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Symposium Commemorating the 60th Anniversary of the Japanese-French Oceanographic Society of Japan: "60 years of Japanese-French cooperation in oceanography"

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Abstract: This article introduces the symposium commemorating the 60th anniversary of the Japanese-French Oceanographic Society of Japan (SFJO Japan), founded in 1960. Due to the COVID-19 pandemic, the symposium celebrating the 60th anniversary was postponed to 2021 and held virtually through the web. The symposium reviewed the historical exchanges between France and Japan in the field of oceanography and fisheries science and looked to the future. The first part highlighted significant moments in the exchange of sciences and technologies and collaboration between the two countries, such as the visit of the French deep-sea research submersible FNRS III to Japan in 1958 and the export of Japanese oyster spats to France in the 1960s and the establishment and activities of the French-Japanese Ocean Development Sub-Committee. Future cooperative plans were also presented: A research cooperation for studying seamounts around New Caledonia decided by the maritime dialogue between Japan and France and the Nature and Culture Project for exchanging knowledge and know-how between France and Japan. The second part introduced congratulation messages from academic societies and organisations related to the oceanography and fisheries science for celebrating 60th anniversary of SFJO of Japan. The SFJO of Japan acknowledged the persons who have contributed to the exchanges of oceanography and fisheries science between France and Japan. Vice-President of SFJO France delivered the message of congratulations and the commemorative medal from the SFJO France to the SFJO of Japan.

Keywords : *Société franco-japonaise d'Océanographie, Japanese-French Oceanographic Society, 60th Anniversary of the Japanese-French Oceanographic Society, Japanese-French cooperation in oceanography*

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1. Introduction

The Japanese-French Oceanographic Society of Japan, founded in 1960, celebrates its 60th anniversary in 2020. To mark this milestone, we wanted to look back at the kind of exchanges that have taken place between France and Japan, and to consider future exchanges in the field of oceanography and fisheries science including aquaculture/shellfish farming issues.

In the first part, we reviewed the history of exchanges between Japan and France in the field of oceanography. The pioneering moment in post-war French-Japanese exchanges in the field of marine science was the visit to Japan in 1958 of the French deep-sea research submersible FNRS Ⅲ called the bathyscaphe), on board of which was the Japanese scientist Professor Tadayoshi Sasaki of Tokyo University of Fisheries (Komatsu and Ceccaldi, 2023). In the mid-1960s, after a large number of oysters died in France, Professor Takeo Imai of Tohoku University, a member of the Japanese-French Oceanographic Society of Japan (*Société franco-japonaise d'Océanographie*: SFJO), and others worked on quarantining for export of Sanriku oyster spats to France (Koike and Komatsu, 2023). Thus, the export of Japanese oyster spats saved the French oyster industry, which was in great danger at the time. In July 1974, the Japanese and French governments signed an agreement on science and technology, under which "the French-Japanese Ocean Development Sub-Committee" for cooperation was established (Totani, 2023). The French and Japanese governments take turns convening the group every two years or so, and it continues to promote research in the field of marine science and fisheries science between Japan and France. The minutes of this meeting are used to review the exchanges in the field of marine science and fisheries science between the two countries. In addition, a maritime dialogue has been initiated between the French and Japanese governments, and the first Japan-France Comprehensive Maritime Dialogue was held in Noumea on 20 September 2019. Thanks to the efforts of Yves Hénocque, a Vice-President of the Japanese-French Oceanographic Society of France and others, it was decided to carry out a study of the seamounts around New Caledonia, based on a memorandum of understanding between the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and the *Institut Français de Recherche pour l'Exploitation de la Mer* (Ifremer). In addition, the two Japanese-French Oceanographic Societies are preparing a "Nature and Culture" project which aims to bring together the traditional and academic knowledge of both countries to achieve sustainable exploitation of the sea (Prouzet, 2023). In the first part, we will reflect on these issues and discuss future cooperation.

The second part aims to reflect on the contribution of the Japanese-French Oceanographic Society of Japan to the French-Japanese exchanges in oceanography summarised in the first part. We would like to present the messages of the academic organisations concerned about the 60 years of work of the Japanese-French Oceanographic Society of Japan and to thank those who have contributed to the French-Japanese cooperation in the field of oceanography and fisheries science.

