Organizing Committee

La mer 日仏海洋学会 Société franco-japonaise d'Océanographie

Société franco-japonaise d'Océanographie

Co-organizer

Toba city

文

FRA

Preface

The 20th Japanese-French Oceanography Symposium
Toba 2025: Ocean Science for a Sustainable Future

"One planet, one ocean: from science to solutions" is a concept that emphasizes the interconnectedness of our planet and its oceans, proposing potential solutions based on rigorous scientific research. To build a sustainable society in today's changing global environment, we need to create a sustainable coexistence between people and oceans. Advances in marine science are essential if people are to understand this and build such a society. The symposium therefore focuses on the scientific elucidation of the ocean's role in global environmental change, countermeasures against the worldwide degradation of marine biodiversity and the pollution including microplastics, securing a stable supply of natural and farmed marine foods, fundamental discovers and technical developments based on rigorous marine sciences including physics, chemistry, biology and technology, coordination between coastal fisheries and offshore wind farms which are the most promising renewable energy, measures to mitigate global warming and the integrated management of coastal areas with researchers from France and Japan at the heart of the symposium, as well as from other countries. The aim is to exchange knowledge on marine sciences with participants in the symposium, and to discuss how to transform today's society into a sustainable one.

The symposium is held in Toba in November 2025. The city of Toba, like the city of Shima, is famous for its ama divers' (female divers') fishing. The history of ama divers' fishing goes back more than 2,000 years, and in the Toba and Shima regions there are traces of ama divers offering the abalone that they had caught as an offering to the Ise Shinto Shrine. Ama divers are allowed to catch abalone and other marine organisms only during the open periods, depending on the ecology of target species, to ensure that they don't catch too many target species. It is precisely because this type of fishing can exist in harmony with nature that ama divers' fishing has been perpetuated from ancient times to the present day. Toba and Shima were called Miketsu-kuni (land of food in Japanese) because they delivered seafood to the imperial court. Toba and Shima are societies where people and the sea have coexisted for over 2,000 years. The 20th Japanese-French Oceanography Symposium is held in Toba in November to learn from this history and use its wisdom for the present and future.

In addition to sessions for research presentations in the fields of oceanography and fisheries science, this symposium also includes a session based on the research cooperation agreement between the *Institut français de recherche pour l'exploitation de la mer* (Ifremer) and the Fisheries Research Agency (FRA) of Japan, and a special session to commemorate the 20th Japanese-French Oceanography Symposium, Sustainable Development of Coastal Areas through Satoumi, a session on integrated coastal area managements including presentations on offshore wind farm and coordination with fisheries and marine environment.

We sincerely hope that the insights and discussions shared during this symposium will contribute to the advancement of ocean science, practice, and policy toward a sustainable ocean in harmony with human society. We extend our heartfelt thanks to all participants, sponsors and supported who support to realize the symposium, and trust that this abstract volume will serve as a foundation for continued collaboration and progress, especially through the cooperation between Japanese and French scientists.

Teruhisa KOMATSU: Président, Société franco-japonaise d'Océanographie du Japon

28 November

		Venue 1: Media Hall					
10:00	0-10	**Opening ceremony and welcome message**					
11:00	10-50	**Keynote speech 1: Concept of Satoumi and related activities**					
	50-60	Group photo					
12:00		**Lunch**					
		Venue 1: Media Hall		**Venue 2 : Multi Labo 2**		**Venue 3: Multi Labo 1**	
		Satoumi Session		**Climate-Change adaptation Session**		**Oral presentation, general**	
13:00	0-10	Opening	0-30	**Theme 1: Umigyo Keynote Speech 3: Promotion of Umigyo by the Fisheries Agency**	0-15	OP-1	
	10-40	**Keynote speech 2: Between Nature and Culture – A needed harmony**			15-30	OP-2	
	40-10	**Keynote speech 4: Creating Satoumi in the Reiwa Era in Japan**	30-50	T1-1	30-45	OP-3	
			50-60	Discussion	45-60	OP-4	
14:00	10-40	SS-1	0-10	**FRA-Ifremer** Opening	0-15	OP-5	
			10-30	**Theme 2: Bivalve and ecosystem** T2-1	15-30	OP-6	
	40-10	SS-2	30-45	T2-2	30-45	OP-7	
			45-60	T2-3	45-5	Coffee Break	
15:00	10-30	Coffee Break	0-15	Coffee Break	5-20	OP-8	
	30-60	SS-3	15-30	T2-4	20-35	OP-9	
			30-45	T2-5	35-50	OP-10	
			45-60	T2-6	50-5	OP-11	
16:00	0-30	SS-4	0-15	T2-7	5-20	OP-12	
			15-30	T2-8	20-35	OP-13	
	30-55	Discussion	30-45	T2-9			
18:00		**Welcome Reception sponsered by Toba City**					

29 November

		Venue 1: Media Hall Satoumi Session		Venue 2 : Multi Labo 2 (By Zoom Translation) Climate-Change adaptation Session		Venue 3: Multi Labo 1 Oral presentation, general
9:00	0-30	SS-5		**Theme 3: FRA-Ifremer novel studies**		
			15-30	T3-1	15-30	OP-14
	30-60	SS-6	30-45	T3-2	30-45	OP-15
			45-60	T3-3	45-60	OP-16
10:00	0-30	SS-7	0-15	T3-4	0-15	OP-17
			15-45	Coffee Break	15-45	Coffee Break
	30-60	Coffee Break	45-60	**Theme 4: Blue Carbon** T4-1	45-60	OP-18
11:00	0-30	SS-8	0-15	T4-2	0-15	OP-19
			15-30	T4-3	15-30	OP-20
	30-60	SS-9	30-45	T4-4	30-45	OP-21
			45-60	Discussion	45-60	OP-22
12:00	**Lunch**					
13:00	0-20	Discussion	0-10	**Theme 5: Offshore Wind Farm**		
			10-40	**Keynote speech 5：Offshore wind farms and fisheries coordination**		
	20-40					
	40-60	Coffee Break	40-10	T5-1		
14:00	0-30	**SPF: Policy and Governance Approach** Opening SP-1 SP-2 SP-3 SP-4 Discussion			0-15	OP-23
			10-25	Coffee Break	15-30	OP-24
	30-60		25-60	T5-2	30-45	OP-25
					45-60	OP-26
15:00	0-30		0-30	T5-3	0-15	OP-27
					15-30	OP-28
			30-45	Discussion		
16:00	0-60	**Poster presentation: core time & voting**				
18:30	**Special Dinner by FJSO Japan**					

30 November

		Venue 1: Media Hall
9:00	0-30	**General discussion for all sessions by SFJO**
	30-60	
10:00	0-30	**Closing Ceremony**
	30-60	

Venue 1: Media Hall

28 November

10:00-11:10 **Opening ceremony and welcome message**
11:10-11:50 **Keynote Speech 1**: Osamu Matsuda (Satoumi Research Institute)
Concept of Satoumi and related activities
11:50-12:00 **Group Photo**
12:00-13:00 **Lunch**

Satoumi Session
13:00-13:10 **Opening remarks and purpose explanation**: Teruhisa Komatsu (President of SFJO Japon)
13:10-13:40 **Keynote Speech 2**: Patrick Prouzet (President of SFJO France)
Between Nature and Culture – A needed harmony
13:40-14:10 **Keynote Speech 4**: Junko Nishikawa (Ministry of the Environment)
Creating Satoumi in the Reiwa Era in Japan
14:10-14:40 **SS-1**: Tatsuya Sato (Ministry of the Environment)
Toba City Red Data Book 2023: Basic reference material for local knowledge and its application to Satoumi development
14:40-15:10 **SS-2**: Kumi Kato (Wakayama University)
Sound of Satoumi: ecological acoutemology of Ama divers
15:10-15:30 **Coffee Break**

15:30-16:00 **SS-3**: Masaru Kanda (Representative of the Kuroshio Experience Center)
The whole island is a museum
16:00-16:30 **SS-4**: Satoki Oba (Secretary general of NPO Otsuchi-noasobi)
Creating satoumi in Sanriku
16:30-17:00 **Discussion**

29 November

Satoumi Session
09:00-09:30 **SS-5**: Patrick Prouzet (SFJO France), Eric Feunteun (Muséum National d` Histoire Naturelle) and Didier Macé (Committee of Inland Professional Fishermen)
Eel restoration in France: the need for a non-sectoral approach using academic and traditional knowledge
09:30-10:00 **SS-6**: Kazumi Wakita (Tokai University)
Hidden effect of local traditional practices for conservation of coastal resources in Niue
10:00-10:30 **SS-7**: Suhender I Sachoemar (BRIN, Indonesia)
Development of Satoumi aquaculture system using material circulation in Indonesia
10:30-11:00 **Coffee Break**

11:00-11:30 **SS-8**: Mitsutaku Makino (The University of Tokyo)
Co-designing coastal monitoring system for Satoumi using smart phone: a case from Indonesia

11:30-12:00 **SS-9**: Hiroaki Sugino (Yamaguchi University)
Visualization of citizen's vista, future vision, and its vector: A practical case study from the Seto Inland Sea of Japan
12:00-13:00 **Lunch**
13:00-13:40 **Discussion** moderated by Dr. Yves Henocque (Vice president of SFJO France)
Panellors: Dr. P. Prouzet (SFJO France), Prof. Osamu Matsuda (Satoumi Research Institute), Prof. Teruhisa Komatsu (SFJO Japon)
13:40-14:00 **Coffee Break**

SPF Session
14:00-15:30 **Policy and Governance Approach in Regional Seas: A Comparison of the Mediterranean and East Asia**
Introducing the session rationale: Xiang Gao (OPRI-SPF)

SP-1: Xiang Gao (OPRI-SPF)
East Asia regional seas: UNDP/PEMSEA - History, functioning, and perspectives
SP-2: Yves Henocque (SFJO France)
Mediterranean Sea: UNEP/MAP - History, functioning and perspective
SP-3: TBD (Researcher from East Asia region)
Specific topic about UNDP/PEMSEA's activity
SP-4: Marie Romani (Romani Consulting)
Specific topic about UNEP/MAP's activities
Discussion moderated by Xiang Gao (OPRI-SPF) and Yves Henocque (SFJO France)

30 November

09:00-10:00 **General Discussion for all sessions moderated by SFJO**
10:00-11:00 **Closing Ceremony**

Venue 2: Multi Labo 2

28 November

Climate-Change Adaptation Session

Theme 1: Umigyo

Facilitator: Kazufumi Takayanagi (Vice president of SFJO Japon)

13:00-13:30 **Keynote Speech 3**: Hiroshi Somekawa (Fisheries Agency)
Promotion of Umigyo by the Fisheries Agency

13:30-13:50 **T1-1**: Shin Onozato (JF Toba Isobe Fisheries Cooperative)
How to create contents for “Umigyo” based on the concept of attractive fishery

13:50-14:00 **Discussion**

Theme 2: FRA-Ifremer collaboration: Bivalve and ecosystem research

14:00-14:10 **Opening remarks and purpose explanation**: Ichiro Nakayama (President of FRA, Vice president of SFJO Japon)

14:10-14:30 **T2-1**: Satoshi Watanabe et al (FRA)
Progress in clam study under the second MOU between Ifremer and FRA

14:30-14:45 **T2-2**: Nathalie Call-Milly and Florence Sanchez (Ifremer)
Management of *Ruditapes philippinarum* fisheries in Arcachon Bay, SW France: New challenges in a changing environment

14:45-15:00 **T2-3**: Nariaki Inoue (FRA)
Protective effect of crushed stone laying on Manila clam (*Ruditapes philippinarum*) juveniles in Funabashi, Tokyo Bay

15:00-15:15 **Coffee Break**

15:15-15:30 **T2-4**: Yannick Gueguen (Ifremer)
Roadmap for the Ifremer COAST Unit within the framework of the FRA/Ifremer MOU. Challenges and prospects in the context of climate change

15:30-15:45 **T2-5**: Tania Hernandez-Farinas (Ifremer)
From monitoring to ecological insights: Decadal observations of phytoplankton in French coastal waters

15:45-16:00 **T2-6**: Aline Gangnery (Ifremer)
In-situ trophic ecology of benthic marine suspension feeders assessed with metabarcoding

16:00-16:15 **T2-7**: Valérie Derolez (Ifremer)
Long-term impacts of climate change on phytoplankton communities and seasonality

16:15-16:30 **T2-8**: Franck Lagarde (Ifremer)
ECOSCOPA, Network for monitoring the life cycle of Pacific oysters to assess the impact of environmental and climate changes

16:30-16:45 **T2-9**: Tomohiro Okamura et al. (FRA)
Field monitoring for successful wild oyster spat collection

Program

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Theme 3: FRA-Ifremer collaboration: Novel studies in the coastal ecosystems

09:15-09:30 **T3-1:** Philippe Riou (Ifremer)
The ODE Scientific Department (Oceanography and Ecosystem Dynamics) : Research focused on three fundamental areas

09:30-09:45 **T3-2**: Jean-Marc Fromentin (Ifremer)
Development of indices of abundance of Mediterranean coastal fish populations using eDNA quantification

09:45-10:00 **T3-3**: Kazuki Yokouchi et al. (FRA)
Community shifts and fisheries adaptation in Ise-Mikawa Bays: Integrated insights from small trawl fisheries and scientific surveys

10:00-10:15 **T3-4**: Tina Erica Odaka (ifremer)
Global fish tracking system and Pangeo-Fish: Advancing collaborative, interdisciplinary biologging data analysis using digital twin technologies

10:15-10:45 **Coffee Break**

Theme 4: FRA-Ifremer collaboration: Blue Carbon

10:45-11:00 **T4-1**: Masakazu Hori (FRA)
Toward sustainable blue economy from blue carbon ecosystems

11:00-11:15 **T4-2**: Pierre Polsenaere (Ifremer)
Integrative carbon budget of a temperate wetland – tidal bay – sound continuum revealed by exchange interface process and flux measurements

11:15-11:30 **T4-3**: Yuto Kawata et al. (TOYOTA Motor Corp.)
Demonstration study on seaweed cultivation for blue carbon expansion and key factors to increase the yield

11:30-11:45 **T4-4**: Atsushi Watanabe (SPF-OPRI)
Blue carbon as a catalyst for sustainable blue economy development

11:45-12:00 **Discussion**

12:00-13:00 **Lunch**

Theme 5: Offshore Wind Farm

Facilitator: Mitsutaku Makino (OPRI-SPF & The University of Tokyo)

13:00-13:40 **Keynote Speech 5**: Shigeto Hase (Tokyo Fisheries Promotion Foundation)
Offshore wind farms and fisheries coordination

13:40-14:10 **T5-1**: Jean-Claude Dauvin (l'Université de Caen Normandie)
Contribution of marine ecology researches towards the implementation of offshore wind power in the English Channel

14:10-14:25 **Coffee Break**

14:25-15:00 **T5-2**: Philippe Pagot (EDF Power Solutions Japan K.K.)
How EDF power solutions has coordinated with fishermen and other stakeholders of coastal waters in France

15:00-15:30 **T5-3**: Hiroyuki Nakahara (Yokohama National University)
Offshore wind vs fisheries - Way of co-existence

15:30-15:45 **Discussion**

Venue 3: Multi Labo 1

28 November

Oral presentation, general

13:00-13:15 **OP-1**: François Poisson (Ifremer) and Daisuke Ochi (FRA)
The MEGABIT (MEGA fauna Behaviors & Longline Gear Interactions for Sustainable Fishing Practices): A collaborative research project

13:15-13:30 **OP-2**: Luka Fujimori (Tokyo University of Marine Science and Technology)
Three-dimensional measurement system with marker and quad camera for marine robot

13:30-13:45 **OP-3**: Makoto Morito (Tokyo University of Marine Science and Technology)
Development of an ASV control system using VSC

13:45-14:00 **OP-4**: Kazuki Masuda (Graduate School of Maritime Sciences, Kobe University)
Development of a method for estimating sea wind from shipboard wind using random forest

14:00-14:15 **OP-5**: Masataka Hirose (National Institute of Technology, Toba college)
Viscosity temperature characteristics of biodiesel fuel synthesised using oyster shell catalysts

14:15-14:30 **OP-6**: Shigeharu Aoyama (Member of the House of Councillors)
Production engineering development of ocean energy resources of JAPAN

14:30-14:45 **OP-7**: Yasuo Utsumi (National Institute of Technology)
GEAR: human resource development project with solving community issues
-Development in the IT fisheries industry in region-

14:45-15:05 **Coffee Break**

15:05-15:20 **OP-8**: Tatsuyuki Sagawa (Tottori University of Environmental Studies)
Monitoring seaweed bed distribution using PlanetScope: A case study in Tottori, Japan

15:20-15:35 **OP-9**: Tomoharu Senjyu (Kyushu University)
Revisit the upper portion of the Japan Sea proper water: Recent structural change and warming trends

15:35-15:50 **OP-10**: Hisayuki Arakawa (Tokyo University of Marine Science and Technology)
Concentration and properties of small microplastic around Japan

15:50-16:05 **OP-11**: Mathilde Charbonnelle (CNRS)
The Fecamp platform: a multidisciplinary observatory for monitoring of marine renewables energies in France

16:05-16:20 **OP-12**: Robin van Paemelen (CNRS)
Taxonomic–functional coupling: a robust approach to monitor benthic communities in the context of offshore wind-farm development

16:20-16:35 **OP-13**: Ferdinand Schlicklin (l'Université de Caen Normandie)
Offshore wind farm development: an opportunity to update the invertebrate diversity in the English Channel

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29 November

09:15-09:30 **OP-14**: Ayumi Hirose (Institute of Science Tokyo)
The fate of olfactory genes in cetaceans: Insights from Ziphiidae

09:30-09:45 **OP-15**: Davin Setiamarga (National Institute of Technology, Wakayama College)
Octopuses were just bootleg squids!? What the vampire squid genome revealed about early cephalopod evolution

09:45-10:00 **OP-16**: Yuki Nagai (Tohoku University)
An overview of infestation in farmed and wild oysters by shell-boring Polydorid Species (Annelida: Spionidae) along the French Metropolitan Coast

10:00-10:15 **OP-17**: Minako Kato (Fishing Port and Grounds Division, Department of Agriculture, Forestry and Fisheries, Okinawa)
Analysis of Catch Trends in Set Net Fisheries in the Waters around Okinawa Island

10:15-10:45 **Coffee Break**

10:45-11:00 **OP-18**: Mega Syamsuddin (Universitas Padjadjaran, Indonesia)
Modeling the migration of Skipjack Tuna (Katsuwonus pelamis) migration: Insights into ENSO-induced seasonal patterns in the Makassar Strait

11:00-11:15 **OP-19**: Takatoshi Higuchi (The University of Tokyo)
Environmentally regulated oceanic spawning migration behaviour of the freshwater eel

11:15-11:30 **OP-20**: Eric Feunteun (Muséum National d`Histoire Naturelle)
The hidden threat: How pollutants impact European eel populations. Implications for management

11:30-11:45 **OP-21**: Haruku Maeda (National Institute of Technology, Toba College)
Effect of mixing pearl powder on the electrical conductivity of beverages

11:45-12:00 **OP-22**: Toshiki Nakano (Tohoku University)
Nondestructive and noninvasive analysis of marine product quality

12:00-13:00 **Lunch**

14:00-14:15 **OP-23**: Patrick Vincent (SFJO France)
International and interdisciplinary research programs are essential to understand and mitigate the impact of climate changes on marine coastal areas, from macro to nano scales

14:15-14:30 **OP-24**: Alexandre Meinesz (University Cote d`Azur ECOSEAS CNRS UMR)
Protecting coastlines from rising sea levels caused by climate change. What is being done off the French Mediterranean coast and long-term projects

14:30-14:45 **OP-25**: Jamila Pacheco Rodrigues (Okinawa Institute of Science and Technology)
Okinawa coastal fishers` perceptions of climate change and its Impact on fisheries and fishers' wellbeing

14:45-15:00 **OP-26**: Ryutaro Kamiyama (FRA)
Local ecological knowledge of oyster famers on the marine environment and productivity

15:00-15:15 **OP-27**: Mai Yoshimura (Nagoya University)
Local ecological knowledge and environmental change: A case study of ama fishing in Mie prefecture, Japan

15:15-15:30 **OP-28**: Akiharu Sasaki (Hokkaido University)
Relationship between land use, river water quality, and fisheries productivity in each marine area of Hokkaido

Program

29 November 16:00-17:00 **Poster presentation**: core time and voting

P1 **Haruka SAKATA（Sanyo Techno Marine Inc.）**
Dust-climate couplings over the Glacial-Interglacial cycle

P2 **Yusuke AMAYA（University of Toyama）**
Changes and Mechanisms of Deep-Water Circulation in The Japan Sea Under Idealized Global Warming

P3 **Takuma SUZUKI（TUMSAT）**
Distribution of Microplastics in the Sediments of the Seto Inland Sea

P4 **Daeyoon JUNG（TUMSAT）**
Microplastics on sandy beaches in Tokyo Bay: spatial and seasonal variations in accumulation

P5 **François GALGANI（IFREMER）**
Plastic Pollution: Recent Developments, Current Issues, and Future Perspectives

P6 **Aoi NAKANO（Graduate School of Bioresources, Mie University）**
Plastic Erosion and Fragmentation Caused by the Foraging Activity of Molluscan Grazers

P7 **Souta TAKITANI（NIT, Wakayama College）**
Rainfall Impacts on River and Marine Water Quality in Wakayama prefecture, JAPAN

P8 **Sachio KUBOTA（NIT, Toba College）**
Development of Ship Systems to Achieve Environmental Protection and Carbon Neutrality

P9 **Maho TANIGUCHI（Tohoku University）**
Detection of Spionid Polychaetes Infesting Established European Flat Oyster *Ostrea edulis* in Japan

P10 **Natsuki HASEGAWA（FRA）**
Yield of Annual Inedible Kelp Farming in Northern Japan

P11 **Natsumi SANO（Graduate School of Bioresources, Mie University）**
Induction of Deposition on the Inner Shell Surface of the Akoya Pearl Oyster （*Pinctada fucata*） by Bacterial Inoculation

P12 **Sayaka TERAMOTO（Iwate Prefectural Fisheries Technology Center）**
Introduction and Establishment of the European Flat Oyster *Ostrea edulis* in Japan

P13 **Hirokazu MATSUDA（Graduate School of Bioresources, Mie University）**
Effect of Rearing Water Temperature on the Occurrence of Skin Ulceration Disease in Cultured Japanese Sea Cucumber （*Apostichopus japonicus*）

P14 **Yutaka OKUMURA（FRA）**
Microalgae detected from sediment cores collected on land

P15 **Yuki AMAKI（TUMSAT）**
Relationship between the distribution of the sakura shrimp *Lucensosergia lucens* and underwater

P16 **Teruhisa KOMATSU（Japan Fisheries Resource Conservation Association）**
Influence of a *Sargassum* forest on the distribution of surface current velocity gradient

P17 **Mizuki KOBAYASHI（Graduate School of Bioresources, Mie University）**
Cultivation Methods and Growth Responses of the Brown Alga *Sargassum horneri*

P18 **Gen NAKAMURA（TUMSAT）**
Power of Citizens: Unveiling the Hidden Ecology of the Endangered Finless Porpoise

P19 **Tadashi MATSUBARA（Fisheries Technology Institute, FRA）**
Investigating the Factors Behind the Decrease in Dominance of the Diatom *Skeletonema* in the Seto Inland Sea: Insights from Growth Response to Light and Nitrogen

P20 **Tatsumasa OKAMOTO（Graduate School of Bioresources, Mie University）**
Diatom-Specific DNA Metabarcoding Reveals the Diet of Manila Clam（*Ruditapes philippinarum*）Larvae

P21 **Tamaha YAMAGUCHI（Fisheries Resources Institute, FRA）**
Preliminary determination of phytoplankton community structure by next-generation sequencing of residuals from pigment samples

P22 **Stéphane PETIT（Sète Maritime High School / Lycée de la Mer Paul Bousquet de Sète）**
Engaging Future Marine Professionals in the Thau Lagoon Clam Recovery with participatory science

P23 **Charles-François BOUDOURESQUE（Aix-Marseille Univ., MIO）**
Insights into the social perception of the possible natural return of a fishers' competitor, the endangered Mediterranean seal *Monachus monachus*

P24 **Hiroki JOSHIMA（TUMSAT）**
A study on the foraging and ship-tracking behaviors of boobies at Izu Islands offing

29 November 16:00-17:00 **Poster presentation**: core time and voting

P25 Hiroshi UCHIDA（JAMSTEC）
The Influence of River Water on the North Pacific Ocean as Seen from Absolute Salinity Anomaly

P26 Juna AKAMINE（TUMSAT）
Current structure inferred from the water mass distribution observed by Argo floats in the Indian Sector of Southern Ocean

P27 Yuumi HIRAYAMA（TUMSAT）
Periodic characteristics of absolute dynamic topography and its spatial distribution in the Australian-Antarctic Basin

P28 Mitsuru HAYASHI（Kobe University）
Spatial and temporal characteristics of tidal fronts tracked by edge detection

P29 Yujiro KITADE（TUMSAT）
Algorithm for actively moving ARGO floats to their destination

P30 Mari KUROKI（The University of Tokyo）
A Literature Survey on the Historical Relationship Between Eels and Humans

P31 Chikako SAKAI（NIT, Toba College）
Effect of Pearl Powder Mixing on the Relationship between Electrical Conductivity and Total Dissolved Solids in Liquids and Solids

P32 Mitsuru IZUMI（NIT, Toba College）
Study of Feeding Activity for Sea Urchins in Aquaculture Systems

P33 Hiroyuki OKAMOTO（NIT, Anan College）
Fishing Conditions Prediction by Ocean Conditions Charts

P34 Kota SHIRAKAWA（NIT, Toba College）
Development of a Phytoplankton Identification System

P35 Kazuto KITANAKA（NIT, Toba College）
Laser beam shooting system to prevent duck damage to seaweed farming

P36 Yuki MATSUBA（NIT, Toba College）
Drone-Based System for Preventing Duck Damage in Nori Cultivation

P37 Kyohei YOKOTA（NIT, Wakayama College）
Prediction of Chlorophyll-a Using Machine Learning in the Kii Channel, JAPAN

P38 Nobuo EZAKI（NIT, Toba College）
Building a Behaviour Analysis System for Sea Urchins in Aquaculture Systems

P39 Keita TSUZUKI（NIT, Toyota College）
Exploring Superconducting Rotating Machinery for Hydrogen Society Review of Fundamental Elements from KOSEN Research

P40 Ryunosuke TAKEHARA（NIT, Toyota College）
Development of Material Evaluation System under Cryogenic Conditions for Marine Hydrogen Equipment

P41 Tetta SAWADA（NIT, Toyota College）
Experimental Preparation of Onboard Hydrogen Cooling Systems on Training Ship

P42 Hiroki KOMURA（NIT, Toyota College）
Prototype of Accelerometer-Based Anomaly Detection System for Marine Equipment

P43 Shie TAKEUCHI（NIT, Toba College）
Study Of The Wire Length Effect For The Undulator-type Tidal Stream Generator

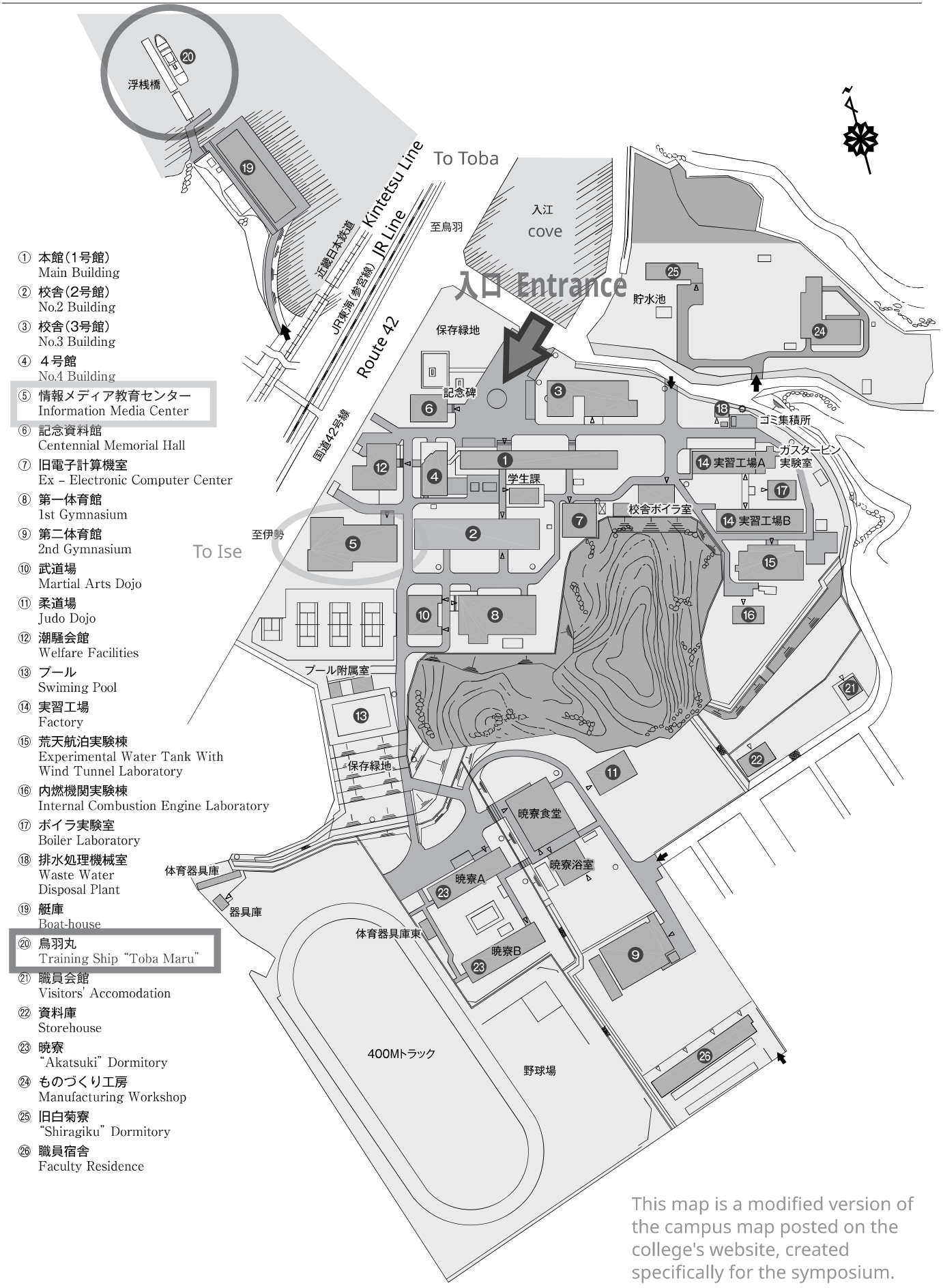
P44 Arisa TANIGUCHI（NIT, Toba College）
Tidal Current Measurement For The Power Generation In Toshijima

P45 Keigo HORIE（Graduate School of Bioresources, Mie University）
The Effects and Current Status of Marine Education for Sustainable Community Development in Satoumi Regions: A Case Study of the Whole-School Survey in Toba City

P46 Masataka KUSUBE（NIT, Wakayama College）
Eelgrass （Zostera marina） Seed Production through Microbial and Sediment Optimization: A Strategy for Coastal Blue Carbon Restoration

P47 Masakazu HORI（FRA）
Toward sustainable blue economy from blue carbon ecosystems

Venue Guide Map



① 本館（1号館）
Main Building

② 校舎（2号館）
No.2 Building

③ 校舎（3号館）
No.3 Building

④ ４号館
No.4 Building

⑤ 情報メディア教育センター
Information Media Center

⑥ 記念資料館
Centennial Memorial Hall

⑦ 旧電子計算機室
Ex – Electronic Computer Center

⑧ 第一体育館
1st Gymnasium

⑨ 第二体育館
2nd Gymnasium

⑩ 武道場
Martial Arts Dojo

⑪ 柔道場
Judo Dojo

⑫ 潮騒会館
Welfare Facilities

⑬ プール
Swiming Pool

⑭ 実習工場
Factory

⑮ 荒天航泊実験棟
Experimental Water Tank With Wind Tunnel Laboratory

⑯ 内燃機関実験棟
Internal Combustion Engine Laboratory

⑰ ボイラ実験室
Boiler Laboratory

⑱ 排水処理機械室
Waste Water Disposal Plant

⑲ 艇庫
Boat-house

⑳ 鳥羽丸
Training Ship “Toba Maru”

㉑ 職員会館
Visitors' Accomodation

㉒ 資料庫
Storehouse

㉓ 暁寮
“Akatsuki” Dormitory

㉔ ものづくり工房
Manufacturing Workshop

㉕ 旧白菊寮
“Shiragiku” Dormitory

㉖ 職員宿舎
Faculty Residence

This map is a modified version of the campus map posted on the college's website, created specifically for the symposium.

Concept of Satoumi and Related Activities

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INTRODUCTION

Traditional Satoumi has long history in Japan. In the Seto Inland Sea, prototype of traditional Satoumi which provides numerous blessings for people is considered to exist already from 13 centuries. Comparing with traditional Satoumi, history of modern Satoumi is still very short. The late professor Tetsuo YANAGI proposed a basic idea of Satoumi in 1998 at the first time. Activities of Satoumi creation have gradually increased and expanded not only in Japan but also in some overseas countries such as Indonesia, Mexico, Taiwan and so on. In the present study, after the brief review of change and recent trend in the concept of Satoumi, cases of actual Satoumi creation which the author was closely concerned will be introduced.

CONCEPT OF SATOUMI

The first clear definition on Satoumi by prof. Yanagi published in 2006 was "a coastal area where biological productivity and biodiversity have increased through human interaction". Following to this, discussion on the definition of Satoumi had been activated and diversified. Definition of Satoumi has been gradually changing from original one to more inclusive one, which means that definition of Satoumi is now expanded and generalized compared with the first one. For example, activity which contributes to the restoration of deteriorated coastal environment, if not directly related to biological productivity and biodiversity, qualifies as Satoumi in many cases. From the viewpoint of Satoumi related keyword, human interaction and sustainability are still very important. In addition to these, type of activities such as inclusive, participatory, local community oriented are suitable for Satoumi. Relationship between human and the sea, fitness for SDGs, ecosystem services, material circulation, circular economy, and human well-being are also valuable as conceptual background of Satoumi.

CASE STUDIES

1) Creation of Satoumi in Reiwa Era

Ministry of the Environment promoted "Creation of Satoumi in Reiwa Era" project in Japan during FY2022-2024. Major aims of this project were "conservation, restoration, creation of seaweed bed and tidal flat" and "good use of local resources and positive economic circulation". The former has been major subject from the first stage of Satoumi creation, while the latter are new objectives of recent Satoumi which characterized the new Satoumi creation project. In case of the year FY2024, Satoumi creation activities in 19 sites were conducted in this project. The author played a role as a member of promotion committee of the project and accompany adviser of four Satoumi creation sites which were located in Aomori, Yamaguchi, Kochi and Saga prefecture. All these four activities were conducted not by single group but by network of diversified groups.

2) Activities of Satoumi Research Institute (NPO)

Almost all Satoumi related activities are under the influence of not only local issue but also global issue such as global climate change. In relation to global climate change, seawater temperature rise is serious in many Satoumi sites. Since main cause of seawater temperature rise is increase of atmospheric CO_2, ocean acidification occurs in parallel with seawater temperature rise in general. Rise of surface seawater temperature makes stratification of water column strong, which then promotes depletion of dissolved oxygen in bottom layer. As a result, there is a strong possibility that seawater temperature rise, acidification and oxygen depletion proceeds in parallel in future. Satoumi Research Institute conducts studies of ocean acidification (Ocean Acidification Adaptation Project) and monitoring project of environmental change in fishing ground in cooperation with the Nippon Foundation, Japan Fisheries Co-operative (JF) and Atmosphere and Ocean Research Institute, the University of Tokyo. Younger generation of fishers around the coast of Japan are valuable monitors of this project and is contributing to the improvement of on-site environmental and biological information.

3) Satoumi Creation by Kagawa Prefecture

As an adviser of Satoumi Council of Kagawa Prefecture, the author has long worked to promote variety of Satoumi related activities in the area. Among these, human resource development program called "Satoumi College" which has impressive achievement is introduced in this case study. The program which contains variety of Satoumi related aspects has been cooperatively organized by both Kagawa Prefecture and Kagawa University, is now quite popular among citizens. One of important aims of this program is to train professional Satoumi guides such as ecotour guides, marine life guides and marine litter guides. Increase of Satoumi guides who can make own living is expected as the result of this program.

CONCLUSION

Human of coastal area in the world are suffering from many problems more or less caused by human activities. Since concept of Satoumi is closely related to the relationship between human and the sea, concept of Satoumi and related activities are widely applicable to solve those problems towards SDGs and beyond SDGs. Final goal of Satoumi might be not only to realize rich and prosperous sea around us but also to achieve human well-being possibly by promotion of international networking of Satoumi.

Between Nature and Culture – A needed harmony

For a more ecological negotiation and a more humane conservation

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INTRODUCTION

In 2017, SFJO France defined a project titled "Between Nature and Culture" in order to better take into account environmental and social aspects in the definition of sustainable development as proposed by the WCED report: 'Our Common Future' [1].

While this commonly used definition theoretically places sustainable development at the convergence of three spheres of equal importance: environmental, social and economic, in most cases the environmental sphere is neglected in favour of the economic one. The social sphere is taken into account in a negotiation framework between weak and strong actors from a social point of view. In this context, many stakeholders who depend exclusively on the exploitation of natural resources are in a weak position to defend the sustainability of their activities in a context of dwindling living resources and deteriorating natural environments. It is the case, for small-scale fishing activities in inland, estuarine and coastal waters, whose economy is strongly dependent on other uses (industry, agriculture, tourism, urbanisation, flood protection, etc.) respecting the integrity of natural environments. Hence the need to add a development framework that minimises the ecological footprint of all uses on natural environments [2] and imposing another sphere of interest, namely culture, the common good of a community characterised by specific knowledge and know-how [3].

RESULTS AND DISCUSSION

The management model recommended for the sustainability of exploited living aquatic resources is the maximum sustainable yield (MSY) management. MSY depends on the biotic capacity of the environment, which determines the shape of the stock/recruitment curve. This biotic capacity is particularly affected in interface zones: coastal, littoral, estuarine and continental waters by the impacts of various uses other than fishing [4].

In this context, small-scale professional marine and inland fishing is an excellent example of weak actors in both environmental and social terms. Its activity is in conflict with the impact of the actors' activity whose socio-economic importance is considered essential for regional development: seaside tourism, agriculture, energy, flood control, urbanisation, etc.

Hence the introduction of an additional component, namely heritage value that refers to a set of tangible and intangible assets that are inherited and passed on. This notion of intergenerational transmission allows future generations, who are often absent from the discussion table, to be included in the negotiation process [3].

These tangible and intangible assets are also present in the concepts of "Sato-yama" and "Sato-umi", whose objective is to maintain harmony between humans and nature through the notion of responsibility and responsible development that minimises our ecological footprint so as not to deplete natural resources, but also to allow other uses related to the exploitation of natural environments to continue.

Professor Kinji Imanishi, in 'The World of Living Things' [5], highlights the strong adaptability of all living beings. He also highlights the fact that Nature as a whole can be seen as "*a living being within which we have always been nourished, alongside a myriad of other creatures*". Thus, through intergenerational transmission and a responsible attitude that allows us to consider Nature as a human being that must be cared for, two absent actors are reintegrated into the negotiation: future generations and Nature.

CONCLUSION

The "Nature and Culture project" promotes an approach that is both ecosystemic and participatory, combining academic and traditional knowledge.

Of course, we must not forget the primary role of our two societies. This guides us towards objectives that are not only scientific mediation, but also building bridges between disciplines without exception, by defining subjects that promote transdisciplinary and eco-socio-systemic approaches

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Creating *Satoumi* in the Reiwa Era (since 2019) in Japan

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INTRODUCTION

Since the period of rapid economic growth in the 1960s and 1970s, Japan has made significant efforts to address river and coastal pollution. Enclosed seas such as the Seto Inland Sea were once severely degraded by industrial effluents and eutrophication. Through strict pollution control laws, effluent regulations, and nationwide water quality improvement programs, water quality has significantly improved. Despite these advancements, the vision of "clean and bountiful sea"—where biodiversity, ecosystem services, and human well-being are all enhanced—has yet to be realized. It is within this context that the concept of *Satoumi* has emerged as a more comprehensive approach to coastal area management.

BACKGROUND

The concept of *Satoumi*—coastal areas where human interaction enhances biodiversity and ecosystem services—has become a cornerstone in Japan's environmental management policies in coastal areas. Emerging in the early 2000s, *Satoumi* has evolved from a descriptive ecological notion to a practical policy framework. The Ministry of the Environment (MOE) has articulated this vision in the *Recommendations on the Future Satoumi Development"* (2025) and launched the *Strategic Satoumi-Building Support Program"* (FY2025–2027).

POLICY EVOLUTION AND CURRENT CHALLENGES

Japan's postwar environmental management policies initially emphasized pollution control in enclosed seas. While water quality improved, ecosystem functions and biodiversity did not fully recover. Today, coastal areas face demographic decline, weakened stewardship, insufficient scientific knowledge, and fragmented governance. These challenges underline the need for integrated and adaptive policy framework.

STRATEGIC PILLARS OF *SATOUMI* DEVELOPMENT

The MOE recommendations highlight three key principles:

1. **Ecosystem Conservation, Restoration, and Creation** – Protecting existing seagrass beds and tidal flats, restoring degraded habitats, and creating new ecological assets.
2. **Sustainable Use and Virtuous Cycles** – Linking ecological values of natural resources with local economies including fisheries, ecotourism, and blue carbon credits, thereby enhancing sustainability of conservation activities.
3. **Local Autonomy and Collaborative Partnership** – Empowering local communities while fostering multi-sector partnership across municipalities, NGOs, academia, and the private sector.

THE STRATEGIC SUPPORT PROGRAM (FY2025–2027)

To materialize these principles, the MOE established a three-year support program. Selected local activity groups receive financial assistance (maximum 6 million yen) plus technical guidance. The program promotes initiatives that integrate ecological restoration with sustainable use of natural resources and stakeholder engagement.

Key thematic areas include:

- Restoration of tidal flats, seaweed and seagrass beds
- Linking watershed (forest–river–sea) management with fisheries
- Utilizing blue carbon credits for climate and biodiversity benefits
- Promoting marine education and community-based stewardship

Pilot projects in Miyagi, Ishikawa, Mie, Osaka, Hiroshima, Fukuoka, and Kumamoto demonstrate diverse approaches—ranging from habitat restoration to regional branding and eco-tourism.

LESSONS AND REMAINING CHALLENGES

The recommendations identify existing difficulties:

- Limited scientific understanding of ecosystem functions
- Need for long-term monitoring and adaptive management
- Aging population and shortage of resources in fishing villages
- Sustaining cross-sectoral coordination

To address some of these, the program incorporates processes for data sharing, scientific evaluation, and cross-regional networking.

INTERNATIONAL RELEVANCE

Satoumi offers insights into coastal area management through human–nature interaction. Its proactive approach—restoration, creation, and sustainable use of natural resources—resonates with global initiatives such as the Kunming–Montreal Global Biodiversity Framework, the Sustainable Development Goals, and the UN Decade of Ocean Science for Sustainable Development.

CONCLUSION

By sharing Japan's ongoing challenges and experiences, the presentation seeks to inspire dialogue with international cases. *Satoumi* development represents innovative approaches to revitalization of local economies with global implications toward resilient and sustainable coastal landscapes.

Toba City Marine Red Data Book 2023: Basic reference material for local knowledge and its application to *Satoumi* Development

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INTRODUCTION

Satoumi, a Japanese coastal management concept, emphasizes harmony between human activity and marine ecosystems. Despite challenges like environmental degradation, population decline, and climate change since the post-war economic boom, the Ise-Shima region continues to embody *Satoumi* culture through the lives, tools, and traditions of local residents—including fishers, *Ama* divers, and tourism operators. This presentation introduces examples from nearly a decade of experience as a fisher and freelance curator, illustrating how sustainable *Satoumi* practices are inherited and maintained.

PRESERVATION OF THE *FURUTAKA-MARU* AND COMMUNITY SUPPORT

The *Furutaka-maru*, a fishing vessel that used in pearl aquaculture, is maintained through *Satoumi* creation projects—such as seagrass bed and tidal flat rehabilitation—supported by volunteers and stakeholders.

Beyond the vessel, *Satoumi* initiatives in Ise-Shima are sustained by community engagement. Crowd funding, volunteer participation, and active involvement of fishers, educators, and residents have enabled continuity even after government programs ended. The fusion of tangible (tools) and intangible (memories) heritage exemplifies resilient, community-driven *Satoumi* stewardship.

Restored *Furutaka-maru*

COMPLILATON OF THE *TOBA MARINE RED DATA BOOK 2023*

To support local conservation, the *Toba Marine Red Data Book 2023* was compiled under commission from Toba City's Tourism Division. It documents over 400 species—marine mammals, fish, mollusks, crustaceans, other invertebrates, and seaweeds—found along the Ise-Shima coast, categorized by conservation status and their habitat.

Crucially, the book integrates local knowledge, including traditional uses, seasonal patterns, and oral histories. It serves as a scientific and educational resource, fostering awareness of marine biodiversity. The combination of ecological data and community wisdom supports conservation and social engagement.

INTEGRATION WITH INTERNATIONAL SCIENTIFIC DATABASS

Parts of the Red Data Book are supported by JAMSTEC and integrated into global marine biodiversity databases such as BISMaL and OBIS. This allows local ecological data to contribute to international scientific understanding and fosters collaboration between local communities and global research networks.

CONCLUTION

The case of Ise-Shima demonstrates that realizing *Satoumi* creation requires not only policy but also the daily lives, tools, and cultural heritage of local residents. The preservation of the *Furutaka-maru*, while merely a personal example from the author's own experience, along with efforts to encourage community participation and compile the Red Data Book, has been undertaken with the intention of contributing to integrated coastal zone management.

These efforts contain valuable lessons applicable to other regions. While the inheritance of culture, personal involvement, and knowledge sharing are essential for ecosystem resilience, each individual initiative tends to be small, fragile, and often invisible from the outside. Looking ahead, it is hoped that the next generation will carry forward the practices and learning environments of *Satoumi* creation. To support this, it is desirable that systems and social infrastructures—including the foundations for local livelihoods, fisheries, tourism, education, and community life—that can nurture human resources capable of collaborating effectively with administrative bodies and research institutions.

Toba City Marine Red Data Book 2023

Sound of Satoumi: ecological acoutemology of Ama divers

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INTRODUCTION

This paper explores ecological significance of the traditional practice of ama divers in Japan. Ama (literally sea women) dive for abalone and other sea produce without an oxygen tank or other technology. Their practice can be signified by the sound of taking breath, or characteristic "sea whistle". The practice has not changed since early documentation in *Makurano-soshi* (1001). This study captures the divers' relationship with the ocean, observations about the environmental changes through the sound, defined here as acoustemology[1](acoustic epistemology) of Satoumi. With the conceptual framework of Social-Ecological System (SER[2]), the study identifies an essential foundation for sustainable resource-based community development, particularly regenerative tourism.[3]

METHODS

Satoumi regions in this study include Iki, Chiba, Iwate and Toba, where sound recordings were made[4]. Divers' narratives, stories and soundscape were interwoven with locally themed literature (*Shiosai* by Mishima), and later developed as a radio documentary (ABC Radio National[5]). The approach taken in this study is ecohumanities defined as "a new inter-discipline that has emerged specifically to address the fact that current ecological problems, including extinction, climate change, water degradation, and many others, are anthropogenic events originating from the nature/culture divide, reflected also in the academic division between arts and sciences[3]". The approach is positive, striving to "engage in life and the living world in an unconstrained and expansive way[6]".

RESULTS AND DISCUSSION

The divers' narratives, observation on the environmental changes and their senses towards the sea can be framed as their ethical orientation centering *reciprocity, resilience* and *regeneration*. Reciprocity is expressed in their deep spiritual engagement with the sea that is dialogical, sensory/experiential, and place-specific. It symbolises *spirit of place,* the authenticity and integrity of a place sustained over time. It is also a source of resilience as the capacity "to deal with changes and use shocks and disturbances to spur renewal and innovative thinking". Resilience embraces "learning, diversity and the belief that humans and nature are strongly connected as one Social-Ecological System[7]", which also supports the capacity to develop and maintain social capital expressed through a sense of belonging, community and place attachment. This leads to regeneration.

Regenerative paradigm as a holistic principle demands "humans to live in conscious alignment with living systems on principles of wholeness, change, and relationship," with a specific emphasis on the ways of knowing and being in the world that is original and distinct to the place. Any resource-based community development, including tourism, should be aligned with these principles, as we now need to "return to the original meaning of travel as a journey of purpose, meaning, adventure and exploration" as much as in agriculture which should be for "nurturing human and ecological health[8]". Ama divers' sound of Satoumi reminds us of such ethical engagement, in this case, with the sea.

CONCLUSION

As six of the nine planetary boundaries claimed to have been crossed, all social and business activities must move towards regeneration. With such orientation, tourism can enhance *destination wellbeing*, a holistic concept that includes environment, socio-cultural and economic aspects of a destination, opening up new possibilities for the host community, visitors and the business. As tourism is expected to increase even further in volume in Japan and globally, it must become a *force for good* for the community, their places and the future of the planet. For this, a critical ethical foundation is found in the Sound of Satoumi.

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The whole island is a museum
~ Creating a sustainable satoumi in Kashiwajima, Kochi Prefecture~

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1. The whole island is a museum

Kashiwajima is a small island located at the southwestern tip of Kochi Prefecture, with a circumference of 3.9 km and a population of about 250 people.

The sea around Kashiwajima is a treasure trove of a wide variety of marine life due to the mix of the clear warm Kuroshio Current from the south and the nutrient-rich seawater that flows south from the Seto Inland Sea through the Bungo Channel. The sea area around Kashiwajima boasts one of the largest numbers and scales of coral species in the country in non-coral reef areas, and is home to over 1,150 species of fish, the largest number in several countries.

Kashiwajima has long been a prosperous fishing industry boasting one of the highest catches in Kochi Prefecture, but recently it has been struggling with slumping fishing prices, decreasing catches, and a lack of successors due to the aging population. On the other hand, due to the high transparency of the sea and the abundance of fish, the scuba diving industry, rock fishing ferry business, and inns and lodging businesses have developed, and the area has become one of Kochi Prefecture's leading tourist destinations, with over 30,000 tourists visiting each year.

The Kuroshio Reality Center not only covers Kashiwajima's rich natural environment but also the lives of the people who live there, and views the entire island as a museum. Based on the island, they disseminate information and activities related to the ocean, such as environmental conservation, satoumi education, and research, and work to create a model for sustainable satoumi.

2. Toward the creation of a sustainable “Satoumi”

“Not only do people unilaterally enjoy the rich blessings of the sea, but they also cultivate, nurture, and protect the sea.”

This is the concept of ``Satoumi'' that we have proposed. The goal of the Kuroshio Reality Center is to create a sustainable "Satoumi" where people and the sea can coexist.

Toward the realization of "Satoumi," the Center is conducting the following three major initiatives.

(1) Initiatives to experience nature

・Marine biology research (collaborative research with universities, etc.)

・Satoumi seminars

・Tosa Marine Environmental Studies (commonly known as Kashiwajima Studies) course at Kochi University (since 2001)

・Marine environmental study sessions, hands-on learning, and ecotours

・Information dissemination both on and off the island (including various lectures and on-site classes)

(2) Creating a lifestyle that takes advantage of nature

・Helping to create rich fishing grounds
-Installation of artificial spawning beds for bigfin reef squid
-Seaweed bed restoration(Creating underwater forests)

(3) Initiatives to protect nature and life

・Monitoring and conservation activities for corals and seaweed beds

・Monitoring and conservation activities for corals and seaweed beds

・Monitoring and conservation activities for corals and seaweed beds

・Disaster risk management (preparing for a major Nankai Trough earthquake)

We believe that not only a natural science approach but also a social science approach is essential to creating a sustainable satoumi.

How should we face and collaborate with the various entities surrounding the ocean? Regarding the above-mentioned efforts, which are being carried out while experiencing the difficulties of theory and practice, We will discuss changes in the industrial structure with the sea as a field and the relationship between "people and people" and "people and the sea."

