosounder in the Jinhae Bay from January 2021 to April 2022. As a result of the analysis, 17 species were identified through eDNA metabarcoding and 27 species were captured using the Trammel net. This confirmed a total of 34 fish species across 25 families. Ten species (29.4%) were identified using both survey methods. Conversely, the number of species found exclusively by each survey method was 17 (50%) for the Trammel net and 7 (20.6%) for eDNA metabarcoding. Contamination was confirmed in some samples during the collection or filtration process for eDNA analysis, and these results were excluded from interpretation. According to the qPCR analysis results, the DNA of *C. pallasii* and *G. macrocephalus* was only detected in January and February of 2022. The acoustic survey detected numerous fish signals from early December, when mooring began, until mid-February, due to the inflow/outflow of migratory fish. From March onwards, signals presumed to be from larval fish or post-spawning hatchlings were detected.

PR-8

## Whale DNA barcoding system for forensic science

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Over the past few centuries, the populations of many whale species have declined sharply due to indiscriminate commercial whaling, and they are on the verge of extinction. The International Whaling Commission's (IWC) moratorium prohibits commercial whaling. As a member of the IWC, Korea also prohibits the commercial capture of whales in principle and only allows the distribution of bycatch cetaceans as an exception. Corporate illegal fishing disguised as bycatch for economic gain occurred, and until recently, illegal fishing was cracked down on. However, since specialized techniques for whale DNA identification have not been established, it takes a long time to obtain identification results for samples related to illegal whaling, making it difficult to secure speedy handling of cases. This study was conducted to develop a DNA barcoding system for rapid and accurate species identification from a small amount of cetacean analysis samples collected by the coast guard at enforcement sites. DNA barcoding is a taxonomic tool for molecular biological species identification. DNA barcoding uses a region of DNA from a specific gene and compares it to a reference library to determine species. First, we analyzed the DNA sequences of 35 species of cetaceans known to inhabit the seas around the Korea to draw a phylogenetic tree, and selected gene regions that are well classified at the species and family levels, and designed DNA barcodes. Next, we would like to build a cetacean library for rapid whale species identification and appraisal techniques. Through this study, we expect that by establishing a whale species identification technique specialized for the Coast Guard Research Center, we will be able to quickly handle cases related to illegal whaling and further contribute to the protection of cetaceans.

PR-9

## Bacteriological Affects of Land Pollutants on Shellfish Production Area in southern sea area of Gangneung-si, Gangwon-do, Korea at rainfall time

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**Introduction** : According to the OECD-FAO, total global seafood production reached 179 million tons in 2018, and is expected to reach 244 million tons in 2030, a 15% increase from 2018. However, food poisoning caused by eating shellfish contaminated by microorganisms is often occurring. Microbial pollutants in shellfish production waters are land pollutants such as streams water and domestic sewage.

**Purpose** : This study was carried out to evaluate the affect of land pollutant on the shellfish production area at rainfall time in southern sea area of Gangneung-si, Gangwon-do, Korea

**Methods** : The total 32 samples (4 of streams water, 3 of domestic sewage and 25 of seawaters) were collected from southern sea area of Gangneung-si, Gangwon-do, Korea. Quantitative analysis of coliform group and fecal coliform were carried out by most probable number (MPN) method recommended procedures for the examination of bacteria from American Public Health Association (APHA).

**Results** :Shellfish production area in southern sea area of Gangneung-si was affected by stream water and domestic sewage at rainfall time. The range of fecal coliform in 4 of streams water was increased mostly (7.8~2,200 MPN/100 mL) at the 2rd day after rainfall, decreased (4.5~1,100 MPN/100 mL) at the 3rd day after rainfall, and recovered (4.5~540 MPN/100 mL) to as level before rainfall at 5th day after rainfall. The range of fecal coliform in 3 of domestic sewage was increased mostly (<1.8~>160,000 MPN/100 mL) at the 2rd day after rainfall and recovered (<1.8~350 MPN/100 mL) to as level before rainfall at 5th day after rainfall. The range of fecal coliform in 25 of seawater was increased mostly (<1.8~22 MPN/100 mL) at the 2rd day after rainfall, decreased (<1.8~9.3 MPN/100 mL) at the 3rd day after rainfall, and recovered (<1.8~4.5 MPN/100 mL) to as level before rainfall at 5th day after rainfall.

These results indicate that bacteriological counts of shellfish production are affected by land pollutants, and bacteriological safety of shellfish production area in southern sea area of Gangneung-si can be secured by continuous management of land pollutants.

**Significance** : These results could be contributed to insurance of bacteriological safety of shellfish from land pollutant at rainfall time and rainy season.

PR-10

## Morphological development of larvae and juveniles in cultured three line grunt, *Parapristipoma trilineatum* (Perciformes: Haemulidae)

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In this study, We describe the morphological development of three line grunt *Parapristipoma trilineatum* cultured at the Subtropical Fisheries Research Institute. At 2 days post hatching (DPH), the mouth opened, melanophores formed in the eyes and egg yolk was absorbed. Oil globule was absorbed at 3 DPH. Flexion larvae in 13 DPH, nostril was formed. Postflexion larvae in 18 DPH, Pelvic fins appeared, caudal fin changed from circle to truncate. Total number of fin rays were complete in 28 DPH. At 48 DPH, three stripes that are characteristic of juvenile were completed. In the case of osteological development, at 3.979 mm NL (Notochord length), in the neurocranium, only the parasphenoid was ossified. Basioccipital, exoccipital, and frontal were ossified at 4.430 mm NL. Vomer and prootic were ossified at 5.818 mm SL (Standard length). Supraoccipital, parietal, epiotic, sphenotic, and pterotic were ossified at 7.073mm SL. Ethmoid, prefrontal, alisphenoid were ossified at 8.477 mm SL. Basisphenoid was ossified at 14.042mm SL. In the jaw bone, Maxillary, premaxillary, dentary, articular, and angular were already ossified at 3.979 mm SL. All elements of the hyoid arch were ossified at 7.073 mm SL, and the suspensorium was completely ossified at 8.477 mm SL. Preorbital was ossified at 8.477 mm SL, and suborbital bones were completely ossified at 16.180 mm SL. Vertebrae began to ossify at 5.633 mm NL, and it proceeded from the first to the last centrum. Urostyle was ossified at 6.289 mm SL, and another elements were totally ossified at 10.540 mm SL. In the pectoral girdle, Cleithrum was ossified at 3.979mm NL. Supracleithrum was ossified at 4.430mm NL. Posttemporal was ossified at 5.818 mm SL. Postcleithrum was ossified at 7.703 mm SL. Scapula, coracoid, and radial were ossified at 8.477 mm SL. Ossification of the caudal fins began at 5.818 mm SL. Ossification of pectoral and pelvic fins began at 7.073 mm SL and 8.477 mm SL, respectively. Ossification of the dorsal and anal fins began at 7.403 mm SL. Dorsal pterygiophores were ossified at 9.590 mm SL. Anal pterygiophores were ossified at 8.477 mm SL. Interneural bones were completely ossified at 10.540mm SL.

PR-11

## Impact of marine aggregate extraction on the catch of primary fisheries resources

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Changes in the catch of fisheries resources due to marine aggregate extraction are a sensitive issue between fishermen and aggregate extractors. So, this kind of research requires scientific analysis using as objective data as possible. The amount of aggregate extraction was reported monthly, and the monthly catch in the 105<sup>th</sup> marine zone where aggregate collection occurs was analyzed from fishing performance data from 2008 to 2020 that must be legally reported. The top seven taxa of fish in terms of market share were analyzed: anchovies, mackerel, cutlassfish, eels, monkfish, squid, and flatfish. Since the fishing performance data and aggregate extraction amount do not follow a normal distribution, the Spearman correlation coefficient, a non-parametric correlation analysis that does not require the assumption of normality distribution, was applied.

The results showed no correlation between marine aggregate activity and the fishing performance of 5 significant fish in the 105<sup>th</sup> marine zone. However, angler fish and flounder showed a positive correlation with an acceptable probability ( $p < 0.05$ ). This means that the fishing performance of angler fish and flounder improved as more marine aggregates were extracted. Angler fish and flounder are benthic fish that are closely linked to changes in the benthic environment. Although marine aggregate collection may have adverse effects, such as noise and physical disturbances with suspended sediment caused by aggregate inhalation, it positively affects the resuspension and spread of prey organisms. This results in gathering benthic fish near the marine aggregate extraction area. This phenomenon contradicts the negative impact on fishery resources caused by marine aggregate extraction. It shows that a moderate amount of sea sand collection can positively affect the fishing of benthic fishery resources.

PR-12

## Current status and key insights of Environmental Impact Assessment for floating offshore wind power development projects

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This study reviewed a case of environmental impact assessment for offshore floating wind power generation projects in Republic of Korea. Based on this, it analyzed the feasibility of the site selection, the current status of marine environmental impact assessment surveys, importantly, the assessment status of fishery resources, noise and vibration, and electromagnetic fields. As a result, it was found that the offshore floating wind power generation site in the East Sea requires coordination due to conflicts with waste discharge areas and spatial location. In terms of survey methods, it is necessary to streamline the methods, such as following the guidelines for preparing impact assessment reports for the use of maritime areas published by the Ministry of Oceans and Fisheries and conducting joint investigations to assess cumulative impacts. Regarding fishery resources, it is important to use actual fishing grounds for assessment, and for underwater noise and electromagnetic fields, since there is insufficient domestic research and no established domestic standards, priority should be given to establishing domestic standards through scientific research.

PR-13

## Spatio-temporal study of Sardine *Sardubios melanostictus* from the Southern Waters of Korea using set net and hydroacoustic method

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Sardine *Sardubios melanostictus*, is a small pelagic fish in the East and South Seas of Korea. Although the catch has been low of the past 20 years, it has been flowing into the Korean coast in large quantities since 2022. Therefore, we monitored sardines through various survey techniques. First, a set net survey was conducted every month from April to November from 2017 to 2023 in coastal of Southern Sea. As a result of set net survey, sardines were not caught at all from 2017 to 2021, but have been caught every month since June 2022. In particular, two annual groups have been caught since March 2023. Next, we were conducted using a moored and ship-type scientific echosounder to determine the coastal inflow pattern and spatial distribution of sardine. A moored echosounder was operated near set net for about 50 days from April 18 to May 31, 2023. Analysis of the acoustic data showed that sardines moved to the coast in large schools at night, and small schools of fish were detected intermittently during the day. During the same period, acoustic-midwater trawl surveys were conducted using R/V Tamgu23 from April 19 to May 2, 2023. When fish school was detected, we caught it using mid-water trawl to confirm the species. Acoustic data processing and analysis were analyzed using a fish detection module using an acoustic data post-processing program, and compared with midwater trawl data to identify detected fish. In April 2023, anchovies and sardines school coexisted and distributed along the southern sea coast, and hairtail schools were detected in the open sea. As a result of the midwater trawl survey, juvenile sardine were caught at two stations, and adult anchovy were distributed in different water depths. This study on fisheries resource management should continue to be conducted on changes in the distribution and resource of sardines due to climate change.

PR-14

## Target strength and swimbladder morphology of Chub mackerel *Scomber japonicus* in the Northwest Pacific Ocean

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The chub mackerel (*Scomber japonicus*) is a pelagic fish species that widely inhabits the temperate ocean regions and is distributed in areas such as South Korea, Japan, and East China Sea. Acoustic target strength (TS; dB) measurements of chub mackerel were made at 38, 70, and 120 kHz split-beam echosounder in 9 groups (Mean fork length: 10.8~28.3 cm) swimming freely in a net cage at the seawater acoustic tank. An underwater video camera was simultaneously used to observe the *S. japonicus* swimming angle. When the slope of the least-squares regression line was forced to 20 in the TS equation, the resulting values for the constant term ( $b_{20}$ ) at 38, 70, and 120 kHz using the caged method were -67.7, -66.6, and -67.3 dB, respectively. The swimming angle of *S. japonicus* in groups was mean -10.5~9.6° and SD 16.3~33.3° in the net cage. The swimbladder height (SBH)/swimbladder length (SBL), SBL/FL, and tilt angle of swimbladder (mean±SD) of *S. japonicus* are  $0.191 \pm 0.060$ ,  $0.245 \pm 0.055$ , and  $9.6 \pm 3.0^\circ$ , respectively. These results can be used to provide acoustic stock assessment of *S. japonicus* in the Northwest Pacific Ocean.



PR-15

## Spatio-temporal distribution of Antarctic silverfish (*Pleuragramma antarcticum*) in the Ross Sea

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The Antarctic Ross Sea is the most productive sea area in Antarctica and is home to a variety of marine life. This is an important sea area in terms of ecology, environment, and research. The Antarctic silverfish (*Pleuragramma antarcticum*), which lives in the Ross Sea of Antarctica, is characterized by its wide distribution area and large population. Additionally, they play an important role as a link between primary producers (krill) and upper predators of most Antarctic populations, such as whales, elephant seals, fur seals, and penguins. Therefore, it is important to understand the distribution of Antarctic silverfish. In this study, the vertical and horizontal distribution of Antarctic silverfish was identified by using hydroacoustic method. This survey was conducted near Cape Hallett, Antarctica, in February and December 2018 and March and December 2020. Acoustic data was collected echosounder system (EK60, Simrad, Norway), equipped with 38, 120 and 200 kHz, split-beam transducers installed in the transducer well of RV "Araon". In order to obtain information on the length and weight of target fish species living in the survey area, fish were caught by a midwater frame trawl. Antarctic silverfish were collected in its length range between 3 to 9 cm body length range. The horizontal distribution showed that Antarctic silverfish were detected as far as 150 meters, but were mainly distributed within 20~30 meter depth. As a result of the horizontal distribution of Antarctic silverfish, high NASC values were mostly found near sea ice. In addition, as a result of comparing NASC values between coastal waters and polynya waters, the value was found to be higher in polynya waters.

PR-16

## Molecular identification and morphological description for larvae and juvenile of *Neosalanx anderssoni* (Salangidae, Pisces) collected from southwestern sea of Korea

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In April and May 2023, six individuals of larvae and juvenile of *Neosalanx anderssoni* were analyzed among ichthyoplankton samples collected by a RN80 net from the southwestern sea of Korea. The six specimens were identified through mtDNA COI sequences, and their external morphological characteristics were described in detail. All six specimens have a slender and elongated body. When preflexion and flexion larval stage (10.24 mm NL and 15.47 mm TL, respectively), oval-shaped black melanophores were distributed in a row along the ventral side of the gut. However, when postflexion larval and juvenile stage (23.58 mm TL, 25.90 mm TL, and 29.20 mm TL, 31.26 mm TL, respectively), melanophores on the ventral side of the gut were disappeared, and dark spot-shaped melanophores appeared along the dorsal side of the gut in a single row. Also, from the postflexion larval stage (23.58 mm TL), two large black spots began to appear symmetrically on the caudal fin. When larval stage, *Neosalanx anderssoni* has a similar body shape with *Konosirus punctatus* and *Engraulis japonicus*, but can be distinguished by the preanus length in SL (78.2-78.5% vs. 83.9% vs. 70%, respectively), the distribution and shape of melanophores (one row of oval shape in *N. anderssoni* vs. two row of oval shape in *K. punctatus* vs. irregular stellate shape in *E. japonicus*), and the length of the maxilla (posterior margin of maxilla not reaching middle of orbit in *N. anderssoni* and *K. punctatus* vs. reaching middle of orbit or beyond the posterior margin of orbit in *E. japonicus*).

PR-17

## First description of *Thryssa kammalensis* (Engraulidae, Clupeiformes) larvae and juveniles collected from the southwestern sea of Korea

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Larvae and juveniles of *Thryssa kammalensis* were collected from the southwest sea of Korea, between June and July 2023, using RN80 net. In this study, we first describe the detailed morphological features of *T. kammalensis* larvae and juveniles. Pre-flexion larve (3.92-10.75 mm TL, n=21) had a slender body which was 4-7% of TL. The anus was located at the posterior of the body and preanal length was 86% of TL. Line shaped melanophores were distributed in a row from the ventral portion of the abdominal cavity to the anal fin base. The pterygiophores of dorsal and anal fins appeared, but no fin rays was observed. Flexion larve (12.63-16.62 mm TL, n=5) had a part of dorsal, anal, and caudal fin rays, dot shaped melanophores distributed in a row in the same position as pre-flexion larvae. Post-flexion larvae (18.75-24.78 mm TL, n=20) had a slender body, its depth 10-12% of TL and preanal length 71% of TL. The number of pectoral fin rays was 5, and that of pelvic fin rays was 10. Dot shaped melanophores were distributed in a row from posterior of preopercle to the ventral portion of the abdominal cavity, and along the anal fin base. The number of dorsal and anal fin rays was completed as 12-15 and 30-33, respectively. Juveniles (25.53-31.71 mm TL, n=44) had body depth 15-17% of TL and preanal length 66% of TL. The upper jaw protruded compared to the lower jaw. All fin rays were completed when the number of pectoral and pelvic fin rays reached to 8-9 and 14-15, respectively. Dot shaped melanophores were confined from the anal fin base to the lower caudal peduncle in a row, and it concentrated lower lobe of caudal fin.

PR-18

## Change of fish species around Dokdo and Ulleungdo by trammel net

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Species composition around Dokdo and Ulleungdo, East Sea of Korea, was investigated using trammel-net catches, from 2006 to 2023. During the survey period, a total of 111 species (43 families and 11 orders) of fishes were identified, and Perciformes and Scorpaeniformes accounted for 80.0% of the total number. The number of species was highest in August 2023 (36 species) and lowest in February 2007 (11 species). The number of individuals peaked in August 2017. Total biomass peaked in February 2017. The dominant species were *Thamnaconus modestus*, *Ditrema temminckii*, *Sebastes pachycephalus* and *Sebastes vulpes*. Biomass of boreal fish (*Alcichthys elongatus*, *Gymnocanthus herzensteini*, *Pleurogrammus azonus*) decreased, and biomass of subtropical fish (*Girella melanichthys*, *Goniistius zonatus*, *Sebastiscus tertius*) increased during the survey period.

PR-19

## Newly discovered eight-gilled hagfish (Agnatha, Myxinidae) based on imported fish specimens

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Hagfishes (Family Myxinidae) are currently classified into 6 genera and 88 species, of which 55 species belong to the genus *Eptatretus* in the world. Recent molecule-based research has resolved many taxonomic problems, suggested new classification, and revealed new species. Here, we describe a new species of hagfish from off western Nagasaki by analysing multiple information of morphological characters, mitochondrial and nuclear gene sequences. The new species was well distinguished from all congeners by a combination of the following morphologic characters: an eyespots conspicuous, no nostril-sinus papillae, eight pairs of gill pouches and gill apertures, 3/2 multicusps, total cusps 46-50, 4-5 gill pouches at the end of dental muscle, total slime pores 85-90 (prebranchial 13-17, branchial 7-8, trunk 54-58, tail 11-15), branchial length 7.5%-8.3% of total length, pharyngocutaneous duct confluent with last gill aperture, ventral aorta bifurcating at about the 5th to 6th gill pouches, ventral fin-fold small or vestigial, and dark brown to blackish body color. In addition, the new species was separated from the congeneric species with high genetic differences (1.5%-14.3% in COI, 0.7%-5.0% in 16S rRNA, 0.2%-1.3% in 18S rRNA+28S rRNA). Also, we herein suggested a key to 23 species of genus *Eptatretus* in Indo-Pacific Ocean.

PR-20

## Maturity and spawning of Spanish mackerel, *Scomberomorus niphonius* in the southwestern waters of Korea

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The Spanish mackerel is an economically important fish species in the southwestern waters of Korea. The study aimed to provide insights into the reproductive biology of this species in the region, as it was not well understood previously. The research involved analyzing various aspects of the mackerel's reproductive biology, including monthly changes in maturity stages, gonadosomatic index (GSI), egg diameter, fecundity by size classes, fork length (FL) at sexual group maturity, and sex ratio between females and males. The overall sex ratio of female to male mackerels was found to be approximately 1:0.92. The study revealed that the spawning period for *Scomberomorus niphonius* in the southwestern waters of Korea occurred from May to July 2020. The main spawning seasons for the entire population were from May to June. The fork length at which 50% of the mackerels reached group maturity was 53.3 cm for females and 53.1 cm for males. The results suggested that environmental factors, such as higher water temperatures, an increase in resource levels, and the presence of Pacific anchovy resources, influenced the spawning period of Spanish mackerel.

PR-21

Distribution characteristics of sailfin sandfish (*Arctoscopus japonicus*)  
using scientific echosounder in Dokdo, Korea

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Sailfin Sandfish (*Arctoscopus Japonicus*) is a cold-current fish species widely distributed in Japan, Russia, and the America. In Korea, it is distributed near the seafloor of the East Sea continental shelf. In this study, we aim to investigate the spatial and temporal distribution characteristics of sailfin sandfish using scientific echosounder with six frequencies (18, 38, 70, 120, 200 and 333 kHz, EK80) in the waters around Dokdo. We collected acoustic data from the waters around Dokdo in February, May, August, and November 2018 using the Research Vessel Tamgu. The sailfin sandfish characteristics were examined by using the difference of mean volume backscattering strength ( $\Delta$ MVBS). Trawl survey was also conducted to identify the species that make up the volume backscattering strength(SV) layer. The SV of sailfin sandfish was lower than -65dB, and was confirmed at a water depth of around 100m. As a result of the trawl survey, the biomass of sailfin sandfish was highest in May. In order to know the distribution characteristics of sailfin sandfish, it is necessary to observe seasonal changes over a long period of time.

PR-22

## A length-based assessment model with environmental conditions being incorporated: illustration with Korea chub mackerel (*Scomber japonicus*) population

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Total Allowable Catch (TAC) is the main fishery management system not only in Korea but also in other developed countries. Currently, 16 species are being managed in Korea, but many fishermen often complain about the amount they can catch. To calculate a TAC that will reduce fishermen's dissatisfaction and successfully conserve the stock, we used a body size-based model because body size data are available. And we intended to allow the natural mortality to vary over years and ages, linking it with year- and age- specific fish body size. Assumptions such as which parameter to set as a random effect, how to calculate the first year's population, and how to assume fishing selectivity were tested to find the optimal combination that best fit the data. And we got the number by age and year, amount of recruits and spawners, and yield-per-recruit (YPR) and spawning-potential-ratio (SPR) as functions of fishing mortality. In the future, we will calculate MSY to determine the TAC for chub mackerel (*Scomber japonicus*), and consider the impact of environmental conditions such as the temperature-Size-Rule (TSR). According to the TSR, as water temperature increases, the von Bertalanffy growth parameters,  $L_{\infty}$  and K, YPR, maturity, SPR, and recruitment could change, which ultimately affect MSY. We will show preliminary results, offering valuable insights into the management of chub mackerel fisheries.



PF-1

## Sexual dimorphism of the olfactory lamellae of *Rhodeus uyekii*

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The olfactory lamellar number of *Rhodeus uyekii* was analyzed using SPSS statistical program to check sexual dimorphism by morphometric analysis and relationship to standard length and weight and ratio to them. As a result, in standard length, male showed  $38.9 \pm 4.2$  mm, 30.8-48.8 and female showed  $35.7 \pm 6.1$  mm, 27.5-43.7 (independent two sample t-test;  $t=1.928$ ,  $df=38$ ,  $P < 0.05$ ). in olfactory lamellar number, male showed  $13.7 \pm 1.0$ , 12-16 and female showed  $12.0 \pm 0.6$ , 11-13 ( $t=6.020$ ,  $df=38$ ,  $P < 0.001$ ). These morphometrical result might implied that specific character of olfactory lamellar number can be used for species identification and its sexual dimorphism is considered morphological adaptation to sense pheromone molecules.

PF-2

## Morphology and morphometry of the olfactory organ of *Rhodeus notatus*

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A detailed investigation of the morphology and morphometric features of the olfactory organ of *Rhodeus notatus* was conducted using both stereo-microscopy and statistical analysis (SPSS statistical program). The olfactory organ exhibited a tubular anterior nostril, a semi-circular posterior nostril parallel to the skin, natal flap in external structure, and internally a rosette containing 15-19 lamellae situated within the nasal cavity. Correlation analysis between the body length ( $n=20$ ,  $38.3 \pm 3.1$  mm, 33.6-45.0; Mean $\pm$ SD) and the number of lamellae ( $n=20$ ,  $16.6 \pm 1.3$  mm, 15-19) using Pearson's correlation coefficient revealed a significant correlation ( $P < 0.001$ ). In summary, the tubular nostril of *R. notatus* represents a distinctive adaptation to a inactive swimming and a stagnant habitat environment with slow-flowing water in ecological lifestyle and unique olfactory lamellae (15-19) serving as an intrinsic taxonomic characteristic of the species. The present findings contribute to a more comprehensive understanding of the olfactory system in *R. notatus*, and may have important implications for future studies on the evolution and ecology of this species.

PF-3

## Osteological study of *Misgurnus* (Pisces, Cobitidae) in South Korea

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A The *Misgurnus* is widely distributed in Korea, China and Taiwan. *Misgurnus mizolepis* and *Misgurnus anguillicaudatus* live in many different habitats and shows various body color and pattern. This variation depends on the habitats where they lived. They look similar in external appearance, causing confusion in classification. The purpose of this study is described and figured the skeletal system of two species, and discussed with previous reports.

Most skeletal characteristics of two species *Misgurnus* accord with each other, there were differences in the number of vertebrae, upper rudimentary ray and lower rudimentary ray. This is thought to be due to difference in the degree of protuberance development between the two species. Each species pharyngeal bone has only one teeth row which has many teeth but there were differences in the number of teeth. And the pharyngeal bone of *Misgurnus mizolepis* is harder than *Misgurnus anguillicaudatus*.

Osteological characteristics of Neurocranium bone, characteristics of two species accord each other however there was a difference in the basioccipital bone of the two species. *M. mizolepis* basioccipital bone is fusion and has single bone however *M. anguillicaudatus* basioccipital bone is non fusion and bifurcation into two parts.

PF-4

## A taxonomical review of differences in body color and measuring characters between geuns *Oryzias* from Korea

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The genus *Oryzias*, Korean ricefish (medaka fish), consist of two species, *O. latipes* and *O. sinensis* with genetical (Sakaizumi and Jeon, 1987) and skeletal differences (Chen, Uwa and Chu, 1989). Also, *O. latipes* has lateral black spots on the body surface, but rare in *O. sinensis*. In spite of these distinct taxonomical differences, they still unclear about their taxonomical positions due to *O. latipes* and *O. sinensis* are not separated distinctly because of low mutation rate (Eah et al, 2006) and their habitat overlap.

Differences in body color are shown, *O. latipes* has bluish band on their lateral body surface, whereas *O. sinensis* has yellow body without bluish band. In *O. latipes*, they showed two type of lateral band color. East Sea group showed purple band on their lateral body, whereas South Sea group showed blue band.

Lateral line scales number showed difference, *O. latipes* was average  $31.53 \pm 1.55$ , 1 more than *O. sinensis*  $30.55 \pm 1.36$ . However, this differences are too slight for distinguishing *O. latipes* and *O. sinensis*. So, we need further study about external differences which can distinguish two species in collection site.

PF-5

## Morphological study of *Rhinogobius similis* (Gobiidae, Gobionellinae) in Jeju Island and Korean peninsula

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*Rhinogobius similis* is a common freshwater goby, widely distributed from temperate to tropical regions. Recently, this species has been redescribed to *R. similis* from *R. giurinus*. *R. similis* which lives in Jeju island, has been confirmed to have the similar result in genetical analysis with *R. similis* in Japan. However, since the genetical analysis and morphological characters of *R. similis* living in Korean peninsula have not been performed, so we compared morphological characters of *R. similis* living in Jeju Island and inland.

Head depth in maximum/HL(%) in Jeju Island is 65.47% bigger than other groups. But this difference is not enough to separate in two group of *R. similis* live in Jeju Island and inland. So we need further studies with more samples in various regions to find differences between the two groups.

PF-6

## Ecological characteristics of Korean dark dleeper, *Odontobutis platycephala* in Jaho stream, Korea

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This study investigated the ecological characteristics of *Odontobutis platycephala* at Jaho Stream from January to December 2022. The riverbed structure of the species habitat was rich in cobble and pebble. The water was deep, ranging from 22 to 153 cm, with an average of 64 cm. The stream velocity was rapid at 0.89(0.42~1.46) m/sec. The ratio of females to males was 1:1.02, and the total length of collected individuals ranged from 38 mm to 156 mm. The age according to the total length-frequency distribution as of May indicated that the group with a total length 38-69 mm was one year old, the group with 60-99 mm was two years old, the group with 100-139 mm was three years old, and the group 140-156 mm was four years old. As a secondary gender characteristic, the females genital papilla had a cylindrical shape, the males had a cone shape with a pointed end. Some females with a length ranging from 60 to 69 mm and all females 70 mm longer were sexually mature. Some males with a length ranging from 70 to 79 mm and all males 80 mm longer were sexually mature. The spawning season was from May to July, and the water temperature was between 17°C to 28°C during that period. The prosperous spawning season was June (24°C). The average number of eggs in the ovaries was 988(284~2,722) per matured female, and the matured eggs were yellowish and spherical with a mean diameter of 1.46(1.19~1.71) mm. The correlation between total length and weight was  $BW=0.00000006TL^{3.12}$  with the constant a as 0.00000006 and parameter b as 3.12. The condition factor (K) was 1.44(0.96~2.26) on average, and the slope indicates a negative value -0.0007.