The symposium was originally scheduled to take place in October 2020, but was postponed to 2021 due to the restrictions on the travel of people between France and Japan following the COVID-19 pandemic disaster. In this situation, we decided to organize this symposium, although it is the 60th anniversary plus one year, using the Internet, as we now have a system in place at the *Maison franco-japonaise* that allows French researchers to participate in the symposium.

2. Structure of the symposium

This symposium was organised by the Japanese-French Oceanographic Society of Japan and the French Institute of Research on Japan at Maison franco-japonaise（*Institut français de Recherche sur le Japon à la Maison franco-japonaise*: IFRJ）. It was supported by the Ministry of Education, Culture, Sports, Science and Technology, the Service for Science and Technology, French Embassy in Japan, the Japanese-French Oceanographic Society of France, the Japan Agency for Marine-Earth Science and Technology of Japan, the Japanese Society of Fisheries Science, the Japanese Society of Fisheries Oceanography, the Oceanographic Society of Japan, the *Fondation Sasakawa franco-japonaise*, the Japanese National Committee of the UN Decade of Ocean Science for Sustainable Development. It consisted of Part 1 "History of Japanese-French exchanges in oceanography" and Part 2 "Celebration of the 60th anniversary of the Japanese-French Oceanographic Society of Japan". The latter part is introduced in the biggening of this special issue.

3. Programme

Time (JST)	Titre of the presentation	Affiliation	Speaker
13：00 ～13：10	Congratulatory speech at the conference	French Institute for Research on Japan	Professor Bernard Thomann
	Explanation of the objective of this conference	President of the Japanese-French Oceanographic Society（SFJO）of Japan	Professor Teruhisa Komatsu
		President of the SFJO France	Dr Patrick Prouzet
Part 1 : History of Japanese-French exchanges in oceanography			
13：10 ～13：40	Why did the FNRS III bathyscaphe come to Japan? A major step in Japanese-French cooperation in the field of oceanography	Honorary President of the SFJO France President of the SFJO Japan	Professor Hubert-Jean Ceccaldi and Professor Teruhisa Komatsu
13：40 ～14：10	Japanese-French exchanges in the field of fisheries science: Mass die-off of oysters in France and export of Sanriku oyster spats	Advisor of the SFJO Japan	Professor Yasuyuki Koike
14：10 ～14：40	Creation of the French-Japanese Ocean Development Sub-Committee and its subsequent activities	Ministry of Education, Culture, Sports, Science and Technology of Japan	Mr Gen Totani
14：40 ～15：10	French-Japanese dialogue on the marine environment and marine research: seamount research in New Caledonia	Vise-President of the SFJO France	Dr Yves Henocque
15：10 ～15：40	Nature and Culture Project: Exchange of knowledge and know-how between France and Japan - Around the 5 pillars of sustainable development and the 5 senses	President of the SFJO France	Dr Patrick Prouzet

15：40 ～15：55	General discussion	Moderator Professor Yuji Tanaka（Vice-President of the SFJO of Japan）
15：55 ～16：05	Break	

Part 2: Celebration of the 60th anniversary of the Japanese-French Oceanographic Society of Japan			
16：05 ～16：25	Creation of the Japanese-French Oceanographic Society in 1960 and its contribution to the development of cooperation in the field of oceanography between France and Japan	President of the SFJO of Japan	Professor Teruhisa Komatsu
16：25 ～16：45	Congratulations from French Embassy in Japan	Scientific Counsellor	Professor Didier Marty-Dessus
	Introduction of congratulatory speeches from the scientific community read on behalf	Vise-President of the SFJO of Japan	Dr Kazufumi Takayanagi
16：45 ～16：55	Message of congratulations and presentation of a commemorative medal from the Japanese-French Oceanographic Society of France to the Japanese-French Oceanographic Society of Japan	Vise-President of the SFJO France	Dr Yves Hénocque
16：55 ～17：05	Presentation of a certificate of appreciation to those who contributed to the oceanography exchange between France and Japan		
17：05 ～17：15	19th Japanese-French Oceanography Symposium - Caen, France - October- 2023	Professor at the University of Caen Normandy/the SFJO France	Professor Jean-Claude Dauvin
17：15 ～17：20	Closing remarks	Vice-President of the SFJO of Japan	Dr Kazufumi Takayanagi