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Seaweed Bed Restoration Efforts in the Sanriku Coastal area

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INTRODUCTION

The Sanriku coast of northeastern Japan was once one of the world's three major fishing grounds, where the confluence of the Oyashio and Kuroshio currents sustained extensive kelp (*Saccharina japonica*) and wakame (*Undaria pinnatifida*) beds. These habitats supported abundant populations of sea urchins and abalone, which were vital income sources for local fishers. However, during the past decade, *iso-yake* (barren ground) phenomena have expanded, leading to severe declines in seaweed beds, reduced body size of sea urchins and abalone, and decreased harvests. In response, Otsuchi Town has initiated collaborative restoration efforts involving local government, fishers, divers, and citizen groups.

Restoration Activities in Otsuchi Town

In fiscal year 2016, the Otsuchi Seaweed Bed Restoration Council was established under the leadership of the municipal government, with participation from local fishers, NGOs, divers, and volunteers. The council implements public–private collaborative activities that include: (1) ecological surveys and monitoring, (2) density control of herbivorous species, and (3) cultivation and transplantation of macroalgae.

Blue Carbon and Corporate Collaboration

Blue carbon sequestration by macroalgae has recently attracted attention as part of carbon offset strategies, while designation as a "Nature Symbiosis Site" by Japan's Ministry of the Environment is increasingly valued for corporate CSR. In Otsuchi, partnerships are developing with companies—including major automobile manufacturers—interested in supporting blue carbon initiatives and joint applications for Nature Symbiosis Site recognition.

Regional Revitalization and Education

Seaweed bed restoration serves not only to recover fisheries resources but also as a foundation for regional revitalization. Eco-tourism programs centered on barren ground and restoration themes contribute to increasing exchange visitors, while elementary schools incorporate these efforts into place-based education, enhancing environmental literacy. We are also working together with local elementary school students and fishers on the preparation and cultivation of kelp seedlings.

Conclusions and Future Perspectives

Through public–private cooperation, Otsuchi Town integrates seaweed bed restoration with fisheries, tourism, education, and corporate partnerships. These efforts aim to achieve sustainable restoration and promote long-term coexistence between local communities and the ocean.

ACKNOWLEDGMENTS

These activities were carried out in close collaboration with local fishers, the Otsuchi Town Office, and volunteer divers. We would like to express our sincere gratitude to the members of the Otsuchi Seaweed Bed Restoration Council and the volunteer divers for their invaluable contributions. This project was supported by the Ministry of the Environment's *Satoumi Creation Project*, the Fisheries Agency's *Multifunctional Role Enhancement Grant*, and the Otsuchi Town *Isoyake Countermeasure Fund*. We deeply appreciate their generous support.

EEL RESTORATION IN FRANCE: THE NEED FOR A NON-SECTORAL APPROACH USING ACADEMIC AND TRADITIONAL KNOWLEDGE.

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INTRODUCTION

Since they were first recorded in the national fisheries statistics at the end of the 19th century, estuarine and continental small-scale fisheries have accounted for a significant proportion of French fisheries production in terms of value until at least the mid-20th century and even for eels on the Atlantic coast until the end of the 20th century. Diadromous fish were an important resource for professional fishing communities operating, particularly the European eel (*Anguilla anguilla*) [1] until the implementation of EC Regulation 1100/2007 establishing a legal framework for the restoration of this species in its European colonization area.
Given the diversity of the aquatic environments harvested and the highly diversified behaviours of the species caught professional fishermen have developed knowledge and expertise based on a very precise understanding of the migratory and colonization behaviour of these species during their different biological phases [2]. This knowledge and expertise have enabled scientists to develop more accurate stock assessment protocols and, above all, to benefit from valuable information for defining sampling plans, using the technical knowledge of professional fishermen.

RESULTS AND DISCUSSION

1 - *Studies on the migratory behaviour of Atlantic salmon and European eel.*
From 1999 to 2001, professional fishermen cooperated with scientists to capture and tag 76 salmon with sonic and radio tags in order to track their migratory behaviour as they approached the coastal zone, entered the estuary and migrated to their spawning grounds. This behavioural information made it possible to better measure the catchability of salmon by nets and to establish staggered non-fishing days between the lower and upper estuary [3].
As part of the INDICANG project [2], a concertation phase with professional fishermen took place to define a conceptual model of glass eel behaviour in relation to hydro-climatic conditions during their migration up the estuary. This behavioural model made it possible from scientific campaigns to estimate abundance of glass eel runs entering large estuaries and thus to estimate the exploitation rates of the professional fisheries.

2 – *Assessment and management of diadromous species in large estuaries and rivers.*
From 1985 to 2005, on the Adour estuary, commercial fishermen recorded their salmon catches, collected blood samples to determine the sex ratio and scales to determine the age of salmon in river and at sea. These data enabled the development of management models highlighting the importance of the quality of spawning grounds, their permeability on the survival of eggs and the abundance of different salmon runs.
On the Loire River, the use of anchored stow net fisheries on the middle course of the Loire River has made it possible, using the mark-recapture method, to estimate the level of silver eel escapement and its fluctuations from 2001 to 2013 on one of the major rivers flowing into the Bay of Biscay [4]. The same methodology will be used on the Rhône River.

3 – Restocking of European rivers with glass eel.
28 tonnes representing 88 million glass-eel have been restocked by professional fishermen from 2011 to 2021. A study was conducted jointly by professional fishermen organised within ARA (Association Repeuplement Anguille) France in conjunction with the Natural History Museum and the Fish Pass consultant firm. This study draws the main conclusions from the observations made and suggests that restocking measures can effectively restore eel populations in sections of rivers (or lake) where eels are no longer present [5].

CONCLUSION

The restoration of diadromous species is primarily carried out at a local level, where an ecosystem-based and participatory approach can be more easily implemented. To be effective, especially for species such as eels, these restoration actions must be coordinated and networked across the entire distribution area. In Europe, and more specifically in France, this is far from being the case, even though we have seen that, under the coordination of associations that bring together professional fishermen such as ARA France, restocking can be coordinated across France.

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Hidden effect of local traditional practices for conservation of coastal resources in Niue

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INTRODUCTION

Ensuring healthy marine ecosystems as well as securing sustainable uses of marine resources is a key for wellbeing of people. People living in the Pacific islands' region, especially, not only depend on their livelihoods for resources from the ocean but also have deep social and cultural connections with the ocean.

To better conserve marine biodiversity, respecting and incorporating knowledge of Indigenous Peoples on marine ecosystem is one of the keys to make marine spatial planning and marine protected areas success. However, as is pointed out by Ban and Frida[1], only 0.5 per cent of academic papers on MPAs have studied on involvement of indigenous people. Hence, this study takes Niue, an island state in the Pacific as a spearheading example of ocean management lead by the people of Niue. This study aims at clarifying key elements to make ocean planning and management success.

METHODS

The author visited Niue in November 2024 to conduct interviews to major stakeholders. Semi-structured interviews were conducted using snowball-sampling. In total, the author made 34 interviews, which reached ample geographical coverage, i.e. 13 out of 14 villages of Niue.

RESULTS AND DISCUSSION

All the interviewees in Niue supported no-take protection of 40% of EEZ. Many of them said the reason "for future generation". One interviewee said "Even our sea tracks, we always close when there's someone died in your family who usually go to the sea tracks. (snip) When we open it, when we go down, there's plenty fish. (snip) The practices we've done in our all villages just prove that". Residents in Niue has experienced recovery of coastal resources due to customary coastal no-take practices called "tapu", which leads to support for no-take protection of offshore area, too.

CONCLUSION

As is proved through the interviews in Niue, experiences of success in recovering coastal resources by exercising customary practices of no-take can lead to support for no-take protection in offshore area. Similar customary practices of coastal resources management exist in other countries in the Pacific islands' region. Recognition of significance of the customary practices by outsiders may strengthen local effort for conservation and sustainable use of ocean resources in the Pacific islands' region.

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ACKNOWLEDGMENTS

The author would like to deeply thank interviewees of Niue, officers of Niue Ocean Wide, Prof. Quentin Hanich from ANCORS, and all collaborators and people who supported the research. The author appreciates funding support by the Japan Foundation for a project entitled "Wellbeing Ocean Planning and Management in the Indo-Pacific" as a Japan Foundation Indo-Pacific Partnership Program.

Satoumi and Sustainable Blue Economic Development in Indonesia

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INTRODUCTION

Indonesia, the world's largest archipelagic nation with over 17,000 islands and 81,000 km of coastline, is endowed with immense marine and coastal resources vital to its socio-economic development[1]. The concept of a sustainable blue economy, which integrates economic growth with environmental protection and social equity, is critical for harnessing these resources responsibly[2]. Satoumi, originating from Japan, emphasizes harmonious interactions between humans and coastal ecosystems through community-based management, ecosystem restoration, and sustainable resource utilization[3]. This study explores how Satoumi principles can be adapted to Indonesia's socio-ecological context, highlighting case studies from Karawang, Raja Ampat, Gili Matra, North Sulawesi, and Maluku.

METHODS

This study employs a qualitative descriptive approach combining literature review, policy analysis, and case study examination. Academic publications, government reports, and international policy documents were reviewed to understand Satoumi's theoretical and practical relevance[4]. Policy analysis focused on the alignment of national marine strategies with Satoumi principles. Case studies from Karawang, Raja Ampat, Gili Matra, North Sulawesi, and Maluku were evaluated based on ecological outcomes, socio-economic impacts, and governance innovations.

RESULTS

The findings reveal significant ecological, economic, and social benefits from Satoumi-based approaches across Indonesia's coastal regions. In Karawang (West Java), Integrated Multi-Trophic Aquaculture (IMTA) systems introduced since 2018 increased fish and seaweed production by 35–40%, boosted fishermen's income by 25%, and improved water quality through nutrient absorption[5]. In Raja Ampat, coral transplantation efforts since 2015 restored approximately 45 ha of reefs, increasing coral cover from 30% to 65% and enhancing reef fish biodiversity by 50%[6]. Community-based management in Gili Matra has increased coral cover by 35% and diversified local livelihoods through eco-tourism. In North Sulawesi and Maluku, Satoumi-driven co-management and ecosystem restoration projects improved governance effectiveness and community participation.

DISCUSSION

The results demonstrate that Satoumi aligns well with ecosystem-based management and supports Sustainable Development Goal 14 (Life Below Water)[2]. Its emphasis on participatory governance, local knowledge integration, and adaptive management makes it a valuable tool to address overfishing, habitat degradation, and climate change impacts[3]. Economic benefits, such as increased income and job creation, show that Satoumi can drive inclusive blue economic growth. However, challenges remain, including policy fragmentation, insufficient funding, and capacity gaps[1]. To scale up Satoumi's impact, stronger legal frameworks, multi-stakeholder collaboration, and integration into national marine spatial planning are essential.

CONCLUSION

Satoumi offers a comprehensive, community-centered approach to advancing Indonesia's sustainable blue economy. The case studies from Karawang, Raja Ampat, Gili Matra, North Sulawesi, and Maluku illustrate significant ecological restoration, socio-economic benefits, and governance improvements. Integrating Satoumi principles into national marine strategies will enable Indonesia to balance economic growth with marine conservation and strengthen its position as a global leader in sustainable ocean governance.

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Co-designing coastal monitoring system for Satoumi using smart phone: a case from Indonesia

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INTRODUCTION

PICES (North Pacific Marine Science Organization) and researchers in Indonesia have been conducting a project to monitor coastal ecosystems by Indonesian local people using smartphone. This project is funded by Overseas Development Assistance (ODA) Fund from Ministry of Agriculture, Forestry and Fisheries of Japan. We employed the Transdisciplinary Research approach[1] proposed by Mauser et al (2013), or Transformative Ocean Science[2] by UNESCO-IOC (2021) to co-create data and knowledge for Satoumi.

METHODS (Free to use title names hereafter)

We organized stakeholders meeting at coastal towns in Indonesia and co-designed the monitoring items such as water quality, fish catch, floating plastics, etc. Organizations of local fishers participated in project meetings and training workshops. Local province governments supported our project to differentiate their area as a destination of eco-friendly tourism. MOU was singed by PICES and Indonesian Institutes and university.

RESULTS AND DISCUSSION

Based on the results with stakeholders, a Smartphone application software, named FishGIS, was developed (Fig.1) . Coastal water colour was monitored using the app., and seasonal changes were detected. Photos of coastal small-scale fishers landings were collected. Unisg AI, those photos are analysed, and preliminary stock analysis was conducted. Strong supports from coastal cominities is the key of capacity building. Fishers who had finished training course provided by the project became a trainer to teach other local people. Sense of ownership and pride enhanced sustainability and effectiveness of the project.

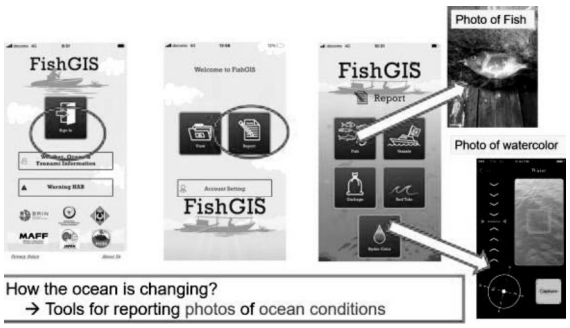

Fig. 1 Image of FishGIS app.

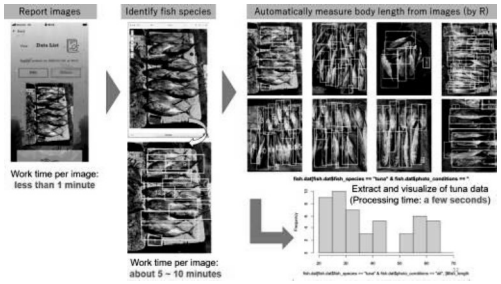

Fig.2 Image of AI analysis

Fig.3 Group of local fishers and NGOs in Indonesia.

Sincee 2024, this approach was imported to Japan and representative coastal fishers from all over Japan are now monitoring changes of coastal ecosystems and fish catch.

CONCLUSION

In order to effectively cope with the social and natural changes, integration of all knowledge in the society is needed. Scientific knowledge is just one of them. Collaboration with local people with help from modern technology is an effective approach to realize Satoumi.

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Visualization of Citizen's Vista, Future Vision, and Its Vector: A Practical Case Study from the Seto Inland Sea of Japan

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INTRODUCTION

Japan's coastal management has shifted from pollution control toward holistic approaches integrating ecological richness and social well-being. The Seto Inland Sea Environmental Conservation Act (amended 2021) and the revised Basic Plan (2022) emphasize the creation of Satoumi—coasts sustained by harmony between people and nature. However, translating this policy vision into practice requires understanding how local citizens project both desirable and undesirable futures. Previous studies on Marine Spatial Planning (MSP) have demonstrated that early and continuous stakeholder participation enhances policy legitimacy and effectiveness[1]. Moreover, adaptive planning frameworks such as Dynamic Adaptive Policy Pathways (DAPP) have stressed the need to design multiple future trajectories under deep uncertainty[2]. Building upon these insights, this study explores residents' future visions of the Seto Inland Sea, as collective "vistas" and "vectors."

METHODS

A free-association questionnaire survey was conducted among residents in 11 prefectures bordering the Seto Inland Sea. Participants described their desirable and undesirable futures for the sea over three temporal horizons: 5, 10, and 20 years ahead. Similar participatory visioning approaches have been shown to integrate diverse knowledge and promote dialogue[3].

Text data were analyzed using Structural Topic Modeling (STM)[4] combined with network analysis to visualize co-occurrence patterns among topics. Two analytical dimensions—temporal horizon and polarity (positive/negative)—were incorporated to construct a trajectory network representing how collective visions evolve and diverge over time. This "vista–vector visualization framework" allows both the clustering of thematic structures and the mapping of transitions among future scenarios.

RESULTS AND DISCUSSION

As results, two dominant patterns emerged: (1) Positive visions shifted from "beautiful landscapes" and "rich fisheries" to "tourism, regional development," and finally to "climate adaptation and disaster prevention." (2) Negative trajectories remained anchored in concerns over "pollution" and "marine litter," later extending to "resource depletion" and "biodiversity loss" (Fig. 1).

These contrasting yet interrelated paths suggest that residents' mental models of the sea form a continuum between ecological and socio-cultural dimensions. The differences in temporal orientation reveal a continuum between ecological and socio-cultural values, linking short-term livelihoods with long-term resilience and supporting adaptive Satoumi governance.

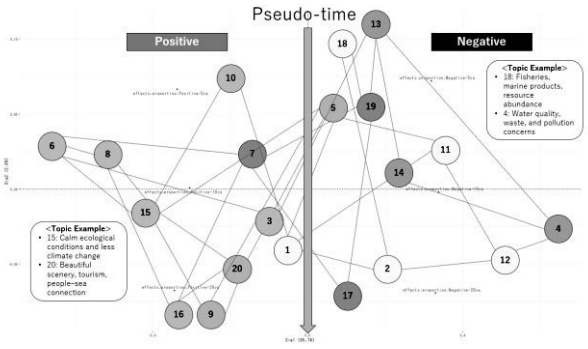

Fig. 1 Visualization of participants' future visions by temporal horizon and polarity

CONCLUSION

The vista–vector visualization framework developed here offers a novel tool for exploring how citizens perceive and navigate the future of coastal environments. By simultaneously considering desirable and undesirable futures across time horizons, it provides actionable insight for inclusive, adaptive, and participatory Satoumi planning. This approach contributes to bridging ecological science and social imagination toward sustainable coastal management.

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East Asia Regional Sea: UNDP/PEMSEA - History, functioning and perspectives

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This study analyzes the governance system established by the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) and clarifies its structural and functional characteristics.

PEMSEA originated from the *Regional Programme on Building Partnerships in Environmental Management for the Seas of East Asia*, launched in 1999. It is a regional partnership comprising 11 government partners—Cambodia, China, the Democratic People's Republic of Korea, Indonesia, Japan, the Lao People's Democratic Republic, the Philippines, the Republic of Korea, Singapore, Timor-Leste, and Viet Nam—together with 22 non-governmental partners[1] and six donor partners[2]. The PEMSEA Resource Facility, which serves as its secretariat, is based in Manila, Philippines.

PEMSEA adopts a partnership-based approach rather than a treaty-based mechanism. As such, it does not create legally binding rights or obligations among its members. Its activities are guided by the *Sustainable Development Strategy for the Seas of East Asia (SDS-SEA)*, under which PEMSEA functions as the regional coordinating mechanism for implementation.

The SDS-SEA provides participating governments and partners with a shared vision, joint strategies, and coordinated implementation approaches aimed at achieving sustainable regional development. Recognizing the significant financial requirements for implementation, the Global Environment Facility (GEF), as a donor partner, approved a ten-year project (2007–2017) to support the execution of SDS-SEA (2003)[3], covering incremental costs associated with regional environmental management. The 2003 framework also established PEMSEA's institutional structure, including the *Partnership Council*, the *Resource Facility*, the *Regional Partnership Fund*, and the *East Asian Seas Congress*, convened every three years to oversee and coordinate implementation[4].

SDS-SEA promotes the formulation and implementation of national policies and action plans for sustainable ocean development, the expansion of integrated coastal management (ICM) programs at national and local levels, and the creation of knowledge-sharing networks through South–South and North–South cooperation[5]. The second phase, SDS-SEA (2015), with subsequent implementation plans (2018–2022 and 2023–2027), places stronger emphasis on advancing the blue economy through ICM, enhancing resilience to climate change, and strengthening disaster risk reduction strategies.

Although PEMSEA, supported by UNDP and GEF, seeks to advance regional strategies comprehensively under a cooperative framework, its progress largely depends on the voluntary commitment of individual member states. Consequently, PEMSEA represents a *non-binding and flexible system of regional ocean governance* in East Asia.

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Act local think global:
how to make the best out of multilateral environmental agreements for local stakeholders' involvement

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INTRODUCTION

The Ocean is one dynamic, interconnected ecosystem impacted by human activities and climate change, making the overall socio-ecosystem highly complex. Managing this complexity requires more than one-size-fits-all rules, it demands a layered, collaborative approach.

METHODS

Nested governance is a way of organizing ocean management across multiple scales (1). It is related to the management of the commons, i.e. how communities' self-governance can be achieved in the context of complex and dynamic social and physical environments (2).

RESULTS AND DISCUSSION

Nested governance happened at various scales: local, where coastal communities manage fisheries, marine protected areas, or pollution control; national, where Governments set laws for territorial waters, exclusive economic zones (EEZs), and marine industries; regional, with neighboring countries sharing the same large marine ecosystem like in the North-East Atlantic and North-West Pacific; and finally global, through global agreements and implementing international bodies under UNCLOS, now reinforced by the BBNJ agreement, setting overarching rules for the high seas and global marine issues. Each level has its own responsibilities, but they are designed to work together, both ways, with coordination, feedback, and shared goals.

Regardless of whether large-scale marine areas occur in national or international waters, their protection provides a unique set of challenges. These areas often encompass large, pelagic processes and are also likely to encompass highly migratory species or dynamic oceanographic features that move in and out of an area's stationary legal boundaries. The animals or habitats may also be exposed to threats beyond the area's boundaries, and the threats they face outside must be accounted for in the development of protection measures and later in the creation of management plans and targets that will be effective as well as realistic and feasible. In addition, the Law of the Sea, reflected in the 1982 United Nations Law of the Sea Convention, recognizes significant differences in the regimes of national and international waters.

CONCLUSION

In such a context, the key question is how to drive local stakeholders' interest to get involved in coastal and ocean management at a bigger scale. Without peoples' and civil societies' participation, there is a great risk that the human heritage of mankind which is the ocean, be altered by economic interests and States' unilateral decisions.

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The Barcelona Convention and Marine Conservation Governance in the Mediterranean: Progress, Partnerships, and Challenges

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The Barcelona Convention constitutes the primary legal and institutional framework for marine conservation in the Mediterranean. It is reinforced by protocols and strategies focused particularly on biodiversity and coastal management, while also maintaining close interlinkages with European policies and alignment with global frameworks. This presentation will outline the Convention's institutional architecture, governance mechanisms, and financial arrangements, before focusing on cooperation dynamics at the Regional Sea level.

Over the years, the Convention has established a solid basis for coordinated action, fostering collaboration with regional and international organizations as well as supporting initiatives. Nonetheless, significant challenges persist, notably in ensuring sustainable financing, enhancing private sector engagement, and strengthening integration from local to regional levels to achieve long-term conservation goals.

Promotion of "UMIGYO" by the Fisheries Agency
(Lecture Summary)

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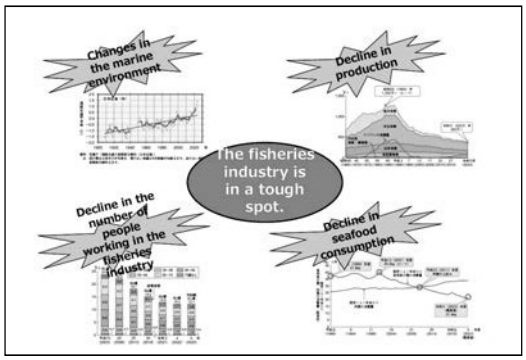
INTRODUCTION

Japan's fisheries industry is facing several serious challenges. Fishing villages—where fisheries are a key industry, are struggling due to declining catches caused by changes in the marine environment. There has also been a decrease in seafood consumption and in the number of people employed in the fisheries industry.



On the other hand, fishing villages possess diverse local resources, including not only fresh seafood but also a rich natural environment providing recreational opportunities such as fishing and seaside bathing. With an annual visitor population of approximately 20 million people (FY 2023: approximately 24 million), these villages have great potential for tourism and other activities.

Many people visit the fishing village.

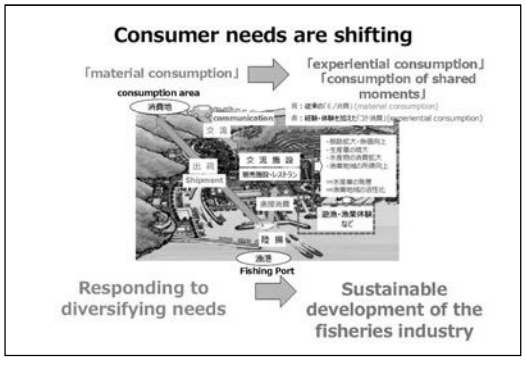
Approximately 20 million people !

(unit : thousand people)

	2018	2019	2020	2021	2022	2023
Exchange population of fishing villages	20,024	20,222	18,558	20,108	23,420	23,710

FROM MATERIAL CONSUMPTION TO EXPERIENTIAL CONSUMPTION

This shift is thought to stem from a change in consumer needs, evolving from "material consumption" such as seafood consumption to "experiential consumption", and further to "consumption of shared moments", where participants share emotional experiences. Consequently, many people are visiting fishing villages to experience these diverse local resources.



WHAT IS "UMIGYO"?

UMIGYO, which fully utilizes the local resources unique to fishing villages and therefore has a mutually complementary relationship with the fisheries industry, will promote exchanges with other regions such as cities and respond to diversifying consumer needs. This approach is expected to generate local vitality, income, and employment, and ultimately lead to the sustainable development of the fisheries industry.

"UMIGYO" are included in the national plan.

March 2022 "UMIGYO" is included in the Basic Fisheries Plan and the Long-Term Plan for Fishing Port and Fishing Ground Development.

Definition of "UMIGYO"

Businesses that utilize the value and appeal of regional resources such as the sea and fishing villages

Increasing regional income and securing employment opportunities

PROMOTION OF "UMIGYO" BY THE FISHERIES AGENCY

In light of these circumstances, the Fisheries Agency is actively promoting UMIGYO initiatives and has incorporated them into national plans.

In this presentation, we will introduce the main initiatives being undertaken by the Fisheries Agency to promote UMIGYO, along with examples of UMIGYO initiatives being implemented nationwide.

Promoting UMIGYO and expanding nationwide initiatives

Key Initiatives

① Promotion of the "Fishery Port Facility Utilization Project"
② UMIGYO Promotion-Related Budget
③ Information dissemination, horizontal deployment
④ System

How to Create Contents For “Umigyo” Based on the Concept of Attractive Fishery

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INTRODUCTION

JF Toba Isobe Fisheries Cooperative is a merged fisheries cooperative covering Toba City and parts of Shima City in Mie Prefecture. Since 2024, our cooperative has been advancing the “Umigyo” initiative, aiming to overcome challenges facing Japan's fisheries sector and achieve sustainable fisheries while revitalizing the local economy. Our fundamental approach to the “Umigyo” is to “monetize “Umigyo” content and return profits to fishers” in order to protect Japan's seas and fisheries. Below are examples of our “Umigyo” initiatives.

1. Adding Value to Local Resources: “Toshijima Toro Sawara” that is Pole-Caught Fatty Spanish Mackerel from Toshijima Island

In Toba City, known as a town of fishery and tourism, the fisheries cooperative, tourism office, city hall and others collaborate to build a mutually beneficial relationship between both fishery and tourism industries. One example is the branded fish “Toshijima Toro Sawara”, launched in 2018. This initiative aimed to add value to the fatty Spanish mackerel, which is in season during winter in Toba, and enhance its market appeal. This branding increased the market price to up to 3.3 times higher than before. In addition, by having clearly mark their catch with their vessel's name, fishermen are fostering a sense of responsibility to improve quality.

2. Toto-mi: A Fisheries Cooperative-Operated Seafood Restaurant

Opened in 2009, Toto-mi is a fisheries cooperative-operated restaurant aiming to address the price of landed fish, solve seafood distribution issues, and promote local food. It primarily serves fish caught in the local shore, is praised for not relying on popular but locally unavailable fish such as bluefin tuna and salmon.

3. Toba Marche: A Local Products Antenna Shop

Established in 2015 through joint investment by the agricultural and fisheries cooperatives, Toba Marche is an antenna shop located opposite Toba Station that sells local agricultural, marine and processed products. By implementing a system where producers set their own prices and selling highly fresh products purchased at the fish market by the fisheries cooperative, it contributes to increasing producers' income and improving fish prices.

4. Local Tours: Where the Entire Island is the Attraction

Toba City has four remote islands, with fishery as the primary industry. Each island has its own unique culture and customs. The island scenery itself offers an escape from everyday life. Tourism offices within Toba City plan programs that let visitors experience fishing and island daily life, offering local tours that showcase the entire island as a tourist attraction.

5. Communicating Marine Issues Through Food: The Blue Carbon Project

This initiative aims to address marine environmental challenges by promoting the consumption of the herbivorous rabbitfish “Aigo *(Siganus successes)*,” a species known to decline seaweed beds. Although rabbit fish have been considered to have little commercial value, collaboration among fishers, processors and retailers has established a supply chain enabling to distribute fresh Aigo. Through study sessions at elementary schools, school lunch programs and tasting events, we are conveying to the next generation about marine issues and the importance of food.

Furthermore, the Cooperative is advancing initiatives related to “blue carbon.” In March 2024, we received credit certification for 71.6 t-CO2 from nori (*Porphyra umbilicalis*) and wakame (*Undaria pinnatifida*) farming. This is the first case that nori farming was certified in Japan. These revenues are being utilized for environmental restoration activities and expanding collaboration with the tourism industry.

CONCLUSION

These initiatives, led by fishermen and involving collaboration with various local stakeholders (tourism industry, city government, schools, businesses, etc.), are expanding the potential of the “Umigyo” beyond mere primary industries. The "special daily life" experienced by tourists and inbound visitors, such as fishing, “ama” female divers' culture and daily life on remote islands, is also a source of new value. JF Toba Isobe Fisheries Cooperative will continue to strive for sustainable fishery and regional revitalization through upgrading seafood processing facilities and offering experiential tourism programs.

*This abstract is machine translated from Japanese.

Cooperation Work under MOU between FRA（Japan Fisheries Research and Education Agency） and Ifremer（French Research Institute for Exploitation of the Sea）

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ABOUT FRA

The Japan Fisheries Research and Education Agency (FRA), a national research and development (R&D) organization, is engaged in various activities designed to ensure stable production and supply of aquatic resources, as well as promoting the sustainable development of the fisheries industry.

Under the supervision of the Minister of Agriculture, Forestry and Fisheries, FRA has formulated its fifth medium- to long-term plan covering the five-year period from fiscal 2021 to fiscal 2025, and has established three research areas.

1. Research and development of marine resources for the sustainable growth of the fishing industry
2. Research and development on production technology for the sustainable development of the fishing industry
3. Research and development for the establishment of new production technology in fisheries and aquaculture.

ABOUT MEMORANDA OF UNDERSTANDING

In 1974 (revised in 1991), the France-Japan Scientific and Technical Cooperation Agreement and its annex were signed between France and Japan.

In 2015, the first Memorandum of Understanding (MOU) on Cooperation in Fisheries Science and Technology was signed between Ifremer and FRA.

The purpose of the MOU was to define the conditions under which the two parties would develop their existing partnership through cooperative activities in fisheries science and related technologies, based on equality and mutual benefit.

Since 2022, the second MOU has been in place between Ifremer and FRA.

METHODS OF COOPERATION

We have cooperated in the following four methods:

- Workshops and symposia
- Promotion of personnel mobility
- Exchange of information
- Joint research projects

MAIN AREAS OF COOPERATION (2015-)

Since 2015, the main areas of cooperation include the following eight topics (Integrated Coastal Management and Ecosystem, Seashell farming (bivalves), Aquaculture Systems, Aquatic Animal Disease, Fisheries Oceanography (monitoring, forecast), Marine Genomics, Harmful Algal Blooms, By-catch and Bio-logging).

The main areas of cooperation from 2022 onwards have been the following seven topics: Coastal Ecosystem and Bivalve Production, Sustainable Aquaculture, Disease, Harmful Algal Bloom, Marine Genomics, Bycatch and Biologging, Fisheries Ecology.

Based on these topics, previous studies included:

- 2015-18 Cooperative Research on “Integrated coastal management for bivalves aquaculture, to establish stable supply chain and high quality”.
- 2017-18 Cooperative Research on “Integrated ecosystem management for exploited coastal ecosystem dynamics under oligotrophication”.
- 2017/5-11 Cooperative research on the production of algal biomass and isolation of toxins from Ostreopsis and Gambierdiscus species.
- 2017-2019 FRA - Ifremer, cooperative research meeting and survey of oyster and seagrass in Thau lagoon .

Ongoing research and future activities include:

- 2023 Cooperative research on clam stock restoration under Topic I: Coastal Ecosystem and Bivalve Production.
- 2023 Exchange of information on Bycatch.

Currently, there are shared concerns about environmental changes due to climate change, ocean acidification and coastal oligotrophication and their impact on fisheries and aquaculture production. We hope to continue working together to address these issues.

Progress in clam study under the second MOU between Ifremer and FRA

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The joint research under the first phase (2017-2022) MOU between Institut Français de Recherche pour l'Exploitation de la Mer (Ifremer) and Japan Fisheries Research and Education Agency (FRA) focused on ecology of oyster aquaculture. In the current second phase (2022–2027), we are conducting research on the theme of 'Coastal Ecosystems and Bivalve Production' in response to a request from Ifremer. This research examines the relationship between the decline of clam fishery resources (Manila and European clams) in Japan and France and the changing state of their coastal ecosystems. The project will also address the challenges associated with countermeasures for resource decline. To date, both parties have actively held mini-symposia and workshops for research presentations and information exchange at Ifremer and FRA, as well as field visits and surveys at Ifremer's research site, the Thau Lagoon, and the Japanese research area, the clam fishing grounds in Mie Prefecture. These efforts revealed that Japan and France face similar environmental challenges, including common issues such as rising seawater temperatures due to global warming and heatwaves, coastal oligotrophication, and associated changes in the food environment for bivalves. In 2023, at the joint research session at the 19th French-Japanese Symposium of Oceanography in Caen, France, we presented our research progress. In 2025, at the International Manila and European Clam Conference hosted by Ifremer in Arcachon, France, the team attended at Ifremer's invitation and delivered a keynote speech and research presentations, and visited a fishing ground of the Arcachon Bay accompanied by fishers. Furthermore, an experiment (PALRNJ project) using mesh bags are being conducted between 2025 and 2027 to collect juvenile clams at various sites in the Thau lagoon, and some were collected as early as 2025. These samples are scheduled to undergo histological, genetic and DNA analysis for species identification and zoosanitary analyses. We plan to continue the mesh bag clam seed collection trials at Thau Lagoon, while advancing research on the feeding environment of bivalves. Collaboration between FRA and Ifremer regarding Arcachon issues may also be explored. The 20th Japanese-French Oceanography Symposium will feature a dedicated joint research session for presenting findings related to Ifremer-FRA joint research program.

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Management of *Ruditapes philippinarum* fisheries in Arcachon Bay, SW France: New challenges in a changing environment

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INTRODUCTION

In Arcachon Bay, along the Atlantic coast of France, professional structures, administration and scientists are involved in the management process applied to Manila clam since 2000. Among the « tools », co-organized surveys have been performed to assess the state of the clam population with the resulting management measures[1,2] and additional research projects have been implemented to better understand the population dynamics[3,4,5]. Until now, stock recoveries were observed after the introduction of the measures. But in 2023, fishers alerted to a drastic decline in the quantity of clams without any evidence of mass mortality. The latest survey in 2024 confirmed the collapse of the Manila clam population with fewer large individuals. The communication aims to identify the factors that may explain this decline and possible solutions.

METHODS

We investigated known factors that influence the biological functions of clams based on data from network monitoring (physicochemical parameters, phytoplankton, metal contaminants), research project results, and feedback from professionals (observations/reports: predators, rate of resource decline in stages).

RESULTS AND DISCUSSION

The main following changes identified for the Bay are:

- Hydrological conditions marked by recent high rainfall and temperatures (REPHY network), and episodes of corrosive water observed and expected to intensify (CocoriCO2 project);
- Major shifts in intertidal habitats, with seagrass decline from hydrodynamic and sediment changes causing self-regression[6], and *Arcuatula senhousia*-driven microtopography potentially increasing local currents[7];
- Nutrient shifts between 1999 and 2018 affected phytoplankton biomass[8] and may have favored dinoflagellate dominance in recent decades;
- Observed population increases of *Hexaplex trunculus*, a clam predator (fishers observations);
- Pathologies, genetics, and pollution have also shown effects in other studies not detailed here.

Insofar as no major mortality episodes are observed, sub-lethal processes seem to be the main driving force. Based on these observations, Figure 1 synthetizes the realized/potential actions to ensure sustainable exploitation of the Manila clam resource. Some are already in place, while others, such as reseeding and alkalinization of the environment, are to be tested in the Bay.

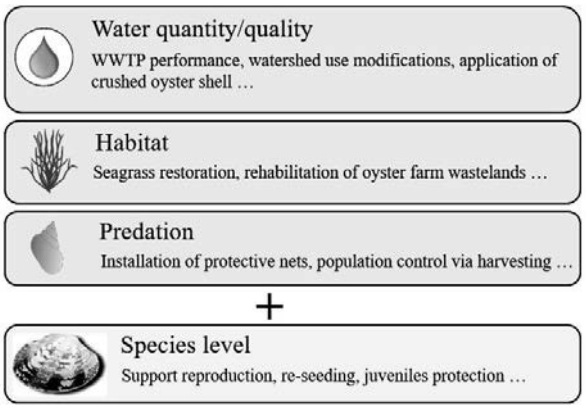

Figure 1 Realized/potential actions to ensure sustainable exploitation of the Manila clam in Arcachon Bay

CONCLUSION

Management relies on a systemic triptych of resources, environment, and exploitation, reflecting an ecosystem-based perspective. Currently fishing effort is expected to decline naturally due to low economic profitability, constrained by limited access and time at sea. In parallel, spatial management within the Marine Park focuses on habitat conservation and restoration. More targeted actions on Manila clam habitat may enhance clam stocks, following a “marine gardening” model where human intervention supports ecological functions for sustainable fisheries. The level of intervention remains to be defined with a potential shift requiring social acceptance to be effective.

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Protective effect of crushed stone laying on Manila clam (Ruditapes philippinarum) juveniles in Funabashi, Tokyo Bay.

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INTRODUCTION

Multiple factors may contribute to the decline of Manila clam resources, including overfishing, starvation, hypoxic conditions, river flushing, erosion by strong waves, and the introduction of new predators, parasites, or diseases. To date, the exact causes of the long-term, large-scale decline at the bay level remain unclear. However, techniques for resource protection have been developed at smaller spatial scales. On tidal flats, waves and currents mobilize bottom sand and form ripples. Localized eddies generated around these ripples can readily lift and transport juvenile clams to unsuitable environments, leading to high mortality. The of crushed stone on tidal flats has been proposed as a countermeasure to reduce juvenile clam losses caused by waves and currents.

METHODS

In this study, crushed stones with a diameter of 5.0 mm were spread over an area of approximately 1,500 m² (25 m × 60 m) in Funabashi, Tokyo Bay. The distribution density of clams was then monitored for eight months and compared between the crushed stone area and a surrounding control area without crushed stone.

RESULTS AND DISCUSSION

The distribution density of clams in the crushed stone area began to increase one month after installation. In contrast, the density in the control area decreased significantly from fall to winter due to intensification of waves and currents. After the eight-month study period, the density of clams in the crushed stone area was approximately seven times higher than that in the control area. These results suggest that the placement of crushed stone is an effective measure for protecting Manila clam resources, particularly during fall and winter.

Roadmap for the Ifremer COAST Unit within the framework of the FRA/Ifremer MOU: challenges and prospects in the context of climate change

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INTRODUCTION

The evolution of coastal ecosystems and the sustainability of the activities that develop within them (aquaculture, fisheries, tourism, nautical activities, etc.) are major concerns for the French State, the local authorities responsible for managing and preserving these ecosystems, the professional sectors involved, and, more broadly, civil society. These ecosystems are subjected to multiple pressures—natural drivers, pressures induced by climate change, and anthropogenic impacts—which may act in combination.

The growing awareness of the value of these environments, of the ecosystem services they provide, of their fragility, and of the pressures they face has raised significant concerns and questions. In response to these challenges, scientific knowledge and expertise are essential to assess the condition of ecosystems, to understand their functioning, and to anticipate their responses to evolving pressures. Such knowledge and expertise are also critical to supporting management actions aimed at conserving and restoring biodiversity, both animal and plant, as well as the ecosystem services associated with them.

RESULTS AND DISCUSSION

In this context, Ifremer has established a new research Unit entitled *"Observation and Ecology of Coastal Ecosystem Restoration"* (COAST). Its primary mission is to investigate the functioning and trajectories of coastal ecosystems under multiple pressures, with the aim of contributing to their conservation and restoration. To achieve this, the COAST unit is developing an approach to the ecology of coastal conservation and restoration in response to public policy priorities and societal demands. The Unit's main scientific challenges are:

- deciphering the ecological functioning of coastal ecosystems and their interactions with pressures and associated ecosystem services,
- studying the trajectories of coastal ecosystems through observation, experimentation, and the analysis of historical time series, in order to understand past and present dynamics and to model future trends,
- assessing the effectiveness of conservation and restoration solutions for coastal ecosystems.

To implement its project, the COAST unit (https://coast.ifremer.fr/) brings together nine Environmental Resources Laboratories (LERs) and a laboratory dedicated to data management and valorization, distributed across fourteen sites covering the entire French metropolitan coastline. The main missions of these laboratories include:

- observing the coastline (monitoring networks and assessments of marine environmental quality),
- studying coastal and shellfish ecosystems,
- monitoring the quality of shellfish products in their natural environment,
- providing expert advice and recommendations to decentralized State services,
- managing, valorizing, and transferring knowledge.

CONCLUSION

This presentation will highlight, through selected examples, the observation and research activities carried out by the COAST unit.

From monitoring to ecological insights: Decadal observations of phytoplankton in French coastal waters

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In 1984, IFREMER established the national network for monitoring marine phytoplankton and phycotoxins (REPHY), with both environmental and sanitary objectives. Since then, the network has evolved in its sampling strategies and operations to address scientific and societal challenges related to global change.

Today, the REPHY (2023) provides high-quality long-term time series on phytoplankton diversity, abundance, and biomass in French coastal waters, complemented by physico-chemical and hydrological measurements. A standardized protocol ensures sub-surface sampling, microscopic identification, and open-access data archiving. Also, as part of the national initiative that created PHYTOBS-NETWORK (2024), a portion of REPHY data is now integrated alongside historical SOMLIT data to provide validated, quality-controlled datasets for the scientific community and partners. Key objectives include analyzing temporal trends to understand phytoplankton responses to environmental changes, shifts in phenology and species distributions, characterizing ecological niches, and functional traits.

Here, through this presentation, we synthesize how these long-term time series improve our understanding of coastal system evolution under global change. Based on two decades of phytoplankton species composition data from the Bay of Seine, we examine patterns and dynamics of community assembly, the influence of ecosystem changes on species distributions and community structure. We highlight insights into harmful algal blooms, potential effects of phytoplankton composition on consumers, and the use of modern monitoring methods to capture detailed, fine-scale changes in coastal phytoplankton communities. These long-term time series are essential for scientific research, ecosystem management, and monitoring harmful algal blooms. Once overlooked, they are now recognized as crucial for understanding and managing coastal ecosystem responses to global change.

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This work was carried out thanks to the long-term work of many people involved in the REPHY monitoring network and other supporting programs.

In-situ trophic ecology of benthic marine suspension feeders assessed with metabarcoding

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INTRODUCTION

Like the physical habitat (i.e., available space), trophic resources strongly influence the structure and functioning of coastal benthic communities. Suspension feeders, which often dominate these communities, exhibit high trophic plasticity, although phytoplankton and resuspended microphytobenthos remain their primary food sources. Additionally, the various co-occurring groups and species employ more or less sophisticated physiological mechanisms to efficiently capture these resources. While several methods are available to study their *in-situ* diets, the use of molecular approaches has increased considerably over the past decade, driven by continuous improvements in sequencing technologies and associated cost reductions[1]. Metabarcoding allows the detection of DNA from degraded prey, offers high taxonomic resolution, and provides insights into short-term feeding patterns—essentially the 'diet of the day'. However, to date, only a dozen studies using DNA-based methods have focused on suspension feeders, and several technical steps remain critical. In this study, we evaluated: (i) multiple steps of the DNA analysis pipeline (e.g., marker gene selection, host-blocking primers, impact of fragment length on taxonomic resolution, choice of reference database), and (ii) the relevance of various DNA-based metrics for trophic ecology studies.

METHODS

Ten aggregates of the flat oyster *Ostrea edulis*, along with surrounding seawater, were collected at a single time point in the Bay of Brest (Brittany, France) in June 2023. Three other main suspension-feeding species were found to be associated with the flat oyster: the variegated scallop *Mimachlamys varia*, the red tubeworm *Serpula vermicularis*, and the long-clawed porcelain crab *Pisidia longicornis*. Gut contents, faeces, and seawater samples were analysed using a metabarcoding approach. A 360 bp region of the 23S rDNA was amplified, and the resulting sequences were taxonomically assigned using two separate databases. In addition, a 160 bp fragment corresponding to the V9 region of the 18S rDNA was amplified using both non-metazoan primers and universal primers combined with consumer-specific blocking primers to prevent the amplification of consumer DNA. Taxa selected or not selected for ingestion and/or assimilation were identified using Ivlev's index by comparing DNA proportional abundances between seawater and gut, and between gut and faeces, respectively. Dietary overlap between species was assessed using the Schoener index.

RESULTS AND DISCUSSION

The results showed that 18S rDNA should be preferred, as the lack of a suitable reference database for 23S makes its use more challenging. For 18S, non-metazoan primers more effectively prevented consumer DNA amplification compared to blocking primers, although the results were similar when considering only sequences assigned to phytoplankton. Using non-metazoan primers, 21% of taxa were identified to the species level and 32% to the genus level. The diet composition of the four suspension feeders was relatively similar, with a dominance of diatoms and dinoflagellates larger than 3µm, which does not support the occurrence of trophic partitioning under this specific phytoplankton community composition. In contrast, members of the class Mamiellophyceae, composed of cells smaller than 3µm, were abundant in seawater but almost absent from gut contents and faeces. However, significant differences in taxonomic composition were observed between gut and faeces, indicating that these two compartments reflect different temporal stages of ingestion and digestion. This highlights their complementarity and underlines the importance of including both compartments in future studies.

CONCLUSION

This study supports a methodological workflow for analysing the trophic ecology of suspension feeders using metabarcoding. The results were interpretable and informative, enabling assessment of diet composition and potential interspecific competition. However, temporal replication is needed to capture variability and strengthen ecological interpretations.

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Long-term impacts of climate change on phytoplankton communities and seasonality… potential impacts on Pacific oyster life traits?

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INTRODUCTION

In recent decades, oligotrophication and climate change have had an impact on the structure and functioning of aquatic ecosystems. The combined effects of these two forcing have been little studied, particularly on Mediterranean coastal lagoons, which are considered vulnerable sentinel ecosystems, harboring numerous ecosystem services. Phytoplankton communities are sensitive indicator for studying hydroclimatic changes, however there is a lack of knowledge about long-term changes in their trends and seasonality.

METHODS

Based on time-series analyses of a 22 years of environmental monitoring in a large coastal lagoon (Thau lagoon), we investigated trends in hydrological and climate variables as well as phytoplankton biomass and microphytoplankton abundances. We investigated the seasonal patterns of 56 dominant taxonomic units (TUs) of diatoms and dinoflagellates and identified the main hydrological and climatic variables determining the changes in their phenology.

RESULTS AND DISCUSSION

Our results show an unprecedented increase in seawater temperature of +0.09°C yr^{-1} from 1998 to 2019. Diatom abundance has decreased significantly over the last decade, with earlier peaks. The three main planktonic diatoms (*Skeletonema*, *Pseudo-Nitzschia* and *Chaetoceros*), dominant in spring and winter, all showed decreasing trends and changes in their phenonology for first two. In contrast, benthic diatoms (*Cylindrotheca*, *Nitszchia*, *Hantzschia*) and two other summer taxa increased steadily. Seawater temperature and solar radiation appear to be the main drivers of changes in community phenology.

CONCLUSION

The results of long-term phytoplankton monitoring are essential for identifying future changes in coastal ecosystems as such changes could have cascading impacts on all the food-web and are likely to have substantial economic repercussions, especially on bivalve shellfish farming activity. In the Thau lagoon, long-term trends in Pacific oyster life traits (mortality, growth, and condition index) have been primarily linked to climatic variations and to changes in phytoplankton communities.

ACKNOWLEDGMENTS

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ECOSCOPA, Network for monitoring the life cycle of Pacific oysters (*Magallana gigas*) to assess the impact of environmental and climate changes in France.

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The Pacific oyster (*Magallana gigas*) is a key species in global aquaculture and a major ecosystem engineer. In France, however, the species is currently facing significant environmental and anthropogenic pressures.

In the context of climate change, the ECOSCOPA network aims to implement a monitoring system of standardized Pacific oyster farming accross eight different coastal ecosystems. This monitoring network also develops physiological and environmental indicators for key stages in the life cycle of the Pacific oyster, in order to analyze its response to environmental pressures. It allows oyster farming professionals, government agencies and scientists to observe, understand and analyze the development of Pacific oysters in French production basins since the 1990s.

To this end, the network conducts bi-monthly monitoring of the physiology, growth, survival and reproduction of standardized oysters in relation to their immediate hydrological environment at eight contrasting sites across France, for which previous monitoring data exists.

More precisely, the growth and survival are monitored on three oyster year-classes transplanted in each spring. The reproduction is followed by tracking larval development and recruitment each summer. In terms of the environment, all the monitored sites are supplied with meteorological data from Météo-France and are equipped with high-frequency multi-parameter hydrological probes to measure temperature, salinity, fluorescence and turbidity. They are also subject to regular sampling for phytoplankton analysis from the nearest site in the national REPHY network (the French observation and monitoring program for phytoplankton in coastal waters).

After proving its usefulness in describing the impact of pathogens such as Ostreid Herpes virus and spat mortality over the past 15 years, this network is now also being used to monitor changes in the distribution of *Magallana gigas* habitats in northern France.

ECOSCOPA continues to serve as a national network, supporting public policy and professionals by providing long-term data series that improve our understanding of how coastal ecosystems function ecologically. There is a growing ambition to implement advanced integration tools, such as environmental DNA monitoring, in order to assess the impact of climate change on oyster farming ecosystems, as well as to improve the management of trends and disturbances by deepening our knowledge and understanding of them.

https://ecoscopa.ifremer.fr

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Field Monitoring for Successful Wild Oyster Spat Collection

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INTRODUCTION

Hiroshima Bay is the largest Pacific oyster *Crassostrea gigas* farming area in Japan. In this bay, wild oyster spat collection is conducted by settling wild larvae to collectors. Spat collection is the fundamental process in oyster aquaculture here, and its success is essential for stable oyster production. Our recent study indicated that filed monitoring of water temperature and food quantity during the early stages of oyster larvae (D-stage larvae) was effective in predicting the success of spat collection[1]. However, subsequent study suggested that information on the species composition of <10 μm sized diatoms (hereafter, small diatoms) which serve as food for larvae was necessary for more accurate predictions. In the summer of 2021, we isolated six species of small diatoms (see the Methods section) from Hiroshima Bay. In this study, we investigated which of these six small diatoms were suitable as food for oyster larvae through filed observations.

METHODS

Cyclotella sp.A, *Cyclotella* sp.B, *Cyclotella* sp.C, *Chaetoceros tenuissimus*, *Minidiscus comicus*, and *Skeletonema menzelii* were isolated from Hiroshima Bay. Since these small diatoms are difficult to identify using optical microscope, we developed quantitative PCR (qPCR) systems to quantify the DNA amounts (hereafter, DNA copy numbers) of each small diatom. Field observations were conducted at Ohno-seto strait (western Hiroshima Bay) at a frequency of five or more days per week from July to August 2023. The DNA copy numbers of six small diatoms in surface seawater were detected using qPCR system. Furthermore, D-stage larvae (< 90 μm) were collected by vertically towing a plankton net (mesh size 50 μm) from a depth of 5 m to the surface, and their numbers (D_d) were counted. Ten days after each D-stage larvae survey, collectors made from scallop shells were placed in the seawater for 24 hours, and the number of settled larvae ($S_{d'}$) were also counted. To assess the settlement success of D-stage larvae observed on day d, the settlement index[1] ($S_{d'}/D_d$) was calculated. The small diatom species suitable as larval food were estimated based on the relationship between the DNA copy number of each small diatom species and the settlement index.