PF-7

## A study on the fish biological survey in the mid- and downstream of Naeseongcheon stream

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The Nakdonggang River, the longest river in Korea, has recently introduced exotic fishes and introduced fish between rivers frequently, causing many changes in fish distribution. This study targeted the Naeseongcheon stream, a tributary river of the Nakdonggang River and Korea's representative sand river, and conducted a fish biological survey in the mid- and downstream of Naeseongcheon stream and inflow rivers to secure data to compare changes in fish distribution due to changes in the habitat environment such as river quantity and river structure after the operation of the Yeongjudam.

In this study, a total of 6 locations for easy access and collection of fish were selected, including 3 survey points in the mid- and downstream of Naeseongcheon stream and 3 survey points in the inflow stream, centering on Yeongjudam, and a total of four surveys were conducted seasonally from March to November 2022. The survey included a river structure survey such as river width, flow velocity, water depth and riverbed structure, a biochemical environmental survey such as water temperature, dissolved oxygen, pH, and a fish distribution surveys were conducted. All surveys were conducted within 200m of the bridge near the bridge at each point, and various habitats were included as much as possible. According to the survey, the river structure of the mid- and downstream survey points of Naeseongcheon stream was a representative type of sand river that appeared in Korea's mid- and downstream rivers, and most of the inflow rivers were composed of gravel, and the proportion of sand increased as it went downstream. The water temperature range for each survey point was 8.4~25.7°C, which was the lowest in St. 1, the upstream point among the survey points in summer, and after November, the water temperature at the upstream point was generally lower than the downstream, and there was no significant difference in water temperature in the inflow river. During the survey period, a total of 3 species, 4 families, 7 subfamily, 19 species, and 764 fish were collected in Naeseongcheon stream. By classification group, a family of carp were collected the most, and pale chub (*Zacco platypus*) were the most dominant with 54.32% of all fish, and a total of 7 species of native species in Korea were identified. In addition, compared with the results of the survey five years ago, forms such as broad-margined bitterling, korean blue dace, and korean slender gudgeon were newly identified.

PF-8

## Egg development and morphology of larva and juvenile of *Hyphessobrycon eques*

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This study aims to contribute to the study of the embryology of characidae and seed breeding by observing the early life history of *serpae*. 10 pairs of broodstock were purchased from an aquarium in Yeosu and collected eggs by using natural spawning method. During the rearing process, we maintained water temperature as  $27\pm0.1^{\circ}\text{C}$ . The egg was adhesive demersal egg and the size egg was  $0.92\pm0.1$  mm,  $n=50$ . The earliest observed stage was the 32-cell stage. After 2 hours and 30 minutes after the 32-cell stage, the blastula covered the yolk and reached the early gastrula stage. After 5 hours, the head of the developed embryo was and an eye vesicle and Kupper's vesicle was formed. After 14 hours and 30 minutes, the eggs started to hatch from the head. The total length of the juvenile was  $2.89\pm0.09$  mm  $n=20$  and the mouth and anus were not open. At 45 days after hatching, total length of larvae was  $12.5\pm0.68$  mm,  $n=20$  and melanocyte began to form at above pectoral fin, near shoulder, and caudal fin. This is a study on the egg development and morphology of larvae and juvenile of *serpae* and is intended to be used as basic data for researchers and the ornamental fish industry as research on the characinidae has increased recently.



PF-9

## Effects of non-native species removal and connectivity on fish community structure in a wetland ecosystem

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Invasion by non-native species can cause major changes in fish diversity. Despite the urgency of this problem, exotic species management (EM) to reduce non-native species is seldom followed up by long-term assessment of the effects on the ecosystems. We conducted intensive field surveys of fishes and analysed long-term ecological data spanning 15 years (2007–2022) on Upo Wetland where EM was conducted targeting two non-native species: bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*). We found that EM affected the non-native fish communities, while no significant changes occurred for the native fish communities in terms of catch per unit effort. At population level, EM also caused instability in the population structure of the remaining non-native fishes as judged from changes in size distribution but increased the stability of the native fish populations. In addition, enhanced regulated connectivity between rivers and wetlands augmented species diversity. In conclusion, we found cascading effects on non-native fish communities and negative structural changes in populations following non-native fish removal efforts in Upo Wetland.

PF-10

## Effects of estuary re-opening management on fish community in the Nakdong River Estuary

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Estuary re-opening is one of the substantial attempts to restore the estuarine habitat, which has recently been adopted by some of developed countries. The effects of the brackish zone restoration programme in the Nakdong River Estuary (NRE) have been tested through series of re-openings of the NRE barrage. We conducted extensive monthly fish surveys in the upper part of the NRE barrage from 2017–2021 to detect whether the population and community of fish were affected by seawater intrusion. We found that the re-opening of NRE hardly shifted fish community structure as non-native species such as *Erythroculter hypselonotus* and *Lepomis macrochirus* maintained their dominance regardless of the series of re-openings. However, total 46 Japanese eels (*Anguilla japonica*) were emerged after the re-openings, indicating that certain species are affected by re-openings. Furthermore, size structure comparison of fish species suggest that native freshwater species and migratory species showed increasing frequency of smaller size classes, while no such pattern was found for the non-native species. A piecewise structural equation modelling revealed that migratory fish species abundance and biomass started showing positive correlation with both hydraulic factor such as discharge, and seasonality after the re-openings. We concluded that seawater intrusion have created changes in migratory and native freshwater species, but not in non-native species. Therefore, appropriate sluice operation methodologies such as considering migration seasons of migratory species should be progressed. Also, human-involving management policies to regulate non-native species population is required.

PF-11

## Fish assemblage of Docheon and Myogok reservoir in Yeongdeok-gun, Kyeongsangbuk-do

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As part of the resource-ecological research for inland water of Kyeongsangbuk-do, fish composition and inhabitation conditions of endemic species, exotic species, and arrival species were investigated for 2 reservoirs(Docheon-reservoir: O1, Myogok-reservoir: O2) in Yeongdeok-gun which are each covering an area of over 10 hectares. As a result, total 4 orders, 8 families, 14 genera, 15 species, and 2,371 individuals were observed and total biomass was 74,046g. The most dominant family was Cyprinidae which had 7 species. Also, the most dominant species was the Bluegill(*Lepomis macrochirus*). Total of 3 orders, 6 families, 6 genera, and 6 species, totaling 1,126 individuals, were observed at O1. The total biomass was 34,392g and the Bluegill was the most dominant species that captured 1,050 individuals. Total of 4 orders, 6 families, 11 genera, and 12 species, totaling 1,245 individuals, were observed at O2. The total biomass was 39,697g and the most dominant species was the Bluegill that captured 744 individuals. Among the total captured individuals, native species was 2 species(3.97%), exotic species was 2 species(75.70%). According to create economic important species and releasing business for larvae, there was severe ecological disruption. Therefore, continuous monitoring and ecological study will be needed.

## Fish community characteristics and distribution aspect of *Rhodeus pseudosericeus* (Cyprinidae) in the Geumdang Stream, a tributary of the Han River Drainage System of Korea

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This study investigated the characteristics of fish communities and inhabiting status of the endangered species, *Rhodeus pseudosericeus*, in the Geumdang Stream in Korea from March to October 2021. A total of 1,698 fish in 5 families and 25 species were collected from 7 survey stations during the survey period. The dominant species was *Zacco platypus* (relative abundance, 46.5%), and the subdominant species was *Squalidus gracilis majimae* (16.7%), followed by *Rhynchocypris oxycephalus* (12.0%), *Z. koreanus* (5.7%), *Pungtungia herzi* (3.2%), *R. pseudosericeus* (2.0%), *R. notatus* (1.9%), and *Acheilognathus rhombeus* (1.8%). Nine Korean endemic species (36.0%) were collected, including *R. pseudosericeus*, *R. uyekii*, *Sarcocheilichthys variegatus wakiyae*, *Microphysogobio yaluensis*, *S. gracilis majimae*, *Z. koreanus*, *Cobitis nalbanti*, *Iksookimia koreensis*, and *Odontobutis interrupta*. An exotic species, *Micropterus salmoides*, designated as an invasive alien species (IAS), was collected downstream. The investigation of the habitat patterns of the endangered species (class II), *Rhodeus pseudosericeus*, showed a habitat range of about 6 to 7 km in the middle of Geumdang Stream (RP-1 to RP-4), and this species inhabited the edge with water depths of 0.3 through 1.0 m with slow water flow and many aquatic plants. According to the community analysis results, the overall dominance and evenness indexes were low, while diversity and richness indexes were high, and the cluster structure was largely divided into upstream and middle-downstream areas. The river health (fish assessment index) evaluated using fish was assessed as good (3 stations), normal (3 stations), and bad (1 station), and water quality was evaluated as good both upstream and downstream. Compared to previous studies, the number of species was relatively similar, and among the species that appeared in the past, 13 species did not appear in this survey, while 6 species appeared for the first time in this survey. Disturbance factors included river construction, many weirs, and the appearance of the ecosystem-disturbing species, *M. salmoides*. Since Geumdang Stream has high conservation value because it is home to many species in the *Acheilognathinae* subfamily, including the endangered species *R. pseudosericeus*, continuous attention and systematic conservation measures are required.

PF-13

## Fish Community Characteristics and Distribution Aspect of Endangered Fish Species in the Downstream of Yongdamdam, a Tributary of the Geum River Drainage System of Korea

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Characteristics of fish community and inhabitation of endangered species were investigated in downstream of Yongdamdam, Geum River from May 2023 to August 2023 to determine using kick net, cast net, long bag stow net, and trap net. During the survey, 35 species and 2,008 individuals belonging to 11 families were collected. Dominant species was *Zacco koreanus* (30.1%) and subdominant species was *Puntungia herzi* (11.9%). Other abundant species were in the order of *Acheilognathus koreensis* (8.6%), *Squalidus gracilis majimae* (7.4%), *Pseudobagrus koreanus* (6.0%), *Acheilognathus yamatsutae* (5.6%), *Iksookimia koreensis* (5.4%), *Zacco platypus* (5.0%), *Coreoperca kawamebari* (3.4%), and *Pseudopuntungia nigra* (3.0%). Endangered species included *P. nigra* of rank I, *Gobiobotia brevibarba* of rank II, and *C. kawamebari* of rank II. In addition, 14 endemic species including *A. koreensis* and two exotic species (*Micropterus salmoides* and *Lepomis macrochirus*) appeared. Results of appeared species in terms of each fishing gear were: 8 families, 23 species, and 294 individuals from kick net; 6 families, 19 species, and 627 individuals from cast net; 8 families, 25 species, and 824 individuals from long bag stow net; and 9 families, 20 species, and 265 individuals from trap net. The number of appeared species and appeared individuals of long bag stow net were higher than other fishing gears. According to community analysis result of each station, dominance was relatively low (0.38~0.57) while diversity (2.01~2.52), evenness (0.66~0.78), and richness (2.98~3.94) were comparatively high. River health (fish assessment index) evaluated using fish was assessed as very good (grade A, 87.5~100.0). *C. kawamebari*, an endangered species, appeared during this investigation. It is artificially adopted species from Tamjingang river. It spread widely in every survey section with a stable total length frequency distribution (55~67 mm for 1 year old, 68~77 mm for 2-year old, and 85~122 mm for 3-year old or more in May). Additional investigation is needed to understand the inhabitation and dispersion of *C. kawamebari*. *P. nigra* was also extensively distributed with 40~50 mm of total length for 1 year old, 64~69 mm for 2-year old, and 70~93 mm for 3-year old or more. Three *G. brevibarba* were collected in May (84~113 mm, total length) and one was collected in August (110 mm, total length). It was assumed that these individuals were the offspring of individuals released under the Endangered Species Restoration Project (2011-2013) of Ministry of Environment. In addition, we discussed fish conservation measures.

## Ichthyofauna in the Geumho River, Nakdong River System, Korea

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The Fish assemblages were examined from 39 locations at the Geumho River from April 2022 to September 2023. A total of 16,578 individuals belonging to 55 species of 18 families were collected. Cyprinidae fish were most abundant, accounting for 49.1% of the total individuals of 27 species. Of these, 19 species are endemic to Korea, including *Tanakia latimarginata* and *Kichulchoia multifasciata*, and three species, which are *Koreocobitis naktongensis*, *Pseudobagrus brevicorpus* and *Lethenteron reissneri*, are designated as endangered wildlife by the Ministry of Environment. Four invasive species were also collected: *Carassius cuvieri*, *Micropterus salmoides*, *Lepomis macrochirus*, and *Oreochromis niloticus*. Six species are domestically introduced: *Opsariichthys uncirostris amurensis*, *Hemiculter eigenmanni*, *Erythroculter erythropterus*, *Pseudobagrus fulvidraco*, *Leiocassis ussuriensis*, and *Odontobutis interrupta*. *Zacco koreanus* (22.77%), *Zacco platypus* (16.2%), *Pungtungia herzi* (9.26%), *Squalidus gracilis majimae* (7.27%), and *Rhinogobius brunneus* (3.45%) were most common. The most dominant species were *Zacco koreanus*, at 17 sites, and *Zacco platypus*, at 13 sites.

PF-15

Anatomical and histological study of the olfactory organ of the grass puffer  
*Takifugu niphobles* (Tetraodontiformes, Tetraodontidae) in the Jeju Island

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The grass puffer, *Takifugu niphobles* inhabits extensively along the Asian coasts including Pacific Northwest of China, Japan, Philippines, Vietnam, and Korea and it also found in freshwater and brakish water. This species exhibit limited mobility and it fed crustacean which means it is a carnivorous predator. *T. niphobles* has fatal poison which called tetrodotoxin in liver, gonad, skin, and intestine.

Genus *Takifugu* has unique olfactory structure but its anatomy has less conducted. To establish basis of the olfactory organ of this Genus, we conducted anatomy and histology of the olfactory organ of *T. niphobles*.

Anatomically, the olfactory organ protrudes ahead of eyes and consist two pairs of anterior nostril, posterior nostril, nasal bridge, and nasal chamber. The olfactory lamellae is formed as tongue and only exist in the posterior nostril. The number of olfactory lamellae is 2. In anterior nostril, instead of olfactory lamellae, some epithelium protrude from inner of nasal chamber.

Histologically, the olfactory epithelium is composed with olfactory receptor neuron, stratified cell, supporting cell, goblet cell, cilia, basal cell, blood cell, and basement membrane. The sensory epithelium is small zonal type that olfactory neuron bundle and stratified cell and goblet cell have distributed alternately. The nuclear of goblet cell stained purple in h-e that located in basal part of cell and stained red in AB-PAS.

PF-16

## Isotopic niche and competition between *Pennahia argentata* and *Larimichthys polyactis* using bulk and amino acid stable isotopes

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The sympatric species often inhabit habitats, sharing space and food resources in marine ecosystems. Small yellow croaker (*Larimichthys polyactis*) and silver croaker (*Pennahia argentata*) belonging to the family Monacanthidae were the high-value species in East Asia. Fish sampling was conducted in September 2020 at the entrance of Gwangyang Bay using a shrimp beam trawl. The fish were divided into small (S) and large (L) groups according to the total length. The stable isotope analysis of silver croakers revealed a  $\delta^{13}\text{C}$  range of -17.75‰ to -14.97‰ and a  $\delta^{15}\text{N}$  range of 13.32‰ to 15.06‰. In contrast, the  $\delta^{13}\text{C}$  range of small yellow croaker was -19.54‰ to -16.11‰, and the  $\delta^{15}\text{N}$  range was 11.30‰ to 14.93‰, indicating differences in stable isotope values between the two sympatric species. Regarding size-based  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  ratios, the small yellow croaker (L) formed a distinct niche, while the silver croaker (S and L) and small yellow croaker (S) exhibited similar values. The one-way ANOVA results showed a significant difference in  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  stable isotope ratios for the small yellow croaker (L) ( $p=0.00$ ). The  $\delta^{15}\text{N}$  of amino acids among the four groups showed similar values ranging from 3.1~3.2. In the results of this study, the reduced bulk carbon and nitrogen consumption in the large group of small yellow croakers and the absence of differences in amino acids among the four groups suggest no change in the prey of the two species according to the size. Furthermore, the large group of small yellow croakers migrated, and their diet consumed in a different area is reflected in the results.



PF-17

# Morphological and morphometric characteristics of leptocephalus collected from the waters around Heuksan Island in Dadohaehaesang National Park, Korea

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One leptocephalus collected from the waters around Heuksan Island in Dadohaehaesang National Park, Korea, was identified using morphological and morphometric methods. Our leptocephalus was identified as belonging to the family Congridae based on morphological characters: the snout is round; black vesicles are arranged in one row in the center of the digestive tract and body; no gut swelling in the digestive tract.

Morphometric traits were measured according to Tesch(1977): ED 1.3mm; HL 4.5mm; Pre-D 65mm; Pre-A 99mm; TL 107mm.

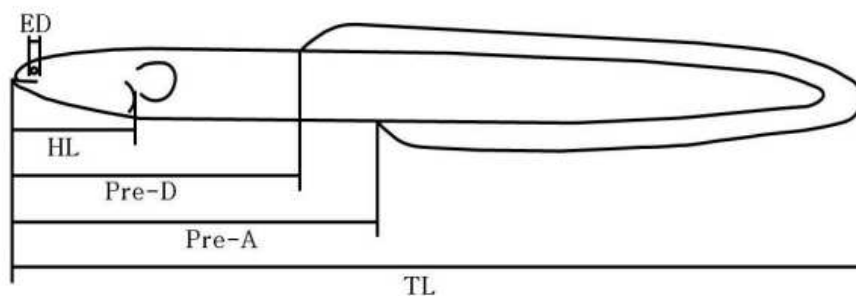


Fig. 1. Morphometric measurements in the eel.

PF-18

## Embryonic and larvae development of hybrid pufferfish, *Takifugu rubripes*(♀) X *T. obscurus*(♂)

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Species hybrid is an industrially useful technology through heterosis. This study was about the egg development morphology of larvae and juveniles. In May 2023, *T. rubripes* (♀) and *T. obscurus* (♂) were collected at the sea cage farm in Tongyeong-si. eggs and sperm were observed after artificial insemination by the dry method. The fertilized eggs were ivory white spherical adhesion-demersal eggs. They began to hatch from the tail 158 hours after fertilization. On the 25th day of the end of the experiment, the total length of the juvenile was 11.87±1.16mm. This study aims to confirm the possibility of a new aquaculture species through artificial insemination between the two species of *T. rubripes* (♀) × *T. obscurus* (♂). It was intended to provide information on the early life history and growth.

PF-19

## Types of *Gymnogobius taranetzi* and genetical classification of 11 species of Gobiidae

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This study aims to identify external morphological differences and reveal the genetic relationship between *Gymnogobius taranetzi* and *Gymnogobius castaneus*. Samples were collected by using cast net at in the lower stream of Ilgwang-stream in Gijang-gun, Busan and scoop net at Hwangbo-stream in Uljin-gun, Gyeongsangbuk-do. The meristic character of the *G. taranetzi* and *G. castaneus* were similar. The oculoscapular canal of the *G. taranetzi* existed only in the second half of the eye and sense ball was open in two pairs. The oculoscapular canal of the *G. castaneus* was connected from the front to the back of the eye through both eyes and sense ball was open in three pairs. According to genetical relationship, there were two groups. One group is formed with *Acanthogobius flavimanus*, *Periophthalmus modestus*, *Tridentiger nudicervicus*, *G. taranetzi*, *Tridentiger obscurus* and *Gymnogobius urotaenia*, and another group formed with *G. castaneus*, *Luciogobius guttatus*, *Tridentiger trigonocephalus*, *Boleophthalmus pectinirostris* and *Rhinogobius brunneus*. In this study, we had different result from existing classification system which is using with morphological criteria. Therefore, genetical analysis is needed to understand existing classification system of Gobiidae family broadly.

PF-20

## First record of *Bathyraja griseocauda* (Rajiformes: Arhynchobatidae) with morphological abnormality in the southwest Atlantic Ocean

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We first report the occurrence of *Bathyraja griseocauda* with abnormality collected from the southwest Atlantic Ocean in June 2022, using bottom trawling. Our specimen showed that both pectoral fins did not fuse with the head, resulting in a horn-like structure separated from the sides of the eyes. Our specimen may belong to *Bathyraja griseocauda* in having following morphological features: rough dorsal disc, densely covered with numerous small denticles; no thorns except for a single row of 14 median thorns on the tail with small denticles around them; a thorn between the first and second dorsal fins; dark blotches on the tail's ventral side. *Bathyraja griseocauda* morphologically similar to *Bathyraja scaphiops*, but is distinguished by its elongated snout and smooth dorsal disc with few small denticles. The abnormality may be due to the lack of fusion between the pectoral fins and the head during the early embryonic development. For more accurate identification, it needs molecular analysis.

PF-21

First record of Bellybarred pipefish, *Hippichthys spicifer* (Rüppell, 1838)  
(Gasterosteiformes: Syngnathidae), from Jejudo Island, Korea

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Three specimens of *Hippichthys spicifer* (Rüppell, 1838) (101-125mm in total length, were collected from Jejudo Island, Korea between July 19 and August 30, 2023. The family Syngnathidae comprises 59 genera and 304 species, of which the genus *Hippichthys* comprises 5 species over the world. In Korea, only one species, *Hippichthys penicillus* has been reported by Cho and Kim (2021). *Hippichthys spicifer* has an elongated body, a long snout, small eyes, rounded tail with black spot. The species is well distinguished from *Hippichthys heptagonus* in the number of trunks between anus and dorsal fin (two vs. one) and the presence of black stripe on the abdomen (present vs. absent). Mitochondrial DNA cytochrome c oxidase subunit I sequences (436 bp) was well matched to *H. spicifer* (99.7%). As this is the first record in the Korean fish fauna, we provide their detailed morphological description.

PF-22

Morphological description of an unrecorded earthworm goby *Luciogobius martellii*  
Di caporiacco, 1948 (Perciformes: Gobiidae) from Seocheon, Korea

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Single specimen of the earthworm goby, *Luciogobius martellii* Di caporiacco, 1948 was collected from Seocheon, Korea, in June 2019. This species is characterized by following morphological combinations: the number of abdominal vertebrae is 16, the number of total vertebrae is 36, the number of segmented caudal fin rays is 10+9, and the horizontal distance of dorsal fin base is longer than caudal peduncle length. *Luciogobius martellii* is morphologically similar to *Luciogobius guttatus*, but is distinguished in the number of total vertebrae (36 vs. 38), Distance of dorsal fin base is longer than caudal peduncle length (Short in *L. guttatus*). We propose the new Korean name “Seo-hae-mi-ggeun-mang-dug” for *L. martellii*.

PF-23

First occurrence of Longarm mullet *Moolgarda cunnesius*  
(Mugiliformes:Mugilidae) from Jeju Island, Korea

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The mugilidae fishes are common euryhaline species that live in coastal marine waters, brackish water, estuaries, and freshwater areas, usually at depths of 20m, but has been reported to depths of more than 300m. There are 26 genera and 78 species in the Mugilidae worldwide. Currently, there are 5 genera and 8 species in Korea, including flathead grey mullet(*Mugil Cephalus*), fringelip mullet(*Crenimugil crenilabis*), Bluespot mullet(*Crenimugil seheli*), Hornlip mullet(*Plicomugil labiosus*), So-iuy mullet(*Planiliza haematocheilus*), Eastern keelback mullet(*Planiliza affinis*), Largescale mullet(*Planiliza macrolepis*) and Squaretail mullet(*Ellochelon vaigiensis*). A specimen of *Moolgarda cunnesius* (Valenciennes, 1836) belonging to the family Mugilidae was collected on July 19, 2023, at Yerae-dong, Seogwipo-si, Jeju Island, Korea. *M. cunnesius* has a cycloid scale, two dorsal and tail fin membranes scattered with small melanophore. It is clearly distinguished from the most similar species, *Crenimugil seheli* in the number of dorsal fin rays, positions of the first and second dorsal fins. Molecular analyses showed that our specimen matched with the *M. cunnesius* in vietnam perfectly, based on mtDNA COI sequences 623bp. This species is widely distributed in the Indo-West Pacific Ocean, including the Red Sea, Taiwan, and northern Australia, and this study revealed that it also inhabits the Jeju Island, Korea. *M. cunnesius* is included in the genus *Osteomugil* according to WoRMS, needs a taxonomic review of the genus name in the future.

PF-24

A new record of snubnose pompano, *Trachinotus blochii*  
(Carangidae) from Korea

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There are 39 genera and 153 species in the family Carangidae worldwide, and 36 species under 17 genera in Korea. Two specimens of Carangidae (29.53-30.78mm SL) were collected from Jeju Island, Korea, using scoop net. They were identified as *Trachinotus blochii* in having 18-20 dorsal fin rays, no black spots on the lateral line, a round snout and an anal fin lobe yellow with a brownish anterior lateral line, a round snout and an anal fin lobe yellow with a brownish anterior margin. This species is the most similar to the congeneric species *Trachinotus bailloni*, but is well distinguished by the black spots on the lateral line and the dorsal fin rays. In order to confirm their taxonomic status, its mitochondrial DNA cytochrome c oxidase subunit I sequences were obtained and compared with those of carangid species recorded in the NCBI database. As a result, it was perfectly matched to *Trachinotus blochii*, and differed from *Trachinotus bailloni* and *Trachinotus mookalee* (genetic distance= 5.46% and 7.52%, respectively). We suggest its Korean name "Mu-jeom-mae-ga-ri" following Kim et al, (2015).



PF-25

First occurrence of the dana pearleye, *Scopelarchoides danae* (Aulopiformes: Scopelarchidae) in the Southern Sea of Korea

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On May 12, 2023, a juvenile specimen (37.61 mm in standard length) of *Scopelarchoides danae* Johnson, 1974 was collected from southern Yokjido, Tongyeong, Korea, using a Bongo net. *Scopelarchoides danae* is distinguished from *Scopelarchus guentheri* and *Scopelarchus analis* in that it has no stripes along the upper and lower of lateral line, and from *Scopelarchus michaelisarsii* in that it has more anal fin rays (24 vs. 18-21, respectively). The species has large eyes, a large mouth, slender body, 7 dorsal fin rays, 24 anal fin rays, a developed adipose fin, and two large pigments below the pectoral fin and posterior to the pelvic fin. Since the original report of this species in the South China Sea by Johnson (1974), it has been widely reported around the world. Because this is the first occurrence among Korean fish fauna, we present its detailed morphological traits.

It was found that *Culter brevicauda* mainly inhabits the lower stream where the bottom substratum is composed of sand and there is little flow rate. Also, during the spawning season, they rose upstream to the middle of Yeongsangang River.

First reliable record of the *Scolecenchelys fuscogularis* (Anguilliformes: Ophichthidae) from Daesambudo Island, Korea

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The worm eel genus *Scolecenchelys* is widely distributed throughout the warm-temperate to tropical Indo-Pacific and characterized by the following combinations of characters: the absence of pectoral fins; the center of eye located posterior to the midpoint of the upper jaw; upper-jaw and vomerine teeth conical, pointed, and arranged in a single to three rows; the posterior nostril situated on the inner fold or margin of the upper lip; three preopercular sensory pores; and two infraorbital sensory pores between the anterior and posterior nostrils.

The genus is composed of 21 valid species and two of them, *S. aoki* (Jordan and Snyder, 1901) and *S. fuscogularis* Hibino, Kai and Kimura, 2013 have been recorded from Korean waters.

Surveying on the benthic fauna of Dadohaehaesang National Park, a single adult specimen (326.5mm in Total length) of *Scolecenchelys fuscogularis* was accidentally caught from the mud bottom of the sea at a depth of 55m in the Daesambudo Island, Southern coast of Korea using a Smith-McIntyre Grab(0.1m<sup>2</sup>). Although it has been already reported that the leptocephali of the species occur from East Sea of Korea, no report of adult fishes of *S. fuscogularis* was made from Korean waters yet.

Thus, we describe *S. fuscogularis* as the first reliable record from Korea based on a single specimen collected from the Southern coastal waters of Korea.

PF-27

## Changes in fish community structure by a gape net in the coast of Nangdo Island, Korea

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This study used the fish data obtained from monthly catches using a gape net collected from March to December 2021 to analyze variations in fish composition and community structure. Water temperature was lowest at 7.5°C in February and highest at 27.6°C in August. A total of 1,441,351 individuals were sampled and classified into 71 species, 41 families, 15 orders. The dominant taxa were Perciformes comprising 31 species, 17 families, followed Scorpaeniformes comprising 7 species, 6 families. The species diversity index ( $H'$ ) was the highest in winter and the lowest in spring. The monthly variations of  $H'$  was the highest in December and the lowest in March. The evenness and richness index were 0.003-0.812 and 1.54-4.39, respectively. As a results of similartiy analysis, *Johnius grypotus*, *Trichiurus lepturus*, *Cynoglossus robustus* appeared simultaneously in summer and autumn. The total catch of seasonally during the study period was 803.4kg in spring, 385.7kg and 400.9kg in summer and autumn, respectively, and the lowest catch was 64.7kg in winter. The dominant species was *Pholis fangi*, *Engralis japonicus*, and *Johnius grypotus*. The fisheries at Nangdo Island coast could be significantly affected by water temperature change, potentially leading to a decline in gap net catches.