4. Abstracts of Part 1

4.1 Why did the FNRS III bathyscaphe come to Japan? A major step in French-Japanese cooperation in the field of oceanography

Hubert-Jean Ceccaldi[1] and Teruhisa Komatsu[2]
1）Japanese-French Oceanographic Society France
2）Japanese-French Oceanographic Society of Japan

On 19 May 1958, the French bathyscaphe FNRS III arrived in the port of Yokohama from the French port of Toulon, transported by a cargo ship, the Atsuta Maru of the NYK Line. The most advanced manned submersible in the world at the time, capable of studying the deep sea, arrived from France to conduct research in the Japan Trenches. Several Japanese oceanographers participated in these dives and obtained excellent results. These joint operations led to the creation of the Japanese-French Oceanographic Society in 1960. In the context of this symposium, where we have the task of reviewing the exchanges between Japan and France in the field of oceanography and fisheries science,

we would like to reveal some little-known aspects of the visit of the FNRS III bathyscaphe to Japan.

The visit of the bathyscaphe FNRS III to Japan started with the encounter of a Japanese oceanographer, Professor Tadayoshi Sasaki of the Tokyo University of Fisheries (Tokyo Suisan Daigaku), and a French oceanographer, Professor Louis Fage of the *Muséum National d'Histoire Naturelle* and Director of the *Institut Océanographique de Paris*. In 1951, Tadayoshi Sasaki, a specialist in physical oceanography, was working as a researcher at the Research Institute of Physics and Chemistry, RIKEN (Rikagaku Kenkyūjo), in Japan, where he studied the ocean floor down to about 200 m in a cable-suspended submersible called Kuroshio.

In 1953, he became a professor at the Tokyo University of Fisheries, and from January to August 1956, he was sent abroad as a researcher by the Japanese Ministry of Education to the *Institut Océanographique de Paris*. In January 1958, Professor Tadayoshi Sasaki, who had a passion for deep-sea research, and Professor Louis Fage, Director of the *Institut océanographique*, met in Paris to discuss their research. In January 1958, after long discussions, the two specialists decided to bring the FNRS III Bathyscaphe to Japan.

On his return to Japan in August 1958, Professor Tadayoshi Sasaki, with the support of the leading newspaper Asahi Shimbun, set up a Japanese committee to coordinate the use of the bathyscaphe and, at the end of December 1956, he informed Professor Fage that the FNRS III bathyscaphe was ready to be received. It was decided to send it to Japan from May to the end of August 1958.

In this presentation, we also give an overview of how the French-Japanese co-operation in the field of oceanography and fisheries science developed after the departure of the FNRS III bathyscaphe from Japan at the end of August 1958.

We would like to recall here that the very existence and current activities of the Japanese-French Oceanographic Society of Japan are the result of these encounters, exchanges and events in 1958.

4.2 French-Japanese exchanges in the field of fisheries science: Mass die-off of oysters in France and export of Sanriku oyster spats

Yasuyuki KOIKE
Japanese-French Oceanographic Society of Japan

The Japanese-French Oceanographic Society (SFJO) was founded in 1960 by Professor Tadayoshi Sasaki of the former Tokyo University of Fisheries, who had been impressed by the advanced technology of French oceanography when the deep-sea exploration bathyscaphe FNRS III made a deep dive off the coast of Sanriku in Japan in the late 1950s. This led to a flourishing scientific and technical exchange, both in oceanography and fisheries. In the 1970s, researchers from Japan and France alternated visits to transfer or study the aquaculture techniques. In particular, France learned a lot from Japan, which had a long lead in the production of fish and shellfish (yellowtail, sea bream, abalone, scallops, shrimp, seaweed, etc.) cultures and in aquaculture techniques. However, in the case of oyster farming, France also has developed its own cultivation techniques adapted to the French marine environment.

In the late 1960s, an oyster disease spread in France, causing massive mortality of French oysters.

