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Selected Papers

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OPRI THE OCEAN POLICY RESEARCH INSTITUTE

Director's Message

As mankind moves through the 21st century, integrated policies of ocean governance are increasingly necessary for the sustainable development and use of our oceans and their resources and for the protection of the marine environment.

Towards this end, the Ocean Policy Research Institute (OPRI) of the Sasakawa Peace Foundation orients its research on ocean issues in line with the mission statement "Living in Harmony with the Oceans."

OPRI aims to conduct cross-sectoral research in ocean related issues in order to initiate debate on marine topics and to formulate both domestic and international policy proposals.

We publish a Japanese-language newsletter titled the "Ocean Newsletter" (previously known as "Ship & Ocean Newsletter") twice a month. "Ocean Newsletter Selected Papers No.24" contains English-language versions of papers from the Japanese Newsletter edition, published from No.431 (2018.7.20) to No.450 (2019.5.5). The Ocean Newsletter seeks to provide people of diverse viewpoints and backgrounds with a forum for discussion and to contribute to the formulation of maritime policies conducive to coexistence between mankind and the ocean.

Our Institute believes that the Newsletter can expand effective communication on these issues by introducing timely research abroad to an informed readership. It also welcomes responses from readers, some of which appear in the Newsletter.

It is our sincere hope that these Selected Papers will provide useful insights on policy debate in Japan and help to foster global policy dialogue on various ocean issues.

Atsushi SUNAMI
President

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●The affiliation of the author and the contents of the article are exactly as they appear in the Ocean Newsletter.

Towards "Zero" Greenhouse Gas Emissions from International Shipping

[KEYWORDS] International Maritime Organization (IMO) / global warming countermeasures / maritime industry

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(Ocean Newsletter No. 431, 20 July 2018)

With growing worldwide momentum towards de-carbonization following adoption of the Paris Agreement in 2015, the reduction in greenhouse gas emissions from international shipping is a pressing issue of the utmost importance to international society. Given this, the following article is to provide the details of the "Strategy on the reduction of Greenhouse Gas (GHG) Emissions from Ships" adopted by the International Maritime Organization (IMO) in April 2018, as well as the status and future perspective of progress at the IMO to develop GHG emissions reduction measures.

Current Status of GHG Emissions from International Shipping

Most of the greenhouse gases (GHG) emitted from international shipping are CO_2, and according to a 2014 survey by the International Maritime Organization (IMO), 2012 emissions were about 800 million tons. This is about 2.2% of the total amount of CO_2 emitted by the entire world. In addition, against the backdrop of the growth of the world economy, as the world's demand for maritime transport is likely to continue to increase, so will CO_2 emissions from international shipping.

Global warming countermeasures for the entire world are discussed in the United Nations Framework Convention on Climate Change (UNFCCC). However, for international shipping and international aviation sectors which operate across the borders, it is not possible to determine which country should be responsible for emissions from each ship or aircraft, and thus the UNFCCC's country-specific frameworks for reduction measures cannot work in these sectors. Therefore, consideration of these sectors has been entrusted to the International Civil Aviation Organization (ICAO) and the IMO, specialized agencies of the United Nations, respectively. As described below, the IMO has been actively promoting GHG reductions in international shipping, such as introducing global fuel efficiency regulations ahead of other sectors. On the other hand, the UNFCCC adopted the Paris Agreement in 2015, which established a global long-term temperature goal, and requires both developed and developing countries to set reduction targets (Nationally Determined Contributions) with the aim to meet the goal in a collective manner. At the ICAO, reduction targets were agreed upon in 2013. Therefore, international community was taking a harder stance towards international shipping, because IMO had not set any worldwide reduction targets. In such situation, adoption of global emissions reduction target in international shipping sector had been an urgent issue of the highest priority.

Greenhouse Gas Emission Reduction Measures at IMO/MEPC

GHG emissions reduction measures for international shipping are deliberated in the IMO's Marine Environment Protection Committee (MEPC). The MEPC deliberates on matters related to prevention and regulation of marine pollution from ships, including not just GHGs, but also sulfur oxide (SOx) and nitrogen oxide (NOx) emissions reductions, ballast water management, and oil pollution countermeasures. There are many matters that have an extremely large impact on the maritime industry, and the committee is receiving a high degree of attention from the entire international community.

The author (center) working on MEPC proceedings.

Japan has been actively engaged in IMO discussions on marine environment protection from the viewpoint of strengthening sustainability of the international maritime society through its technical expertise based on its maritime industries including shipping, shipbuilding and ship machineries

As a specific IMO initiative to reduce GHG emissions from international shipping, fuel efficiency regulations to be applied equally across the world, both for developed and developing countries, began in 2013. These regulations require newbuilt ships to calculate the Energy Efficiency Design Indexes (EEDI) and meet the mandatory standards. The EEDI requirements have been continuously strength-

MEPC deliberations.

ened in phased approach. Compared to the original standard applied in 2013, it was strengthened by 10% in 2015 (phase I), by 20% 2020 (phase II), and by 30-50% in 2022 or 2025 based on ship size and type (phase III). In addition to these regulations, all ocean-going ships, including existing ships, are obliged to develop a Ship Energy Efficiency Management Plan (SEEMP).

Furthermore, in 2019, IMO started a fuel consumption performance reporting system that requires ships engaged in international voyage to report fuel consumption, voyage distance, and voyage time to the IMO every year (this has effects to promote reduction of GHG emissions from ships by acknowledging the annual fuel consumption performance of each ship).

In addition, after approximately one and a half years of negotiations, the "Initial IMO Strategy on GHG Emissions Reduction" was adopted in April 2018, which defines GHG reduction targets and candidate measures to achieve them. This strategy is the world's first commitment to aim for phasing out GHG emissions in this Century in a single industrial sector, worldwide. The three main points of the GHG reduction strategy are: (1) to improve fuel efficiency of international shipping at least by 40% by 2030, reduce GHG emissions at least by 50% by 2050, and ultimately aim for phasing out GHG emissions as early as possible during 21st century; (2) list of candidate short, medium, and long-term measures including measures to improve technical and operational energy efficiency of ships, market-based measures and introduction of zero-carbon or fossil-free fuels into the shipping sectors; and (3) guiding principles such as implementing mandatory measures regardless of flags, consideration on impact of measures on States and the need for evidence-based decision making.

■Initial IMO Strategy on Reduction of GHG Emissions from Ships

Future Outlook

By adopting this GHG reduction strategy, the IMO has demonstrated the international shipping sector's commitment to the international community. On the other hand, unless the reduction targets are achieved, they will only be a "pie in the sky." From this point of view, the IMO has only just arrived at the starting line, and the substantial discussion toward adoption of new GHG reduction measures to achieve the targets has just began at MEPC. This year, MEPC has just approved further strengthened EEDI regulation on new ships. Besides, a number of the IMO member States have already submitted proposals on new measures, including mandatory energy efficiency requirements on existing ships, mandatory operational speed limit and mandatory audit scheme on ship operation. Through the 4th GHG Study to be initiated this year and impact assessment of the proposed measures, IMO will finalize and agree the short-term measure by 2023. In aiming for early action, potential early measures could be developed to achieve further reduction of GHG emissions before 2023.

In closing, I would like to ask for the support and cooperation of all concerned parties both from the industry and the public sectors to the ongoing work at the IMO to establish global frameworks contributing to sustainable future of maritime sector. ■

Protecting Palau's Oceans through Disposal of Explosive Remnants of War (ERW)

[KEYWORDS] unexploded munitions disposal / conservation of ocean areas / international contributions

Yasuo TERADA
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(Ocean Newsletter No. 432, 5 August 2018)

In Palau, the non-governmental organization Japan Mine Action Service (JMAS) has been working to dispose of explosive remnants of war (ERW) since 2012. For example, the outsides of many depth charges (weapons for anti-submarine warfare) remaining on the Japanese cargo vessel known as Helmet Wreck have rotted in the 70 years since the war, releasing the poisonous picric acid. As this acid has negative impacts on the water condition in the gulf, JMAS took efforts to prevent this up until 2015. Currently, the organization deals with monitoring and disposing ERW found on sunken ships and in shallow waters and in securing safety in the oceans.

Japan Mine Action Service (JMAS)

Japan Mine Action Service (JMAS) is a designated non-profit organization (NPO) that has been certified by the Tokyo Metropolitan Government, and is sometimes referred to as an NGO because of its activities. Japan Ground Self Defense Force retirees set up the organization in 2002 and immediately started the Cambodia unexploded bomb disposal program. After that, the organization has worked in Afghanistan, Angola, and Pakistan. At present, the organization is involved in a comprehensive machinery project related to landmine and unexploded bomb disposal in Cambodia's Kampong Thom Province, a regional development promotion project that includes landmine and unexploded shell disposal in Banteay Meanchey Province, a "Safe Village Construction" comprehensive community development project in Battambang Province, a cluster munitions processing mechanization project in Laos's Xiangkhouang Province, a project to deal with unexploded munitions in Palau, and the Oil Leakage Countermeasures Project for World War II Wrecks in Truk Lagoon Marine Area, Federated States of Micronesia" (Chuuk State).

With the exception of the "Safe Village Construction" project in Cambodia, the organization is funded as part of Japan's Official Development Assistance (ODA) and is expected to contribute to the Sustainable Development Goals (SDGs), a global standard set by the United Nations.

Explosive Remnants of War

A basic bomb mechanism operates through the combination of an explosive charge, which is the center of the explosive power, and a fuse that ignites it. Normally, when the bomb is not used, the explosive charge and the fuse are separated to prevent the bomb from exploding unexpectedly, which allows the bomb to be stored safely.

What are commonly referred to as unexploded ordinance are either unexploded or abandoned ordinance. Unexploded Ordinance (UXO) are bombs that did not explode even though a fuse was attached to the explosive charge for use in combat. Abandoned Explosive Ordnance (AXO) are

Investigating depth charges in shallow water.

munitions that have been abandoned or left unattended because of withdrawal or disarmament, etc. In many cases AXOs had not been used and, usually, a fuse was not attached.

UXO and AXO are collectively defined as Explosive Remnants of War (ERW), but both ERW and UXO are used in the same way as terms for unexploded munitions.

Unexploded Munitions in Palau

After World War I, Palau became a Japanese mandate from a German colony, the Nan'yo Cho (Territorial Government of the South Seas) and its Palau Branch were established, and Palau became the core island of the South Pacific Islands. Palau became an important base for the Japanese Navy when World War II began, and was therefore subject to attack by the U.S. military. On March 30 and 31, 1944, aircraft launched from U.S. Navy aircraft carriers attacked ships and ground facilities, dropping mines in Palau's harbor and surrounding waterways. This was the so-called Palau Air Raid. As a result, every ship berthed on that day was sunk while at anchor.