PF-28

## Changes in fish community structure near the Yeosu Coast, Korea: A study based on the daily set-net catch data from the last 15 years

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The Yeosu Coast is an ecologically and economically crucial coastal water area around the Korean Peninsula. This study used the fish data obtained from daily catches using set-nets collected from 2008 to 2022 (excluding 2017) to analyze variations in fish composition and community structure over the past 15 years. Warm-water fish species were found to be overwhelmingly dominant over the entire study period, indicating temperate and subtropical characteristics of the Yeosu Coast. The total catch during the survey period was 1,819.6 tons, with the highest and lowest catch recorded in 2010 and 2013, respectively. Combined catch of the two dominant species, *Scomberomorus niphonius* and *Engraulis japonicus*, accounted for 78.9% of the total catch during the study period. Additionally, the Shannon–Weaver diversity index values were lower in 2015 than in 2008. The shifts in species composition showed the strongest correlation with sea surface temperature. The fisheries at Yeosu Coast could be significantly affected by climate change and domination of jellyfish population, potentially leading to a decline in set-net catches and reduced biodiversity within this ecosystem.

PF-29

## Species composition of fish collected by gill net at the coastal waters of Goseong in Gangwon-do, Korea

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The East Sea coastal area, characterized by its deep waters and a uniform coastline, is utilized as a valuable fishery due to its marine environmental features, which provide abundant spawning and growth grounds for numerous marine organisms (Sohn et al., 2014; Chun et al., 2004). The gill net used as a survey fishing gear is known to be suitable for studying benthic fish and semi-benthic fish is a passive fishing gear that is not an active fishing gear that searches and captures a specific fishing group, and is suitable for identifying species and fish group fluctuations in the survey area (Hwang et al., 1997; Choi et al., 2012). The purpose of this study is to confirm the monthly species composition of fish caught in gill net in Goseong, Gangwon-do. The survey areas were Gonghyeonjin and Ayajin located in Goseong, and the monthly appearance species, population, and biomass were surveyed from January to December 2022. The caught fish were transported to the East Sea Fisheries Research Institute's laboratory at the National Institute of Fisheries Science to identify the species. During the survey period, 1,437 individuals of 6 orders, 13 families and 31 species were caught in Gonghyeonjin, and their total weight was 260.7kg. The caught fish in Ayajin were 1,448 individuals of 6 orders, 11 families and 35 species, and their total weight was 214.3kg. In Gonghyeonjin and Ayajin, Scorpaeniformes appeared the most, with 6 families 19 species, 5 families 20 species, and followed by 1 families 5 species, and 1 families 8 species. The dominant species of Gonghyeonjin was *Glyptocephalus stelleri*, a total of 313 individuals (21.8%), and *Theragra chalcogramma* was a total of 291 individuals (20.3%). The dominant species of Ayajin was *Glyptocephalus stelleri* in a total of 469 individuals (32.4%) and *Cleisthenes pinetorum* in a total of 214 individuals (14.8%). The month with the most species appeared was the same as in May of Gonghyeonjin (15 species) and May of Ayajin (16 species), and the month with the fewest species appeared was different in August of Gonghyeonjin (6 species) and April of Ayajin (6 species). The highest monthly catch was in May for both Gonghyeonjin and Ayajin, while the lowest monthly catch differed, being in January for Gonghyeonjin and in March for Ayajin.

## Species composition of fish collected by gill net in Donghae, East sea of Korea

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The East coast is a sea with deep water and monotonous marine environment characteristics. The coast sea is highly basic productive and used as a spawning and nursery ground for various marine organisms, so they are valuable as fishing grounds(Chun et al., 2004). Gill net is not active fishing gear that searches for and captures fish groups, so they are appropriate phrases for grasping the species composition of the survey area and changes in fish groups(Hwang et al., 1997; Choi et al., 2012). Therefore, using gill net, the species that apper on the East sea coast, the frequency of apperance of major fish species, and the monthly average length composition were investigated. From February to December 2020, a gill net was used once a month on the coast near Donghae, located in the southern part of Gangwon-do, casting and once day later hauling at a depth of about 60m. The collected samples were transferred to the laboratory of East Sea Fisheries Research Institute and measured the population, length, and biomass. A total of 9 orders, 20 families, 32 genus, and 36 species during survey period. Dominated 7 species of Pleuronectidae, followed 5 species of Cottidae, and 4 species of Scorpaenidae. A total of 1,689 individuals were caught during survey period, dominate species were *Gymnocanthus intermedius*(23.7%), *Pleuronectes herzensteini*(15.6%), and *Hippoglossoides pinetorum*(12.8%). A total of biomass was 233.8kg, dominate species were *Lophius litulon*(18.0%), *G. herzensteini*(15.0%), and *P. herzensteini*(11.3%). The length range of dominant species *G. intermedius* was 10.5-24.3cm, the average length was 16.7cm, and the length range of *P. herzensteini* was 19.5-22.3cm, the average length was 20.5cm.

PF-31

## Species composition and seasonal variation of fish collected in coastal waters off Jindo-myeon, Sinan-gun, Korea

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Coast water off Jindo-myeon, Sinan-gun has high ecological value as breeding place and habitats for marine life. Fish samples were collected by a both sides fyke net the coastal waters off Jindo-myeon, Sinan-gun to investigate species composition and seasonal variation from 2021 to 2022. In this study, a total of 29 families, 42 species, and 1,603 individuals were appeared. The dominante species were *Engraulis japonicus*(23.3%), *Thrissina chefuensis*(15.0%), *Collichthys lucidus*(10.0%) and *Nuachequula nuchalis*(7.4%). Seasonally, the highest amount of individuals were appeared in May with 32 species and 514 individuals. The dominante species were *E. japonicus*(28.6%), *T. chefuensis*(15.2%), *C. lucidus*(13.6%), and *N. nuchalis*(9.3%). The lowest amount of individuals were appeared in February with 9 species and 41 individuals. The dominante species was *Coilia nasus* (26.8%). The richness was the highest in August(2.82) and lowest in February(2.00). The evenness was the highest in February(0.91) and lowest in August(0.71). The diversity showed higher values in May(2.82), August(2.45), and November(2.37), but relatively lower values in winter. The dominance was the highest in February(0.46) and lowest in May(0.32). In this study, *Mugil cephalus*, *P. haematocheilus*, *L. japonicus*, *Lateolabrax maculatus*, and *M. miiuy* showed increased appearances during their spawning seasons. Therefore, we need to preserve the coastal waters off Jindo-myeon, Sinan-gun, which provides as both a habitat and a spawning ground for various fish species.

## Comparative analysis of fish assemblage characteristics between closed and opened estuaries

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Due to the presence of estuary dams, a closed estuary exhibits different ecological characteristics compared to an open estuary, as it prevents the discharge of industrial wastewater and domestic sewage from the surrounding area. This study collected the fish data in the Seomjin (opened estuary) and Yeongsan (closed estuary) rivers from Ministry of Environment (MOE). The Yeongsan River showed the characteristics of freshwater with a salinity under 0.25 psu at all sites. A total of 21 species and 2,280 individuals were collected. The dominance index was 0.42, and the diversity index was 2.21. Freshwater fishes were the dominant species at all study sites, and *Lepomis macrochirus*, *Micropterus salmoides*, and *Zacco platypus* were the primary species. A total of 30 species and 1,990 individuals were collected in the Seomjin River. The dominance index was 0.39, and the diversity index was 2.53. Salinity at SJ1 and SJ2 was an average 0.2 psu, indicating freshwater characteristics. Salinity increased from SJ3 to SJ5, and *Nuchequula nuchalis* and *Lateolabrax japonicus* were collected as primary species, indicating brackish water characteristics. In particular, *Engraulis japonicus* appeared as a dominant species in SJ4 and SJ5, clearly reflecting the fish community's response to salinity changes. NMDS analysis revealed a distinct difference in the fish community between the Yeongsan River and the Seomjin River, with clusters classified by species appearing upstream and downstream of the Seomjin River. Also, the clusters were classified by the species that appeared upstream and downstream of the Seomjin River. Compared to the Yeongsan River, the Seomjin River exhibited more diverse species, higher individual counts, and a higher dominance index but a lower diversity index. This study suggests that the open estuary, due to its high ecological importance, likely has greater primary production than the closed estuary.



PF-33

First report of morphology of a oneknife unicornfish *Naso thynnoides*  
(Acanthuridae, Perciformes) identified based on COI sequences

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Morphology of a larval *Naso thynnoides* (7.2 mm in body length) identified based on cytochrome c oxidase subunit I (COI) barcodes is reported for the first time in this study. The larval fish was kite-shaped, with serrated first spine of dorsal and anal fins, and had parallel serrations running vertically across the body surface. There were six melanophores in a row in front of the abdomen, five melanophores on the base of the anal fin, dense melanophores on the caudal peduncle, and scattered melanophores on the surface of the brain. The morphological description of larval *N. thynnoides* analyzed by COI barcoding will be useful for larval fish species identification.

PD-1

## Toxic effects on growth performance and hematological parameters of Korean bullhead, *Pelteobagrus fulvidraco* exposed to Phenthoate

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With the development of science and technology, the world's population has increased tremendously. Accordingly, a variety of food crops are grown to feed this huge population. In order to grow a large number of crops, it is essential to use many pesticides, which are toxic to the organisms they affect. Toxic effects include carcinogenicity, epigenetic disruption, and reproductive and neurological disorders. Pesticides remain in the aquatic environment for a long time, leading to high possibility of exposure to fish.

Phenthoate, an organophosphorus pesticide, has toxic effects on physiological functions of fish, resulting in retarded growth performance and changes of hematological parameters. Korean bullhead, *Pelteobagrus fulvidraco* is a representative aquaculture freshwater fish in Korea due to fast growth, easy breeding environment and high flavor. Therefore, the aim of this study focused on growth rate changes and hematological parameters of Korean bullhead, *Pelteobagrus fulvidraco*.

*P. fulvidraco* (body weight,  $35.8 \pm 1.9$  g; total length  $14.9 \pm 0.3$  cm) was exposed to phenthoate at the concentrations (0, 10, 50, 100, 200 and 400 µg/L) for 20 days. During the acclimation, fish were fed with a commercial feed with a rate of 2% of body weight, and the photoperiod was 12 hours. The water temperature is  $17.8 \pm 1.0^\circ\text{C}$  and pH is  $7.4 \pm 0.3$ . The residuals such as feces and uneaten feed were removed and the water was changed daily.

In this study, growth performance such body weight gain, specific growth rate (SGR), hepatosomatic index (HSI) were significantly decreased in proportional to phenthoate concentration. Hematological parameters such as red blood cell (RBC) counts, hematocrit (Ht) value, and hemoglobin (Hb) concentration were significantly decreased in a concentration-dependent manner. In plasma components, glucose, glutamic oxalacetic transaminase (GOT) and glutamic pyruvate transaminase (GPT) were significantly increased in a concentration-dependent manner, while total protein, calcium and magnesium were significantly decreased.

PD-2

## Toxic effects on growth performance and hematological parameters in starry flounder, *Platichthys stellatus* exposed to Bisphenol A

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Bisphenol A (BPA) is a representative endocrine disruptor, and it is mainly used in various industrial fields including the production of epoxy resin and poly-carbonate plastic. As the increase of these industrial activities, exposure of fish to BPA has increased. Fish is exposed to BPA through multiple pathways such as gill and skin, resulting in developmental and metabolic disorders.

This study evaluated the toxic effects of BPA on the growth performance and hematological parameters of starry flounder, *Platichthys stellatus* (average body weight  $38.6 \pm 6.8$  g, average length  $14.8 \pm 0.6$  cm). *P. stellatus* were exposed to various levels of BPA (0, 100, 200, 400, and 800  $\mu\text{g/L}$ ) by the waterborne method for 20 days. 2% of the fish's body weight was supplied as feed twice a day. The water temperature was  $17.5 \pm 0.5$  °C, the dissolved oxygen content was  $8.3 \pm 0.3$  mg/L, and the pH was maintained at  $7.6 \pm 0.1$ . Sampling was conducted on the 10 and 20 days.

Growth performances such as body weight gain (BWG), specific growth rate (SGR) and hepatosomatic index (HSI) were significantly decreased in 400  $\mu\text{g/L}$  BPA. Hematological parameters such as red blood cell (RBC) count and hemoglobin (Hb) were also significantly decreased in 400  $\mu\text{g/L}$  BPA. In plasma components, glutamic oxalate transaminase (GOT), glutamic pyruvate transaminase (GPT) and glucose were significantly increased in 400  $\mu\text{g/L}$  BPA. Total protein (TP) was significantly decreased in 400  $\mu\text{g/L}$  BPA.

Considering these values, 400  $\mu\text{g/L}$  BPA had toxic effects on growth performance, hematological parameters and plasma components.

PD-3

## Toxic effects on growth performance and hematological parameters of Korean Rockfish, *Sebastes schlegelii* exposed to polyethylene microplastic

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Microplastics(MPs), size of <5mm, proliferated and widespread in marine environment. MPs has a critical risk for exposure to fish, and can cause bioaccumulation which induces toxic effects on physiological functions, such as inhibition of development and changes of hematological parameters.

*Sebastes schlegelii* is highly preferred to aquaculture in Korea due to the high tolerance to low water temperature and easiness of seeding production. Many studies have been conducted to assess the toxic effects on various marine fish exposed to polyethylene microplastic (PE-MPs). However, there were few studies on *S. schlegelii* exposed to PE-MPs. Therefore, the purpose of this study was to evaluate the toxic effects on growth performance, and hematological parameters of *S. schlegelii* exposed to PE-MPs.

*S. schlegelii* (weight  $34.55 \pm 5.82$ g, length  $12.59 \pm 0.79$ cm) were exposed to PE-MPs at the concentration of 0, 400, 800, 1600, 3200  $\mu$ g/L for 20 days. In growth performance, the body weight gain (BWG), specific growth rate (SGR) and hepatosomatic index (HSI) showed significant decrease at the PE-MPs concentration of  $\geq 1600$   $\mu$ g/L at 10 and 20 days. In hematological parameters, both red blood cell (RBC) counts and hemoglobin (Hb) showed significant decrease at the PE-MPs concentration of 3200  $\mu$ g/L and  $\geq 1600$   $\mu$ g/L at 10 and 20 days, respectively. Glutamic pyruvic transaminase (GPT) and magnesium showed significant decrease at the PE-MPs concentration of  $\geq 1600$   $\mu$ g/L at 10 and 20 days. Glucose and calcium showed significant decrease at the PE-MPs concentration of 3200  $\mu$ g/L at 10 and 20 days. Glutamic oxaloacetic transaminase (GOT) and total protein (TP) showed significant decrease at the PE-MPs concentration of 3200  $\mu$ g/L and  $\geq 1600$   $\mu$ g/L at 10 and 20 days, respectively.

This study demonstrated that the PE-MPs concentration of  $\geq 1600$   $\mu$ g/L had toxic effects on growth performance and hematological parameters.

PD-4

## Toxic effects of combined exposure to microplastics and cadmium on antioxidant and immunity in *Platichthys stellatus*

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Plastic wastes discharged into aquatic environment are broken down into small particles called microplastics (MPs, <5mm) by various factors such as ultraviolet rays, waves, and microorganisms. MPs present in the marine environment can move within the ecosystem and cause toxicity to various organisms, including fish. In addition, MPs have a large surface area relative to their volume, which makes them advantageous for adsorbing harmful chemicals such as heavy metals and persistent organic pollutants in aquatic environments. These characteristics allow MPs to act as transporters that can accumulate toxic substances in the body of various aquatic organisms.

The non-essential element cadmium (Cd) is a toxic heavy metal that is widely used in various industries and is frequently discharged into the environment. Cd is known to be toxic to fish at relatively low exposure levels. Moreover, the high persistence of Cd in the aquatic environment leads to exposure and accumulation of Cd in various organisms along the food chain.

In this study, the antioxidant and immune responses of *Platichthys stellatus* (length  $22.9 \pm 0.4$ cm, weight  $85.11 \pm 7.6$ g) exposed to MPs and Cd for 10 and 20 days. The experimental concentrations were set at control, MPs 500  $\mu$ g/L (MPs-L), MPs 1000  $\mu$ g/L (MPs-H), Cd-MPs combined exposure group (Cd 50  $\mu$ g/L, Cd 50  $\mu$ g/L, plus MPs-L and Cd 50  $\mu$ g/L plus MPs-H). In antioxidant responses, the activities of superoxide dismutase (SOD) and catalase (CAT) were analyzed in the gills, intestine and liver of *P. stellatus*. The SOD and CAT activities were significantly increased in the MPs-Cd combined exposure groups. In immune responses, the lysozyme (LZM) activities and Immunoglobulin M (IgM) levels were analyzed in the gills, intestine and liver of *P. stellatus*. The LZM activities and IgM levels were significantly decreased in the MPs-Cd combined exposure groups. We believe that this study will help inform people of the toxicity risk of MPs-Cd complexes and establish standards for the toxic effects of MP-Cd combined exposure.

PD-5

## Red sea bream iridovirus (RSIV) infection in rock bream (*Oplegnathus Fasciatus*) according to stocking density

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In keeping with the continuous increase in the world's population, aquaculture technology is highly developed, and intensive aquaculture methods for mass production are primarily used. Farmed fish raised in confined spaces are at risk of mass mortality due to increased susceptibility to stress and disease in intensive farming environments. Red sea bream iridovirus (RSIV) has been reported to affect various marine fish species in Asian countries such as south korea and Japan, causing significant economic losses, especially in the case of rock bream (*Oplegnathus fasciatus*) due to mass mortality. However, no research has reported whether the infection level of RSIV-infected rock bream varies depending on the stocking density. Here, we simulated flow-through conditions after RSIV infection in rock bream and investigated the dynamics of the virus depending on its release into seawater and stocking density. Our data showed that RSIV-infected rock bream had an elevated viral load with increasing water temperature. Our findings suggest that RSIV-infected rock bream in fish farms are likely to shed the virus as water temperature rises. Furthermore, our results confirmed that at low RSIV immersion group( $10^3$  copies/mL), the mortality rate increased with higher rearing density. In the high RSIV immersion group( $10^5$  copies/mL), high viral load were observed, starting from the high-density range.

PD-6

## Development and validation of a multiplex quantitative polymerase chain reaction assay for detecting and genotyping red sea bream iridoviral disease

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Megalocytiviruses are responsible for severe mortality in various marine and freshwater fish species worldwide. Specifically, the red sea bream iridovirus (RSIV) and infectious spleen and kidney necrosis virus (ISKNV) subtypes are known to cause the red sea bream iridoviral disease (RSIVD). Although several quantitative polymerase chain reaction (qPCR) assays have been developed for diagnosing RSIVD, these methods fail to differentiate between viral genotypes within Megalocytivirus. The present study introduces an innovative multiplex qPCR assay for the precise detection of RSIVD. This diagnostic method targets the histidine triad motif (HIT)-like protein and ORF080L genes, which are unique markers for the RSIV and ISKNV subtypes. The assay exhibited high analytical sensitivity, expressed as the 95% limit of detection ( $LoD_{95\%}$ ), of 8.69 copies/5  $\mu$ L for RSIV and 19.07 copies/5  $\mu$ L for ISKNV. Notably, the assay exhibited no cross-reactivity and was unaffected by common inhibitory substances. The diagnostic sensitivity and specificity were 100% for both RSIV and ISKNV, demonstrating the reliability of the assay. The multiplex qPCR assay was 100–1000 times more sensitive than conventional PCR methods, emphasizing its importance in early-stage infection detection. The repeatability and reproducibility of the assay were confirmed through extensive testing, showing low variation and high correlation across different technicians and laboratory settings. Furthermore, the ability of the assay to selectively detect and differentiate between RSIVD genotypes represents a significant advancement in aquatic animal disease diagnostics. This multiplex qPCR assay offers a rapid, specific, sensitive, and quantitative diagnostic tool for global RSIVD surveillance efforts and contributes to the prevention and understanding of disease progression in the aquaculture industry.

PD-7

## Molecular characterization and expression analysis of the zinc finger protein 703 (ZNF703) gene from starry flounder (*Platichthys stellatus*)

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The zinc finger protein 703 (ZNF703) gene plays a pivotal role in the immune response of fish against bacterial and viral infections. In the antiviral defense mechanisms, ZNF703 notably influences interferon signaling pathways and the subsequent activation of interferon-stimulated genes (ISGs), crucial for limiting viral replication. Concurrently, the gene regulates the production of key pro-inflammatory cytokines such as Interleukin 1 beta (IL-1 $\beta$ ) and Tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), which are instrumental in the innate immune response against bacterial pathogens. We analysed the coding sequence (CDS), genomic structure, and temporal variations in the mRNA transcription of ZNF703 after challenge with viral hemorrhagic septicemia virus (VHSV) and *Streptococcus parauberis* PH0710 in starry flounder (*Platichthys stellatus*) (Ps). *P. stellatus* ZNF703 (PsZNF703) consisted an CDS of 1770 bp, encoding a polypeptide of 589 amino acids with an isoelectric point of 9.36 and theoretical molecular weight of 61.9 kDa. PsZNF703 was confirmed to have a NLZ1 domain (326–375 aa) and ZNF C2H2 domain (463–491 aa). PsZNF703 was clustered into corresponding subgroups and showed the closest relationship to fish. In addition, it was confirmed that ZNF703 of *Pleuronectes platessa* was the closest relatives. The strongest expression of PsZNF703 mRNA in healthy starry flounder was observed in the gills. The expression pattern of PsZNF703 mRNA after infection with pathogens was analysed in the kidney, spleen, gill, liver, brain, intestine, and heart. The quantitative real-time PCR (RT-qPCR) results showed that PsZNF703 mRNA expression was significantly up-regulated in the spleen, liver, and intestine 12 h post-VHSV injection ( $***p < 0.001$ ). After infection with *S. parauberis* PH0710, the PsZNF703 mRNA expression pattern was up-regulated in almost all major tissues, whereas it was significantly down-regulated in the gills and heart. Our results indicate that PsZNF703 may be involved in the host immune response to starry flounders.



PD-8

## Insights of the molecular mechanisms of the antioxidant effector glutaredoxin1 from yellowtail clownfish (*Amphiprion clarkii*)

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Glutaredoxins (GRXs), belonging to the thioredoxin superfamily, are antioxidant enzymes known to protect living organisms from oxidative stress. GRXs participate in several cellular processes, such as reducing oxidative stress, inhibiting apoptosis, and regulating transcriptional factor activity. In this study, we focused on the role of GRXs in facilitating redox reactions in immune response. We first examined the structure of glutaredoxin1 gene from yellowtail clownfish (AcGRX1). The AcGRX1 gene sequence was obtained from a transcriptome database of *A. clarkii*, revealing a length of 892 bp with an open reading frame (ORF) of 321 bp, encoding a protein with 106 amino acids. Predictions estimated AcGRX1's molecular weight as 11.59 kDa and its theoretical isoelectric point (pI) as 6.82. The gene showed a more than 99% sequence identity and similarity with *Acanthochromis polyacanthus*. Tissue distribution assay indicated that AcGRX1 had widespread expression across all tested tissues, with the highest levels found in brain tissue. To investigate the immune response of AcGRX1 mRNA expression, healthy fish were challenged with immune stimulants like LPS, poly I:C, and *Vibrio harveyi*. The qPCR results revealed that all immune challenges led to a significant increase in AcGRX1 expression in both the head kidney and spleen at early time points. To assess the antioxidant properties of AcGRX1, we conducted disk diffusion and cell viability assays. Experiments with varying concentrations of H<sub>2</sub>O<sub>2</sub> showed that the clear zone of MBP was larger than that of AcGRX1-transformed *E. coli* under all concentrations. Additionally, different arsenate concentrations applied to AcGRX1 overexpressed FHM cells showed significant cell survival compared to the control. Immune stimulants activate key immune pathways, leading to inflammation or apoptosis in cells, while antioxidant enzymes like GRX1 are crucial in the protection mechanism to counterbalance this excessive stress. Elevated mRNA expression of AcGRX1 observed during immune stimulation indicates that it may play a role in reducing oxidative stress in yellowtail clownfish when facing pathogenic invasions.

PD-9

Serotype and mitochondrial cytochrome c oxidase subunit 1 gene analysis of the scuticociliate *Miamiensis avidus* in cultured olive flounder (*Paralichthys olivaceus*) in Jeju island

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Scuticociliatosis can occur from juveniles to adult olive flounder (*Paralichthys olivaceus*) and the infection usually causes mass mortality. *Miamiensis avidus* is a parasitic pathogen that showing typical symptoms of ulceration and hemorrhages in skeletal muscle and fins in cultured marine fishes. Also, there is no clear way to treat it once the parasite has invaded the internal organs of fish. Therefore, it is important to clarify the antigenic differences between isolates since antigenic variation in fish pathogens has been widely reported. The *cox1* gene has been suggested as a useful taxonomic marker for the identification of animals such as fishes. According to a study by Jung (2011), they suggested a relationship between the *cox1* genes and the serological grouping of the organism.

In our previous study, scuticociliate *M. avidus* was isolated from farmed olive flounder during the July to December 2022 in Jeju island. We determine the phylogenetic classification of the detected pathogens. The nucleotide sequences of all 4 strains obtained from olive flounder farms in 4 different regions, were 100% homologous with SSU rRNA gene of *M. avidus* deposited in GenBank. In this study, we aimed to analyze the tendency between serotypes and *cox1* genes that based on 232 positive samples through PCR assays. Unusually, serotype II and cytochrome c oxidase subunit 1 gene type II showed a high degree of matching results. Based on this study conducted using strains in Jeju Island, it is possible to demonstrate the potential relationship between serotypes and *cox1* genes.

PD-10

## Molecular characterization and immune response of a *suppressor of cytokine signaling 3a* gene from *Scomber japonicus*

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Suppressor of cytokine signaling 3a (SOCS3a) regulates immune response via inhibiting STAT3 activation in the cells. In this study, a SOCS3a homolog (*SjSOCS3a*) was identified from *Scomber japonicus*. Its open reading frame contains 618bp nucleotides, encoding 205 amino acids of protein with 23.42 kDa molecular mass. The deduced protein sequence of *SjSOCS3a* contains SH2 domain and SOCS3 box domain between 39 and 137 amino acids and 165 and 205 amino acids, respectively. Pairwise sequence alignments were used to discover the identity and similarity of *SjSOCS3a* with other SOCS3a orthologs. The results showed that *SjSOCS3a* had the highest homology with the ortholog from *Perca flavescens* and lowest homology with *Mus musculus* SOCS3a. Moreover, SH2 domain and SOCS box domain of SOCS3a was conserved amongst all selected species. Phylogenetic analysis revealed four distinct taxonomic clusters of SOCS3a, including fish, amphibia, aves and mammals. Tissue distribution of *SjSOCS3a* mRNA was analyzed and the results showed that it was ubiquitously expressed in almost all of the examined tissues, including heart, blood, brain, muscle, gill, spleen, skin, stomach, kidney, intestine, head kidney and liver, with the highest level in heart and the lowest level in liver. In immune challenge, poly inosinic:polycytidylic acid (poly I:C), lipopolysaccharide (LPS), *Vibrio harveyi* and *Streptococcus iniae* was injected to healthy *Scomber japonicus* fish and the blood was sampled at 0, 6, 12, 24, 48 and 72h post injection. The mRNA expression of *SjSOCS3a* was significantly upregulated at 12h upon poly I:C, LPS, *Vibrio harveyi* and *Streptococcus iniae* challenges. Collectively, these findings suggest that *SjSOCS3a* may have important roles in innate immune system of *Scomber japonicus*.

PD-11

## Galectin-8-like isoform X1 from redlip mullet (*Planiliza haematocheilus*) exhibits protective effects against oxidative damage and cell death

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Galectin 8 (Gal8) belongs to the tandem-repeat sub class of the galectin superfamily. It possesses two homologous carbohydrate recognition domains (CRDs) linked by a short peptide and preferentially binds to beta-galactoside containing glycol-conjugates in a calcium-independent manner. To date, six isoforms of *Gal8* have been identified, which were evolved by alternate splicing. In mammals, the functional properties of Gal8 have been investigated by a number of studies; however, knowledge of fish Gal8 is limited. Therefore, in this study, we aimed to clone Galectin-8-like isoform X1 from *Planiliza haematocheilus* (*PhGal8X1*) to investigate its role in fish immunity. We identified *PhGal8X1* with an open reading frame of 918bp encoding a protein of 305 amino acids. *PhGal8X1* protein showed an estimated molecular weight of 34.078 kDa and a theoretical isoelectric point of 7.7. The instability index was 38.66 and the estimated half-life was 30 hours, which classified the protein as stable. *PhGal8X1* contained no signal peptide sequence and was secreted through unconventional protein secretory pathways (threshold score=0.55). *PhGal8X1* was expressed in all tissues investigated and prominently found in brain, stomach, and intestine. When the fish were stimulated with Poly I:C, LPS, and *L. garvieae*, the expression of *PhGal8X1* in the blood was significantly ( $p < 0.001$ ) elevated by 14-fold, 1.5-fold, and 4-fold, respectively at 12 h post-injection. Subsequently, the expression was gradually dropped to basal levels at 72h post-injection. To evaluate the role of *PhGal8X1* during the oxidative stress induced by  $H_2O_2$ , we performed the tetrazolium bromide based MTT cell viability assay and popidium iodide/ Hoechst 33342 double staining of cell apoptosis assay in *PhGal8X1* overexpressed FHM cells. The results indicated that cell viability in *PhGal8X1* overexpressed cells were significantly ( $p < 0.05$ ) higher than the control. Further, the expression of antioxidant genes including catalase, peroxidase, and superoxide dismutase were upregulated in *PhGal8X1* overexpressed cells. Our results demonstrate that *PhGal8X1* might be involved in regulating antioxidant defense in redlip mullet fish.