The response was to transplant Portuguese oysters, but a few years later this species was also severely damaged by another disease. At that time, the Scientific and Technical Institute of Marine Fisheries of France (*l'Institut Scientifique et Technique des Pêches Maritimes*) asked the member of SFJO Professor Takeo Imai of Tohoku University, with whom it had a close relationship, to send the oyster spats from Japan to France. In response to this request, a research group of Professors Takeo Imai and Tadashi Nomura, Akimitsu Koganezawa of the Tohoku Regional Fisheries Research Laboratory and Kunio Goto of the Miyagi Prefectural Fisheries Experimental Station, developed techniques to prevent exported Japanese oysters from carrying parasites and diseases to France and to grow the single-seed oysters requested by France. As a result, a large quantity of oyster spats was exported from Sanriku to France in early 1970, and the spats were delivered to oyster farmers throughout France to revive oyster farming.

Forty years later, on 11 March 2011, the Sanriku Coast of Japan was hit by a devastating tsunami caused by the earthquake, which brought extensive damage to aquaculture facilities. In response, the French oyster farming industry launched the "*Okaeshi*" (meaning "return gift" in English) project, providing aquaculture materials such as ropes and buoys for oyster farmers in Sanriku Coast. Apart from the *Okaeshi* project, a group of researchers belonging to the SFJO of Japan and France voluntarily pooled donation in each society. The total of the donations from two societies pooling the donation from volunteer members, the Association for the Development of Aquaculture, the Air Liquide Foundation, the Rotary Club of Marseille-Saint-Jean was 3,300,000 yen for recovering Sanriku Coastal fisheries. We consulted prefectural fisheries research centres of Iwate and Miyagi prefectures, with which France has had close relations since export of Sanriku oyster spats to France, about what aquaculture equipment Sanriku oyster farmers need now. According to the responses, we purchased seven sets of plankton nets and microscopes needed to collect oyster larvae, with the help of equipment manufacturers Olympus Medical Science and Rigosha, who offered discounts, and donated them to research institutions in both prefectures in summer 2011, when the oysters were spawning. In the summer of the year of the disaster, this equipment, along with those French oyster farmers sent to Sanriku, played a role in making the collection of oyster spats possible.

The following year, in the autumn of 2012, the SFJOs of Japan and France organised a seminar in Shiogama to exchange information between researchers and oyster farmers of Japan and France. Two months later, Dr Tetsuo Seki (former director of the Tohoku Regional Fisheries Research Laboratory) and I were invited as speakers to the World Oyster Congress organized by the oyster farmers in Arcachon, France, together with Dr Kunio Goto and two other oyster farmers. Dr Goto was welcomed as a contributor to the rescue of the French oyster crisis 40 years ago. We discussed the continuation of technical exchanges of oyster farming in the future.

The great bond created by the export of oyster spats from Sanriku to France has since been nurtured and carried on to a large extent by the SFJOs which regularly organise symposia and technical exchanges on oceanography and fisheries science in Japan and France.

4.3 Establishment of the French-Japanese Ocean Development Sub-Committee and its subsequent activities

Gen TOTANI
Ocean and Earth Division, Research and Development Bureau,
Ministry of Education, Culture, Sports, Science and Technology

The French-Japanese Ocean Development Sub-Committee has its origin in the Agreement on Scientific and Technological Cooperation between the Government of Japan and the Government of the French Republic signed on 2 July 1974. Article 3 of the agreement provides for the establishment of a joint Japan-France Committee for Scientific and Technological Cooperation and the creation of specialised groups within this committee. It was quickly agreed to set up a French-Japanese Ocean Development Sub-Committee to promote cooperation between the two countries. This reflected a great interest in marine development in both countries at the time, and it was on this basis that the Japanese-French Oceanographic Society was established in 1960, following the visit of the FNRS III bathyscaphe to Japan in 1958 and the Archimedes in 1962. Since then, understanding in the field of oceanography has been deepened and the basis for cooperation between the two countries has been developed. In both countries, fisheries research institutes were established in the 19th century to support the then flourishing fisheries sector, and both countries have set up institutions to promote the development of marine technology, such as the *Centre National pour l'Exploitation des Océans* (CNEXO) in France established in January 1967 and the Japan Marine Science and Technology Center (JAMSTEC) in October 1971. At the first meeting of the French-Japanese Ocean Development Sub-Committee, held in Tokyo in April 1975, in addition to the proposals made by the French side, the Japanese side proposed specific areas of interest, namely (1) diving technology, (2) coastal development and marine structures, and (3) marine observation devices. Since then, the sub-committee has been one of the most active and long-standing organisations of its kind. The two parts of the group meet approximately every 18 months, alternately in Japan and France. Currently, the Chair of the Japanese side is the Director of Deep Sea Exploration, Ocean and Earth Division, Office of Research and Development, MEXT, and the Chair of the French side is the Director of European and International Affairs, *Institut français de recherche pour l'exploitation de la mer* (Ifremer), the successor organisation to CNEXO.