JMAS Palau is currently dealing with unexploded bombs and shells used by the U.S. military, as well as abandoned bombs left in the sea, which were at the time mounted on Japanese ships that sank. In the three years from 2012 to

2015, JMAS dealt with the depth charges loaded on a ship known as the Helmet Wreck, which sank in water that is 30m deep and 1km off the coast of Malakal Port, Palau's only commercial port. Helmet Wreck is a tentative name and was a transport ship used by the Japanese military, but the ship's real name is unknown. A depth charge is a bomb that attacks submarines; it is dropped from a ship into the water and when reaching a set depth, the fuse is activated and it explodes.

The depth charges were disposed of because 70 years after the war, the depth charge containers in the water had corroded and cracked. Picric acid, which is a toxic explosive charge, was leaking from the inside and having an adverse effect on the environment. In 2013 the Palau government asked the Geneva International Centre for Humanitarian Demining (GICHD) in Switzerland to conduct an environmental survey. As a result of the survey, two depth charges, which had fuses attached and were leaking picric acid, were removed from the Helmet Wreck.

Permicron Guard (trade name), which hardens in water to form a harmless plastic, was used to prevent leakage of picric acid. Permicron Guard is used for reinforcement and rust prevention in harbors, river facilities, etc., and the components do not contain toxic substances and do not dissolve in water. Leakage of picric acid is prevented by smearing Permicron Guard on cracks in the depth charge containers.

In 2014, 105 depth charges were treated to prevent picric acid leakage, and the pH value of the seawater in the ship improved from 6.80 to 8.07, which is the average value for the ocean area, and seawater transparency increased. In addition, signs of fish life have increased and the ecosystem is also recovering. Two depth charges with fuses were destroyed on land in 2015. Thereafter, periodic monitoring is conducted to check for environmental abnormalities and new picric acid leaks, and to take measures to prevent leaks.

Raising a depth charge using a balloon.

Using Google Earth to record depth charges.

Slight leakage of picric acid continues, but it has been suppressed to such an extent that there is almost no major impact on the environment.

From 2016, JMAS surveyed 36 shipwrecks and unexploded munitions over approximately 700,000m2 of ocean in depths of less than 10m in Malakal Bay and the Rock Islands Southern Lagoon World Heritage site. Of the 36 recorded shipwrecks, 15 have been confirmed, 5 had unexploded munitions, and many depth charges, etc., were discovered, even in shallow waters.

The Palau government is trying to establish a database of unexploded munitions that records their location, type, number, etc., on a map, using it as an index to ensure safety. Initially it was registered in the Palau government's map system, but now it uses Google Earth, which is simpler and more generalized. The figure on the right shows shallow water depth charges recorded in Google Earth: red marks indicate depth charges scheduled to be disposed of, white circles have already been disposed of, and numbers identify each depth charge. The situation of this unexploded ordinance is clear at a glance, and JMAS intends to dispose of all depth charges in the area during the year.

In Palau, the Lagoon Monument legal provision requires the obtaining of approval from the President when working on underwater ruins. Therefore, depth charge disposal is also carried out with the President's permission. From next year, JMAS intends to dispose of an estimated 165 depth charges that are left in the Helmet Wreck. Unlike the work in shallow water, the water at Helmet Wreck reaches 30m depth, which makes it more difficult, but we want to make every effort to ensure that Palau is as safe as possible. ■

● NPO Japan Mine Action Service (JMAS) https://jmas-ngo.jp/

What Environmental DNA Brings to the Future of the Oceans

[KEYWORDS] eDNA / visual diving survey / marine biological resources

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(Ocean Newsletter No. 435, 20 September 2018)

Environmental DNA analysis refers to the technology that estimates the presence and absence as well as the biomass of organisms from DNA found in the environment. While it has only been 10 years since the birth of this technology, in freshwater areas one example of its utilization has been in the detection of alien species. A methodology utilizing environmental DNA for the assessment of marine biological diversity and biomass estimation has also been gaining recognition. Given the enormous power of environmental DNA analysis, there should be careful discussions on its appropriate use, giving due consideration to the conservation of the organisms that are its focus.

What is Environmental DNA?

Environmental DNA analysis is a technology that detects very small amounts of DNA contained in water, thereby detecting living organisms. Animals discharge feces and urine, and their skin may peel off, while plants can also have parts of their leaves and stems torn off. A filter is used to collect these things floating in the water, then DNA is extracted, amplified to the amount that can be analyzed via PCR[*1] techniques, and detected.

In the study of microorganisms, DNA identification is more reliable than identification of shape with a microscope. Therefore, in the 1990s, the technology to filter water and distinguish types of microorganisms by their DNA already existed. It was in 2008 when it was first shown that even vertebrate species could be distinguished from leftover DNA. Regarding bullfrogs that had invaded France as an alien species, the status of the habitat was determined using DNA left in pond water. In 2011, Dr. Toshifumi Minamoto (currently Associate Professor at Kobe University) of the Research Institute for Humanity and Nature reported that the DNA of each species of freshwater fish being raised in a tank could be detected from the tank's water.

Environmental DNA analysis uses species-specific primers[*2] or universal primers. The former only amplifies DNA specific to the target species so that the species can be detected. On the other hand, in the latter case, DNA from a wide range of organism families are amplified together and automatically compared with DNA sequences in DNA databases where various species are registered, to estimate what organisms are present. Species-specific primers make it easier to quantify specific species, but universal primers are powerful because they can detect, at the same time, the presence or absence of diverse organisms.

Testing Environmental DNA at Sea

In 2012, an environmental DNA project was launched as part of the Japan Science and Technology Agency's Strategic Basic Research Programs (CREST, at the request of Associate Professor Michio Kondo of Ryukoku University (currently Professor at Tohoku University). According to Prof. Kondo, while speaking with the aforementioned Dr. Minamoto, he thought it would be revolutionary if this technique could be used to evaluate the distribution and diversity of marine biological resources.

I have been raising fish in aquariums and conducting research while keeping records of fish seen while diving. In Maizuru Bay, where my workplace is located, I have conducted diving surveys twice a month for more than 16 years. Prof. Kondo invited me to give a lecture at a Ryukoku University seminar, which then created the opportunity for me to test environmental DNA technology at sea.

My first task was to confirm whether the DNA of fish found while diving could be detected from collected seawater. When Dr. Minamoto used a species-specific primer to examine the seawater I collected, not only fish that could be seen while diving, such as wrasses and black sea bream, but DNA from perch, which could be caught in the area but which could not be seen while diving, were also detected. Additionally, in the aquarium experiment, we also confirmed that the amount of DNA released increased as the number of fish increased.

In 2015, MiFish, a set of vertebrate universal primers, was developed by Dr. Masaki Miya of the Natural History

The author and buddy graduate students carrying out diving surveys. The right hand holds an underwater camera, and the left an underwater notebook and a water sampling bag. The collected water sample is carried in the buddy's catch bag. (Photo taken by Mr. Kaito Fukuda (Fukuda Kaiyo Kikaku), at Moune Bay, Kesennuma City, in March 2017)

Museum and Institute, Chiba, and others. When Dr. Miya, who tested this on seawater from Maizuru Bay, showed me the results and said, "These DNA have been detected," I was shocked. Surprisingly, the results of the DNA analysis of seawater collected in the afternoon on a summer day covered most of the fish that had been recorded through diving observations over long years.

With the environmental DNA meta-barcoding technique using MiFish, animal species can be listed in descending order based on the amount of detected DNA. In the survey of Maizuru Bay, anchovy was ranked first, followed by horse mackerel; these are the top two fish species recorded during diving observations. This was followed by spotted sardine, humans, yellowtail, black sea bream, etc. The list also included many fish caught at Maizuru Port. I was astonished again when I saw one species name at the lower level in the list of 119 species -- Neanderthal are listed in the 90th place. I thought that, by chance, it indicated myself. Being curious, I asked Dr. Miya about it, and was relieved when he said, "They were false positives because there is no difference between humans (Homo sapiens) and Neanderthals in the MiFish amplification area."

Environmental DNA is detected at higher concentrations when it is closer to the source, and degrades by 70-90% in one day after being released. Therefore, it is a technology that can detect organisms living nearby relatively recently. Still, it has incredible detection power when compared to diving surveys, which might overlook fish that were there just a moment ago or hidden. I feel that my life of diving and counting fish is like that of a Neanderthal's, who has been displaced by modern humans.

Uses of Environmental DNA

There are limits to environmental DNA analysis. First of all, it does not differentiate between many small fish or one big fish. Moreover, since even a single dead fish releases a large amount of DNA, it is estimated in this analysis as if there were large numbers of that fish. When a fish is eaten by another fish, a large amount of DNA is released, so sardines, which are likely to be eaten, will release a relatively large amount of DNA. When a fish lays or fertilizes eggs, it also releases a large amount of DNA. Of course, this may also make it possible to investigate the location and timing of egg laying.

Environmental DNA has already been put to practical use to clarify the status of invading alien species, and it is also useful for finding and conserving the habitats of rare species. It may also be used to clarify fish migration routes.

A Kobe University student and researcher collecting seawater samples for environmental DNA analysis from the research vessel Ryokuyo Maru, belonging to Kyoto University's Maizuru Fisheries Research Station. Work in the field is completed simply by scooping up water. (Photo taken by author in Maizuru Bay, June 2016)

In addition, since DNA remains in sediment for a relatively long time, it can be used to obtain information on past biological communities.

Although the technology is only 10 years old, environmental DNA has infinite potential. I think that it is one of the missions of researchers involved in its development to set the path for the correct use of these technologies. For example, if this technology is used to identify places with large numbers of fish, then environmental DNA technology should be considered together, as a set, with conservation.

In April 2018, the eDNA Society was established. As stated on the Society's website[*3], the Society aims to "Nurture and develop environmental DNA science as an academic field that contributes to the well-being of all mankind, such as through sustainable use of ecosystems and environmental conservation," and will hold its first annual meeting at the end of September 2018. I hope to discover the proper use of this dream technology, which all those interested in the ocean can also no doubt imagine applications to meet their various needs. ■

*1 Polymerase Chain Reaction (PCR) = Principles or techniques for amplifying specific sequences in DNA
*2 DNA sites and fragments required for DNA synthesis and replication
*3 eDNA Society http://ednasociety.org/

Development of an Underwater Floating-type Ocean Current Power Generation System and the Demonstration Sea-trial

[KEYWORDS] ocean current turbine / Kuroshio current / Kairyu

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(Ocean Newsletter No. 437, 20 October 2018)

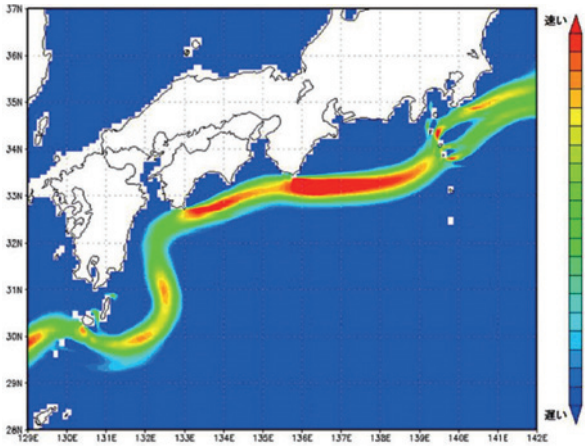
Ocean current power, an example of ocean renewable energy, is a renewable energy technology that aligns well with Japan's aims for effective utilization of the "Kuroshio" current. In August 2017, IHI Corporation and the New Energy and Industrial Technology Department Organization (NEDO) conducted an experimental test off the shore of Kuchinoshima in Kagoshima Prefecture, and gained data that can be utilized for future operationalization. The 100kW device is one of the largest devices for ocean currents in the world. Here, I will give an overview on the world's first floating offshore ocean current power system.