PD-12

## Molecular and functional characterization of a ladderlectin-like molecule from red-spotted grouper (*Epinephelus akaara*)

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Ladderlectin is a member of C-type lectins (CTLs), which are a diverse group of proteins that bind to carbohydrates. Although ladderlectin and other CTLs shares some common characteristics, such as the existence of C-type lectin-like domains (CTLDs), they differ in terms of their structure and cellular location. In mammal, ladderlectin was reported to be involved in the innate immune response. However, ladderlectin genes in fish has not been extensively studied. Therefore, in this study, we identified the ladderlectin-like (*EaLL-like*) gene from red-potted grouper (*Epinephelus akaara*) and characterized its molecular and functional features. Various bioinformatics tools were employed to conduct structural analysis. The spatial expression analysis was conducted on 12 different tissues of healthy *E. akaara*. An immune challenge experiment was carried out using poly I:C, LPS, and nervous necrosis virus (NNV) to analyze temporal expression patterns of *EaLL-like*. The results of in-silico analysis discovered an open reading frame (ORF) of *EaLL-like* with 576 bp, which translates into 191 amino acid residues. The calculated molecular weight and theoretical isoelectric point of the predicted protein are 19.5 kDa and 4.74 pI, respectively. The phylogenetic analysis revealed *EaLL-like* is closely clustered together with the orthologs from other fish species. Under normal physiological conditions, blood and brain tissues exhibited the highest mRNA expression of *EaLL-like* while the intestine displayed the lowest mRNA expression. Under immune stimulation, *EaLL-like* exhibited upregulated expression for all stimuli at 24 and 48 hpi. It is noteworthy that in LPS and NNV challenges, *EaLL-like* was upregulated at all time points. The upregulation of *EaLL-like* at early time points was potentially due to the CTL-related innate immune responses in *E.akaara*. Furthermore, bacterial agglutination assay revealed its capacity to identify and bind different bacterial strains. Taken together, these results suggested that *EaLL-like* might have a potential role in host immune responses of red-potted grouper.

PD-13

## Interferon regulatory factor 2 in red-spotted grouper (*Epinephelus akaara*): Structural and functional investigation for its immunological properties

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Interferon regulatory factor 2 (*IRF2*) is specifically involved in interferon (IFN)/IRF-dependent signaling pathways through various immune responses of the host organism. In the present study, a *IRF2* homolog (*EAIRF2*) was identified and characterized in *Epinephelus akaara*. The structural characteristics of *EAIRF2* were determined using different bioinformatics tools. *EAIRF2* is closely related to *Epinephelus coioides* with the highest identity and clustered into the fish group, revealing that *EAIRF2* was conserved during evolution. The mRNA level of *EAIRF2* was highest in blood. In the immune challenge analysis, significant transcriptional modulation of *EAIRF2* was observed upon lipopolysaccharide (LPS), polyinosinic:polycytidylic acid (Poly I:C), and nervous necrosis virus (NNV) treatment at different time points, demonstrating the involvement of *EAIRF2* in immune response against various pathogens. The subcellular localization analysis confirmed that the *EAIRF2* protein was predominantly present in the cell nucleus. Under the overexpression of *EAIRF2*, the transcription of the viral hemorrhagic septicemia virus (VHSV) genes were significantly inhibited, while the relative mRNA levels of different downstream genes related to IFN/IRF signaling pathways were increased, suggesting the antiviral effect of *EAIRF2*. Results of the macrophage polarization and cytokine gene expression revealed that the overexpression of *EAIRF2* activated the polarization of the macrophages into the M1 phase. Overall, our results suggest that *EAIRF2* is an important immune-regulatory gene that is specifically involved in the protective mechanism against viruses through the IFN/IRF signaling pathways in the *Epinephelus akaara*.

PD-14

## Molecular identification and characterization of interferon-stimulated gene 20-kDa protein in red-spotted grouper (*Epinephelus akaara*)

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Interferon-stimulated gene 20-kDa protein (*ISG20*) is a broad-spectrum antiviral gene that is directly involved in degrading viral RNA. In the present study, we identified a *ISG20* ortholog from *Epinephelus akaara* (*EAISG20*) and characterized its structural and functional properties.. The structural features of *EAISG20* were examined using various bioinformatics tools. *EAISG20* is closely related to *Epinephelus lanceolatus* with the highest identity and clustered into the teleost group, revealing that *EAISG20* was conserved during evolution. The highest mRNA level of *EAISG20* was observed in the blood. The temporal mRNA expression results showed that a significantly higher expression of *EAISG20* were identified upon lipopolysaccharide (LPS), polyinosinic:polycytidylic acid (Poly I:C), and nervous necrosis virus (NNV) treatment at different time points, revealing the immune capacity of *EAISG20* against various pathogenic stimulants. The subcellular localization assay confirmed that the *EAISG20* was ubiquitously expressed in the cell nucleus. Upon the overexpression of *EAISG20*, six genes of viral hemorrhagic septicemia virus (VHSV) were significantly downregulated, suggesting the antiviral properties of *EAISG20*. Furthermore, results obtained from the flow cytometry analysis indicated that overexpression of *EAISG20* reduced the mitochondrial depolarization in fathead minnow epithelial cells, revealing anti-apoptotic characteristics of *EAISG20*. Taken together, these results suggest that *EAISG20* is a vital immune-related gene that is involved in the defensive immune response against viral pathogens in red-spotted grouper.

PD-15

Characterizaation of yellowtail clownfish (*Amphiprion clarkii*)  
cc chemokine ligand 4 (ccl4): expression profiles and biofunction in innate  
immunity

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CC chemokine ligand 4 (CCL4) is a chemokine protein that plays a critical role in the recruitment and activation of immune cells, including macrophages, natural killer cells, and lymphocytes, to sites of inflammation or infection. Although CCL4 has been cloned and extensively studied in mammals, its function in teleost fish is not yet well understood. In this present study, we identified the full-length cDNA sequence homolog of *CCL4* (*AcCCL4*) from yellowtail clownfish cDNA database. *In silico* analysis was carried out to characterize its structural features using molecular biological software and other web-based servers. The open reading frame of *AcCCL4* was shown to contain 297 bp which encoded the polypeptide chain of 99 amino acids (aa) with the predicted molecular weight of ~11 kD. Characteristic SCY domain was identified between 29-87 aa where highly conserved CC motif laid within. Swiss-model revealed that *AcCCL4* functions as a homodimer with the QMEANDisCo Global value of 0.66 +/- 0.07. The tissue specific mRNA expression analysis was carried out using quantitative real time PCR (qPCR) and the temporal transcriptional modulation of *AcCCL4* was investigated by stimulating yellowtail clownfish with *Vibrio harveyi* bacterium, Poly I:C and lipopolysaccharide (LPS), respectively. qPCR analysis revealed that *AcCCL4* transcripts were ubiquitously and differently expressed in all the examined tissues, where the highest expression of *AcCCL4* was identified in spleen and gills. Upon stimulation with *V. harveyi*, Poly I:C and LPS, *AcCCL4* expression in spleen tissue was significantly upregulated in a time-dependent manner. Collectively, our findings indicate that *AcCCL4* is involved in the innate immune response of the yellowtail clownfish.



PD-16

## Insights into metal tolerance, immune response, and oxidative stress of metallothionein from disk abalone (*Haliotis discus discus*)

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Metallothioneins (MT) is a low-molecular-weight metal-binding protein with a cysteine-rich feature. Its synthesis can be induced when marine organisms are exposed to elevated concentrations of some essential and non-essential metals. Consequently, MT is well recognized as specific biological response markers for metal pollution and the measurement of MTs has been included in several bio-monitoring programs. In the present study, a MT homolog from disk abalone (AbMT) was identified. AbMT showed its conserved structural features of other MT counterparts. Tissue-specific mRNA expression was analyzed for several tissues in healthy abalones and subsequently challenged with *V. parahaemolyticus*, *L. monocytogenes* and VHSV to investigate the modulation of AbMT mRNA by using RT-qPCR. The results showed that AbMT was ubiquitously expressed in all the analyzed tissues, and it showed its vitality in immune function by upregulating at early phase of the *V. parahaemolyticus*, *L. monocytogenes* and VHSV challenges. In functional assay, the metal tolerance ability of AbMT was shown against Zn, Cu and Cd. To examine the functional characteristics of AbMT *in vivo*, AbMT was subcloned into pcDNA3.1(+) vector and transfected into RAW264.7 cells. AbMT overexpressed cells were then subjected to LPS stimulation and the expression of downstream genes were analyzed using RT-qPCR. AbMT was able to induce the mRNA expression of IL-1 $\beta$ , IL-6 and COX-2 upon LPS stimulation but not the expression of TNF- $\alpha$  in RAW264.7 cells. Moreover, AbMT was able to polarize macrophages into M1. The ability of protecting RAW264.7 cells by AbMT against ROS was confirmed by NO production assay and H<sub>2</sub>O<sub>2</sub> induced cell viability assay. Collectively, these findings show the versatility of AbMT as a protective molecule against heavy metal pollution and oxidative stress in disk abalone.

PD-17

## Correlation of rock bream iridovirus (RBIV) replication and hematological indicators in rock bream (*Oplegnathus fasciatus*)

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Rock bream iridovirus (RBIV), which is a member of the *Megalocytivirus* genus, causes severe mass mortalities in rock bream. Nearly all deaths by RBIV are accompanied by enlargement of spleen as well as anemia. While red blood cells (RBCs) are known to be involved in the immune response against viral infections, the participation of rock bream RBCs in the immune response against RBIV has not been studied yet. In this study, we evaluated the virus replication patterns, blood characteristics analysis and anemia-related factors in rock bream RBCs after RBIV infection. In Ficoll-purified RBCs, when virus replication reached to peak at 4 d to 17 dpi (average range of  $10^4$ - $10^5$ /100  $\mu$ l), hematocrit (HCT) levels gradually decreased from 14 dpi. Interestingly, hemoglobin alpha and beta mRNA expression level were gradually decreased from 4 dpi. On the other hand, aminotransferase (AST), alkaline phosphatase (ALP), Blood Urea Nitrogen (BUN) and BUN/Creatine levels gradually increased during RBIV progression. These findings suggest that HCT level, hemoglobin expression level and hematological pattern can be an indicator of disease severity of RBIV disease.

PD-18

## Effect of rock bream iridovirus (RBIV) infected tissue intake on mortality in rock bream (*Oplegnathus fasciatus*)

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In the last decade, an average of 569,600 tons of feed was consumed in marine fish farms, of which 482,800 tons (84.6%) were grounded (raw) fish feed and 8,700 tons (15.2%) were assorted feed in Korea. In this study, we evaluated the administration of rock bream iridovirus (RBIV) infected tissue to rock bream as feed to determine whether it causes mortality or lead to any clinical symptoms due to RBIV infection. Virus infected tissue (spleen, kidney, liver and heart) were administered [50mg ( $1.53 \times 10^8$ /MCP gene copies), 100mg ( $3.06 \times 10^8$ ), 200mg ( $6.12 \times 10^8$ ), 400mg ( $1.22 \times 10^9$ ), 600mg ( $1.84 \times 10^9$ ), 800mg ( $2.45 \times 10^9$ ), 1000mg ( $3.06 \times 10^9$ ), 1200mg ( $3.67 \times 10^9$ ), 1400mg ( $4.28 \times 10^9$ ), 1600mg ( $4.89 \times 10^9$ ), 1800mg ( $5.51 \times 10^9$ ), 2000mg ( $6.12 \times 10^9$ ), 2200mg ( $6.73 \times 10^9$ ) and 2400mg ( $7.34 \times 10^9$ )] to rock bream held at 23 °C lead to 100% mortality by 24 days' post administration. Interestingly, the mortality of rock bream with RBIV-infected tissue administered was not viral dose/concentration dependent. Further, the copy number of MCP gene was high in all the nine organ (gills, liver, intestine, stomach, spleen, heart, kidney, brain and muscles tissue, range of  $1.52 \times 10^8$  to  $2.00 \times 10^9$ /100ul) in the dead fish. Distribution of virus based on the tissue quantity was in the following order: 200mg (average  $2.00 \times 10^9$ /nine organ), 1800mg ( $1.94 \times 10^9$ ), 1000mg ( $1.21 \times 10^9$ ), 2200mg ( $1.07 \times 10^9$ ), 1400mg ( $1.02 \times 10^9$ ), 600mg ( $8.39 \times 10^8$ ), 2400mg ( $8.06 \times 10^8$ ), 400mg ( $7.54 \times 10^8$ ), 1200mg ( $7.18 \times 10^8$ ), 50mg ( $5.10 \times 10^8$ ), 1600mg ( $3.31 \times 10^8$ ), 2000mg ( $3.29 \times 10^8$ ), 800mg ( $2.09 \times 10^8$ ) and 100mg ( $1.52 \times 10^8$ ). Interestingly, consuming just 50mg of RBIV-infected tissue caused mortality in rock bream (50mg of tissue is equivalent of the average spleen weight of rock bream weighting 20g). Therefore, it is necessary to determine the RBIV susceptibility of fish species used as grounded (raw) fish feed in aquaculture industry and in order to minimize the risk of virus outbreak it is advised to avoid feeding pathogen infected grounded (raw) fish feed. Hence, we aim to procure raw feed infected with RBIV among the raw feed widely used in aquaculture (imported and domestic: sand lance and horse mackerel, etc.) and administer it directly to rock bream to test whether mortality is observed.

PD-19

## Virulence shift of rock bream iridovirus (RBIV) during serial passage in rock bream (*Oplegnathus fasciatus*)

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Transmission is a fundamental component of pathogen fitness. A better understanding of pathogen transmission can greatly improve disease management. In particular, controlled studies of multiple rounds of natural transmission (i.e. serial passage) can provide powerful epidemiological and evolutionary inferences. Rock bream is very sensitivity to RBIV and it is difficult to avoid the mortality, even when they are exposed with low virus concentration (range of  $10^2$  to  $10^3/100\mu\text{l}$ ). We investigated changes in virulence by generation in the host by RBIV infection over 5 serial passages in rock bream to find out why RBIV inevitably shows strong pathogenicity to rock bream following order: i) Each experimental group (5 fish) were infected with 7 strains RBIV ( $10^6/\text{MCP}$  copy number) and held at 23 °C. ii) Tissues (spleen, heart, liver and kidney) were collected from dead fish, and virus isolation and quantification were performed. The above processes i to ii were referred to as passage 1, and the same process was performed through successive generations of hosts, and comparative analysis was conducted up to the current passage 5. As a result of the pathogenicity test, all of the individuals used in the five consecutive infection experiments died. Moreover, as the host generation continues, the amount of virus produced from the dead individuals increases and the time to final death tends to accelerate: The virus obtained at passage 1 stage was at the level  $10^7$ , with final death occurring between 22 and 35 days, and the virus secured at passage 4 stage was at level  $10^8\sim 10^9$ , with final death occurring between 18 and 23 days. Interestingly, one type of virus caused the entire mortality of rock bream in the passage 1 stage, but did not cause any mortality in the passage 2 stage, and no clinical signs or mortality through 60 days' post infection when they were determined to have low virus copy numbers (average  $7.66 \times 10^3$ ). Various RBIV and RSIV strains are distributed in Korea, it is not known which strain is causing significant damage to domestic rock bream aquaculture farms. Our result suggests that the RBIV occurring in Korea has very strong pathogenicity, and its pathogenicity is becoming stronger with each generation, causing repeated outbreaks every year and it is believed that mortality is occurring. Through additional serial passage experiments, we aim to improve our understanding of the interaction between rock bream and virus transmission.

PD-20

## Systemic infection of rock bream iridovirus (RBIV) through blood vessels

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*Megalocytivirus* genus contains viruses associated with serious systemic infections resulting in significant mortality. In this study, we compared and analyzed the mortality rate observed when the rock bream iridovirus (RBIV) progresses to systemic infection through the blood, when infected through the intra-arterial injection method, which involves injecting the virus into blood vessels located in the caudal area of rock bream, along with the intraperitoneal and intramuscular injection method. Based on this, we attempted to conduct blood-based viral infection mechanism research through research on blood cell changes according to virus distribution over time. Mortality patterns were confirmed after administering the virus to the blood vessels, muscles, and abdominal cavity of rock bream at concentrations of  $10^7$ ,  $10^6$ ,  $10^5$ ,  $10^4$  and  $10^3/100\text{ul}$ . Based on the mortality pattern,  $10^6/100\text{ul}$  of virus was infected and 10 tissues (gills, liver, intestines, stomach, Spleen, heart, kidney, brain, muscle and blood) were collected. In addition, the presence of anemia (blood hematocrit, hemoglobin concentration, ratio of red blood cells and white blood cells, etc.) and the distribution and changes of blood cells were observed through blood sample preparation. When we draw blood from the tail of rock bream, we can see that the tail area turns black within 5 minutes. Interestingly, upon intra-arterial injection, the tail turned black 10 days after infection. This suggests that the similar symptoms appear when blood is lost in the body or the virus penetrates the blood. Moreover, complete mortality occurred in 26 days when  $10^3/100\text{ul}$  of the virus was injected intra-arterial, but complete mortality occurred in 35 and 34 days when injected intraperitoneally and intramuscularly, respectively. This indicates the fact that intravascular injection method involves blood, as systemic infection occurs, it is observed that even a very small amount of virus can cause death within short period of time. In addition, compared to the intraperitoneal and intramuscular injection methods, the intra-arterial injection method was confirmed to rapidly induce anemia symptoms with a significant decrease in hematocrit and hemoglobin levels at 15 days after infection. Based on the results of this experiment, it is predicted that the intra-arterial injection method will cause systemic infection in a different way from general infection methods and provide an advanced result regarding the interaction between virus and host.

PD-21

## Oral transmission as a route of infection for rock bream iridovirus (RBIV) in rock bream (*Oplegnathus fasciatus*)

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Surveys among wild marine fish have revealed occurrence of *Megalocytivirus* infections in a high number of diverse fish species. In marine aquaculture of rock bream, preying on invading wild fish might thus be a risk factor for introduction of rock bream iridovirus (RBIV) and subsequent disease outbreaks. Our objective was to determine whether an oral transmission route for RBIV in rock bream exists. Virus was placed in a syringe and the needle was removed. After opening the rock bream's mouth, the virus was administered by inserting the tip of a syringe into the mouth. Fish injected intraperitoneally (i.p.) with RBIV ( $10^6$ ,  $10^5$  and  $10^4/100\mu\text{l}$ ) and held at  $23^\circ\text{C}$  showed 100% after 18, 21 and 24 days' post infection (dpi), respectively. Interestingly, rock bream infected by oral transmission route showed delay in final mortality by 19, 19 and 17 days ( $10^6$ ,  $10^5$  and  $10^4/100\mu\text{l}$  of RBIV, respectively). It was thought that the pathogenicity of the virus and the amount of virus produced by infected individuals would have decreased due to the delay in the final death point. Rather, viruses at levels above  $10^9$  were detected in dead fish, confirming that they produced higher levels of virus than those that died due to intraperitoneal and intramuscular injections. The average number of viruses carried by dead fish ranges from  $6.05 \times 10^7$  to  $4.16 \times 10^9$  (gills, liver, intestine, stomach, spleen, heart, kidney, brain and muscles tissue). Virus distribution by administered virus amount in the dead fish organs was high in the following order: over  $10^9$  (7 tissues: spleen, liver, intestines, stomach, heart, kidney and gills) and over  $10^8$  (2 tissues: muscle and brain), high virus load was detected from the intestine and stomach areas where the virus was directly administered. This suggests that the spread and proliferation of the virus will vary depending on the method and route of virus administration or infection. We aim to establish the infection mechanism of the virus by oral infection by conducting research on the immune response, distribution and morphological changes of immune cells seen in the stomach and intestines by collecting samples over time following oral administration of the virus.

PD-22

## Role of tumor necrosis factor receptor-associated factor 6 in regulating antiviral immunity in red-spotted grouper (*Epinephelus akaara*)

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Tumor necrosis factor receptor-associated factor 6 (TRAF6) is a member of the TRAF family of adaptor proteins that are involved in the signal transduction pathways of both TNF receptor and interleukin-1 receptor/Toll-like receptor superfamilies. The protein encoded by this gene is a key molecule in antiviral innate and antigen-specific immune responses. In this study, we identified and characterized TRAF6 from red-spotted grouper (*Epinephelus akaara*; *EaTraf6*). The open reading frame of *EaTraf6*, 1713bp in length, encodes a putative protein of 570 amino acids and has a predicted molecular weight and theoretical isoelectric point of 64.11 kDa and 6.07, respectively. *EaTraf6* protein comprises an N-terminal RING-type zinc finger domain, two TRAF-type zinc finger domains (zf-TRAF), a coiled-coil region, and a conserved C-terminal meprin and TRAF homology (MATH) domain. *EaTraf6* shared the highest amino acid sequence identity (97.7%) and similarity (99.5%) with its ortholog from *Epinephelus coioides*. The phylogenetic analysis showed all fish TRAF6s clustered together, apart from other species. The qRT-PCR results indicate that *EaTraf6* was expressed ubiquitously in all examined tissues, with the highest mRNA expression level detected in blood, followed by spleen and *EaTraf6* exhibited modulated mRNA expression levels in response to the immune challenge in blood and spleen. The analysis of subcellular localization revealed that *EaTraf6* protein was predominantly localized in the cytoplasm; however, it could translocate into the nucleus upon poly (I:C) stimulation. The antiviral function of *EaTraf6* was confirmed by analyzing the expression of host antiviral genes and viral genomic RNA upon infected with viral hemorrhagic septicemia virus. Overall, these findings suggest that *EaTraf6* is a crucial immune-related gene that significantly contributes to antiviral functions in the red-spotted grouper.

PD-23

## TRAF2 of red-spotted grouper (*Epinephelus akaara*) promotes the polarization of M2 macrophages and antiviral defence.

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Tumor necrosis factor receptor-associated factor-2 (TRAF2) is an intracellular junction protein, which plays a vital role in signaling pathways that activate NF- $\kappa$ B, MAPKs, and IRFs. It is a member of TNF superfamily signalling complexes and plays an essential role in the regulation and homeostasis of immune cells. To elucidate the functions of TRAF2 in teleost fish, TRAF2 of red-spotted grouper (*Epinephelus akaara*) (*EaTraf2*) was identified, cloned and characterized. The open reading frame of *EaTraf2* was 1563bp, encoding a putative protein of 520 amino acids with a predicted molecular weight and theoretical isoelectric point of 58.67 kDa and 8.16, respectively. The pairwise sequence analysis revealed that *EaTraf2* shared 99.6% Identity and 99.5% similarity with its ortholog from *Trachinotus ovatus*. The phylogenetic analysis revealed that *EaTraf2* has a close evolutionary relationship with other fish TRAF2 orthologs. The tissue distribution expression analysis revealed that *EaTraf2* was ubiquitously expressed in all 12 examined tissues, including blood, head kidney, spleen, liver, gill, intestine, kidney, brain, muscle, skin, heart, and stomach, with highest level detected in blood and spleen. *EaTraf2* mRNA expression levels were modulated in response to the lipopolysaccharide, poly (I:C), and nervous necrosis virus stimulation in blood and spleen. The fluorescence microscopy observation revealed that *EaTraf2* protein was predominantly localized in the cytoplasm of FHM cells. The effect of *EaTraf2* on macrophage polarization was investigated by marker gene expression analysis by RT-qPCR and morphological analysis by fluorescent microscopy. Our results demonstrated that overexpression of *EaTraf2* promoted the polarization of macrophages into the anti-inflammatory M2 phenotype. Further, antiviral assays showed that overexpression of *EaTraf2* inhibited the replication of VHSV in FHM cells. Collectively, these findings suggest that *EaTraf2* plays a role in macrophage activation and antiviral immunity response in the red-spotted grouper.



PD-24

## Thioredoxin-interacting protein links oxidative stress and immune functions in yellowtail clownfish (*Amphiprion clarkii*)

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Thioredoxin-interacting protein (TXNIP) is a member of the alpha-arrestin family protein, also known as vitamin-D3-up-regulated protein-1 or thioredoxin-binding protein 2. TXNIP is the only alpha-arrestin protein that interacts and negatively regulates the function of Trx from six alpha-arrestins. In this study, we isolated the TXNIP gene from the previously constructed *A. clarkii* database (AcTXNIP) and characterized. In addition, the immune function of the AcTXNIP was evaluated using the in-vivo analysis against the *Vibrio harveyi*, Poly I:C and LPS infections, and the oxidative stress capabilities of wild-type and active site mutated AcTXNIP (C65S and C250S) were also assessed in the first time in lower vertebrates. The AcTXNIP coding sequence consisted of 1191 bp and encoded of 396 amino acids(aa) protein. The predicted molecular mass and isoelectric point of wild-type AcTXNIP were 44.1 kDa and 8.13, respectively. The predicted 3D structure comprised of 17  $\alpha$  sheets and an  $\alpha$  helix. According to the multiple sequence analysis, AcTXNIP contained the conserved arrestin\_N and arrestin\_C domains. Tissue distribution analysis revealed that AcTXNIP transcripts were ubiquitously expressed in all examined tissues and highly expressed in blood compared to other tissues. According to the immune challenge experiment, AcTXNIP transcript was significantly upregulated by Poly I:C and downregulated upon *V. harveyi* and LPS infections. Functional analyses demonstrated that nitric oxide (NO) production was significantly elevated at 18 h post-stimulation with LPS in wild-type AcTXNIP transfected murine macrophage cells (RAW 264.7). Furthermore, the cell viability was reduced considerably, and cellular oxidative stress was significantly elevated in wild-type AcTXNIP overexpressed macrophages over the H<sub>2</sub>O<sub>2</sub>-stimulation. However, mutated AcTXNIP transfected cells didn't show any significant changes against LPS or H<sub>2</sub>O<sub>2</sub> compared to the control or negatively correlated with the wild-type AcTXNIP distribution pattern. Collectively, our findings revealed that AcTXNIP is involved in innate immune responses, and active site cysteines (C65 and C250) regulate the oxidative stress of the yellowtail clownfish.

PD-25

## Genome Wide Association Study (GWAS) and Genomic Prediction for resistance to *Entereomyxum leei* in olive flounder (*Paralichthys olivaceus*)

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*Entereomyxum leei* is an intestinal myxozoan parasite of fish. This parasite leads to loss of appetite, poor food conversion rate and decreased growth characterized by emaciation and cachexia. Therefore, it causes high mortalities and significant financial losses within South Korean aquaculture industries. In this study, we focused on identifying the single nucleotide polymorphisms (SNPs) associated with *E. leei* resistance in olive flounder using GWAS. We collected intestine samples from 752 olive flounder in a naturally infected *E. leei* farm and conducted quantitative real-time PCR to check the degree of infection by absolute copies (high infection, middle infection, and low infection). In addition, we determined two kinds of log indexes using absolute copies, and spores per cell. SNP genotyping was performed using Affymetrix® Axiom® myDesign™ Array and 59,509 high quality SNPs were obtained. According to the GWAS analysis, several significant SNPs were mapped to chromosomes 1, 2, 9, 10 and 12 by the GASTON and ASReml. Heritability was estimated for both basic values and the log values which were ranged from 0.22 to 0.39. After functional annotations, it was identified that significant SNP-harboring genes were directly or indirectly associated with *E. leei* resistance pathways. Genomic prediction accuracy was estimated using several models such as GBLUP, PBLUP, Bayesian, Elasticnet, Ridge regression, Random forest, and Support vector methods with 3-fold cross-validation. Among prediction models, Random forest showed the highest range of prediction accuracy for the log value of each two indexes (0.48 to 0.52). Therefore, our results may provide the information of *E. leei* resistance SNPs which could be used for genomic selection in South Korean aquaculture.

PD-26

## Molecular characterization and detoxification of a Glutathione S-transferase omega 1 from redlip mullet (*Liza hematocheilus*)

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Xenobiotics have been defined as chemical substances in the organisms. After exposing to xenobiotics, organisms generally suffer a biotransformation process which is metabolism. Glutathione S-transferases (GSTs) are one of the most important enzymes of metabolism. GSTs have multi-functional roles which catalyze the conjugation of electrophilic substrates to glutathione or reduce hydroperoxides. In this study, we aimed to report GST omega detoxification and immune response from redlip mullet. The *in silico* analysis revealed that the full-length of cDNA was 720 bp and deduced protein was encoded with 239 amino acids encompassed thioredoxin-like superfamily domain (N-terminal domain, 3-92 aa) and C-terminal domain (106-227 aa). In addition, LhGSTO showed higher similarity and identity with GSTO1 of *Parambassis ranga* (87.9 %, 78.2 %). In tissue specific mRNA expression, the *LhGSTO* transcripts were strongly expressed in the blood. After injection of immune stimulants, *LhGSTO* mRNA upregulated by LPS at 6h, whereas, in *Lactococcus garvieae* (*L.garvieae*) treatment, highest expression level was observed in 24h. To analyze the detoxification ability of LhGSTO, recombinant vector of LhGSTO was constructed, then a disk diffusion assay was performed using the *Escherichia coli* BL21 (DE3) (*E. coli*) transformed with LhGSTO recombinant vector. According to disk diffusion assay, clearance zones were observed around all the disks treated with heavy metal. Notably, the smallest clearance zone of LhGSTO1 was observed against CdCl<sub>2</sub>. Collectively, these results suggest that LhGSTO involves in immune response and xenobiotic detoxification.