More recently, the 27th meeting was held in Tokyo in May 2018, and the next edition was planned to be held in France in 2020, but the new COVID-19 pandemic has made international travel difficult, and the meeting has not taken place to date.

This symposium will be an opportunity to look back at the establishment of the French-Japanese Ocean Development Sub-Committee, the evolution of its focus and the results obtained so far. This event will also be an opportunity to discuss the activities and cooperation between our two countries in the framework of the United Nations Decade of Marine Science for Sustainable Development (2021–2030) launched this year.

4.4 About the France-Japan deep observatory project in New Caledonia: political context, preparation process, and perspectives

Yves HÉNOCQUE
Japanese-French Oceanographic Society France

This summary uses large excerpts from the 2019 workshop that was held between all the scientific parties in Noumea, New Caledonia

Political and institutional context

The French State and the New Caledonian government representatives support the observatory project as a tangible action for regional cooperation on the preservation of biodiversity, fisheries management, and climate change. New Caledonian lagoons are registered as UNESCO World Heritage and its entire EEZ has been adopted as a multi-use natural park with a management plan 2018–2022[1)] including (i) Research development, (ii) Innovation more particularly for shipping surveillance, (iii) Economic development and (iv) Regional cooperation with neighboring countries. It is about the preservation and development of the natural heritage with the participation and for the well-being of local communities.

The Pacific Community (SPC)[2)], an intergovernmental organization with 26 Member States and territories, has a mission "to work for the well-being of Pacific people through the effective and innovative application of science and knowledge" with a vision to 'assist the Pacific Community in achieving SDGs and contributing to the Blue Pacific vision.'

The Consortium for Cooperation in Research, Higher Education and Innovation in the New Caledonia (CRESICA[3)]) federates university and research institutes in order to optimise resources and equipment, as well as reinforcing the cooperation in the Pacific area. The University of New Caledonia is also a member to the Pacific Islands Universities Research Network (PIURN)[4)].

Ifremer and JAMSTEC, long term partners in ocean research, spearhead the organization of this workshop to define the scientific and technological objectives whilst bearing in mind the social issues through local participation.

New Caledonia: protection and sustainable development

The area: Natural Park of the Coral Sea

Created in 2014, the Natural Park of the Coral Sea cover the entire EEZ of New Caledonia of 1.3 million km². It has a rich biodiversity with many deep water habitats like seamounts, submarine volcanoes in the South and deep trenches in the eastern part. The first concern is to develop a better understanding of the deep-sea ecosystem functioning which is poorly known. There is a need for an integrated scientific monitoring system to better assess the impacts of anthropogenic activity and the effectiveness of ecosystem-based management plan.

New Caledonia maritime activities

Labeled as one of the 'Innovation territory', more specifically in relation with the ocean, New

Caledonia is considered as a 'demonstration area' for ocean observation in the Pacific. Among others, there are four important innovation projects: (1) SMART cable initiative, using the opportunity of telecom cable laying between New Caledonia and Vanuatu, to create two observation nodes on each side of the trench in between the two countries; (2) ABYSSA, consisting in the development of a fleet of underwater submarine vehicles; (3) REMORA, utilizing wave gliders as surface and subsurface platforms for measuring contaminants, and (4) a geospatial marine data hub.

New Caledonia: underwater geological characteristics

98% of the New Caledonia territory is underwater. The bottom of its marine area is made of diverse features from east to west: the oceanic domain with crusts and volcanic arc, the submarine continent, and the Tasman basin. From what is known but also largely unknown, some ideas of what could be an observatory contribute to are given as:

- Volcanism and hydrothermal vents
- Subduction/collision seismicity (earthquakes)
- Sea-level rise and land motions (e.g.subsidence)
- Coastal dynamics (sediments) and source to sink sediment transfers
- Abrupt margins and slope instabilities
- Climate change and short to long term changes in the deep

Which technology from what has been already developed?

Ifremer and JAMSTEC have respectively about 10-year experience of running deep-sea observatory systems but for different purposes and with different technological concepts.