Power Generation Using the Kuroshio Current

Japan's territorial waters and exclusive economic zone (EEZ) are the sixth largest in the world, and the use of marine renewable energy in the EEZ is being actively promoted from the viewpoint of energy security and reducing greenhouse gas emissions. In particular, the Kuroshio current (Fig. 1), which flows in the waters near Japan, is one of the strongest ocean currents in the world, in which it is estimated that an enormous 205 GW of energy exists[*1*2]. Enabling power generation from the Kuroshio current would make it a very useful renewable energy source for Japan.

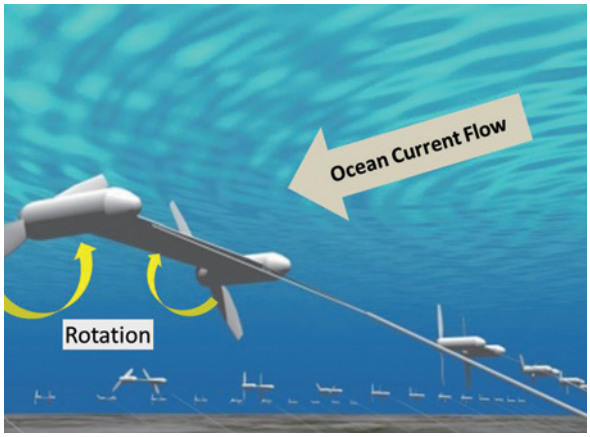
With respect to this ocean current power generation, the author and others started research and development of an underwater floating-type ocean current power generation system (Fig. 2) for a NEDO project in FY2011 as an efficient power generation device that has low power generation costs, and a power generation demonstration test in the Kuroshio area was completed in the summer of 2017. This article introduces an outline of it.

■Fig. 1: Example forecast by numerical analysis of the Kuroshio current's axial distribution



The Kuroshio current passes through the Tokara Strait and enters the Pacific Ocean.

■Fig. 2:Image of a large-scale power generation farm using underwater floating-type ocean current power generation systems



Features of Underwater Floating Ocean current power Generation Systems

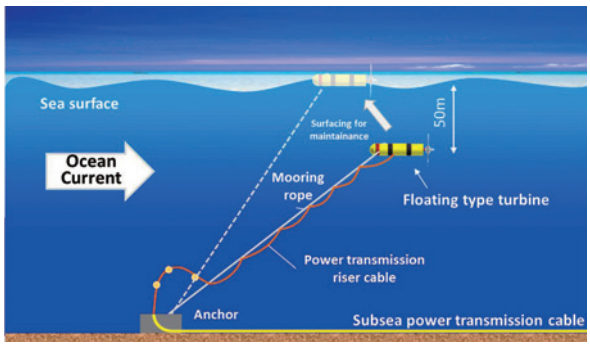
Marine currents must have the following characteristics in order to realize power generation from them: few daily or seasonal fluctuations in the speed and direction of the flow; a large current about 100km wide off the East China Sea and the Pacific Ocean, and; a flow near the sea surface in a sea area with a depth of several hundred meters.[*3] In order to generate power from such an ocean current, the underwater floating ocean current power generation system has the following characteristics:

(1) The goal is to achieve the capacity factor of 60% or higher, which is extremely high for renewable energy, due to being able to continuously use energy from stable ocean currents for a long time. This stable power supply can also be expected to be a base load power source.

(2) The floating body with turbine is moored to the bottom of the sea with a mooring line, and floating in the sea by the marine current as if it were a kite (Fig. 3). It can easily be installed in deep water by extending the mooring line, so it is possible to set a wide range of installable sea areas and to deploy large-scale power generation farms with a large number of power generators.

In addition, because they are all underwater, they can be

■Fig. 3:Conceptual diagram of an underwater floating ocean current power generation system



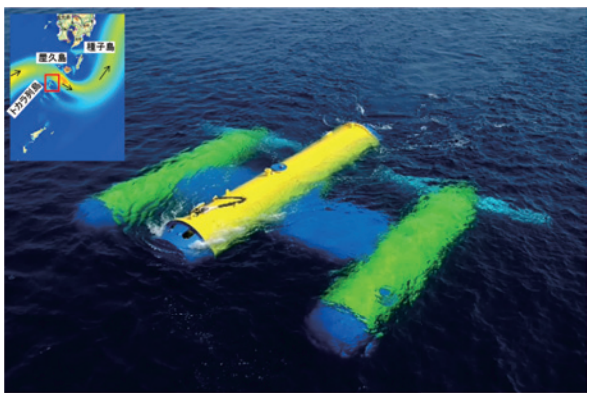
operated at a stable depth without being affected by waves, and they will not interfere with ship navigation. Furthermore, since it is possible to use simple mooring, the ease of installation also contributes to cost reduction.

(3) The rotational torque accompanying turbine rotation can be canceled by connecting two counter-rotating turbines, thus maintaining a stable position in the sea and enabling efficient power generation.

(4) Maintenance and repair are easy because the turbine can be sent to the ocean surface as needed by adjusting the direction and buoyancy of the turbine.

Taking advantage of these characteristics, it is assumed that an actual underwater floating ocean current power generation system would have a power output of 2MW (1,000kW x 2) per unit. A large-scale ocean current power generation farm with a large number of them would aim to achieve a power generation cost of ¥20/kWh or less, which is the target set for NEDO projects, and to realize a power generation system comparable to other power generation methods in terms of power generation costs.

■Fig. 4:External view of the 100kW "Kairyu" demonstration prototype and the demonstration test area



Offshore Operational Tests

Using the results of essential element technology development that began in 2011, a power generation demonstration experiment of an underwater floating ocean current power generation system was conducted in the actual Kuroshio current region from July to August 2017.

For this demonstration test, an actual demonstration prototype with a turbine diameter of approximately 1/3 scale (Fig. 4. Named "Kairyu" after soliciting names from local elementary and junior high school students) was developed and built at IHI Yokohama Engineering Center, using the same mechanism, structure, and materials as the actual machines of the future.

This "Kairyu" floats in the water with an overall length and width of approximately 20m and a weight of approximately 330 tons. It is composed of three watertight and pressure-resistant vessels (pods) that contain various machinery. At the rear ends of the left and right pods, there is a horizontal axis turbine equipped with a controllable blade pitch angle mechanism, with a rotor diameter of 11 meters. Together, the left and right pods can generate a maximum of 100kW in a 3-knot current. The central pod is equipped with a mechanism for adjusting buoyancy, power transmission equipment, and so forth. During power generation in the sea, the depth and position of the machine, power generation performance, and emergency response are controlled autonomously in response to the changing external environment by the built-in control device. In an advance trial run during which the unit was towed, it was confirmed that it can generate a maximum output of 100kW, as planned, and that it could stably float through autonomous control.

The next verification test in the Kuroshio area was conducted in the coastal area north of Kuchinoshima, Toshima Village, Tokara Islands, Kagoshima Prefecture, which has been approved as a marine energy demonstration field by the National Ocean Policy Secretariat, Cabinet Office. A power generation test was carried out by mooring "Kairyu" in the marine area where the Kuroshio current flows, about 5km offshore from Kuchinoshima, with a seafloor depth of approximately 100m. There was a current of 2 knots maximum during this test period, and power generation of approximately 30kW was achieved as a result of this demonstration test. Valuable data about the actual Kuroshio current area's characteristics was also obtained, such as the float stability of floating objects, and installation and operational work in the actual marine area. This is the world's first power generation using a 100kW class ocean current generator that is installed in an actual ocean current area.

Towards Practical Use

Underwater floating ocean current power generation systems are a new power generation technology that can shoulder the role of a base load power source through

1) Marine current energy and high efficiency underwater turbine power generators that bring high capacity factor, and

2) Low-cost float mooring methods, regardless of the sea area.

In the future, we aim to commercialize the ocean current power generation system in the 2020s by carrying out detailed investigations and research on the Kuroshio current as a renewable energy source, and long-term operation trials are planned to be implemented from 2019 to 2020. ■

● This paper is based on the results of a NEDO project, the "Marine Energy Technology Research and Development / Marine Energy Power Generation Technology Demonstration Study."

*1 New Energy and Industrial Technology Development Organization (NEDO): "NEDO Renewable Energy Technology White Paper -- Towards a New Energy Society" (2010)

*2 New Energy and Industrial Technology Development Organization (NEDO): Results report for "Research and Development of Natural Energy Technologies such as Wind Power / Research and Development of Offshore Wind Power Generation Technology, etc. / Operations Related to Understanding Marine Energy's Potential" (2011)

*3 In addition to ocean current power generation, tidal current power generation is a method of power generation that utilizes underwater currents. Tidal currents associated with tidal fluctuations are characterized by large fluctuations in the speed and direction of the flow during the day.

Creation of the 2nd Taketomi Basic Plan on Ocean Policy: A town living in harmony with *Churaumi* (beautiful ocean)

[KEYWORDS] island-type marine municipalities / conservation of remote islands / towns that live with the ocean

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(Ocean Newsletter No. 438, 5 November 2018)

Taketomi Town created Japan's first local government-level Basic Plan on Ocean Policy. While there have been successes in implementing each of the policies, situations surrounding the town have changed. Keeping in mind the role of the town government, we are currently revising the "Taketomi-cho Basic Plan on Ocean Policy" in order to rapidly response to these changes.

Japan's Southernmost Marine Municipality

In May 2018, in order to aim for the "realization of a new maritime nation," which is the purpose of the Basic Act on Ocean Policy, the Cabinet decided on the Third Basic Plan on Ocean Policy, positioning "Challenges to a new maritime nation" as a policy direction. In line with this, Taketomi Town completed revisions to the Taketomi-cho Basic Plan on Ocean Policy, which had been in progress since last year, submitted it to and received approval from the Town Assembly.

This Second Taketomi-cho Basic Plan on Ocean Policy is the ocean policy of Taketomi Town, following the First Plan, and has a very important role in the policies of this Town, which is composed of an archipelago surrounded by the sea.