PD-27

## Molecular Delineation, Expression Profiling and Antiviral Immune Response of AclFI44L from *Amphiprion clarkii*

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Viral infection accounts for a substantial proportion of mortality and morbidity in aquaculture. Interferon-stimulated genes (ISGs) serve as the effectors to curb every step of viral replication in host cells. There are a number of ISGs such as Viperin, Mx, and protein kinase R whose antiviral functions have been well-characterized in mammals, although many other ISGs remain to be elucidated. This study has functionally characterized the interferon-induced protein 44-like (IFI44L) from *Amphiprion clarkii*, a type 1 ISGs in the IFI44 family. The AclFI44L cDNA was 1350 bp which encodes a polypeptide of 449 amino acids with a TLDc domain and an MMR\_HSR1 domain. The mRNA transcripts of *AclFI44L* showed the highest expression in peripheral blood cells ( $p < 0.01$ ) with a fold value of 596.3. Immune stimulation with polyinosinic:polycytidylic acid (poly I: C), lipopolysaccharides (LPS), and *Vibrio harvei* caused significant upregulation ( $p < 0.01$ ) in the mRNA transcripts levels at 24 h post-injection (p.i) compared to the basal level. The overexpression of AclFI44L increased the cell viability of fathead minnow (FHM) cells against a range of multiplicity of infection (MOI) of viral hemorrhagic septicemia virus (VHSV). Moreover, the overexpression of AclFI44L significantly downregulated the expression of viral transcripts ( $p < 0.05$ ) in FHM cells at 24 h and 48 h p.i. Collectively, our findings revealed the profound antiviral role of *AclFI44L* in immune responses against viral infections.

PD-28

## Identification of MAP kinase-interacting kinase 2 (*MKNK2*) from yellowtail clownfish (*Amphiprion clarkii*): insights into its molecular, transcriptional, functional properties and immune regulatory functions

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A mitogen-activated protein kinase (MAPK or MAP kinase) is a type of protein kinase-specific to the amino acids serine and threonine. These protein-coding genes regulate cellular processes such as cell growth, proliferation, and differentiation. MAP kinase-interacting serine/threonine-protein kinase 2 (MKNK2) is involved in regulating protein synthesis through phosphorylation of eukaryotic initiation factor 4E (eIF4E). In this study, MKNK2 was identified from the transcriptomic database of *Amphiprion clarkii*. AcMKNK2 contains an open reading frame of 1,425 bp, encoding 467 amino acids with the calculated isoelectric point value 6.10 pI, and molecular weight 53.25 kDa. The relative mRNA expression of AcMKNK2 was evaluated in 12 distinct tissues, with muscle tissue exhibiting the highest expression and head kidney tissue exhibiting the lowest. Furthermore, blood, gill, and head kidney tissues were used for the immunological challenge evaluation; here, stressors included lipopolysaccharide (LPS), *Vibrio harveyi* (VH), and polyinosinic:polycytidylic acid (poly(I:C)). In comparison to the other immune stimulants, blood tissue among these three tissues had a considerable expression against poly(I:C). At 24 hours, head kidney tissue demonstrated significantly positive responses against all three immune stimulants, while gill tissues strongly expressed against LPS. The AcMKNK2 protein is localized to the nucleus, according to the results of the subcellular localization. With the overexpression of AcMKNK2, an elevated Bax/Bcl-2 mRNA expression ratio was observed following exposure to H<sub>2</sub>O<sub>2</sub>. In conclusion, the obtained results suggest that AcMKNK2 plays a key mechanism in pro-apoptotic activities and immune regulatory responses in the *A. clarkii* host defense system.

PD-29

## Insight into the molecular characteristics, antioxidant properties, and immunological expression of thioredoxin-domain containing protein 12 (TXNDC12) from yellowtail clownfish (*Amphiprion clarkii*)

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Thioredoxin domain-containing protein 12 (TXNDC12) is a member of a diverse antioxidant group called the thioredoxin-like superfamily. The characteristic CXXC catalytic motif contributes to the thiol-dependent antioxidant properties of TXNDC12. Initially, the identified *TXNDC12* gene from yellowtail clownfish (*Amphiprion clarkii*) was *in silico* characterized and the immunological expression was checked. The recombinant protein rAcTXNDC12 protein was prepared and the sequence confirmed AcTXNDC12/pcDNA3.1<sup>(+)</sup> and AcTXNDC12/pEGFP-N1 constructed plasmids were transfected to the cells for the detection of the antioxidant properties and the subcellular localization in the endoplasmic reticulum. The AcTXNDC12 sequence consisted of 522 bp and encoded a protein with 173 amino acids and 19.198 kDa molecular mass. Characteristic <sup>66</sup>WCGAC<sup>70</sup> active motif and the <sup>170</sup>GDEL<sup>173</sup> signature were identified. According to the tissue distribution analysis, the highest expression of *AcTXNDC12* was observed in the brain. Immune challenge revealed a significantly higher expression of *AcTXNDC12* in blood and gill tissues upon the stimulation of polyI:C, LPS, and *Vibrio harveyi*. rAcTXNDC12 protein showed the potent turbidimetric disulfide reduction activity, ABTS decolorization antioxidant capacity, and ferric (Fe<sup>3+</sup>) ion reducing antioxidant potential (FRAP). In the cell culture-based activity assays, a significant reduction of the nitric oxide (NO) production in AcTXNDC12 overexpressed RAW 264.7 cells upon LPS stimulation was observed. Significant upregulation of redox regulatory genes such as Cat, Nrf2, Prx1, Rrm1 and downregulation of MsrA1 upon the overexpression of AcTXNDC12 in fathead minnow (FHM) cells in response to the time-dependent H<sub>2</sub>O<sub>2</sub> stress revealed the redox regulation ability of AcTXNDC12 in the cellular environment. The wound healing assay explained the tissue regeneration and cell proliferation ability enhanced by the over-expression of AcTXNDC12. Collectively, the current study revealed the antioxidant activity within the *invitro* and cellular environment, wound healing ability, and immunological properties of AcTXNDC12 to prevent pathogenic diseases in yellowtail clownfish.

PD-30

## Molecular characterization, antioxidant, and DNA protective functions of peroxiredoxin1 from yellowtail clownfish (*Amphiprion clarkii*)

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Peroxiredoxin 1 (Prdx1) is an antioxidant protein containing conserved cysteine residues naming as peroxidatic (C<sub>P</sub>) and resolving (C<sub>R</sub>) cysteines. Due to the peroxidase function of Prdx1, cells can be protected against reactive oxygen species (ROS) during oxidative stress. In the present study, the Prdx1 cDNA sequence of *Amphiprion clarkii* (AcPrdx1) was isolated and structural and functional characteristics were studied using several bioinformatic tools and functional assays respectively. AcPrdx1 consisted of 597 bp and encoded of 198 amino acids while, the molecular weight and theoretical isoelectric point were 22.1 kDa and 6.3 respectively. Insulin disulfide bond reduction and metal catalyze oxidation assays confirmed that the antioxidant and DNA protective functions of AcPrdx1 is concentration-dependent. Furthermore, LPS-induced NO production assay showed that AcPrdx1 is involved in the regulation of oxidative stress against ROS in AcPrdx1 over-expressed FHM cells. Under normal physiological conditions, *AcPrdx1* was ubiquitously expressed in all tested tissues. However, significantly higher expression was observed in the spleen followed by the head kidney, and blood. Temporal expression analysis revealed that *AcPrdx1* expression was significantly upregulated in the spleen, head-kidney, and blood after the infection of different immune stimulants such as, Poly I:C, LPS and *Vibrio harveyi*. In the spleen tissue, relative mRNA expression of *AcPrdx1* was dramatically increased up to 12 hour post infection (hpi) and then the expression decreased gradually against all three immune stimulants while, peaked expression was observed with over 2 folds at 12 hpi in the presence of *V. harveyi* and poly I:C. Relative mRNA expression of *AcPrdx1* in blood was dramatically increased upon poly I:C until 24 hpi and then reduced gradually while, significantly higher expression of *AcPrdx1* against LPS and *V. harveyi* was observed at 12 and 6 hpi respectively. Therefore, this study provides insights into the role of AcPrdx1 in immune protection against pathogenic infections and oxidative stressors in yellowtail clownfish.

PD-31

## Assessing the prediction accuracy for resistance to viral hemorrhagic septicemia virus in olive flounders

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Recent years have seen the discovery of novel beneficial mutations through genome-wide association studies (GWAS) and genomic prediction (GP) that can be employed in aquaculture to heal diseases, enhance fish condition, and boost fish production, ultimately increasing profits. Genomic prediction focuses on making predictions about phenotypes by calculating the full genetic contribution to favorable characteristics. In animal breeding, the quantity of genetic contribution is sometimes referred to as the estimated breeding value (EBV). This means that extremely precise and reliable EBV predictions can be made after identifying and evaluating all genetic components. As a result, cutting-edge statistical models and algorithms are developed to compute genomic prediction in order to raise productivity, increase statistical power, and decrease false positives. There are high mortality rates in marine and freshwater fish, notably olive flounders, are a major economic loss that can be attributed to viral hemorrhagic septicemia (VHS), which is caused by VHSV. Breeders use selective breeding strategies to boost VHSV resistance genes because of the scarcity of effective preventative measures and therapies. Previously, selective breeding and pedigree analysis were the only options for creating VHSV-resistant animals. But in this study we used genomic prediction to identify correct breeding value for VHSV resistance and compared the results using several models such as PBLUP, GBLUP, Bayesian methods, Elastic Net, Ridge Regression, and Random Forest to evaluate the progeny data. We found that GP accuracy of RF is 0.66-0.69 and GBLUP is 0.61-0.63, where the accuracy ranged from 0.53-0.68 (lowest PBLUP and highest RF). In contrast RF and GBLUP outperformed PBLUP by 12.8% and 11.7% respectively in terms of accurately predicting breeding value. Based on these findings, we propose genomic selection as a means to enhance the genetic resistance against VHSV in olive flounder aquaculture, using of advanced models which may be more effective than traditional pedigree-based approaches.



PD-32

Molecular characterization and *In silico* analysis of isoform of thioredoxin domain containing protein 9 (TXNDC9) from chub mackerel (*Scomber japonicus*)

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Thioredoxins (Trxs) are small (~20 kDa) ubiquitously distributed oxidoreductive proteins which responsible for interacting against oxidative stress in cells. The thioredoxin domain-containing protein 9 (TXNDC9) or phodusin-like protein 3 is a thioredoxin superfamily protein that bears the thioredoxin family domain while lacking the CXXC redox active motif. It can negatively impact on ATPase activity and protein folding activity. In this study TXNDC9 sequence was isolated from the previously establish *Scomber japonicas* (SjTXNDC9) database and immunological functions were characterized. According to the results, phylogenetic tree indicated that SjTXNDC9 has close evolutionary proximity with teleost among the other clades. Open reading frame (ORF) of the SjTXNDC9 consists of 669 bp and encodes for 222 amino acids. The predicted molecular weight and isoelectric point (pI) of SjTXNDC9 were 25.47 kDa and 6.47 respectively. According to the NCBI Domain analysis results, SjTXNDC9 comprise the TRX domain in its 63–175 bp positions. The SjTXNDC9 has shown a higher likelihood of localization in the cytoplasm. The tissue-specific mRNA expression profiles of SjTXNDC9 exhibited higher expression in brain followed by blood. In addition, lowest mRNA expression was observed in skin tissue. The SjTXNDC9 mRNA expression levels in blood tissue were significantly increased after injection of Polyinosinic:polycytidylic acid (Poly I:C) and lipopolysaccharide (LPS) immune stimulants. In conclusion, the obtained results suggest SjTXNDC9 plays a major role in maintaining host immunity and cellular homeostasis.

PD-33

### Quantitative evaluation of the viability of *Miamiensis avidus*

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*Miamiensis avidus* is known to cause scuticociliatosis in cultured olive flounders (*Paralichthys olivaceus*), resulting in serious economic losses in the aquaculture industry of Korea. Quantitatively assessing the viability of *M. avidus* is imperative for the development of effective vaccines or chemotherapeutic agents against this pathogen. In the present study, a colorimetric assay utilizing WST-1 reduction was applied to precisely quantify the viability of *M. avidus*. Further investigation to determine the impact of protease inhibitors on the viability of *M. avidus* using the assay was conducted. The assay showed a conspicuous difference in optical density (OD) among samples containing over 10<sup>4</sup> ciliates. Particularly, the metalloprotease inhibitors 1,10-phenanthroline and ethylenediaminetetraacetic acid (EDTA) substantially reduced *M. avidus* viability by more than 90% when applied at concentrations of 5 mM and 100  $\mu$ M, respectively. Interestingly, exposure to these two inhibitors elicited distinct morphological changes in the parasite. These findings indicate that the WST-1 assay is a simple and reliable method to quantify the viability of *M. avidus*. Additionally, the study suggests the possibility of metalloproteases as targets for the development of agents and vaccines to effectively control *M. avidus* infections.

PD-34

## Analysis of serotype and antibiotic resistance gene of *Streptococcus parauberis* isolated from cultured olive flounder (*Paralichthys olivaceus*) in Jeju in 2023

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In 2022, the total production of farmed fish in South Korea reached 90,545 tons, with olive flounder (*Paralichthys olivaceus*) accounts for 50.6% of aquaculture industry and is an important fish species in South Korean aquaculture industry. Bacterial diseases that cause disease in olive flounder include streptococcosis, vibriosis, and edwardsiellosis. Among streptococcosis, *Streptococcus parauberis* was identified as the causative agent causing serious economic losses in farmed olive flounder. *S. parauberis* has been classified into three serotypes. In this study, *S. parauberis* strains collected from cultured olive flounder in Jeju Island from January to August 2023. Serotyping of 91 *S. parauberis* strains were performed. Analyzed the differences in the detection of antibiotic resistance genes associated with these serotypes. A total of 91 *S. parauberis* stains isolated from olive flounder in Jeju were used in this study. The collected strains were cultured in tryptic soy broth supplemented with 2% NaCl at 28°C for 24 hours. Genomic DNA was extracted using the Higene Genomic DNA Prep Kit (Biofact, Korea). Serotyping of *S. parauberis* was performed using polymerase chain reaction (PCR) with the For-Ia F/Rev-Ia, For-Ib/Ic/Rev-Ib/Ic, and For-II/Rev-II primer sets. Analysis of antibiotic resistance genes was conducted using PCR with *erm*(B)-F/*erm*(B)-R, TMF/TMR, TSF/TSR, TETF/TBR, and *tet*(Y)-F/*tet*(Y)-R primer sets. Using serotype-specific PCR, these strains were classified into subserotype Ia (70 strains), subserotype Ib/Ic (4 strains), and serotype II (17 strains). Antibiotic resistance gene detection (*tet* (B), *tet* (M), *tet* (S), *tet* (Y), *erm* (B)) revealed that none of the three serotypes tested positive for *tet* (B) or *tet* (Y). Approximately 84.3% (59/70) of subserotype Ia isolates had *tet* (S), and 20% (14/70) had *erm* (B). In the case of subserotypes Ib/Ic, all five antibiotic resistance genes were not detected. In the case of serotype II, *tet* (S) and *erm* (B) were not detected, but *tet* (M) was detected in 88.2% (14/17).

PD-35

## CRISPR/Cas9-induced knockout of Tlr5a enhances the resistance of zebrafish larvae against *Edwardsiella piscicida* infection while attenuating over inflammation

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Toll-like receptor (TLR) is an innate immune related pattern recognition receptor, which can recognize different microbial infections. TLR5 is recognized as a bacterial flagellin receptor. Previous studies have found two types of Tlr5 receptors in most of the teleost, known as Tlr5a and Tlr5b. Some studies show Tlr5 recognize host invading flagellated bacteria and activate innate immune response. Other studies show flagellated bacteria use Tlr5 receptor to recognize and invade the host cells in mammals. However, there are little evidence about the role of Tlr5a in flagellated bacterial infections in teleost. Therefore, in the present study, we have assessed the role of Tlr5a against *Edwardsiella piscicida* (*E. piscicida*) infection by generating Tlr5a-deficient (Tlr5a<sup>-/-</sup>) knockout zebrafish using the CRISPR/Cas9 techniques. To perform this, we have investigated the survival of Tlr5a<sup>-/-</sup> zebrafish larvae upon *E. piscicida* infection. RT-qPCR was performed to *E. piscicida* infected Tlr5a<sup>-/-</sup> zebrafish larvae to unveil the behavior of *nf-kb*, pro- inflammatory cytokine, and chemokine mRNA expressions after 0, 6, 12, 24, 48 and 72 post infection (p.i.). Moreover, DCFH-DA, Sudan Black, and neutral red staining were performed to investigate the reactive oxygen species (ROS), neutrophil and macrophage generation in larvae respectively upon *E. piscicida* infection. Interestingly, survival assay result reveals that high survival and low bacterial infection in Tlr5a<sup>-/-</sup> zebrafish larvae compared to the wild type larvae. However, RT-qPCR results show reduced level of *nf-kb*, *tnf-α*, *il-6*, *il-1β*, and *il-8* expression levels in Tlr5a<sup>-/-</sup> zebrafish larvae. Staining results reveal low level of ROS, neutrophil and macrophage generation in Tlr5a<sup>-/-</sup> zebrafish larvae. Taken together our results are unveiling that Tlr5a deficiency may beneficial not only to attenuate *E. piscicida* adhesion during the infection process but also to reduce the over inflammation and cell damage by suppressing *nf-kb*, pro- inflammatory cytokine, and chemokine expressions. Therefore, Tlr5a will be a potential candidate to enhance the resistance against *E. piscicida* infection in teleost fish.

PD-36

## CRISPR/Cas9-mediated tumor necrosis factor-alpha-type I in zebrafish leads to susceptibility to *Edwardsiella piscicida* infection

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Tumor necrosis factor-alpha (TNF- $\alpha$ ) is a well-known multi-functional cytokine that belongs to the TNF superfamily member 2 (TNFSF2). It is produced by non-immune cells and immune cells. In addition to its immunological roles in innate and adaptive immunity, TNF- $\alpha$  plays an important role in normal physiological functions of immune cells such as cell differentiation, proliferation, survival, and death. In teleost fish, *tnf- $\alpha$*  paralogs were identified. Zebrafish has two *tnf- $\alpha$*  paralogs, such as; *tnf- $\alpha$ 1* and *tnf- $\alpha$ 2*. There are several *in vitro* Tnf- $\alpha$  characterized studies in fish. However, its role during infection is ambiguous. Therefore, to understand the function of Tnf- $\alpha$ 1 upon bacterial infection, we generated *tnf- $\alpha$ 1* knockout (*tnf- $\alpha$ 1*<sup>(-/-)</sup>) zebrafish using CRISPR/Cas9-mediated genome editing tool. The mutant was established with 8 bp deletion and truncated protein (55 amino acids) with a premature stop codon. The tissue distribution analysis of *tnf- $\alpha$ 1* in zebrafish showed that it is highly expressed in the spleen followed by the muscle. The downstream gene analysis in 7 days embryos of wild type (WT) and *tnf- $\alpha$ 1*<sup>(-/-)</sup> revealed that there is no significant difference in *tradd*, and *traf2* expression, and other cytokines were down-regulated. Further, we examined the mortality of WT and *tnf- $\alpha$ 1*<sup>(-/-)</sup> zebrafish in the presence of *Edwardsiella piscicida* (*E. piscicida*) at different concentrations. The mortality was observed at 5 and 6 days of post-infection (dpi) in *tnf- $\alpha$ 1* deficient fish for the high ( $1 \times 10^8$  CFU/mL) and low ( $1 \times 10^7$  CFU/mL) bacterial concentrations, respectively. The maximum mortality rate was reached at 9 (~43%) and 10 dpi (~19%), respectively, for these bacterial concentrations. The WT fish started to die at 7dpi and reached its peak mortality rate at 10 dpi for  $1 \times 10^8$  CFU/mL. Further, downstream gene analysis in *tnf- $\alpha$ 1* deficient fish showed a differential expression pattern compared to wild-type fish. Overall, our findings suggest that Tnf- $\alpha$ 1 plays a part in zebrafish antibacterial immunity.

PD-37

## Molecular characterization and transcriptional expression profiling of E3 ubiquitin/ISG15 ligase TRIM25-like isoform X1 from *Amphiprion clarkii*

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TRIM25 is a member of the Tripartite motif (TRIM) protein family which play an important role in antiviral innate immunity via activating the RIG-I mediated signaling pathways. Furthermore, TRIM family members possess E3 ubiquitin ligase activity and mediate various cellular processes including cell growth, development, differentiation, cancer, and innate immune responses. In this study, TRIM25-like isoform X1 from *Amphiprion clarkii* (AcTRIM25X1) was cloned and studied at molecular and transcriptional levels. The ORF region of *AcTRIM25X1* contains 2418 basepairs, encoding 805 amino acids with 89.11 kDa molecular weight. The theoretical *pI* was 8.14 and it lacks a signal peptide. AcTRIM25X1 comprises N terminal RING domain, B-BOX domain, C-Coli domain, and C-terminal PRY-SPRY domain. The RING and B-BOX domains contribute to the E3 ubiquitin ligases activity of the TRIM protein. While the C-Coli and PRY-SPRY domains mediate protein dimerization and protein-protein interactions, respectively. In pairwise sequence analysis, AcTRIM25X1 has 91.1% sequence similarity and 90.6% identity with *Amphiprion ocellaris* ortholog. The evolutionary relationship analysis unveiled that the AcTRIM25X1 clustered on the Actinopterygii branch of the vertebrate clade. In tissue distribution analysis, *AcTRIM25X1* showed ubiquitous expression in all examined naïve tissues. But, the highest expression was noticed in Gill followed by blood, skin, intestine, and brain. In the Gill tissue, the *AcTRIM25X1* expression was significantly downregulated upon all three immune stimulants such as LPS, poly(I:C), and *Vibrio harveyi* in different time points, indicating that the expression of *AcTRIM25X1* may be complexly regulated at both pre-and posttranscriptional levels. It has been reported that the mRNA level and localization of TRIMs could be changed during viral infection. Taken together, these findings suggest the role of *AcTRIM25X1* in the *A. clarkii* innate immunity.

PD-38

## Molecular characterization and expression profiling of *trim59* in red-spotted grouper (*Epinephelus akaara*)

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Trim59 is a member of the tripartite motif-containing (TRIM) proteins superfamily and is the largest subfamily among the RING-type E3 ubiquitin ligases. This study aimed to functional characterization of *Trim59* from red-spotted grouper (*Epinephelus akaara*-*Eatrim59*). *In-silico* analysis was performed using the *trim59* ORF of *E. akaara* to characterize the sequence and structure domains that are predicted to hold the functional properties to the gene. The *in-vivo* expression of *eatrim59* was analyzed in different healthy and challenged tissues of *E. akaara*. *Eatrim59* was transiently transfected to ZF4 cells. VHSV proliferation in the presence of *Eatrim59* on cells was assessed using RT-qPCR. *Eatrim59* consists of 406 amino acids with a molecular weight of 45.84 kDa and has a theoretical isoelectric point of 5.25. It is composed of a RING domain, a B-box motif, and a coiled-coil region from N to the C-terminal. It also consists of a transmembrane region at the C-terminal. Phylogenetic tree construction has clustered *Eatrim59* with Perciformes. Further, it is evolutionarily conserved with other orthologs by its RING and B-box domains, as revealed by the multiple sequence alignment. Subcellular localization analysis revealed that *Eatrim59* has localized to the endoplasmic reticulum indicating its regulatory effects upon a virus infection. Unchallenged tissue expression analysis with RT-qPCR showed the highest expression of *eatrim59* in the blood and the lowest expression in the liver. Temporal expression of *eatrim59* was analyzed against LPS, poly I:C, and Nervous Necrosis Virus (NNV) by RT-qPCR. According to the immune challenge results, the expression of *eatrim59* was significantly upregulated after being stimulated with LPS and poly I:C up to 12 hours and was gradually decreased with the time. The propagation of Viral Hemorrhagic Septicemia Virus (VHSV) was higher in the presence of *Eatrim59*. These results provide insights into the regulatory effect of *eatrim59* in the innate immune system of the red-spotted grouper and might provide a beneficial background for future research. The exploitation of the viral regulatory mechanism of *eatrim59* may suggest strategies for preventing viral diseases in aquaculture.

PD-39

## Molecular characterization, immune responses, and functional delineation of E3 ubiquitin ligase March5 from yellowtail clownfish (*Amphiprion clarkii*)

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Mitochondrial E3 ubiquitin ligase, March5 is a novel trans-membrane protein which acts as a key regulator of mitochondrial dynamics by governing the proteins Mfn2 and Drp1. Furthermore, MARCH5 negatively regulates MAVS aggregation and hamper the activation of type I interferon pathway in mammals. Thus, prevent excessive activation of immune system upon viral infections. However, immune regulatory function of March family proteins in teleost remains unknown. Therefore, present study was conducted to investigate the molecular characteristics and immune response of March5 orthologous from *Amphiprion clarkii*, which is an excellent choice in tropical aquarium trade. *A. clarkii* March5 consists of 288 amino acids with the molecular weight of 32.02 kDa and theoretical isoelectric point of 9.11 pl. Structural studies uncover that March5 consists of N-terminal RING-cysteine-histidine (CH) domain which directly regulates the ubiquitin transferring, and four C-terminal transmembrane (TM) domains. Multiple sequence alignment suggested high homology of March5 with orthologues from other taxonomic groups. The highest identity (94.4%) and similarity (95.8%) were performed with the *A. ocellaris* during the pairwise sequence alignment. The tissue distribution of unchallenged *acmarch5* was performed using quantitative reverse transcription PCR (RT-qPCR). The temporal expression of *acmarch5* in blood was evaluated after the injection of immune stimulants poly I:C, lipopolysaccharides (LPS), and *Vibrio harveyi* (VH). In the unchallenged conditions, muscle, brain, and kidney showed relatively highest expressions. During the immune challenge, all the stimulants were able to alter the expression of *acmarch5* significantly in blood. However, the highest expression was observed in poly I:C treatment at 24 h. Moreover, fluorescence images concluded that AcMarch5 localizes to the mitochondria. Together, these results suggested that AcMarch5 may have a significant role in the innate immune system of *A. clarkii*.



PD-40

## Thioredoxin domain-containing protein 17 (TXNDC17) in Chub mackerel (*Scomber japonicus*): Molecular characteristics and immune response

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All living creatures have evolved a network of interconnected tiny antioxidant molecules and enzymes to scavenge extremely reactive radicals, where the thioredoxin (Trx) systems being the most notable. Thioredoxin domain-containing protein 17 (TXNDC17) also called thioredoxin-related protein of 14 kDa or thioredoxin-like 5, is a member of the family of thioredoxin (Trx)-fold proteins as well as a conserved oxidoreductase that is widely expressed. It is also combined with thioredoxin 1 (Trx1) expression. In this study, TXNDC17 was identified and characterized from *Scomber japonicus* (*SjTXNDC17*). The open reading frame (ORF) consisted of 372 bp and 123 amino acids. The predicted molecular mass and isoelectric point of *SjTXNDC17* were 14.1 kDa and 5.71 respectively. Even though *SjTXNDC17* consists of five cysteines, only the two Cys residues in its <sup>42</sup>WCPDC<sup>46</sup> motif were redox responsive. Moreover, the phylogenetic tree revealed that *SjTXNDC17* is clustered with other teleost and is closely linked to vertebrates. The relative mRNA expression level was assessed in 12 different tissues. Results exposed the highest spatial mRNA expression of *SjTXNDC17* in the brain followed by the lowest expression in skin. Interestingly following the stimulation with the polyinosinic-polycytidylic acid (poly I:C), lipopolysaccharide (LPS), *Vibrio harveyi* (VH), and *Streptococcus iniae* (SI), *SjTXNDC17* expression in the head kidney was dramatically and time-dependently increased. In particular, there was a drastic upregulation of *SjTXNDC17* at 72 h for the stressor SI. Insulin reduction assay ensured a significant disulfide reduction with the *SjTXNDC17* concentration. These findings elucidate that the *SjTXNDC17* is involved in the immune mechanism of *Scomber japonicus* and contributes to cellular redox homeostasis.

PD-41

## Bacterial Extracellular Vesicles Isolated from *Edwardsiella piscicida*: Isolation, Characterisation, and Immunomodulatory Activities

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Extracellular vesicles (EVs) are an emerging research area among the scientific community due to their potential use as biochemical transporters. Many studies have described that bacterial EVs can be utilized to not only function as a molecule transporter but also as a modulator of immune responses, which is essential for regulating the host immune system. The present study focuses on the isolation and characterization of EVs from Gram negative bacteria *Edwardsiella piscicida* (Ep-EVs), and investigate the immune responses. Ep-EVs were isolated by ultracentrifugation method. Transmission electron microscopy results confirmed the spherical globular shape of isolated EP-EVs. The average size and zeta potential were  $85.3 \pm 1.8$  nm, and  $-8.28 \pm 0.41$  mV, respectively. SDS-PAGE results showed a number of protein bands at different molecular weights suggesting the presence of variety of proteins. Cell proliferation was observed without toxicity when treated to fathead minnow cells up to 50  $\mu\text{g/mL}$  and at 100  $\mu\text{g/mL}$  cell viability was at 100 %. Fluorescent-labeled Ep-EVs showed ample cellular internalization in FHM cells at 24 h. *In-vivo* gene expression revealed that 5 mg/fish injected group had the highest relative fold expression compared to the 10 mg/fish injected group at 6 h and 24 h post-injection for interleukin (IL)-10, 6, 8, toll-like receptor 2, 4, 5b, heat-shock protein 70, tumor necrosis factor  $\alpha$ , and myeloid differentiation primary response 88. However, in both groups, the highest relative fold values were given at 6 h post-injection time point. The above results confirm that the Ep-EVs can be successfully isolated by following the ultracentrifugation method. Moreover, it is required to investigate the immunomodulatory mechanism of Ep-EVs to use them as novel therapeutics agent in fish medicine.