RESULTS AND DISCUSSION

The high DNA copy numbers were detected for *Cy.* sp.A, *Cy.* sp.B, *S. menzelii* and *C. tenuissimus* during the observation period. A significant positive correlation was observed between the DNA copy number of *Cy.* sp.A and the settlement index, suggesting that *Cy.* sp.A was a suitable food for larvae (Fig.1A). On the other hand, a significant negative correlation was observed between the DNA copy number of *C. tenuissimus* and the settlement index, suggesting that *C. tenuissimus* was an unsuitable food for larvae (Fig.1B).

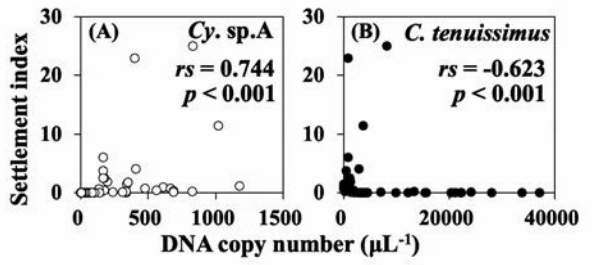

Fig. 1. Relationship between DNA copy number of *Cy.* sp.A and *C. tenuissimus* and the settlement index.

Although no significant positive correlation was observed between the DNA copy number of *S. menzelii* and the settlement index, *S. menzelii* was frequently dominant during periods with high settlement index (Fig. 2). Therefore, it was inferred that this species also serves as suitable food for larvae.

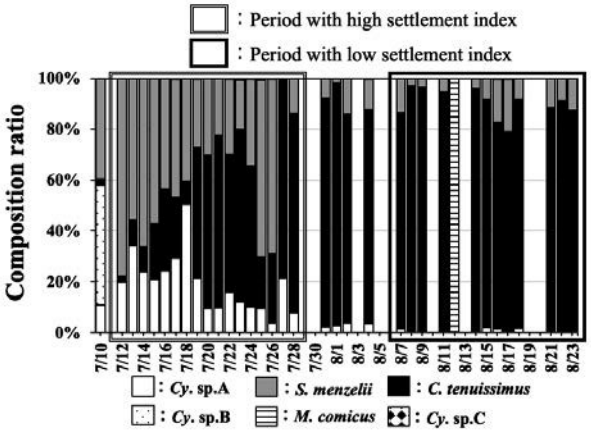

Fig. 2. Changes in the composition ratio of small diatoms.

CONCLUSION

This study showed that *Cy.* sp.A and *S. menzelii* might be suitable food for oyster larvae. This will be confirmed through feeding test using larvae in the future and is expected to contribute to improving the accuracy of settlement predictions.

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ACKNOWLEDGMENTS

This work was supported by EMECS Grants-in-Aid for young researchers.

Roadmap of the ODE scientific depratment
The ODE Scientific Department (Oceanography and Ecosystem Dynamics): Research focused on three fundamental areas

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INTRODUCTION

In the current context of climate change, where several planetary boundaries have already been transgressed or are on the verge of being crossed, it is imperative (i) to advance our knowledge of the ocean and its physical and biological functioning, and (ii) to evaluate the extent of anthropogenic impacts on the ecosystem and climate-regulating services provided by the ocean. As a key regulator of the Earth's climate, a major carbon sink, and a primary source of oxygen, the ocean represents an essential component of the Earth system that requires urgent protection.

The Oceanography and Ecosystem Dynamics (ODE) department focuses its activities on observing, modelling and understanding the physical ocean at different scales, as well as pelagic and benthic coastal ecosystems.

The department is composed of four research units:

- COAST: Observation and Ecology of Coastal Ecosystem Restoration
- DYNECO: Coastal Environment Dynamics
- LOPS: Physical and Spatial Oceanography Laboratory
- PHYTOX: Physiology & Toxins of Toxic & Harmful Microalgae

Within the framework of research, innovation, and public policy support, the department implements Ifremer's scientific strategy by focusing on three of its four priority themes:

- **A healthy and productive ocean**, where the development of next-generation observation systems, the advancement of sustainable aquaculture, and the conservation of biodiversity are key priorities.
  Thanks to its work observing the ocean in terms of its environmental, biological and ecosystem components, and its expertise in developing and monitoring strategies for conserving biodiversity and managing maritime space usage, Ifremer plays a decisive role in reconciling the challenges of food sovereignty and the preservation/restoration of biodiversity and ecosystems.
  "Combining a healthy ocean with a nourishing one" is therefore a natural priority theme.

- **An ocean as a driver of the energy transition**, where offshore infrastructures function as platforms for ecosystem observation and for the evaluation of their environmental impacts.
  Future observation must be more integrated and non-targeted, with samples collected at high temporal frequency and with broad spatial coverage, using technologies that are more autonomous and less disruptive to the marine environment.

- **Ocean scenario modelling**, where the digital twin is a virtual representation of the ocean. It can be used to simulate, analyse and optimise the behaviour of the physical object or process. Advanced modelling tools are employed to anticipate and project ocean dynamics in the context of climate change.

  The virtual replica of the ocean and its digital twins are now becoming essential in scientific research and the implementation of services and monitoring through major national and international initiatives.

  The entire observation chain must be adapted so that it can be integrated into digital twins, from the definition of experimental protocols, the choice of observations to be made, the definition and testing of sensors, data acquisition, their format, storage, management and quality monitoring.

  Ultimately, digital twin emulators, which serve as valuable demonstrators for the national and international scientific community and public authorities, should enable us to answer key questions related to energy, the impact of climate change (temperature, ocean acidity, water cycle, sea level rise, extreme events, etc.) and human activities on marine ecosystems (changes in biodiversity, the physical and chemical quality of the environment, biological or chemical contamination, sustainable fishing and aquaculture, and the impact of measures to reduce climate risks, etc.).

Development of indices of abundance of Mediterranean coastal fish populations using eDNA quantification

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INTRODUCTION

The French Mediterranean coastal fisheries are mainly artisanal and exploit a wide variety of species, but catches are poorly reported and subject to a high degree of uncertainty. As a result, none of the coastal species are currently assessed, meaning that the status of these stocks is unknown and, by extension, the sustainability of these coastal fisheries. Following advances in molecular techniques, we propose to develop indices of abundance for two key species of the artisanal fisheries of the French Mediterranean coast, the gilthead seabream and the seabass, by quantifying environmental DNA (eDNA)[1-3]. We will also aim to test the possibility of identifying key spawning areas and determining the age of fish, using eDNA[4].

METHODS

The project includes experiments in tanks (Ifremer station in Palavas-les-Flots) on seabream and seabass of known numbers, sizes, and ages to establish allometric relationships between abundance/biomass and eDNA quantity. Experiments with gametes and larvae will also be conducted to test the effectiveness of new molecular markers for detecting *in-situ* spawning areas and obtaining a proxy for age. A partnership between scientists and fishermen through participatory workshops aims at identifying sites where eDNA sampling will be carried out along the French Mediterranean coast.

RESULTS AND DISCUSSION

The project started early this year. Through this presentation, we will present the performances of different protocols to estimate eDNA quantities collected through seawater filtration, and the results of the first experiments that confirm the significant relationship between fish biomass and eDNA quantity (Fig.1).

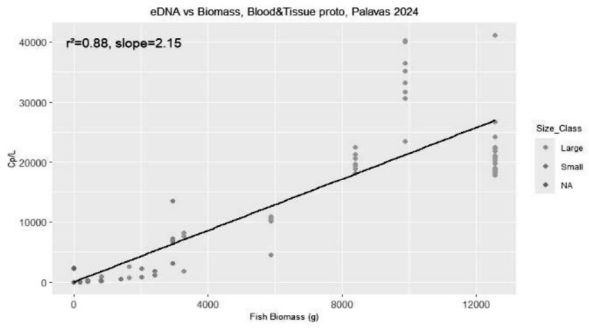

Fig.1: Relationship between fish biomass (g) in tanks and eDNA (number of copies/liter)

CONCLUSION

We will conclude about the main challenges regarding the protocol at sea and how eDNA sampling strategy at sea will be designed.

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Community Shifts and Fisheries Adaptation in Ise-Mikawa Bays: Integrated Insights from Small Trawl Fisheries and Scientific Surveys

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INTRODUCTION

In recent years, small trawl fisheries in Ise-Mikawa Bay have experienced significant changes in species composition of their catches. Traditional inner-bay species such as conger eel, and mantis shrimp have declined, while larger, offshore-associated species like red seabream, spanish mackerel, and pike conger have increased. These shifts would be closely linked to changes in benthic community structure and primary productivity, with notable implications for fishery operations. This study integrates long-term fishery records and scientific survey data to analyze community shifts and fishers' adaptive strategies.

METHODS

To clarify how individual vessels adapted to changes in target species, we classified 25 small trawl vessels operating from Toyohama Port based on species-specific annual landing values (2012–2021; 250 records) using hierarchical cluster analysis (Euclidean distance, Ward's method). The optimal number of clusters was determined using the SD index.

From 2023 to 2024, we conducted quarterly surveys at 15 fixed stations within Ise Bay using a small trawl net to collect comprehensive benthic fauna. For each specimen, total length and body weight were measured, and muscle tissue was sampled for stable isotope analysis of carbon and nitrogen, commonly used to infer trophic structure.

To assess changes in food-web structure before and after species turnover, we compared these data with muscle $\delta^{13}C$ and $\delta^{15}N$ values previously obtained for 12 species collected in 2011 under comparable conditions (species, size range, sampling season, and location). From the current dataset, we extracted species matching those from 2011 and compared isotopic ratios between periods.

RESULTS AND DISCUSSION

Cluster analysis of vessel-specific catch data (2012–2021) revealed diverse responses, including strategic changes in target species and operational adjustments. Some vessels maintained profitability by switching to emerging species.

Stable isotope analyses on the species of the community in the bay further implied shifts in carbon sources and trophic structure, indicating changes in primary production pathways within the bay.

These findings highlight the complex interplay between ecological dynamics and fishery adaptation, emphasizing the need for regionally tailored management approaches.

CONCLUSION

This presentation introduces an ongoing research project on community shifts and fisheries adaptation in Ise Bay and discusses the implications for coastal and inner-bay ecosystem changes, fishery responses, and the potential for ecologically informed management strategies under climate variability.

ACKNOWLEDGMENTS

We would like to thank all project members of the Japan Fisheries Research and Education Agency, universities and Aichi Fisheries Research Institute for their contribution to this work. This study was supported by Grant-in-Aid for Scientific Research (C) (KAKENHI No. 24K09120) and Grant-in-Aid for Transformative Research Areas (B) (KAKENHI No. 22H05027). The field sampling was conducted as part of the stock assessment project commissioned by the Fisheries Agency of Japan.

A Global Fish Tracking System and Pangeo-Fish: Advancing Collaborative, Interdisciplinary Biologging Data Analysis Using Digital Twin Technologies

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INTRODUCTION

The Global Fish Tracking System (GFTS) and Pangeo-Fish address key challenges in conservation and sustainable exploitation by integrating biologging (Data Storage Tags and acoustic telemetry) with high-resolution environmental information in a digital-twin framework (1,2). Destination Earth (DestinE) is a European Commission flagship initiative to build highly accurate digital twins of the Earth (3). By connecting fish-movement modelling to projections from the DestinE Climate Change Adaptation Digital Twin, the framework underpins an evidence-based decision-support tool for marine conservation and fisheries management. The implementation builds on the open-source Pangeo ecosystem—a community originating in ocean and climate physics and designed to tackle big-data analytics on high-performance computing and cloud infrastructure (4).

METHODS

The system comprises three components: (i) a Pangeo cloud infrastructure deployed on the DestinE platform; (ii) the pangeo-fish software that computes fish tracks from biologging data; and (iii) a decision-support tool for management use. Tracks are reconstructed using pangeo-fish software, which utilises a Hidden Markov geolocation model (5,6). The model is constrained by temperature/depth time series, bathymetry, acoustic detections, and release/recapture locations. Processing leverages cloud-native tools (Jupyter, Dask, Xarray, Zarr/VirtualiZarr) and Hierarchical Equal Area isoLatitude Pixelisation (HEALPix) to scale to terabyte-scale archives while maintaining provenance (7). Environmental reference fields are sourced from the DestinE Climate Adaptation Digital Twin and Copernicus Marine Service. The pipeline preserves HEALPix-native grids from ingestion to visualisation to avoid distortive resampling. HEALPix originates in cosmology; to the authors' knowledge, this represents one of the first applications of HEALPix to fish-tracking.

RESULTS AND DISCUSSION

Applying the Pangeo ecosystem—matured in ocean and climate physics for petabyte-scale analysis on cloud/HPC—to biologging enables higher throughput and reproducibility for state-space track reconstruction and downstream habitat inference. In parallel, HEALPix, originally developed in cosmology as an equal-area, iso-latitude tiling of the sphere, provides a domain-agnostic spatial index that improves workflow for path-likelihood evaluation.

The integrated workflow reduces compute time via chunked Zarr storage and Dask parallelisation and yields both most-probable tracks and daily presence probabilities with quantified uncertainty. A decision-support layer aggregates quarterly species distributions and intersects them with projections from the DestinE Climate Change Adaptation Digital Twin—operationally using IFS–NEMO outputs available to ~2040—to evaluate exposure of habitats under climate scenarios. GFTS has been onboarded as an early DestinE Platform use case and operates alongside DestinE Digital Twin services.

CONCLUSION

GFTS and Pangeo-Fish operationalise digital-twin approaches for biologging and oceanography by bridging state-space geolocation models and big-data infrastructure. Leveraging technologies from adjacent scientific domains avoids reinventing the wheel and enables an effective, reproducible platform. By making advanced methods accessible to biologists and decision-makers, the system supports biodiversity conservation and sustainable exploitation. Ongoing work targets broader integration on the DestinE user platform, connection to the European Tracking Network, and incorporation of additional environmental datasets and more species.

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Toward sustainable blue economy from blue carbon ecosystems

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INTRODUCTION

The contribution of blue carbon ecosystems as a CO_2 sink has been increasing attention in recent years. In Japan, methodologies have been successfully developed to calculate CO_2 sequestration by marine macrophytes, including not only seagrass beds but also macroalgal beds and seaweed aquaculture (FRA 2023). In 2024, the nationwide CO_2 sequestration by natural seagrass and macroalgal beds was officially registered in Japan's greenhouse gas inventory.

Seaweed is also recognized as a blue resource that is effective in promoting climate change measures (UNEP 2023), so that seaweed farming is rapidly spreading around the world. Research and practical application have been progressing not only for edible purposes but also for non-edible uses such as cascade utilization.

Furthermore, Japanese people have traditionally used seagrass and macroalgal beds as fishing grounds and fertilizer harvesting areas since ancient times. Local stakeholders have been managing them to increase their sustainability, suggesting that the Japanese local knowledge is adept at protecting seagrass and macroalgal beds while utilizing their functions.

Among the topics related to climate change countermeasures utilizing blue carbon ecosystems, this study introduce (1) methodology to calculate the CO_2 sequestration by marine macrophytes, (2) seaweed farming techniques to maximize both CO_2 sequestration and yields for cascade utilization, and (3) a management technique that enable to increase both CO_2 sequestration and manila clam stocks in seagrass beds.

METHODS

(1) Calculation method: the basic structure of the calculation formula was determined according to the IPCC Guidelines for Wetlands. Seagrass and macroalgal species distributed along the Japanese coast were classified into 17 vegetation types. The annual CO_2 sequestration was calculated using the formula based on four organic carbon (OC) storage processes in each vegetation type. (2) seaweed farming techniques: seaweed farming can be also considered as a carbon sink because multiple OC storage processes function during cultivation (Duarte et al. 2025). We developed a technique that maximizes CO2 sequestration using multiple layers and multiple species, unlike conventional cultivation for food. (3) seagrass bed management: moderate vegetation structure of *Zostera japonica* can increase manila clam recruitment and survival under oligotrophic environment. We developed a technique to increase both seagrass primary production and manila clam abundance through clam harvesting activity.

RESULTS AND DISCUSSION

(1) The annual CO2 sequestration was highest in surfgrass vegetation type at 20.4 tonnes CO_2/ha, and lowest in ephemeral green algal vegetation type at 0.02 tonnes CO_2/ha. Our calculation revealed that seagrass beds generally exhibit higher CO2 sequestration than macroalgal beds. This was because seagrass beds effectively enabled all four OC storage processes (Fig. 1) to function.

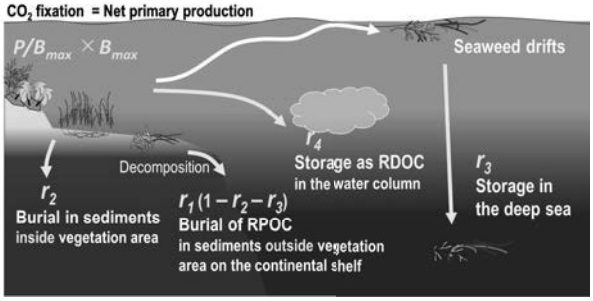

Fig.1 Four OC storage processes in the CO_2 sequestration. OC stored for at least 100 years was calculated for each process.

(2) By combining multiple species that grow at different depths through several manipulations, it was possible to grow macroalgae in three dimensions and maximize the yield per unit area. (3) Our technique of harvesting manila clams together with seagrass shoots increased seagrass growth by 1.5 times and clam density by 3.0 times. Furthermore, we found the additional revenue through cascading valorization of harvested seagrass leaves, suggesting the possibility of a circular bioeconomy from blue carbon ecosystems.

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Integrative carbon budget of a temperate wetland – tidal bay – sound continuum revealed by exchange interface process and flux measurements

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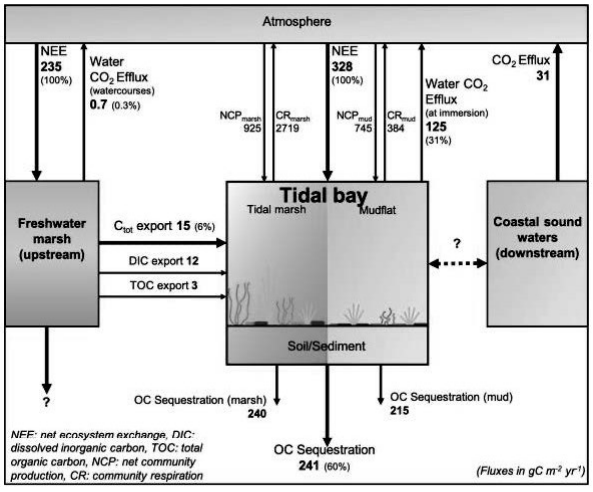
INTRODUCTION

Coastal ecosystems, key areas in the coupling of biogeochemical cycles, play an essential role in the carbon cycle by transporting significant quantities at the land-coastal zone-atmosphere interfaces[1-3]. These fluxes reflect a complex dynamic controlled by a multitude of biogeochemical factors and processes in the associated compartments. Faced with pressures and in the context of global change, this dynamic needs to be studied by coastal typology and in an integrative manner at all time scales to address uncertainties on the role of the coastal zone in carbon budgets[1-3].

MATERIALS and METHODS

In the framework of the Aiguillon Bay LIFE (2016-22) and the La Rochelle Territory Zero Carbon projects (2019-27), integrative carbon process/flux measurements were carried out over a temperate wetland – tidal bay – sound continuum located on the French Atlantic coast. Atmospheric Eddy Covariance CO_2 exchange (NEE), along with aquatic carbon concentration, planktonic metabolism, horizontal flux, sediment carbon sequestration values were obtained upon the different exchange interfaces (soil/sediment-air, water-air, wetland-bay) and time scales (diurnal, tidal, seasonal, interannual to multidecadal) allowing to draw the regional integrated carbon budget of the studied continuum.

RESULTS AND DISCUSSION



Carbon budget of the Marais poitevin wetland – Aiguillon bay – Breton sound continuum (France)[3,4]

The carbon budget of the studied continuum is presented along with published and ongoing studies[4-9]. On the 235 gC m^{-2} yr^{-1} absorbed upstream by the lowland freshwater marsh (mainly wheat crop)[5], 6% is exported downstream to the tidal bay[6] where 328 gC m^{-2} yr^{-1} is absorbed from the atmosphere to the mud-saltmarsh system through intense net primary production and to the contrary low respiration rates especially from the mudflat[7]. Large quantities of organic carbon (60%) are then sequestrated in soils and sediments owing to the active sedimentation of the bay and significant direct material inputs from the freshwater marsh upstream[8]. At immersion, 125 gC m^{-2} yr^{-1} (31%) is degassed from turbid tidal bay waters due to low primary production rates but high organic matter (microphytobenthic community) resuspension feeding aquatic respiration. Downstream, coastal sound waters act as a small annual CO_2 source to the atmosphere[9].

CONCLUSION

Though representing globally small surfaces, coastal marsh-bay systems, as other blue carbon ecosystems (i.e. mangroves or seagrasses), contribute disproportionally to carbon fluxes among the global coastal zone[1,2,3]. This chosen carbon budget example highlights this contribution at the regional scale but also the need to further constrain and specify all carbon fluxes and related processes (surfaces, EC measurements, lateral fluxes, root production and fates, water level controls) to better understand the role of such systems under natural and anthropogenic pressures in regional and global carbon budgets.

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Demonstration study on seaweed cultivation for blue carbon expansion and key factors to increase the yield

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INTRODUCTION

Towards achieving carbon neutrality by 2050, blue carbon-based CO_2 sequestration technologies are attracting attention both domestically and internationally. In Japan, the development of CO2 absorption technologies using seaweed is accelerating, as Japan reported the carbon sequestration effect of seaweed beds in its Greenhouse Gas inventory in 2024 [1].

Meanwhile, seaweed cultivation methods are largely supported by traditional knowledge accumulated through years of trial and error by fishers in each coastal area. Therefore, a quantitative approach based on cross-sectional analysis of numerical data from actual seaweed cultivation across Japan's diverse marine environments is important for establishing seaweed cultivation as a CO2 absorption technology. Therefore, this study aims to clarify the impact of seaweed cultivation conditions and marine environmental conditions on harvest yield, as well as to identify technical factors that improve harvest yield regardless of marine regions.

METHODS

Seaweed cultivation trials were conducted over three cycles between 2022 and 2025 at selected sea sites in Japan: Kushiro, Hokkaido(KUS), Sagami Bay, Kanagawa(KAN), Futtsu and Minamiboso, Chiba(CHI), Goto, Nagasaki(GOT). Annual species (*Costaria costata* (Subarctic zone) and *Undaria pinnatifida* (Temperate zone)) were selected as subject species based on growth rate. During the cultivation period, cultivation conditions (cultivation period, seedling twine density, initial seedling size) and environmental data (water temperature, photon flux density, nutrient concentrations, current velocity)—were measured and monitored as explanatory variables. Upon completion of cultivation, harvest yields were measured as the response variable. Data and model analysis were conducted to clarify the effects of the cultivation conditions and environmental data on harvest yields.

RESULTS AND DISCUSSION

Figure 1 shows the progression of seaweed harvest yields across each sea site and cultivation cycle. The highest yield was recorded for *Costaria* at 55.9 kg-WW/m per meter of rope. Across all sea sites, harvest yields increased as trials repeated, reaching approximately 2.4 times the initial trial. Analysis of cultivation conditions revealed three key factors for maximizing yield: (1) seedling size, (2) planting density, and (3) timing of offshore deployment. (1) Regarding seedling size, in Chiba, larger seedlings (with greater leaf area) resulted in higher yields, reaching up to 41.5 kg-WW/m (Figure 2). (2) For planting density, denser spacing between seedling twines than conventional edible seaweed farming led to increased yields. However, the effect plateaued at high densities, indicating a saturation point. In some cases, multilayer cultivation also contributed to yield improvement. (3) As for deployment timing, yields tended to increase by obtaining the longer cultivation period at the time, when the seedlings were deployed immediately after water temperature fell below the physiological upper temperature limit of target species.

Furthermore, to analyze environmental factors, a growth model was constructed using the yielded and environmental data of *Undaria* on Kanagawa as the model species and site. Simulated yields based on this model reflected differences between sea sites. Contribution analysis of environmental factors revealed that among water temperature, photon flux density, and nutrient flux, nutrient flux had the highest impact on yield. This indicated that the model can evaluate numerical contribution of environmental factors on harvest yield.

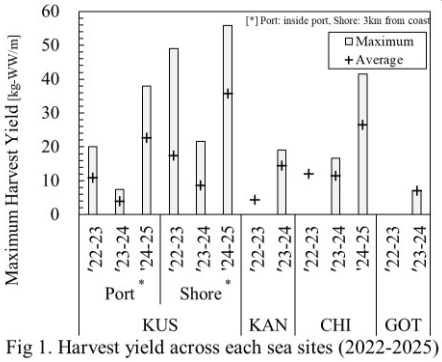

Fig 1. Harvest yield across each sea sites (2022-2025)

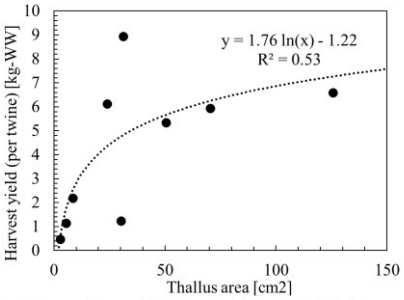

Fig 2. Dependence of harvest yield on initial thallus area

CONCLUSION

To improve CO_2 absorption through the seaweed cultivation, the following practices are suggested to be important: screening large-sized seedlings, increasing spatial efficiency by denser spacing between seedling twines, and maximizing the cultivation period by adjusting timing of deployment by coinciding with the match between the species' upper growth temperature limit and water temperature, based on conventional edible seaweed farming technique.

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ACKNOWLEDGMENTS

This research was conducted with the support and cooperation of the fisheries cooperatives and local governments in each region. We express our deepest gratitude.

Blue Carbon as a Catalyst for Sustainable Blue Economy Development

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INTRODUCTION

We established the Japan Blue Economy Association (JBE) in FY2020 and have been implementing the voluntary carbon market trading of the Blue Carbon Credit (J Blue Credit Scheme, JBC) in Japan[1]. This presentation will introduce the results and features of the JBC to date, as well as discuss solutions to systemic issues identified through the questionnaire survey and the possibility of improving synergy with other related measures, which could lead to a sustainable blue economy.

METHODS

This presentation provides an overview of the key points from the guideline published by JBE and the current status of JBC up to the end of FY2024. We also present the results of a questionnaire survey (n = 28) regarding technical challenges encountered during the JBC application process. Furthermore, the relationship between JBC and related national initiatives—such as *satoumi* and *umigyo*—is examined. Finally, the potential of JBC to contribute to the development of a sustainable blue economy in Japan is discussed.

RESULTS AND DISCUSSION

The number of JBC certifications reached 61 as of the end of FY 2024, and the total amount of JBC certifications reached 9,184.9 tons of CO_2 (Table 1).

Table 1 Summary of JBC from FY2020-FY2024

FY	Certified sites	Certified amount	Certified area	Unit price
				(excl tax, weighted ave.)
		ton CO_2	Excl. farming (ha)	yen/ton CO_2
2020	1	22.8	14.3	>13,157
2021	4	80.4	30	72,816
2022	21	3733.1	1100.4	78,063
2023	29	2170.3	535	49,111
2024	46	3178.3	692.8	66,713
Cumulative value	61	9184.9	-	-

Characteristically, fishers are involved in 85% of the projects, with the regional government involved in 69%, the private sector in 52%, and universities in 10%. The target ecosystems are also 74% seaweed, 33% seagrass, and 8% tidal flats. Project categories include environmental restoration (66%), creation (62%), and macroalgal farming (20%).

JBE published the JBC guidelines in 2022 and has been updating them periodically[2]. In accordance with the guidelines, the applicant measures the area and absorption coefficient of the blue carbon ecosystems targeted by the project, analyzes the data, and reports the results. When asked in a survey about challenges in such applications, the following issues were pointed out: technical challenges of the survey (cf. drone operation and image analysis, observation in turbid and deep areas, difficulties in measuring the appropriate survey volume and dry weight), lack of uniform measurement methods and baseline data, balance between cost and accuracy, selection of parameters that take regional characteristics into account, and selection, etc., were pointed out.

The presentation will introduce examples of blue carbon being dealt with in the Fisheries Agency's *umigyo* and the Ministry of the Environment's *satoumi* policy, and discuss its potential for regional development and development into a blue economy.

CONCLUSION

The J Blue Credit (JBC) scheme has demonstrated steady growth since its launch, with increasing participation and certified CO_2 absorption by the blue carbon ecosystems. While technical and systemic challenges remain—such as measurement standardization, cost-accuracy balance, and regional parameter selection—the scheme shows strong potential to contribute to Japan's sustainable blue economy. Strengthening collaboration with related initiatives like *satoumi* and *umigyo* could further enhance its impact and regional development.

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ACKNOWLEDGMENTS

Authors acknowledge Mr. Masanori Furuya and Ms. Yuka Suzuki of JBE for their support.

Offshore Wind Power and Fisheries in Japan
(Consideration for mitigating possible impacts of offshore wind power on the fisheries in Japan)

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INTRODUCTION

In Japan, offshore wind power is legally permitted on the condition that it is "not expected to cause any disruption to fishing activities." In reality, it is impossible to expect no disruption at all, so it is necessary to integrate various proposals related to the interests of fishers to derive the best solution, which can be accepted by the fishers involved overall. Its implementation requires consensus through councils involving stakeholders such as fishermen. However, the relationship between offshore wind power and fishing activities varies greatly depending on the fishing method, highlighting the need for smoother coordination.

FISHERIES IN JAPANESE WATERS

In the context of offshore wind power development, Japanese fisheries can be broadly categorized into three types:

Coastal fisheries targeting less mobile resources using methods like angling and diving

Coastal fisheries that capture migratory fish by waiting for them, such as fixed-net fisheries, which account for about half of coastal fishery production

Offshore fishing, which is dominated by methods that pursue migratory fish, such as purse seine fishing, bottom trawling, and driftline fishing.

ISSUESN ON THE COEXISTANCE OF OFFSHORE WIND POWER AND FISHERIES IN JAPAN

For coastal fisheries targeting sedentary species, offshore wind power facilities may offer benefits such as artificial reef effects on fish resources and local employment opportunities during facility maintenance and inspections. In contrast, for coastal fisheries that wait for migratory fish, wind power facilities may alter fish migration routes (disrupting migration patterns), preventing fish reaching the nets.

Offshore fisheries that pursue migratory fish encounter operational obstacles from wind power facilities. These fisheries typically do not benefit from fish reef effects and employment opportunities. Moreover, the simultaneous development of multiple offshore wind projects across various regions makes it difficult for offshore fishermen operating across wide areas to assess the cumulative impacts of each facility. This complicates decisions on whether to support or oppose individual projects.

RECOMMENDATIONS

To facilitate coordination between offshore wind power and fisheries, the following measures are proposed:

Habitat segregation: For fisheries that cannot physically or spatially coexist with wind power facilities, avoid overlapping with fishing grounds. Especially for offshore fisheries, we should also incorporate diplomatic, defensive, shipping, and environmental perspectives. Displaying potential candidate areas for adjustment on the Marine Situation Display System (MSDS) can increase predictability of the overall project for all stakeholders including power producers and fishermen.

Scientific monitoring: Even with these measures, fishers still concern about adverse impacts on resources. Therefore, a combination of scientific survey methods, including acoustic telemetry, biologging, and acoustic fish finders, will mitigate concerns about impacts to resources. Multiple regional councils related to migratory resources should organize federated councils involving neutral experts possessing knowledge based on the scientific monitoring.

Relief and support fund: Contributions to a fund to support fishermen affected by unforeseen adverse impacts (establishment of a joint fishery promotion fund for businesses) could also be effective.

Contribution of marine ecology researches towards the implementation of offshore wind power in the English Channel

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INTRODUCTION

After two decades of adjournment, uncertainty and multiple procedures, the installation of Offshore Wind Farm (OWF) along the French coast is now well underway on the three French maritime coasts. In the English Channel, in 2025, those of Saint-Brieuc and that of Fécamp are in production. Two others are under construction at Courseulles-sur-Mer and at Dieppe le Tréport. For French metropolitan coast, the objective by 2050 is the installation of 50 OFW with a capacity of 45 GW, including 12-15 OFW for the English Channel. This new marine activity is in addition to other anthropogenic activities which impact the coastal environment of the coastal seas. I analyse the place of scientific research to the development of OFW in the English Channel: solicitation and involvement of researchers and teacher-researchers from scientific research organizations and universities over the last 15 years.

RESULTS AND DISCUSSION

It is a whole potential of knowledge that had been accumulated over the last six decades before the decision to develop OWF by several regional, national and European projects by scientists. A first phase of research in relation to the OWF is part of doctoral projects begin with the first tenders (2012-2014). The subjects are on Ecosystem Approach including sampling of several biological compartments of plankton, benthos and fish, the cumulative impact of OWF in order to assess their consequences on the trophic functioning of the ecosystem, its resilience and ecosystem services, the social acceptability mechanisms by integrating the renewable alternative, and the role of OWF on the larval dispersal of benthic species. Nowadays, scientists are solicited to participate in decision-making. A Scientific Council has been created in support of the coastal maritime council to take into account the scientific knowledge to the marine spatial planning. In addition, researchers and teacher-researchers participate in others scientific councils and to the National Commission for Public Debate (NCPD) '*La mer en débat'* a large public debate on the future of the sea. Over the past fifteen years, we have been witnessing to a multitude of calls for projects from the French State, without coordination or overall vision, which is detrimental to the mobilization of research teams. Furthermore, many public and private organizations are interested in the development of OWF as well as research organizations. Moreover, several potential funders are participating in this scientific development. The need for knowledge at a small scale, particularly on the offshore ecosystem, is giving way to scientific research and fundamental research, in particular by promoting an ecosystem approach. This needs to develop knowledge on all compartments of the ecosystem: primary producers including phytoplankton, zooplankton, benthos, fishery resources, fish, molluscs including cephalopods, birds, bats, mammals (cetaceans and pinnipeds). Finally, a large number of design offices are involved in the initial state and regulatory follow-ups.

CONCLUSION

In short, there is a multitude of solicitations with a considerable number of actors involved in the environmental impacts of OFW (in addition to industrial Research and Development), without any real coordination or global vision. Nevertheless, scientists are faced with a double challenge: to take into account man and his activities, including fishing, which is subject to offshore wind development without really being heard, in the future of socio-ecosystems, and to identify the role of climate change in the evolution of coastal systems. What kind of sea do we want tomorrow? Undoubtedly a shared space where we have to live together and an increase of occupancy of sea coastal surface by human activities. Finally, the OFW offers an opportunity for the scientific community of ecologists to increase knowledge on the structure and functioning of offshore systems before and after wind farming.

ACKNOWLEDGEMENTS

I thank the Franco-Japanese Society of Oceanography, Japan for its invitation to the Toba Symposium, the Franco-Japanese Society of Oceanography, France for its financial support and the Caen Normandy University and the Centre National de la Recherche Scientifique (UMR 6143 M2C CNRS) for welcoming me as at the M2C laboratory.

How EDF Power Solutions coordinated its actions with fishermen and other stakeholders in coastal waters in France

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INTRODUCTION

The development of offshore wind represents both an energy opportunity and a challenge for the management of coastal maritime areas. EDF Power Solutions has been involved in these projects since 2010 and has developed, built, and operated several wind farms, particularly in Europe.

Maritime space management constraints are numerous, and the risk of conflict with other stakeholders must be considered early in projects. Furthermore, territorial waters are under pressure, and technologies allow for the development of deeper territories with the deployment of floating offshore wind. Fishing is a historical player in the marine environment, and its presence must be considered when implementing these projects. The types of fishing activities, management of fishery resources, the safety of uses, and coexistence arrangements must be anticipated; solutions are applicable.

METHODS

Various methods have been implemented to ensure optimal coexistence with other sea stakeholders, particularly fishermen. To be done…

✓ Specific surveillance and security resources for the wind farm:

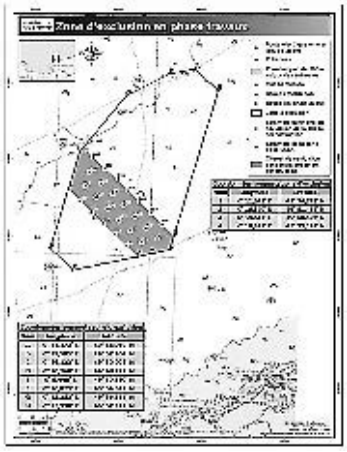
- Surveillance radars connected to the emergency center - Physical and virtual marking of the wind farm
- PTZ camera operable from the control center
- Two cameras on each wind turbine
- Updated professional navigation software

✓ Provisions and regulations:

- Preferred communication channel
- Restriction of uses with specific navigation rules (12 knts, 25m, AIS…)
- Organization of crisis drills
- Introduction of a "wind turbine" tax, 35% of which goes to fishing

✓ Consultation and organization:

- Allocation of a wind farm area (FLO) per project
- Consideration of fishing zones
- Fish resource evaluation
- Adaptation of the design (alignment of wind turbines and cables) of the wind farm to minimize the footprint and allow fishing within the perimeter
- Proposal of compensation measures



- Implementation of individual and collective compensation fees
- Implementation of measures monitoring for more than 30 years; in development, construction and operation.

Offshore Wind Farm vs Fisheries
--- Way to Co-Existence ---

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INTRODUCTION

Coastal fisheries are actively being done around Japan from long time ago. On the other hand, offshore wind farm projects are being rapidly planned in recent years. Sometimes it raises a kind of conflicts between wind farm developers and fishermen, and co-existence is the most desirable solution for both sides

BACKGROUND

The author had been worked at RIOE, currently PRIOE, Promotion and Research Institute for Ocean Economics, more than 45 years until 2020, and at that institute, the author involved in developing Proposals on Co-Existence Between Offshore Wind and Fisheries publicized in 2013 for fixed-type turbines and its revised edition in 2015 along with proposals for floating type turbines. They made great influence on both sides of wind farm developers and fisheries related communities as well as on public sector. Also, the author made inspection tour to Calvados Wind Farm construction office after participating Joint French-Japan Symposium on Offshore wind farm and Fisheries in November, 2023. What the author learned from this experience is included in the proposals.

WAY TO CO=EXISTENCE

Key points of Co-Existence Between Offshore Wind and Fisheries are as follows; Firstly, the design of the base structure contributes the magnitude of effectiveness of co-existence, because base structure plays a kind of role of artificial reef for fisheries. Structural characteristics of offshore turbine, particularly those of base structure, may have different impact on environment and on fisheries both in positive and negative manner. Focusing on the positive side, in the case of bottom-fixed type turbine which will be deployed in the shallow water, particularly in the case of Mono-Pile type, usually needs scour protection bed which has positive impact because it plays a kind of role of artificial reef, working as adhesion substrate attracting seaweeds and bottom fish. In the case of floating type turbine which will be deployed in rather deep water more than 30-50m to around 100m or more, it may also have function of floating artificial reef, attracting fish living close to surface and migratory species. In the case of Mono-Pile Structure, a typical design of fixed type, which will be applied for sandy sea-bottom, it needs scouring bed, and it is just like the artificial reef. (See Fig.1&2)
Secondly, the layout of multiple turbines may contribute to form marine ranch,

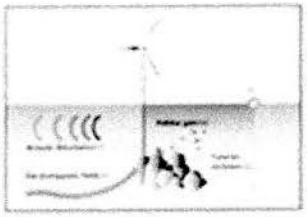

Figure 1. Overview of main pressures from OWF during the operational phase. Expected effect on the local abundance of marine organisms is indicated as (+) aggregation/refuge, (-) avoidance/displacement.

(Source : Lena Bergström et al, Effects of offshore wind farms on marine wildlife – a generalized impact assessment. 2014)

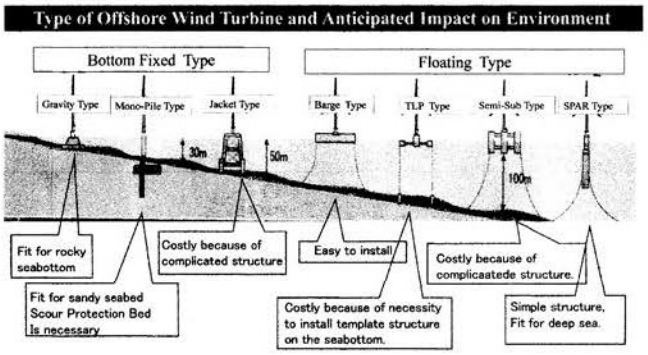

Figure 2. Map of Offshore Wind Farm Development
(Source: Japan Wind Power Association)

Some proposal on the co-existence between offshore wind farm and fisheries are shown below.

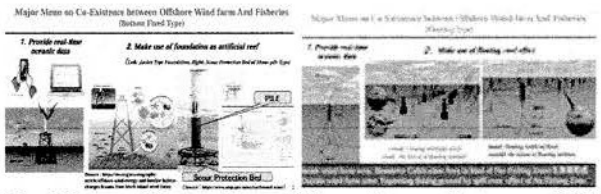

Fig.3.Image Illustrations of Co-existence between OWF and Fisheries (Left: for fixed type turbine, Right: for floating type turbine)(Source; RIOE's Proposal, 2013 and 2015.)

People may ask others that can fisheries and offshore wind farms co-existed? The answer to this question is, of course, yes-but happy co-existence require specific conditions. This phrase is based upon the following source.
(https://windeurope.org/newsroom/news/Jan.22, 2020)

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The MEGABIT (MEGAfauna Behaviours & Longline Gear Interactions For Sustainable Fishing Practices): A Collaborative Research Project

François Poisson[1], Daisuke Ochi[*2], Kei Okamoto[2], Tsutomu Takagi[3], Daisuke Shiode [4], Olivier Adam [5], Yasuko Semba[2], Jean-Christophe Burie[6]

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INTRODUCTION

Marine animals of different taxa (i.e. teleosts, reptiles, birds and marine mammals) may interact with pelagic longline gear and be caught or escape, either unharmed or seriously injured. Reducing the mortality of the unwanted species is critical to marine biodiversity conservation and sustainability of the fisheries. All tuna regional fisheries management organisations (RFMOs) recommend research into gear technology development for bycatch reduction and potential mitigation measures. The specific behaviours of megafauna around fishing gear may influence efficacy of measures designed to mitigate hooking, entanglement and also depredation. Understanding animals' interactions with fishing gear, such as when and where they investigate and strike the bait, is therefore crucial. The MEGABIT (MEGAfauna Behaviours & longline gear Interactions for Sustainable Fishing Practices) project's main concept is to simultaneously investigate the behaviour of longline fishing components and all animals approaching baited hooks, while also documenting and recording environmental parameters during fishing operations. A key concern for the project is collecting crucial information to mitigate the impact of artisanal, small-scale longline fisheries targeting large pelagic fish in Japanese and French waters, respectively in the Pacific Ocean and the Mediterranean Sea, and testing efficient, holistic mitigation measures for sustainable fisheries.

METHODOLOGY AND TECHNOLOGY

The MEGABIT project brings together complementary expertise to implement recent technological innovations, including instrumented longlines with hydrophones, TDRs, cameras as well as an autonomous underwater vehicle equipped with cameras and miniature sensors, and aerial drones and eDNA. Innovative tools based on artificial intelligence techniques, which have already been developed, will be used to survey, identify and quantify marine species by analysing recorded photos and videos.

COLLABORATION AND FUTURE DIRECTIONS

We present the initial results obtained from the collaboration of scientists from FRA, IFREMER, the University of Hokkaido, the Tokyo University of Marine Science and Technology, La Rochelle and La Sorbonne universities and the actions to come.

Three-dimensional Measurement System with Marker and Quad Camera for Marine Robot

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INTRODUCTION

We are developing an ASV and ROV for seabed surveys in shallow waters[1]. Robot control requires position and velocity information. This study proposes a position and angle measurement system for underwater robots using a quad camera and AprilTag. Recognizing AprilTag with a camera enables acquisition of angular information in addition to the robot's 3D position[2]. This study applies AprilTag for camera calibration, measuring calibration data including camera lens distortion. Using the measured calibration data, we examined the results of position and angle measurements by recognizing AprilTags recognition on the ROV.

QUAD CAMERA SYSTEM

The quad camera system used in this study is configured with two pairs of cameras synchronized. The four cameras are positioned at 70 [mm] intervals in all four directions. The resolution of the quad camera images is 1280×960, with each individual camera having a resolution of 640×480. Experiments are conducted at a video frame rate of 15 [fps]. With four cameras, it enables multi-angle shooting and allows for analysis even underwater, such as with ROV.

THE METHOD OF CAMERA CALIBRATION

Underwater camera calibration is particularly affected by sunlight in shallow waters. Consequently, AprilTag recognition accuracy deteriorates underwater, making it difficult to prepare sufficient calibration images. Therefore, the calibration board of 446 × 303.5 [mm] with AprilTags of 40 [mm] per side arranged in 4 rows and 5 columns at equal intervals is used in this study. Calibration was performed using 27 images for each camera. The average reprojection errors of the four cameras were 0.296 to 0.340 [pix]. Thus, calibration results with sufficient accuracy were obtained. Using this calibration data, we measured the position and angle by recognizing AprilTags on the ROV.

APRILTAG RECOGNITION ON THE ROV

AprilTags with 100mm sides were placed on both sides of the ROV to acquire 3D position and angle information. Figure 1 shows the measurement results for the position and angle of one camera. In Figure 1, the ROV is positioned to the left front of the screen, maintaining a horizontal orientation relative to the camera while repeatedly moving backward and forward. Figure 1 confirms backward and forward movement based on the measured Z-coordinate data. The data interruption is caused by disturbances such as light reflection, which disrupt the acquired frames and prevent AprilTag recognition. This will require supplementation and correction using measurement results from four cameras going forward.

CONCLUSION

By recognizing AprilTags on the ROV, we acquired its 3D position and angle. We found that AprilTag recognition is susceptible to disturbances and cannot maintain stable accuracy with a single camera. Therefore, we will create a system to supplement and optimize measurement data from four cameras, enabling the measurement of ROV behavior. This is expected to allow ROV control and other operations in shallow waters through image processing.

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ACKNOWLEDGMENTS

This study was supported by the President's Discretionary Expenses of Tokyo University of Marine Science and Technology and a Grant-in-Aid for Research from the Fundamental Research Developing Association for Shipbuilding and Offshore (REDAS).

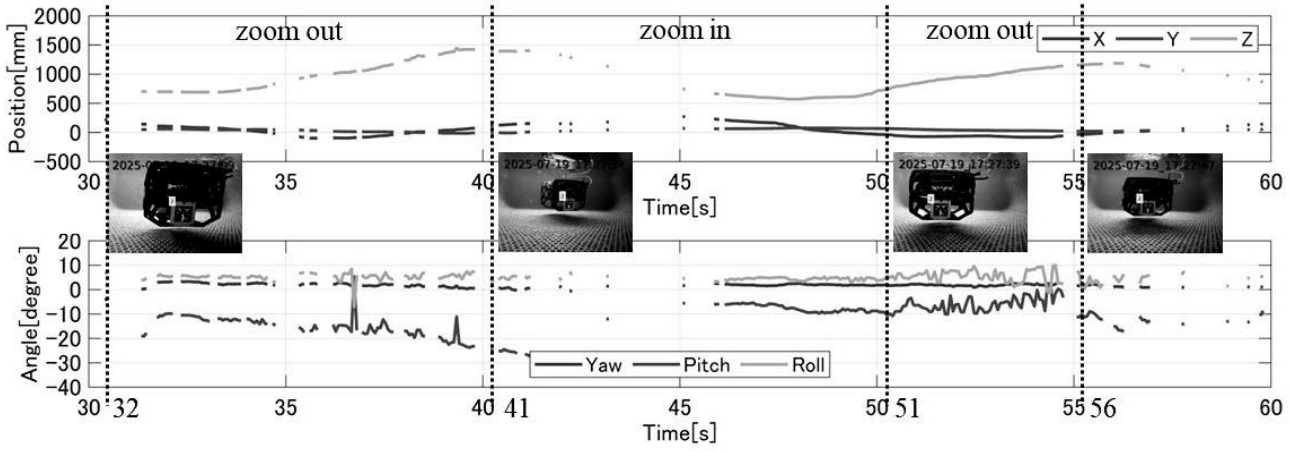

Figure1 3D position and angle of the ROV obtained by AprilTag recognition

Development of an ASV Control System Using VSC

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INTRODUCTION

We are developing a small Autonomous Surface Vehicle (ASV) for marine surveys. This small ASV can operate autonomously using an IMU and GNSS. For the ASV to conduct surveys, navigation capability (WayPoint) and dynamic positioning (DP) capability are critical. In this study, we conducted sea trials using Variable Structure Control (VSC) to improve the ASV's position-holding capability when performing dynamic positioning in wind-disturbed conditions.

ASV

This ASV has a hull length of less than 2 meters and an airborne weight of 90 kg. The ASV is equipped with a main thruster for forward and reverse motion, and bow thrusters and stern thrusters for lateral movement and turning, all housed within a frame below the waterline. Figures 1 and 2 show the ASV's exterior and thruster layout.

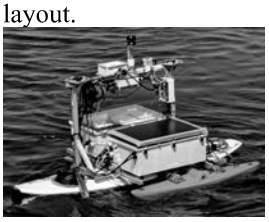

Figure 1 ASV

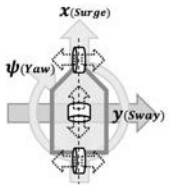

Figure 2 thrusters layout

VSC CONTROL METHODS

The ASV navigates using three thrusters: the main thruster, bow thruster, and stern thruster. However, both the bow thruster and stern thruster are used to perform lateral movement and turning. Rather than controlling both lateral movement and turning with a single system, this research enables the ASV to maintain a position-angle holding by appropriately switching between the two actions using VSC[1].

Figure 3 shows the control block diagram of the ASV. The ASV manipulates Surge, Sway, and Yaw using a Sliding Mode Controller (SMC). Based on the SMC outputs σ for Sway (lateral movement) and Yaw (turning), a VSC-SMC is created to switch between Sway and Yaw operations. The ASV switches between Sway and Yaw operations along the hyperplane of this VSC-SMC, controls each SMC, and stabilizes the entire system.

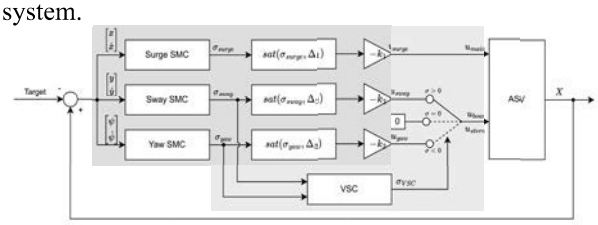

Figure 3 Control Block Diagram

SEA TRIAL

Field tests were conducted in Shizuoka Prefecture's Orito Bay using an ASV equipped with the VSC switching method. The results confirmed that while the previous method[2] could no longer maintain a position-angle holding under disturbances of approximately 6 m/s wind speed, the new method enabled stable position-angle holding at an average wind speed of 8 m/s (Max 10 m/s). The data from this test is shown in Figures 4 and 5 .

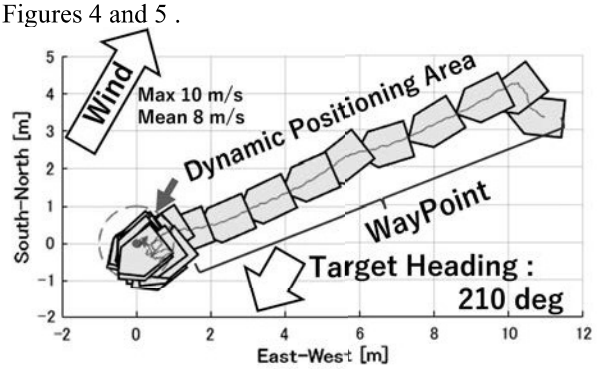

Figure 4 ASV Trajectory

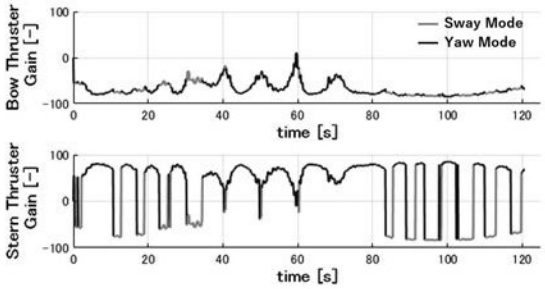

Figure 5 ASV Thrusters Output During DP

At this time, the dashed lines in Figure 6 represent the VSC's Sway (lateral movement) mode, while the solid lines represent the Yaw (rotation) mode. This demonstrates that the VSC is operating effectively.

CONCLUSION

This study confirmed that the ASV can maintain a position-angle hold in an environment with an average wind speed of 8 m/s (maximum 10 m/s) using a position-angle hold control method employing VSC.