Taketomi Town is a municipality belonging to the Yaeyama Islands, located at the southernmost end of the Okinawa Prefecture. It consists of 16 islands, including 7 uninhabited islands, with a total land area of approx. 334 km^2 in a vast ocean of approx. 1,700 km^2, which is approx. 40 km north to south and 42 km east to west.

Since it belongs to a subtropical marine climate that is warm and humid throughout the year, a rich ecosystem is formed by the overlap of this warm climate and the geographical conditions of the islands surrounded by the sea. All of the islands, which are rich in nature and have a great deal of precious wild life, represented by the Iriomote wildcat, are designated as Iriomote-Ishigaki National Park. In addition, the sea area is the largest coral reef area in Japan, called Sekisei Lagoon, and the coral reef area of and between the islands is 296 km^2, almost the same as the land area. The islanders living there have nurtured a unique culture on each island by receiving the blessings of nature.

Taketomi Town has these characteristics, but it is also a municipality with regional issues caused by the "ocean." The islanders' primary and only transportation is by boats, which are expensive and have limited routes, and the service rate is greatly affected by the weather. The logistics costs are very high for such maritime traffic, the medical environment is unstable, and there is no high school on the island, so the educational environment is also insufficient. Overall, there is a high cost for social capital development. Administrative costs are high because they are "remote island municipalities" scattered across a vast ocean area, and as islands located in subtropical region they are vulnerable to natural disasters and environmental changes. Additionally, since the island has a natural ecosystem that is vulnerable to human pressures, conservation of the natural environment and the landscape also remains a challenge.

More than 1 million tourists have visited the islands of Taketomi town in recent years, and the islands are, inherently and for multiple aspects of daily life, a difficult place.

Formulation and Revision of the Town's Basic Plan on Ocean Policy

The Taketomi-cho Basic Plan on Ocean Policy was formulated in March 2011 and was the first such plan formulated by a local government in Japan. It is an activity plan voluntarily and independently formulated by Taketomi Town, the southernmost municipality in Japan, based on Japan's Basic Act on Ocean Policy. This Basic Plan was formulated to be used as a tool for the town to solve its problems that were caused by the ocean itself, appropriately using the Basic Act on Ocean Policy, which clearly states the country's basic philosophy regarding the ocean and the responsibilities of the country, local governments, businesses, and citizens.

In this Plan, 23 policies were set forth, and various initiatives were carried out, relating to the natural environment, the living environment, and industrial promotion. As a countermeasure against coastal litter, an oil-making device that produces styrene oil from Styrofoam was introduced, and it was implemented as a project to create employment by using it as island-produced energy. Meanwhile, the coral reef area plays the role of Taketomi Town's fishing resource and tourism resource, and the sea route plays the same role as a road. Because this is a place where we live our daily lives, we are steadily implementing the business items listed in the Plan, such as conducting activities to request to the national government to make the coral reef an area for calculating the portion of tax revenue allocated to the local government.

However, there are still issues that require ongoing efforts, such as the natural environment of the ocean and

islands, a safe and secure living infrastructure for the ocean and islands, industrial promotion utilizing the ocean, passing on the history and culture raised and nurtured here by the ocean, and issues regarding the securing of financial resources and human development resources. Additionally, it is estimated that Taketomi Town's future population will decrease unless more people in their twenties continue to move to the town.

Furthermore, newly emerging issues related to the ocean, which surrounds the town, include ensuring safety and the impact on the precious natural environment due to the rapidly increasing development pressures accompanying the rise in domestic and foreign tourists, etc., and people entering the area; ensuring safety and the impact on the natural environment due to environmental changes from global warming, such as rising seawater temperature; increased friction with neighboring countries in the oceanic area; and the shortage of human and financial resources.

In addition, the islands within the town are border islands that serve as the basis for territorial waters, such as inhabited islands (Kuroshima, Iriomotejima, Haterumajima, Hatomajima) and uninhabited islands (Sotobanarijima, Uchibanarijima, Yonasone, Umanofapi, Nakanouganjima), a total of nine islands. It was recognized again that the entire town, including the uninhabited islands, plays a major role in conserving Japan's territorial waters.

In response to these various situations, the 2nd Taketomi-cho Basic Plan on Ocean Policy was formulated with the main objectives of realizing a better living environment and preserving border remote islands based on Taketomi Town's role, which has border remote islands that are the basis for Japan's territorial waters, etc., and passing on to the next generation the precious nature and culture raised and nurtured here by the ocean.

The 2nd Taketomi Basic Plan on Ocean Policy was formulated together with Japan's 3rd Basic Plan on Ocean Policy, considering and formulating plans for the important issues surrounding Taketomi Town's ocean and islands.

As a major feature, the following points regarding the achievement of each project are more focused than previously: evaluations by the regional assembly and representatives of the town residents as well as evaluations by a third-party committee with outside experts were strengthened, indicators to appropriately manage progress were set, and these were described in the Basic Plan.

Nakanouganjima Island, a remote and uninhabited island.

Bringing the Ocean Together

As part of its public relations, Taketomi Town is planning to hold a symposium in January 2019 that connects the islands together, focusing on the inhabited border islands, through a simultaneous broadcast (web conference). Under the theme of "Ocean," this is an attempt to transform an ocean that has been separating islands to an ocean that will connect the islands together. We would like to build a place that will enable us to have hearings and discussions with the other islands while staying here, and, with the theme of the town's ocean, we would like to discuss with the people on the island the various issues and future of the town while being aware of the sea. Through the activities of various policies based on this Plan, Taketomi Town will create a better future for the town and work on new development as a town living in harmony with *Churaumi* (the beautiful ocean), and we hope to contribute to the promotion of Japan's maritime policy, which aims to build a new maritime nation. ■

● Taketomi Town is the winner of the 11th National Marine Nation Promotion Contributor Merit Award in 2018.

On the Utilization of Water Transportation in Tokyo Bay

[KEYWORDS] 2020 Tokyo Olympics / water taxi / pier usage

Hajime TABATA
President and Representative Director, Tokyo Water Taxi, Inc.
(Ocean Newsletter No. 440, 5 December 2018)

Water taxis are a part of the waterborne transport in and around Tokyo Bay. In an effort to provide customers with new Tokyo discoveries, we have been dealing with the two themes of education and boat design. With the 2020 Tokyo Olympic and Paralympic Games coming up, it is expected that more boats will be needed to respond to the increase in customers. In order to do so, planning for effective use of boarding locations is an important issue to be resolved.

Playing a Role as New Transportation

Tokyo Water Taxi, Inc., is developing its business as a new public transportation service that has not hitherto been available in Japan, through the "Tokyo Port Marine Traffic Revitalization" project. As the first step in this project, since 2016 the company has been promoting Tokyo as a "Waterside City," trying to improve its international image, appealing to the world that it is an international and environmentally friendly port city by revitalizing diverse transport means that do not rely solely on road transport, and demonstrating unsurpassed boating functions, such as emergency transportation for victims in the event of a large-scale disaster and as a means of communication and transportation in the event of a land transportation blockage.

Here, focusing on the Tokyo Port area, a "port" refers to a place in a "bay" where ships can be safely moored and passengers can get on and off smoothly. Tokyo Port is located in Tokyo, which has the largest population in Japan, so naturally diverse businesses have been actively carried out there. Currently, sightseeing is also offered by water bus. In fact, many canals that have been used since the Edo period (1603 - 1868) still exist. However, generally, there have been little opportunities to see their charm and elegance. It is our hope to give many more people the chance to see such waterways and that boats become loved as a means of transportation between Tokyo Port and the waterways.

Of course, one of the first things that we paid attention to as a means of port transportation is the boat's hull. Some of the canals are very narrow and there are places that eventually don't allow any boats to proceed; in that case, boats must be able to make a U-turn. Considering those conditions, the size of the boat's hull had to be approx. 7m long. In addition, there are many bridges over the canals, and the canals are also affected by tides, which therefore required consideration ? the height of the hull could not be too high. Having considered these points, in order for passengers to safely board regardless of the weather, we made the cabin interior as wide as possible, ensured a fully air-conditioned indoor environment, and installed a toilet. Where we struggled was the use of a simple disaster prevention wharf. Simple disaster prevention wharfs have a staircase, but no floating pier. That means that the bottom of the boat is level with the staircase during high tide, so you would have to

Tokyo Water Taxi http://water-taxi.tokyo/top

■Lock gate

The gate closes after you enter from the river. Then, water is drained out and the water level is lowered below that of the river. When the water is at the correct level, the sluice on the opposite side opens, and you can advance into the canal. When going out of the canal, the opposite procedure is performed.

get on and off from below the boat's deck, and the ceiling of the boat's cabin is level with the staircase during low tide, so you would have to get on and off from the roof of the boat. Therefore, we eventually decided on attaching a "dedicated step" to the boat to be used for getting on and off. The initial version was made yellow because that color is easily recognized as a taxi and could be found even at night.

In addition, as a means of port transportation, boat handling education was taken into consideration. There are no traffic lights on the sea or rivers, and, unlike cars, ships do not have brakes. If you think of a boat as a car, then there is only an accelerator and a reverse. When turning, you may also think of it as driving a car on a snowy road. With those conditions, high maneuvering skills are required to get the boat's hull to and from the pier. At the same time, boats move through seas and rivers where there are no traffic lights, so compliance with the rules and a high degree of attention are required. Training and recovery practice are being conducted repeatedly, thanks to which our customers are able to get on and off safely. In this regard, I am thankful for the companies involved.

Tokyo Water Taxi has been operating on a charter-only basis since November 2015, and has operated 3 boats since September 2016.

To Contribute to the Future Development of Tokyo Harbor

The number of overseas visitors is expected to increase as the Tokyo 2020 Olympic and Paralympic games draw closer, a feeling that is now palpable in the city. Facilities facing the sea and rivers will be completed, one after another, such as the opening of the new Toyosu Market, the Tokyo Olympic/Paralympic Village in Harumi, the Ariake Passenger Ship Terminal, and the partial development of Hinode Pier.

Water taxis are common in Sydney, Australia, and Sydney Harbor has many facilities facing the sea. Tokyo Port is not a big port compared to Sydney, but considering its connection to rivers, Tokyo Port is deemed to have the same high potential as Sydney.

■Tokyo Water Taxi boarding/disembarking map

Transportation is essential for the development of facilities. The Yurikamome (Tokyo Waterfront New Transit Waterfront Line), which is now the heart of the coastal area, is also very crowded for major events at Tokyo Big Sight. Even on roads, heavy traffic jams are expected when the Olympics are held. We are still small, but it is our mission to play a role in reducing traffic congestion as a water transportation system. We are convinced that we can contribute to the further development of seaside facilities by expanding their potential.

Where You Want to Go, When You Want to Go

In Tokyo, excluding certain hours and places, you can get a taxi by raising your hand. You can also call one by phone or app. Water taxis don't work that way unfortunately, but if you are in our operational area then it is our greatest hope to take you "Where You Want to Go, When You Want to Go."