PD-42

## Isolation, Characterization and Immune Modulatory Properties of Extracellular Vesicles Derived from *Streptococcus parauberis*

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Bacterial extracellular vesicles (EVs) are nanoscale structures having important role in intercellular communication and the transport of bioactive molecules. *Streptococcus parauberis*, a Gram-positive pathogenic bacterium responsible for causing Streptococcosis in fish. Our study focused on the isolation of EVs derived from *S. parauberis* (SpEVs) and the subsequent determination of their physicochemical and immunomodulatory properties in order to determine their biological functions. SpEVs were isolated by ultracentrifugation of the culture supernatant of *S. parauberis*. The SpEVs were found to contain approximately  $1.12 \pm 0.19$  mg/mL of proteins and had a particle concentration of about  $1.52 \times 10^{11} \pm 7.54 \times 10^9$  particles/mL. The average particle diameter of SpEVs measured  $168.3 \pm 6.5$  nm, with a zeta potential of  $-17.96 \pm 2.11$  mV. TEM analysis showed the spherical or oval shape of SpEVs, with distinct membrane boundaries. Furthermore, sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) results clearly revealed the presence of three well-defined protein bands upon Coomassie blue staining. We assessed the *in vitro* toxicity of SpEVs using murine macrophage RAW 264.7 cells and fat-head minnow cells (FHM) and found that SpEVs had no significant ( $p < 0.05$ ) impact on cell viability up to a concentration of 50  $\mu$ g/mL. Furthermore, we confirmed the SpEVs internalization capability in to FHM using fluorescence stained SpEVs. In terms of immune modulation, qRT-PCR results of SpEVs treated Raw264.7 cells indicated that significantly ( $p < 0.05$ ) induced the expression of pro-inflammatory genes (Il1 $\beta$ , Il6, Tnf $\alpha$ , Infa, and Inf $\beta$ ) as well as the anti-inflammatory cytokine Il10, in a concentration-dependent manner. To explore the *in vivo* immunomodulatory effects of SpEVs, we injected them intraperitoneally (IP) into adult zebrafish at doses of 5 and 10  $\mu$ g/fish. Transcriptional analysis, based on qRT-PCR, demonstrated significant ( $p < 0.05$ ) upregulation of pro-inflammatory genes (il1 $\beta$ , il6, and tnfa) as well as the anti-inflammatory gene il10 in the zebrafish kidney, in a concentration-dependent manner. In conclusion, SpEVs share characteristics with bacterial EVs and possess immunomodulatory properties, suggesting their potential applications in the field of biomedicine.

PD-43

## Immune Modulatory Properties and Proteomic Analysis of Extracellular Vesicles (EVs) Isolated from *Streptococcus parauberis* Challenged Olive Flounder (*Paralichthys olivaceus*) Plasma

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The emergence of multidrug-resistant *Streptococcus parauberis* has led to a surge in economical loss in aquaculture industry, requiring immediate attention to novel and innovative disease control methods. This research study was conducted on developing of an immunizing agent against *S. parauberis* infection, utilizing exosomes isolated from the plasma of *S. parauberis*-infected olive flounders (Sp-Exo). Initially, we assessed the *in vitro* immunomodulatory potential of Sp-Exo in murine macrophage RAW264.7 cells, comparing it to exosomes isolated from uninfected fish, (PBS-Exo). Remarkably, Sp-Exo treatment showed a significant ( $p < 0.05$ ) upregulation of pro-inflammatory genes ( $Il1\beta$ ,  $TNF\alpha$ ,  $Il6$ , and  $Isg15$ ), the anti-inflammatory cytokine  $Il10$ , along with defensins  $Def-rs2$  and  $Def-ps1$ . Additionally, *in vivo* experiments conducted on larval and adult zebrafish displayed a similar pattern of gene and protein expression associated with immune responses, featuring increased expression of pro and anti-inflammatory genes. Furthermore, these zebrafish exhibited high resistance to *S. parauberis* infection following Sp-Exo treatment compared to PBS-Exo. Proteomic analysis unveiled distinct protein expression patterns in Sp-Exo, with 16 significantly upregulated and 32 downregulated proteins ( $p < 0.05$ ). Gene ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) analysis highlighted enriched GO terms and pathways associated with complement activation, innate immune responses, and acute phase responses. String analysis delved into protein-protein interactions, revealing immune-related interactions in processes such as complement activation, acute phase responses, phospholipid efflux, and chylomicron remodeling. In conclusion, Sp-Exo demonstrated superior immunomodulatory activity and a notable capacity for resisting *S. parauberis* infection compared to PBS-Exo. This finding was further corroborated by proteomic analysis, which identified differentially expressed proteins in Sp-Exo linked to immune activation.

PD-44

## Molecular Profiling of *Edwardsiella piscicida* Infected Olive Flounder (*Paralichthys olivaceus*) Plasma Derived Extracellular Vesicles

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All living eukaryotes, prokaryotes, and cells release extracellular vesicles (EVs) as part of their normal physiology or acquired abnormalities. EVs are cell derived heterogeneous molecules (~30-1000 nm in diameter) secreted by cells into the extracellular space. They are a lipid-bound membrane structures with various biological cargo molecules, such as nucleic acids (DNA, mRNA, miRNAs), proteins, and lipids and present in various body fluids and tissues. They are important molecular vehicles in regulation of physiological and pathological processes including intercellular communication and immune regulation and also act as biomarkers for disease. Studies revealed the multifunctions of exosomes (30-150 nm), a sub type of EVs. However, sufficient experimental research related to therapeutic application on fish exosomes is still lacking. In this study, we isolated and characterized (morphology, particle size, zeta potential, and proteomics) the EVs (exosomes) from phosphate buffered saline (PBS) injected (PBS-Exo) and *Edwardsiella piscicida* challenged (Ep-Exo) olive flounder (*Paralichthys olivaceus*) plasma. High throughput sequencing was conducted for molecular characterization of exosomes and differentially expressed proteins between PBS-Exo and Ep-Exo were identified and quantified for the first time. Transmission electron microscopy results showed cup-shaped vesicles similar to previously reported EVs. In both Evs from PBS-Exo and Ep-Exo, 407 proteins were identified of which 260 were upregulated proteins (ratio  $\geq 1.2$ ,  $q < 0.05$ ) and 61 were down regulated proteins (ratio  $\leq 0.83$ ,  $q < 0.05$ ). The important proteins that significantly ( $q < 0.05$ ) up regulated was complement system components, which involve in stimulation of phagocytosis and clearance of foreign and damaged cells. This study gives deeper understanding of *E. piscicida* infection with the useful molecular information in the plasma exosomes that could be use as biomarker for early detection of the *E. piscicida* infection. Moreover, it provides deeper insight of immune defense mechanism upon the acute infection of *E. piscicida*.

PD-45

## Development and validation of cross-priming amplification combined with lateral flow assay (CPA-LFA) for the detection Koi herpesvirus (KHV)

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Koi herpesvirus (KHV) causes the highly transmissible koi herpesvirus disease (KHVD) and may result in significant economic losses the ornamental and food producing carp industry. The control and prevention of KHVD hinge on effective hygiene and biosecurity measures to avoid viral exposure, with early disease diagnosis being crucial for preventing disease spread and minimizing economic losses. Currently, suspicion of KHVD is initiated through clinical symptoms, followed by confirmation through laboratory techniques. However, laboratory diagnosis is labour- and time-consuming, and require specialized equipment and trained personnel. Therefore, in this study, we developed and validated a rapid and reliable cross-priming amplification combined with lateral flow assay (CPA-LFA) for on-site KHV diagnosis. To detect both the asian and european genotypes of KHV, primers were designed from the consensus sequence of the enlarged thymidine kinase (TK) genes. The optimized conditions for the CPA amplification system were determined as follows: the optimal amplification temperature and time were 60°C and 60 minutes, respectively, and the optimized concentrations of Mg<sup>2+</sup>, dNTPs and betaine were 4.0 mmol/L, 1.0 mmol/L and 0.5 mol/L, respectively. No cross-reactions with other fish pathogens were observed, and the limit of detection 95% (LOD<sub>95%</sub>) was determined to be at the threshold of 675.60 viral genome copies. The DSe and DSp were compared to WOA reference real-time PCR assay for positive fish samples (n=100) and negative fish samples (n=100), and the results were 92.0% and 100%, respectively. When combined with the nucleic acid strip detection technology, visual detection of KHV amplified was realized within 3-5 min following amplification. The developed CPA-LFA for KHV could be used as an appropriate diagnostic tool for on-site diagnosis.

PD-46

## Diagnostic biomarkers and models for assessing obesity in rainbow trout (*Oncorhynchus mykiss*)

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Excessive energy intake surpassing energy expenditure is the primary contributor to weight gain and obesity, a 21st-century epidemic with profound implications for public health, including its association with infectious diseases. In the context of fish farming, overfeeding not only compromises feed efficiency and increases waste and bacterial load, but also causes obesity in fish, posing significant challenges to fish health management. This study adopts receiver operating characteristic (ROC) analysis to delineate standardized ranges for key biomarkers and attempts to establish a model for obesity assessment in fish. Using a data set comprising 222 rainbow trout samples from five overfeeding experiments, we measured body mass index (BMI) alongside six serological factors. ROC curves were constructed and cut-off points were for sensitivity and specificity. Subsequently, the data set was randomly partitioned into 80% (test data) and 20% (training data), followed by comprehensive visualization, encompassing decision trees, random forests, logistic regression, K-nearest neighbors (KNN), and support vector machines (SVM). Of the biomarkers examined, four areas under the curve (AUC) values exceeding 0.8: BMI, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and triglyceride (TG), with associated cut-off values of 0.208, 333.5 U/liter, 14.5 U/liter, and 327 mg/dl, respectively. Additionally, various combinations of biomarker were employed to construct decision tree, random forest, logistic regression, KNN, and SVM models. Notably, the decision tree model, amalgamating AST, total cholesterol, and TG, exhibited superior performance metrics, including an accuracy of 0.919, a positive predictive value of 0.930, a negative predictive value of 0.910, an AUC of 0.90, a sensitivity of 0.904, and a specificity of 0.934, making it the most optimal model for obesity assessment in this context. In conclusion, our study introduces novel biomarkers and predictive models that enable precise diagnosis and effective management of obesity in aquaculture. These findings contribute to the advancement of a sustainable and health-conscious aquaculture industry, highlighting the significance of our research in the field.

PD-47

Dynamics of VHSV infection in olive flounder (*Paralichthys olivaceus*): size-dependent viral loads and temperature-mediated decay rates in seawater

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Viral hemorrhagic septicemia virus (VHSV) is among the most significant viral diseases affecting aquatic animals. While it can transmit horizontally, its associated minimal infective dose (MID) under varying fish sizes and the decay rate of VHSV in raw seawater have not been comprehensively studied. In this study, we examined the MID and dynamics of VHSV infection in immersed olive flounder of different sizes. We also assessed the potential for horizontal transmission by determining the VHSV decay rate at different water temperatures. Briefly, 11 fish were challenged to VHSV via immersion, grouped by size: 10 g and 200 g. They were subjected to viral doses ranging from 10<sup>3</sup> to 10<sup>5</sup> copies/mL for 3 hours. At 14 days post-challenge, spleen samples from all fish were analyzed to quantify VHSV levels using a quantitative PCR assay. Additionally, we monitored VHSV decay in raw seawater at 5, 10, 15, 20, and 25 °C over a period of 4 days post-inoculation (dpi), with viral titers measured using TCID<sub>50</sub>. Our findings consistently indicated that both the viral loads and infection rates in the spleen of 10 g fish surpassed those in the 200 g fish group across all administered doses. However, VHSV infection did not manifest at concentrations below 10<sup>4</sup> copies/mL for either size group. This implies that reinfection might occur in adjacent uninfected fish if VHSV concentrations in water, shed from infected specimens, exceed 10<sup>4</sup> copies/mL. The average duration for VHSV inactivation in raw seawater was observed to be: 3 dpi at 10, 15 °C, 2 dpi at 20 °C and less than 1 dpi at 25 °C. Remarkably, at lower water temperatures, VHSV decay rates were slower, indicating a significant positive correlation with stability. Consequently, our study highlights the heightened risk of VHSV infection associated with smaller fish size and colder water temperatures, emphasizing an increased threat of horizontal transmission.



PD-48

## Screening for antibacterial activity of medicinal plants and chemicals against fish pathogen

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To meet the world's growing consumption of seafood, there is growing interest in fisheries and aquaculture production as a source of high-protein meals. Over the past 10 years, Korea's salmon imports have increased approximately six-fold as 76,000 tons. However, salmon are greatly damaged by disease, and the mortality rate when infected reaches 100%. In particular, in order to successfully promote the domestic salmon farming industry, it is necessary to develop therapeutics including vaccines and treatments suited to the domestic aquatic farming environment. This study evaluated the antibacterial activity of natural products and compounds to develop treatments for infectious bacteria isolated from *Salmo salar* in Korea. As a result of investigating the therapeutic efficacy of 4 bacterial strains isolated from *S. salar* using 5 types of active ingredients for aquatic medicines and veterinary medicines, the oxytetracycline minimum inhibitory concentration (MIC) of *Aeromonas salmonicida* and *A. hydrophila* was 0.5 mg/mL, the florfenicol of *A. hydrophila* was 2 mg/mL, showing a high antibacterial effect. *Flavobacterium plurextorum* was ineffective against all chemical agents except fluemequine. The MIC of *Artemisia japonica* and *Fallopia multiflora* against *A. hydrophila* was 10 mg/mL, showing high antibacterial activity, and *Vibrio anguillarum* showed no antibacterial activity except for *Morus alba* and *Artemisia capillaris* using 8 types of native plant extracts. The MIC of extracts of *Lycium chinense*, *Gardenia jasminoides*, and *Gardenia jasminoides* for *A. salmonicida* and *F. plurextorum* were found to be 10 mg/mL.

PD-49

## Changes in vitamin D binding protein (DBP) expression in rainbow trout (*Oncorhynchus mykiss*) according to LED light

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Vitamin D Binding Protein (DBP), also known as Group-specific Component (GC), is a member of the albuminoid family and genetically the oldest among them. This includes proteins like albumin,  $\alpha$ -fetoprotein, and afamin, all of which play roles in transporting fatty acids and hormones. DBP is primarily synthesized in the liver and has a molecular weight ranging from 52 to 59 kDa. In serum, the majority of 25(OH)D is bound to DBP, accounting for 85-90%, while the remaining 10-15% is bound to albumin for transport. In humans, vitamin D is synthesized from 7-dehydrocholesterol in the skin through exposure to UVB light in the wavelength range of 270 - 320 nm. Once combined with DBP in plasma, vitamin D is rapidly absorbed by the liver. There, it is hydroxylation by enzymes like 25-hydroxylase and is subsequently secreted into the circulatory system. Metabolites of vitamin D, such as 25(OH)D and 1,25(OH)<sub>2</sub>D, exhibit a strong affinity for DBP. Unlike albumin, which has multiple low-affinity binding sites, DBP has only one binding site for all vitamin D metabolites. In addition to its role in vitamin D binding, DBP serves various functions, including actin elimination, fatty acid transport, and macrophage activation. Most fish have been known not to synthesize vitamin D in their skin, but according to a report by S.L. Pierens, there is evidence that rainbow trout can produce vitamin D in their skin when exposed to blue light in the 380 - 480 nm wavelength range. To explore the expression levels of DBP in response to light. The experimental tanks were equipped with two photoperiod conditions, either 24-hours light or 24-hours dark. Liver tissues from the rainbow trout were collected at various time points (0, 30, 60, and 90 days) following the establishment of these photoperiod conditions. Total RNA extraction and cDNA synthesis were performed. The rainbow trout DBP amino acid sequence was determined using NCBI ORF (open reading frame) finder, and specific primers were designed based on this sequence. Phylogenetic analysis compared the DBP gene sequence of rainbow trout with albumin and DBP protein sequences from various fish, mammals, reptiles, and amphibians, revealing distinct differences. To investigate the difference in DBP expression between light and darkness, real-time PCR was executed.

PD-50

## Expression analysis of biorhythm genes of rainbow trout, *Oncorhynchus mykiss* in response to the length of day

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Living organisms respond to the physical environment which is primarily driven by light from the sun. The core cyclical processes such as digestion, sleep and migration are controlled by set of genes know as circadian genes, clock/bmal, cryptochrome (cry) and period (per). Among these genes, cry protein are known to regulate the circadian rhythm through light-dependent or light-independent mechanisms in animals. The expression of circadian genes has been well studied in multicellular animals. In european seabass (*Dicentrarchus labrax*), cry gene is expressed in various tissues such as the brain, liver, and membrane. Since there has not been much research on rainbow trout, we aimed to analyze the expression pattern of cry gene in the brain of rainbow trout at various light environments. The rainbow trout that we used in the experiment was purchased from Samcheok. During the experiment, the water temperature was maintained at 12.1 °C, and the feed was supplied once a day (1% of fish weight). In order to artificially control the photoperiod, we installed it at 80 cm above the water tank using LED lighting and surrounded the water tank with a dark film to prevent the inflow and outflow of light from the outside. The experimental group and control group were set to 24 hours of light (24L), 24 hours of darkness (24D), and natural light (NL). Brain tissues of rainbow trout were collected at 0, 30, 60 and 90 days after the start of the experiment, and total RNA isolation and cDNA synthesis were performed. The whole sequence of Cry was obtained from the reverse transcribed cDNA using the total RNA of rainbow trout and a specific primer, and the amino acid sequence was obtained from the sequence of the cry using the ORF finder of NCBI. The phylogenetic tree of vertebrate cry genes was generated by neighbor-joining analysis and visualized by the Molecular Evolutionary Genetic Analysis (MEGA7) program. In addition, we determined expression levels of cry gene using quantitative real-time PCR. This study may provide evidence for the direct and indirect role of rainbow trout cry in response to various photoperiods.

PD-51

## Rainbow trout AKT1 (RAC- $\alpha$ Serine/Threonine-Protein Kinase) Expression Analysis in Response to Photoperiods

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RAC- $\alpha$  serine/threonine-protein kinase (AKT1) is one of three types of AKT kinases (e.g., AKT1, AKT2 and AKT3) and regulates vital physiological processes including metabolism, proliferation, cell survival and growth. This gene is associated by serine and threonine phosphorylation in a large range of protein substrates. AKT1 activates protein synthesis through mTORC1 pathway by phosphorylating TSC2 at Ser-939 and Thr-1462. It facilitates insulin-stimulated protein synthesis by inducing phosphorylation of 4E-BP1 and activation of RPS6KB1. Salmon consumption has increased from 38,318 tons in 2018 to 62,730 tons in 2021 in Korea. However, as salmon farming continues to fail, salmon prices are steadily rising. Rainbow trout (*Oncorhynchus mykiss*) is considered as an alternative to salmon due to unstable prices and production of salmon in Korea. Therefore, the objective of this research is to set appropriate photoperiod condition to increase the growth rate of rainbow trout while minimizing production cost and maximize yields. Light is one of the factors acting on physiological functions such as growth and sexual maturity. Manipulating photoperiod in fish can inhibit sexual maturity and promote growth, which is also helpful in terms of economic feasibility of aquaculture. Therefore, in this study, the AKT1 gene, known as a marker of protein synthesis and muscle growth was isolated and characterized from rainbow trout, *Oncorhynchus mykiss* muscle. Photoperiod experiment was conducted for 30 days and three groups were treated: natural light (NL), 24h light/ 0h dark (24L) and 0h light/ 24h dark (24D). Each tank was covered with black cloth to block external light except for natural light tank. Real-time PCR analysis was conducted to compare the relative gene expression level of AKT1 in response to different photoperiods.

PD-52

## Natural killer cell activity of splenocytes from olive flounder injected by a novel toltrazuril derivative, PK08

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Olive Flounder, a representative fish species that accounts for more than 50% of Korea's farmed fish production, is highly valuable as the most competitive export species to the world market. The myxosporean *Kudoa septempunctata* releases the proteolytic enzymes which cause a rapid softening of the muscle fibers in flounder, causing economic damage. Toltrazuril, a triazinetrione derivative, is used in chickens and turkeys for the prevention and treatment of coccidiosis. Toltrazuril exhibited significant anthelmintic activity for *Kudoa*, although it was observed to have various hematologic and histopathological toxicity in flounder. Therefore, PK08, a novel toltrazuril derivative, was developed. Natural killer (NK) cells are innate immune cells that show strong cytolytic function against physiologically stressed cells such as tumor and/or infected cells. In this experiment, natural killer cell activity was carried out in accordance with Guidance document on aquatic toxicity testing of aquatic animal drugs by the National Institute of Fisheries Science. Thirty flounder (average weight 104.1 g, average length 20.5 cm) was randomly allocated into five groups, non-treatment, 0(control), 120, 150 and 200 mg/kg. A Lactate dehydrogenase (LDH) assay was used to determine the cytotoxic activity of splenic NK cells on the YAC-1 cell line and HINAE cell in flounder (n = 3). NK cells as effector cells ( $2 \times 10^6$  /100  $\mu$ l) were mixed with YAC-1 cells and HINAE cell as target cells ( $4 \times 10^4$  /100  $\mu$ l), resulting in an effector-target ratio of 1 : 50 in the culture medium. The percentage of NK cell cytotoxicity of the flounder was significantly increased at 200 mg/kg after 30-day injection by PK08 compared with the non-treatment group. We have demonstrated the presence of natural cytotoxic cells (NCC) activity against the murine or piscine cell line YAC-1 and HINAE. In terms of the altered NK cell cytotoxicity, high concentration of PK08 (200 mg/kg) injection can cause changes in the normal performance of the immune function. .

PD-53

## Verification of protective efficacy against different viral hemorrhagic septicemia virus (VHSV) isolates belonging to genotype IVa depending on various dose-boosting immunization of rVHSV-G $\Delta$ TM in olive flounder

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Well-established reverse genetics techniques have led to the analysis of virulence mechanisms through mutation or deletion in the VHSV genome as well as vibrant research on attenuated recombinant VHSV vaccines. Single-cycle viruses, which involve the replacement or deletion of essential viral genes required for the completion of the life cycle of the virus, have been described as feasible vaccine candidates for the prevention of viral infections. In addition, replication in a single cycle in parental cells is limited, and various studies have been conducted due to these attractive characteristics that induce safe and high immunogenicity. Viral hemorrhagic septicemia virus (VHSV) is listed by the World Organization for Animal Health (WOAH) as a notifiable disease due to the causes of mass mortality in fish worldwide. VHSV isolates can be divided into four genotypes (I, II, III, and IV), with VHSV genotype IVa causing disease mainly in olive flounder in Korea. Even if VHSV isolates belong to the same genotype IVa, pathogenicity is widely distributed among the isolates. Therefore, considering cross-protection for different isolates in the development of a vaccine to control VHSV could increase the versatility of the vaccine.

In the present study, to know whether the rVHSV-G $\Delta$ TM single-cycle virus vaccine, based on the KJ2008 isolate, can lead to cross-protective efficacy against GCVP-02 isolates belonging to VHSV genotype IVa, we have conducted an immunization test in olive flounder. As a result, the rVHSV-G $\Delta$ TM single-cycle virus showed very high protective efficacy even in low-concentration prime immunization against KJ2008, while showing relatively low protective efficacy against GCVP-02 in prime immunization. However, boosting immunization with the rVHSV-G $\Delta$ TM single-cycle virus showed enhanced protective efficacy against both KJ2008 and GCVP-02 isolates. These results suggest that boosting immunization with rVHSV-G $\Delta$ TM can protect other isolates as well as could be a promising vaccine candidate to control VHSV.

PD-54

## Effect of viral hemorrhagic septicemia virus genotype II on gene expression in $\Delta$ TRAF6- *Epithelioma papulosum cyprini* (EPC) cells

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Tumor necrosis factor receptor-associated factor 6 (TRAF6) is a signaling protein that plays an important role in signal transduction and immune signaling in teleost fish during viral infections. In our previous study, the viral hemorrhagic septicemia virus genotype II (VHSV-II) didn't show any cytopathogenic effect (CPE) in EPC cells. However, we observed CPE in  $\Delta$ TRAF6-EPC cells during infection with VHSV-II. Therefore, to investigate the role of TRAF6 during viral hemorrhagic septicemia virus genotype II infection in TRAF6 knockout EPC cells, we explored the transcriptome profiles of EPC and  $\Delta$ TRAF6 cells following viral infection with VHSV-II. The differentially expressed genes (DEG) analysis demonstrated that over 2469 genes were differentially expressed in  $\Delta$ TRAF6-EPC cells in comparison to 2049 genes in EPC cells at 48 hours post infection. In addition, the number of downregulated genes in  $\Delta$ TRAF6-EPC cells was higher in comparison to downregulated genes in EPC cells. Moreover, the gene ontology analysis demonstrated that the DEGs were enriched in immune-related terms. The KEGG pathway enrichment analysis showed DEGs were significantly enriched in various immune-related pathways including RIG-I-like receptor signaling pathway, Toll-like receptor signaling pathway, MAPK signaling pathway, and Cytokine-cytokine receptor interaction pathway. The present study expands our understanding of immune mechanisms in fish and provides valuable insights into the role of TRAF6 during immune response to viral infection.

PD-55

## Antiviral effect of miR-155 on infectious hematopoietic necrosis virus (IHNV) and infectious pancreatic necrosis virus (IPNV) in *Epithelioma papulosum cyprini* (EPC) cells

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MicroRNAs (miRNA) are a small non-coding RNA molecules that consist of approximately 22 nucleotides. MiRNAs exist in plants, animals, viruses and play an important role in RNA silencing and post-transcriptional gene expression regulation. Among them, miR-155 is involved in the regulation of various immune responses that occur in organisms. In our previous study, we investigated the antiviral role of miR-155 against viral hemorrhagic septicemia virus (VHSV) and observed that miR-155 inhibited viral replication in EPC cells.

In this study, we confirmed the antiviral effect of miR-155 when *Epithelioma papulosum cyprini* (EPC) cells were infected with infectious hematopoietic necrosis virus (IHNV) and infectious pancreatic necrosis virus (IPNV). To confirm the antiviral role of miR-155, we transfected EPC cells with different concentrations (20, 40, 60, 80, 100 pmol) of miR-155 mimics and observed the cytopathogenic effect (CPE) of IHNV and IPNV (MOI 0.01 and 0.001) for 10 days. As a result, CPE appeared only in negative control cells and cells transfected with 20 pmol of miR-155 mimics. However, we didn't observe any CPE in cells transfected with mimics at a concentration of 40 pmol or higher. The supernatant was collected at 1, 3, 5 days post infection, and the virus titers were measured by plaque assay. In addition, the expression of type I interferon immune genes (Mx1 and ISG15) was determined through RT-qPCR upon transfection with miR-155 mimics. Furthermore, western blot was performed to compare viral protein expression when transfected with miR-155 mimics and infected with each virus. The whole study was based on three independent experimental replicates. Also, miR-155 target prediction indicated its potential role in regulating gene expression within the host's immune response pathway. The target prediction was performed using miRanda and Targetscan. MiR-155 can target BCL2 and CYLD genes, which are involved in the negative regulation of the RIG-I-like receptor signaling pathway. In conclusion, miR-155 can increase the expression level of immune genes and inhibit virus proliferation through regulating gene expression. These results suggest that miR-155 has an antiviral effect against IHNV and IPNV in EPC cells.



PD-56

## Optimization of viral hemorrhagic septicemia virus (VHSV) detection based on CRISPR-Cas13a system

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Viral hemorrhagic septicemia virus (VHSV) is an RNA virus that causes viral hemorrhagic septicemia, leading to high mortality during low-temperature seasons (winter and spring) and the cumulative mortality can reach 100%. Until now, specific field detection methods for VHSV have not yet been commercialized. Therefore, in this study, a diagnostic method using SHERLOCK (Specific High-Sensitivity Enzymatic Reporter unLOCKing) was optimized based on the CRISPR-Cas13a system. First, we designed 7 CRISPR-derived RNA (crRNA) targeting N and G genes, then we optimized reaction temperature, RNA reporter concentration and Cas13a RNA reporter ratio. The crRNA targeting N genes showed high specificity and fluorescence in comparison to crRNA targeting G genes. In addition, this assay could detect  $10^7$  copies/ $\mu$ L of VHSV-N *in vitro* transcribed RNA in 10 min at 37°C. Furthermore, the limit of detection and specificity of the assay was investigated with other fish RNA virus. These results suggest that the new detection method based on Cas13a could be used for early diagnosis of virus infection in aquaculture and can minimize the time and cost of detection.