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Development of a Method for Estimating Sea Wind from Shipboard Wind Using Random Forest

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INTRODUCTION

Ships play an essential role in acquiring meteorological data over the ocean. However, shipboard anemometers measure winds affected by the hull[1,2], requiring correction to sea wind. The objective of this study is to develop a method for estimating sea wind from shipboard wind.

METHODS

The method developed in this study is as follows. Using the machine learning technique Random Forest, wind at an altitude unaffected by the hull is estimated. By applying altitude correction to this estimated value, wind at any desired altitude is obtained.

This study constructed models to estimate the wind at a height of 42 m measured by Doppler LiDAR (hereafter "LiDAR") from the shipboard wind at a height of 16 m height measured by the Kaijin-Maru (hereafter "the vessel"). Wind Direction (WD) on the vessel was measured with an accuracy of ±5°. Wind Speed (WS) with an accuracy of 5% for WS ≥10 m/s or ±0.5 m/s for lower WS. The observations were conducted at the pond at Kobe University. The observation period was from August 2024 to January 2025. The data were processed as 10-min means, and relative wind with the vessel's bow defined as 0° was used.

The measured data were randomly divided into two parts: 70% for model construction and 30% for accuracy validation. After the models were constructed, the vessel's WD and WS values in the validation dataset were input into the models to obtain estimations. Accuracy metrics were then calculated by comparing these model estimations with the LiDAR observations. This process, from dividing the data to calculating the accuracy metrics was repeated 50 times, and the resulting 50 sets of metrics were averaged.

There are 5 metrics: Bias, RMSE (Root Mean Square Error), MAE (Mean Absolute Error), EE (Estimate Error), and R^2 (coefficient of determination). The EE of WD and WS (EE_{WD}, EE_{Ws}) were defined as:

$$EE_{wd}(\%) = \frac{RMSE[rad]}{\pi} \times 100 \qquad (1)$$

$$EE_{ws}(\%) = \frac{RMSE[m/s]}{\bar{y}} \times 100 \qquad (2)$$

where $\bar{y}$ is the mean LiDAR WS.

First, models estimating LiDAR measurements from vessel observations were constructed based on regression analyses, for both WD and WS. These models are hereafter referred to as the "regression models". Models 1–3 were constructed using the Random Forest algorithm. Model 1 was constructed using WD and WS. Model 2 used u and v. Model 3 used WS, u_n, and v_n. Here, u and v represent the WS components along the 90-270° and 0-180° axis, respectively. u_n and v_n are the normalized values obtained by dividing u and v by WS.

RESULTS AND DISCUSSION

Table 1 summarizes the estimation results for all models. For the regression models, both WD and WS showed high R^2, but their RMSEs were at least as large as the accuracy of the shipboard anemometer. In Model 1, WS showed a smaller EE and a larger R^2 than in the regression model. In Model 2, WD showed better accuracy across all metrics than in both the regression model and Model 1, whereas WS showed a larger EE and a smaller R^2 than in Model 1. In Model 3, WD showed a higher R^2 than in Model 2, but WS showed a larger EE than in Model 1.

Even the models with the best performance still exhibited substantial RMSEs: 6° for WD (Model 3) and 0.5 m/s for WS (Model 1). Figure 1 illustrates the relationship between WD errors between observations and estimations and WS for the case with the smallest EE among 50 trials of Model 3. For WS of 3–9 m/s, WD errors were mostly within ±5°. However, larger difference was observed at lower WS, suggesting that instability of WD under weak winds[3] was the main source of errors.

Table 1 Model Estimation Accuracy.

		Regression	Model 1	Model 2	Model 3
Wind Direction	Bias[deg]	0	0	0	0
	RMSE[deg]	12	12	6	6
	MAE[deg]	10	5	4	4
	EE(%)	6.6	6.8	3.3	3.3
	R^2	0.98	0.98	0.99	1.00
Wind Speed	Bias[m/s]	0.0	0.0	0.0	0.0
	RMSE[m/s]	0.5	0.5	0.5	0.5
	MAE[m/s]	0.4	0.4	0.4	0.4
	EE(%)	12	10	11	11
	R^2	0.83	0.87	0.86	0.86

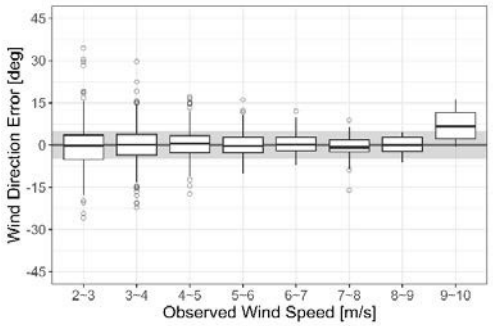

Figure 1 WD Error Distribution by WS.

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Viscosity–Temperature Characteristics of Biodiesel Fuel Synthesised Using Oyster Shell Catalysts

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INTRODUCTION

In the field of marine engineering, the transition to carbon-neutral fuels is under active investigation. Meanwhile, in the fisheries sector, efforts have been made to utilize discarded shells such as oysters. Furusaki et al.[1)] focused on scallop shells, which are discarded in large quantities in Hokkaido, and attempted biodiesel fuel (BDF) synthesis. In the previous studies, authors et al.[2)3)] reported on the kinematic viscosity and flash point characteristics of the BDF synthesised the oyster and akoya pearl oyster shells as catalysts This study investigated the effect of temperature on kinematic viscosity, which directly influences fuel spray characteristics for marine diesel engine.

EXPERIMENTAL METHOD

1. Catalyst Preparation
   Based on the method of Furusaki et al., waste shells were crushed, heated up to 900 °C in an electric furnace, cooled, and then immersed in methanol. This treatment generated strongly basic calcium methoxide on the shell surface.
2. BDF synthesis
   Edible oil (soybean oil in this study) and methanol were mixed and reacted with the prepared catalyst under a temperature of 65°C to promote transesterification. After the reaction, the mixture was subjected to settling and centrifugal separation, and the upper biodiesel layer was collected.
3. Kinematic Viscosity Measurement
   Kinematic viscosity was measured using a Cannon–Fenske reverse flow viscometer (Fig.1). The kinematic viscosity measurement tests were conducted at temperatures from 20 °C to 60 °C in 10 °C increments.

RESULTS AND DISCUSSION

Table 1 shows the kinematic viscosities of edible oil, BDF produced with oyster shell catalyst, and diesel fuel at 30 °C. The results indicate that the raw edible oil exhibits a viscosity about 9–10 times higher than that of diesel fuel, whereas BDF shows a viscosity about 2 times higher.

Fig.1 shows that the viscosity–temperature curves of diesel fuel, canola oil, soybean oil and Oyster shell BDF. The results reveal that viscosities decrease with increasing temperature for both raw edible oils and diesel fuel. Though the rate of decrease is not discrepancy. The raw edible oils exhibit a more pronounced viscosity drop with temperature. The kinematic viscosity of the BDF slightly increased with increasing temperature. It is due to degradation, as the sample had been stored for one year under ordinary room conditions. Although it is not possible to conduct an appropriate discussion on the viscosity–temperature characteristics of BDF, the results suggest that the fuel is strongly affected by storage conditions.

Table1 The kinematic viscosity at 30°C

Sample name	Kinematic viscosity[cSt]
Canola oil	49.573
Soybean oil	45.354
Diesel oil	4.970
Oyster shell BDF	10.571

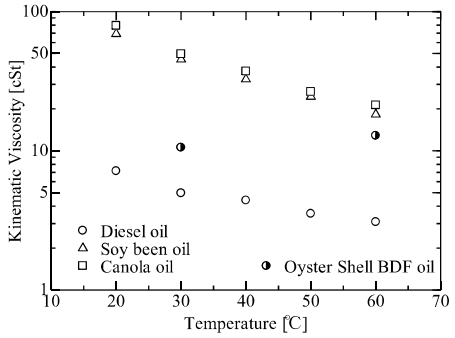

Fig.1 Viscosity–Temperature characteristics

CONCLUSION

This study investigated the kinematic viscosity–temperature characteristics of BDF and its raw edible oils.

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Production engineering development of ocean energy resources of JAPAN

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INTRODUCTION

Recent studies have confirmed that abundant energy and mineral resources, such as methane hydrates and hydrothermal deposits, are found within the Exclusive Economic Zone of our country, Japan. We believe that it is essential to develop production technologies for these self-sufficient resources in order to ensure energy security.

Overview of our initiatives in the technological development of ocean energy resource production

Japan's initiatives in the production technology for ocean energy and mineral resources include the development of shallow-type methane hydrate production technology led by the Agency for Natural Resources and Energy, and the construction of the Marine Security Platform within the Strategic Innovation Promotion Program (SIP) led by the Cabinet Office. We will introduce these two initiatives by the government of Japan.

GEAR: Human Resource Development Project with Solving Community Issues - Development in the IT Fisheries Industry in Region -

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INTRODUCTION

The GEAR Project[1] is a project to develop human resources capability of responding to Society 5.0, an initiative being promoted in Japan. More than 30 participating colleges of technology have formed a research network to work on solving social issues in the regions where their campuses are located.

They research applicable methods together with students, implement them in society, and develop social innovators. They aim to achieve independence through sustainable activities while collaborating with local stakeholders such as local governments and companies.

TARGETTED FIELDS

GEAR is comprised of six fields, each with its own unit leader and sub-leader.

- Materials
- Nursing Care/Medical Engineering
- Disaster Prevention/Mitigation(Epidemic Prevention)
- Disaster Prevention/Mitigation (Energy)
- Agriculture/Fisheries
- Energy/Environment

All fields use Project-Based Learning (PBL) to develop human resources through solving local community issues.

UNIT OF AGRICULTURE AND FISHERIES

Toba National College of Maritime Technology is the unit leader, with Hakodate National College of Technology, Ichinoseki National College of Technology, Wakayama National College of Technology, and Anan National College of Technology participating.

Starting in 2022, a summer school has been held every year. In 2025, it was held in Wakayama prefecture from September 16th to 18th, with approximately 40 students from the five colleges participating. To date, marine education has been the main theme in all programs, and entrepreneurship education has also been incorporated.

Individual projects include IT fishing using the sensors employed, producing beverages and foods such as beer and bread using local yeast, manufacturing leather substitutes using skim milk powder, cultivating eelgrass that absorbs CO2, and land-based sea urchin aquaculture, some of which are now for sale.

Furthermore, with regard to IT fishing, the activity is exhibited with Maizuru National College of Technology at the Japan International Seafood Show[2] and shares information of universities and companies in Japan, with accompanying events

DISCUSSION

The process of resolving local issues allows students to deepen their understanding of the local situation, work collaboratively with a diverse range of people with different ways of thinking, ages, occupations, etc., to consider for themselves what other knowledge is needed in addition to the learned at the technical college, and to be involved in project management to solve the issues. This is considered an effective method of human resource development. Its effectiveness has been confirmed in human resource ability tests conducted by contractors.

By incorporating elements of entrepreneurship education from 2022, participants in the project will be able to understand the reality of matching needs and seeds in society, and consider how to disseminate and realize their own ideas in society. This will support the start-ups that the Japanese government is promoting.

GEAR's activities have also been cited as an example of the use of comprehensive knowledge, which is being promoted by the Cabinet Office[3]. Discussions with the person in charge of comprehensive knowledge have confirmed that GEAR in general is a manifestation of comprehensive knowledge.

SUMMARY

The six fields of GEAR were introduced, that is, a human resource development project that corresponds to Society 5.0. Field of the agriculture and fisheries field is explained. The effectiveness of human resource development was indicated through solving local community issues, which is a feature of this project.

Also it is mentioned that the independence and social implementation of activities have become partially sustainable through the establishment of regional and national frameworks and start-ups, but this is a theme that needs to be addressed in the future.

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Monitoring seaweed bed distribution using PlanetScope: A case study in Tottori, Japan

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INTRODUCTION

Seaweed beds are important habitats for many marine organisms. In recent years, its role as blue carbon, which fixes carbon dioxide in the ocean, has also been attracting attention. Because seaweed beds are distributed in coastal areas, they are susceptible to the impact of human activities such as coastal development. Changes in water temperature due to climate change are also thought to have a major impact on seaweed beds. In order to understand the current state and changes in seaweed beds, the Ministry of the Environment and the Fisheries Agency in Japan have conducted surveys of the distribution areas of seaweed beds.

Traditionally, surveys have been conducted based on visual observation by diving and questionnaires of local experts, but in recent years, satellite remote sensing has also become an efficient method. Satellite image covers wide area and suitable for constant monitoring. However, there are several issues with current satellite remote sensing method. The current method in practical use in Japan is mainly based on supervised classification, which requires field surveys to obtain supervised data each time, and is not necessarily efficient[1]. Furthermore, there has also been insufficient research into monitoring seasonal variations in distribution.

In this study, we attempted to monitor seaweed beds distributed on artificial blocks, where their location and fluctuations are easy to grasp. We also investigated whether it would be possible to build a general model for mapping seaweed beds using satellite images.

STUDY AREA

The Otani Coast in Iwami Town, Tottori Prefecture was selected as the research area. As shown in Figure 1, there are submerged artificial concrete blocks, on the Otani Coast, and beds of *Sargassum* species and *Undaria pinnatifida* are distributed together on top of the blocks. Although it is small, only 50m wide and 400m long, drone observations allow us to see seasonal changes in the distribution of seaweed beds, making it easy to compare with satellite images.

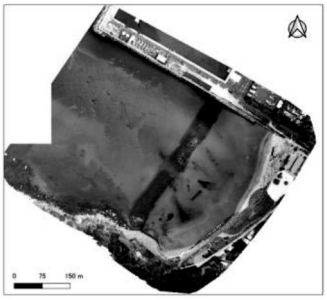

Figure 1 Image of Otani Coast taken by drone

METHODS

In this study, drone photography was used to obtain a detailed and accurate distribution of seaweed beds. Images taken by drones have a much higher spatial resolution than satellite images, making it possible to clearly identify the location of seaweed beds, so they were used to create supervised data for the location of seaweed beds in satellite images. Drone photography was conducted from April to October 2024 and April to May 2025. The drone used was a DJI Mavic Air 2.

PlanetScope provided by Plane Labs was used as satellite image, which has a spatial resolution of 3 m and collects data almost daily. PlanetScope images taken on a day close to the day the drone images were taken were obtained. Surface reflectance products with 8 bands were selected for analysis.

We used supervised classification of Random Forest to classify PlanetScope images and map the distribution area of seaweed beds for each image. We also analyzed reflectance data from seaweed beds and sandy areas at different depths to examine whether it was possible to automatically extract seaweed beds based on their reflectance characteristics.

RESULTS AND DISCUSSION

PlanetScope images were classified into seven classes: dense seaweed beds, sparse seaweed beds, sandy areas of different depths (four classes), and deep water areas. The overall accuracy of the classification results for each image was 0.800 to 0.990 when classified using Random Forest.

Next, we analyzed the profiles of the reflectance data, but found that the reflectance values varied greatly from image to image and standardization was not easy.

On the other hand, it was found that Random Forest can also generate general models that can be applied to all obtained images. Although the accuracy of the general model is lower than when supervised data is used for each image, it was confirmed that an accuracy of 0.802 to 0.848 can be achieved.

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Revisit the Upper Portion of the Japan Sea Proper Water: Recent Structural Change and Warming Trends

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INTRODUCTION

The Japan Sea, a marginal sea in the western North Pacific, is often called "a miniature ocean" owing to its self-contained thermohaline circulation system (Fig. 1). The deep water in the sea, the Japan Sea Proper Water (JSPW), is formed south off Vladivostok in the northwestern part of the sea through winter deep convection. Based on the hydrographic datasets during 1964–1985, the upper portion of the JSPW (UJSPW) was defined as the water mass in a density range 27.31–27.34σ_θ, as well as the core density of 27.32σ_θ[1] However, significant warming due to global warming has been reported in the JSPW, which may have changed the UJSPW characters and the thermohaline circulation in the Japan Sea. Therefore, we revisited the UJSPW based on the recent datasets.

DATA AND METHODS

Two hydrographic datasets were analysed: the NEAR-GOOS and the ARGO float datasets. The NEAR-GOOS datasets were obtained along the 134°E meridian in the northern Japan Sea during 2011–2019 by the Pacific Oceanological Institute in Russia. The temperature, salinity (S), and dissolved oxygen (DO) measurements at 1 m intervals are archived. On the other hand, the ARGO floats provided winter temperature and salinity profiles in a wide Japan Sea area during 2001–2019, although the vertical resolution of original dataset was 10–30 m and the maximum observation depths were limited to ~700 m.

RESULTS AND DISCUSSION

As the UJSPW is formed by deep convection in winter, the UJSPW shows a pycnostad structure with high DO concentration, which can be detected as a potential vorticity (PV) minimum layer. The frequency distribution of PV minima with respect to potential density in the NEAR-GOOS datasets showed that 28.6% of PV minima were in the range 27.30–27.31σ_θ. In addition, 66.2% of the PV minima were in the density range 27.30–27.33σ_θ. Therefore, we redefined the UJSPW as the water mass in the density range of 27.30–27.33σ_θ, as well as the core density of 27.30–27.31σ_θ. The θ–S diagram showed that the newly defined UJSPW is lighter than the old version by 0.01σ_θ, and it is mainly due to the temperature increase by 0.03°C (Fig. 2a). In addition, θ–DO diagram indicates that substantial DO decrease in the UJSPW occurred between the past (1964–1985) and the 2010s (Fig. 2b).

Table 1 summarizes potential temperature changing rates in the representative areas (JW, JE, YB, and TB in Fig. 1) based on the ARGO float dataset. All of the areas and depths showed positive rates, indicating warming in the entire Japan Sea area. Interestingly, the warming rates in the southern areas (YB and TB) were larger than those in the northern areas (JW and JE) by a factor of 2–3. This indicates that the UJSPW in the southern basins are rapidly modifying compared to the northern basin.

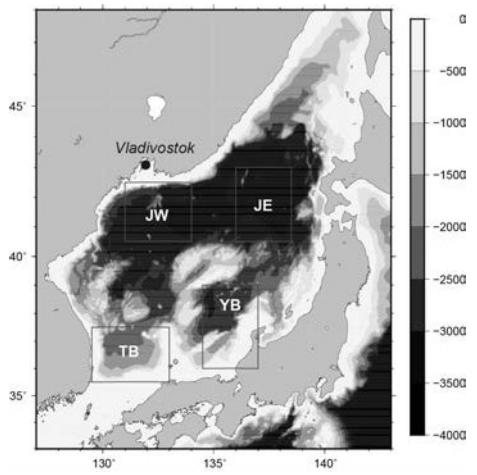

Fig. 1 Japan Sea bottom topography. The four rectangles (JW, JE, YB, and TB) indicates the representative areas in Table 1.

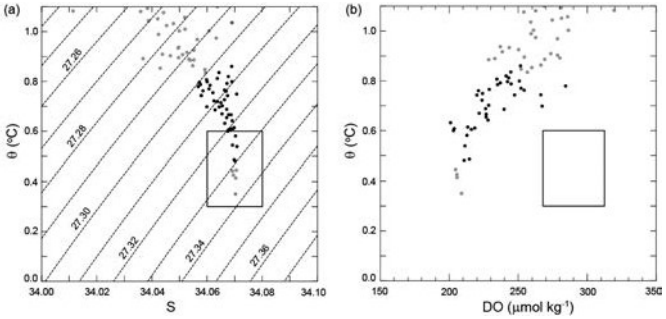

Fig. 2 (a) θ–S and (b) θ–DO diagrams for the PV minima in the NEAR-GOOS datasets. The PV minima within the density range 27.30–27.33 are represented by black. The θ, S, and DO ranges in the past (1964–1985) are indicated by the rectangular area in each panel.

Depth (m)	Changing rates (×10^{-2} °C year^{-1})			
	JW	JE	YB	TB
400	+0.172	+0.060	**+0.864**	**+1.173**
500	+0.466	**+0.349**	**+1.008**	**+1.111**
600	**+0.522**	**+0.388**	**+0.955**	**+1.046**
650	**+0.571**	**+0.316**	+0.891	**+0.973**
700	+1.180	**+0.527**	+0.880	**+0.889**
400–650	+0.413	+0.279	**+0.931**	**+1.075**

Table 1 Potential temperature changing rates in JW, JE, YB, and TB in Fig. 1 based on the Argo data. Bold and bold-underlined figures indicate statistically significant values at 95 and 99% confidence levels, respectively.

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Concentration and properties of small microplastic pollution around Japan's waters

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Introduction

Large quantities of plastic waste enter marine areas, where they fragment into microplastics (MPs) (Eriksen et al., 2014). MP concentrations in East Asian waters are exceptionally high (Isobe et al., 2016), and Tokyo Bay also exhibits very high MP contamination (Arakawa et al., 2023). Conventional MP surveys in marine waters involve towing surface nets with mesh sizes of 300–350 μm, such as Manta nets or Neuston nets, to collect samples. MP are then extracted, analysed for size and polymer type, and used to determine MP concentrations in seawater. Isobe et al. (2015) presented the particle size distribution of MP from these results, reporting that concentrations increase with decreasing particle size up to approximately 1000 μm, after which concentrations of smaller MP decrease. Thus, the conventional method does not capture the distribution of MP smaller than the net mesh size. This report summarises the distribution and degradation characteristics of small microplastics (SMPs) in Japanese coastal waters, which were not captured by previous surveys.

Collection and distribution of small microplastic

To collect small microplastics that escape conventional nets (350 μm mesh size), a double-layered Neuston net (double net; inner layer: 350 μm mesh size, outer layer: 50 μm mesh size) was devised. The results showed that in Tokyo Bay, the concentration of MP >350 μm (LMP) was 0.55–3.98 particles/m³, whereas the concentration of SMP (50–350 μm) was 3028–3220 particles/m³. Furthermore, in the Tokai offshore region, LMP concentrations ranged from 0.04 to 0.17 particles/m³, while SMP concentrations ranged from 1060 to 5900 particles/m³. These results indicate that concentrations of microplastic smaller than 1000 μm do not decrease smaller than 1000 μm, and small microplastics exhibit higher particle number concentrations.

In Tokyo Bay, Polyethylene (PE), Polypropylene (PP), Polyamide (PA), Polystyrene (PS) and copolymers are primarily detected. PE in particular is the predominant type both horizontally and vertically, accounting for 40-50% (Sato et al., 2024). An investigation of polymer types in SMP from the Tokai to Okinawa regions revealed that PE constituted 40-50% at the sea surface in all areas. In vertical distribution, PE accounted for approximately 50% down to 100 m depth, but decreased sharply below this depth, with Polyoxymethylene (POM) becoming predominant.

Next, we examined the total MP quantity in Tokyo Bay. Here, we collected not only surface MP but also sub-surface MP using submersible pumps. Both LMP and SMP were detected at the surface. Vertically, the concentration of SMP was highest at the surface. We calculated the MP quantity down to a depth of 200 m by multiplying each concentration by the corresponding seawater volume. The LMP at the sea surface was approximately 10 m³, while the SMP at both the sea surface and in the water column was approximately 15 m³. Thus, the total MP mass in Tokyo Bay (to the depth of 200 m) was estimated to be 25 m³ (Sato et al., 2024).

Degradation degree of MP

Marine plastic degradation is thought to occur over time, leading to microplastic fragmentation. Plastic degradation is assessed using the carbonyl index (CI) (Almond et al., 2020).

$$CI = \frac{Area\ under\ band\ from\ 1{,}650{-}1{,}850\ cm^{-1}}{Area\ under\ band\ from\ 1{,}420{-}1{,}500\ cm^{-1}} \quad (1)$$

We investigated the relationship between the size and CI of MP in the waters surrounding Japan. The results revealed a negative correlation between particle size and CI for both PE and PP. Specifically, CI was smaller when particle size was larger, and larger when particle size was smaller.

We examined the CI of PE MP from the Tokai offshore region to the Okinawa offshore region. The results indicated that the CI was low offshore Okinawa and significantly higher offshore Tokai. This demonstrates that MP in the East China Sea undergoes little degradation (being relatively new) and that degradation progresses as it flows eastward carried by the Kuroshio Current. Thus, it has been established that CI provides clues for elucidating the behaviour of MP under environmental conditions.

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We extend our gratitude to the captains and crew members of Tokyo University of Marine Science and Technology's training vessels Umitaka Maru, Shinyō Maru, and Seiyō Maru for their invaluable cooperation in acquiring the samples for this study.

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The Fécamp Platform: a Multidisciplinary Observatory for Monitoring of Marine Renewables Energies in France

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INTRODUCTION

The urgent need to reduce greenhouse gas emissions has driven rapid growth of marine renewable energies, particularly offshore wind, now the second largest source of renewable electricity worldwide[1]. However, their construction and operation may may generate long-term ecological impacts, notably through the persistent presence of artificial structures that influence biodiversity and ecosystem functioning[2].Artificial structures, are rapidly colonized by organisms such as algae, barnacles, bryozoans, and bivalves, and act as artificial reefs[3], leading to changes in benthic community composition and trophic interactions[4]. In France, offshore wind energy development has accelerated over the past decade, with seven large-scale projects planned along the Atlantic and English Channel coasts[5]. Despite this expansion, ecological research remains largely descriptive, and quantitative data on benthic and biofouling assemblages remain scarce. Long-term, multidisciplinary monitoring is therefore needed to better understand community dynamics and ecosystem functioning. The DRACCAR project, the first French offshore wind research platform in the English Channel, aims to address this gap using ecosystem-based approaches and innovative monitoring tools. The aim of this study is to characterize the communities associated with the Fécamp platform using an ecosystem-based approach.

METHODS

The Fécamp platform, located 13–24 km off the French coast within the Fécamp offshore wind farm, covers 60 km² (figure 1). Commissioned in 2015, it rises 40 m above sea level on a gravity structure resting on a soft, pebble habitat (up to 20 mm in size).

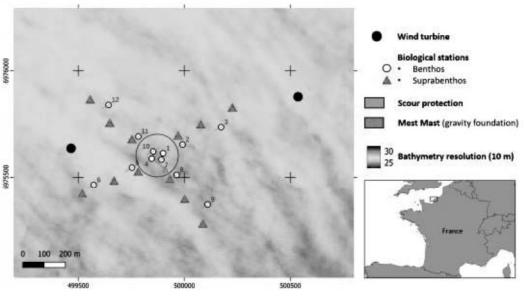

Figure 1: Localisation of sampling stations (adapted from Pezy et al. 2023).

Biofouling communities were sampled at the base of the instrumentation mast using five 0.1 m² replicates along a depth gradient (-4 m, -14 m, -27 m) across two seasons and under varying current exposures. Suprabenthos were sampled at 12 stations day and night along distances of 15 m, 115 m, and 315 m from the mast using a sled towed for 5 minutes at 1 knot, targeting organisms exhibiting diel vertical migrations.

RESULTS AND DISCUSSION

Biofouling sampling identified 168 taxa with 10,929 ± 7,731 individuals per m². Total abundance was significantly higher in autumn than in spring (Wilcoxon signed-rank test, W = 174.3; p = 0.03448). For both seasons, stations at –4 m were significantly richer than deeper stations (Autumn: Dunn's post-hoc test, Z = 3.07, p.adjusted = 0.006; Spring: Z = 4.25, p.adjusted = 6.3e-5; Z = 3.68, p.adjusted = 6.9e-4). Deeper stations revealed more stable communities due to sessile species creating complex substrates that facilitate vagile species settlement[6]. Suprabenthos sampling identified 47 taxa with 30.48 ± 47.87 individuals per 100 m³. Taxonomic richness varied temporally and between day and night. In autumn, day samples were significantly less rich than night samples (Dunn's post-hoc test, Z = 4.68, p.adjusted = 1.7e-5), and in spring, richness was also higher at night (Z = 2.70, p.adjusted = 0.042). No significant seasonal differences were observed within the same period, with observed day-night differences reflecting the nychthemeral behavior of the species.

PERSPECTIVES

The measurement mast provides a unique platform for quantitative ecosystem-based monitoring within a broader program aimed at understanding ecosystem functioning, particularly the reef and reserve effects. Isotopic analyses support ecosystem modelling at the wind farm scale, allowing effective monitoring and comparison with other offshore wind farms.

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Taxonomic–Functional Coupling: A Robust Approach to Monitor Benthic Communities in the Context of Offshore Wind-Farm Development

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1. INTRODUCTION

The development of marine renewable energies, particularly offshore wind, may affect coastal ecosystems. In the English Channel, these pressures add to already substantial disturbances in a context of climate change, underscoring the need for robust monitoring protocols for benthic communities. Classical, taxonomy-centred approaches remain informative but do not capture the diversity of ecological functions or functional redundancy, both crucial for resilience[1]. A trait-based approach (Biological Trait Analysis, BTA) complements this perspective by describing community functioning and provides a relevant indicator of stability and sensitivity[2]. However, taxonomic–functional coupling is not currently integrated into impact-assessment protocols, and very few studies address the effects of offshore wind on coarse sediment benthic communities, even though these habitats dominate in the English Channel (>80%). This study provides an overview of the functioning of coarse sediment communities and, based on the literature, examines the potential effects of introducing hard substrates. It also evaluates taxonomic–functional coupling prior to construction in order to assess the congruence of patterns and the added value of integrating traits into monitoring protocols.

2. METHODS

The data analysed come from baseline surveys of the future offshore wind farms Centre Manche 1 and Centre Manche 2, located off Seine Bay (English Channel, France). Community functioning was characterised using eight biological "response" traits subdivided into 36 modalities, selected for their relevance to organismal sensitivity to disturbances. Functional diversity indices (FRic, FEve, FDiv, RaoQ) were computed, and community weighted means (CWM) were estimated for each station. The relationship between taxonomic and functional composition was analysed using co-inertia analysis, following Hellinger transformation, and the strength of association was quantified with the RV coefficient.

3. RESULTS AND DISCUSSION

CWMs indicate assemblages dominated by free-living, walking epifauna of medium body size and intermediate longevity, with diverse feeding strategies. This profile is consistent with the highly dynamic conditions of coarse sediments in the English Channel (strong tidal currents, low organic matter content, abrasion). Despite these constraints, communities did not appear functionally impoverished: FRic and FEve were relatively high and stable, FDiv consistently very high, and RaoQ substantial, providing a robust baseline. The literature on hard structures in soft sediments reports local organic enrichment and taxonomic shifts (proliferation of annelids, declines of molluscs and echinoderms)[3], sometimes associated with granulometric fining near foundations[4]. In such an energetic system, these effects are expected to remain limited and localised. Nevertheless, we anticipate a shift in CWMs toward modalities typical of opportunistic species: surface/subsurface deposit feeders, burrowers/tube builders, small-bodied and short-lived, at the expense of suspension feeders and predators, with a decrease in functional diversity indices (homogenisation). Taxonomic–functional coupling was strong (RV = 0.82); greater dispersion in taxonomic than in functional space (**Fig. 1**) suggests higher taxonomic than functional β-diversity, environmental filtering, and functional redundancy among stations. Peripheral stations carry rare combinations of traits, whose loss could locally contract the functional envelope.

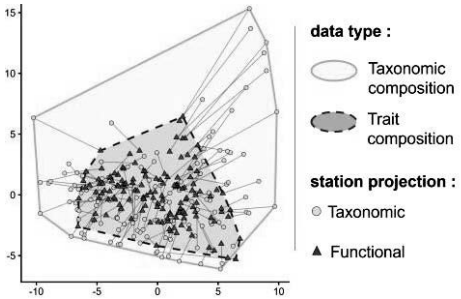

Fig. 1 Co-inertia analysis between species and traits.

CONCLUSION

Our results indicate that, in coarse sediments of the English Channel, communities are functionally diversified and taxonomy and functions are tightly coupled. At the wind farm scale, effects are expected to remain spatially limited in this hydrodynamic context, but there is a risk of local functional contraction if assemblages carrying rare traits decline. Integrated taxonomic–functional monitoring in a BACI framework along distance to foundation gradients is recommended to detect early CWM shifts and potential losses of rare functions.

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Offshore wind farm development: an opportunity to update the invertebrate diversity in the English Channel (France)

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INTRODUCTION

As climate change intensifies, the demand for sustainable energy has increased, leading to the rapid expansion of Marine Renewable Energies (MRE), particularly Offshore Wind Farms (OWF), which remain the most operational technology[6]. These developments are embedded in multi-scale policy frameworks, from international agreements (e.g., UN Ocean Decade, Convention on Biological Diversity) to European directives and national regulations[2,3]. Each project requires ecological impact assessments (EIA), but methodological heterogeneity in survey design hampers comparability across sites[1,2]. While technological advances and increasing energy demand drive larger OWF projects (≈2900 MW projected in France)[3], associated surveys also expand in scale, offering unprecedented sampling opportunities. These larger datasets enhance biodiversity assessments in poorly known habitats, such as the English Channel (EC), where monitoring remains costly and knowledge gaps persist[1,5]. Harmonizing EIA protocols would improve cross-study comparability and help address taxonomic gaps, particularly in groups like syllid polychaetes, which are ecologically widespread yet historically understudied.

METHODS

The EC is a shallow epicontinental sea, and one of the most anthropized sea worldwide. It is also an optimal location for the development of offshore wind farms[4]. Since 2012, 8 OWF projects have been developed, of which 2 are already operational (Fécamp, Saint Brieuc), and 2 others should be operational between 2025 and 2026 (Dieppe-le-Tréport, Courseulles) and 4 others are still under development. Our team worked on 5 projects : Courseulles, Dieppe-le-Tréport, Fécamp, and Centre Manche 1&2. For each EIA, sampling was performed with grab or a dredge. Every sample was sieved through a 1 mm circular sieve to preserve only macrofauna, which then was fixed with formalin, to be later sorted, determined, and weighed to obtain values of abundance and biomass per specie. Based on these values, a variety of biotic index have been used to describe the communities. Comparison between samples and stations was done through univariate and multivariate statistics.

RESULTS AND DISCUSSION

To study the benthic invertebrate community, two different strategies were developed, a quantitative approach with a Van Veen grab (sediment surface) and a semi-quantitative approach with a Rallier du Baty dredge (sediment volume). The number of stations varies from 5 to 35 between the five sites, and the number of replicate is one for semi-quantitative approach and varies from 3 to 9 by station. The sediment habitat corresponded to coarse sand, with a variable proportion of gravels and pebbles between sites. The taxonomic richness (TR) was important with a minimum of 222 taxa at Courseulles and a maximum of 370 taxa off the bay of Seine (Centre Manche 1&2), including up to 30 species of Syllids at Dieppe.

Tab. 1 OWF characteristics and benthic protocols and diversity.

	OWF details		Benthic samples			
	Surface (km²)	Power	Station NB	Replicate	Date	TR
Centre Manche 1&2	183 - 270	1 – 1.5 GW	35	1	2022-2024	379
Courseulles	50	450 MW	5-6	9	2020-2021	222
Fécamp DRACCAR	67	498 MW	12	3	2024-2025	In progress
Dieppe-le Tréport	110	496 MW	25	5	2014-2016	307
			32	5	2022	369

CONCLUSION

Given the high level of TR observed, functional approaches are the next step to improve EIAs. However they should be consistent and standardized across projects and biogeographical regions. Biofouling data sampled from the wind turbines will complement the present data to a better understanding of OWF impacts on biodiversity in the EC.

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The Fate of Olfactory Genes in Cetaceans: Insights from Ziphiidae

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INTRODUCTION

Whales and dolphins (cetaceans) have undergone a drastic reduction in their sense of smell during their transition to aquatic life. While baleen whales are hypothesised to use olfaction for foraging, toothed whales lack the anatomical structures necessary for this sense. This study examined olfactory receptor (*OR*) genes and other olfactory-related genes, with particular focus on the family, Ziphiidae, which has been rarely investigated in detail. Our aim is to provide an overview of the reduction of olfactory capacity in cetaceans.

METHODS

We mined *ORs* and several chemosensory genes from published whole-genome assemblies of five ziphiid and one physeterid species by using FATE (https://github.com/Hikoyu/FATE). Gene sequences from baleen and other toothed whales were obtained from previous studies.[1,2] Subsequently, phylogenetic trees were constructed based on maximum-likelihood (ML) optimality criterion by using RAxML-ng,[3] in order to annotate each gene sequence.

RESULTS AND DISCUSSION

The number of *ORs* was larger in ziphiids than in other toothed whales (Table 1). Ziphiid whales also tended to retain genes responsible for the olfactory signal transduction pathway to a greater extent than other toothed whales.

As a result, family Ziphiidae exhibited more extensive genetic features necessary for olfaction than other toothed whales. Common orthologous *ORs* among baleen whale species were expressed in the olfactory mucosa of the common minke whale (*Balaenoptera acutorostrata*).[4] Some of these *ORs* were also shared with ziphiids but not with other toothed whale families.

Although 20 *ORs* are broadly conserved among mammals,[5] fewer than half of them were annotated in cetacean genomes (Table 1). Notably, *OR51E1* and *OR51E2* are strongly conserved across the cetacean lineage; however, a previous study suggested that these two genes were not significantly expressed on the olfactory mucosa of common minke whale.[4] This implies that *ORs* may play roles beyond olfaction in mammals.

Table 1 Approximate numbers of *ORs* in cetaceans.

	Baleen whale	Toothed whale	
		Ziphiidae	Others
Total	77-102[2]	Around 35	13-22[1]
Widespread 20 *ORs*	5-9	3-6	2-5

CONCLUSION

Our findings suggest that toothed whale families exhibit lineage-specific pathways of olfactory regression. Furthermore, the maintenance or loss of *ORs* is unlikely to be attributable only to olfactory function, highlighting the need to account for their ectopic expression and possible non-olfactory roles.

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Octopuses were just bootleg squids!? What the vampire squid genome revealed about early cephalopod evolution

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INTRODUCTION

The vampire squid (*Vampyroteuthis infernalis*) is the most primitive extant representative of the Octopodiformes, and analysis of its genome is pivotal for resolving cephalopod evolution. Extant Decapoda (squids and cuttlefishes) generally carry about 46 chromosomes, whereas extant Octopoda (octopuses excluding *Vampyroteuthis*) carry about 30. However, the evolutionary direction linking these states has been unresolved. To address this, we sequenced a draft genome of the vampire squid and a chromosome-level genome of the paper nautilus (*Argonauta hians*) and conducted comparative genomic analyses with publicly available cephalopod genomes[1].

METHODS

1. Genome Sequencing and Assembly

High-molecular-weight genomic DNA was extracted from individuals of *V. infernalis* and *A. hians* using protocols optimized for cephalopod tissues. For *V. infernalis*, we generated Illumina short reads, PacBio long reads, and Hi-C chromatin contact maps. For *A. hians*, PacBio and Hi-C data produced a chromosome-level assembly.

2. Comparative Genomic Analyses

New genome assemblies were aligned to published cephalopod genomes to assess synteny. Chromosome complements were compared with representative decapodiform and octopodiform genomes to infer ancestral states. Conserved noncoding elements (CNEs) were identified by whole-genome alignments and analyzed for lineage-specific retention or loss.

RESULTS AND DISCUSSION

Chromosome-scale synteny comparisons show that *V. infernalis* retains a substantial fraction of the decapodiform chromosomal complement (Figure 1), making its genome structure squid-like rather than octopus-like. These results identify *V. infernalis* as closer to the ancestral coleoid condition and support the derived nature of the modern octopod karyotype. CNE comparisons independently recover the same pattern. The regulatory landscapes in *V. infernalis* align more closely with squids than with octopuses, while large regions carry octopodiform fusion-with-mixing signatures. This dual signal confirms the placement of *V. infernalis* within Octopodiformes and marks a near-intermediate genomic state at the Octopodiformes–Decapodiformes split. The *A. hians* assembly exhibits the derived octopodiform architecture and corroborates that characteristic octopus chromosomes arose after divergence from the lineage leading to *V. infernalis*.

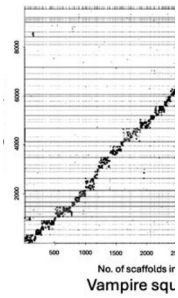

Figure 1. A dot plot depicting one-to-one relationships between assembled genomic scaffolds of *Vampiroteuthys* and the longfin squid (*Doriteuthys*), indicating karyotypic and genomic conservation of the two taxa. (Simplified from [1])

CONCLUSION

These results resolve the polarity of change within Octopodiformes and show that octopuses derive from a squid-type ancestor. The framework reconciles genome architecture with fossil-based hypotheses that the ancestral coleoid was a squid-like organism with ten appendages and links genomic remodeling to downstream regulatory innovation and early lineage diversification in coleoids[1].

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An Overview of Infestation in Farmed and Wild Oysters by Shell-Boring Polydorid Species (Annelida: Spionidae) along the French Metropolitan Coast

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INTRODUCTION

Polydorid species (Annelida, Spionidae) bore into the shells of molluscs, causing negative impacts to their hosts. Their infestations have become a serious concern, as the global trade of commercially important molluscs facilitates the unintentional spread of the polydorid species. In France, the Pacific oyster *Magallana* (*Crassostrea*) *gigas* was introduced from Japan and other regions after mass mortalities of *Ostrea edulis* and *M. angulata* in the late 1960s, and it is now extensively cultured along the French coast. Such transportation of oyster stock likely facilitated the introduction of polydorid species, which have caused widespread infestation and negative impacts on oyster aquaculture. Following the survey in 2018 in Normandy[1], we investigate polydorid infestation in oyster farms and surrounding wild habitats across the French Metropolitan coastline to discuss their distribution and dispersal potential.

METHODS

Sampling was conducted in October 2023 and from May to July 2024 along the English Channel, the Atlantic, and the Mediterranean. Farmed or natural reefs Pacific oysters *M. gigas* and flat oysters *O. edulis* were collected from 21 oyster sites. In addition, substrates potentially containing polydorids were collected in eight surrounding wild habitats, which included *M. gigas*, unidentified limpets, unidentified coralline algae, sandstone and chalk. Polydorid worms were extracted from those substrates, counted and identified to the species level through morphological examination and molecular analysis of 18S rRNA, 16S rRNA and COI sequences, with comparisons to the GenBank database.

RESULTS AND DISCUSSION

A total of 286 oysters (275 *M. gigas*, 11 *O. edulis*) were examined, and 51.7% were infested by polydorids (Fig. 1). Mud blisters formed by the burrowing activity of polydorids were observed on the inner surface of severely infested oyster shells. Infestation intensity ranged from 0 to 49 individuals per single oyster, and multiple species often co-occurred within the same host shell. In total, eight polydorid species were identified—*Boccardiella hamata*, *Boccardia proboscidea*, *B. pseudonatrix*, *Polydora hoplura*, *P. onagawaensis*, *P. websteri*, *P. calcarea* and *P. cornuta,* with *P. calcarea* and *P. cornuta* representing first attested records from France. Seven species were found in both farmed and wild habitats, indicating that they may spread from aquaculture facilities into natural environments, and vice versa. Among these, *B. hamata*, *B. pseudonatrix*, and *P. hoplura* demonstrate extensive distributions across different waters, likely facilitated by human transportation. *Polydora onagawaensis*, originally described from Japan, was widely recorded from wild sites along the English Channel and found across diverse substrate, including oyster shells, limpets, sandstone, and chalk, highlighting its broad host range. Although *P. ciliata* has been historically reported from France and other European countries, no specimens were found in this survey. The absence of *P. ciliata* and the widespread distribution of morphologically similar *Polydora* species indicates that previous reports should be re-examined to clarify its taxonomic identification.

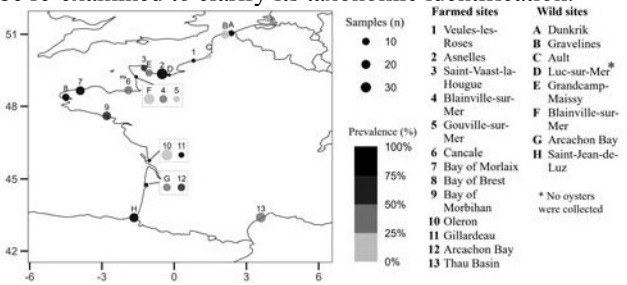

Fig. 1. Prevalence of polydorid infestation in farmed and wild oysters in each sampling sites.

CONCLUSION

This study provides the first overview of polydorid infestations across the French coastline and highlights invasive potential of several key species. Understanding the dispersal patterns underlying their widespread distribution is essential to prevent further spread and to ensure the sustainability of aquaculture and biodiversity conservation.

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Analysis of Catch Trends in Set Net Fisheries around Okinawa Island

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INTRODUCTION

This study analyzed species composition and resource dynamics in set-net fishing grounds around Okinawa Island, comparing Chinen (inner-bay, impacted by coastal development) and Yomitan (open-sea, relatively natural). As set-net catches reflect local fish communities, they provide a useful basis for assessing long-term resource trends.

METHODS (Free to use title names hereafter)

Catch data (1996–2019) from Chinen and Yomitan set nets were analyzed using haul frequency ("yama") and catch weight. After excluding rare species (retaining 50 species in Chinen and 41 in Yomitan), composition was analyzed using 20 categories. CPUE (catch weight / "yama") was used to calculate Shannon's and Simpson's diversity indices, and mean H′ values were compared by t-tests. Size-related trends were examined using catch-weighted plots based on species ranked by total length. Data on biological characteristics utilized information from existing field guides [1].

RESULTS AND DISCUSSION

1. Catch composition: In Chinen, the top 10 species made up ~70% of catches without strong dominance, while in Yomitan they comprised ~60% with higher concentration. Catch peaks, notably in 2005, reflected the characteristic large school entry common to set-net fisheries.

2. Diversity indices The Inverse Simpson Index (1/D) clearly demonstrated higher diversity and evenness in Chinen compared to Yomitan (Fig. 1). Chinen showed higher Shannon and Inverse Simpson (1/D up to 48.6) values than Yomitan (up to 24.4), indicating greater richness and evenness, likely supported by nearby seagrass, tidal flats, and reefs. Lower diversity in Yomitan reflected dependence on specific migratory schools.

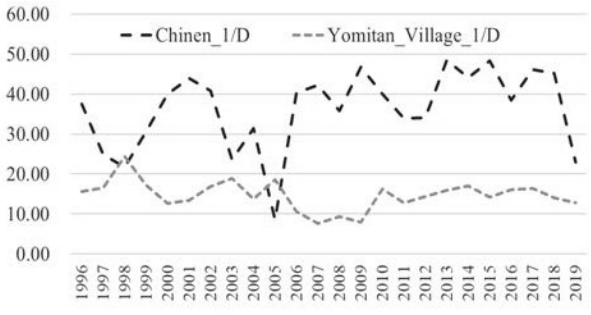

Fig.1 Inverse Simpson Index in set-net catches from 1996 to 2019 in Chinen and Yomitan villages.

3. Body size structure: Yomitan catches were dominated by small–medium species (*Decapterus* spp., *Rastrelliger kanagurta*), whereas Chinen had species across size classes, suggesting a more balanced structure (Fig.2).

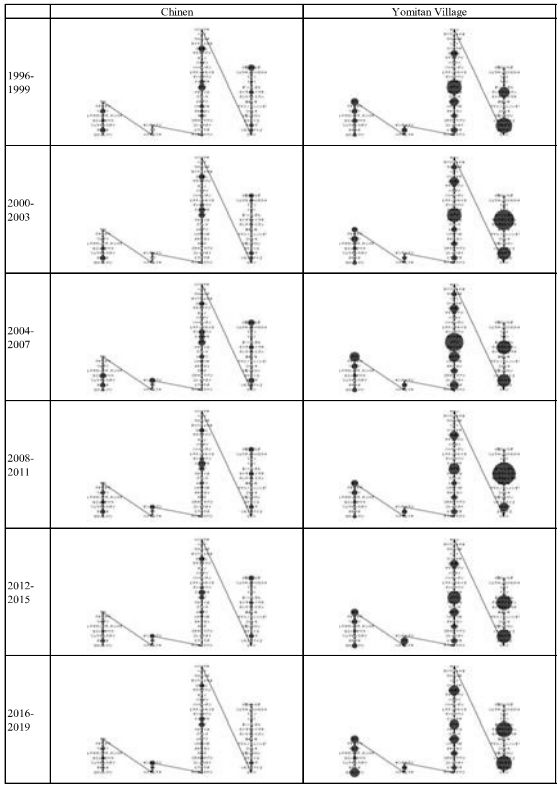

Fig.2 Figure showing catch expressed as ball size, sorted by size of fish species caught in fixed nets in Chinen and Yomitan Village.

CONCLUSION

A detailed analysis of set-net catch data from Okinawa Island (1996–2019) demonstrated that differences between Chinen (inner-bay) and Yomitan (open-ocean) fishing grounds were clearly reflected in catch diversity, species evenness, and catch patterns. Chinen exhibited higher diversity indices, indicating a more even and balanced utilization of the fishing grounds by multiple species. Conversely, Yomitan demonstrated a stronger dependence on specific schooling species. These findings underscore that long-term catch data provide an effective means of understanding resource dynamics in coastal fisheries and of inferring environmental drivers of change in marine ecosystems.

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Modeling the Migration of Skipjack Tuna (*Katsuwonus pelamis*): Insights Into ENSO-Induced Seasonal Patterns in the Makassar Strait

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INTRODUCTION

Predictive distribution modeling using habitat data is commonly employed to examine the spatial and temporal dynamics of the tuna population and has been utilized for numerous fish species globally[1,2]. Environmental conditions significantly impact tuna distribution, feeding grounds, and reproductive characteristics[3]. The prediction of fishing areas employs the MaxEnt model, which utilizes a principle-based approach to study the connectivity of oceanographic parameters in relation to schools of tuna. This study aims to investigate the effects of regional climate variability, particularly the El Niño Southern Oscillation (ENSO) and seasonal impacts on the migration patterns of skipjack tuna catches in the Makassar Strait.

METHODS

The migration patterns of skipjack tuna were predicted using monthly satellite-derived oceanographic variables, including sea surface temperature (SST), chlorophyll-a, salinity, surface currents, sea surface height (SSH), the Nino 3.4 index, along with skipjack tuna catch data collected from 2018 to 2021. The MaxEnt model will produce outputs such as model assessments, variable contributions, response curves, and prediction maps.

RESULTS AND DISCUSSION

The model results showed the most favorable oceanographic condition for skipjack tuna are current speed ranging from 0.1 – 0.9 m/s, salinity ranged from 33 – 34 ppt. chlorophyll-a, SSH, and SST are 0 – 2 mg/m^3, 0.56 – 0.58 m, and 31 - 35ºC, respectively.

Table 1. Contribution of oceanographic parameters to skipjack tuna catch

Oceanographic Variable	Contribution (%)
Current	61.8
Salinity	22.4
Chlorophyll-a	14.2
SSH	1.4
SST	0.1

"Table 1 show that the MaxEnt model identified the most influential factor affecting the skipjack tuna catch as surface current speed, followed by salinity, chlorophyll-a, SSH, and SST".

During the La Niña period, the SST distribution exhibits higher values in the 29,5 – 30°C range. The fishing grounds for skipjack tuna during the La Niña period are located at coordinates 3°S – 5°S and 115°E – 120°E with more fishing points than during El Niño. The CPUE values obtained during this period ranged from 50 – 5000 kg/trip. Skipjack tuna prefers warm, low-salinity seas[4], which aligns with the La Niña phase.

CONCLUSION

The predicted catch distribution of skipjack tuna during the La Niña event indicated a potential area with higher catch probability of approximately 0.7-0.9 based on the HSI value. This condition has altered skipjack tuna migration patterns, which have spread across practically the entire Makassar Strait, resulting in favorable fishing catches. These findings highlight the MaxEnt model's ability to predict skipjack tuna migration in the Makassar Strait during ENSO conditions.

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Environmentally Regulated Oceanic Spawning Migration Behaviour of the Freshwater Eel

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INTRODUCTION

Freshwater eels (genus *Anguilla*) are catadromous species that migrate between tropical oceanic spawning habitats and coastal, brackish, or freshwater growth habitats. They undertake long-distance oceanic spawning migrations for reproduction. During the spawning migration, eels exhibit diel vertical migration (DVM). In previous publications[2,3], it is known that the swimming depths of the Japanese eel's DVM are related to light and thermal environments in nighttime and daytime, respectively, because depth profiles mirrored the light regime: eels occupied shallower strata under low irradiance and shifted deeper as irradiance increased, correlating with solar altitude and lunar position (phase and altitude) throughout the day. However, these findings are based mainly on behavioural data from open-ocean regions where spatial environmental gradients are relatively gradual. An integrated analysis incorporating behavioural data from the Kuroshio Current region, where the marine environment is complex, is required.