Currently, you can only get on or off at designated boarding areas. In addition, there are 7 places where you can get on and off with a same-day reservation. Most other boarding points require a reservation about one week in advance. This is, without a doubt, a major hurdle. In conjunction with the relevant boarding places, we have been making efforts, and hope to eliminate this time lag in order to increase connections to new facilities.

There is a statistic that approx. 4% of Tokyo's transportation is carried out by taxi, and so if this time lag disappears, there is a possibility of covering about 4% of all water traffic in coastal and operational areas.

Our company currently has three water taxis in operation, but we plan to increase the number of boats as the pier environment changes. By solving the pier problem, we expect an increase not only in our company, but also in water taxis. ■

Launch of the Japan Coast Guard Mobile Cooperation Team (MCT)

[KEYWORDS] Indo-Pacific Strategy / Assistance Project for Strengthening Maritime Surveillance Capacity in the Micronesia Region /Coast Guard Global Summit

Akira KURAMOTO
Director for Coast Guard International Cooperation, Administration Department, Japan Coast Guard
(Ocean Newsletter No. 441, 20 December 2018)

For more than 40 years, the Japan Coast Guard has continuously provided support for capacity building to coastal countries in the Asia region, among others, regarding maritime safety and security. Launched in October 2017, the "Japan Coast Guard Mobile Cooperation Team (MCT)" is a department that specializes in support for capacity building efforts. As of December 20, 2018, 54 members including from the MCT have been dispatched on 15 missions to eight countries, carrying out efforts for improvement of maritime safety and security capacities in the Indo-Pacific region to "connect the oceans."

Inauguration of MCT

For more than 40 years, the Japan Coast Guard has continuously provided support for capacity building to coastal countries in the Asia region and elsewhere regarding marine rescue, oil removal, maritime law enforcement, and the ensuring of maritime traffic safety, etc. However, in recent years it has become necessary to respond to increasing requests for technical guidance and other kinds of assistance.

Therefore, the Japan Coast Guard Mobile Cooperation Team (hereinafter referred to as "MCT"[*1] was established in October 2017 as a special team for supporting capacity development with seven members, led by the Director for Coast Guard International Cooperation. Going forward, MCT aims to enhance its activities in order to become a core player in the field of technical guidance of the maritime safety and security field, which is one of the pillars of Japan's efforts towards a "Free and Open Indo-Pacific."

Ensuring safety at sea is of the utmost importance for Japan, which relies on sea transport for most of its imports and exports. In addition, collaboration and cooperation with related countries connected by sea is extremely important in responding to large scale accidents, disasters, and the globalization of crimes as seen in pirate cases along the world's most important maritime traffic routes, namely in the Malacca Singapore Straits, the Sulu and Celebes Seas, and off the coast of Somalia and in the Gulf of Aden. Therefore, the Japan Coast Guard actively engages in various cooperative and collaborative activities to develop international cooperation relationships into more substantial activities, through joint drills and joint patrols with foreign Coast Guard agencies. Capacity building assistance for foreign Coast Guard agencies is part of such initiatives, and technical guidance for marine rescue, oil removal, maritime law enforcement, and the ensuring of maritime traffic safety, etc., has been continuously provided through the framework of the Japan International Cooperation Agency (JICA) and the Nippon Foundation for over 40 years. A great deal of training was carried out by dispatch staff during those years, but it was conducted in the form of temporarily dispatching Coast Guard officers to the site, and was faced by the need for detailed responses to the needs of the target organizations and agencies, as well as restrictions on the numbers of dispatch times and dispatchable officers. In addition, requests for technical guidance have increased in recent years with the establishment of maritime security organizations in Asian countries. In response to these requests, MCT was established in October 2017 as a special team with seven members that provides capacity building assistance for maritime safety and security.

MCT Activities

Under the new system, MCT staff consult with counterparts of the target organization regarding necessary support contents on a daily basis, building a relationship of trust while sharing understanding of the issues of the target organizations and agencies. In addition, by constant monitoring of the progress of technical guidance and the providing of instruction, MCT intends to implement more consistent and continuous capacity building assistance.

Additionally, MCT aims to increase efficiency by systemically verifying the implementation status of activities based on the PDCA cycle and gradually improving the guidance systems and procedures. From the MCT's inauguration until December 20, 2018, a total of 54 MCT and other personnel have been dispatched 15 times to 8 countries[*2].

Dispatch Example

Coordinating functions are strengthened through MCT's establishment, and at the same time are aimed at realizing improved efficiency by providing technical guidance to trainees from multiple countries and by other means. Examples are introduced below.

(Dispatch Example 1) Law Enforcement Training at the Philippine Coast Guard

This was the first MCT dispatch for technical guidance.

Small high-speed boat training with the Philippine Coast Guard (a patrol boat donated from Japan is in the background)

From November 5 to 17, 2017, 17 personnel comprised of MCT and others were dispatched as law enforcement training lecturers for 40 Philippine Coast Guard members, and they conducted law enforcement training using patrol boats and small high-speed boats provided by Japan. In addition to two participants each from the Indonesia Maritime Security Agency, the Malaysian Maritime Enforcement Agency, and the Vietnam Coast Guard, U.S. Coast Guard instructors conducted engine handling training for small high-speed boats. This was the first training conducted with the U.S. and Japanese Coast Guards. In addition, Mr. Kentaro Sonoura, Special Advisor to the Prime Minister, observed a training exercise on November 16.

(Dispatch Example 2) JCG Training Ship Kojima On Board Training

On July 28, 2018, the Japan Coast Guard Academy's training ship Kojima departed Da Nang, Vietnam, and returned to Kure on August 3, 2018, conducting on board training for 6 trainees, 2 each from the Philippine Coast Guard, the Malaysian Maritime Enforcement Agency, and the Vietnam Coast Guard. After arriving in Japan and until August 8th, facility tours and other training was conducted for the Philippines and Malaysia trainees. One MCT staff member accompanied the trainees during the entire period. Southeast Asian maritime security organizations do not have a system that can conduct training using a dedicated training ship, so this training provides a valuable opportunity. This training has been implemented 14 times since 2003, and a total of 66 trainees were accepted, including 41 from the Philippines, 20 from Malaysia, 3 from Singapore, and 2 from Vietnam. It should be noted that this was the first time that trainees from 3 countries were accepted at the same time.

"Connecting the Sea": Coordination and Cooperation in Japan and Overseas in the Field of Support for Improving Maritime Safety and Security Capabilities

Japan's efforts towards a "Free and Open Indo-Pacific" will maintain and strengthen a free and open maritime order based on the rule of law, and one of the pillars of that is assistance in the field of maritime safety and security, promoting coordination and cooperation with countries in the region with the aim of making the Indo-Pacific an "international public good" that brings stability and prosperity to all countries. Based on this, in recent years provision of materials and equipment, such as patrol boats, to foreign maritime security organizations has been actively implemented through Japan's Official Development Assistance (ODA).

Group photo of the trainees (center of the front row) and students from the Japan Coast Guard Academy

In addition, the Nippon Foundation, the Sasakawa Peace Foundation, and the Japan Association of Marine Safety have promoted the "Assistance Project for Strengthening Maritime Surveillance Capacity in the Micronesia Region" in cooperation with the Japanese, U.S., and Australian governments, and have implemented activities such as donating a number of equipment and patrol boats.

Furthermore, in September 2017, in order to build inter-regional cooperation/collaboration between Coast Guard agencies, the world's first "Coast Guard Global Summit"[*3] was co-hosted by the Nippon Foundation, to which were invited secretary-level officers from 38 countries and international organizations from around the world. At the meeting, opinions were exchanged on issues in the field of maritime safety and security that need to be solved on a global scale, and the importance of international cooperation in the field of human resource development was also discussed. Additionally, in November 2018, the "The Coast Guard Global Summit Working Level Meeting" was held,

to which were invited Coast Guard practitioners from 66 countries and international organizations from around the world, to carry out specific considerations for realizing the content and goals discussed during the Coast Guard Global Summit in 2017.

Against this background, MCT will contribute to activities that "connect the sea" from the viewpoint of improving the capability to secure maritime safety and security in the Indo-Pacific region by enhancing its activities, while at the same time coordinating and cooperating with related organizations in Japan and overseas so that MCT will become the core of technical guidance in the field of maritime security.

*1 Common name of "Mobile Cooperation Team: MCT"
*2 Indonesia, Djibouti, Sri Lanka, Seychelles, Pakistan, Philippines, Malaysia, and Vietnam
*3 Reference: Kentaro Furuya, “Hosting of the Coast Guard Global Summit (CGGS)—Towards the Maintenance of International Maritime Order—”, Ocean Newsletter, No. 416

The World Maritime University—Sasakawa Global Ocean Institute: A New Institute in a Unique University

[KEYWORDS] ocean sustainability / ocean governance / human resource development

Ronan LONG
Director, WMU-Sasakawa Global Ocean Institute, World Maritime University
(Ocean Newsletter No. 442, 5 January 2019)

A new chapter in ocean education, research and capacity-building commenced at the World Maritime University with the inauguration of the WMU-Sasakawa Global Ocean Institute on 8 May 2018. With the aim of passing on a sustainable ocean to future generations, creation of the new research institute in WMU is expected to lead to the building of cooperative relationships with a variety of ocean stakeholders as well as research and capacity development programmes to address some of the most intractable problems concerning anthropogenic impacts on the ocean environment and its many resources.

REMARKABLE SUCCESS

The sea covers two-thirds of the planet and modern State practice shows that a high degree of international cooperation is required to ensure peaceful and sustainable uses of ocean space and marine resources. Moreover, contemporary trends in the law of the sea demonstrates that the development of human expertise and scientific knowledge of the marine environment facilitates good decisions in ocean governance. An important milestone was achieved in capacity development with the establishment of the World Maritime University (WMU) in Malmö in 1983. The University has trained a whole generation of maritime and ocean experts over the past three decades and the remarkable success of the University in this regard can be gauged from the presence today of 4,654 alumni in 167 countries. Among its many distinguished alumni is the IMO Secretary General and Chancellor of the WMU, Mr. Kittack Lim, who studied maritime administration at the University in the early 1990s.

NEW CHAPTER

A new chapter in ocean education, research and capacity-building commenced at the University with the inauguration of the WMU-Sasakawa Global Ocean Institute on 8 May 2018. The Institute operates within the framework of the Charter of the World Maritime University and is tangible evidence of the commitment of the University to implement the ocean related goals of the 2030 Agenda for Sustainable Development (the 2030 Agenda), including most notably Goal 4 on Quality Education and Goal 14 on Life Below Water. In particular, the Institute is tasked with research and the delivery of capacity development programmes addressing some of most intractable problems concerning anthropogenic impacts on the ocean environment and the resources that it supports. Furthermore, the founding of the Institute is testament to the unrelenting commitment and vision of Chairman Sasakawa in the development of human resource capacity and the utilisation of education as a means to improve sustainable and peaceful uses of the ocean for the benefit of present and future generations.