PD-57

The complete mitochondrial genome of *Megalobenedenia derzhavini*  
(Monogenea: Capsalidae) infecting cultured black rockfish (*Sebastes schlegeli*)  
in Korea

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*Megalobenedenia derzhavini* is a capsalid monogenean parasites on the gills and skin of black rockfish (*Sebastes schlegeli*) in Korea. In this study, we report the complete mitochondrial genome of *M. derzhavini* (Monogenea: Capsalidae) collected from black rockfish. Parasites (n=17) were collected from 8 host fish (average total length: 31.0 cm, average body weight 488.9 g). The total genomic DNA (1 ug) was extracted from the tissue of *M. derzhavini*. Library preparation was performed with MGIEasy DNA library prep kit (MGI). Briefly, After size selection, the fragmented gDNA was end-repaired and a-tailed at 37 °C for 30 min, and 65 °C for 15 min. Indexing adapter was ligated to the ends of the DNA fragments at 23 °C for 60 min. After clean up of adapter-ligated DNA, PCR was performed to enrich those DNA fragments that have adapter molecules. The library is circularized, and then digested, followed by cleanup of circularization product. To make DNA nanoball(DNB), the library is incubated at 30 °C for 25 min using DNB enzyme. Finally, Library was quantified by QauntiFluor ssDNA System (Promega). Sequencing of the prepared DNB was conducted on the MGISEQ system (MGI) with 150 bp paired-end reads. The total length of the mitogenome was 14,235 bp, containing 12 PCGs (protein-coding genes), 22 tRNA genes, 2 rRNA genes and a D-loop control region. The total A+T content was 73.18 %, which was significantly higher than that of the C+G content (26.82 %). The PCGs sequence (9,884 bp) of *M. derzhavini* accounted for 69.4% of the total mitogenome sequence. *M. derzhavini* used ATG as the start codon in 11 PCGs, but *nad4L* were exceptions, using ATT. In addition, 2 different types of stop codons were used, TAA for *atp6*, *nad2*, *nad3*, *cox1*, *cox2*, *nad5*, *cox3*, *cytb* and TAG for *nad1*, *nad6*, *nad4L*, *nad4*, respectively. All 22 types of tRNA were discovered in our specimen, and the total tRNA sequence was confirmed to be 1,406 bp. The 16S rRNA (large subunit rRNA) sequence was 956 bp, and the 12S rRNA (small subunit rRNA) sequence was 718 bp. Based on sequences of 12 PCGs (*cox1*, *cox2*, *nad6*, *nad5*, *cox3*, *cytb*, *nad4L*, *nad4*, *atp6*, *nad2*, *nad1*, *nad3*), the phylogenetic tree of 16 other monogeneans available in GenBank was constructed by maximum likelihood method. The results showed that *M. derzhavini* forms a capsalid cluster with *Benedenia seriola*, *B. hoshinai*, *Neobenedenia melleni*.

PD-58

## Structural identification of TNFSF15 receptors (death receptor 3 and decoy receptor 3) in rock bream (*Oplegnathus fasciatus*)

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Tumor necrosis factor superfamily (TNFSF) are pleiotropic cytokines playing important roles in immune response by binding to TNF receptor superfamily (TNFRSF). TNFSF and TNFRSF interaction important roles in biological processes including proliferation, differentiation, inflammation, hematopoiesis, cell survival, cell death, cytokine production, affinity maturation and apoptosis. In general, the TNF homology domain (THD) of TNFSF interacts by binding to the extracellular cysteine-rich domain (CRD) of TNFRSF. The intracellular domain of TNFRSF can be classified into three types according to the function of the recruitment protein. There are TNFRSF (TNFR2, LT- $\beta$ R, etc.) having a TRAF interacting motif (TIM) that recruits TNF receptor-associated factor (TRAF) and TNFRSF (TNFR1, Fas, DR3, etc.) including a death domain. The decoy receptor superfamily members (DcR1, DcR2, DcR3, etc.) do not contain an intracellular signaling domain or motif and act as inhibitors of TNFSF. TNFSF15 is known to bind to death receptor 3 (DR3, TNFRSF25) and decoy receptor 3 (DcR3, TNFRSF6B) in mammals. In this study, DR3 and two isoforms of DcR3 genes were identified in rock bream. In silico analysis revealed that they are similar to those genes in other fish species and mammals. Two isoforms of DcR3 were found to be positioned in separate clusters in phylogenetic tree and located in different loci in synteny analysis. Also, we performed structural alignment (T-COFFEE) and receptor-ligand binding (HDOCK) predictions. Consequently, T-COFFEE found DcR3.1 and DcR3.2 were conserved in cysteine residue of CRD2 which directly bonds to those ligands. DR3 confirmed the conservation of CRD1 and death domains in mammals and other fish species. HDOCK also identified that TNFSF15 can bind to CRD2 of DcR3.1 and DcR3.2 via similar amino acids in THD.

PD-59

Evaluation of its protective immune potency in olive flounder (*Paralichthys olivaceus*) of chitosan microsphere-based oral vaccine against the scuticociliate parasite *Miamiensis avidus* (Ciliophora: Scuticociliatida)

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*Miamiensis avidus* (syn. *Philasterides dicentrarchi*) is a parasitic pathogen that causes scuticociliatosis, a severe and often lethal marine infection that affects marine fishes worldwide, including olive flounder (*Paralichthys olivaceus*) in Korea. This parasite infects all size groups of flounder year-round, causing recurring mortalities and huge economic losses to the Korean flounder industry each year. However, few efforts have been made to implement effective remedial measures to control this parasite. Therefore, our study sought to develop a chitosan microsphere (MS)-encapsulated inactivated vaccine (IMa+chitosan) for oral delivery (adsorbed in feed) to flounder fingerlings and assess its protective efficacy at different modalities via two *in vivo* experimental trials. Immunisation trial-1 was conducted to determine the effective concentration of antigen. Our findings indicated that an IMa+chitosan 0.05% vaccine formulation was elicited similar protective immunity (30.8%–57.1% RPS) in olive flounder against *M. avidus* at varying antigen doses (high:  $2.38 \times 10^6$  cells/fish; low:  $1.5 \times 10^5$  cells/fish), immunisation periods (2 and 5 wpv), and challenge modes (IP injection and immersion). In trial-2 validated the use of chitosan MS as an IMa antigen carrier to improve survivability (41.7% RPS) in the host by significantly ( $p < 0.05$ ) upregulating specific anti-*M. avidus* antibody titres in the fish sera and mucus of the group immunised with IMa-containing chitosan MS. In contrast, non-specific immunomodulatory effects (16.7% RPS and enhanced mucosal antibody titres) were observed in the group treated with chitosan MS without IMa. Therefore, our findings suggested that oral administration of chitosan MS (0.05%)-encapsulated IMa vaccine is a promising immunisation strategy against *M. avidus* that can protect the IMa antigen from digestive degradation, facilitates its targeted delivery to the host immune organs, and helps in orchestrating protective immune induction in olive flounder, thus controlling parasite infection.

PD-60

## Comprehensive characterization of a tandem-repeat Galectin-9 gene from sevenband grouper (*Hyporthodus septemfasciatus*)

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Grouper is widely recognized as highly a valuable cultured fish on a global scale. The susceptibility of numerous groupers to various pathogens has been documented, resulting in significant economic losses. This research paper presents a study on the transcriptome of the kidney of the sevenband grouper (*Hyporthodus septemfasciatus*) generated using next generation sequencing (NGS) technology. Furthermore, this study focuses on characterization of galectin-9 gene of sevenband grouper (SGGal-9) from the transcriptome data, and gene cloning and recombinant protein overexpression techniques were employed. Complete complementary DNA (cDNA) sequence is a total of 2005 base pairs (bp), encompassing specific regions such as the 5'-untranslated region (UTR) measuring 162 bp, the 3'-UTR measuring 829 bp, and the open reading frame (ORF) measuring 1014 bp, encoding a protein consisting of 338 amino acids (aa). SGGal-9 is characterized by the presence of two conserved carbohydrate-recognition domains (CRDs), consisting of an N-terminal CRD domain of 135 aa and a C-terminal CRD domain of 123 aa. SGGal-9 was sub-cloned into the pCold I vector. Recombinant SGGal-9 (rSGGal-9) was observed to be overexpressed with a molecular weight of approximately 34 kDa. It was expressed in a soluble form in *Escherichia coli* BL21 (DE3) and induced using 0.1 mM isopropyl- $\beta$ -D-1-thiogalactopyranoside (IPTG). Activity of rSGGal-9 was evaluated using erythrocytes from olive flounder (*Paralichthys olivaceus*) and sevenband grouper. Hemagglutination were observed at minimum concentrations of 3.125 and 12.5 ( $\mu$ g/ml), respectively. Furthermore, the aggregation effect of rSGGal-9 on different bacteria was confirmed, including *E. coli*, *Vibrio parahaemolyticus*, *Streptococcus parauberis*, *Streptococcus iniae*, *Photobacterium damselae*, and *Lactococcus garvieae*. The findings indicate that galectin-9 exhibits potential as a preventative agent for bacterial infections in sevenband grouper aquaculture.

PD-61

## Effects of *Lactobacillus* fermented brewing by-product on innate immunity, growth performance and antibacterial activity in Carp, *Cyprinus carpio*

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This study was investigated to find out the effects of fermented brewer's spent yeast as feed additives for *Cyprinus carpio*. We made feed by adding 0.1%, 0.2% and 0.5% of heat dried brewer's spent yeast (HD), freeze-dried brewer's spent yeast (FD), and freeze-dried fermented brewer's spent yeast (FF), respectively. The produced feed was fed to *Cyprinus carpio* for 3 weeks. Every 7 days of feeding, immune parameters such as ACH<sub>50</sub>, lysozyme activity, phagocyte activity (PA) and immune-related gene expression level were analyzed. The growth performance and antibacterial activity were evaluated 21 days after feeding. Both ACH<sub>50</sub> and lysozyme activity significantly increased ( $p<0.05$ ) in the experimental groups of FF 0.2% and 0.5% compared to the control group from day 7 to day 21. Additionally, PA was also significantly elevated ( $p<0.05$ ) in FF 0.5% group compared to the control group at all time points. Both IL-1 $\beta$  and TNF- $\alpha$  expression levels increased significantly ( $p<0.05$ ) in all FD and FF groups compared to the control group on day 21. Furthermore, FF 0.5% group showed significantly higher expression levels ( $p<0.05$ ) at all time points. Similarly, the expression of IL-10 also significantly increased ( $p<0.05$ ) in FF 0.2% and 0.5% group at all time points. SOD gene expression significantly increased ( $p<0.05$ ) in the FD 0.5% and all FF groups on day 14 and day 21. Among the supplemented diet groups, the highest expression level of SOD appeared in FF group. Results from a 10-day challenge experiment using *E. piscicida* showed that diets supplemented with FD and FF at all concentrations displayed higher relative survival rates (35.6%, 73.8%, 57.9%, 52.4%, 78.6% and 52.4%) compared to the control group. Furthermore, the results for growth rate and feed conversion ratio of fish fed with HD, FD, or FF for 21 days demonstrated a significant increase ( $p<0.05$ ) in the FF 0.5% supplemented diet group. Considering the results from the study, it is assumed that FF 0.5% can effectively enhance the innate immunity, growth rate and antibacterial activity of carp rather than using the waste brewer's yeast supernatant alone as a functional feed additive.

PD-62

## Development and application of quantitative detection method against *Miamiensis avidus* (Ciliophora: Scuticociliatida)

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*Miamiensis avidus*, the causative agent of scuticociliatosis, is a major pathogenic parasite that causes high mortality rates in olive flounder (*Paralichthys olivaceus*). The detection method for *M. avidus* is observing infected tissues such as the skin and gills under a microscope. However, this method requires sacrificing fish, and microscopic observation is conducted when the disease has already progressed. Therefore, to establish prevention and control measures against *M. avidus* as quickly as possible, sensitive and specific quantification methods that can detect very low levels of *M. avidus* in seawater are needed.

In this study, we developed a real-time PCR to detect *M. avidus* in culture water. Real-time PCR primers were designed using the Primer3Plus program and Primer-BLAST analysis, and were targeted at the *M. avidus* cytochrome c oxidase subunit 1 (cox1) gene (GenBank accession no. EU831221.1). A positive plasmid was prepared by cloning the cox1 gene of *M. avidus* into the pGEM T-easy vector, standard curve was created by plotting Ct values against plasmid copy numbers serially diluted 10-fold. The correlation coefficient for the log copy number and ct values of the standard plasmid showed a good linearity with  $R^2$  value of 0.9985, and was calculated the slope of -3.4146. The amplification efficiency was 96.26%, and a range of  $1.7 \times 10^1 \sim 1.7 \times 10^7$  copies of the standard plasmid was stably detected. After counting *M. avidus* at  $4 \times 10^6$  cells/mL, 10-fold serial dilutions were performed and the cox1 gene copy number of *M. avidus* was estimated through real-time PCR. The copy number of the cox1 gene of *M. avidus* was estimated to be average an 7000 copies/cell. Sensitivity and reproducibility were evaluated from samples spiked with 1, 2, 4, and 8 cells of *M. avidus* in 1 L of seawater. Detection was possible with 100% probability from 4 *M. avidus* in 1L of seawater.

To determine whether detection was possible from natural samples, seawater from a olive flounder farm tank infected with *M. avidus* was collected and analyzed. As a result of testing the flounder rearing seawater at the farm, *M. avidus* was detected in the infected tank, but not in the recovery tank and control tank. These results allow efficient monitoring of *M. avidus* in olive flounder farms without sacrificing fish.

PD-63

Anti-VHSV activity of *Cirsium japonicum* aerial parts:  
determination of the optimized extract and its efficacy in olive flounder  
*Paralichthys olivaceus*

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Traditional medicinal plants are important sources for new drug discovery. Viral hemorrhagic septicemia virus (VHSV) is the main cause for virus-related deaths in olive flounder (*Paralichthys olivaceus*) aquaculture in Korea. The current study was conducted to find the optimal extract of *Cirsium japonicum* (Japanese thistle) aerial parts for the activity against VHSV, and further study its anti-VHSV activity in olive flounder. Optimization was carried out following a 2<sup>3</sup> full-factorial extraction model, including center points. Ethanol concentration (0 or 100%), extraction temperature (25 or 85 °C), and time (5 or 10 h) were selected as the optimization variables. Center point (50% ethanol, 55 °C, 7.5 h) was triplicated in the design. The antiviral activity of the extracts was evaluated by a cytopathic effect (CPE) reduction assay in fathead minnow (FHM) cells. Cytotoxicity was evaluated by neutral red uptake after a 96-h exposure of extracts to FHM cells. The optimized extract (CJ-OE), for maximum antiviral activity, and minimum cytotoxicity, was achieved by 100% ethanol extraction at 25 °C for 10 h, showing  $4.4 \pm 2.1$  µg/mL EC<sub>50</sub> (50% effective concentration) against VHSV and  $141.3 \pm 7.9$  µg/mL CC<sub>50</sub> (50% cytotoxic concentration). The selective index (SI) of CJ-OE was 32.1. The preventive and therapeutic efficacy of CJ-OE was determined by administering to olive flounders at 10, 30 100 mg/ kg bw/ day as 1% bw/ day medicated feed. Preventive administration was done 14 days before and 7 days after intraperitoneal VHSV infection. Therapeutic administration, and the reference control, 3 mg/ kg bw/ day ribavirin, were administered 3 days before and 4 days after the infection. Preventive treatment showed 33% and 44% relative percent survival (RPS) at 10 and 30 mg/ kg bw/ day, respectively. Therapeutic treatment showed 33% RPS at both 10 and 30 mg/ kg bw/ day doses. The growth parameters, and the tested plasma biochemical parameters; alanine aminotransferase (ALT), aspartate aminotransferase (AST), and glucose, and the innate immunological parameters; lysozyme activity, and myeloperoxidase activity were checked after administering CJ-OE medicated feed for 28 days. Olive flounders were not affected up to the maximum tested dose administration, 1000 mg/ kg bw/ day. In conclusion, CJ-OE can be considered a potential candidate for VHSV prevention and treatment during outbreaks due to its high anti-VHSV activity without affecting the fish condition.



PD-64

## Effects of serotonin and melatonin on the expression of reproduction-related genes in the pituitary cells of eels (*Anguilla japonica*)

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Fish reproduction is regulated by the action of various hormones around the brain-pituitary-gonad axis. Serotonin and melatonin are hormones related to seasons and photoperiods that affect various physiological functions *in vivo*, including immune regulation and antioxidant activity. Previous studies have also suggested that the treatment of serotonin and melatonin may be involved in the regulation of fish reproduction, including the secretion of gonad-stimulating hormones and gonadal maturation. However, in the eels, the functions of melatonin and serotonin during the reproductive process have not been clearly understood.

In this study, we investigated the effects of melatonin and serotonin by culturing eel pituitary cells. After the primary culture, these cells were treated with serotonin and melatonin at low and high concentrations in the presence of GnRH (gonadotropin-releasing hormone). Afterward, RT-PCR was used to analyze the effect of these hormones on inducing mRNA expression of FSH $\beta$  (follicle stimulating hormone  $\beta$ ), LH $\beta$  (luteinizing hormone  $\beta$ ), GH (growth hormone), and SL (somatolactin), which were reproduction-related genes in the pituitary cells.

There were no significant differences in mRNA expressions of the reproduction-related genes in the cells treated with serotonin. However, the mRNA expressions of FSH $\beta$  and LH $\beta$  significantly increased in the low-concentration treatment of melatonin, and the expression of GH and SL, which were examined together, also significantly increased in the low-concentration treatment group. These results suggest that melatonin may be involved in the maturation and reproduction process of eels.

PD-65

## Elucidation of molecular and cellular mechanisms against formalin-inactivated infectious hematopoietic necrosis virus vaccine in rainbow trout (*Oncorhynchus mykiss*)

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IHNV is a viral disease that is widespread worldwide and causes serious damage in salmonid fish. In Korea, IHNV was first reported to have occurred in fry from a trout farm in Samcheok, Gangwon-do in 1990, and is still continuously detected. Vaccine development is needed to prevent IHNV, which continues to damage salmon farms in Korea. In order to better characterize the role of vaccines, it is necessary to analyze the immune response of vaccines and hosts from various perspectives. To overcome host resistance, many viruses have anti apoptotic factors. In addition, it triggers inhibition of apoptosis in the later stages of viral replication to promote viral release. Three different immunoglobulins have been reported in rainbow trout, and IgM is the first class of Ig identified in fish. Single cell RNA sequencing has recently been used in aquatic animals, allowing rapid advances in knowledge. However, the effect of vaccination on the molecular and cellular mechanisms for resistance to viruses is still insufficient in fish. Therefore, we analyzed the efficacy of formalin-inactivated vaccine against IHNV by challenge test at 6 weeks post-vaccination. To help understand the immune mechanisms of vaccines in rainbow trout, IgM+B cells (head kidney cells) and peritoneal cells were analyzed by flow cytometry at 1, 3, 7, and 14 days after vaccination. Apoptosis analysis were performed at 20 and 48 hours after IHNV infection at 6 weeks post-vaccination. Gene expression was performed in head kidney and blood at 1 and 3 days post-vaccination and at 20 and 48 hours after IHNV infection at 6 weeks post-vaccination. As a result, the vaccine group (RPS: 83.4%) showed a higher survival rate than the control group upon IHNV infection at 6 weeks after vaccination. An increase in IgM+B cells and apoptotic cells may have provided protection against IHNV infection. Gene expression analysis showed that vaccine enhanced early TH1-like immune responses. Single cell transcriptome analysis is identified various cell types such as B cells, T cells, mesenchymal stem cells, macrophages M1/M2, DCs, lymphocyte progenitor cells, and smooth muscle cells in the head kidney of rainbow trout. Most of these cells activated the immune response more than the control group. Thus, this study provided various evidence of protective efficacy against formalin inactivated IHNV vaccine.

PD-66

## Development of an early detection PCR assay for infectious haematopoietic necrosis (IHN) in salmonids

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Infectious haematopoietic necrosis (IHN) is a viral disease that significantly impacts the salmonid aquaculture industry worldwide. Given the absence of effective treatments, early and precise diagnosis becomes paramount to prevent its spread. This research was initiated to establish a more sensitive and early detection method by targeting the Nucleocapsid gene of IHNV, known for its high transcription levels during the initial infection stages. From six candidate primer sets designed around the conserved region of the IHNV gene prevalent in Korea, the most sensitive set was identified. Its detection sensitivity and specificity were then compared with the diagnostic method recommended by the World Organisation for Animal Health (WOAH), which targets the glycoprotein gene. Through blind tests among 4 experimentors, the reproducibility of our method was validated. Furthermore, when applied to monitoring 30 rainbow trout farms in Gangwon Province, our method demonstrated greater detection capabilities over the WOAH's recommended approach. This discrepancy is believed to arise from the mismatch between the primer sequences and the genetic types of IHNV found in Korea. In conclusion, the early detection method developed in this study offers enhanced sensitivity and precision, making it a promising tool for the early diagnosis of IHN in the region.

PT-1

## A study on the effect of additional resistance on engine power in towing fishing gear of a bottom trawl ship

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A bottom trawl ship is a fishing boat that catches fish living on a sea floor, The fishing gear of the ship is cast into a sea and a fishing group is caught by towing the gear in a towing direction and a towing speed. While the ship is towing a fishing gear, the net is likely to be damaged due to friction with the sea floor, accidents involving obstacles, and an increase in water resistance, as a result, the engine load is increased, which can cause engine failures. Therefore, the propulsion performance of the ship should be carefully considered when determining the size of a fishing gear. In general, when a fishing gear is towed, the hull and the gear must be moved at the same time by the power of the main engine, the effective horse power(EHP) in towing a fishing gear includes the power(EHPs) required to move the hull and the power(EHPn) required to move the gear. In the actual sea, the additional resistance due to external forces such as wind, current and wave is accompanied, and the required power is added in response to these resistance. It was known that the magnitude of these additional resistance in a rough sea condition may exceed the hull resistance value in a still water. Especially when the ship is sailing at low speed, the effects of wind and current have a great impact on the safe control of the ship. Likewise, since the towing speed of a bottom trawl ship is a low speed of 3 to 4 knots, it is thought that the effects of wind and current have a great impact on the trawl ship control, and if the reduce of ship speed and the increase of engine power due to the influence of wind and current can be identified, the safe towing power can be calculated based on a given engine output, so the appropriate size of a fishing gear can be determined. In this study, a total of 20 trawl operations were conducted for seasonal maritime research in the same research area according to the operation mode of propeller. Based on navigation data, trawl fishing data, and engine performance data were acquired during the towing fishing gear, and data of ship speed, hull resistance, fishing gear resistance, wind force and current force according to an incidence angle were estimated. The overall load for these resistance was calculated and compared with the measured engine power, and the effects of wind force and current force on the engine power were investigated.

PT-2

## Development of a safety system for Haenyeo (Korean traditional fisher women diver) using a wireless network and smart working tool

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Korea's "Haenyeo" culture, a UNESCO-recognized intangible cultural heritage, is distinguished by its traditional method of harvesting marine resources using simple tools such as "Tewak" (buoyant equipment) and "Homi" (handheld tool). Unfortunately, accidents within this culture have been on the rise, primarily attributed to the absence of safety equipment and aging workforces.

Smart Tewak is a safety management system developed for Haenyeo communities engaged in marine resource harvesting in designated maritime zones. This system has been developed to efficiently respond to safety incidents that occur during Haenyeo's underwater activities by employing two ways of transmitting emergency signals. Taking into account the traditional and unique characteristics of Haenyeo's working culture, where Haenyeo grouped together to perform underwater tasks, the system provides the primary emergency signal to nearby Smart Tewak units in case of emergencies. This primary signal includes GPS location information of the accident-occurring Tewak, which is converted into relative direction and distance data by utilizing GPS and magnetometer sensors, along with geometrical modeling. It is transmitted optically to the display and LED modules mounted on the Smart Tewak, enhancing the efficiency of swift initial rescue efforts. Simultaneously, the clustered Smart Tewak units promptly notify the control center or server of secondary emergency signals. This communication is facilitated through LoRa network technology, with multiple IDs assigned to each Smart Tewak unit, establishing a grid network infrastructure of bidirectional communication to enhance system responsiveness and communication distances.

The proposed safety management system was tested in an open sea environment, utilizing two Smart Tewak units and one control center. In this test, we confirmed that the primary and secondary accident signals were stably delivered within a distance of 1.5 km from the control center. This result demonstrates the proposed cluster system can stably establish the LoRa grid network and practically enhance Haenyeo communities' safety in urgent situations, enabling a stepwise safety management approach.

PT-3

## Basic study on the sinking material improvement for offshore small yellow croaker drift gill net fishing gear

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Due to ghost fishing gear accumulating in fishing grounds, the Offshore Small Yellow Croaker Drift Gill Net Fishing Gear operating in shallow waters is used for fishing operations. The gear is made up of 4 to 5 concrete circular weights attached to a sinker line per width. These weights (hereinafter referred to as 'sinkers') weigh approximately 1.4 to 1.5 kg in the air and are also commonly known as 'cement stones'. During fishing operations, friction occurs between the sinkers and the seafloor, causing the gear to get entangled with other types of ghost fishing gear. This gives rise to fishing operation losses, smaller catches, and increased fishing net-related maintenance costs, resulting in a loss of economic efficiency. To prevent loss and damage of the Offshore Small Yellow Croaker Drift Gill Net Fishing Gear, the sinker material was improvised in this study and 7 sea trials were conducted on the improvised Offshore Small Yellow Croaker Drift Gill Net Fishing Gear to identify and analyze the development characteristics brought about by the improvisation of the sinker material. The results are as follows. As with similar water depth and FS results, a very high correlation between changes in water depth and SFL was shown, with the 5th and 6th sea trials conducted on changes in water depth and SFL recording values of 74% and 43% respectively. A  $R^2$  value closer to 1 suggests a greater effect brought about by a change in water depth on the FS and SFL of the Small Yellow Croaker Drift Gill Net Fishing Gear with an attached floor line. A value closer to 0 would then suggest that the effect of the floor line on the FS and SFL of the Small Yellow Croaker Drift Gill Net Fishing Gear is insignificant. With regards to fishing gear replacement due to damaged Small Yellow Croaker Drift Gill Net Fishing Gear (torn nets), the improvisation showed positive results as the Small Yellow Croaker Drift Gill Net Fishing Gear with an attached floor line had a very low replacement volume of 2.4% of the total net replacement volume.

PT-4

## Analysis of risk factors for gillnet fishing in floating offshore wind farms using AHP technique

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In this study, we categorized and defined potential risk factors that could arise during gillnet fishing within a floating offshore wind farm and assessed the risk levels of these factors using the Analytic Hierarchy Process (AHP) technique. We defined the risks associated with gillnet fishing within a floating offshore wind farm as collision, snagging, and entanglement during operations. And ship navigation, ship movement during fishing operations, and fishing gear deployment were classified as the upper-level categories of risk factors that could cause these risks. Ship navigation within a floating offshore wind farm refers to the complete movement of vessels without engaging in fishing operations. Ship movement during fishing operations within a floating offshore wind farm represents the movements of ship engaged in fishing operations. The risk associated with gear deployment pertains to the location and method of deployment at varying water depths. Sub-categories were defined for each upper-level categories of risk factors. The results of the AHP analysis, conducted with 12 experts in fisheries and marine-related fields, to analyze the risk factors associated with gillnet fishing within a floating offshore wind farm, are as follows: Within gillnet fishing in a floating offshore wind farm, the highest-ranked risk factor among the upper-level risk factors was the gear deployment location, followed by ship movement during fishing operations and ship navigation. Among the sub-categories of ship navigation during fishing operations, berthing (mooring) risks were ranked highest, followed by risks during anchoring (berthing) and risks during vessel movement. For ship movement, risks during the final netting stage were ranked as the highest, followed by risks during net deployment, risks during ship movement, and risks during drifting while waiting. Among the risks associated with gear deployment, risks during bottom net deployment were ranked the highest, followed by risks during midwater net deployment and risks during surface net deployment. The integrated importance analysis revealed that the highest-risk factors for gillnet fishing within a floating offshore wind farms were associated with gear deployment locations, including surface, midwater, and bottom nets.

PT-5

## Density distribution of giant jellyfish (*Nemopilema nomurai*) using acoustic and sighting survey

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In this study, we analyzed acoustic data collected for 4 years in order to determine the distribution of giant jellyfish entering into the Korean coastal waters and compared it to the density of sighting survey. For the acoustic survey conducted in May 2020, since the Tamgu 8<sup>th</sup> was not equipped with acoustic equipment, a split beam type scientific echosounder (EK-60, Simrad, Kongsberg Maritime AS, Norway) with frequencies of 38 and 120 kHz was attached and used on the side of the survey vessel. In other research scheme, a split beam type scientific echosounder (EK-80, Simrad, Kongsberg Maritime AS, Norway) attached to the bottom of Tamgu 21<sup>st</sup>, a vessel belonging to the National Institute of Fisheries Science, was used to detect fish schools at 38, 70, 120, 200, and 333 kHz. We compared the density of giant jellyfish using acoustic survey and the results of sighting survey. The average acoustic survey density in 2020 is 184.2 ( $10^{-6}$ ind./m<sup>3</sup>), 250.0 ( $10^{-6}$ ind./m<sup>3</sup>) in 2021, 147.5 ( $10^{-6}$ ind./m<sup>3</sup>) in 2022 and 66.3 ( $10^{-6}$ ind./m<sup>3</sup>) in this year. The average distribution density of the sighting survey is 330.9 ( $10^{-6}$ ind./m<sup>3</sup>) in 2020, 1,651.0 ( $10^{-6}$ ind./m<sup>3</sup>) in 2021, 256.5 ( $10^{-6}$ ind./m<sup>3</sup>) in 2022 and 130.2 ( $10^{-6}$ ind./m<sup>3</sup>) in this year. The sighting survey was about 0.6 times higher in 2020 and 2022 compared to the acoustic survey, and more than 0.2 times in 2021 and 0.5 times in 2023 this year. Both hydro-acoustic and sighting survey results showed an increasing trend in the distribution density of jellyfish from 2020 to 2021. However, starting in 2022, its distributed density showed a tendency to gradually decrease, and in 2023, it showed the lowest distribution density in all surveys.