The IFREMER EMSO-Azores deep sea observatory is located offshore the Azores on the mid-Atlantic ridge. It is a fix point observatory with two nodes (seismic activity and environmental parameters) and a buoy at surface for transmission of data. Several tools are linked to the nodes and in addition there are unconnected components for measuring temperature and many other physical parameters. Data management is done in real time and periodically (images). More recently, the ocean dynamic close to the bottom has been studied, more particularly regarding possible larval dispersion (connectivity). The perspectives include the deployment of an observatory in a protected area in the Bay of Biscay (West of metropolitan France) where deep coral habitats will be monitored. The challenges are about multidisciplinary observation, the dynamics and functioning of the ecosystem, and environmental monitoring for management. Ifremer has also a know-how in developing and running in situ instrumentation for chemistry, from surface to deep sea, including in specific environments such as hydrothermal vents.

In Japan, JAMSTEC has deployed the Dense Ocean floor Network for Earthquake and Tsunamis (DONET) with a high reliability and flexibility. Each node has 8 laboratory modules that can be connected to the network. The system may be complemented with the use of subsurface floating buoys (MERMAID) with different type of sensors for seismic, acoustic (cetaceans), pressure data application (meteorology, sea level change). Long-term sediment trap moorings in deep water are also being run.

Sharing knowledge and information with local stakeholders

Developing such a project requires attracting local stakeholders including decision makers at regional and local level in related science and technology fields. This can be achieved by engaging them with deep-sea research challenges, raising awareness of deep-sea exploration and discoveries, andemphasizing the need to fill gaps in ocean/climate interaction processes, seafloor geological processes, and deep-ecosystem functions and dynamics. Citizen Science is increasingly viewed as a way to empower communities by involving them in research that can be used to drive forward policy changes.

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4.5 Nature and Culture Project: Exchange of knowledge and know-how between France and Japan: Around the 5 pillars of Sustainable Development and the 5 senses

Patrick PROUZET
President of the Japanese-French Oceanographic Society France

The objective of Sustainable Development as defined by the World Commission on Environment and Development in 1988 is: "to promote a state of harmony between human beings and between Human and Nature". The Brundtland Report in 1987 defined Sustainable Development as the convergence of three spheres of equivalent interest: social, economic and environmental.

It is clear not only from the assessment of the state of our environment within structures such as the IPCC (Intergovernmental Panel on Climate Change) or the IPBES (International Panel for Biodiversity and Ecosystem Services), but also from the observations made by many local players that the implementation of a sustainable development policy associated with genuine environmental governance does not correspond to the initial objectives announced (Millennium Assessment or Conferences of the Parties).

The implementation of a sustainable development policy is decided within a set of actors of varying strength and influence. Within this framework, economic and social imperatives have largely taken precedence over environmental interests and the actors whose future depends directly on the exploitation of environmental resources, particularly aquatic resources, are not sufficiently listened to. Hence the need to consider environmental governance as one of the pillars of sustainable development in order to put environmental protection at the top of managers' concerns and to minimise the ecological footprint of all uses.

To avoid future generations being left behind in these negotiations and to put intergenerational solidarity at the heart of the negotiations, it is important to take culture into account as the 5^{th} pillar of this development and to link "Nature and Culture" in order to ensure the transmission of knowledge

and know-how between generations.

This is the philosophy of the "Nature and Culture" project, which integrates the different expertises, knowledge and know-how for the development of territorial projects between French and Japanese actors: restoration of sea grass beds（Seto Sea and Arcachon Basin）; enhancement of fisheries and shellfish production（eel, oyster farming networks）, promotion of local products and regional cultures（implementation of Franco-Japanese projects within a slow-food framework）and education on the environment It is also for this reason that the 5 pillars of sustainable development are associated with the 5 senses: hearing, smell, sight, taste and touch in order to highlight the culture and productions of the fishing and aquaculture/shellfish farming communities within a framework of sustainable development.

5. Conclusion

Although the symposium was conducted with a web-based system, it was attended by 100 participants from France as well as Japan. The success of the symposium can be attributed to the long history of exchanges between Japan and France in the fields of oceanography and fisheries science, which began in 1958. Collaboration in these fields between Japan and France may contribute to the future generations and realising sustainable development goals through its activities.

Acknowledgements

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