From left: Cleopatra Doumbia-Henry, President of WMU; Yohei Sasakawa, Chairman of The Nippon Foundation; Kitack Lim, WMU Chancellor and Secretary-General of the International Maritime Organization; Isabella Lövin, Deputy Prime Minister of Sweden

EXTRAORDINARY PHILANTHROPY

The establishment of the new Institute has to be viewed within the wider context of the extraordinary philanthropy of The Sasakawa Peace Foundation and The Nippon Foundation in building human resource capacity and in supporting advanced academic research on complicated and contentious ocean issues. The scale and success of these endeavours can be measured from the broad spectrum of programmes the Nippon Foundation has supported since the 1980s. Thus, for example, it champions 30 fellowships per annum for students from developing countries pursuing MSc degrees at WMU. Other remarkable achievements include the Nereus Program, which is an inter-institutional partnership between 17 of the world's leading universities including the University of British Columbia, Princeton, Stockholm, Duke, Utrecht and Cambridge universities, all of whom are engaged in collaborative natural and social science research pertaining to the ocean.

The list of international bodies that have benefited from the largesse of the Nippon Foundation in capacity building is equally impressive and includes the International Tribu-

nal for the Law of the Sea, the International Hydrographic Organization, the Division for Ocean Affairs and the Law of the Sea at the UN, as well as the International Maritime Law Institute (IMLI) in Malta, which has hosted over 150 fellowships.

The establishment of the new Institute at the WMU should not therefore be viewed in isolation, as it is intrinsically linked to the major contribution in capacity building made by the Nippon Foundation in assisting international efforts to pass on a sustainable ocean to future generations.

POSITIONING THE NEW INSTITUTE

Beginning with the UN 'family', many international organisations are shaping ocean governance decisions and fostering greater scientific understanding of human impacts on the marine environment. In particular, substantial capacity building and educational efforts in ocean affairs are undertaken by a wide range of UN System bodies through their technical cooperation programmes including those provided by the IMO, IOC-UNESCO, FAO, DOALOS and the ISA, among others.

In light of these initiatives and with a view to exploring how the new Institute can best complement existing public and private capacity building efforts, the University convened the WMU Global Ocean Conference on 8 and 9 May 2018. The conference brought together 240 participants from more than 50 countries, along with senior representatives from UN System bodies and selected states, as well as a diverse range of stakeholders and experts from industry and civil society including the Nippon Foundation and the Governments of Seychelles, South Africa, Indonesia, Sweden, Canada, Germany, Norway and Japan. The aim of the conference was threefold, namely: (1) to identify the many threats to the world's ocean ranging from land-based pollution to coral bleaching, overfishing, marine habitat degradation, ocean acidification and the impacts of climate change; (2) to explore how best to build transformative partnerships between public and private bodies for ocean sustainability in light of the Sustainable Development Goals (SDGs); and (3) to identify research priorities for the future work programme of the new Institute.

Ronan Long, Director, WMU–Sasakawa Global Ocean Institute, at the Global Ocean Conference

For the purpose of promoting wide-ranging and inclusive discussions, the Conference was divided into six panels focusing on the theme of building transformative partnerships to implement the ocean-related goals of the 2030 Agenda from distinctive perspectives and constituencies. On the basis of two days of comprehensive deliberations, broad consensus emerged among the participants that the Institute should contribute to the implementation of international ocean governance instruments.

There is also universal support for the mission of the Institute, which is tasked with becoming an internationally recognised centre of excellence in ocean governance research, to act as a nexus and convergence point between diverse ocean stakeholders, while building global capacity in ocean governance and contributing to the implementation of Goal 14 of the 2030 Agenda. In realising its vision and discharging its mission, the Institute is informed by five guiding principles drawn from the 2030 Agenda pertaining to people, planet, prosperity, peace and partnerships. In keeping with these principles, the Institute will undertake research and related educational and outreach activities closely aligned with the ocean-related goals of the 2030 Agenda.

The 2018 WMU Global Ocean Conference welcomed 240 participants from 50 countries, including from the Nippon Foundation, representatives from the governments of the Seychelles, South Africa, Indonesia, Sweden, Canada, Germany, Norway, Japan, etc., as well as a wide variety of stakeholders and experts from industry and civil society organizations.

VOYAGE AHEAD

The changing geopolitical realities of the ocean are complex and demand constant scientific review and analysis from different perspectives. For this reason, the projects and extra-mural activities planned by the Institute are very much focused in taking a long-term perspective and looking ahead to intergenerational impacts of current activities,

as well as shorter term impacts over the next 20 to 30 years. The Agenda is directly linked to the Charter of the WMU, the extensive deliberations undertaken with key stakeholders across a broad spectrum of interests represented at the 2018 WMU Global Ocean Conference, as well as discussions with the principal sponsors from Japan, Sweden, Germany and Canada. The work of the Institute is needs driven and centres in many instances around the core mission of the WMU in assisting international organizations and States, particularly developing countries, as well as other ocean stakeholders in advancing sustainable development under the 2030 Agenda.

A key aspect is to work with non-traditional partners from other sectors with a view to developing innovative and radical solutions to some of the most pressing challenges in ocean governance. The work programme includes a spectrum of tailored project initiatives on the following: marine debris; navigational rights and freedoms with an initial focus on the sustainable use of straits used for international navigation; capacity building relating to areas beyond national jurisdiction in conjunction with the International Seabed Authority and the International Maritime Organization, especially in relation to governance issues and the institutional architecture for the implementation of a legally binding instrument under UNCLOS; issues concerning greater convergence between the ocean and climate action legal regimes in line with Goals 13 and 14 of the 2030 Agenda, particularly in the context of sea level rise and the related challenges for the maritime boundaries of Large Oceanic States in the Pacific Ocean; spatial governance of ocean space and ocean leadership in relation to the land-to-sea interface; enduring and emerging challenges in ocean governance pertaining to gender empowerment, as well as concerning the application of new technologies and platforms for data acquisition and sharing.

The underlying premise of the work programme is that education, research and human resource development are vital catalysts for engendering a sustainable ocean for the benefit of humankind. This is acknowledged by the UN First Global Integrated Marine Assessment, which points out that achieving sustainability requires a strong understanding of the functioning and importance of the ocean by experts and the public alike. In many ways, the WMU is the embodiment of the axiom that education and capacity development are the twin-motors of sustainable development. Accordingly, as an integral part of WMU, the success of the Institute on the voyage ahead will be determined by how well it mentors a new generation of ocean governance leaders and builds transformative partnerships that make a difference on ocean sustainability worldwide. ■

Efforts towards the Creation of an Oyster Farming Pipe Utilizing Biodegradable Plastics

[KEYWORDS] Hiroshima Bay / aquaculture materials / outflow prevention

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(Ocean Newsletter No. 447, 20 March 2019)

Oyster farming utilizes several plastic materials including oyster pipes (20cm-long polyethylene tubes to provide spaces for farmed oysters) and Styrofoam floats of oyster rafts. The number of oyster pipes used in Hiroshima Bay are estimated to be more than 200million, and some of them are lost due to ship collisions. Introduction of biodegradable materials used for oyster pipes could reduce the environmental problems associated with the lost and drifted pipes. To identify the strength of biodegradable oyster pipes, strength tests have been conducted since 2018, in addition to exiting studies to reduce pollutions caused by broken styrofoam floats.

Can Oyster Farming Pipes be Prevented from Outflowing?

The problem of oyster farming materials and drifting waste in Hiroshima Bay has been around for more than 20 years, and the Styrofoam floats (hereinafter referred to as "floats") and oyster pipes (hereinafter referred to as "pipes") have been alternately attracting attention over the past several years. In 2017, the Umi & Nagisa Foundation conducted a demonstration test in which float pellets were turned into fuel at four locations nationwide, and achieved a certain level of success, at the end of 15 years development. Next, an experiment using oyster pipes made of biodegradable plastic was conducted in Hiroshima. This has been a long-standing challenge, even before marine plastics became a social problem.

Plastic pipes for oyster farming are used when hanging scallop shells to which the seedlings will be attached, to secure a certain amount of space between them. The existing polyethylene (hereinafter referred to as PE) pipes are 20cm long, have a 1.5cm outside diameter, approx. a 1.0cm inside diameter, and cost only a few yen per pipe, but they are important materials and are kept for reuse, and not allowed to outflow. Pipe outflows have become both an economic and an environmental problem for oyster farmers. Currently, more than 200 million pipes are used in Hiroshima Bay, with 17,000 pipes per floating raft for oyster farming. Even if a tenth of a few percent of using pipes are outflowing, it means that 100,000 pipes will be released. This is a considerable amount if you have accumulated the outflow pipe, but the cause of outflows is not just the aquaculture work, and it seems impossible to completely prevent outflows by the efforts of fishermen alone. For example, over the past three years, there have been, average per year, 40 oyster farming floating rafts collide with the ship and are broken. If all the pipes became disengaged during these accidents, then the outflow from these accidents would be 680,000 pipes/year. Fishermen must work on outflow prevention and improvements, but because of this background, we decided to conduct a field experiment with biodegradable plastic pipes that would decompose faster than PE pipes.


Fragmented oyster pipes and white Styrofoam floats drifted down

Initiatives in Hiroshima Prefecture

More than 15 years ago, the Western District Hiroshima Prefectural Fisheries Promotion Council established a program for purchasing pipes that have been released and drifted out of the prefecture, but purchases are subject to conditions, such as the shape of the pipes, and local municipalities where the beach with drifted pipes is located may dispose of them. In addition, officers in charge at Hiroshima Fisheries Cooperative and the the Fisheries Division of Hiroshima Prefectural Government were aware of the problems and visited the float processing demonstration test conducted by the Foundation in FY2017, but it did not lead to a proper disposing project.

However, on May 14, 2018, a representative of Yamaguchi Prefecture visited the Hiroshima Prefectural Office and requested, in writing, "Thorough outflow prevention and recovery of plastic pipes used in oyster farming". In response, Hiroshima Prefecture sent an administrative guidance about outflow prevention to the head of the fishery cooperative that handles oyster farming in the prefecture. At the Governor's regular press conference, reporters asked questions about marine litter countermeasures, in particular about outflows of oyster farming materials and the request

lodged by Yamaguchi Prefecture.

When oyster farmers from Hiroshima Prefecture collected drifting pipes and other litter in Suo-Oshima Town and other places in Yamaguchi Prefecture on September 7, apparently some of them were surprised by the large number of pipes. It shows that there is not precise information of the issue amongst oyster farmers. On the other hand, there is also an initiative for float processing in which the Hiroshima Fisheries Cooperative acts as a contact point, and we expect that this will lead to an improvement in fishermen's awareness and efforts to solve the pipe outflow problem.