METHODS

Tracking: We attached pop-up satellite archival tags (PSATs) to 27 silver-phase Japanese eels released in Japan's coastal and offshore waters in the western North Pacific, recording time-series of swimming depth and ambient water temperature at 5–10-min intervals. DVMs were identified based on characteristic patterns of depth change.

Migration pathway: To reconstruct the migration pathways of eels, a particle filter analysis was conducted, comparing the time series of water depth and temperature data recorded by the PSAT with the distribution of water temperature in JCOPE-FGO.

DVM mechanisms: A linear mixed-effects model (LMM) was constructed to elucidate the effects of light and temperature (T) stimuli on the swimming depth of DVM (D). The lunar (Alt_L) and solar altitudes (Alt_S) were used as indirect indicators of the light environment in the night (Eq1) and day models (Eq2), respectively.

$$D_{night} \sim intercept + Alt_L + T + Alt_L{:}T \quad \text{(Eq1)}$$

$$D_{day} \sim intercept + Alt_S + T + Alt_S{:}T \quad \text{(Eq2)}$$

RESULTS AND DISCUSSION

Tracking: Repeated and distinct DVMs were observed across all three tracking regions, coast of Japan, off Ogasawara Islands (pelagic), and west of Mariana Islands (spawning area). This provides compelling evidence that Japanese eels perform DVM consistently throughout their entire spawning migration period.

Migration pathway: Eels in coastal waters moved eastward with the Kuroshio and its Extension before entering the subtropical gyre via counter-currents; offshore eels swam south toward the spawning area. Active swimming directions inferred from the tracks broadly aligned horizontal gradients in total geomagnetic intensity. These findings provide a broad-scale delineation of broad-scale migration corridors of the Japanese eel and support geomagnetic orientation as a plausible navigation mechanism during spawning migration in the offshore oceanic areas.

DVM mechanisms: The LMM showed that both light and water temperature exerted independent positive effects on the swimming depth of eels in both night (Eq3) and day models (Eq4).

$$D_{night} \sim 237.9 + 0.37 * Alt_L + 20.6 * T - 0.02 * (Alt_L * T) \quad \text{(Eq3)}$$

$$D_{day} \sim 613.7 + 2.08 * Alt_S + 1.55 * T - 0.19 * (Alt_S * T) \quad \text{(Eq4)}$$

A positive coefficient in the light variable indicates that swimming depth increases as light intensity rises. Conversely, a positive coefficient in the water temperature variable suggests that swimming depth decreases as water temperature falls. These results indicate that DVM depth in Japanese eel is modulated jointly by photic cues (driving descent) and thermal cues (driving ascent). Such behavioural plasticity likely optimises the trade-off between predation risk and physiological demands, including locomotor cost and gametogenesis, during the prolonged spawning migration.

FUTURE PERSPECTIVE

Tracking experiments on Japanese eels have revealed their migration routes and the regulation of their DVM. To date, we have collected behavioural tracking data on eel species in the South Pacific, Indian Ocean, and Atlantic Ocean. We are currently conducting individual-level analyses for each species[3,4], our future aim is to clarify the ecological significance and evolutionary background of spawning migration behaviour within the eel genus through interspecies comparisons. Elucidating the response rules of DVM to environmental cues in the genus *Anguilla* is essential for predicting the potential impacts of climate change on their migratory behaviour.

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The Hidden Threat: How Pollutants Impact European Eel Populations. Implications for management.

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INTRODUCTION

There is growing recognition that organic and metallic pollutants are among the primary drivers of biodiversity decline, ecosystem degradation, and adverse effects on human health. These chemicals interfere with life history traits by mimicking or blocking hormones, leading to impaired reproduction, development, and behavior. Awareness, led to policies like the Stockholm Convention. Yet, reducing pollutants use and adopting sustainable alternatives remains essential to safeguard ecosystem health.

METHODS (Free to use title names hereafter)

The presentation provides a review of articles and summary of research led by author, based on analysing long term and large-scale variability of life history traits of eels in relation to organic and metallic pollutant loads, and environmental parameters.

RESULTS AND DISCUSSION

Pollution is a silent but powerful force driving the dramatic decline of the European eel (*Anguilla anguilla*). Their unique life cycle makes them especially vulnerable: during their time in freshwater, they accumulate fat-loving pollutants in their muscles. When they migrate to the ocean to reproduce, these toxins mobilize and concentrate in their reproductive organs, disrupting hormones and impairing their ability to reproduce. Since the 1980s, these hidden, sublethal effects have played a major role in their population collapse. Research by Belpaire et al. highlights how endocrine-disrupting chemicals interfere with eel development, reproduction, and migration, while the ICES Working Group on Eel (WGEEL) points to chemical pollution as a leading human-driven threat across their entire range. Indeed, every European eel tested carries a cocktail of organic and metallic pollutants—often at levels that damage their physiology. By analyzing data from eight river systems, scientists linked pollutant levels to 11 key fitness traits using machine learning, revealing that contamination impacts eels more than geography or environment. Remarkably, cutting pollution to the lowest recorded levels could nearly double eel fecundity. This creates an estimated deficit of c.a. 450 tons of glass eels per year.

CONCLUSION

Despite these findings, current European eel management focuses mainly on controlling fishing mortality, restocking and restoration of river continuum. Future strategies must broaden to tackle pollution head-on. How much does this apply to the management of eels, does pollution control offer promising perspectives for protecting these remarkable creatures from further decline? This is a remarkable example of how the land ocean continuum applies to an efficient management of the iconic freshwater eels.

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Effect of Mixing Pearl Powder on the Electrical Conductivity of Beverages : A Case Study of Earl Grey

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INTRODUCTION

Toba, where my college is located, is well known for its pearl industry. Pearls contain a variety of minerals such as calcium, sodium, and magnesium[1]. These minerals can influence the physical properties of solutions.

For instance, W. Zhang et al., calculated the electrical conductivity of solutions containing Na and Ca. They reported that the conductivity of Na-containing solutions increased with increasing molarity, while that of Ca-containing solutions first increased but then decreased after exceeding a certain concentration[2].

In recent years, people have been paying more attention to their health, and pearl powder has gained popularity as a natural health supplement.

This trend inspired us to explore some of its effects, such as its electrical conductivity when dissolved in beverages like Earl Grey tea.

METHODS

A photograph of the pearl powder used in the experiment is shown in Figure 1. Solutions were prepared using Earl Grey tea, both with and without pearl powder, for comparison (Figure 2).

The conductivity meter CD-4322 (Kennis Co., Ltd.) was used, and it was calibrated using a standard solution with a conductivity of 1413 µS/cm at 25°C.

The electrical conductivity (EC) and total dissolved solids (TDS) of the plain Earl Grey tea were measured first. Then, 0.5 grams of pearl powder were added to the tea. After thoroughly mixing the solution, the same measurements were taken again.

Each measurement was performed three times to ensure accuracy and reproducibility. All measurements were conducted at solution temperatures ranging from 27.0°C to 27.6°C.

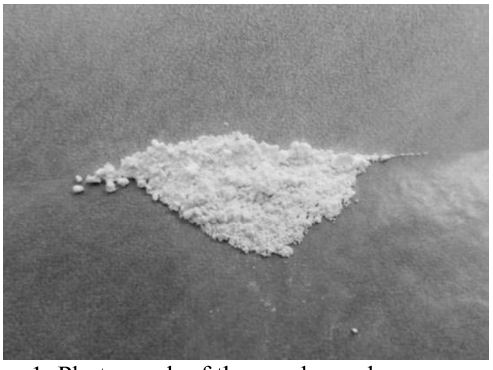

Figure 1. Photograph of the pearl powder

RESULTS AND DISCUSSION

Table 1 shows the average measurement results of EC and TDS. The average electrical conductivities of Earl Grey tea with and without pearl powder were 498.3 µS/cm and 641.7 µS/cm, respectively. The addition of pearl powder clearly increased the electrical conductivity. TDS values also showed a similar increase.

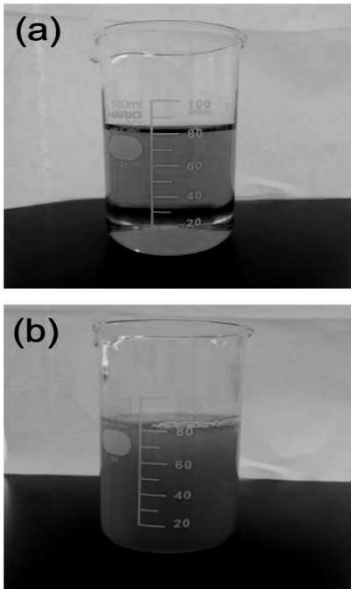

Figure 2. Comparison of Earl Grey tea before (a) and after (b) mixing with pearl powder

Table 1. Measurement results of EC and TDS

Solution	EC (µS)	TDS (ppm)
Tea	498.3	328.0
Tea + powder	641.7	427.3

This increase is likely due to the release of mineral ions such as calcium, sodium, and magnesium, from the pearl powder into the solution.

CONCLUSION

In this study, the effect of pearl powder on the electrical conductivity of Earl Grey tea solution was investigated. The experimental results showed that the addition of pearl powder, which contains ionic components, led to an increase in the solution's conductivity. This increase is likely due to mineral ions released from the pearl powder. While the detailed mechanisms require further investigation, these results demonstrate that natural ionic additives can modify the properties of aqueous solutions. In future work, we will examine how changes in the concentration of pearl powder affect electrical conductivity, and we also plan to test this in other liquids.

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Nondestructive and Noninvasive Analysis of Marine Product Quality

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INTRODUCTION

Aquaculture is a significant development that supports global food security and production. In particular, the effective and sustainable use of marine products is important in Japan, which is surrounded by the sea on all sides. Therefore, to secure sufficient quantities of marine products, technologies will need to be improved for resource conservation, aquaculture, and post-harvest. The relationship between the quality of food and its microstructure has recently been shown to play a crucial role in understanding the properties of food products. Hence, nondestructive, noninvasive, and rapid observation techniques for the qualities of fish and seafood products have been desirable.

In this paper, the application of nondestructive and noninvasive analysis, such as synchrotron radiation analysis, in the field of marine products is reviewed.

SYNCHROTRON RADIATION (SR)[1-3]

The electromagnetic radiation emitted from a synchrotron accelerator is SR. Its brightness is 1 billion times that of sunlight. Accordingly, it can be said that SR is a huge microscope that can observe materials on a nanoscale. SR interacts with the substance by either absorption, scattering, or emission processes. It has been required to develop nondestructive observation methods to evaluate the structure and distribution of components in marine products. Observation of the internal structure of products generally requires destructive sample preparation. In this respect, it can be said that the measurement by SR is suitable for marine products because it is a nondestructive and short-time analysis. A next-generation SR facility must be capable of handling soft X-rays with higher brightness and be suitable for the functional analysis of soft materials, such as chemical bonds and electronic states. The next-generation SR facility, NanoTerasu, which covers the soft X-ray region, is more than 100 times brighter than the conventional light source. Compared with hard X-rays (5～20 keV), soft X-rays (～2 keV) beamlines are more sensitive to light (low-atomic-weight) elements, such as C, N, O, Na, etc. Therefore, NanoTerasu is suitable for soft materials such as biological materials and food, and is expected to visualize and analyze their dynamics at the nanoscale. It is hard to observe the distribution of ice crystals in the muscle of fish *in situ*. Recently, it is reported that the distributions of lipid, water (ice crystals), and protein in frozen tuna muscle have been successfully observed nondestructively by X-ray computed tomography (XRCT) derived from SR.

NEAR-INFRARED (NIR) SPECTROSCOPY[4, 5]

In NIR spectroscopy, a substance is irradiated with light having a wavelength in the NIR region of 800-1,200 nm, which is closest to the visible region in the infrared region outside the long wavelength edge of the visible region, to obtain a spectrum. A major feature of NIR spectroscopy is the spectral transparency of combination bands and overtones, which is used for component analysis. Conventional NIR spectroscopy has been used mainly for general composition in foods. Recently, research on quantitative analysis of trace ingredients, such as amino acids, fibres, salt, and inorganic substances, has been developed. Furthermore, NIR spectroscopy has also been applied to evaluate the quality of marine products. A handheld NIR spectrophotometer device has been developed and used to measure lipid content in the muscle of several fish species, such as mackerel and blackthroat seaperch.

CONCLUSION

Nondestructive and noninvasive analytical methods, such as SR, NIR spectroscopy, and bioelectrical impedance analysis (BIA), are expected to be further studied and applied to evaluate the quality of marine products. Additionally, these advanced technologies will surely contribute to the sustainable use of limited marine resources.

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Unconventional approaches to understanding and mitigating the impact of climate change and human activities on marine coastal areas point to the existence of latent sources of creativity.

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INTRODUCTION

In the realms of scientific and technological fields, knowledge, discoveries and innovations stem usually from the endeavor of specialized individuals within dedicated institutions. Marine sciences and technologies are no different with researchers and engineers, as well as practitioners such as fishermen or sailors.
Yet, there are occasions when original ideas or innovative technologies that prove highly relevant to marine and coastal sciences come from individuals or organizations with entirely unrelated backgrounds.

METHODS

This presentation highlights such "unconventional" encounters through concrete examples drawn from a variety of activities. Special attention is given to the processes by which individuals or organizations have "crossed borders" and became involved in marine sciences and technologies.
These "case studies" encompass a broad spectrum of individual backgrounds and of applications, including social sciences, renewable energy, aquaculture, finance and even social gaming.

DISCUSSION

While these observations may seem anecdotal, they serve as reminders of the potential for creativity in the areas of marine and coastal sciences and technologies that arises from cross-border approaches and individual curiosity.

Occurrences of such unconventional contributions are, by their nature, rarely documented in detail, in a communication landscape typically structured by disciplinary silos. Nevertheless these may be more common than perceived, underscoring the need to recognize and evaluate this creative potential.
This prompts the question of how to systematically mobilize this latent source of creativity to the benefit of marine and coastal research. There is value in considering how to "reverse" the process, proactively bringing unsolved problems to the attention of a wider community beyond established "experts," thereby inciting curious minds to offer their unconventional, unbiased perspectives.

CONCLUSION

Coastal zones, characterized by their complexity, demographic importance, and vulnerability to environmental changes, present significant scientific, technological, environmental and societal challenges. Addressing these challenges calls for a comprehensive approach by which every avenue is explored. The principle that "no stone should be left unturned" is especially relevant, emphasizing the necessity of embracing both conventional expertise and unconventional insights in pursuit of sustainable solutions.

ACKNOWLEDGMENTS

I wish to thank the scientists and innovators mentioned in this work for generously taking the time to answer my questions and share their experiences.

Protecting coastlines from rising sea levels caused by climate change. What is being done off the French Mediterranean coast and long-term projects

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INTRODUCTION

Climate change is causing sea levels to rise. The IPCC's average projections suggest a rise of 1 meter by 2100. Extreme sea-level scenarios estimate an increase in ocean levels of 1.84 to 2.92 meters (Bars *et al.*, 2017). Regardless of well-intentioned efforts to reduce greenhouse gas emissions, all of the world's coastlines will be affected by permanent submersion.

Taking the French Mediterranean coastline (2,100 km) as an example, we have identified the actual coastal protection structures. They are detrimental to the landscape and also to fish nurseries, as the sandy or muddy substrates at mean sea level are replaced by hard substrates (sea walls of rock or concrete).

We also mention long-term projects based on dams isolating seas or coastal areas to protect them permanently from the future impacts of submersion.

METHODS

The current state of artificialisation of the French Mediterranean coastline is monitored exhaustively using GIS software available on a dedicated website (Bottin *et al.*, 2022).

RESULTS AND DISCUSSION

Along the French Mediterranean coastline, defenses against rising sea levels currently include: (i) annual beach nourishment**,** with pebbles or sand, (ii) rock groynes built perpendicular to the shoreline (over 447), (iii) seawalls**,** typically constructed from rock blocks either at the water's edge (more than 181) or at the upper edge of the highest tide levels (more than 86), (iiii) submerged seawalls**,** often made from rock blocks or geotextile materials (more than 31). All these structures will require constant reinforcement in the future to cope with the exponential and ongoing sea-level rise, which will almost certainly surpass the much-cited 2100 deadline. Off the French Mediterranean coast, 1,100 coastal structures (ports, embankments, dikes, etc.) have already been built on the sea, resulting in the permanent destruction of more than 5,400 hectares of shallow marine habitat. Today, 12% of the coastline is artificial—it exceeds 90% in Monaco. Nonetheless, the efforts to save infrastructure along the seafront will inevitably accelerate the artificialization of the coastline, with major repercussions for marine landscapes, public access to the sea, and marine biodiversity.

As a result, other large-scale solutions have already been implemented. For example, dams over 30 km long protect low-lying areas from flooding in the Netherlands and South Korea, Long-term projects such the dam across the Strait of Gibraltar (25 km long, maximum depth 284 meters, with an estimated cost of $50 billion) would be to stabilize the sea level of the entire Mediterranean indefinitely and avoid the concrete or rock reinforcement of nearly 46,000 km of coastline along the Mediterranean shores. (Gower 2015, Meinesz and Bottin 1922,). Similarly proposal is to build dams to protect the coastline of 15 countries (the English Channel, the North Sea, and the Baltic Sea) (Groeskamp and Kjellsson, 2020). The North European Enclosure Dam (NEED) project include (i) a dam from France to England (161 km long, average depth 85 m), (ii) a dam from Scotland to the Shetland Islands (145 km long, average depth 49 m), (iii) a dam from the Shetlands to Norway (331 km long, average depth 161 m). The estimated cost of the NEED dams (between $250 and $550 billions) compares favorably to the vast and recurring costs of reinforcing thousands of kilometers of coastline. To protect just the German coast from a 1-meter sea-level rise would cost approximately $280 billions.

Could the Seto Inland Sea in Japan, which has a coastline of 7,230 km, be protected from sea-level rise by constructing dams in the Naruto Strait (1.3 km wide, 90 m max depth), the Akashi Strait (4 km wide, 140 m max depth) and the Kanmon Strait (600 m wide, 60 m max depth)? Such a project would protect all coastal areas of the Seto Inland Sea—including its coastal cities and the Satoumi developments ? This idea has very likely already been considered by Japanese scientists and hydraulic engineers !

CONCLUSION

One thing is certain: the irreversible, exponential, and foreseeable rise in sea levels worldwide. Local and short-term countermeasures will increasingly disfigure coastlines, with major consequences for marine biodiversity, tourism, and human livelihoods. To preserve some specific regions around the world, pharaonic engineering projects may be the only way to ensure long-term stability in the face of a rising ocean.

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Okinawa Coastal Fishers' Perceptions of Climate Change and its Impact on Fisheries and Fishers' Wellbeing

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INTRODUCTION

Japan's coastline is characterised by the presence of fishing communities which play a pivotal role in the provision of seafood (Makino, 2011).These community-based fisheries provide employment for local families while embodying cultural heritage. Fishing communities worldwide are confronted with challenges such as the impact of climatic stressors that affect marine ecosystems and the fishing industry. In this presentation, we will present our project focus on small island fishers' communities in Okinawa, Japan's southernmost prefecture. We developed a transdisciplinary study in collaboration with scholars, local fishers, and the Okinawa Prefecture Fisheries Cooperative Federation. The aim of our study is to analyse fishers' perceptions of local climate change, their concerns about the future of the fisheries industry and their notions of well-being.

METHODS

A stratified survey was conducted across 36 fisheries associations in Okinawa, with strata defined by cooperative size. Of the 700 targeted respondents, 511 completed surveys were obtained from 33 cooperatives. Survey responses (covering demographics, fishing methods, climate change perceptions, health and safety and wellbeing questions) were compiled into a correlation matrix and visualized via heat map. Factor analysis was used to group highly correlated items, which were then assigned descriptive labels (e.g., "Fishing Operations," "Responsible Actions"). Pairwise correlations between factors were examined, and a probabilistic causal model was developed to assess cause–effect relationships among factors

PRELIMINARY RESULTS AND DISCUSSION

Preliminary results indicate a discrepancy between fishers' perceptions and metereological data. While respondents reported that rainfall has changed over the last decade, meteorological data show no clear trend. Perceptions of typhoon frequency aligned with data, showing no increase, but fishers reported stronger winds, likely influenced by a damaging typhoon in 2023. Additionally, while respondents reported declining fish stocks, governmental data indicate that while long-term catches have declined, sea surface fisheries have stabilized and aquaculture production has increased.

Preliminary results from Bayesian network analysis revealed several key relationships:
-Fishers are aware that the climate in their local region is changing.
-A strong attachment to the region correlates with higher environmental awareness and valuing the attractiveness of the fishing industry.
-Awareness of future climate risks is linked to valuing the industry's attractiveness and the perceived need to address those risks.
-A strong sense of nature-related well-being correlates with higher general health indicators.

CONCLUSION

This study highlights the need of incorporating Okinawa's fishers' perceptions into climate adaptation planning. Fishers' local knowledge provides ground information that complements scientific data, offering valuable insights into marine environmental trends, fisheries resource management, and culturally appropriate adaptation strategies. Preliminary findings reveal that Okinawa's fishers have high environmental awareness, particularly those with strong regional attachment, and recognize changing climate patterns in their local region. While discrepancies exist between respondents perceived and meteorological trends, these perceptions reflect lived experiences and cultural connections to marine ecosystems that are crucial for fisheries governance. So far, our findings suggest for the need for policymakers to consider fishers' perceptions and local knowledge when developing climate adaptation policies. By doing so, we can foster more effective and culturally sensitive fisheries management strategies, ultimately enhancing the resilience of vulnerable fishing communities.

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Local ecological knowledge of oyster famers on the marine environment and productivity

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INTRODUCTION

Local Ecological Knowledge (LEK) refers to the environmental understanding developed by local residents through experience, including traditional resource management practices[1]. In oyster farming, LEK supports farming practices that respond to region-specific fluctuations in environmental factors like water temperature, tides, and plankton. However, recent changes in marine conditions have begun to undermine these experience-based systems. Sustainable oyster farming now depends on how farmers perceive and adapt to these changes.

Uramura, located in Toba City, Mie Prefecture, is one of the major oyster farming areas in Japan with a traditional management system that values productive grounds and ensures fair access for small-scale farmers[2]. Since around 2022, environmental shifts have reduced productivity in these valued areas, disrupting the balance that the system had long sustained[3]. The system's ability to adapt hinges on farmers' environmental awareness, yet their perceptions remain unclear. This study explores LEK in Uramura, focusing on how farmers perceive environmental and productivity changes, and what influences these views.

METHODS

The study site was a local village near Ohnoura Bay in Uramura, Mie, Japan. The major industry is oyster farming, targeting the Pacific oyster *Crassostrea gigas*.

A self-administered questionnaire survey was conducted among 18 oyster farmers in Uramura, Toba City, Mie Prefecture between September 2023 and January 2024. Participants were recruited voluntarily with assistance from representatives of the local oyster farming community.

The questionnaire asked participants to evaluate nine oyster farming sites in Uramura based on the following criteria: experience farming at the site, environmental conditions (current speed, oyster feed concentration), productivity (shell growth rate, meat yield), ease of operation, and the value of the farming site. Evaluations were conducted using a 7-point scale based on the conditions in the 2022/23 harvest season and the average conditions over the five years prior to that. The questionnaire also collected information on the farmers' characteristics, including age, years of oyster farming experience, production scale, sources of environmental information, and educational background.

To identify the characteristics of farmers who perceive changes in the marine environment, we conducted a statistical analysis examining the relationship between farmer attributes and changes in their evaluations of the marine environment between the 2022/23 harvest season and the preceding period.

RESULTS AND DISCUSSION

Perceptions of "meat yield" differed between the most recent season and the five-year average preceding it, likely reflecting farmers' direct awareness of environmental changes during harvesting. Other evaluation items showed little variation.

Analysis of individual attributes revealed that sensitivity to changes in tidal flow was higher among older farmers, those with higher educational attainment, and those receiving environmental information from the local Fisheries Cooperative Association (FCA). Similarly, sensitivity to changes in feed concentration was associated with higher education, longer farming experience, and access to FCA information. Even among less experienced farmers, those with higher education or access to FCA information demonstrated greater perceptiveness.

CONCLUSION

Our findings suggest that experiential knowledge, community-shared information, and formal education each contribute to the recognition of environmental changes. To adapt to intensifying environmental changes, strengthening both individual education and community knowledge-sharing is expected to be effective. Scientific knowledge, such as ICT, can support these efforts.

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Local Ecological Knowledge and Environmental Change: A Case Study of *Ama* Fishing in Mie Prefecture, Japan

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INTRODUCTION

Coastal fisheries in Japan face various environmental changes, including climate change and the meandering of the Kuroshio Current, raising critical questions regarding adaptation strategies. According to Giddens[1], adaptation is more complex than mitigation because it involves identifying intertwined impacts and translating them into actionable measures. Previous studies have emphasized the importance of linking fishers' local ecological knowledge (LEK) with scientific knowledge to develop effective adaptation strategies[2]. However, this study reveals that recent marine changes along Japan's coasts are so rapid and unprecedented that there are cases where neither form of knowledge can be effectively applied. As an interim report, this study examines the development of new knowledge and adaptive strategies to address these unknown changes. It focuses on *Ama* divers (female divers) who have acquired deep knowledge of underwater environments through their fishing practices. This study contributes to a broader understanding of adaptive strategies for coastal fisheries by examining their experiences and perceptions.

METHODS

This study employed qualitative research methods, specifically in-depth interviews with *Ama* divers and participant observation of their fishing practices. The fieldwork was conducted over an extended period (August 2018 to July 2025), which allowed for longitudinal insights into changes in *Ama* practices and perceptions. These methods facilitated the collection of data on how *Ama* divers interact with the marine environment through their daily fishing practices and how they perceive and experience recent environmental changes. The *Ama* perceptions, practices, and adaptive strategies were systematically analyzed using thematic analysis.

RESULTS AND DISCUSSION

In the Shima Peninsula of Mie Prefecture, where traditional *Ama* fishing is practiced, *isoyake* (sea desertification) has been progressing in recent years, causing significant negative impacts on local fisheries. Marine scientists attribute *isoyake* to the long-term effects of global warming and short-term effects of the Kuroshio Current's meandering, which began in August 2017[3]. *Isoyake* has led to a decline in the catch of abalone, the primary target of *Ama* divers, as well as a decrease in the number of *Ama* divers themselves. Before the rapid progression of *isoyake* became evident in 2018–2019, *Ama* divers were able to maintain stable fishing practices by integrating their LEK with the market value of various marine resources by adjusting their fishing schedules and catching volumes accordingly. They developed this LEK through micro-level interactions between their bodies and various elements of the marine ecosystem, including ocean currents, water temperature, seaweed, and shellfish. Although *Ama* divers have experienced and recognized the recent rapid *isoyake* through similar micro-level observations, they have struggled to connect this unprecedented phenomenon to their existing LEK. Consequently, the stable relationship between *Ama* divers and the marine environment has collapsed, resulting in an increasing number of withdrawals from fisheries.

This study highlights the limitations of applying LEK to sudden and unknown environmental changes and presents a preliminary report of the findings. In the Shima Peninsula, efforts are being made to create new knowledge through collaboration between *Ama* divers and marine scientists. Future research will monitor and analyze these collaborative attempts.

CONCLUSION

This study investigates how *Ama* divers have developed LEK through fishing activities and reveals the limitations of applying LEK to sudden and unprecedented environmental changes. Previous research has emphasized the importance of using LEK to adapt to environmental changes, whereas this study highlights the need to understand such limitations and the mechanisms underlying them. Furthermore, it argues that effective utilization of LEK requires collaboration with other stakeholders, such as marine scientists, to develop new knowledge. This finding will contribute to discussions on sustainable resource management and resilience in coastal fisheries in response to environmental changes, including climate change, in coastal areas.

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OP-28

Relationship between land use, river water quality, and fisheries productivity in each marine area of *Hokkaido*

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INTRODUCTION

Hokkaido has five marine areas. Agricultural development has progressed rapidly in each area since the mid-1800s. Furthermore, since 1950, the scale of agricultural operations has expanded, leading to increased consumption of purchased fertilizer and feed.

As a result, the area of forests in the watershed has decreased and the amount of anthropogenic material input to the watershed has increased. This may have affected river water quality and salmon aquaculture. Meanwhile, rising seawater temperatures due to global warming have also been noted to be affecting fisheries productivity.

In this study, we therefore first attempt to examine the impact of seawater temperature on salmon aquaculture productivity. Next, we attempt to examine the impact of agricultural production in each marine area on salmon aquaculture productivity. The purpose of this study is to obtain basic information from this information on how to maintain agricultural production while minimizing the impact on the fisheries industry.

METHODS

The survey targeted 40 rivers, primarily those where salmon proliferate in each marine area of *Hokkaido*.

River water quality was continuously monitored from 2010 to 2024. Cultivated land area was identified using GIS. The relationship between cultivated land area and river water quality was then analyzed.

River surveys and water quality analysis were carried out as follows: Water depth and ORP were measured at the survey sites. The samples were then brought back to the laboratory and measured for pH, EC, NO_3-N, PO_4-P, Na, K, Ca, Mg, Ca (+La-(-La)), and Fe. Note that a high value for Ca (+La-(-La)) mmol/L measured by flame photometry is inferred to indicate high levels of P, Si, and AL (Ca measurements by flame photometry will be lower than the true value if a buffer inhibitor (La in this case) is not used).

The rate of increase in mean seawater temperature in each marine area was calculated using the following formula.

(2024 average annual seawater temperature) /
(2014 average annual seawater temperature) × 100%

Based on the trends in salmon catch in each area, the rate of change in salmon catch was calculated using the following formula:

(2016-2024 average catch) / (2014-2015 average catch) × 100%

The correlation between the rate of increase in average seawater temperature and the rate of change in salmon catch was analyzed. The correlation between river water quality and the rate of change in salmon catch was also analyzed.

RESULTS AND DISCUSSION

First, we examined the relationship between the rate of seawater temperature rise and the rate of change in salmon catches. No correlation was found between the rate of seawater temperature rise and the rate of change in salmon catches（Fig.1）.

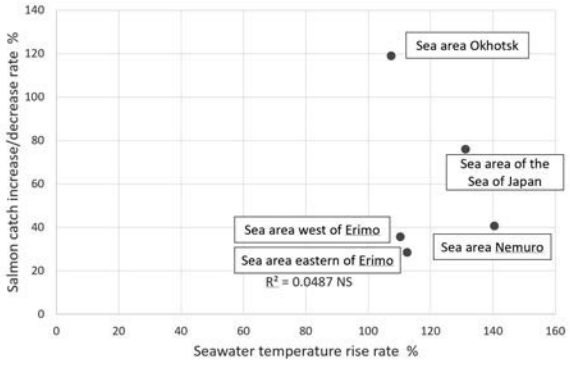

Fig.1 Rate of seawater temperature rise and rate of salmon catch increase/decrease

On the other hand, a negative correlation was observed between the percentage of cultivated land in each area and the rate of change in salmon catch
(R = -0.54 (P < 0.05): Fig. 2).

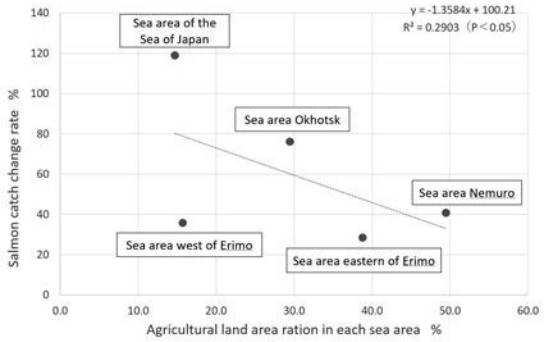

Fig.2 Relationship between the agricultural land area ration and the salmon catch change rate in each sea area

CONCLUSION

It was suggested that fluctuations in salmon catch may be influenced not only by seawater temperature but also by the area of cultivated land in the area.

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Dust-climate couplings over the Glacial-Interglacial cycle

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INTRODUCTION

Dust fluctuations observed in Antarctic ice cores include glacial-interglacial cycles, and in particular, rapid increase in dust flux
(hereinafter referred to as dust peak) during the peak of the glacial period has been confirmed 1). The definitive mechanism of the dust peak is not clear (GCM cannot reproduce the dust peak during the ice age in Antarctica [1)]).

It is still not fully understood that the cyclical relationship between the principal patterns of dust fluctuations including glacial-interglacial periods in common to multiple Antarctic bases and paleoclimate records related to the entire process of Antarctic dust generation-transport-deposition.

We analyzed the dust fluctuations pattern using principal component analysis of seven dust proxy records (dust flux, Fe flux, Ca concentration) at three Antarctic statio (EPICADomeC, Vostok, Dome Fuji) including glacial-interglacial cycles. Furthermore,
using this dust fluctuation patterns, we investigated the relationship between Antarctic dust disturbance and climate change (Global Relative Sea Level, atmCO_2, ssNa+, VSMOW) from wavelet analysis.

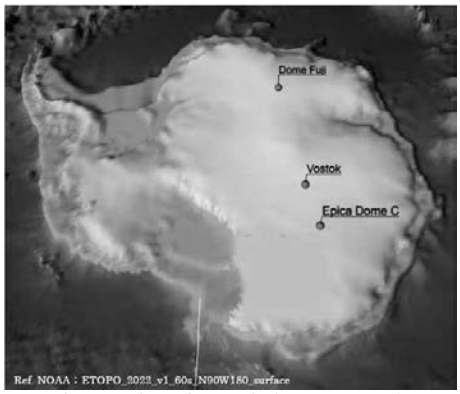

Fig.1 Locations of Antarctic dust proxy records

METHODS

1. Resampling data

Missing values were subjected to spline interpolation and resampled at 100 and 1000 yearintervals.

2. Standardization of data

Each data has different units, so it has been standardized

3. Principal component analysis

Calculate eigenvalues, eigenvectors, contribution rates of eigenvalues, and factor loadings of eigenvectors.

4. Spectrum and Wavelet Coherence

Analysis We confirmed a significant spectral correlationbetweenfluctuations in principal component scores (PC1 and PC2) of dust fluctuations and climate change.

RESULTS AND DISCUSSION

Coherency between PC1 and CO_2 in the precession frequency band: Change in precession term:

Reflects change in humidity in the source area (e.g.monsoon weakens → Decreased precipitation → Drying → Increased dust generation [4)])

It is necessary to confirm whether the dust change affected CO_2, or whether the precession change affected CO_2 and then dust.

Coherency between PC1 and other records in the Obliquity frequency band:

Suggests that dust responded to the Obliquity cycle of the westerly jet.
(Change in the Obliquity → Change in temperature gradient between high and low latitudes → Change in jet stream → Change in north-south transport
of dust (Indicated by $ssNa^+$).)

In the future, we will carefully examine these mechanisms in light ofthe atmospheric field.

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Changes and Mechanisms of Deep-Water Circulation in The Japan Sea Under Idealized Global Warming

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INTRODUCTION

The Japan Sea's deep-water circulation, driven by winter monsoons, is weakening. This has led to rapid deoxygenation, at a rate over five times the global average[1-3]. Observational evidence confirms this weakening, showing a reduced thickness of the Japan Sea Upper Proper Water (σθ 27.30-27.33), likely due to warming and increased freshwater input[4]. However, the specific response mechanisms of the circulation to global warming and its effect on water mass structure are still unclear. We address these questions using a warming experiment with an ocean general circulation model.

METHODS

We conducted sensitivity experiments using the COCO ver4.0 ocean-sea ice coupled model[5]. A control experiment was forced by pre-industrial atmospheric conditions from the MIROC AGCM 3.2[6]. Using this control as the initial state, we then ran a sensitivity experiment (TSFC+1) with a uniform +1°C increase in global air temperature. The control experiments used initial conditions from the World Ocean Atlas 2001. Both experiments were integrated for 2000 years. The strength of the deep-water circulation was defined as the mean current speed below 1,000 m.

RESULTS

In the TSFC+1, clustering analysis separated the Japan Sea's water column into a surface layer (0–400 m) and a deep layer (400–3300 m). The surface layer responded quickly to warming, with temperatures rising by approximately 0.3°C in about 20 years. The deep layer responded much more slowly, taking about 500 years to warm by a similar amount. The deep-water circulation weakened for the first 150 years and then began to fluctuate on a centennial timescale. Peaks in deep-water warming coincided with peaks in the strength of the circulation.

DISCUSSION

The weakening of the deep-water circulation during the first ~120 years of the TSFC+1 can be attributed to enhanced stratification from rising sea surface temperatures. However, thermal variations alone are insufficient to explain the subsequent rapid intensification of the circulation. To investigate the mechanism, we isolated the respective contributions of SST (Sea Surface Temperature) and SSS (Sea Surface Salinity) to sea surface density, a key driver of deep-water circulation (Fig. 2). These results show that while the initial decrease in sea surface density over the first ~20 years and the overall trend of lower density were thermally driven. While subsequent density variations were largely controlled by salinity changes.

Accordingly, we propose that after the initial period of enhanced stratification, the continuous influx of salinity to the surface layer via the Tsushima Warm Current (TWC) leads to a destabilization of the water column. This destabilization, in turn, drives the re-strengthening of the deep-water circulation. This result suggests that the salt transported by the TWC plays a crucial role in the long-term variability of the Japan Sea's deep-water circulation.

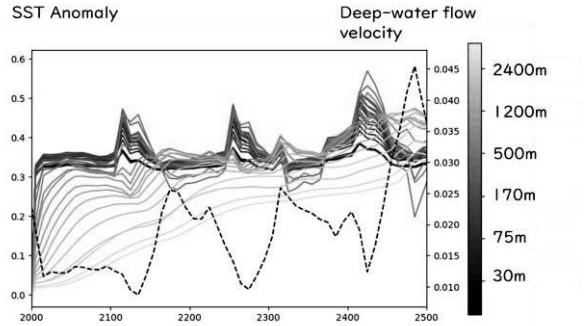

Fig. 1 Mean water temperature anomaly by depth (color bar) and mean current speed below 1,000 m (black dashed line).

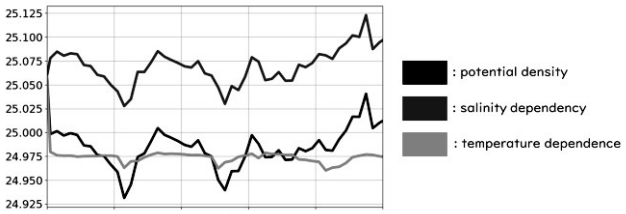

Fig.2 Sea surface density change (black line), with contributions from salinity (blue line) and temperature (red line).

CONCLUSION

This study suggests that while global warming weakens the Japan Sea's deep-water circulation, it is later strengthened by salinity transport to the surface from the TWC. The salinity transport from the TWC may therefore be a key driver of the deep-water circulation's long-term variability.

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Distribution of Microplastics in the Sediments of the Seto Inland Sea

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INTRODUCTION

The global production and disposal of plastics continue to increase, and the number of plastics into the marine environment has become a serious issue. Once released, plastics undergo degradation and fragmentation, forming microplastics (MPs), which is defined as plastic particles with size smaller than 5 mm. MPs are widely distributed in marine environment, particularly in coastal areas. Recently, sediments have been recognized as one of the ultimate sinks of MPs (Andrés et al., 2014).

The Seto Inland Sea is a semi-enclosed water body surrounded by large cities and industrial zones, receiving numerous inflows from large rivers, and thus is strongly influenced by terrestrial inputs (Fujieda et al., 2010). However, this region is rarely investigated. Thus, this study aimed to clarify the concentration distribution and properties of MPs in surface sediments collected from 38 sites across the Seto Inland Sea.

METHODS

Samples were collected from surface sediments at 38 sites in the Seto Inland Sea in May 2020. Water content, organic matter content, and grain size of the samples were measured. Approximately 5 g of wet sediment was subjected to chemical treatment (density separation and oxidation) and then collected on PTFE filters. For the detection of plastics, a micro-Fourier transform infrared spectrometer (μ-FTIR) was used to measure infrared spectra, and polymer types were subsequently identified using the commercial library *KnowItAll*.

RESULTS AND DISCUSSION

The average MP concentrations were 27.3±11.7 pcs g-dry^{-1} in Bisan Seto, 27.9±12.7 in Harima Nada, 52.8±17.5 in Hiroshima Bay, 94.6±61.3 in Hiuchi Nada, 54.7±34.5 in Kii Channel, and 51.7±26.2 in Osaka Bay (Fig 1). Lower concentrations in Bisan Seto and Harima Nada suggest a strong influence of tidal dispersal. In contrast, Osaka Bay, Hiroshima Bay, and the Kii Channel showed moderate concentrations, reflecting the influence of urban activities and river inflows. Hiuchi Nada exhibited a remarkably high concentration. Because tidal currents are relatively weak in this area, stratification and water stagnation tend to occur. Under such strongly enclosed conditions, suspended particles and MPs are less likely to be dispersed offshore, leading to their accumulation in sediments.

The mean MP particle sizes were 80.3±57.9 μm in Bisan Seto, 91.3±91.2 in Harima Nada, 85.4±57.4 in Hiroshima Bay, 76.6±56.2 in Hiuchi Nada, 101.9±101.5 in the Kii Channel, and 73.3±52.1 in Osaka Bay. In Osaka Bay and Hiroshima Bay, where enclosure is strong and urban influence is pronounced, particle sizes tended to be smaller due to extensive fragmentation during transport. By contrast, larger particle sizes in the Kii Channel suggest that relatively coarse MPs are retained in sediments where water exchange with the open ocean is more active.

Polymer type analysis revealed that polyethylene (PE) was the dominant component, reflecting strong influence from household waste. Polyamide (PA) was also detected at high levels in some sites, indicating potential contributions from textile industries and fishing activities.

CONCLUSION

This study demonstrated that the distribution of microplastics in the sediments of the Seto Inland Sea varies among regions. Lower concentrations in Bisan Seto and Harima Nada reflect tidal dispersal, while enclosed areas such as Hiuchi Nada promote accumulation. Smaller particles were common in Osaka Bay and Hiroshima Bay due to enhanced fragmentation, whereas coarser particles remained in the Kii Channel under active exchange with the open ocean. PE dominated overall, indicating strong household sources, while PA at some sites suggested additional inputs from textile industries and fisheries. These results confirm that MP distribution in the Seto Inland Sea is governed by both anthropogenic inputs and hydrodynamic conditions.

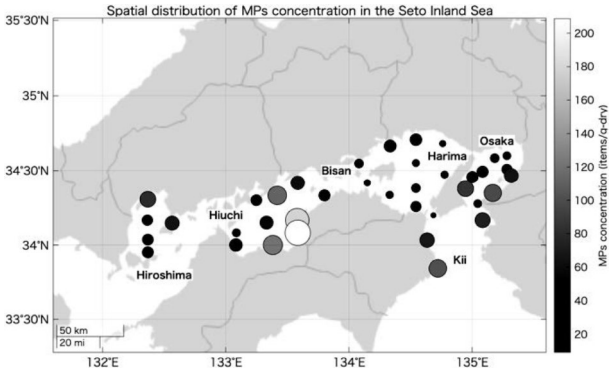

Fig 1 MPs concentration in the Seto Inland Sea

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Microplastics on sandy beaches in Tokyo Bay: spatial and seasonal variations in accumulation

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INTRODUCTION

Global plastic production reached 381 million tons in 2015, with millions of tons entering the ocean annually[1]. Once in the marine environment, plastics fragment into microplastics (MPs; <5 mm), which are widely distributed across seawaters, sediments, and even remote regions[2].

Tokyo Bay, surrounded by ~32 million people, is highly vulnerable to MPs pollution due to heavy riverine input and limited water exchange. While MPs in seawater and sediments are widely studied[3–5], little is known about their accumulation and degradation on sandy beaches, which can act as both sinks and sources of MPs.

Therefore, this study aims to:

(1) quantify large MPs (LMP: 350 μm–5 mm) and small MPs (SMP: 32–350 μm) in beach sand,

(2) investigate their spatial and seasonal variations,

(3) evaluate degradation using carbonyl index (CI), and

(4) estimate total MPs volume to assess the role of beaches as MPs reservoirs.

METHODS

Beach sand samples were collected seasonally in 2023–2024 at three distinct sites: the inner bay (urban, river-influenced), mouth of bay, and outer bay (open coast). Sand samples (top 5 cm) and surface seawater (60 L) were processed to isolate MPs. MPs were separated using a saturated sodium chloride solution followed by organic matter digestion with Fenton's reagent. Potential MP particles were identified by ATR-FTIR and μFTIR (HQI ≥ 60). Polyethylene (PE) MPs were analysed for the CI to assess degradation. MPs volume was calculated from particle dimensions and extrapolated to the total beach area. Statistical analyses were performed in R using Wilcoxon and Chi-square tests ($p < 0.05$).

RESULTS AND DISCUSSION

Abundance and composition

SMP concentrations were highest in the inner bay (5890–6030 pcs/kg), followed by the bay mouth (1080–1610 pcs/kg) and outer bay (1130–1930 pcs/kg).

LMP concentrations were lower but followed the same spatial pattern, with inner bay values of 40.7–140 pcs/kg and ≤10 pcs/kg elsewhere. No statistically significant seasonal variation in MP concentrations was detected at any site.

Although SMP dominated by number, LMP accounted for >99% of total MPs volume (up to 1.81×10^6 mm³/kg). Polypropylene (PP) was dominant in the inner bay, while polyamide (PA) increased toward the outer bay, indicating selective transport related to polymer density and hydrodynamics[5]. While no statistically significant seasonal variation was detected in overall MPs abundance, certain polymer types showed distinct seasonal patterns. In the inner bay, PP tended to be higher in summer, while PE increased in winter. At the mouth of bay and outer bay, PA was higher in winter and summer, respectively.

Table 1 MPs abundance in beach sand in Tokyo Bay

Station	LMP (pcs/kg)	SMP (pcs/kg)
Inner Bay	40.7-140	5890-6030
Mouth of Bay	0.05-4.00	1080-1610
Outer Bay	0.05-10.0	1130-1390

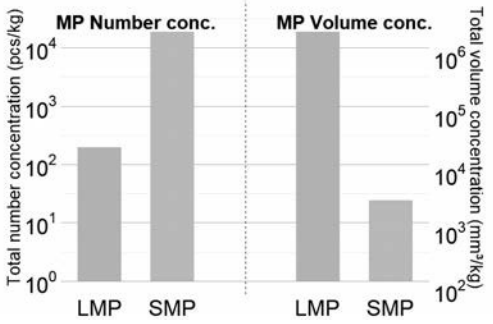

Fig. 1 Total MP number vs. volume concentrations in Tokyo Bay

Degradation and morphology

CI values were significantly higher in sand than seawater (sand: 1.97–2.20; seawater: 1.70–1.92, $p < 0.05$), indicating post-deposition degradation through UV exposure and mechanical abrasion.

SMP in sand were also smaller (65.4 μm) and had slightly lower aspect ratios than those in seawater, suggesting further fragmentation after beach deposition.

Total MPs volume

Based on seasonally averaged concentrations, the total MPs volume on Tokyo Bay beaches was 132 m³, far exceeding the seawater estimate of 25.3 m³ [4], showing that sandy beaches are major MPs sinks, especially for LMP.

CONCLUSION

Sandy beaches in Tokyo Bay contain large numbers of SMP and large volumes of LMP, with the inner bay being most affected. Higher CI and smaller particle sizes in sand indicate enhanced degradation after beach deposition. The estimated MPs stock in beaches greatly exceeds that in seawater, highlighting beaches as critical accumulation zones and key components of coastal MPs dynamics.

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Plastic Pollution: Recent Developments, Current Issues, and Future Perspectives

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INTRODUCTION

Plastic pollution is both an oceanic and public health crisis, costing over US$1.5 trillion annually[1] with many questions still to be resolved.

STATE OF THE ART

Nanoplastics are now detected in oceans, with over 16,000 plastic chemicals still poorly studied[1,2]. The seafloor remains a major but largely unexplored sink[3]. New tools like satellites, drones, riverine cameras, and AI improve litter monitoring[4], but harm and additive hazards remain largely unknown[1]

MONITORING

Harmonized QA/QC, reference materials, and FAIR data platforms are urgently needed[5]. New Indicators (Pellet spills, FRP vessels, storm-driven litter) are emerging signals[6]. Invasive species transport highlight impacts. Seafloor Monitoring: AI annotation of existing dive videos offers scalable monitoring. Non-destructive imaging will replace trawling[5]

GLOBAL INITIATIVES

Policy remains fragmented, with delays in global treaty negotiations. Global observing systems and industrial imagery can be harnessed. Training and baseline data are key for the future Plastic treaty.

PERSPECTIVES

Standardized methods, real-time alerts, and new indicators are priorities. For global Monitoring. The science-policy-health nexus must guide the next decade

.

CONCLUSIONS

Plastics are both an ocean and public health emergency. Globally Integrated monitoring, focus on additives, nanoplastics and seafloor have become critical.

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Plastic Erosion and Fragmentation Caused by the Foraging Activity of Molluscan Grazers

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INTRODUCTION

Microplastics (MPs), a major concern in marine pollution, can infiltrate the digestive tracts, tissues, and even the cells of organisms, potentially causing serious adverse effects[1]. To date, the primary sources of MPs in the marine environment have been attributed to abiotic factors such as wind, waves, and ultraviolet radiation, which are mainly produced in coastal areas and at the sea surface. However, even on the seafloor, where such influences are limited, the activities of benthic animals known as bioeroders may also contribute to MPs generation. For example, molluscan grazers inhabiting rocky seafloors at high densities scrape algae and other deposits from substrate surfaces using their specialized feeding organs, the radulae, which function as biological graters. Among these molluscs, chitons and limpets possess extremely hard radula teeth[2,3], which cause significant bio-erosion of substrates such as bedrock and reef-building corals[4]. Therefore, when these molluscs graze on plastic objects deposited on the seafloor, the plastic surfaces may be eroded and fragmented, leading to the generation of MPs. This study examined plastic erosion and fragmentation caused by the foraging activities of four molluscan grazers and investigated the relationship between radular tooth characteristics and their erosion and fragmentation ability. Furthermore, the potential generation rates and size distributions of the fragmented particles were analyzed.

METHODS

Four molluscs comprising two chitons (*Acanthopleura japonica* and *Lepidozona coreanica*), a limpet (*Cellana nigrolineata*), and a topshell (*Lunella coreensis*), and five types of plastic plates (PVC, PMMA, PET, PE, and PP) were used in this study. Each mollusc and one type plate type covered with microalgal biofilm were placed in a glass aquarium tank and maintained for several days. Subsequently, the scraping marks on surfaces of plastic plates were observed using scanning electron microscope (SEM). The morphology of the radula teeth of each mollusc was observed using a SEM. The elemental composition of the cusp was analyzed using a SEM-EDS, and their mechanical properties (hardness and Young's modulus) were measured using a Nanoindenter. Two types of plastic plates (PMMA and PET) were stained with Nile Red fluorescent dye. *Le. coreanica* and a single type of stained plastic plate covered with microalgal biofilm were placed in a glass aquarium tank and maintained for several days. All excreted fecal pellets were collected and digested in a 10% KOH solution. Suspensions of digested fecal pellets and the rearing water from the experimental tanks were filtered through 0.2 μm pore size membrane filters. Each membrane filter was observed under a fluorescence microscope to enumerate the fluorescent particles and measure their maximum Feret diameters.

RESULTS AND DISCUSSION

The radula teeth of two chitons *A. japonica* and *Le. coreanica* were enriched in Fe, and a limpet *C. nigrolineata* of Si as well as Fe, exhibited high mechanical strength. These three molluscs left distinct scraping marks even on surfaces of hard plastics (PMMA and PVC). Moreover, scraping marks from *Le. coreanica* and *C. nigrolineata* which possess sharp-tipped radulae were recognized as significant damage, such as cracks. In contrast, scraping marks from *A. japonica* and *Lu. coreensis*, which possess spoon-shaped radula tips were recognized as insignificant damage, such as wavy deformations and indentations. MPs ranging from 1 to 130 μm were detected in the fecal pellets and rearing water. Among these, particles <5 μm accounted for more than 90% of the total. Furthermore, the potential generation rate of MPs caused by foraging of *Le. coreanica* was estimated to range from 225 to 526 particles individual^{-1} day^{-1}.