PT-6

## Species composition and community structure of aquatic organisms caught by the shrimp dredge in Gomso Bay, Jeollabuk-do

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Since commercial fishing of *Anguilla Japonica* and *Acetes japonicus* is actively carried out in the No-Take Zone of Gomso Bay, complaints from local fishermen about the validity of setting the prohibition period applied to the area are increasing. Therefore, in order to solve this problem, the purpose of this study is to identify the species composition and community structure of aquatic organisms living in the No-Take Zone of Gomso Bay and use them as basic data to verify the feasibility of establishing a No-Take Zone. This study was conducted a total of 12 times, once a month from January to December 2022, and the fishing gear used was a shrimp dredge, which is a type of dredge among dragged gears. For the fishing test survey, four stations were set inside the No-Take Zone in Gomso Bay, and 20 minutes were towed for each stations. During the survey period, a total of 56 species, 2,130,564 fish, and 45,262g of aquatic organisms were caught. Among them, fish were the most numerous with 37 species, followed by 15 species of crustaceans, 2 species of shellfish, and 1 species of cephalopod. As for the catch population ratio by species, *Acetes japonicus* accounted for 97.6% of the total population, followed by *Thrysa chefuensis* (2.0%), *Mugil cephalus*, *Leiognathus nuchalis*, and *Sardinella zunasi* accounted for 0.1% each. As a result of the community structure analysis, the species diversity index was in the range of 0.012-0.7753, the highest in April and lowest in June. The evenness index was in the range of 0.005-0.4264, the highest in August and lowest in June. The richness index was in the range of 0.3822-2.0392, the highest in December and lowest in August. The dominance index was in the range of 0.9173-0.9998, the highest in August and lowest in March.

PT-7

## Domestic market and assembly status of gillnet fishing gear

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Offshore gillnets account for 15.7% of 373 out of a total 2,372 offshore fishing boats, and coastal gillnets account for 33.2% of 12,170 out of the total 36,694 coastal fishing boats (Statistics Korea, 2021). The proportion of fishing gear costs in offshore and coastal net fishing was 14.7% and 15.7%, respectively, which was the highest compared to other fisheries. According to a gillnet fishing gear manufacturer, the largest portion of the use is swimming crab, small yellow croaker, and snow crab gillnets. Depending on the tonnage of the vessel, the swimming crab gillnet fishery uses 500~3,000 widths per vessel per year, the small yellow croaker gillnet fishery use about 3,000 widths per vessel, and snow crab gillnet fishery use 300~1,000 widths per vessel. Gillnet fishing gear generally consists of netting, float line, and sinker line, and has various types of finished nets depending on the species caught and fishing method, and each fisherman has a different preferred fishing gear configuration.

The production of gillnet fishing gear goes through the following steps: fishing net (net) → assembly process → fishing gear (finished net). The assembly process involves repeatedly tying float and sinker to the rope and tying them to the rope tied to the gillnet. Currently, gillnet fishing gear assembly methods include manual assembly and semi-automatic assembly, and most of them are manual assembly. Manual assembly is a method of threading the binding of the float and sinker with a needle, and is tighten by winding the needle bar more than four times. Semi-automatic assembly is a form of replacing needle-based binding work using an industrial sewing machine. For both methods, production efficiency and quality vary depending on the skill of the assembler, and mass production is not possible due to the low production volume per unit time. More than 95% of domestic gillnet fishing gear is imported from China and Vietnam due to the rise in domestic raw material and labor costs. The import price is about 35,000 won and the domestic price is about 50,000 won. As the price of Chinese fishing gear has recently risen and domestic production of biodegradable fishing gear has become regulated, there is an urgent need to expand domestic production facilities and reduce production costs.

PT-8

## Test survey using a broadband echo sounder and bottom trawl to examine acoustical species identification technique

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Recently, with the development of acoustic systems and analysis theory, acoustic resource surveys using broadband acoustic systems and fish species identification research on target organisms are attracting attention, moving away from acoustic resource surveys using existing narrow-band acoustic systems. In this study, a bottom trawl survey and acoustic data collection using a broadband scientific echo sounder were carried out to test the availability of acoustic fish species identification techniques. The test survey was conducted in September 2022 and April 2023 using the Sae Hae Rim (T/S, 2996 G/T) of Kunsan National University. The sound system used for the sound survey was a split beam type scientific fish finder (EK80, Simard, Norway). Acoustic data were collected for 18, 38, 70, 120, 200, and 333 kHz, and information on target organisms was collected using bottom trawls for the catch survey. The acoustic data was collected using broadband mode during the bottom trawl survey. The towing duration of bottom trawl was about 20 minutes and the towing speed was about 3 knots. In the first survey in September 2022, a total of three survey tracks were set and surveyed. As a result of the catch survey for track #1, the most dominant fish species was the beka squid (29.3%), cutlassfish and beka squid (24.4%) at track #2, and the cubed snailfish (38.1%) at track #3. In the second survey conducted in April 2023, two tracks were set and surveyed, and the most dominant species at track #1 was the sand crab (29.6%) and skate (42.8%) at track #2. As a results, the broadband acoustic scattering pattern of individual echoes, experimentally extracted from the acoustic data obtained during trawl surveys, showed a very complicated patterns with many lobes and nulls repeated. In order to identify fish species acoustically, it is necessary to develop a verification technique and investigate much more information on the broadband acoustic scattering characteristics of the shore fishes in South Korea.

PT-9

## Understanding the seasonal status of fisheries resource in the East China Sea by using bottom trawl

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The East China Sea is rich in nutrients and food organisms with various water masses formed in each sea area, and is a good environment for marine resources to live in, and is used as a spawning and breeding ground for migratory fish species. However, fisheries resources are decreasing in the East China Sea due to changes in fishing grounds due to rising water temperatures due to global warming and a decrease in resources due to illegal overfishing from each fishing boats. This study investigated the composition and density of fishery resources using bottom trawl in the East China Sea in April, July, August, and November 2022. The average density of fishery resources was estimated using the Swept Area method, and marine environmental data in the survey area was collected using CTD. As a result, the seasonal distribution of water temperature in the East China Sea was 11.9 ~ 14.5 °C in April, 13.0 ~ 23.2 °C in July, 13.9 ~ 24.4 °C in August, and 13.0 ~ 23.2 °C in November. Additionally, 35 species were collected in the East China Sea. These included 21 species of fish, 6 species of crustaceans, 6 species of cephalopods, and 2 species of echinoderms. The dominant species by taxonomic group ranged from crustaceans to *Ovalipes punctatus*, with 394 individuals (74.1%) appearing. The dominant species of cephalopods was the *Lolius japonica*, with 18 individuals (39.1%), and the dominant species of fish was the *Trachurus japonicus*, with 173 individuals (38.4%). Seasonally, the average density of crustacean individuals per unit area were highest in November at 692.1 (inds./km<sup>2</sup>), and the average density of cephalopods individuals per unit area were highest in August at 39.4 (inds./km<sup>2</sup>). The average density of fish individuals per unit area were highest in August at 355.0 (inds./km<sup>2</sup>). The average biomass density per unit area of crustaceans was highest in November at 29,597.0 (g/km<sup>2</sup>), and the average biomass density per unit area of cephalopods was highest in August at 3,399.8 (g/km<sup>2</sup>). The average biomass density per unit area of fish was highest in August at 23,798.0 (g/km<sup>2</sup>).

PT-10

## Development of poly (butylene adipate-co-butylene succinate-co-ethylene adipate-co-ethylene succinate) (PBEAS) net twine as biodegradable fishing gear

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Nylon fishing nets have excellent strength and durability, but when lost at sea, their insufficient decomposition destroys habitats and spawning grounds, and pollutes the marine environment. This led to the development of poly(butylene succinate) (PBS) resin for biodegradable fishing gear based on aliphatic fibers. Prompted by the low stiffness and elastic recovery of PBS, we introduced two additional components into the molecular structure of PBS: adipic acid and ethylene glycol. These two new components were combined with succinic acid and 1,4-butanediol, the existing components of PBS, to synthesize poly(butylene adipate-co-butylene succinate-co-ethylene adipate-co-ethylene succinate) (PBEAS) resin via esterification and polycondensation reactions of a quaternary aliphatic copolyester. Although the molecular weight and molecular weight distribution of PBEAS are similar to those of PBS, it has excellent tensile strength, stiffness, elastic recovery, and biodegradability, with a low melting point for good production efficiency. These improvements are expected to allow PBEAS resin to be applied to gill nets for fish that require high stiffness, thereby expanding the use of biodegradable fishing gear.

PT-11

## The comparison of catch performance of available fish species with different net height for trawl net

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Two research vessels have been conducting survey trawl for demersal fish assessment in waters ranging from 60 to 230 m deep in the Sea. These vessels use trawl nets of the same design, but details including buoyancy and weight are adjusted for each vessel. It is known that the scope ratio, which is the ratio between length of warp line released to the depth of water in which a trawl is operated, changed the trawl net shape and consequently catch result. It is therefore important to understand the change in net shape by depth (scope ratio) especially for survey trawl gear. We compared shapes and catches of two trawl nets having differing headrope and groundrope configurations from paired tow data collected by two research vessels from 7 years. Vertical opening of the net was significantly higher in net which employed a headrope kite in the paired data ( $p < 0.01$ ) than net which used floats on the headrope, while horizontal opening of the net was significantly wider in net which used floats than net which employed a headrope kite. Net which employed headrope kite captured largehead hairtail *Trichiurus lepturus* more in paired data when either or both the vertical and horizontal openings of the net which employed a headrope kite increased and the horizontal opening of the net which used floats on the headrope decreased according to the GLM analysis. Catch of blackthroat seaperch *Doederleinia berycoides* was more influenced by the horizontal opening of the net.

PT-12

## Fishing operation characteristics of coastal composite fishing vessels exclusive to long arm octopus (*Octopus minor*) fishing in Korea

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Longline fishing for *octopus minor* is mainly carried out on vessels with a gross tonnage of around 1 ton on the southwestern coast of Korea. The fishing period is from February to June and from August to December. Since the work on board is done by one person, one may be exposed to various types of marine accidents. However, it is difficult to find previous studies on marine accidents involving longline vessels of *octopus minor*. Accordingly, the authors of this paper investigated and analyzed the fishing patterns of longline vessels of *octopus minor*, whose home ports were Muan and Mokpo, during the fishing period in November 2022 with the goal of collecting basic data on identifying potential marine accident risk factors on *octopus minor* fishing vessels. To investigate fishing patterns, an inertial measurement unit, IMU 06 (Race Technology Ltd., UK) equipped with GPS was used.

The minimum, maximum, and average time spent in the operation for one day was 3.8, 9.3, and 8.5 hours in Muan, and 9.7, 11.3, and 10.5 hours in Mokpo, respectively. It was found that they were engaged in fishing for more than 8 hours a day. In terms of the minimum, maximum, and average time spent sailing from the home port to the fishing ground, waiting, fishing operation in the fishing ground, and sailing to the home port, it was found to be 3.3, 7.3 and 5.1(1.0%), 276.6, 0.0 and 170(33.5%), 205.2, 462.9 and 321.5(63.4%), 8.2, 16.5 and 11.1(2.2%) in Muan, and 17.6, 80.0 and 39.6(6.3%), 282.8, 462.9 and 399.7(63.6%), 121.0, 199.6 and 168.4(26.8%), 20.1, 21.2 and 20.8(3.3%) minutes in Mokpo, respectively.

Since there is a tendency to go out to fish at the same time at sunset and return to port after retrieving fishing gear at sunrise, it seems necessary for ships entering or leaving the port to be careful about small fishing boats during this time. In addition, they tend to sail at high speeds of 25 to 30 knots or more, so they are considered to be exposed to collisions and strandings. Most of all, there is a waiting time of 3 to 6 hours at the fishing grounds, but due to the narrow and uncomfortable space and pitch and roll of the ship, they are difficult to get quality rest. In the future, we will investigate marine accidents related to these fishing boats and propose accident reduction measures that can contribute to the safe operation of one person in a fishing vessel.

PT-13

## A study on the marine mammal bycatch reduction based on buoy material in coastal trap fishery

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Research on marine mammal bycatch reduction has been ongoing at the National Institute of Fisheries Science. In particular, research on trawls, gillnets, purse seines, and set nets is ongoing, and research on longline fishing is also being conducted. Tension-maintaining buoy line system was designed to reduce marine mammal bycatch in the red crab trap fishery, and the study was conducted by applying the concept that high stiffness buoy line system in the trap fishery makes it difficult to catch marine mammals.

In this study, four different materials and shapes were designed and tested to reduce marine mammal entanglements in the coastal trap fishery by maintaining a high stiffness of the buoy line underwater, even at waves and currents. At sea, the tension of the designed buoy line systems was compared with each buoy line systems using an underwater tension meter.

Through material-specific sea experiment, obtained and analyzed test data on marine mammal bycatch prevention to identify suitable materials for buoy lines in coastal trap fisheries.



PT-14

## Stock assessment of small yellow croaker caught by multiple fisheries in Korean waters

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Small yellow croaker, one of the major fish species caught in Korean waters, has undergone significant changes in its fishing gears over the years. Before 2000, it was primarily caught by the large pair trawl and stow net fisheries. However, since 2000, the proportion of small yellow croaker caught by the gill net fishery has steadily increased. Currently, over 80% of the catch is attributed to both gill net and stow net fisheries. It is necessary to consider both of these fisheries together when assessing the stock status of small yellow croaker. In this study, the length data of small yellow croaker collected from the two fisheries from 2020 to 2022 were used to estimate the coefficient of total mortality ( $Z$ ) and the age at first capture ( $t_c$ ) of small yellow croaker using Pauly method (Pauly, 1984). The  $Z$  and  $t_c$  were estimated to be 1.11/year and 1.55 years, respectively, and the coefficient of fishing mortality ( $F$ ) was 0.67/year by subtracting the natural mortality ( $M=0.41$ /year) from  $Z$ . From the yield per recruit (YPR) model, under the current  $F$  (0.67/year) and  $t_c$  (1.55 years), the YPR was approximately 43 g which is lower than  $F_{\max}$  (0.75/year) and higher than  $F_{0.1}$  (0.52/year). Keeping the age at first capture and adjusting the  $F$  level does not result in significant changes, while YPR of 47 g can be achieved by increasing  $t_c$  from the current level to 2.5 years under the current fishing level. From the spawning biomass per recruit (SBPR) model, under the current level of  $F$  and  $t_c$ , the SBPR was about 16% of the virgin spawning biomass (when  $F=0$ ). Therefore, to reach  $SB_{40\%}$ , it needs to be reduced the fishing intensity up to below 0.3/year from the current level.

PT-15

## Underwater stability according to the shape of giant octopus pots on the east coastal sea in Korea

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The giant octopus (*Enteroctopus dofleini*) is one of the important fish resources along with snow crab in the east coastal sea of Korea. The giant octopus is most commonly caught by net pot. In the pot fishery for giant octopus, the shape and size of the pots vary depending on the region and there are also differences in the usage of pots.

In this study, water tank experiments were conducted to determine the underwater stability of each type of pot used to catch giant octopuses in the East Sea of Korea.

The underwater resistance and underwater behavior of three types of experimental pots caught for octopus in the east sea were investigated: drum type pot, square type pot, and cylindrical type pot.

The experiment used the NIFS's circulation water tank (25m × 4m × 1.4m, L × W × D / 280ton). Tank experiments were conducted with five interval flow speeds (0kt, 0.5kt, 1.0kt, 1.5 kt, 2.0kt, 2.5kt) and underwater fluid resistance and behavior of the pot were investigated in the water tank. We investigated pot behavior according to four attack angles on the flow speeds.

The experiments were performed 5 times for each element, and the underwater resistance was measured by connecting an underwater load cell with a capacity of 10kgf (SMM10k, senstech, co., Korea) to an amplifier (AM-310, senstech, co., Korea), and data were obtained through a PC.

As a result of the test, each pot was positioned horizontally with respect to the flow when the flow speed exceeded 0.5kt. The fluid resistance of the drum type pot was 0.128±0.02kgf at a flow speed of 0.5kt, 7.040±0.04kgf (2.5kt) at a flow speed of 2.5kt, and the fluid resistance of the square pot was 0.177±0.01kgf at a flow speed of 0.5kt, and 7.163±0.03 at a flow speed of 2.5kt. kgf (2.5kt), the cylindrical type pot showed 0.183±0.07kgf at a flow speed of 0.5kt, and 7.658±0.05kgf (2.5kt) at a flow speed of 2.5kt.

The underwater tension according to the flow speed was higher for the cylindrical type pot than for other pots, and the drum type pot showed the lowest tension.

PT-16

## A study on the conger eel (*Conger myriaster*) catching mechanism according to the shape of the hook in longline shapes and sizes

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In this study, we analyze the catch mechanism in accordance with the shape of the fishing hook in the longline fishery and collect basic data that can reduce the bycatch of small size fish. The longline fishery has a high bycatch rate of small size fish due to the use of baits. In addition, the hook shapes and sizes affect to catch size.

In this study, the tank experiments were conducted with two types of hook shapes ('J' shape and circle shape) and three barb types (inline, offset, hangnail) for verifying fish behaviors and catch mechanism

Experiments were conducted with a rectangular tank(1.1m×0.6m×0.6m, W×D×H) and the experimental individuals used 10 conger eel (*Conger myriaster*) which is the target species of longline in the coastal sea of Korea. Fish behaviors were recorded by the memory 3-axis acceleration sensor (WT901SDCL, Witmotion) connected to the line, and the hook and catch process was recorded by two cameras (Gopro8, Gopro) set at the top and front of the experimental tank. Behaviors were classified and nine patterns for verifying the catch mechanism.

In this study, We found the shape and barb's angle of the fishing hook affect the catching performance in a longline fishery. To change the shape and barb type of hook effect for reducing small size fish and non-target species in longline fishery through these results of tank experiments. Therefore, the result of this study will contribute to realizing a sustainable longline fishery.

PT-17

## Characterization of seawater sterilizers using carbon nanotube fiber UV lamps

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Seawater sterilizers using UV lamps are used in land-based fish farms to control water quality. General UV lamps have a short lifespan of 5000 hours, and it is difficult to emit high-powered light. Therefore, it is necessary to develop a long-life and high-powered UV lamp and to develop a seawater sterilization device using it.

In this study, we compared the optical properties of UV lamps using carbon nanotube fibers (CNTF) and ordinary UV lamps, and designed a seawater sterilization device using CNTF UV lamps and analyzed the flow characteristics.

The optical efficiency of CNTF UV lamps was 1.4 times higher than that of ordinary lamps, and the optical efficiency could be increased by more than 50% by applying an aluminum reflector to the seawater sterilization device.

Through this study, we aimed to provide basic data for the development of a long-life, high-efficiency seawater sterilization device using CNTF UV lamps.

PT-18

## A study on the estimation of the catch of large purse seine boat by combining AIS data and TAC catch data

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Out of Korea's total production of 887,239 tons of offshore fishing and fisheries products in 2022, large purse seine fishing accounted for 18% of 161,854 tons. One fleet of large purse seine fishing usually consists of one main boat, two light boats, and three carrier, a total of six boats. The main target fish species are mackerel and horse mackerel, and are subject to Total Allowable Catch (TAC). Research purpose is estimating the catch amount of the large purse seine fishing boat by combining the trajectory data and the TAC catch data. We requested the Korea Fisheries Resources Resoources Agency to collect data on the consignment amount of mackerel and horse mackerel by date and by consignment site of large purse seine fishing from July 2019 to August 2022. Data on the amount of consignment include the date of consignment, the name of the consignment, the species of consignment fish, fishing boat number, and catch amount. The Automatic Identification System(AIS) receiver installed near the summit of Jeju National University and Halla Mountain collected the AIS data of purse seine fishing boat. The AIS data includes the boat's resources, MMSI number, location of the boat, and speed of the boat. For information on the fleet of large purse seine fishing boats, refer to the list of fishing boats registered in the large purse seine Fishheries cooperative. The list of fishing boats includes the name of the fleet, the fishing permit number, the clarity of each fleet, the fishing boat number, and the main dimensions. Using Python's folium library, all the ship locations of the received AIS data were connected by lines. At this time, the casting net and the hauling net were distinguished through the navigation pattern and the speed of the ship. Labeling was conducted to distinguish between the start and end of the casting net and the start and end of the hauling net. The ships belonging to the same fleet were expressed to analyze of each ship at the same time. If the main boat and light boat move the same at a certain distance. or if the light boat is gathering the fish from the fishing ground, it was confirmed that the main boat came and cating the net. After the cating net, the carrier approached the main boat and proceeded with the hauling net together. After the completion of hauling the carrier moved to the port and consignment sale.

PM-1

## Changes in the cultural environment after the introduction of the rack oyster farms in tidal flat

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Tidal flat, one of the most productive areas, has been exploited for fisheries, especially aquaculture. The tidal flat fisheries were stagnant with population decline, and now they are growing for a profitable industry coupled with mechanization and automation. Among cultural bivalves, cultchless oyster culture is one of the most promising species in a tidal flat. Considering the geographical features of the cultural ground for oyster rack culture, primarily held in closed waters, it is necessary to control the cultural intensity less than environmental capacity. The study aimed to give insight into environmental changes after introducing oyster rack culture at closed tidal flats. The study was carried out in April. 2011 to April. 2018, and the culture system (about 1 ha) was introduced into tidal flats in 2015. After oyster culture, nitrogen and phosphate sources tended to decrease with higher fluctuation, directly connected to the decline of primary production. However, increased COD and AVS were attributed to the increased sedimentation from oyster farms. Our result indicated that the increased grazing forces facilitate nutrient recycling, but the land-source nutrient load shortage limits cultural capacity. Furthermore, augmented sedimentation could accelerate the self-deterioration of oyster farms.

PM-2

## the Korean Peninsula

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Assimineids are minute and amphibious snails, inhabiting the temperate and tropical areas of the world. They are known for exhibiting wide habitat preferences like brackish waters, estuaries, seashores, and terrestrial environments. There are ten species in five genera in South Korea so far. The specimens were collected from river estuaries and the upper inter-tidal zone of the West and South Sea and Jeju islands of the Republic of Korea. We identified two unrecorded species of Assimineidae in the Korean Peninsula through morphological characteristics and DNA barcoding. In this study, the morphological diagnoses, photographs, and phylogenetic tree of the species are provided.

PM-3

### Characterization of a novel protist belonging to the Mesomycetozoea class isolated from Manila clam, *Ruditapes philippinarum*

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The west coast of Korea is renowned for its extensive tidal flats, providing an ideal habitat for the cultivation of a diverse range of molluscan species. This region holds particular significance for local shellfish industries, notably the Manila clam, *Ruditapes philippinarum*. The unique environmental conditions, diverse aquatic ecosystem, and geological location of the west coast make it a prime area for investigating microorganisms. Notable microorganisms isolated from the Manila clam in this region include *Perkinsus olseni*, *Cercaria tapetis*, *Parvatrema duboisi*, and *Thraustochytriaceae* sp. The presence of these parasites and other environmental factors has led to a decline in Manila clam production, significantly impacting the aquaculture industries. In this study, we present the isolation, morphological characterization, and genetic analysis of a previously undiscovered protist species within the Mesomycetozoea class, obtained from Manila clam (*R. philippinarum*) samples collected from the west coast of Korea. A partial sequence of 18S rDNA sequence (1,503 bp) was retrieved from basic molecular biology techniques, and characterized bioinformatically. Multiple sequence alignment analysis was conducted with homologous sequences revealing three mutations and 2 deletions at the nucleotide level. The percentage of identity was 99.7% with the highly homologous DNA sequence of *Ichthyosporea* sp. available in the NCBI. Phylogenetic analysis was performed using the Geneious Prime 2023.1.2 software, revealing that the newly isolated protist belonged to a separate clade near to Dermocystida group of the Mesomycetozoea family. Morphological features were examined under a light microscope and scanning electron microscope, and observed closely resembled features compared to other members of the Mesomycetozoea family. This discovery contributes to our understanding of the diversity within the Mesomycetozoea class and sheds light on the evolutionary relationships within the Dermocystida group. Further research is warranted to explore the ecological roles and potential pathogenicity of this newly identified protist species.



PM-4

## Expression of biomarker genes related to health and immunity for health assessment in *Haliotis discus hannai*

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This study was conducted to evaluate the health of *Haliotis discus hannai*. To prepare abalone samples, classification was conducted according to the size of spat and adult produced during the same period in Jindo and Wando regions. The number of abalone used in the experiment was spat(220 animals) and adult(40 animals). Size was determined as spat(3.0 cm or less, 3.5 cm or more) and adult(7.0 cm or less, 10.0 cm or more). After extracting mRNA from gill tissue of abalone spat and adult classified according to size, qRT-PCR experiment was performed. The purpose of this study is to evaluate the health level of *H. discus hannai* using biomarker genes such as stress and immunity related genes. IL3, TNF, and TRX2 were selected as biomarker genes. The results showed that biomarker genes were differentially expressed depending on the size of abalone spat and adult. These results suggest that biomarker genes may play a role in assessing health levels.

PM-5

## The complete mitochondrial genome of a chiton *Acanthochitona defilippii* (Mollusca: Polyplacophora) from South Korea

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*Acanthochitona defilippii* (Mollusca: Polyplacophora) is a common species in South Korea and can be found throughout Japan, China, and the Indo-Pacific. The complete mitochondrial genome of *A. defilippii* from Korea is characterized in this study. The circular genome is 14,991 bp long, which comprises 13 protein-coding genes (PCGs), 22 transfer RNA genes (tRNA), two ribosomal RNA genes (rRNA), and an A+T-rich region (165 bp). The base composition is as follows: A (31.41%), G (17.16%), C (12.19%), and T (39.24%). The result of phylogeny shows that *A. defilippii* was clustered with *Acanthochitona avicula* (BP 100%). Also, the family Acanthochitonidae forms a sister group with Mopaliidae within the monophyletic clade of the order Chitonida. This study will provide valuable insights into the phylogeny and evolution of Polyplacophora.

PM-6

## The complete mitochondrial genome of *Melampus sincaporensis* (Gastropoda: Ellobiidae) from South Korea

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A pulmonate snail, *Melampus sincaporensis* L. Pfeiffer, 1855 belongs to the family Ellobiidae, which dwells between stones in freshwater tidelands near the shoreline and on halophytes. With the global presence of approximately 250 species of Ellobiidae, there was no study that identified the complete mitochondrial genome of *M. sincaporensis*. Here, we first characterized the complete mitochondrial genome of *Melampus sincaporensis* (Gastropoda: Ellobiidae) in South Korea. It is 14,962 bp in total length and includes 13 protein-coding genes (PCGs), small and large rRNA genes, and 21 tRNA genes absence of *trnS2*. Among 36 genes, 24 are encoded on the heavy-strand and 12 on the light-strand. It has a base composition of 28.95% for A, 30.58% for T, 18.65% for C, and 21.84% for G. We compared the patterns of mitochondrial gene arrangement with the five Ellobiid species and found some rearrangements. The phylogenetic tree reconstructed using the maximum-likelihood (ML) method confirms that the family Ellobiidae was divided into the two different clades of Groups 1 and 2. *M. sincaporensis* was placed within the ellobiidae Group 1 with a lower node confidence value (BP, 25%). These data could provide useful molecular information for phylogenetic studies concerning ellobiids and related species.

PM-7

## The complete mitochondrial genome of a worm snail *Thylacodes adamsii* (Littorinimorpha: Vermetidae) from South Korea

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A worm snail *Thylacodes adamsii* (Littorinimorpha, Vermetidae) is a sessile gastropod and inhabits mainly in rocky shores along the warm temperate coastal regions in East Asia. For last decades, the mitochondrial genomes have been considered useful phylogenetic markers in mollusks, but only four mtgenomes from Vermetid species have been reported. Here, we characterized a complete mtgenome of *T. adamsii* from South Korea. It is 14,913 bp in length, which contained 13 protein-coding genes (PCGs), 22 transfer RNA genes, and two ribosomal RNA genes. The nucleotide composition is slightly biased with A+T contents of 65.36% (A, T, C, and G was 27.33%, 37.93%, 15.63%, and 19.11%, respectively). The *T. adamsii* mitochondrial gene order is identical to that of *Thylacodes squamigerus*. Phylogenetic trees reconstructed using nucleotide sequences of the 13 PCGs the maximum-likelihood (ML) method showed a close relationship with *T. squamigerus* (BP, 100%) within the family Vermetidae.