Challenges for Trial Production, Experimentation, and Introduction of Biodegradable Plastic Pipes

Two types of experiments were planned, using a total of three types of prototype pipes (20cm long PBS and 2 types of PLA)*1, and using the existing PE pipes for comparison. In Experiment (1), hanging the pipes down on an aquaculture cage, the percentage of good reusable pipes was measured by selecting not-reusable pipes that had cracks or were bent, assuming actual work such as moving rafts. As for biodegradable plastic pipes, unused prototype pipes and pipes that had deteriorated after being boiled in seawater for several hours were used and installed in the same rack for comparison. They were installed at the fisheries cooperative on October 25, 2018, and would be collected in January and May, 2019. For experiment (2), pipes will be installed at depths of 0m (surface level), 1m, and 5m, and then their weight and surface deterioration will be observed. The Hiroshima Prefectural Fisheries Division and Ocean Technologies Center of Hiroshima prefectural Technology Research Institute will begin a seawater immersion test on November 2, and will measure weight changes after 1, 3, and 6 months to investigate durability and degradability.

When compared to the ready-made PE, the PLA prototype seems to be very hard and strong, but it is vulnerable to cracking. The PBS prototype is flexible and seems to be the closest to the ready-made PE. In January 2019, we observed the status after three months of immersion. Just like in actual harvesting, scallop shells were dropped on the ship and the pipes were collected separately. According to the fishermen who cooperated in the experiment, they felt that more pipes had cracked than the PE pipes that they use on a daily basis, and they were worried that the pipes would break when put into a cleaning machine for reuse. There are still lots of tasks in this work.

It may be better to consider introduction to "blister pipe (mame-kuda)" first. For collecting oyster seedlings, a short pipe, cut to about 1 cm in length and known as a " blister pipe (mame-kuda)" is used. Blister pipes were the most commonly collected piece of the marine litter. Blister pipes are less likely to break due to resistance to running water, and are therefore easier to introduce into actual faming than longer pipes.

Hanging ropes with biodegradable plastic pipes

"Blister pipes" are used in between scallops

Also, as a matter of concern for their introduction, there is a specific gravity issue that is difficult to notice when used on land. Most biodegradable plastics sink, so more floats will be attached to the rafts if biodegradable plastic is used and the burden on fishermen will increase. In the case of outflows, PE pipes can be collected by rafts and work boats, but biodegradable plastic will become seabed waste and will be difficult to collect. It is said that used PVC pipes and PE pipes are still on the seabed. There is no material that is good to leave in nature, not just biodegradable plastic.

Sustainable Aquaculture

The non-use of plastic, such as straws and plastic bags that are provided directly to customers, will lead to improving corporate images, while measures for floats and pipes,

which are items not to be provided to customers, tend to be delayed, as they are unlikely to lead to increased product prices. For this reason, the Public Awareness of Hiroshima Prefecture residents are important, but at the same time, it is necessary that distributors show concern when fishermen take countermeasures against outflows and to see whether fishermen are properly managing their fishing gear. In addition, certification for eco-labels, etc., shall also require added items to be checked off regarding proper treatment and disposal of fishing gear.

Some ear-pleasing information has been reported on the problem of marine plastics, but there is no quick remedy for the marine litter problem. The best way is to keep up steady, uninterrupted efforts. This probably wouldn't have been so exciting if the Ocean Plastics Charter had been signed.

It is important not to focus on the G20 declaration to be held in Osaka in June 2019, but to focus on the subsequent government and industry efforts. ■

*1 PBS (polybutylene succinate) and PLA (polylactic acid) are both a type of biodegradable plastic.

The Kuroshio Large Meander and its Impacts

[KEYWORDS] Kuroshio Large Meander / ocean prediction / marine science

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(Ocean Newsletter No. 448, 5 April 2019)

The phenomenon known as the Kuroshio Large Meander began in August 2017, and is ongoing as of February 2019, more than a year since it began. The current of this Kuroshio, which comes 12 years after the previous one that occurred between 2004 and 2005, should provide an opportunity to review the impacts that the ocean has on Japan's coastal environments. We hope to make use of predictions concerning this Kuroshio phenomenon and provide information to the public.

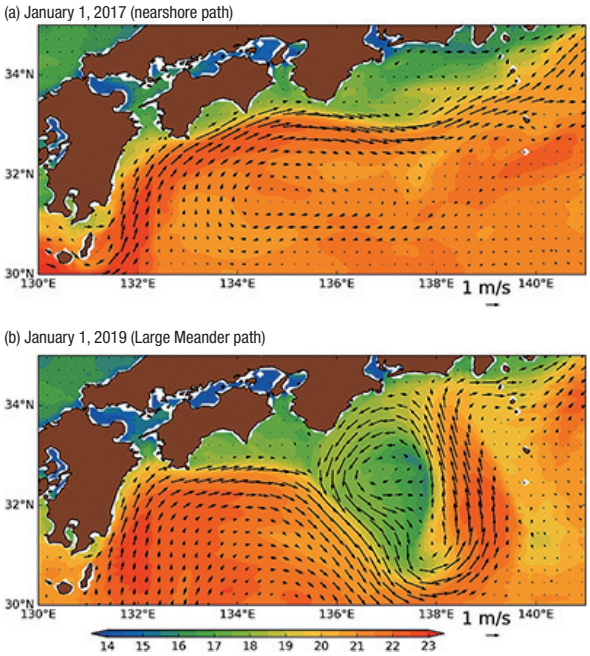
The Kuroshio Large Meander and its Impacts

The phenomenon known as the Kuroshio Large Meander began at the end of August 2017. It is the first time in 12 years since 2004/2005 that the Kuroshio Large Meander has occurred. The Kuroshio Large Meander is a phenomenon in which the Kuroshio Current takes a meandering path to the south, from the Kii Peninsula to off Tokai, and continues to do so for a long time. Once started, it lasts for over a year.

Figure 1 is a comparison of sea surface temperature and current velocity between 2017, before the Kuroshio Large Meander, and January 1, 2019, during the meander. During the Kuroshio Large Meander, the Kuroshio Current, which is a warm current, changes its position offshore, and water temperature decreases off the Kii Peninsula. On the other hand, the Kuroshio Current shoots directly from the Kanto area of Japan to the off Tokai area, and the temperature rises.

When the Kuroshio Current meanders, the temperature distribution and flow change significantly, as shown in Figure 1, and changes in marine ecosystems and the climate also occur. Although the Kuroshio has a great influence on the natural environment around Japan, this influence is only truly felt when the Kuroshio changes drastically.

■**Figure 1: Sea surface temperature (color: C°) and current flow velocity (vector: m/s), estimated by the JCOPE2M ocean prediction model**



On the Tokai coast, which is directly hit by the Kuroshio, the Kuroshio pushed the tide level up 20-30cm higher than usual, which contributed to the storm surge and high waves in the Tokai region during Typhoon No.21 (Lan) in 2017. In addition, a study shows that it is more likely than usual to snow in Tokyo due to low pressure along the southern coast during the Kuroshio Large Meander, and backing this claim, there was more than 20cm of snow in Tokyo from before dawn on January 22 to 23, 2018, leading to traffic disruptions.

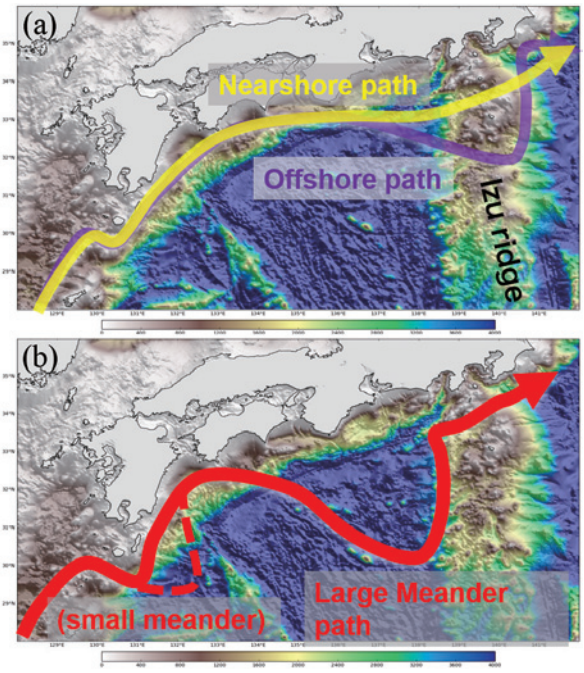
Living things are also impacted. On the Kii Peninsula, the Kuroshio moved away, and this movement is thought to have contributed to the massive coral death in the winter of 2018. Fishing was also affected, such as the fishing ground for skipjack tuna, which ride the Kuroshio, moving further away. On the other hand, from the Kanto area to the Tokai coast, where the Kuroshio drew closer, the impact of the Kuroshio was also pointed out, including the sightings of whales in Tokyo Bay and a poor catch of whitebait.

Diverse Current Paths Created by Coastal and Seashore Topography

Japan's unique coastal and seashore topography creates a variety of current paths for the Kuroshio, unlike any other ocean current in the world. Figure 2 shows the seabed topography of the southern coast of Japan. At the end of the Kuroshio Current, a submarine mountain range called the Izu Ridge extends from north to south. The Kuroshio, a current that flows at a depth of more than 1,000 meters, tries to pass through a deep-sea ridge one way or another. Depending on the path that the current passes through, different current paths arise, such as the nearshore path and the offshore path (Fig. 2a). Even without the Large Meander, the Kuroshio constantly goes through significant changes.

Furthermore, there is the route of the Kuroshio Large Meander (Fig. 2b). The trigger arises southeast off Kyushu. The southeast off Kyushu area is a place where the Kuro-

■Figure 2: Seafloor topography (Color: meters (blue is deep)) and the Kuroshio Current's paths: (a) nearshore path and offshore path, and (b) Large Meander current path.



shio jumps out of the shallow East China Sea into the deep Pacific Ocean, turning north at a steep angle with the coastline. Because of this coastal/undersea terrain, the Kuroshio Current path tends to swell and bulge like a dotted line (small meander). If this small meander encounters favorable conditions, then it grows while being swept east by the Kuroshio Current, becoming the Large Meander. As the meander grows larger, it is affected by the rotation and roundness of the earth, and its tendency to head west (called the β effect) becomes stronger. The balance between the power to move west and the Kuroshio's power to flow east makes the Large Meander last for more than a year. Furthermore, the Izu Ridge in the east also prevents the meander from flowing east and contributes to prolonging the Large Meander.