CONCLUSION

The results of this study revealed that plastics were eroded and fragmented during the foraging activity of molluscan grazers, and that the elemental composition, mechanical properties, and shape of radula teeth influenced their capacity to erode and fragment plastic. Specifically, molluscs possessing radula teeth that contain iron and silicon, and that are hard with sharp tips, exhibit a high capacity for plastic erosion and fragmentation. Furthermore, the MPs generated through grazing were extremely small in size, sufficiently fine to be internalized by tissues and cells, thereby posing risks of tissue damage and immune impairment.

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Rainfall Impacts on River and Marine Water Quality in Wakayama prefecture, JAPAN

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INTRODUCTION

The fish catch has been decreasing nationwide in recent years. In Osaka Bay, rivers impact phosphorus loadings and concentrations, because of that has changed the fish catch. However, the impact of post-rainfall rivers on phosphorus concentrations in marine waters remains unclear. The purpose of this study was to investigate the concentration of orthophosphate (PO_4-P concentration), a nutrient for phytoplankton, in order to understand the reasons for the decrease of fish catch in fish catch in Wakayama Prefecture.

METHODS

As shown in Figure 1, the study area is the Yamada River and surrounding waters downstream of the river in Yuasa Town, central Wakayama Prefecture. We selected (A) as river, (B) as seawater, (C) as mouth of river, and (D) as bottom layer of mouth of river. Water was sampled from the bridge using a plastic bucket with a rope attached. A filter of 0.45 μm was used for filtration when sampling the water. The PO_4-P concentrations of the water samples were found by molybdenum blue absorbance spectrophotometry. In addition, the turbidity, salinity, and Cl- concentration of the samples were also measured.

RESULTS AND DISCUSSION

First, (A) for the rivers, PO_4-P concentration was high when there was no rainfall. The reason was domestic wastewater. When there was rainfall, there were two trends: when water was sampled during rainfall, PO_4-P concentration was higher, and when water was sampled after rainfall, PO_4-P concentration was lower. It is considered that the reason is based on the timing of water sampling. During rainfall, The PO_4-P concentration increased because of the first flush phenomenon (FF), where phosphorus components deposited in the bottom layer upstream are flushed out, along with the mixing of soil components from upstream. After rainfall, the PO_4-P concentration decreased because of dilution caused by the rain.

Second, (B) for the seawater, PO_4-P concentration stayed low with or without rainfall. The reason for this is the distance from the mouth of the river (C) and the breakwater, it is considered that the area was not impacted by the mouth of river (C).

Third, (C) for the mouth of the river, when there was no rainfall, the values between the PO_4-P concentrations of the river (A) and seawater (B) were observed. However, on days with high tide, PO_4-P concentration was lower because of the inflow of seawater (B). When there was rainfall, there were two trends: when water was sampled during rainfall, PO_4-P concentration was higher, and when water was sampled after rainfall, PO_4-P concentration was almost unchanged. During rainfall, a similar phenomenon to that in the river (A) occurred, and it is considered that the PO_4-P concentration increased. After rainfall, the first flush phenomenon that occurred upstream caused the deposition of phosphorus components at the river mouth, but over time, rainfall dilution occurred. As a result, the PO_4-P concentration showed values almost equivalent to those observed when there was no rainfall.

Finally, (D) for the bottom layer of mouth of river, PO_4-P concentration stayed low with or without rainfall. The reason for this is that the bottom layer, even with rainfall, was not affected by the river, and it was almost the same as the seawater (B).

Figure 1 summarises the overview.

CONCLUSION

Based on the above, as a result of rainfall, the phosphate concentrations in the river (A) and the river mouth (C) changed, while those in the seawater (B) and the river mouth bottom layer (D) remained unchanged. During rainfall, the phosphate concentrations in the river (A) and the river mouth (C) increased, while after rainfall, the phosphate concentration in the river (A) decreased, and that in the river mouth (C) was almost unchanged.

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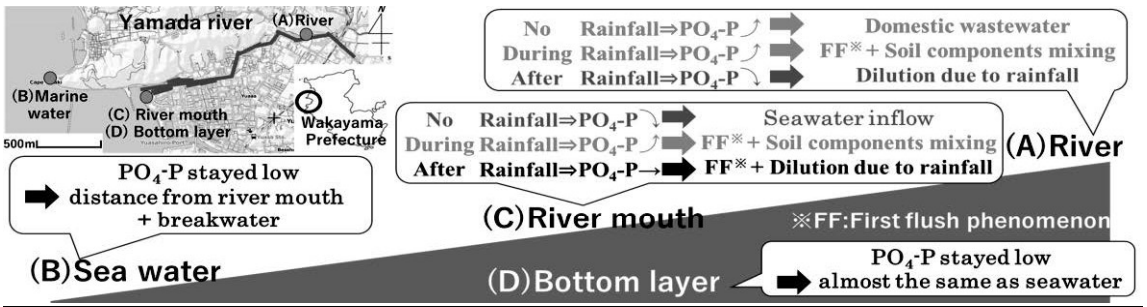

Fig. 1. An illustrated outline of Yamada River

Development of Ship Systems to Achieve Environmental Protection and Carbon Neutrality

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INTRODUCTION

In response to global warming, the shipping industry is pursuing carbon neutrality by 2050 through alternative fuels such as hydrogen and ammonia. Nevertheless, oil-based fuels, including biofuels, are expected to supply about 40% of marine energy demand, making emission reduction from diesel engines a persistent challenge.

This study proposes an exhaust gas purification system employing induction heating to reduce harmful emissions. The system incorporates a robust power supply to ensure stable operation under varying conditions, while thermal energy from high-temperature exhaust gas is effectively recovered using an economizer. The proposed approach provides an efficient and practical solution for reducing emissions in marine transportation, contributing simultaneously to environmental protection and enhanced energy efficiency.

DIESEL EMISSION CONTROL SYSTEM

Typical harmful emissions from diesel engines include nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter (PM). While SOx emissions can be reduced through low-sulfur fuels and NOx through combustion control and engine improvements, NOx reduction often results in increased PM emissions. PM is associated with adverse health effects and contributes to the acceleration of Arctic ice melt by darkening the surface of ice and snow, thereby increasing solar absorption.

Therefore, post-treatment systems for PM reduction are essential. Although such technologies are well established for vehicles, their development for heavy machinery and marine applications remains limited.

In this study, a PM reduction system is proposed, as illustrated in Fig. 1. The system comprises an induction heating unit installed on the exhaust pipe and a high-frequency power supply. Induction heating is used to heat a metallic filter inside the unit, enabling effective removal of particulate matter from diesel exhaust gases.

INTEGRATED PROPULSION SYSTEM

Fig. 2 illustrates the proposed integrated power system for next-generation ships. Whereas conventional ships employ AC power distribution due to its low cost and suitability for high-power applications, DC power distribution is more appropriate for battery-propelled vessels owing to its higher efficiency, fuel savings, and compatibility with renewable energy sources. To support carbon neutrality, the proposed system adopts DC distribution. Electrical energy is managed through converters and inverters, while exhaust heat is recovered via thermoelectric generation. Consequently, the proposed system provides a sustainable solution that integrates energy recovery and emission reduction for environmentally friendly marine operations.

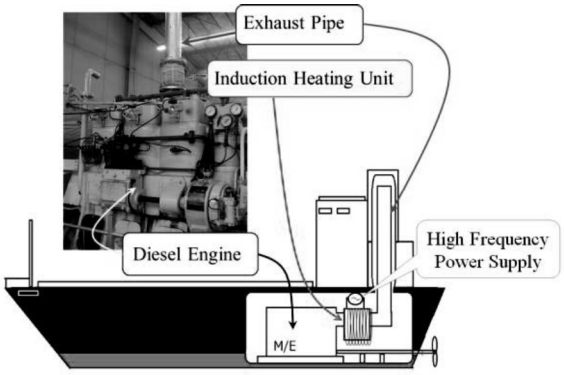

Fig.1 PM reduction system

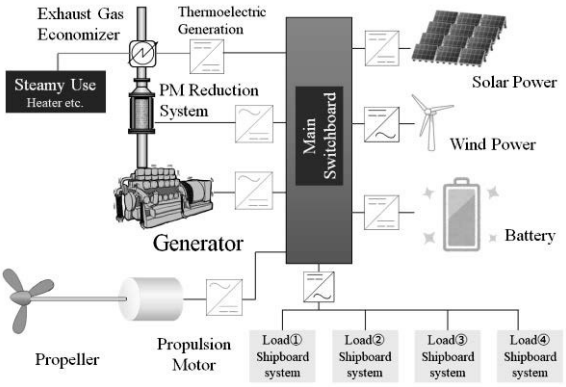

Fig. 2 Integrative system with PM reduction system

CONCLUSION

This study proposed the PM reduction system for marine diesel engines to support carbon neutrality and environmental protection in next-generation ships. The system employs metallic filters regenerated by induction heating, enabling maintenance-free operation without clogging. To ensure stable induction heating under fluctuations in circuit parameters, a quasi-variable capacitor was introduced to maintain consistent soft switching. By combining sustainable fuel utilization with effective exhaust purification, the system contributes to the realization of a sustainable maritime society. The proposed approach demonstrates significant potential for practical implementation in future ship technologies.

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ACKNOWLEDGMENTS

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Detection of Spionid Polychaetes Infesting Established European Flat Oyster *Ostrea edulis* in Japan

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INTRODUCTION

Some species belonging to the annelid family Spionidae are known to bore into mollusk shells. They often damage commercially important mollusks such as oysters and scallops, resulting in decreasing commercial value, reducing growth, and increasing mortality[1]. To address this, understanding the biological traits of these species is important, such as reproduction and larval development. In fact, some boring polychaetes exhibit poecilogony, producing both planktotrophic and adelphophagic larvae, which enables them to better adapt to the environment and enhance reproductive success. In Japan, the European flat oyster *Ostrea edulis* was imported from France and the Netherlands for aquaculture from 1952 to the 2000s and was presumed to have become extinct by the Great East Japan Earthquake occurred in 2011. However, it was later found to have established its populations in the wild environment[2]. In this study, we investigated the shells of *O. edulis* and examined the presence of spionid species along with the observations of their reproduction and larval development.

METHODS

We examined 13 shells in June and 23 shells in August of farmed *O. edulis* obtained from Yamada Bay in Iwate Prefecture, Japan. Most of them were two years old. In addition, 16 tank-cultured oysters were examined. They were maintained at approximately 20-21°C throughout the year, and seawater was changed twice a week. Their sizes and estimated ages varied. After removing the soft tissues of the oysters, boring worms were extracted by breaking the shells carefully using pliers. They were identified morphologically to the species level under a stereomicroscope.

RESULTS AND DISCUSSION

Mud burrows were observed on the inner surface of the shells as shown in Figure 1. In all oysters except one specimen, two *Polydora* species, *P. onagawaensis* and *P. hoplura,* were observed either individually or both together. In total, 362 worms were extracted. Oysters farmed in the bay tended to be infested by *P. onagawaensis*, with mud burrows being inconspicuous. In contrast, tank-cultured oysters tended to be more infested by *P. hoplura* with large and conspicuous mud burrows. No correlation was found between the host size and the species nor the number of worms.

Egg capsules and larvae of *P. hoplura* were observed from tank-cultured oysters. All broods exhibited adelphophagic larvae, with three-chaetiger larvae being the most advanced. However, reproduction was not observed in farmed oysters from the bay. The water temperature was around 14°C in June and 24°C in August at Yamada Bay, respectively. On average, it decreases to around 20°C from late September to October, which is similar to the tank culture conditions.

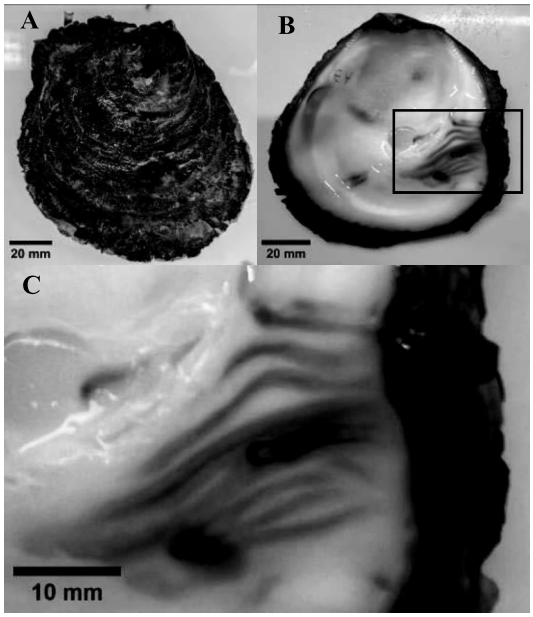

Figure 1 European flat oyster *Ostrea edulis*. **A** Outer surface. **B** Inner surface. **C** Enlarged view of mud burrows indicated in B.

CONCLUSION

Ostrea edulis is non-native to Japan, having been introduced from overseas and subsequently established in the country. In this study, we confirmed two *Polydora* species, *P. onagawaensis* and *P. hoplura*, infesting *O. edulis* oyster shells in Iwate Prefecture for the first time. Reproduction and larval development of *P. hoplura* were observed in tank-cultured oysters. As both *Polydora* species are well known to inhabit commercially important mollusk shells worldwide, it is necessary to clarify the life history of them in Iwate Prefecture to reduce their infestation. It is also meaningful to discuss the origin of the two species in the future.

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Yield of Annual Inedible Kelp Farming in Northern Japan

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INTRODUCTION

As part of efforts to expand blue carbon, a highly anticipated source of carbon dioxide sequestration, attention is being paid to the expansion and use of seaweed farming. In Japan, where seaweed including kelp species has a long history of use, harvesting and farming for food purposes are popular, but globally, the seaweed biorefinery is also expected which is the analogous of a petroleum refinery to produce a wide variety of chemicals and fuels using the technological invention from seaweed biomass in a sustainable manner[1]. We conducted the kelp farming experiments as a trial for biomass use in Japan. In farming experiments, the native kelp species *Costaria costata* (Order Laminariales, Family Agaraceae) was selected. In Japan, most edible kelp species takes more than two years to be harvested with exception of forced farming less than one year. However, *C. costata* is an annual and can be harvested through short-term farming[2], so it is expected to be a kelp species suitable for biomass utilization from the standpoint of production efficiency. In addition, it is expected to be a suitable farming species for global warming because it is also distributed in relatively warm waters among kelp species in northern Japan.

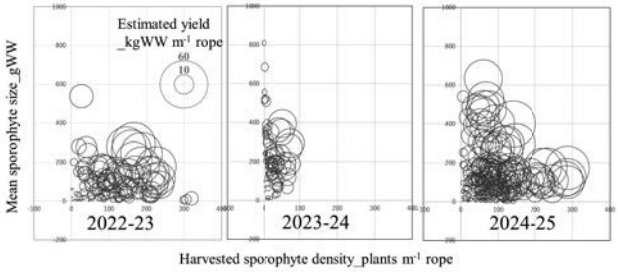
METHODS (Free to use title names hereafter)

The farming experiments were conducted over three periods: 2022-23, 2023-24, and 2024-25, at two locations (offshore site, port site) in the Kushiro waters off northeastern Hokkaido, which have significantly different farming ground environments. In the experiments, two type seedling threads of young sporophytes was used; one had been directly cultivated by using spore extracted from natural matured sporophytes and other had been indirectly cultivated by applying a mixture of male and female free gametophytes that had been isolated and cultured in advance were used. These seedling threads were planted to the farming systems in two sites between October and January. The grown sporophytes were harvested in June of the following year, and the harvest size and density were measured. The harvest yield per meter of farming rope was estimated, and various factors affecting faming results were assessed.

RESULTS AND DISCUSSION

There was a large variation in the harvested kelp size, density and estimated yield due to the variation of the juvenile sporophytes in size and density. In addition, it was revealed that the size of the harvested kelp increases when larger juveniles were sent open water early in the fall (Oct, Nov) and that overplanting causes a decrease in harvest size, and this tendency was similar to the findings known in existing kelp farming. In addition, the natural growth depth in coastal reef areas with high turbidity is shallower than 4 m depth, but in offshore farming where turbidity is limited, it was confirmed that the sporophytes can grow to deeper depths. Variations in estimated yield were also observed between the years, which is presumably influenced by the year-variations of juvenile sporophyte density in the seedling thread. The estimated maximum yield per meter of rope length was 50 kgWW over a 7-month farming period, suggesting the possibility of ensuring high productivity, which is essential for biomass farming, by optimizing initial juvenile cultivation and setup in exposed offshore site where environmental conditions are more suitable for kelp farming than sheltered port site. However, in biomass utilization, where cost reduction is important, it is important to develop technologies at the farming site, such as large-scale farming and mechanization, and to develop utilization and processing technologies that do not require a drying process, unlike edible kelp.

Figure 1 Variation of estimated yield of farmed *Costaria costata* among three years.



CONCLUSION

Farming experiments of inedible kelp *Costaria costata* in northeastern Hokkaido, Japan suggested that estimated farming yield reached 50 kgWW m^{-1} rope over a 7-month farming period. It is essential for ensuring high productivity for biorefinery by optimizing initial juvenile cultivation and offshore setup.

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We are grateful to Kushiro-tobu Fisheries Cooperative Association for assistance with the farming experiments. This study was carried out as part of a joint research project between Japan Fisheries Research and Education Agency and TOYOTA MOTOR CORPORATION.

Induction of Deposition on the Inner Shell Surface of the Akoya Pearl Oyster (*Pinctada fucata*) by Bacterial Inoculation

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INTRODUCTION

In the Akoya pearl oyster (*Pinctada fucata*) aquaculture throughout Japan, individuals with dark brown to black deposits on the inner shell surface have been observed. Such symptom oysters often become weakened and may eventually die. Although black deposits have been attributed to infestation by the polychaete Polydora, recent findings show that it can also develop in the absence of Polydora, with bacteria, *Tenacibaculum* dominating in the black deposits[1]. Similar shell disorders are collectively referred to as "shell disease" in countries such as Australia. Furthermore, it has been reported that similar symptoms can be induced by inoculation with *Escherichia coli* or yeast.[2]. In this study, we tested whether inoculation of bacteria into the extrapallial cavity could induce deposits even with bacteria isolated from mantle of healthy pearl oyster or killed *Tenacibaculum* cells.

METHODS

Experiment 1. Nine bacterial strains isolated from the mantle of healthy *Pinctada fucata* were inoculated into the left extrapallial cavity of two-year-old oysters at $10^{9–10}$ CFU per individual (three oysters per strain). Oysters were reared in tanks without feeding at 25 °C for two weeks, after which the presence and severity of shell blackening were assessed. DNA was extracted from blackened areas of one oyster per strain, and bacterial community composition was analysed by 16S rRNA metagenomics.

Experiment 2. Two *Pseudoalteromonas* strains that induced more severe blackening in Exp.1 were each inoculated into 20 oysters (10^9 CFU per individual). The oysters were suspended from pearl culture rafts (26-29 °C), and at 10, 20, and 30 days post-inoculation, five oysters were collected for observation of their shell surfaces. Bacterial communities in blackened areas at day 30 were analysed by metagenomics.

Experiment 3. Inoculation trials were performed using formalin- or heat- killed *Tenacibaculum* cells by the same procedure.

Experiment 4. DNA was extracted from various tissues of spontaneously occurred pearl oysters and was subjected in quantitative PCR using species-specific primers.

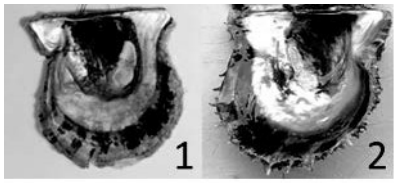
RESULTS

Although severity varied, all nine inoculated strains induced black deposits. In six of the nine strains, the inoculated bacteria predominated in the black deposits. After inoculation with two *Pseudoalteromonas* strains, *Tenacibaculum* predominated in the black deposits in seven of eight individuals 30 days later.

Both methods of killed bacteria induced black deposits, although to a lesser extent than live bacteria. Copy numbers of the specific sequences were low in hemocytes, visceral mass, gonad, adductor muscle, and mantle, but high in black deposits and the adjacent mantle.

DISCUSSION

Since bacteria other than *Tenacibaculum* and killed *Tenacibaculum* cells could also induce black deposits, proliferation of *Tenacibaculum* is unlikely to be an essential factor. Moreover, the finding that *Tenacibaculum* was predominantly detected only in black deposits suggests that its proliferation is restricted to these sites. In mantle atrophy disease of the Akoya pearl oysters, recently associated with a birnavirus infection in Japan, brown deposits have also been observed along the edges of inner shell and identified as melanin[3]. Furthermore, cohabitation infection experiments revealed that *Tenacibaculum* increased in the mantle of pearl oysters infected with this virus[4]. Collectively, these findings suggest that *Tenacibaculum* tends to proliferate at melanized sites generated by the host immune response.



1. Spontaneously occurred deposits.
2. Experimentally induced deposits.

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ACKNOWLEDGMENTS

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Introduction and Establishment of the European Flat Oyster *Ostrea edulis* in Japan

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INTRODUCTION

The European flat oyster, *Ostrea edulis* Linnaeus, 1758, an edible bivalve native to Europe, was introduced to Japan in 1952 from France and the Netherlands for aquaculture purposes at lower water temperatures, particularly in northern Japan[1]. Subsequently, seed production was centered in Prefectures Miyagi and Aomori, and aquaculture trials using these seeds were conducted in four prefectures along the Pacific coast of north-eastern Japan, including Hokkaido and Iwate. However, these attempts were discontinued in the early 2000s, primarily because its market value was lower than expected compared to Pacific oysters (*Crassostrea gigas*) and scallops (*Mizuhopecten yessoensis*). The broodstock strains that had been preserved for genetic conservation were lost due to the tsunami caused by the Great East Japan Earthquake in 2011, and it was presumed that the species had been extirpated from Japan. However, photographic records of a specimen from Yamada Bay, Iwate, publicly posted on social media by a fisherman in 2023, prompted a re-evaluation of its status. This study reports the first confirmed establishment of *O. edulis* in a natural marine habitat in Japan and summarizes the process of its human-mediated introduction and dispersal, and its current status in Iwate.

METHODS

Ten oyster specimens were provided by a fisherman from Yamada Bay for species identification. Morphological characteristics of the shells were observed, and DNA barcoding was performed to determine the nucleotide sequence of the mitochondrial 16S rRNA gene region, which was then compared with reference sequences in an international database. Furthermore, a literature review, interviews with former researchers, and a questionnaire survey of 24 fisheries cooperative associations in Iwate were conducted to clarify the process of artificial translocations and current distribution of *O. edulis* in Japan.

RESULTS AND DISCUSSION

Morphological and genetic analyses confirmed the specimens as *O. edulis*. This is the first documented case of a non-indigenous oyster species being introduced to Japan for aquaculture purposes and subsequently establishing a feral population in Japan's natural marine environment. Literature and interview surveys confirmed that *O. edulis* had been introduced to at least 29 locations across four prefectures in Japan (Fig. 1A). The questionnaire survey revealed the presence of *O. edulis* in at least nine bays across a wide area of the central and southern coasts of Iwate (Fig. 1B). In Yamada Bay, individuals have been continuously observed for over 20 years since around 2002, and the wide size range of discovered specimens (10-150 mm SH) suggests that a stable population is maintained within the bay. In the multiple bays where no artificial introduction was recorded, the oysters are considered to have spread through processes such as contamination with aquaculture seeds or larval dispersal.

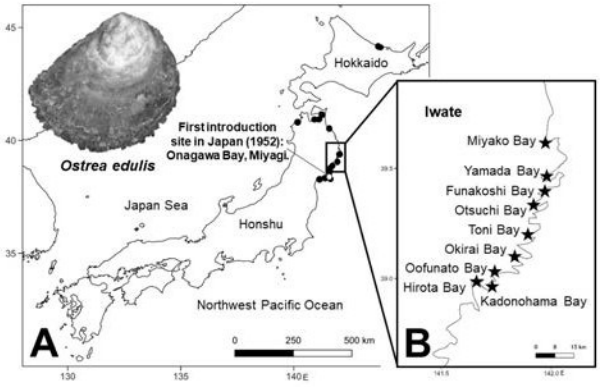

Figure 1 A Map showing the locations where European flat oysters, *O. edulis*, were introduced from 1952 to the early 2000s (●). **B** Map showing where *O. edulis* have been found in natural waters in Iwate as of 2025 (★).

CONCLUSION

This study confirmed the establishment of *O. edulis* in Japan. The questionnaire survey showed that the observations of this species are increasing in the coastal areas of Iwate in recent years. In addition, the fact that *O. edulis* was introduced to many locations indicates that it has widely expanded its distribution, spreading from Hokkaido to the Sanriku coastal waters.

The abundance of wild broodstock presents a new opportunity for commercial aquaculture, particularly in terms of diversifying Japan's food culture, increasing market potential, and rising scarcity value due to production declines in its native European habitats. However, this necessitates a multi-faceted risk assessment, including ecological and epidemiological considerations, before planning any commercial use.

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ACKNOWLEDGMENTS

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Effect of Rearing Water Temperature on the Occurrence of Skin Ulceration Disease in Cultured Japanese Sea Cucumber (*Apostichopus japonicus*)

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INTRODUCTION

The Japanese sea cucumber *(Apostichopus japonicus*) is an important fishery resource along northeastern Pacific coast, mainly harvested via diving and bottom trawling methods. In recent years, catch volumes have declined, with rising sea surface temperatures suggested as a possible cause, though the underlying mechanisms remain unclear. Laboratory rearing experiments are essential to assess environmental impacts such as water temperature on growth and survival. However, these studies are often complicated by skin ulceration disease (SUD), a condition marked by severe skin erosion and high mortality[1]. This study investigated the relationship between water temperature and SUD incidence by rearing sea cucumbers in natural and chilled seawater from April to May 2025.

METHODS (Free to use title names hereafter)

Specimens of the Japanese sea cucumber (green morphotype) were collected from the coastal waters of Toba City, Mie Prefecture, in March 2025. The average body weight was 83.5 ± 11.8 g (mean ± SD, n = 16). Individuals were randomly divided into two groups (n = 8 each): one reared under ambient seawater temperature (natural temperature group), and the other under chilled conditions (cooled temperature group). Rearing was conducted in individual black acrylic tanks (12 L), using sand-filtered seawater from Ohama, Toba City. The natural temperature group received unmodified seawater at 0.6 L/min via a flow-through system, while the cooled group received seawater chilled by ~4°C, supplied at half the flow rate due to equipment limitations. Average temperatures during the experiment were 16.9°C (natural) and 12.4°C (cooled), with ranges of 14.4-19.4 °C and 10.8-13.7°C, respectively (Fig. 1). All sea cucumbers were fed daily to satiation with pellets made from equal parts of commercial feed (Kaisan Growth) and zeolite.

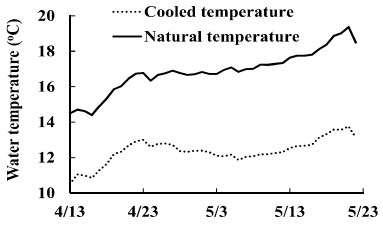

Fig. 1 Water temperature trends in the natural and cooled temperature groups

RESULTS AND DISCUSSION

In the natural temperature group, no cases of SUD were observed until day 18 (April 30). However, after day 19 (May 1), when water temperature reached 16.7°C, SUD occurred frequently, resulting in an 87.5% incidence rate by the end of the experiment. In contrast, only one case (12.5%) was observed in the cooled temperature group on day 13 (April 25), with no further occurrences. A statistically significant difference in SUD incidence was found between the two groups (Fisher's exact test, $P = 0.011$) (Fig. 2).

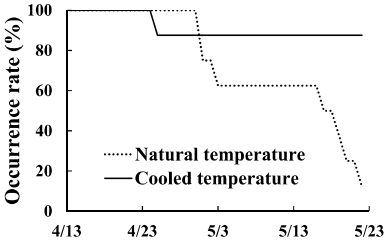

Fig. 2 Occurrence rates of skin ulceration disease in the natural and cooled temperature groups

SUD in cultured holothurians has been linked to bacterial infections—primarily *Vibrio* species[2]—as well as stress from sudden temperature drops[3] and high stocking densities[4]. The markedly lower incidence of SUD in the cooled group in this study suggests that lower temperatures may suppress bacterial growth. Given that *A. japonicus* is a cold-water species, rearing at reduced temperatures may be inherently more suitable. However, since the occurrence of SUD in *A. japonicus* has not been observed under natural conditions, it is unlikely that water temperature alone is responsible for its occurrence. Additional factors such as nutrition and water quality warrant further investigation.

CONCLUSION

In this study, Japanese sea cucumbers were reared for 40 days under two temperature conditions: natural seawater (14.4–19.4°C) and chilled seawater (10.8–13.7°C). In the natural temperature group, 87.5% of individuals developed SUD, whereas the incidence in the cooled temperature group remained at 12.5%. This difference was statistically significant. This suggests that rearing sea cucumbers in chilled seawater below 13.7°C may effectively prevent the occurrence of SUD.

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Microalgae detected from sediment cores collected on land

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INTRODUCTION

We applied NGS analysis targeting the *psbA* gene to tsunami deposits in sediment cores collected on land. Our aim was to determine whether it is possible to reconstruct the coastal phytoplankton assemblages that were present at the time of past tsunamis by analyzing phytoplankton transported ashore during these events.

METHODS

Samples were collected from the landward side of Yamada Bay, Iwate Prefecture, Japan. To investigate tsunami deposits, two sediment cores, stored under refrigeration after previous analyses, were examined. Results on sedimentological characteristics, tsunami deposits, and depositional ages were already reported[1,2].

The procedures were carried out as described previously[3]. The chlorophyll content of the supernatant was analyzed using an equation reported earlier[4] with an SP-3000nano spectrophotometer (OPTIMA, Japan).

Habitat categories (marine, brackish, and freshwater) were determined for phytoplankton species detected by DNA sequencing. Assignments were based on reference databases, including AlgaeBase[5] and the NCBI Taxonomy Browser[6].

RESULTS

DNA concentrations were generally higher in the upper layers (recent deposits) than in the lower layers (older deposits). Tsunami deposits, composed primarily of sand and gravel, generally showed lower DNA concentrations compared to non-tsunami deposits in both cores.

Similar to DNA concentrations, tsunami deposits generally exhibited lower chlorophyll *a* (Chl *a*)-like pigment concentrations compared to non-tsunami deposits. Chl *a*–like pigment concentrations were typically higher in organic sediment layers.

Although the number of sequence reads can be influenced by factors such as PCR amplification, purification, and sequencing efficiency, *psbA* gene reads generally were higher in the upper layers. Plants identified by *psbA* gene sequencing were predominantly phytoplankton, with only a minor proportion of terrestrial plants.

The number of samples analyzed from non-tsunami deposits exceeded those from tsunami deposits. Freshwater phytoplankton generally accounted for a larger proportion than marine/brackish phytoplankton. Although the relative abundance of marine/brackish versus freshwater taxa varied considerably among samples, marine/brackish phytoplankton were detected consistently in all tsunami deposits of both cores, except in cases where DNA sequencing was not possible, whereas they were only occasionally observed in non-tsunami deposits of both cores.

Among marine and brackish phytoplankton, diatoms were the most frequently detected group. Assemblages were generally biased toward specific taxa, except in the upper layers, with *Nanofrustulum shiloi* as the dominant diatom. *Melosira varians* was intermittently dominant. In contrast, the presence of *Chaetoceros* spp., *Skeletonema* spp., and *Thalassiosira* spp. was limited, detected mainly in the upper layer.

DISCUSSION

A major limitation was the lower DNA concentrations in tsunami deposits, attributable to their larger sediment grain sizes compared with non-tsunami deposits, as well as the progressive decline in DNA concentrations with depth, likely due to the greater susceptibility of terrestrial sediments to UV-induced degradation relative to marine sediments. Despite the reduced DNA concentrations in deeper tsunami deposits, *PsbA* sequencing remained feasible for most deposits, enabling reconstructions as far back as 3000 BC. Among the detected marine/brackish phytoplankton, diatoms were most frequently identified; however, benthic microalgae were more common than planktonic forms. Given that tsunami deposits generally contain coarser grains than non-tsunami sediments, it is likely that benthic microalgae attached to the seafloor were transported together with bottom sediments rather than suspended in seawater.

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ACKNOWLEDGMENTS

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Relationship between the distribution of the sakura shrimp *Lucensosergia lucens* and underwater irradiance

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INTRODUCTION

The sakura shrimp *Lucensosergia lucens* is a valuable fishery resource harvested only in Suruga Bay, Japan. Spawning peaks in summer, and fisheries occur during the spring (April–June) and autumn (October–December) seasons. The catch drastically declined in spring 2018, and poor catches have continued, although the causes remain unclear. Along with stock decline, the location of spring fishing grounds has shifted. The former ground was 1–2 km offshore of the Fuji River estuary at 200–300 m depth, whereas the current ground is 10–15 km offshore at depths exceeding 500 m. One potential cause is turbidity from Fujikawa River discharge[1]. According to previous report, Sakura shrimp perform diel vertical migration, inhabiting 200–300 m during the day and ascending to 20–50 m at night. If turbidity influences fishing grounds, underwater light changes may be important. This study aimed (1) to compare former and current fishing ground positions, and (2) to examine differences in their underwater light environments.

METHODS

(1) The former spring fishing ground positions were identified from operational records of the commercial vessel *Suwamaru* (6.6 tons) from 2003–2022. The current ground positions were determined using GPS records in 2024–2025. Positions were compared with nautical charts to determine depths.

(2) Underwater irradiance at the former ground (Fuji River estuary) was obtained from Sugimori & Sakamoto (1985)[2]. Irradiance at the current ground was measured down to 80 m with a submersible radiometer in September 2022, December 2024, and May 2025. Daytime habitat irradiance of sakura shrimp was estimated. Simultaneously, CTD and turbidity surveys were conducted.

RESULTS AND DISCUSSION

Changes in fishing ground positions: Until 2022, spring fishing ground positions were mainly in the inner bay, extending toward the bay mouth, while autumn grounds were south of the Abe River estuary (Fig. 1), at 200–300 m depths. In 2024–2025, spring grounds shifted 5.5–16.7 km offshore at 600–1400 m depths.

Underwater irradiance: Diffuse attenuation coefficients in the upper 10 m were 0.208 m^{-1} (normal, former ground 1985), 0.149 m^{-1} (high turbidity, former ground), 1.24 m^{-1} and 0.0820 m^{-1} (current ground). Relative irradiance at 200 m was 2.38×10^{-7} %, 2.08×10^{-7} %, 2.66×10^{-22} %, and 1.87×10^{-6} %, respectively; at 500 m and 800 m in the current ground position, 1.41×10^{-21} % and 3.91×10^{-29} %.

In the former ground position, turbidity and seafloor irradiance showed little interannual change. Bottom irradiance at the current ground position was far lower than the former ground position even under high turbidity.

Thus, the offshore shift cannot be explained by irradiance alone.

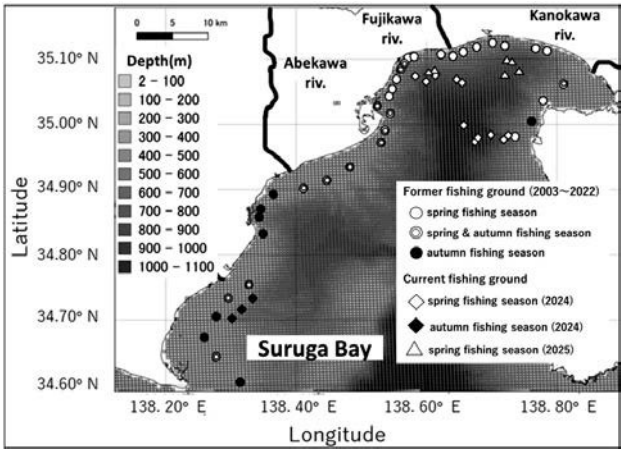

Fig.1 Changes in fishing grounds

CONCLUSION

The offshore migration of sakura shrimp fishing grounds cannot be explained by light conditions alone, suggesting other environmental drivers. Understanding these factors is essential for effective management and supporting recovery of this valuable fishery in Suruga Bay.

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Influence of a *Sargassum* forest on the distribution of surface current velocity gradient

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INTRODUCTION

Sargassum forests play an important-ecological roles in coastal waters. Their biological roles include spawning, nursery and feeding grounds for marine animals. On the other hand, they influence on their marine environments. For example, a *Sargassum* forest keeps water temperature under the forest lower than the upper layer by shading effect of the forest during its luxuriant season[1]. This means that the temperature environment in a *Sargassum* forest is moderate rather than outside the forest during the luxuriant growth season. A *Sargassum* forest makes water flow slow by resistance against the flow during its luxuriant growth season[2]. Such flow environment in a *Sargassum* forest would be favourable for juveniles, which have less swimming capacity, living in the forest. However, these studies focus on water flow at fixed stations. It is interesting to investigate how a *Sargassum* forest influences on the whole distribution of surface current gradient by comparing the surface current between the luxuriant and scanty growth seasons. A Lagrangian-type current measurement was conducted using drifting buoys[3]. The results obtained were described, and the distribution of horizontal divergence was calculated to investigate the temporal changes in the flow structure.

OBSERVATION METHODS

Study site

We selected Kodomari Cove in Takahama Bay included in the Wakasa Bay, the Sea of Japan. In Kodomari Cove, *Sargassum* species grow luxuriantly from March to May when *Sargassum* species mature and scantly from July to September when their stipes are detached from or with the holdfasts or from the basal part of the sipes. Kodomari Cove is surrounded by the cliff from which we took oblique photographs from there.

Release of drifters

Twenty beer bottles were used, each marked with differently coloured tape on top for identification as drifters, with buoyancy adjusted by filling them with sand. They were released from a boat to place them for covering the area of the *Sargassum* forest in the cove on 21 May and on 7 September 1983. Before releasing the bottles, six maker buoys were fixed to enclose the study area. Two cameras were mounted on the cliff surrounding the cove, positioned sp their directions were perpendicular to each other. Both cameras photographed drifters with the marker buoys at two-minute intervals. Additionally, two transits were also used for surveying the position of the marker buoys before the survey and that of one drifter during the May and September experimental periods.

Localization of drifters

After the obaservation, the fixed-marker buoys' positions were plotted on a map of Kodomari Bay based on the transit data. The spatial relationship between the fixed-marker buoys and the drifters on the plane is maintained in oblique photographs. Using this relationship, the positions of the floating buoys were determined graphically on the map. Finally, we affixed a map plotting the drifters' trajectories to a magnetic tablet and digitally read their positions using a cursor.

RESULTS AND DISCUSSION

Currents play a crucial role in the movement and diffusion of substances and organisms. How does a *Sargassum* forest during the luxuriant growth season affect the surface currents?

It is observed that surface current velocity was retarded on the developed *Sargassum* forest in the luxuriant growth season. Changes in the direction of surface current were greater during the luxuriant growth season than during the scanty growth season. The spatial distribution of the area-averaged divergence values at 4-minute intervals showed that convergence and divergence values during the luxuriant growth season were larger than during the scanty growth season, with strong convergence and divergence occurring over the most luxuriant *Sargassum* individuals. This is thought to occur because *Sargassum* individuals growing large enough to reach the sea surface during the luxuriant growth season act as greater resistance to the current than that during the scanty growth season. At the lower part of the forest, the current is also thought to weaken due to the *Sargassum* individuals that are resistant against the current.

In this way, the attenuation effect like that of terrestrial forests in weakening wind was observed in the surface current in the *Sargassum* forest under the sea. In such current environments, the current structure during the luxuriant growth season tends to favour the retention of organisms with weak swimming ability that float near the surface layer. *Sargassum* individuals alter the current regime in coastal areas as they grow. Thus, by creating its own unique current environment through growth, *Sargassum* forms a vital habitat for the organisms within the *Sargassum* forest, including itself.

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Cultivation Methods and Growth Responses of the Brown Alga *Sargassum horneri*

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INTRODUCTION

Recently, blue carbon ecosystems, such as seagrasses and macroalgae, have attracted considerable attention as nature-based solutions for long-term carbon sequestration in coastal areas. Specifically, the brown alga *Sargassum horneri*, widely distributed along the Japanese coast, is promising blue carbon resource due to its rapid growth rate and high CO_2 sequestration capacity[1]. However, realizing largescale cultivation requires established culture techniques for seedling production, which are currently lacking. Therefore, this study aims to examine the optimal culture conditions of *S. horneri* to provide fundamental knowledge essential for efficient seedling production.

METHODS

Mature *S. horneri* individuals were collected from the coastal waters of Hyuga Island, Toba, Mie Prefecture, Japan, in April 2025. Fertilized eggs, naturally released from receptacles, were initially cultured under the following conditions: 20 °C water temperature, a 12 h light/dark cycle, aeration, and a light intensity of 150 µmol photons m^{-2} s^{-1} (PAR). Once the germlings reached an average total length of 5 mm, their growth was compared under combinations of three factors: light intensity (PAR 50 µmol photons m^{-2} s^{-1} vs. PAR 200 µmol photons m^{-2} s^{-1}), nutrient enrichment (PESI 20 mL L^{-1} added vs. no addition), and diatom inhibitor (GeO_2 1 mg L^{-1} added vs. no addition).

RESULTS AND DISCUSSION

Germling growth demonstrated marked variation in response to light intensity, nutrient enrichment, and the presence of the diatom inhibitor. The optimal growth was achieved under a PAR of 50 µmol photons m^{-2} s^{-1}, combined with nutrient enrichment and GeO_2 addition. With this optimal treatment, germlings reached an average length of approximately 20 mm after one month. Furthermore, GeO_2 effectively suppressed diatom proliferation, which is major challenge in *Sargassum* cultivation. However, considerable individual variation in growth was observed, even among germlings under identical culture conditions. This suggests conclusion, these findings suggest that balancing light intensity, nutrient supply, and the management of epiphytic algae is critical for successful and efficient *S. horneri* seedling production. The detailed results are shown in Table 1.

CONCLUSION

In summary, our findings indicate that the successful large-scale seedling production of *S. horneri* is contingent upon the optimization of light intensity and nutrient enrichment, coupled with the effective control of epiphytic organisms, particularly diatoms and green algae. These optimized conditions are crucial for maximizing the initial growth rate while minimizing cultivation loss.

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Table 1 Growth response of *Sargassum horneri* under different culture conditions

PAR	PESI	GeO_2	Growth Results
PAR 200	no addition	no addition	No growth was observed. Most thalli decayed and died.
PAR 200	added	no addition	No growth was observed. Most thalli decayed and died, and diatoms and green algae proliferated.
PAR 50	no addition	no addition	Slight growth occurred initially. Thalli later showed bleaching and softening.
PAR 50	added	no addition	Growth occurred but was subsequently suppressed by diatom and green-algal proliferation. Thalli remained free from bleaching or softening.
PAR 50	added	added	Diatom growth was inhibited (green algae still present). Growth varied greatly among individuals even under the same conditions.

Power of Citizens: Unveiling the Hidden Ecology of the Endangered Finless Porpoise

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INTRODUCTION

The finless porpoise (*Neophocaena asiaeorientalis*) is a small odontocete measuring approximately 1.5 meters in length (Figure 1). It prefers shallow waters less than 50 m in depth and is therefore highly vulnerable to the impacts of coastal development and fisheries[1,2]. As a result, its populations are declining worldwide. Along the Japanese coast, the species shows strong regional endemism, divided into five stocks (genetically isolated populations), highlighting its susceptibility to local environmental alterations directly affecting survival[3,4].

Tokyo Bay, a semi-enclosed embayment surrounded by one of the world's most densely populated catchments with nearly 30 million residents, has undergone extensive port construction and coastal development since the rapid economic growth. Consequently, critical habitats such as tidal flats and seagrass beds have been largely lost. In fact, the proportion of artificial coastlines making up nearly 90%. Despite such drastic modifications to the marine environment, finless porpoises have long been known to inhabit Tokyo Bay, a fact of great ecological significance when considering the bay's ecosystem health.

Finless porpoises in Tokyo Bay are regarded as part of the Sendai Bay–Tokyo Bay stock; however, recent studies have suggested the possibility of further subdivision into two or three substocks due to discontinuities in distribution and differences in genetic diversity[5]. Population assessments of this small cetacean typically rely on aerial surveys or drone observations. Still, these methods are infeasible in Tokyo Bay due to airspace restrictions imposed by Haneda Airport and Yokota Air Base. Ship-based sighting surveys conducted intermittently by research institutions and university vessels have yielded extremely low encounter rates, with only a handful of groups detected even after years of effort. As a result, the current status of the Tokyo Bay population remains unclear.

Figure 1. A finless porpoise, swimming with a seabream in the Sendai Umino-Mori aquarium.

METHODS

The authors launched a year-long citizen science initiative in July 2024, calling for finless porpoise sighting reports in the Tokyo Bay, mainly via social media.

RESULTS AND DISCUSSION

Nearly 70 reports have been collected to date. Notably, paramotor footage off Futtsu recorded a group of more than 30 individuals swimming with a fish school. While finless porpoises are generally observed alone or in pairs, the Tokyo Bay population may frequently form groups of five or more. Most reports were concentrated in the inner bay north of Futtsu Point, consistent with previous reports.

Finless porpoises in the Tokyo Bay may show a stronger tendency toward group-living than other regional populations, where solitary individuals are typically more common. The concentration of sightings in the northern part of the bay further indicates that this area functions as a key habitat, possibly linked to prey availability such as seasonal fish aggregations. Such observations align with the hypothesis that the Tokyo Bay subpopulation is relatively localized, with limited interchange with neighbouring waters. Although these results are provisional, they highlight the potential ecological distinctiveness of this group and underscore the importance of continued monitoring through both citizen reports and complementary scientific surveys.

CONCLUSION

Although surveys in Tokyo Bay face constraints inherent to heavily urbanized waters, the area also benefits from exceptionally high levels of human observation. Leveraging this condition to encourage citizen participation can be a powerful complementary tool for scientific data collection. Moving forward, we plan to expand the citizen science framework further by integrating morphological and genetic analyses of stranded individuals and haplotype studies using environmental DNA. Through these approaches, we aim to clarify whether the Tokyo Bay porpoises constitute an independent population and to delineate their distribution in greater detail.

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Investigating the Factors Behind the Decrease in Dominance of the Diatom *Skeletonema* in the Seto Inland Sea: Insights from Growth Response to Light and Nitrogen

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INTRODUCTION

The species composition of diatoms has been changing in the Seto Inland Sea, Japan. Until the mid-1980s, the genus *Skeletonema* was highly dominant. However, after the mid-1980s, the prevalence of the genus *Skeletonema* decreased, and that of the genera *Chaetoceros*, *Pseudo-nitzschia* and *Leptocylindrus* increased[1]. In the Seto Inland Sea, a long-term increase in seawater transparency (i.e., increase in light intensity in the water) and a long-term decrease in dissolved inorganic nitrogen (DIN) have been observed, and these factors are suspected to have contributed to the decrease in dominance of the genus *Skeletonema*. In this study, we examined the growth responses of several diatoms to light intensity and nitrogen concentration and investigated whether increased light intensity and decreased DIN could decrease the dominance of the genus *Skeletonema*.

METHODS

Growth response of five diatoms to light intensity

Axenic strains of *Skeletonema marinoi-dohrnii* complex (NIES-323), *Chaetoceros debilis* (NIES-4079), and *Chaetoceros socialis* (NIES-3713), and non-axenic strains of *Pseudo-nitzschia* sp., and *Leptocylindrus danicus* were used in the experiments. The growth rate (divisions d^{-1}) of each diatom was examined at five light intensities (15~500 μmol m^{-2} s^{-1}) with a 12 h:12 h LD cycle at 25°C. The obtained data were fitted to the equation developed by Lederman and Tett[2] to estimate the maximum growth rate ($M_{max,I}$), the value of light intensity at $M_{max,I}/2$ (K_I; the half-saturation constant), the threshold value of light intensity for growth (I_0), and the affinity index[3] ($\alpha_I=M_{max,I}/K_I$).

Growth response of three diatoms to DIN concentration

Axenic strains of *S. marinoi-dohrnii* complex (NIES-323), *C. debilis* (NIES-4079), and *C. socialis* (NIES-3713) were used in the experiments. The growth rate of each diatom was examined at eight DIN concentrations (1~222 μM) under growth-saturating light intensity at 25°C. The obtained data were fitted to the equation developed by Monod[4] to estimate the maximum growth rate ($M_{max,N}$), the value of DIN concentration at $M_{max,N}/2$ (K_N; the half-saturation constant), and the affinity index ($\alpha_N=M_{max,N}/K_N$).

RESULTS AND DISCUSSION

Growth response of five diatoms to light intensity

The values of $M_{max,I}$, K_I, I_0 and α_I for each diatom are shown in Table 1. The α_I value was highest in *S. marinoi-dohrnii* complex, indicating that this species had greater tolerance to low light intensity than other diatoms. This result suggested that increased light intensity in the water could reduce the competitive advantage of the genus *Skeletonema* over other diatoms, leading to a decrease in its dominance.

Table 1 Estimated $M_{max,I}$, K_I, I_0 and α_I for each diatom.

Species	$M_{max,I}$	K_I	I_0	α_I
S. marinoi-dohrnii complex	1.97	15.52	8.34	0.13
C. debilis	1.82	21.23	9.22	0.09
C. socialis	3.37	34.09	6.75	0.10
Pseudo-nitzschia sp.	3.89	38.03	4.23	0.10
L. danicus	2.37	19.84	11.81	0.12

Growth response of three diatoms to DIN concentration

The values of $M_{max,N}$, K_N and α_N for each diatom are shown in Table 2. The α_N value was highest in *S. marinoi-dohrnii* complex, indicating that this species had greater tolerance to low DIN concentration than other diatoms. This suggested that a decrease in DIN could not decrease the dominance of genus *Skeletonema*.

Table 2 Estimated $M_{max,N}$, K_N and α_N for each diatom.

Species	$M_{max,N}$	K_N	α_N
S. marinoi-dohrnii complex	1.72	2.02	0.85
C. debilis	2.61	3.63	0.72
C. socialis	3.40	5.08	0.67

CONCLUSION

Increased seawater transparency may have contributed to the decrease in dominance of the genus *Skeletonema* in the Seto Inland Sea.

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Diatom-Specific DNA Metabarcoding Reveals the Diet of Manila Clam (*Ruditapes philippinarum*) Larvae

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INTRODUCTION

One possible factor contributing to the recent decline in the Manila clam (*Ruditapes philippinarum*) stocks in Japan is a shortage of food microalgae[1], making the assessment of food environments in fishing grounds a critical issue. To achieve this, a detailed understanding of the clam's feeding habits is essential; however, current knowledge of its diet in natural waters remains insufficient. Furthermore, research on the diet of larvae, which are considered especially vulnerable to starvation, is limited to a single study: Raby et al. (1997)[2], who investigated the size of microalgae in the gut using microscopic observations. Consequently, it remains unclear which species of microalgae serve as potential food for the larvae. In diet analyses of bivalve larvae, conventional approaches such as microscopic examination of gut contents or feces, and stable isotope analysis, are unsuitable due to the larvae's small size. On the other hand, molecular approaches enable comprehensive diet analysis regardless of the organism's size or developmental stage.
This study aimed to elucidate the species of microalgae available as food for clam larvae, as well as their physical characteristics, such as cell size by DNA metabarcoding (DNA-MB) analysis specifically targeting diatoms, which dominate phytoplankton in coastal areas in terms of biomass and are extremely diverse in cell size and shape.

MATERIALS AND METHODS

In this study, we conducted a laboratory feeding experiment three times to simulate the natural feeding environment.
Surface sea water of 20 L each were collected from Fukue Bay (Aichi Prefecture) in May 2024 and Ise Bay (Mie Prefecture) in October and November 2024. Surface sea water was filtered through meshes and filters with pore size of 2, 10, 20, 45, and 75 μm to fractionate microalgae into five size classes. Equal volumes of the suspended fractions were mixed to obtain the mixed water. After placing 10,000 to 20,000 clam larvae into a 2 L beaker containing mixed water, they were fed for 2 hours, followed by fixation with 99% ethanol. Three beakers were prepared and used as replicates. 100 mL of fractions and mixed waters prior to feeding were filtered through a GF/F filter. Larvae were divided into three stages based on shell length: small (95-120 μm), medium (120-160 μm), and large (160-200 μm). DNA was extracted from larvae and GF/F filters. Additionally, 30 individuals of larvae were pooled to form one sample. After carrying out DNA-MB analysis with diatom specific primer[3], sequences were identified to diatom genera from matches on NCBI BLAST (>95% sequence similarity with 100% sequence coverage). The Bray-Curtis index based on diatom genera compositions was calculated between each sample and mapped on two dimensional coordinates using the non-metric multidimensional scaling (nMDS).

RESULTS AND DISCUSSION

Through three feeding experiments, *Cyclotella* spp., *Skeletonema* spp., *Thalassiosira* spp., and *Chaetoceros* spp. were detected frequently in guts of larvae. In the May and October experiments, diatom compositions in larvae guts were similar to those in the 2 to 10 μm fraction. In the November experiment, diatom composition in larvae guts were similar to that of the <2 μm fraction. On the other hand, in all experiments, several diatom genera were detected in the fractions, the mixed waters, or both, but not in the larvae guts. Particularly in the October experiment, of the 31 diatom genera detected, 20 were not detected in the larvae guts. Based on the results of this study, it was shown that Manila clam larvae particularly ingest microalgae contained in <10 μm fraction within various microalgae in natural waters, and they can ingest not only solitary diatoms such as *Cyclotella* spp. but also chain-forming diatoms such as *Skeletonema* spp. and *Chaetoceros* spp.

CONCLUSION

Using diatom-specific DNA metabarcoding, this study demonstrated that: Manila clam larvae can ingest not only solitary diatoms but also chain-forming diatoms, that their ingestible diatom size is less than 10 μm, and that diatom-specific DNA-MB is effective for diet analysis of bivalve larvae. To accurately evaluate the food environment during the early life stages of Manila clam, quantifying microalgae biomass by size fractions is recommended.

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Preliminary determination of phytoplankton community structure by next-generation sequencing of residuals from pigment samples

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INTRODUCTION

The well-known conventional method for evaluating the phytoplankton community structure is the high-performance liquid chromatography (HPLC), which is based on the differences of pigment composition among phytoplankton taxa. In addition, next-generation sequencing (NGS) analysis has been recently used to examine the community structure as well. However, there are still some concerns to be addressed in using NGS results, such as their quantitative performances. One factor that makes this evaluation difficult is the heterogeneity among the collected subsamples for parallel analyses by different methodologies.

In order to fill this knowledge gap, we conducted a subsequent NGS analysis using the residual samples provided for HPLC, which enables the direct comparison of phytoplankton composition derived from a completely identical sample.

METHODS

A total of 15 samples were collected from two cruises conducted by the R/V Soyo-maru in August and November, 2023 (Figure 1). 2.3 L of seawater from 10-m depth was filtrated on 25 mm GF/F filters. These filters were kept frozen in 1.5 mL of N,N-dimethylformamide (DMF) until HPLC analysis on land. The remaining 200 µl of DMF were examined by NGS targeting the psbA region. DNA was extracted from the DMF solution using the FastGene Gel/PCR Extraction Kit, followed by PCR amplification. The resulting amplicons were sequenced on the Illumina MiSeq platform, and the sequence data were analyzed using the QIIME 1 bioinformatics pipeline.

RESULTS AND DISCUSSION

From the HPLC results (Figure 2a), an obvious latitudinal trend in phytoplankton community structure was observed. In both summer and autumn seasons, the proportion of Bacillariophyta decreased from north to south. In addition, Bacillariophyta increased its proportion during autumn, indicating an autumn bloom due to the seasonally deepened surface mixed layer. Cyanobacteria and Haptophyta dominated the remaining community during the summer. In contrast, Haptophyta was the major taxon in autumn, and its proportion was significantly higher in autumn than in summer ($p < 0.05$, Wilcoxon test).

As for the NGS results (Figure 2b), no clear latitudinal trend was observed. Although there were some exceptions, the detected phytoplankton community was generally dominated by either Cyanobacteria or Haptophyta in both summer and autumn. No significant correlation was found between the relative proportions of each taxon derived from HPLC and NGS.

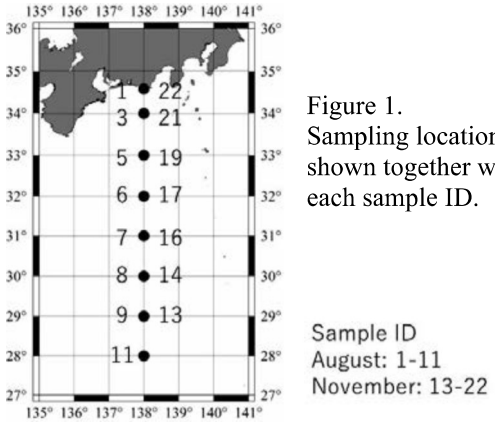

Figure 1. Sampling locations shown together with each sample ID.

CONCLUSION

The disagreement between HPLC and NGS results was most likely due to the poor amount of DNA extracted from DMF. This indicates that most phytoplankton DNA were likely retained on GF/F filters themselves, despite the cell damage and pigment extraction by DMF, which remains a subject for future investigation.

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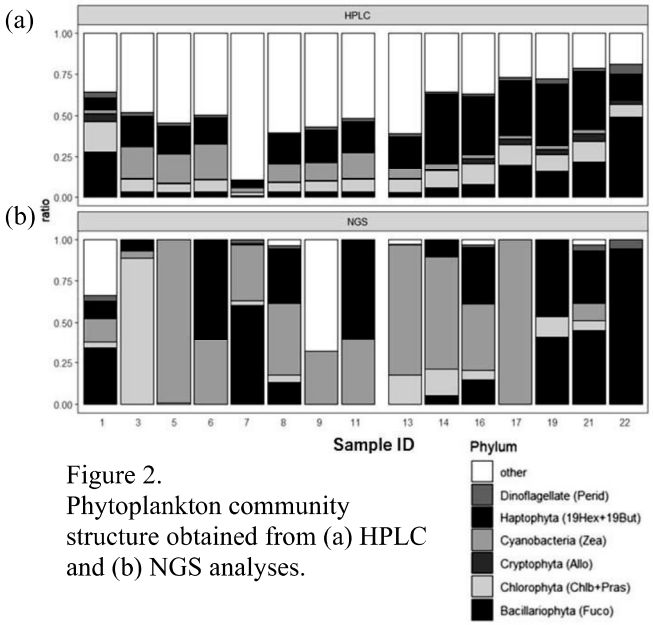

Figure 2. Phytoplankton community structure obtained from (a) HPLC and (b) NGS analyses.

Engaging Future Marine Professionals in the Thau Lagoon Clam Recovery with participatory science

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INTRODUCTION

For decades, the Thau lagoon supported a thriving clam (especially the Ruditapes decussatus and Venerupis pullastra) fishery, providing livelihoods for hundreds of people and contributing to the local economy. As in many places around the world, the clam's fishery collapsed in the 90s[1]. Overexploitation and ecosystemic changes are the main causes. Various stakeholders including fishermen scientists and public organizations have initiated projects focus on this living resource. The Lycée de la Mer, a Public Vocational School that train future fishermen and shellfish farmers, is actively involved in these research efforts. Younger generations are largely unaware of the historical of the importance of this small-scale clam fishery. Inspired by a « low-technology » Japanese methods for clams spat collection, they have conducted a small-scale experiment under the scientific supervision of IFREMER. This kind of initiative aims to rebuild the relationship between local communities and the coastal environment through positive actions such as concrete experiments and fieldworks.

METHODS

The Lycée de la Mer is a regular technical partner for local organizations, with direct access to the lagoon, nautical facilities, and various practical workshops. However, the project goes beyond: students actively participate in field investigations and scientific monitoring. Students participate in the construction of metal tables and nets, they put the catchment structures into the water, they did the sampling and processed the data (unpublishable results).

RESULTS AND DISCUSSION

Around thirty students were involved in the project. As active participants, they developed scientific literacy: rigor, protocol design, and understanding the temporal scales of experimentation. Compared to other environmental education approaches, this method is better suited to students specializing in living marine resources. It is a highly technical and hands-on project, with less formalism than existing initiatives such as the Aires Marines Éducatives implemented in French schools.

CONCLUSION

This type of action helps combat eco-anxiety and environmental inaction among younger generations. By transmitting historical ecological changes, the project emphasizes the role of humans, their capacity for action, and fosters attachment to the ecosystem. The human environment relationship is approached with a touch of humor and cunning, as it revolves around a bivalve mollusk that, while seemingly unremarkable at first glance, holds significant gastronomic and cultural value

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Insights into the social perception of the possible natural return of a fishers' competitor, the endangered Mediterranean seal *Monachus monachus*

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INTRODUCTION

The monk seal *Monachus monachus* was present, until the 19th century, in the Black Sea, the entire Mediterranean and the Atlantic coast of northwest Africa, from Portugal to Mauritania[1]. It underwent a dramatic decline in the 20th century, due to interaction with humans, mainly killing by small-scale fishers, from most of its range area. It then reached the brink of extinction, with only three remaining breeding populations: Cap Blanc (Mauritania), Madeira (Portugal) and Greece-Turkey[2,3].

Since the early 2000s, thanks to effective protection measures and interaction with fish farms (possibly used as a food resource), monk seal populations have started to increase. Vagrant individuals are increasingly sighted in the north-western Mediterranean[4,5]. The natural return of the monk seal is therefore a possibility that must be considered[5,6].

However, to ensure that this return does not fail, due to the opposition of certain users of the sea, possibly including fishers, and the lack of food resources that leads the seals to seek food in fishing nets, it is necessary to assess the social perception and representations of the monk seal by all sea users.

METHODS

The study is based on a comprehensive analysis of available literature, including gray literature: Research Gate, Scholar Google, specialized libraries of Aix-Marseille University and web sites.

The study is completed by the preliminary (informal) analysis of a questionnaire (confidentiality of responses and informed consent) carried out among sea users (e.g., small-scale fishers, tourism operators, managers, academic scientists, the general public) in five regions of the NW Mediterranean Sea: Corsica, Région Sud (France), Liguria, Tuscany and Sardinia (Italy).

RESULTS AND DISCUSSION

Sightings of vagrant monk seals have been increasing since 2000. They mainly occurred in Sardinia and Tuscany, while the French Région Sud is the least concerned. These are young individuals, generally isolated, which, for the moment, do not settle in an area and therefore do not constitute breeding colonies. The reasons for the failure of these vagrant individuals to settle could be the disturbance by recreational navigation, intensive in the NW Mediterranean, or an insufficient food resource (fish, large crustaceans, cephalopods).

For the majority of people, apart from some members the academic community, the former presence of the monk seal has been forgotten, including in Corsica and Sardinia where its disappearance is the most recent (ca. 50 years).

As for the perception of the monk seal, an animal well known since ancient times, often graphically portrayed (e.g., coins, mosaics), it has varied greatly over time and between regions. It is currently positive in the study area, among all categories of sea users, which constitutes a favourable factor for its acceptance in the event of a return.

CONCLUSION

A successful natural return of the monk seal requires the prior implementation of accompanying measures. To plan them, it is important to work with all coastal users on the basis of a preliminary and concerted process of reflection, which is the only way to achieve applicable and workable measures.

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ACKNOWLEDGMENTS

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A study on the foraging and ship-tracking behaviors of boobies at Izu Islands offing

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INTRODUCTION

Boobies prey on flying fish and squids near Japan as their preys jump out of water as ships approach. There have been reports on the possibility of boobies using ships for foraging, and they are known to migrate from areas up to 11 kilometers away for feeding (Tomas *et.al,* 2014)[1].

The Japanese name for boobies, "katsuo-dori," literally means "bonito bird" as fishermen used them as a sign of good fishing grounds, but now instead of fishing vessels gathering where boobies are, boobies gather where ships are. So, we studied, by ship, the foraging and ship-tracking behaviors of boobies.

METHODS

We observed boobies from a ship's bridge (T/V Shioji Maru:775 tons), and recorded them in a field notebook (time, number, species). Eye point height of the ship was 9.5 m from the sea surface. We cruised along the 141° 30' E line off Izu Islands, from 36°30' N to 29°N.

The ship speed was about 11kt, and the effective perpendicular distance was about 100m, and since boobies fly ahead of the vessel, we mainly focused on the space ahead and observed both sides as appropriate. Because there was little attention being paid to the birds that follow behind, if a bird flew away from the ship and did not return for more than 30 minutes, it was counted as not tracking the ship.

In the case of the Brown Booby (*Sula leucogaster*), we can identify juvenile birds, but with other boobies, identifying each individual bird is almost impossible as there is little sex difference. For the above reasons, when a bird left the ship, it was considered as the bird that had been there the longest to count the ship-tracking time.

The ship-tracking time and distance were measured for each species (Brown Booby, Red-footed Booby (*Sula sula rubripes*)). The ship-tracking distance was measured by electromagnetic log (YDK tech. EML900).

RESULTS AND DISCUSSION

In total, we counted 19 Brown Boobies and 9 Red-footed Boobies. The mean ship-tracking time of Brown Boobies was 2h17m, and the one by Red-footed Boobies was 1h02m. Red-footed Boobies are known for its flying ability, and even just looking at them, the first author felt that their flight speed was faster than Brown Boobies. Although we had only one juvenile Brown Booby, this bird's ship-tracking time was 4h30m, which was longer than the mean of mature individuals. The tracking time may have been shorter due to the birds' high-flying speeds and ability to catch prey, so further studies by camera focusing on their success rate of prey hunting and their flight speeds. Incidentally, not all the birds kept flying. One of the Brown Boobies observed stayed on top of the foremast 4h30m at night.

Next, we calculated the ship-tracking distance. The mean ship-tracking time of Brown Boobies was 25.7miles (47.6km), and the one by Red-footed Boobies was 9.6 miles (17.8km).

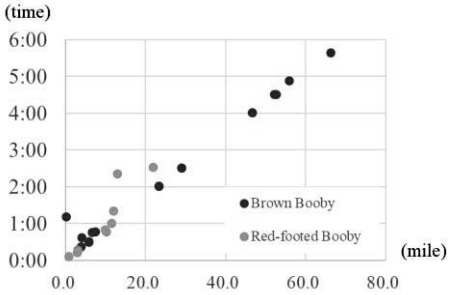

Figure 1 Tracking distance and tracking time. X-axis is distance (mile) and Y-axis is time(h:mm).

Figure 1 shows a scatter plot of the ship-tracking distance versus ship-tracking time. The points fall roughly in a straight line, but the graph does have some outliers. This is because some boobies circled around the ship and waited when the ships stopped at several observation points. On this voyage, the ship reduced speed at the observation points, so we analyzed the relationship between the ship-tracking time and the ship speed.

The ship reduced speed 5 times during our observation cruise, and 3 times out of these 5 occasions, the birds flew away from the ship, and twice they flew around the ship and waited for a while. The ship-tracking time until they flew away was as follows:24min, 45min, 1h20min.

In one of the remaining 2 occasions, one booby approached our ship 3 hours after the ship stopped and waited for 1h20min and flew away. In the last case, one booby waited for 1 hour and when the vessel started, the bird tracked the ship for 34min. Waiting for ships could be a strategy to catch preys for them, and one thing was in common: the ship had stopped at 3 PM in both cases. Boobies are said to feed during daylight hours, so it is possible that they were waiting for a ship considering the time of sunset (20th/JUL/2025, 18:52). They may fly away to search for new feeding opportunities or a new ship during early hours before noon.

CONCLUSION

Brown Boobies tend to fly with ships for longer periods and longer distances than Red-footed Boobies. And the ability to catch preys may be the reason for this. The ship speed and sunset time are very intriguing factors that can be contributing to the Booby's foraging behavior involving ship-tracking.

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The Influence of River Water on the North Pacific Ocean as Seen from Absolute Salinity Anomaly

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INTRODUCTION

Rivers take in nutrients such as decomposed plant matter as they through mountains and fields, and flowing into the sea, they maintain coastal oceans rich in biological production. However, the dynamics of river water in the ocean remain poorly understood.

Composition of Absolute Salinity anomaly (δS_A) is defined as deviation from the Reference Composition, which is close to the composition of North Atlantic surface water. Therefore, while the δS_A at the sea surface in the open ocean is generally close to zero, it increases significantly when influenced by river water, which has a higher alkalinity than seawater.

This study investigates the influence of river water in the North Pacific with the aid of δS_A.

METHODS

The δS_A is defined by Absolute Salinity (S_A) and Practical Salinity (S_P) (Eq. 1).

$$\delta S_A \ [\mathrm{g\ kg^{-1}}] = S_A - 1.0047154\ S_P . \quad (1)$$

S_A can be estimated from direct density measurement[1], and S_P is measured by the conductance-based salinity measurement. δS_A can also be estimated from the chemical composition anomalies[2] (Eq. 2).

$$\delta S_A \ [\mathrm{g\ kg^{-1}}] = (5.07\ \mathrm{Si(OH)_4} + 3.89\ \mathrm{NO_3} + 5.56\ \Delta\mathrm{NTA} + 0.47\Delta\mathrm{NDIC}) \times 10^{-5} \quad (2)$$

where ΔNTA is the total alkalinity (TA) anomaly (TA – 2300 × S_P / 35), and ΔNDIC is the dissolved inorganic carbon (DIC) anomaly (DIC – 2080 × S_P / 35).

In this study, δS_A was determined by using ship-based water sampling data, mainly by Eq. (2).

RESULTS AND DISCUSSION

The estimated δS_A at sea surface are shown in Fig. 1. Although the δS_A are almost zero across a wide area of the North Pacific, the δS_A are significant in the following areas: East China Sea, Okhotsk Sea, Bering Sea, and north of Subarctic.

From the correlation between δS_A and S_P, the δS_A of the river waters can be estimated at S_P = 0: 0.136 and 0.140 g/kg with seasonal variability for the Yangtze River (green lines in Fig. 2), and 0.041 g/kg for the Amur River (red line). The waters of the Amur River mix with the distinctive seawater (S_P = 32.5, δS_A = 0.006 g/kg) in the Okhotsk Sea. Although the distinctive seawater is on the line of the Yangtze River (Fig. 2), δS_A in the Japan Sea is smaller than 0.006 g/kg. From the δS_A estimated from Eq. (1) near the mouth of Yukon River (S_P = 26.7, δS_A = 0.034 g/kg) and Fraser River (S_P = 20, δS_A = 0.03 g/kg) of the North America, the δS_A of the river waters can be estimated at S_P = 0: 0.155 g/kg for the Yukon River and 0.065 g/kg for the Frazer River. It has been suggested that these river waters in the North America mix in the Bering Sea to form the distinctive seawater, which extends in to the Okhotsk Sea and the north of Subarctic region.

CONCLUSION

In the North Pacific, the influences of three rivers on the surface water are detected: Yangtze River in the East China Sea and Japan Sea, Amur River in the Okhotsk Sea, and Yukon River in the Bering Sea. The influence of Yukon (and probably with rivers in the north of North America, such as Fraser River) is widely detected in the north of Subarctic region.

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ACKNOWLEDGMENTS

Part of this work was supported by the JSPS KAKENHI Grant 23H04827.

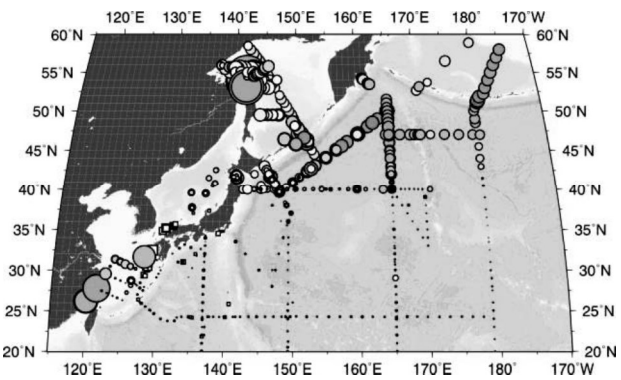

Fig. 1. Spatial distribution of δS_A at sea surface. The size of the mark corresponds to the magnitude of the value. The intensity of the red colour corresponds to the magnitude of the silicate value.

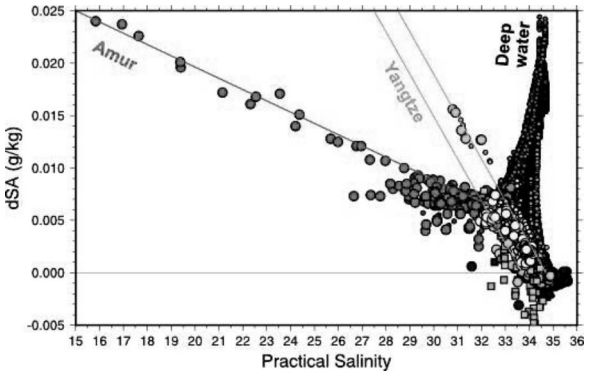

Fig. 2. δS_A plotted against S_P. Large and small marks indicate sea surface and deeper layer data, respectively. Red: Okhotsk Sea, Green: East China Sea, Yellow: Tsugaru Strait, Magenta: Bering Sea.

Current structure inferred from the water mass distribution observed by Argo floats in the Indian Sector of Southern Ocean

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INTRODUCTION

Accelerated glaciers and ice sheets melt with global warming has led to freshening and density decrease of Antarctic Bottom Water (AABW), raising concerns about abyssal warming in the Southern Ocean and a weakening of the meridional overturning circulation. Shimada et al. (2022)[1] pointed out that the reduced density prevents the water from sinking to the abyssal layers and instead to spread northward along the neutral-density surface γ^n = 28.19. However, few studies have focused on spatial extent of water masses. In this study, to infer the distribution of interior flows in the Indian sector of the Southern Ocean from patterns in water mass distributions.

METHODS

In this analysis, after applying quality control tuned to Southern Ocean water-mass characteristics to Argo data over the South Australian Basin and the Australian–Antarctic Basin (80–150° E, 40–70° S), we constructed and utilized a 1°×1° latitude-longitude gridded dataset.

RESULTS AND DISCUSSION

Figure 1 shows the 2003–2023 mean density field at 1500 dbar and the northward extension of cold water was observed in regions such as near Kerguelen at 80°E and around 150°E, where the ridges extend close to the Antarctic continent, as well as in a broad area between 100-120°E (broken line). On γ^n = 28.19 isopycnal surface, water mass properties are nearly uniform and local contrasts are indistinct. However, in areas where cold water spreads northward, the isopycnals showed a raised structure. At fixed depths, these cold-water areas are slightly fresher and denser. These indicate wide range doming of isopycnals surface in near center of the basin and suggest the production of a baroclinic geostrophic flow current field. A northward flow is therefore likely to exist along the flanks of this doming. These results imply that the observed cold water mass spreads horizontally rather than along isopycnal surface. In this region, the central ridge is interrupted and the seafloor topography is deepened steeply. The effect of the change in ACC flow paths and topography is thought to have formed an upwelling area and local circulation surrounding the upwelling area that results in material transport equatorward.

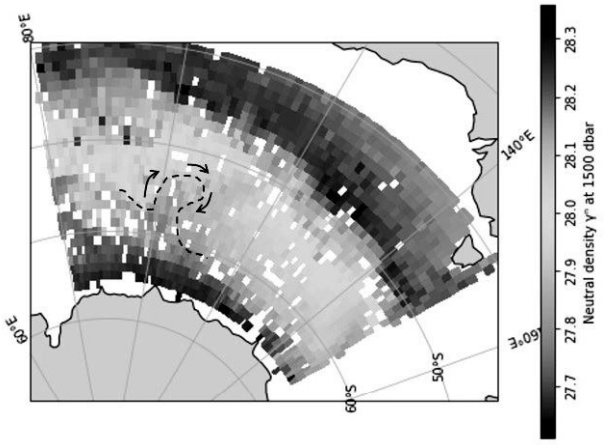

Figure 1 density field at 1500 dbar

CONCLUSION

This study indicates northward extensions of cold water mass and wide range doming of isopycnals surface in the Indian sector of the Southern Ocean, suggesting that baroclinic geostrophic flow along the dome rim forms a northward transport corridor. The water mass with reduced density may be directly exported toward lower latitudes via this corridor.

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Periodic characteristics of absolute dynamic topography and its spatial distribution in the Australian-Antarctic Basin

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INTRODUCTION

The Australian-Antarctic Basin, located in the Indian Ocean sector of the Southern Ocean, is part of the pathway for the deep ocean circulation. It is an important region for understanding how the water mass transformation, which is recently observed at the Antarctic margin due to the weakened bottom water subduction, will be incorporated into the global circulation. However, no clear structure indicative of the circulation throughout the entire basin has been observed in the Australia-Antarctic Basin, and the mechanism governing material circulation in this region remains unknown. Therefore, in order to get hint of the mechanism of material circulation, we analyzed absolute dynamic topography data that were obtained continuously in both time and space.

DATA

We use CMEMS Absolute Dynamic Topography (ADT) gridded data over the 29-year period spanning from 1993 to 2021. The spatial resolution is 0.25° and the temporal resolution is 24 hours.

ANALYSIS AND RESULTS

Analysis of the Hovmöller diagrams along latitudes revealed that the displacement of ADT shift westward from 135°E to 110°E between 58°S to 62°S. However, the temporal variation, magnitude, and east-west spacing of the displacement were not always constant.

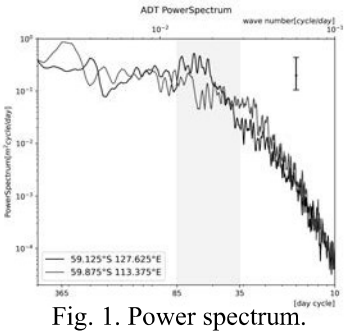

Fig. 1. Power spectrum.

Therefore, we performed a time-domain spectral analysis on all ADT data points. Even within the area where the Hovmöller diagrams showed westward propagation, the characteristics of the power spectrum varied depending on the location.

As representative examples, Fig.1 shows power spectrums at point A:59.125°S,127.625°E and point B: 59.875°S,113.375°E. At A, the power spectrum is high for periods longer than 35 days, and at B, it is high for periods longer than 25 days. Comparing A and B, the value of B is larger than that of A in the period of 25-30 days, while in the period of 35-80 days, the value of B is smaller, showing a reversal trend.

Then, we calculated the integrated value of the power spectrum for each frequency band and examined its spatial distribution. The value obtained here can be considered proportional to the available potential energy in each band, and henceforth they will be referred to simply as the energy of each periodic band. Fig.2 shows the energy distribution of the 35-80 days periodic band as a representative band. In the figure, the white lines represent the bottom topography, "＋" and "×" indicate the point A and B respectively. In the area around 58°S from 115°E to 135°E, toward the deepest of the basin including A, the energy of the 35-80 days periodic band was high, that of less than 35 days band was low. On the other hand, in the area around 60°S including B, high energy is observed in both the 35-80 day and less than 35 days periodic bands.

Furthermore, Fig.3 shows annual average ADT (2011). As in Fig.2, the white lines represent the bottom topography. At 58°S and 60°S, the gradients of ADT were steep following the bottom topography. Referring to Fig.2, one of the high energy areas of the 35-80 days periodic band is located between steep gradients at 58°S and 60°S, while the other is located south steep gradient at 60°S.

The above results suggest the possibility that the periodic characteristics of ADT are generated and propagated in relation to the steep ADT gradients and the bottom topography. Further discussion will be explained at the time of presentation.

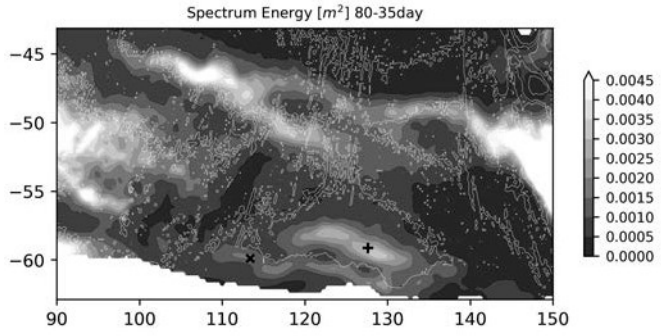

Fig. 2. The energy of the 35-80 days periodic band.

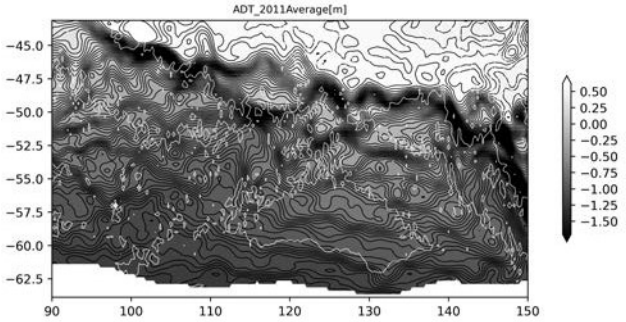

Fig. 3. Annual average ADT in 2011.

Spatial and temporal characteristics of tidal fronts tracked by edge detection

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INTRODUCTION

The front visible at the sea surface marks the boundary where water masses of different properties meet. The distributions of water temperature, salinity, and current change across the front. Understanding the formation mechanisms and the characteristics of fronts contribute to understanding the current, stratification and mixing structures of the whole sea area. The objective of this study is to quantitatively clarify the spatial and temporal characteristics of tidal front in relation to tidal current. In this study, fronts appearing in the Harima-nada Bay were identified on sea surface temperature (SSS) distributions obtained by the Himawari-8 satellite, and were tracked using edge detection.
References must be added in the text with superscripts[1].

METHODS

SST data for the Harima-nada Bay was obtained from the Himawari Monitor[1] published by JAXA. The standard data of the Himawari-8 satellite has a spatial resolution of 1/50 deg = 1.2 miles and an observation frequency of 10 minutes.
Edge detection was performed using the Canny edge detection method described below. First, for each 3×3 pixels block, the Sobel filter coefficients for the x and y directions were multiplied by the SST of each pixel. The sum of these nine pixels (f_x, f_y) is calculated as the differential image of the central pixel. The intensity, G, and angle, θ, for each pixel were calculated using the following equations.

$$G = \sqrt{{f_x}^2 + {f_y}^2} \quad (1)$$

$$\theta = \tan^{-1}(f_x/f_y) \quad (2)$$

θ corresponds to the normal direction of the edge, representing the direction of the gradient of G. When the G of the central pixel is the maximum among the three pixels in the normal direction, thinning processing was performed to extract only the central pixel. Furthermore, pixels were selected by two thresholds (high-intensity, HT, and low-intensity, LT). Pixels where $HT \leq G$ were retained, while pixels where $G < LT$ were discarded. For pixels where $LT \leq G < HT$, those connected to pixels retained by HT were also kept. These procedures were applied to the period during which SST images were obtained consecutively. An example of G distribution is shown in Figure 1. The tidal front near the Akashi Strait was determined on the G distribution and SST image at the initial time of the period. This front was tracked using the G distribution and SST images at each subsequent time. The average edge intensity, water mass area, and distances westward and southward from the Akashi Strait were quantified.

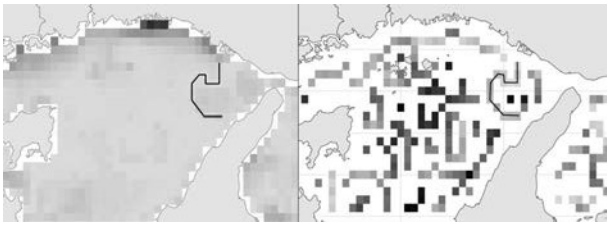

Figure 1 Example of SST and G distributions

RESULTS AND DISCUSSION

Figure 2 shows an example of the analysis results. G of the front increased with the acceleration of the flood tidal current in the Akashi Strait and then decayed after the peak of the flood tidal current. A new front formed with the next flood tidal current. During the flood tidal current in the Akashi Strait, the front continued moving westward. Its southward movement during this period was slight, but as the ebb tidal current strengthened in the Naruto Strait, it suddenly shifted southward. Subsequently, the ebb tidal current also reached its peak in the Akashi Strait, bringing the front close to the strait. Based on these analysis results, the dynamics of the tidal front formed near the Akashi Strait in the Harima-nada Bay can be inferred as follows. The front is strengthened by the flood tidal current in the Akashi Strait but weakens as it moves westward. It rapidly moves southward due to the ebb tidal current in the Naruto Strait, but becomes indistinct as it approaches the Akashi Strait due to the ebb tidal current there, being replaced by a new tidal boundary.

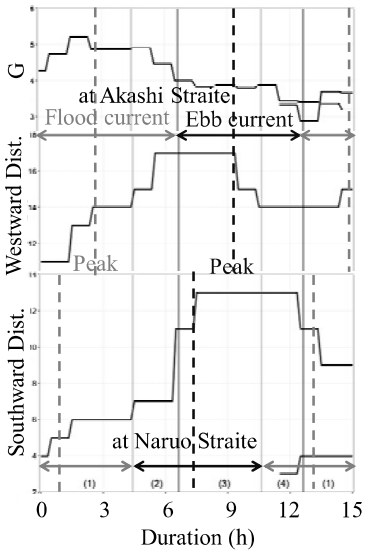

Figure 2 Example of the analysis results

ACKNOWLEDGMENTS

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Algorithm for actively moving ARGO floats to their destination

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INTRODUCTION

This research was fundamental research toward the creation of an AI system for float observations, and utilized detailed ocean structure and flow fields from global reanalysis model data and high-resolution model data to conduct research into actively and accurately moving elevating floats such as ARGO floats to their destinations. If this research's flow estimations, flow verification experiments using elevating floats, and the development of an active movement algorithm progress and are put into practical use, it will be possible to freely control over 4,000 ARGO floats that exist throughout the ocean and use them for various observations. Furthermore, the establishment of an observation network with no data gaps is expected to contribute to climate change predictions and highly accurate weather forecasts.

HYCOM model and drift tracking experiments

This study used the HYCOM consortium's Global Ocean Forecasting System (GOFS) 3.1. GOFS 3.1 provides data on current velocity, water temperature, salinity, and sea surface height at 3-hour intervals on a 0.04° latitude x 0.08° longitude grid. This data is hereafter referred to as HYCOM data.

First, we conducted a tracking experiment to verify the accuracy of the model using HYCOM data. Actual Argo float log data includes depth and time data. Figure 1 shows the results of a year and a half of Lagrangian tracking using only the latitude and longitude of the initial launch point and its log data. The figure shows the tracking results of two floats and the model data. While this may seem like a rough match, we confirmed that even a one-hour shift in the launch time resulted in completely different drifts. This means that the model has high reproducibility for tracking oceanic drift. Therefore, we next proceeded with algorithm development, assuming that the currents obtained by HYCOM are realistic.

Results of drift tracking experiments using active lifting and lowering

In order to direct the float towards its destination, we considered setting a waiting depth that matches the current in each ocean area and moving it there. Here, we show the results obtained using two algorithms. Algorithm α: Find the depth of the current heading towards the destination and have the float wait at that depth. Algorithm β: Drift at each depth for an arbitrary amount of time to find the optimal depth to approach the destination and have the float wait at that depth. Assuming the actual movement of a float, we calculated that the float would rise and fall at a vertical speed of 6 cm/s, and that it would be moved by the current at each depth even while rising and falling.

Due to space limitations, here we introduce the case of a float moving from 25° N to 40 ° N. Fig. 2 shows the float trajectories obtained using algorithms α and β, and Fig. 3 shows the relationship between distance and time to the destination.

Algorithm α, which is a relatively easy condition to set, makes it impossible to move against the subtropical circulation and across the Kuroshio Extension. On the other hand, algorithm β, as shown in Fig. 2, was able to find a migration route that goes against the general circulation by having the float move across various eddies of various sizes.

The algorithm developed in this study should make it possible to maintain a float in a fixed position or to conduct concentrated observations using multiple floats.

A patent application has been filed for the algorithm developed in this study.

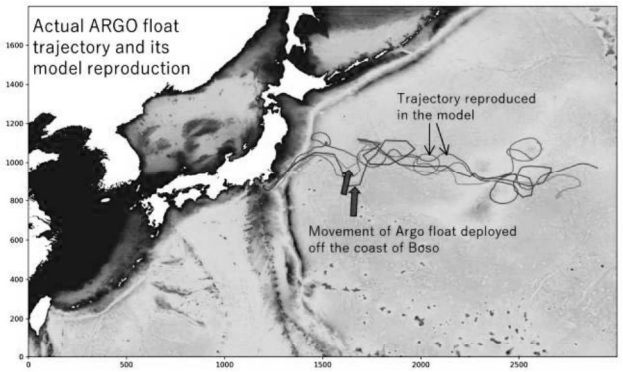

Fig. 1. Results of trajectory model experiments. Actual ARGO float trajectory and its model reproduction.

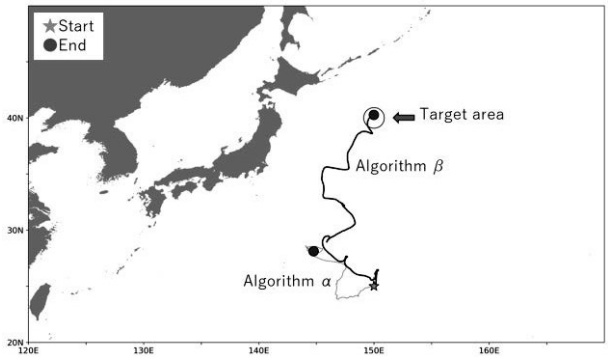

Fig. 2. Trajectory from Start to Target area calculated by using Algorithm α and β.

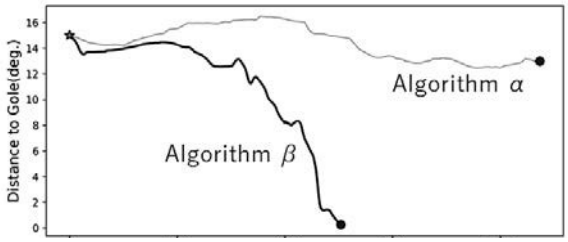

Fig. 3. Time and distance to Target area (Goal) for the cases using Algorithm α and β.

A Literature Survey on the Historical Relationship Between Eels and Humans

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INTRODUCTION

Hokkaido, Japan, lies at the northern limit of the distribution of the Japanese eel *Anguilla japonica*. No commercial eel fishing currently occurs in this region, and knowledge of its habitat remains limited[1,2]. In the 2001 edition of the Hokkaido Red Data Book, the Japanese eel was classified as a rare species with a fragile foundation for survival. In the revised 2018 edition, however, it was noted that there was insufficient information—particularly regarding habitat status—to make a classification. To address this gap, a literature survey was conducted on the historical relationship between eels and humans in Hokkaido.

METHODS

We collected and organized historical records concerning eels from past literature across three periods: the Jomon period, the early modern Ainu cultural period, and the Meiji period and beyond. This approach allowed us to examine the historical distribution of eel in its northernmost range and its relationship with humans.

RESULTS AND DISCUSSION

Jomon Period

Archaeological investigations from the Jomon period revealed remains of Anguilliformes at sites in Hokkaido. Although its frequency of occurrence is lower than that of other fish species such as salmon, the warmer climate and the environmental changes associated with the Jomon transgression may have provided suitable habitats for eels.

Ainu Culture Period

Regarding interactions with the Ainu people in the early modern period, oral records collected from Ainu elders were examined, identifying six distinct Ainu terms for eel. *Tanne-cep* (meaning "long fish") was widely used, particularly in southern Hokkaido. However, some terms may have been confused with those for lamprey, which share a similar body shape. The records also indicate fishing methods and consumption practices, suggesting possible regional and temporal variations within Hokkaido.

Meiji Period Onward

For the Meiji period onwards (1868–), investigations of stocking and capture records have revealed that numerous attempts were made to introduce eels from Honshu into lakes and marshes in Hokkaido as part of the island's development. From the mid-Meiji to mid-Showa periods (1870s–1960s), eel stocking for fishery purposes continued, with commercial operations in southern and eastern Hokkaido. Local traditions, such as legends and monuments related to eels, further indicate their cultural significance during this period and afterwards. Since the Heisei era (ca. 1990s onward), however, no official records of eel stocking have been confirmed, and catch reports have been fragmentary.

CONCLUSION

These findings demonstrate that although the relationship between eels and humans in modern Hokkaido is tenuous, a deep and diverse relationship existed in the past. With global climate change, concerns are growing regarding the potential impacts of seawater and river temperature changes on fish distribution. Similar effects may influence eel recruitment and habitat use. Long-term trends in eel migration suggest a northward shift in recruitment areas over the past 30 years, likely driven by changes in the Kuroshio, Kuroshio Extension, and Oyashio Currents[3]. Consequently, rivers and lakes in Hokkaido may become increasingly important habitats for eels. Therefore, conserving rivers and lakes in high-latitude regions such as southern Hokkaido may play a vital role in preserving the future habitats of this species.

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ACKNOWLEDGMENTS

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Effect of Pearl Powder Mixing on the Relationship between Electrical Conductivity and Total Dissolved Solids in Liquids and Solids

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INTRODUCTION

Pearl powder is known for its cosmetic benefits, such as skin whitening and antioxidant effects[1]. Up to now, X. Chen *et al*., reported that the micro and nanosized pearl powders were able to increase the proliferation of skin cells[2]. In addition, conductivity measurements have been used for water quality management[3]. In this study, we measured the electrical conductivity (EC) and total dissolved solids (TDS) before and after mixing pearl powder into liquids and solids, to examine whether quality control based on electrical conductivity is possible.

METHODS

The conductivity meter CD-4322 (Kennis Co., Ltd.) was used for the measurements. The electrical conductivity was calibrated using a conductivity standard of 1413 µS/cm (HANNA Instruments). Pearl powder obtained from Akoya oysters cultivated in Ise-Shima, Mie Prefecture, was used.

First, the EC and TDS of a Japanese sake "ZAKU" were measured. Next, 0.1 g of pearl powder was mixed into the "ZAKU" and the EC and TDS were measured again. Subsequently, the amount of pearl powder was increased stepwise by 0.1 g until the total amount reached 0.5 g, and the same measurements were repeated each time. The above measurement was carried out three times. These measurements were done at room temperature. Figure 1 shows photographs taken during the measurements.

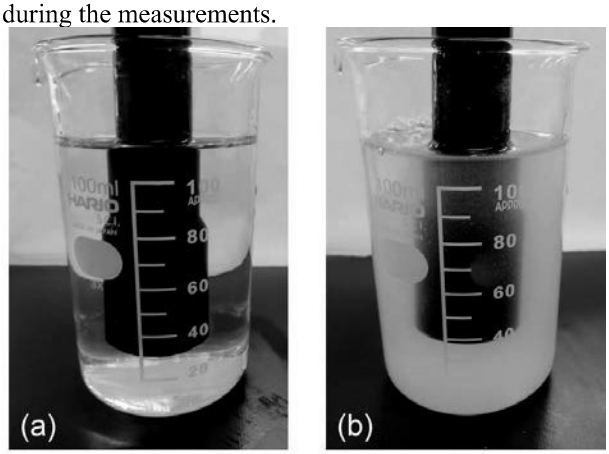

Figure 1. Photographs during the measurement: (a) without powder and (b) with powder (0.2 g).

RESULTS AND DISCUSSION

Figure 2 shows the EC and TDS measurement results of "ZAKU" with and without pearl powder. The electrical conductivity of "ZAKU" increased when mixed with pearl powder. The linear approximation curve is shown as a dashed line. With increasing amounts of pearl powder, the TDS values increased. Furthermore, it was found that the EC values increased in proportion to the increase in TDS values. These results suggest that electrical conductivity measurements can be used to estimate the mixing concentration of pearl powder, thereby enabling quality control.

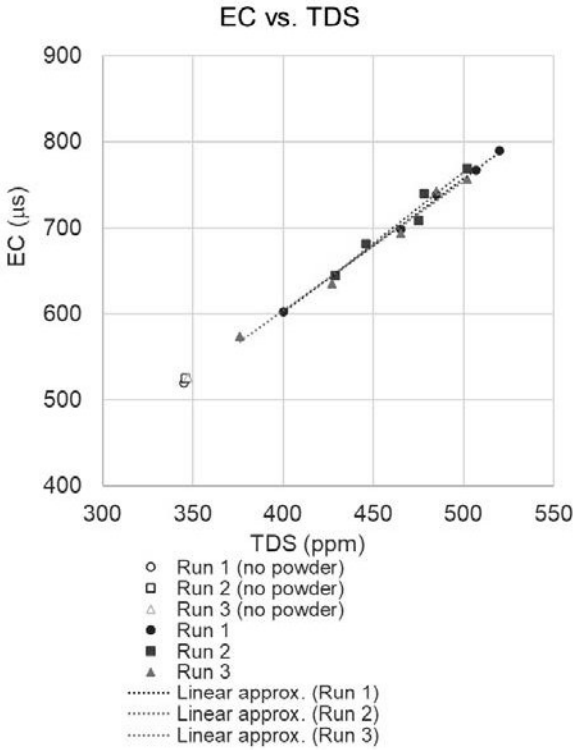

Figure 2. EC and TDS measurement results of "ZAKU" with and without pearl powder.

CONCLUSION

We measured the ECs and TDSs of Japanese sake "ZAKU" with and without pearl powder. Since the EC values varied in proportion to the TDS values, we consider that the mixing ratio of pearl powder can be estimated, making quality control feasible. At the presentation, we will also report that the EC and TDS measurement results for other beverages (Meyer lemon beverage) and solid foods mixed with pearl powder.

Our next plan is to measure EC and TDS under varied conditions, such as changing the temperature during measurement and changing the particle size of the pearl powder. We also intend to examine possible effects on taste. Furthermore, to improve the accuracy of quality control, pH measurements will be carried out.

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Study of Feeding Activity for Sea Urchins in Aquaculture Systems

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INTRODUCTION

The coastal seaweed beds of Japan, referred to as SATOUMI, have historically supported rich marine biodiversity and served as essential fishing grounds for species such as abalone. In recent years, however, these habitats have experienced a substantial decline due to rocky shore denudation. There has been a marked increase in sea urchin populations, presenting new challenges for their effective management. To address this, we utilise advanced remote monitoring technologies, including high-sensitivity cameras and integrated information systems. These tools are designed to ensure optimal viability and comprehensive traceability at each stage from the acquisition of healthy sea urchin seedlings with intact spines and tube feet, through cultivation, to shipment. Our overarching objective is to develop a sustainable production and service framework capable of delivering premium-quality sea urchins, thereby meeting evolving market demands.

EXPERIMENTAL PROCEDURE

Figure 1 shows a concept diagram of the sea urchin (Heliocidaris crassispina) farm system. Observation devices in aquaculture ponds capture images using visible light during the day and infrared at night, water temperature and dissolved oxygen (DO). The collected images are used to develop a model for tracking sea urchin displacement and identifying food. The results are integrated with sensor readings and lunar phase data to illustrate relationships with the feeding patterns of sea urchins. The outcomes support feeding decisions and are presented to farmers via a web application dashboard. Data analysis allows for the feeding and raising of fish based on quantitative information rather than intuition or previous experience.

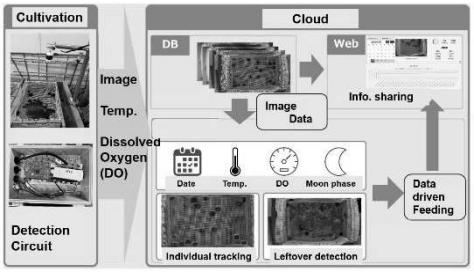

Figure 1 Schematic diagram of the urchin farm system

RESULTS AND DISCUSSION

When feeding, we not only track the movements of individual sea urchins and detect bait, but also consider the effects of weather and ocean conditions to realise feeding based on the feeding behaviour of sea urchins. In this study, we analysed the relationship between water temperature and lunar phase and feeding rate to determine the effect of sea urchins' feeding on bait. For the analysis, we used data from 18 feedings that recorded the period from when bait was released until it was gone (hereinafter referred to as "bait retention period"). The sea urchins were fed fresh wakame seaweed, fresh kelp, and salted wakame seaweed.

1. Feeding and seawater temperature

The results of the analysis of water temperature and feeding rate are shown in Figure 2. As the water temperature approaches 25°C, the food retention period decreases and the feeding rate increases. However, it was confirmed that once the water temperature exceeds 25°C, the food retention period increases sharply and the feeding rate decreases.

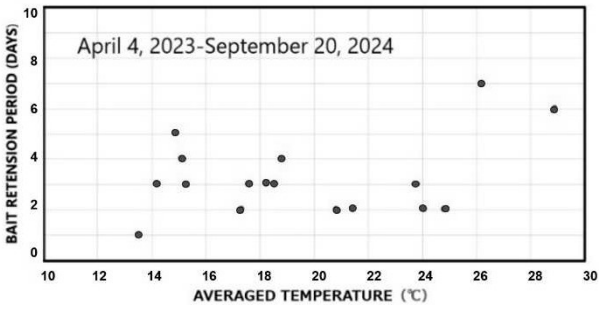

Figure 2 Feeding and seawater temperature

2. Feeding and lunar phase

Figure 3 shows the relationship between feeding rate and lunar phase. As shown in Fig. 3, the feeding rates increase around the time of the new moon and full moon. It is desirable to feed fish at water temperatures below 25°C, and effective feeding is also desirable during the new moon and full moon periods.

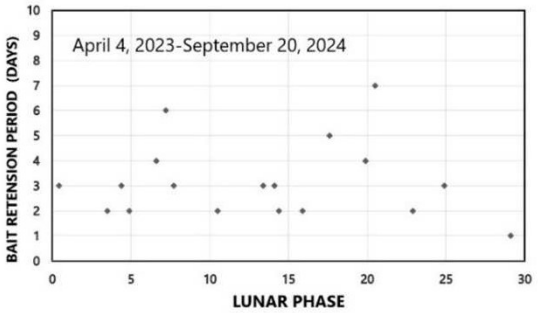

Figure 3 Feeding and lunar phase

CONCLUDING REMARK

Mobility and feeding speed were investigated according to water temperature and lunar phase. Movement tracking and food detection were clearly observed. The feeding speed increases around the new moon and full moon when the water temperature is below 25°C.

ACKNOWLEDGMENT

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Fishing Conditions Prediction by Ocean Conditions Charts

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INTRODUCTION

Fishery resources are subject to significant fluctuations due to meteorological, marine, and oceanographic conditions. In recent years, climate change has particularly altered traditional fishing seasons and grounds, placing fisheries businesses in a challenging operational environment. In response, the promotion of smart fisheries is advancing, leveraging information and communication technology and artificial intelligence for applications such as fishing conditions prediction[1]. Previous studies have reported on the development of fishery prediction models using machine learning[2,3,4]. We propose a fishery prediction model based on ocean conditions charts. The ability to predict fishing conditions allows fisheries businesses to operate more strategically and efficiently, which can contribute to improved business stability.

FISHING CONDITIONS PREDICTION MODEL

In this study, we selected Japanese spineless cuttlefish as the target species for fishing conditions prediction, as it is caught in the Kii Channel and its movement patterns are known to be influenced by water temperature changes[5].

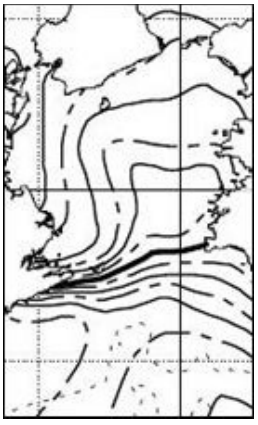

Fig. 1 Ocean conditions charts used in model building

For this study, we used a dataset of ocean conditions charts from 2014 to 2021. We prepared 308 images for the training set and 178 images for the evaluation set. A representative example of these charts is shown in Fig. 1. The constructed model is designed to perform a binary classification based on the input ocean conditions chart. It outputs a value of 1 when the predicted CPUE (Catch Per Unit Effort) for Japanese spineless cuttlefish is equal to or greater than 20 kg, and 0 when it is less than 20 kg. To ensure balanced training and evaluation, the number of samples with a CPUE of 20 kg or higher was matched with the number of samples with a CPUE below 20 kg in both the training and evaluation datasets. The model architecture includes an input layer, a DenseNet-121 layer for feature extraction, followed by three fully connected layers, and a final output layer.

RESULTS AND DISCUSSION

Figure 2 shows the accuracy during both the training and evaluation phases. The training was conducted for 1,000 epochs. The solid black line represents the training accuracy, while the dashed gray line indicates the evaluation accuracy. The training accuracy reached 100 %. This result suggests that the model successfully learned to predict the CPUE (>= 20 or < 20) of Japanese spineless cuttlefish using ocean conditions charts. The maximum classification accuracy achieved during the evaluation was 79 %. The improvement of the model is essential because a predictive accuracy of 90 % or higher is typically required for practical fishing conditions prediction. A primary limitation is the input data; as shown in Fig. 1, the ocean conditions charts only provide isotherm information. Consequently, incorporating additional environmental data will be necessary to enhance the model's performance. Furthermore, we need to consider that human factors, such as no fishing was done even though fishing grounds were available, have contributed to low accuracy.