Predicting the Kuroshio Large Meander and Disseminating Information

The Japan Coastal Ocean Predictability Experiment (JCOPE) Group from the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) has been predicting the Kuroshio's current path since 2001. If the growth from the small meander to the large meander, as described above, is followed, then it will be possible to predict occurrences of the Kuroshio Large Meander. In fact, following the 2004/2005 Large Meander, the current Kuroshio Large Meander, which began in 2017, was also successfully predicted. Furthermore, the JCOPE Group has opened the "Kuroshio-Oyashio Watch" website (http://www.jamstec.go.jp/aplinfo/kowatch/), which provides predictions and explanations of the latest prediction research. The Kuroshio Large Meander has also been explained in numerous articles, not limited to JAMSTEC research, and has been featured in the media, contributing to the spread of knowledge about the Kuroshio Large Meander. For example, the relationship between the Kuroshio and snow is from a new study by Prof. Hirohiko Nakamura of Kagoshima University after 2004/2005. As a result, research on the relationship between the Kuroshio Current and the climate has become widely known, which has led to an expanded interest in the Kuroshio Large Meander itself, not just limited to its effect on the ocean.

The Kuroshio's Future

For ocean researchers, the Kuroshio Large Meander is one of the Kuroshio Current's patterns that occurs when certain conditions are met, and is not considered an unusual phenomenon. Looking at the past durations of the Kuroshio Large Meander (Table 1), the Kuroshio Large Meander's duration was quite long in the 1980s, etc., and sometimes lasted more than four years, as in the 1970s. However, if you take the past twenty years since the 1990s, it was only seen in 2004/2005, so there may have been many people who were surprised to learn the Kuroshio could change so much. In Ocean Newsletter No.323. (2014), Dr. Yasumasa Miyazawa introduces the view that the power of the Kuroshio current washing out to the east will see a relative increase with further advance in global warming, and that stable Kuroshio Meanders, which last for a long time, will be less likely to occur. However, as of February 2019, the present Kuroshio Large Meander has continued for about 1 year and 6 months, has already lasted longer than the duration of the previous two Kuroshio Large Meanders, and is likely to continue for a long time. This reaffirmed that the Kuroshio Current's path could continue to change

■Table 1: Starting months, ending months, and durations of the Kuroshio Large Meanders since 1965.

	Start	End	Duration
1	Aug. 1975	Mar. 1980	4 years 8 months
2	Nov. 1981	May 1984	2 years 7 months
3	Dec. 1986	Jul. 1988	1 year 8 months
4	Dec. 1989	Dec. 1990	1 year 1 month
5	Jul. 2004	Aug. 2005	1 year 2 months
6	Aug. 2017	(Continues)	?

significantly and continue for an extended period of time. As such, it is necessary to keep in mind the aforementioned effects, in addition to fishery policies and storm surge measures, when selecting sites for maritime transport and maritime current power generation sites, which is currently progressing.

However, it should be noted that nature is complex and that impacts of the Kuroshio Large Meander on fishing and the weather are difficult to prove, and that this is just one of many factors, which are intertwined. For example, there is a view that the poor catch of eels in 2018 may be related to the Kuroshio Large Meander, but, according to Dr. Yu-Lin Chang, researcher at JAMSTEC, the relationship is a negative one. There still remain the mysteries of the Kuroshio Large Meander's influence and why the Kuroshio Large Meander has lasted so long this time, but taking this Large Meander as an opportunity we will advance our research on what the Kuroshio brings to Japan's natural and social environments. The JCOPE Group also intends to use the Kuroshio forecast to provide useful information to society.

Japan Fisheries Research and Education Agency's Contribution to SDGs: Promotion of the SH"U"N Project

[KEYWORDS] SDGs / SH"U"N Project / seafood sustainability

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(Ocean Newsletter No. 450, 5 May 2019)

Leading up to the hosting of the Tokyo Olympics / Paralympics, many SDG themed events are being held around the country, gradually raising consciousness in society about sustainable development. Among the various initiatives concerning ocean resources such as seafood, I would like to introduce how the Japan Fisheries Research and Education Agency is promoting one of its outreach activities, the SH "U" N Project.

Increased Awareness of Sustainability for the Olympics

About two years ago, when I asked some people on the street, "Do you know what SDGs are?", I got reactions such as, "Is that some sort of vaccination?" But now, there is a feeling that this word has quickly spread ahead of the Tokyo Olympics. People from major companies are also saying, "We have to be engaged in SDGs from now on," but when they are asked what actions should be taken related to fisheries, they answer, "It's going to be serving dishes using an eco-labelled fish in the company cafeteria, isn't it?"

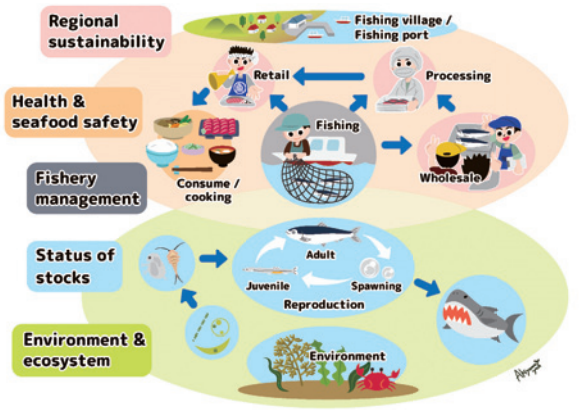
Sustainable Development Goals (SDGs) are the sustainable development goals included in the "2030 Agenda for Sustainable Development" adopted at the United Nations Sustainable Development Summit in September 2015. This is a global master plan consisting of 17 development goals aimed at realizing a sustainable society by 2030. Goal 14, "Conserve and sustainably use the oceans, seas and marine resources for sustainable development," includes marine resources such as seafood.

After the London 2012 Olympics, "Ensuring Environmental Sustainability" was praised as a theme that should be carried forward, and consideration of the sustainability of seafood to be served during the event also became a requirement. This has been passed on to the Tokyo Games, and the promotion of SDGs in Japan has been accelerated by the government's decision in 2017 on the "SDGs Action Plan 2018."

Promotion of SDGs in the Fisheries Industry

The fisheries industry uses naturally reproducing seafood resources that can be used in a sustainable way if properly managed. However, it is not easy for the general public to know if it is being properly managed, so a fisheries eco-label has been devised. In this eco-label initiative, the certification review organization examines the status of individual fishery products based on their resource status, fishing status, environmental impact, etc., on behalf of consumers, and then labels and sells the products that have been approved. Through these activities the review organization will correct fisheries that adversely affect resources and the environment. The MSC (Marine Stewardship Council) and ASC (Aquaculture Stewardship Council) are well known worldwide. You may have recently seen the MSC mark at major mass retailers, but only a few types of seafood have been certified in Japan. MEL (Marine Ecolabel Japan) is a Japanese fishery ecolabel, and even though they certify more than 50 fisheries, they still do not have full penetration at stores. As a result, there are only a very few SDG-compatible dishes, such as catfish imported from Vietnam and scallops from Hokkaido, served in the company cafeteria mentioned earlier.

■Figure 1: "Fisheries System" Concept for the SH"U"N Project (Japan Marine Fishery Research Center, 2009, modified)



[Fish in the Ocean], [Marine Ecosystem], [Fishing Activities in the Sea], [Local Industry and Society Around the Fishery], and [Health, Safety, and Security] of food -- fisheries products cannot be used sustainably unless efforts are made in all these areas.

Japan's fisheries industry has a history of well over 2,000 years. Many species have been fished sustainably, and so more than 1,000 fish species and brands are traded in the fisheries market. In order to seriously promote SDGs, each citizen needs to be aware of sustainable resource use, in addition to the ecolabels, and to have the correct knowledge about how to enjoy seafood in season. Furthermore, it is important to ensure that communities producing marine resources can continue to produce sound and sustainable products (Goal 8: Economic growth and employment).

The National Research and Development Agency, Japan Fisheries Research and Education Agency (FRA) was established with the aim of supporting domestic fishermen from the standpoint of research institutions and support-

ing domestic consumers in their own efforts to maintain resource sustainability. As part of its outreach programs for providing scientific information in an easy-to-understand manner, FRA launched the SH"U"N (Sustainable, Healthy and "Umai" Nippon seafood) project in 2016. Its main component derives from the results of resource surveys of many fish species that the FRA has conducted over many years in cooperation with prefectural fisheries research institutions.

The SH"U"N Project

The SH"U"N Project compiles and publishes information on fishery resources, fishery status, fishery management, etc., by production area and for each species. We hope that consumers will use this as a source of information when choosing fish that are good both for their body and for nature, and that they will help producers acquire ecolabels.

This project is based on the "Grand Design of Fisheries and Resources Management in Japan," compiled in 2009 by the Fisheries Research Agency (predecessor to the current FRA). In the project, the entire fish cycle in nature and society is called the "Fisheries System," and this involves fish being born and growing, being caught by local fishermen in accordance with specific regulations, having their value enhanced on land through processing and distribution, and finally being eaten at the table of each family as delicious food. We believe that making the entire "Fisheries System" strong, robust, and smooth leads to sustainable use that at the same time protects marine resources. (Fig. 1)

Based on this understanding, as a perspective for evaluation, it has been decided that the viewpoint of sustainability should take into account not only the sustainability of marine resources and marine ecosystems, but also the sustainability of the local culture and economy. To ensure that consumers can purchase Japan's sustainable marine products with peace of mind, FRA evaluates from four perspectives, including the status of marine ecosystems, fisheries management, local culture, and local socio-economic conditions, in addition to the level of marine resources, and then distributes that information to consumers along with product information such as nutrition and food safety.

FRA is Japan's only comprehensive research institute for fisheries, but the fishermen themselves and the local fisheries administration organizations are often more familiar with their areas. Therefore, after experts at FRA have prepared a draft evaluation report, they listen to opinions from people involved in the fisheries under evaluation to deal in advance with information leaks and misunderstandings. At the same time, it has been decided to invite public comment on the draft evaluation report and publish responses to those comments. In addition, an external review committee is also held to see if there are any problems with the chain of responses.

■Figure 2: SH"U"N Project Homepage QR Code

http://sh-u-n.fra.go.jp/?lang=en

The evaluation results are published on the website in a form that corresponds to the item name and place of origin displayed at the store(Fig. 2). By citing references and evidenced data, we hope that these results will be used as a scientific information source in the certification and examination of fishery ecolabels. So far, evaluation results for 10 fish species have been published, while a further 6 species, including Japanese sardines from the Tsushima Current, will be published soon, and work is underway on 7 species, including Pacific cod in the Tohoku region. Our plan is to have published evaluations for around 50 species by the end of this year, when procurement for the Tokyo Olympics begins. In addition, a smartphone app has been released so that consumers can think about the sustainable use of fishery products in a more informal way.

Society has undergone major changes in the past two years since this project started. In seafood procurement for the Tokyo Olympics, attention is being paid to the resource management plans nationwide. The Fishery Act was revised at the end of last year, and now resource management incorporates the concept of establishing and maintaining scientific achievement targets. Under these circumstances, we believe that the importance of appropriate outreach activities for consumers will become increasingly important going forward. ■