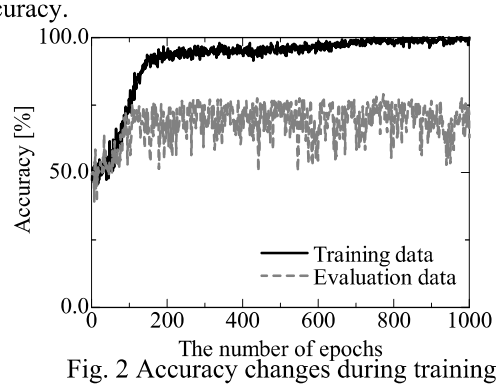

Fig. 2 Accuracy changes during training

CONCLUSION

We built a model to predict Japanese spineless cuttlefish fishing conditions based on ocean conditions charts. The model's accuracy was 100 % on the training data but dropped to 79 % on the evaluation data. For this model to be useful in practice, we need to boost its accuracy on unseen data. Our next steps will focus on identifying and optimizing the parameters needed to achieve this.

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Development of a Phytoplankton Identification System

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INTRODUCTION

We are analysing the relationship between oceanographic conditions and the growth of single-seed oysters in aquaculture. We believe that the quantity and types of phytoplankton are related to oyster growth, and we are working on building an automated identification technology that combines AI and IoT for phytoplankton species that serve as indicators.

SYSTEM OVERVIEW

This system automatically moves a microscope table to continuously acquire plankton images. After that, the acquired images are transmitted to the cloud in real time, and an AI model automatically identifies and counts the species. This automates the identification and counting work that previously relied on human labour, making it possible to quickly capture the presence of specific phytoplankton species. It also improves the efficiency of data collection, allowing for continuous acquisition of more data.

RESULTS AND DISCUSSION

1. Model Overview

For plankton detection, we adopted the object detection model RF-DETR (Nano). This model is an advanced model that balances computational efficiency and accuracy compared to other models such as Faster R-CNN and YOLO. For model training, we used a dataset created from images provided by JST Tohoku University.

2. Evaluation Results

In the evaluation using the test dataset, we obtained results of mAP@50 at 79.2%, precision at 76.4%, and recall at 68.8%. These numbers mean that while the model has shown a certain level of success in plankton detection and identification, there are still many challenges for practical use. A recall rate of 68.8% suggests that there is a possibility of overlooking nearly 30% of the plankton that should be found. If harmful plankton are overlooked the system would not fulfill its important role of early detection, and re-verification by human eyes would ultimately be necessary. From this, the challenge remains that complete automation has not been achieved at this point, and it does not lead to a substantial reduction in labour.

3. Performance and Similarity Analysis by Class

There was variability in the average precision (mAP@50) for each class. Some classes with clear morphological features, such as *Karenia papilionacea* and *Noctiluca scintillans*, achieved 100% mAP@50. On the other hand, some classes like *Gonyaulax polygramma* (9.8%) and *Alexandrium fraterculus* (9.0%) showed low performance in terms of precision. This variability in performance is primarily caused by the morphological similarity of the plankton species. For example, we concluded that *Gonyaulax polygramma* and *Alexandrium fraterculus* are similar in cell shape, size, and surface patterns, which causes misidentification.

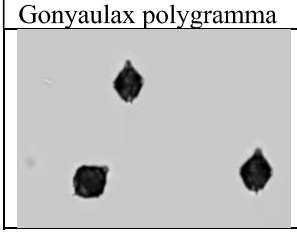
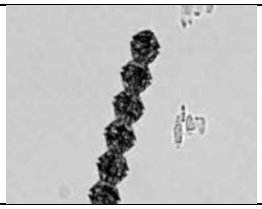
Gonyaulax polygramma	Alexandrium fraterculus
	

Figure 1. Images of similar plankton

CONCLUSION AND FUTURE OUTLOOK

This study achieved a certain level of detection performance for automated phytoplankton species identification using the RF-DETR (Nano) model. However, the current identification accuracy is low for some classes, and it has not yet reached the level required for practical use. In the future, we will deepen the data analysis of highly similar plankton species to establish a concrete approach to further enhance the model's identification capabilities.

AQUACULTURE APPLICATION

The results of this research are not limited to simply determining the quantity of plankton but will directly contribute to solving challenges in aquaculture. Specifically, by monitoring the types and quantities of plankton that serve as nutrients for oysters in aquaculture in real time, it is possible to detect food shortages, enabling data-driven feeding that does not rely on experience or intuition. Additionally, by detecting harmful plankton like *Karenia mikimotoi* or plankton that cause red tides early and sending alerts to oyster farmers, it becomes possible to quickly take countermeasures to prevent damage.

ACKNOWLEDGMENTS

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Laser beam shooting system to prevent duck damage to seaweed farming

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INTRODUCTION

In recent years, the decline in seaweed *(nori)* production in Japan has become a serious problem. Poor harvests in seaweed aquaculture have been attributed to various factors, including shortened cultivation periods, disease outbreaks, and damage caused by herbivorous animals. This study focuses on the damage caused by ducks. Once seaweed is eaten by ducks, it cannot regrow, and the affected areas remain unharvestable until the next season. Such damage poses a serious challenge for seaweed producers and must be urgently addressed.

Countermeasures such as sound cannons, repellent bands, and hunting have been attempted. However, because ducks are nocturnal and highly adaptive, these methods have limited sustainability and effectiveness, and no long-term solution has been established. Therefore, in this study, we aimed to resolve this issue by developing an AI-based duck detection and automatic repelling system, and by verifying the effectiveness of lasers as a deterrent.

METHODS

In this study, we developed an automatic repelling system that combines a PTZ camera with a laser, as illustrated in Figure 1. The system automatically controls the PTZ camera installed in the aquaculture site, using panning and zooming functions to monitor the entire farm with 360-degree coverage. During surveillance, when ducks are detected by the AI, a class-3 green laser is activated to repel them. To avoid habituation, the laser is only triggered upon detection rather than being continuously illuminated. Furthermore, since ducks tend to move in flocks, repelling only a few individuals with the laser induces the entire group to leave, thereby preventing the spread of damage.

The system is integrated with the ocean monitoring device *Umilog* and cloud services, enabling real-time analysis of captured images while simultaneously storing them in a database for long-term monitoring and management. Through this mechanism, the system aims to reduce duck damage, restore seaweed production, and contribute to improving farmers' income.

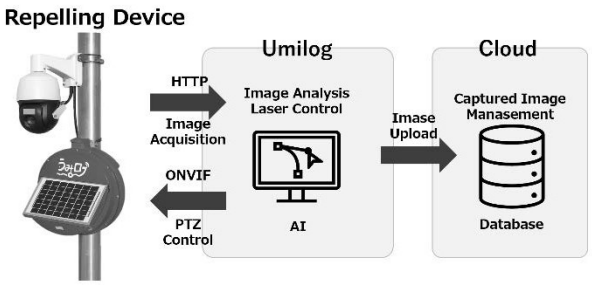

Figure 1. System Overview

EXPERIMENTAL RESULTS AND DISCUSSION

1. Duck Detection Model

In this study, SSD Mobilenet V2 was adopted for duck detection. Images captured by the ocean monitoring device *Umilog* were used for training, and the model was selected with emphasis on processing speed and energy efficiency. While YOLOv8 required an average inference time of approximately 0.3 seconds per frame, SSD Mobilenet V2 achieved performance of 0.15 seconds per frame, demonstrating about twice the speed. This indicated that SSD Mobilenet V2 is more suitable for seaweed farms, where long-term continuous operation is required.

The constructed model was evaluated using precision and recall as performance metrics. Since avoiding false negatives—cases where ducks are present but not detected—is critical in this application, recall was emphasized. The evaluation threshold was set at 0.5. Using the test dataset, the model achieved a precision of 97.4% and a recall of 90.5%. These results indicate that the model successfully prevented more than 90% of missed detections, demonstrating high recognition performance. Therefore, the model can be considered to have sufficient practical applicability for use in seaweed aquaculture sites.

2. Effectiveness of Laser Deterrence

Field experiments were conducted at night when ducks appeared in rivers and seaweed farms. In more than 100 trials, manual activation of the laser successfully repelled ducks in all cases, confirming the high effectiveness of the laser as a repelling method. In addition, because ducks exhibit flocking behaviour, we observed that directing the laser at only a few individuals caused the entire group to move away, thereby preventing the spread of damage.

CONCLUSION AND FUTURE PROSPECTS

In this study, we developed an automatic repelling system that integrates AI-based duck detection with laser irradiation, and demonstrated that high-accuracy detection and reliable repelling are possible even at night. Compared with traditional methods such as sound cannons and hunting, this approach offers advantages in nocturnal operation and sustained damage reduction. However, several challenges remain, including waterproofing, protection against salt damage, power capacity, and responses to habituation over long-term use. Future work will focus on enhancing environmental resistance and energy efficiency, conducting long-term field demonstrations, and promoting miniaturization and cost reduction, with the goal of practical application at aquaculture sites and deployment on a regional scale.

Drone-Based System for Preventing Duck Damage in Nori Cultivation

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INTRODUCTION

A decline in nori production has become a serious issue. Poor harvests in nori aquaculture have been reported to result from various factors, including shortened fishing seasons, the outbreak of diseases, and grazing damage caused by ducks. Once a cultivation area is grazed by ducks, nori can no longer grow there, making it impossible to harvest until the following season. Such damage by ducks has become a significant source of distress for nori producers.

METHODS

In nori aquaculture, various measures have been attempted to prevent damage caused by ducks; however, no effective repelling method has yet been established.
In this study, we propose the development of an automated duck-repelling system using drones in nori farming areas. Specifically, drones are deployed to patrol the farming site, and when ducks are detected by AI, the system initiates repelling actions immediately. This approach aims to reduce damage caused by duck, promote the recovery of nori production, and ultimately improve the profitability of producers.

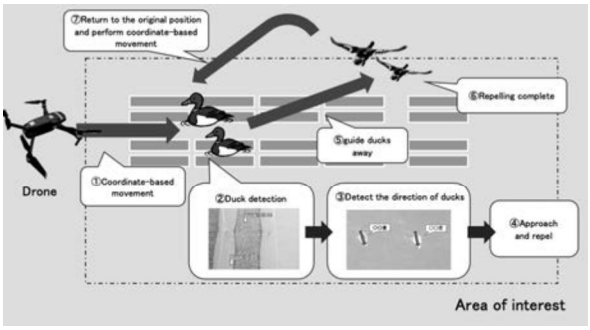

Figure 1 System operational flow

The operational flow of the automated duck-repelling system is illustrated in Figure 1.
In this system, the drone performs fully autonomous flight. A patrol route within the nori farming area is defined using coordinates, and the drone navigates along this route. When AI detects ducks during the patrol, the drone moves directly above them. The flight direction of the flock is predicted, and the drone is oriented toward that direction, approaches the flock, and repels them. After guiding the targeted ducks outside the boundaries of the farming area assigned to the drone, the drone automatically returns to its original patrol route and continues navigation. The implementation of this system enables efficient mitigation of damage caused by duck.

RESULTS AND DISCUSSION

1. AI model overview

   In this study, we focused on detecting ducks. For object detection, we employed the YOLOv8 model. The model was trained using images collected by a drone over nori farming areas. Assuming that the drone patrols above the farming site while facing directly downward, we used images captured form a top-down perspective. Approximately 400 images were used for training.

2. AI model evaluation results

   The evaluation using the test dataset yielded the following results.
   - Precision：97.7%
   - Recall：96.9%

3. Discussion

   Although the number of images used for training was limited, both precision and recall achieved high values. Therefore, we evaluated the detection accuracy using images that were not included in the training dataset. As a result, it was confirmed that ducks could be correctly detected even in top-down images. This can be attributed to the fact that images of the sea form a top-down perspective contain only a limited number of elements, such as nori nets, the sea surface, and supporting poles, allowing the construction of a high-accuracy model even with a relatively small number of training images.

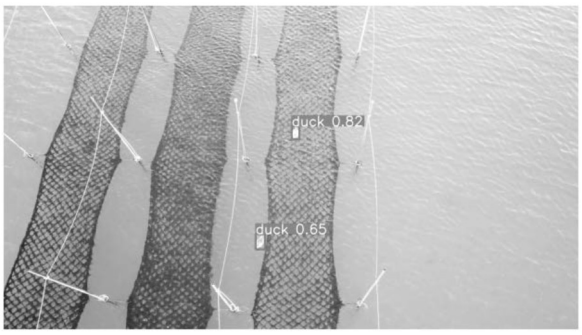

Figure 2 Duck detection results

CONCLUSION AND FUTURE PROSPECTS

In this study, we created a duck detection model using top-down images, assuming that the drone patrols above the nori farming area while facing directly downward. Although a high-accuracy model was achieved, we will continue to increase the number of training images in the future to further improve its performance.
Moreover, after completing the duck detection model, we will also work on developing a model for detecting the flight direction of ducks. In parallel, the development of the drone's operational program will proceed step by step, aiming to establish a drone-based system for mitigating duck damage in nori cultivation.

Prediction of Chlorophyll-a Using Machine Learning in the Kii Channel, JAPAN

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INTRODUCTION

Fuel costs and vessel repair expenses in coastal fishing can potentially be reduced if fishing grounds can be predicted. This study aims to predict the future Chlorophyll-a concentration in the sea based on data provided from JAXA by using machine learning[1]. By predicting future chlorophyll-a concentrations, it is expected that optimal fishing grounds in marine areas can be estimated. The target sea areas were the Kii Channel, the Naruto channel and Tomogashima channel between Wakayama prefecture and Tokushima prefecture in japan.

METHODS

This study predicted the result of chlorophyll-a for November 2023 to October 2024 by using the mechanic learning. The predicted locations were the Kii Channel, the Naruto channel and Tomogashima channel shown in Figure 1. There were 2518 measurement points and Epoch number were 1000. The input data used were chlorophyll-a concentration obtained from the JAXA Earth Observation Satellite Data Provision System (G-Portal). The measurement interval for that data was 250 meters. To compare and verify the results of the predicted values and the actual measured values, data from November 2023 to October 2024 was used. Water quality data used on maritime areas published by Wakayama city, Wakayama prefecture and Tokushima prefecture.

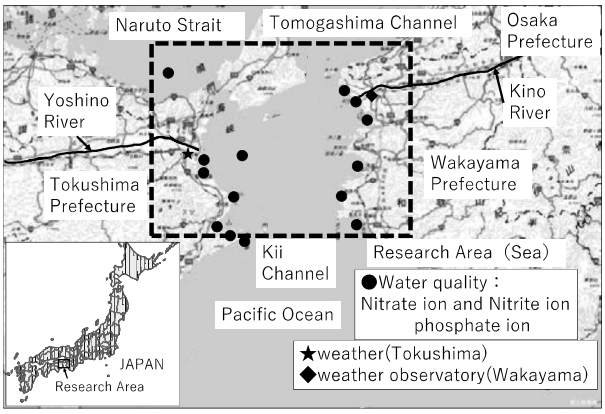

Figure 1 Research area

RESULTS AND DISCUSSION

Predicted values and measured values shown high concentration in Tokushima prefecture including the southern parts of Osaka prefecture. In Wakayama prefecture, the concentration shown low values however one of the northern parts of Wakayama shown high concentration. This point shown high concentration both predicted value and measured value. Machine learning enabled the estimation of locations where chlorophyll-a concentrations increased. Therefore, the possibility of estimating fishing grounds has been demonstrated for using machine learning. Figure 2 shown results of error value of chlorophyll-a and water quality. Chlorophyll-a is known to vary depending on meteorological factors such as air temperature and wind strength, as well as water quality factors such as nitrogen and phosphorus concentrations. The phosphorus concentrations shown 0.102 mg/L at the point in Wakayama prefecture where high concentration of Chlorophyll-a shown. However, along the coast of Tokushima Prefecture, phosphate ion concentrations showed lower values compared to Wakayama prefecture. Nitrate and nitrite concentrations were high in areas where chlorophyll-a concentrations were elevated. Those concentrations showed low values at locations where chlorophyll-a concentrations were low. Based on the above, it can be inferred that the increased concentration of chlorophyll-a in the sea area is due to enhanced photosynthesis caused by high concentrations of nitrate ions and nitrite ions.

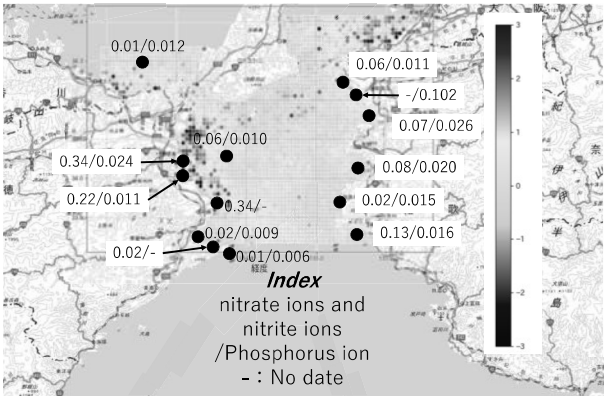

Figure 2 Results of chlorophyll-a concentration by the Machine Learning and Water Quality

CONCLUSION

This study aims to predict the future chlorophyll-a concentrations using machine learning based on chlorophyll-a concentrations in marine areas provided by JAXA. The prediction of chlorophyll-a concentration used the data from April 2018 to August 2023 as input data, with the output data covering the period from September 2023 to November 2024. Based on the results of actual measurements and predictions, this study was able to predict locations where concentrations would be high. Those increases were due to the rising concentration of dissolved nitrogen in the sea.

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Building a Behaviour Analysis System for Sea Urchins in Aquaculture Systems

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INTRODUCTION

A rocky shore denudation has become a serious issue. It seems to be enhanced by a variety of factors. Overgrazing by sea urchins, which feed on the algae, has become noticeable as a factor. Sea urchins are popular as a luxury food; however, sea urchins that grow in deteriorated seaweed beds have thin flesh and are of little value, so in the Ise-Shima region, AMA, female free divers exterminate the sea urchins by splitting them open in the sea. Efforts have been conducted to capture sea urchins from the denudation area, and feeding, maturing and selling them through cultivation. However, there are few established technical studies for sea urchin culture, and the effort relies on experience and manual judgment, which limits the ability to improve and stabilise quality control.

METHODS

In this study, we track the displacement of individual sea urchins, detect feeding and combine them with meteorological and oceanographic data to scientifically analyse the behavioural ecology of sea urchins.

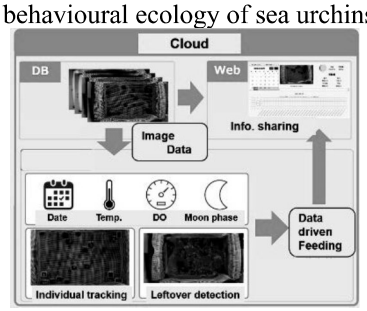

Figure 1 Schematic diagram of the tracking system

An urchin tracking concept is shown in Figure 1. The sensor/camera devices installed in the culture ponds take images using visible light during the day and infrared at night, obtaining data on water temperature and dissolved oxygen (DO). A model was created to track the displacements of sea urchins and detect food. The results are then combined with sensor data to visualise the relationship with the feeding behaviour. The results obtained are used to determine feeding and are presented to the fisherman via a web application (dashboard).

RESULTS AND DISCUSSION

1. Tracking individual sea urchin mobility

A sea urchin detection AI was created using machine learning. Object detection was applied to camera images. The model was built using MobileNet SSD v2, which tags and trains sea urchins. The detected urchins were identified and tracked using the MOT (Multiple Object Tracking) library "motpy," and the target displacement was numerically visualised. Two models for sea urchin detection AI were created: one for visible light and another for infrared. 1,130 sea urchins were tagged under visible and 950 under infrared, and 15 types of padding were randomly applied to create training samples. For verification, 400 sea urchins under visible light and 354 sea urchins under infrared light were used, which led to high precision and recall rates based on images of the cages. For tracking individual mobility, verification was performed using 180 consecutive images, for visible light and infrared. MOTA (Multiple Object Tracking Accuracy) achieved an accuracy of 94.5% for visible and 71.9% for infrared.

2. Building a feed detection AI

To understand the feeding behaviour of sea urchins, it is necessary to reduce false positives and accurately calculate the presence or absence of feed, the amount of feed, and the trend of feed decline. In this study, we report the results of using a machine learning method that is easily adaptable to changes in the brightness of the input image and the environment. The machine learning method detects feed using a feed detection AI (Figure 2). The food region was segmented in the input image, and transfer learning was performed using Deeplab v3+ trained with Pascal VOC 2012 for the food detection AI.

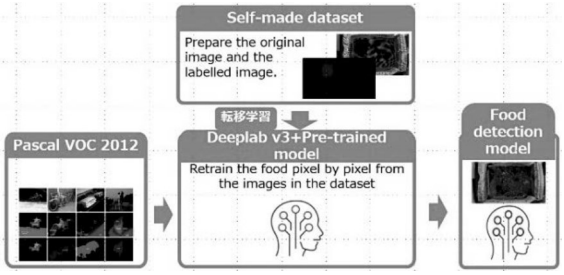

Figure 2 Feeding detection AI concept

In the feeding analysis, in order to accurately grasp food quantity, evaluation was performed using FPR (False Positive Rate) as an indicator in addition to IoU (Intersection over Union). The results suggested that the low water level machine learning method had fewer false positives and could accurately calculate food quantity.

CONCLUDING REMARK

Present challenge supports a data-driven feeding for sea urchin (Heliocidaris crassispina), contributes to restoring coastal ecosystems, and may enhance the value of thinly fleshed sea urchins as a new local food source. Analysis of the data makes it possible to feed effectively and raise gonads in a short period.

ACKNOWLEDGEMENT

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Exploring Superconducting Rotating Machinery for Hydrogen Society
Review of Fundamental Elements from KOSEN Research

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INTRODUCTION

Within the global trend towards decarbonisation, reducing CO_2 emissions in the maritime sector has become an urgent priority. Achieving this goal requires not only technological breakthroughs but also a holistic vision for future policy and societal implementation. To address this challenge, our research group has investigated the efficiency of energy systems utilising storage-type liquefied hydrogen (LH_2) cooling and explored the applicability of high-temperature superconducting (HTS) technology. This abstract provides a comprehensive overview of the findings.

ENERGY BALANCE FOR HYDROGEN PORTS

A fundamental energy balance calculation method for future hydrogen ports was developed and its feasibility was evaluated. Beyond the technical aspects, this framework offers insights into how energy systems can be modelled to support decision-making in sustainable port design, highlighting implications for both infrastructure planning and operational policy.

APPROACHES TO HTS MACHINERY DESIGN

Previous research has often retrofitted HTS materials into conventional rotating field magnets. However, such incremental approaches may not be sufficient to meet the dual demands of efficiency and structural simplification. Our analysis suggests that novel superconducting rotating machinery, supported by hydrogen-based cooling, could play a transformative role in enabling the recovery of unused energy within port environments, bridging technical innovation with practical application in maritime industries.

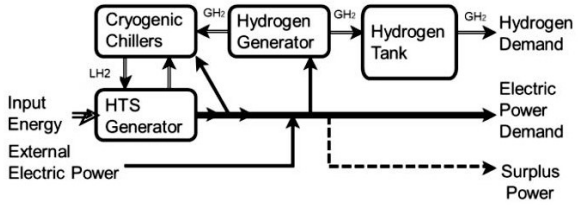

Figure 1 Schematic view of the HTS generator and system.

CONCLUSION

The integration of high energy density with hydrogen cooling technology (using hydrogen as a coolant) demonstrates the potential to realise sustainable and scalable next-generation electrification for port and marine environments. The results are significant not only for engineering solutions but also for broader strategies towards zero-emission vessels and carbon-neutral maritime infrastructure, where collaboration between technological, policy, and societal perspectives is indispensable.

Table 1 Standardisation Performance Comparison of Rotating Machine Models

Model	**MHI 8 kW *(ref.)***	**POD 75.0**	**W/O Teeth**	**With Teeth *(Opti.)***
Type	**IPMSM**	**BLDC**	**HTS**	**HTS**
Rotating speed (rpm)	1.00	5.69	1.00	0.13
Output (kW)	1.00	9.38	1.71	1.66
Total torque (N·m)	1.00	1.65	1.71	12.40
Propeller dia. (mm)	1.00	0.78	0.77	0.77
Active volume (m^3)	1.00	3.11	8.09	8.09
Torque density ($N·m/m^3$)	1.00	0.53	0.21	1.53

ACKNOWLEDGMENTS

This work was supported by JKA and its promotion funds from KEIRIN RACE (2024M-477), This work was supported by JSPS KAKENHI Grant Number JP16H06136

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Development of Material Evaluation System under Cryogenic Conditions for Marine Hydrogen Equipment

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INTRODUCTION

The use of cryogenic fluids such as liquefied hydrogen is increasing in the field of marine engineering. Currently approved SUS316 has a high thermal expansion coefficient and is costly. Therefore, we are focusing on the more affordable SUS304 with a lower thermal expansion coefficient. By evaluating its material properties under cryogenic hydrogen conditions, we aim to establish a highly reliable and economical material option for marine equipment.

METHODS

This research aims to evaluate material properties under cryogenic conditions. First, a test system utilizing a cryocooler (refrigerator) as the primary cooling source is constructed to stably achieve the specified target temperature (e.g., liquid hydrogen temperature range of 20K).

The core of the system is the design and fabrication of a specimen mounting attachment connected to the cryocooler's cold head. SolidWorks is used for the structural design of this attachment. Furthermore, thermal analysis simulations are performed on the created model to determine the optimal thermal contact interface and shape, thereby maximizing cooling efficiency to the specimen.

After fabrication, the attachment's temperature control capability will be verified. Multiple high-precision temperature sensors will be installed. By adjusting the cryocooler operating conditions and the conditions of the heater attached to the attachment, we will confirm whether the specified target cryogenic temperature can be stably reproduced and maintained. Once the system is established, test specimens such as SUS304 will be mounted. Fracture strength tests will be conducted under cryogenic and stable conditions to quantitatively evaluate the mechanical properties.

RESULTS AND DISCUSSION

In the constructed cryogenic test system, the cold head of the cryocooler, which serves as the cooling source, reached the target temperature of **13.36 K.** Consequently, the temperature of the attachment holding the test specimen also dropped to **20.04 K**, confirming the achievement of the cryogenic environment. However, since this temperature was achieved without using the temperature control heater, it is evaluated as insufficient to ensure the necessary cooling capacity margin for stable temperature control. Two main causes for this temperature deficiency were identified: increased contact thermal resistance due to insufficient contact area between the cold head and the attachment, and insufficient radiation shielding measures leading to external radiative heat influx. Therefore, future improvement measures will include adding a thermal conduction bypass to the attachment to reduce contact thermal resistance, while optimizing the shield plate placement to minimize external heat influx, aiming to achieve stable target cryogenic temperatures.

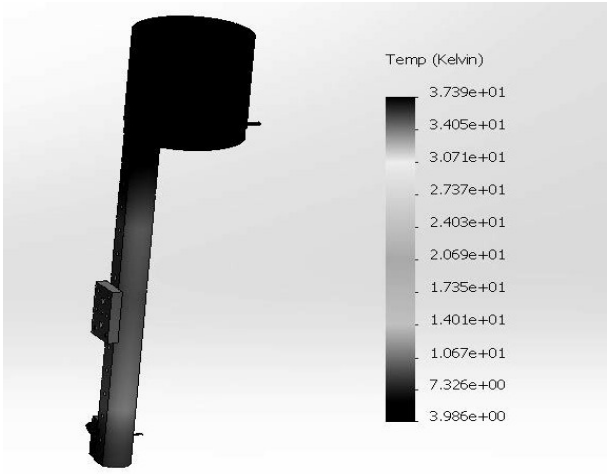

Figure 1 Thermal Simulation Results

ACKNOWLEDGMENTS

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Experimental Preparation of Onboard Hydrogen Cooling Systems on Training Ship

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INTRODUCTION

In the port and maritime sectors, the realization of carbon-neutral ports is strongly demanded to reduce greenhouse gas emissions and minimize environmental impact[1]. Among potential energy sources, liquefied hydrogen has attracted attention as a next-generation clean energy due to its higher energy density compared to fossil fuels and its potential use as a refrigerant[2,3]. This research aims to evaluate a shipboard hydrogen cooling system utilising high-temperature superconductors as a foundational technology for liquefied hydrogen utilisation. This system achieves cooling to -240°C and an 800-fold improvement in volumetric density, verifying its performance under actual marine environmental conditions.

Land-based nitrogen cooling tests have confirmed the system's basic performance, and preparations are now underway for a December sea trial to verify safe operation under real marine conditions, as reported in this study.

EXPERIMENTAL SETUP

In May 2025, an on-board inspection of the training vessel *Toba Maru* was conducted to examine in detail the delivery route, power supply locations, and installation sites for the hydrogen cooling system. As shown Figure 1, the inspection revealed that, due to the limited space within the vessel and narrow passageways, the transportation and installation of large equipment would require careful planning and handling. Test liquified condensor would be brought from NIT, Toyota, while large devices such as the compressor, and cold head for cryo-cooling would be provided by NIT, Toba.

For the loading procedure, the plan is to use the deck crane installed on the vessel and bring the equipment on board through the upper hatch. During the loading process, special attention will be paid to ship motion and weather conditions, with the highest priority placed on safety when handling liquid nitrogen and liquid hydrogen. Following installation, the piping connections, power supply setup, and control system verification will be conducted in sequence. Plans are in place to perform safety checks and system operation tests in preparation for the upcoming sea trial.

PLANNED RESULTS AND DISCUSSION

The experiment will be conducted while the vessel is berthed.. This will allow us to acquire fundamental data and verify the system's operational performance in preparation for future experiments planned during voyages. This will be the first time an experiment using hydrogen is conducted on board a ship, marking a significant step in verifying the effectiveness and safety of a hydrogen cooling system in a real-world maritime environment. Compared to being berthed, conditions during a voyage are expected to be more severe, with factors such as waves, mechanical vibrations, and changes in ambient temperature and humidity. Therefore, based on the knowledge gained from the berthed experiment, we plan to evaluate the system's stability against environmental fluctuations and formulate strategies for improvement.

Figure 1: Experimental environment on the training vessel

SUMMARY

An on-board inspection clarified routes and locations for installing the hydrogen cooling system, highlighting the need for careful planning due to space limitations. The upcoming trial will focus on verifying temperature control performance and ensuring operational safety in a stable environment. Through collaboration, the project also provides students with practical, hands-on training, integrating technical validation with meaningful educational value.

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ACKNOWLEDGMENTS

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Prototype of Accelerometer-Based Anomaly Detection System for Marine Equipment

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INTRODUCTION

The goal of this study is to establish indicators for high-precision monitoring and analysis of the operational status of a superconducting cooling system to be installed on a training vessel, thereby ensuring stable operation. The existing laboratory system centrally controls multiple temperature and pressure sensors; however, the overall architecture is complex and presents maintainability challenges. In addition, operational data for superconducting coolers are limited, making it difficult to define necessary benchmarks and identify trends for anomaly detection. Considering shipboard deployment, wave motion and mechanical vibration must be accounted for, necessitating accurate condition monitoring under marine environmental conditions.

OBJECTIVES

The objectives are threefold: (1) acquire and analyze temperature, pressure, and acceleration data during normal operation of the cooling equipment and organize them into time-aligned datasets; (2) visualize operational status and establish anomaly-detection indicators based on the acquired data; and (3) modularize the existing LabVIEW control system by sensor unit to enable function-centric project management and enhance readability and maintainability.

METHODS

An MPU-6050 accelerometer is rigidly mounted on the equipment to capture tri-axial vibration during operation. The sensor communicates over I²C to an Arduino that serves as an edge-computing node. The Arduino timestamps and buffers the stream, applies basic denoising through moving-average or low-pass filtering, rejects spikes, packetizes frames, and forwards the data to the measurement PC at deterministic intervals for real-time acquisition. Multiple accelerometers are deployed on the housing, the support frame, and the mounting base in order to separate equipment-generated vibration from hull motion and wave excitation. Differential and common-mode separation is used to isolate local vibration components, and coherence across sensor pairs is examined to confirm source attribution.

Frequency analysis is carried out with FFT using windowing and overlap processing. Band power, spectral peaks, sideband patterns, spectral centroid, and kurtosis are computed as features. Amplitude demodulation is used to form envelope spectra where bearing or rubbing signatures are suspected. Temperature and pressure streams are resampled to a common timeline with the acceleration data. Clock drift between the edge node and the PC is corrected by aligning periodic triggers or by cross-correlation of shared markers, and a single time-aligned dataset is produced for subsequent analysis.

As shown in Figure 1, all sensor streams are integrated into a LabVIEW dashboard that provides multi-panel plots, alarm flags, and a simple health index. Data are logged with run metadata for offline replay. The previously monolithic LabVIEW project is refactored into sensor-level and function-level modules with a hardware abstraction layer and a lightweight message queue. Configuration and error handling are centralized to improve readability, maintainability, and per-function control, and to support future deployment in marine environments.

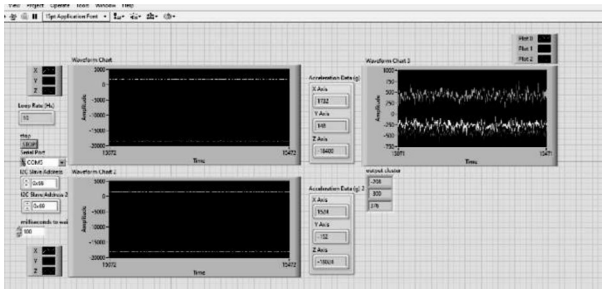

Fig. 1 Vibration Data Measurement Screen

FUTURE PROSPECTS

By utilizing the system and dashboard being developed, it is expected that operational abnormalities in cooling equipment can be detected early, enabling predictive maintenance. This is anticipated to promote stable equipment operation, contributing to reduced maintenance costs and improved operational efficiency.

ACKNOWLEDGMENTS

This work was supported by JKA and its promotion funds from KEIRIN RACE (2024M-477), and JSPS KAKENHI Grant Number JP16H06136

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Study Of The Wire Length Effect For The Undulator-type Tidal Stream Generator

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INTRODUCTION

Developing renewable energy is essential for combating global warming. There are many types of generators that utilize various renewable energy sources. One such option is tidal power generation, which harnesses energy from tidal currents. By utilizing tidal currents, tidal generators can provide a stable supply of electricity, and their power output can be predicted. Thus, MW-class tidal turbine generators capable of producing large amounts of power have been developed worldwide[1)]. However, these large tidal turbines require ocean depths and current speeds, making them unsuitable for small islands. To adapt tidal energy generation for small island, we focused on an undulatortype stream generator. This type of tidal generator consists of a membrane and a linear generator. The membrane, which is deformed by current flow via an attached wire, is bent by the tidal current. The linear generator then converts this membrane deformation into electrical power. This tidal generator can operate in shallow water and has no rotating parts, which helps reduce noise[2)]. Although the power output of the undulator-type generator is lower compared to traditional tidal turbines. In this paper, using the various length wire, we aimed to improve the membrane deformation which can work at lower tidal currents.

EXPERIMENTAL PROCEDURE

We have studied for the movement of undulator-type stream generator using various length wire. The undulator-type tidal stream generator was composed with the membrane, float, linear generator and wire. The wire is equipped with between the float and the membrane, and it makes a deformation of membrane. The linear generator placed on the membrane, and it convert the deformation energy of membrane to electric energy. However, we equipped the air cylinder instead of the linear generator for add various load as a generator and five air cylinders were equipped on the membrane. To obtain the movement of the membrane and linear generator, the undulator-type tidal stream generator was immersed in the circulating water channels and applied current flow. Figure 1 shows the experimental set up in circulating water channel. During the experiment, the current flow was applied 0.3 m/s to 1.0 m/s by the circulating water channels. For the experiment, we tightened the wire until the membrane was bent to 0.85, 0.9 and 0.95 times the length of the membrane without bent. Moreover, we added the 0.2 MPa air pressure for each air cylinder.

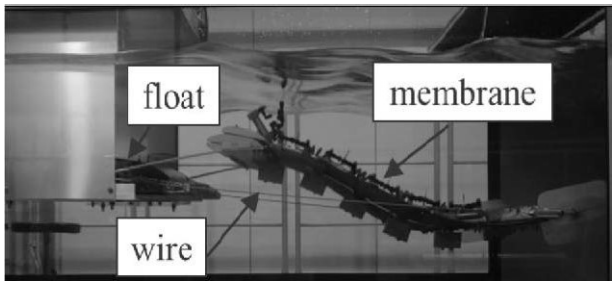

Figure 1 Experimental set up in circulating water channel

RESULTS AND DISCUSSION

When we added the 0.6 m/s current flow, the undulation was started in the experiment with membrane which bent 0.95 times. Over the 0.6 m/s current flow, the movement becomes fast according to increase the current flow. The trajectory of the membrane with 0.6 m/s current flow shows in figure 2.

Figure 2 The trajectory of the membrane with 0.6 m/s current flow

Using the 0.9 times membrane bent condition, the undulation started with 0.55 m/s. And using the 0.85 times membrane bent condition, the undulation started with 0.48 m/s. These results show that shortening the wire length makes it possible to operate the device even at slow flow rates.

CONCLUSION

In this paper, we focused on the effect of the wire length for the Undulator-type stream generator. As a result, we obtained the movement of the generator with various wire length. This result has a potential to develop and realize the undulator-type stream generator.

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Tidal Current Measurement For The Power Generation In Toshijima

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INTRODUCTION

Toba city has many remote islands, and a system that can supply electricity independently is necessary. Utilizing ocean currents and wind power is one possible way to generate electricity in a remote island. The tidal currents around the remote islands in Toba City are relatively fast, and it is desirable to utilize these. However, the sea area around the remote islands has navigational area and this sea area are shallow. This indicates the sea area around the remote islands in Toba city is not suitable for power generation using tidal turbine generators.

In recent years, the tidal power generators, such as a undulator-type tidal power generator, have been developed. It can work in shallow sea area and with low-speed tidal current. It is possible to fully utilize tidal currents even in Toba city. In this study, we measured the tidal currents and verified the amount of power generated by tidal power generators around Toshijima to use them.

EXPERIMENTAL PROCEDURE

In this experiment, tidal currents were measured by installing a tidal current measurement device (AEM-USB, JFE Advantech Co., Ltd.) as shown figure 1. This tidal current measurement device uses the phenomenon of Faraday's low of electromagnetic induction.

Figure 1. Tidal current measurement device (AEM-USB, JFE Advantech Co., Ltd.)

To measure the tidal current continuously, we avoid the navigation area near the Toshijima and use the oyster raft. So,the measurement device was set on an oyster raft located between Toshijima and Ukishima as shown figure2. Tidal currents were measured for one month in August 2024. The water depth in the area where tidal current measurements were conducted was approximately 10 m, and tidal currents were measured at a depth of 2m, the maximum depth at which an undulator-type tidal current turbine can be installed.

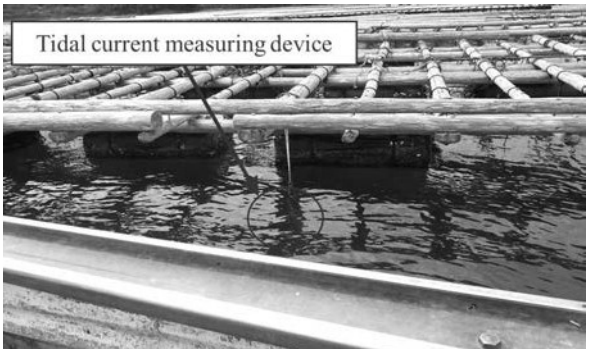

Figure 2. The measurement set up with oyster raft

RESULTS AND DISCUSSION

Figure 3 shows the maximum daily values of the measured tidal currents. From these results, it was confirmed that the current speed between Toshijima and Ukishima was a maximum of 0.6 knots, with an average of about 0.3 knots. The current speed was low because the waters between Toshijima and Ukishima were relatively calm. However, faster current speeds are expected in other areas of Toshijima.

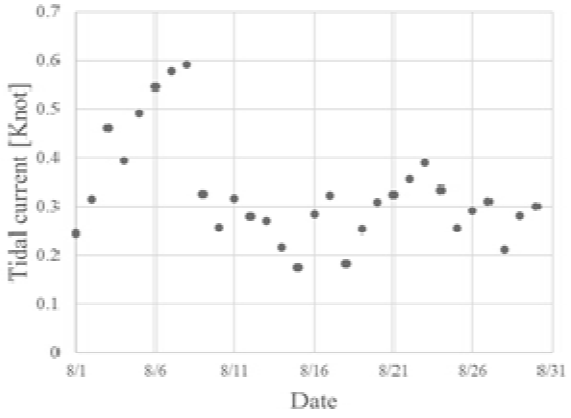

Figure 3. The measurement results of the maximum tidal current

CONCLUSION

To generate tidal power using the abundant tidal currents in Toba City, measurements of the tidal currents on Toshijima were carried out. The results showed that the tidal currents near Momotori on Toshijima were low, averaging around 0.3 knots, but faster current speeds can be expected in other ocean areas, and with the development of a tidal current generator, sufficient power generation is expected even on Toba City's remote islands.

The Effects and Current Status of Marine Education for Sustainable Community Development in Satoumi Regions: A Case Study of the Whole-School Survey in Toba City

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INTRODUCTION

In recent years, Japan has faced population outflow and aging, leading to depopulation that has caused the decline or disappearance of region-specific cultures and industries[1]. Toba City, Mie Prefecture, is designated as a depopulated area by the Ministry of Internal Affairs and Communications[2]. At the same time, it is a "Satoumi" region where people and the natural environment coexist, and the Toba City Board of Education has been actively promoting marine education by taking advantage of this feature. Marine education that utilizes local ecosystems, culture, and industries related to the sea can play an important role as community-based education and is considered highly significant for the formation of a sustainable region. However, its actual practices and educational effects have not been sufficiently clarified. Therefore, this study conducted a "whole-school survey" targeting all elementary and junior high school students in Toba City. The purpose was to evaluate the educational effects of marine education in Toba City, to understand the students' awareness, and to use the findings for future improvement of marine education programs (hereafter, programs).

METHODS

Marine education in Toba City was conducted 50 times in FY2023 and 49 times in FY2024, including activities such as collecting and observing marine organisms, visiting seaweed cultivation sites, and learning about Ama diver culture. The whole-school survey targeted 5th grade elementary to 3rd grade junior high school students enrolled in all schools in Toba City, and was conducted three times in July each year from 2023 to 2025. The questionnaire consisted of multiple-choice and open-ended questions. The multiple-choice questions asked about awareness of the local community, the sea, and the natural environment, while the open-ended questions asked about "the image of Toba." For the multiple-choice questions, the most positive option on the five-point scale was scored as "5" and the most negative as "1." For the open-ended questions, each response was categorized into one or more categories, and the frequencies were compared.

RESULTS AND DISCUSSION

The number of valid responses was 399 in 2023, 389 in 2024, and 467 in 2025. A year-by-year comparison showed that the average score for "I like Toba" (sense of hometown attachment) was 3.90 in 2023, 3.92 in 2024, and 3.98 in 2025. For "I want to live in Toba" (settlement intention), the scores were 3.61, 3.69, and 3.77, respectively. For "I like living organisms," the scores were 3.55, 3.70, and 3.71, respectively. Meanwhile, items such as "I like nature," "I care about nature," "I like the sea," and "I care about the sea" varied within 0.04 points, and the average scores of all these items were 4 or higher in every year. Grade-level analysis revealed that both hometown attachment and settlement intention decreased as students advanced in school. Specifically, hometown attachment was 4.20 among 5th graders and 3.82 among 3rd-year junior high students, while settlement intention was 4.25 among 5th graders and 3.34 among 3rd-year junior high students. In the open-ended responses, many students mentioned the sea and natural environment, such as "the sea is beautiful," "nature is abundant," and "seafood is delicious." Particularly, students with higher levels of hometown attachment were more likely to refer to natural resources and seafood, using more concrete and positive expressions. These results suggest that students have a high level of interest in nature and the sea, and that their interest in living organisms and the local community increased. At the same time, since hometown attachment and settlement intention tend to decline with grade level, it is necessary to implement programs in junior high school that foster stronger ties to the local community. Furthermore, the open-ended responses revealed that students with a deeper understanding and attachment to their community tended to focus on natural and marine resources in concrete and positive terms. Conducting programs that utilize such tangible local resources is considered effective in further enhancing students' understanding and attachment to their community.

CONCLUSION

From 2023 to 2025, students' attachment to Toba, settlement intention, and interest in living organisms gradually increased, while strong interest in nature and the sea was sustained. However, attachment weakened as students advanced in grade. Open-ended responses showed that students with deeper community ties emphasized local resources such as nature and seafood. These results provide useful insights not only for Toba City but also for other regions seeking sustainable development.

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ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the Toba City Board of Education, as well as the teachers and students of each elementary and junior high school, for their cooperation in conducting this study.

Eelgrass (*Zostera marina*) Seed Production through Microbial and Sediment Optimization: A Strategy for Coastal Blue Carbon Restoration

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INTRODUCTION

Seaweed beds play a very important role in carbon fixation. However, the area of algal beds is currently declining; therefore, methods to recover seagrass are needed to restore them. Accordingly, this study aimed to establish a technique for the artificial propagation of eelgrass, one of the main seagrasses, in the ocean. The germination rates of eelgrass seeds and soil under various conditions in natural seawater were assessed to evaluate the optimal conditions for germination and cultivation in the aquarium.
In the future, artificially cultivated eelgrass seeds and seedlings will be planted in oceans to restore seaweed beds and biodiversity.

METHODS

Eelgrass (*Zostera marina*) seeds were sown in groups of five in plastic seedling cups filled with different types of sediments, including flower bed soil collected from Hiki Junior High School (33.5664374°N, 135.4407249°E), coastal sediments near the National Institute of Technology, Wakayama College (33.837695°N, 135.175279°E), and soil from the HIOKI Forest on the premises of HIOKI E.E. Co. (36.3809514°N, 138.1944103°E). The flowerbed soil from Hiki Junior High School consisted of a mixture of humus and sand aged outdoors for one year. Soil from the HIOKI Forest was prepared as part of a greening project initiated in 1988 by the HIOKI E.E. Co. The seedling cups were placed in tanks filled with artificial seawater maintained at 15 °C and observed continuously for approximately 30 d (Figure 2). Once germination occurred, white LED lights were installed above the tanks to provide 12-hour photoperiods for photosynthesis, continuing under the same temperature conditions for four months. Germination rates were assessed after approximately 20 days under controlled water temperature, light illuminance and salinity.

RESULTS AND DISCUSSION

Seedling development was observed in the compost, hiki soil, and HIOKI Forest soil. Plant heights measured 20 days after sowing revealed two distinct groups. The taller group (42.05–67.9 cm) successfully formed flowering branches (Figure 1), whereas the shorter group (4.3–33.4 cm) did not. The observation that seed formation occurred in soils rich in organic matter aligns with previous findings for *Zostera noltei*, a closely related species. In addition, Fe ions have been shown to alleviate sulfide stress and significantly promote plant density and flowering branch formation. Consistent with this, our study also confirms that Fe^{2+} plays a crucial role in flowering branch and seed formation [1].

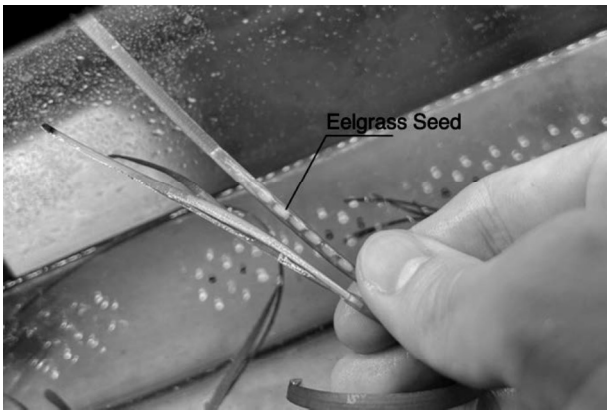

Figure 1. Individual eelgrass seedlings generated under artificial conditions in an aquarium.

CONCLUSION

Our results also indicate that iron supplementation in marine systems should be considered as an alternative measure to mitigate the Fenton reaction.

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Toward sustainable blue economy from blue carbon ecosystems

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hori_masakazu70@fra.go.jp

INTRODUCTION

The contribution of blue carbon ecosystems as a CO_2 sink has been increasing attention in recent years. In Japan, methodologies have been successfully developed to calculate CO_2 sequestration by marine macrophytes, including not only seagrass beds but also macroalgal beds and seaweed aquaculture (FRA 2023). In 2024, the nationwide CO_2 sequestration by natural seagrass and macroalgal beds was officially registered in Japan's greenhouse gas inventory.

Seaweed is also recognized as a blue resource that is effective in promoting climate change measures (UNEP 2023), so that seaweed farming is rapidly spreading around the world. Research and practical application have been progressing not only for edible purposes but also for non-edible uses such as cascade utilization.

Furthermore, Japanese people have traditionally used seagrass and macroalgal beds as fishing grounds and fertilizer harvesting areas since ancient times. Local stakeholders have been managing them to increase their sustainability, suggesting that the Japanese local knowledge is adept at protecting seagrass and macroalgal beds while utilizing their functions.

Among the topics related to climate change countermeasures utilizing blue carbon ecosystems, this study introduce (1) methodology to calculate the CO_2 sequestration by marine macrophytes, (2) seaweed farming techniques to maximize both CO_2 sequestration and yields for cascade utilization, and (3) a management technique that enable to increase both CO_2 sequestration and manila clam stocks in seagrass beds.

METHODS

(1) Calculation method: the basic structure of the calculation formula was determined according to the IPCC Guidelines for Wetlands. Seagrass and macroalgal species distributed along the Japanese coast were classified into 17 vegetation types. The annual CO_2 sequestration was calculated using the formula based on four organic carbon (OC) storage processes in each vegetation type. (2) seaweed farming techniques: seaweed farming can be also considered as a carbon sink because multiple OC storage processes function during cultivation (Duarte et al. 2025). We developed a technique that maximizes CO2 sequestration using multiple layers and multiple species, unlike conventional cultivation for food. (3) seagrass bed management: moderate vegetation structure of *Zostera japonica* can increase manila clam recruitment and survival under oligotrophic environment. We developed a technique to increase both seagrass primary production and manila clam abundance through clam harvesting activity.

RESULTS AND DISCUSSION

(1) The annual CO2 sequestration was highest in surfgrass vegetation type at 20.4 tonnes CO_2/ha, and lowest in ephemeral green algal vegetation type at 0.02 tonnes CO_2/ha. Our calculation revealed that seagrass beds generally exhibit higher CO2 sequestration than macroalgal beds. This was because seagrass beds effectively enabled all four OC storage processes (Fig. 1) to function.

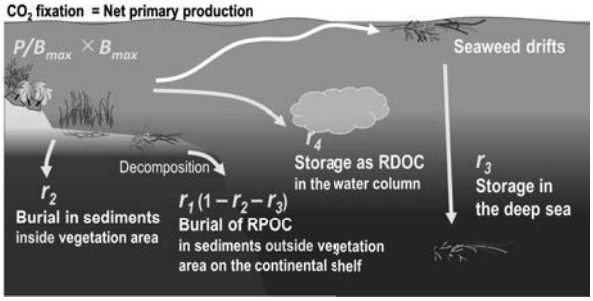

Fig.1 Four OC storage processes in the CO_2 sequestration. OC stored for at least 100 years was calculated for each process.

(2) By combining multiple species that grow at different depths through several manipulations, it was possible to grow macroalgae in three dimensions and maximize the yield per unit area. (3) Our technique of harvesting manila clams together with seagrass shoots increased seagrass growth by 1.5 times and clam density by 3.0 times. Furthermore, we found the additional revenue through cascading valorization of harvested seagrass leaves, suggesting the possibility of a circular bioeconomy from blue carbon ecosystems.

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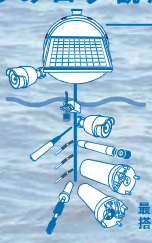

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  - 濁度
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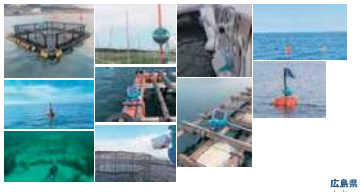

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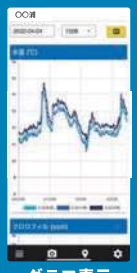

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各センサー別にグラフ表示

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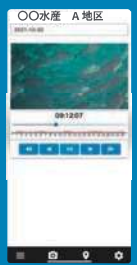

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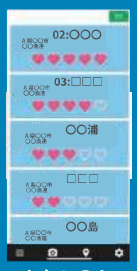

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