

Ship & Ocean Newsletter

Selected Papers

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Ocean Policy Research Foundation

Director's Message

As mankind moves into the 21st century, integrated policies of ocean governance are 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 Foundation (formerly: Ship & Ocean Foundation) orients its research on ocean issues in line with the mission statement "Living in Harmony with the Oceans".

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

We publish a Japanese-language newsletter called the "Ship & Ocean Newsletter" twice a month. The "Ship & 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 Foundation believes that the Newsletter can expand effective communication on these issues by introducing timely research to abroad and informed readership. It also welcomes to responses from readers, some of which appear in the Newsletter.

"Ship & Ocean Newsletter Selected Papers No.15" contains English-language versions of papers from the Japanese Newsletter edition, published from No.251(2011.1.20) to No.270(2011.11.5).

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.

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Executive Director

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Creating Harmonious Oceans by Understanding Them Better

[KEYWORDS] East China Sea continental shelf / ecological productivity / economic zones

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(Ship & Ocean Newsletter No.253 February 20, 2011)

The East China Sea continental shelf has a complex structure that combines a variety of elements. Although the bio-resources it contains are a matter of great interest to surrounding countries, it is not possible to understand oceans within artificially drawn boundaries. By understanding oceans as a single system, we will see how we should relate to them. My vision is that a scientific understanding of the oceans will change the international community.

Drawing lines on the sea

As everyone knows, Japan's land is surrounded by sea. It is also common knowledge that we have territorial disputes with neighboring countries over those surrounding seas. What nobody knows, however, is what those seas actually are and what happens in them. There is even a limit to what experts can say with confidence.

In spite of that, we are continuing to reduce budgets spent on knowing the seas. Take the East China Sea. China clearly has ambitions for a variety of activities in the East China Sea; even South Korea is increasing its ocean observation bases there. Japan alone has reduced the number of observation vessels and even removed existing stationary buoys.

We may talk of the sea as a single entity, but it has various different facets. Here, I will not concern myself with what goes on beneath the seabed, but would like to consider the sea as a whole body of water. While the resources lying beneath the seabed are clearly important elements of maritime interests, fishery resources, a bone of contention since time immemorial, are also a matter of great international concern. This stems from the method of drawing a line on a map and saying "This side is ours."

As everyone knows, however, the water in the oceans is constantly moving. It is also well known that marine organisms move their habitats on principles independent of water currents. What is not sufficiently known, however, is how fishery resources are governed by bio-production systems in the sea and the marine environment that is so deeply linked to them. We don't even have a rough sketch of how climate change and human activity are involved in this. Merely drawing lines of bottom topography and saying "This is a map of the sea" is like drawing contour lines of altitude on land and saying "This is a map of the land."

Bio-resources and environmental research in the East China Sea

We have started to harbor concerns about the environment of the East China Sea and the structure of its bioproduction. This originates in the fact that fishery production there has been a matter of concern for surrounding coun-

tries. Recently, however, we should also be paying attention to the fact that the health of this sea area appears to play an important role in the coastal environment of surrounding sea areas.

Conceivable sources of nutrients that support biore-sources in the East China Sea would include inflow from the Changjiang and other rivers, the contribution of sub-surface waters in the Kuroshio Current, and load from the atmosphere or seabed; but none of these has been clearly identified. We set up a research group with colleagues from South Korea, China and Taiwan, with the aim of studying how nutrients from each respective source contribute to ecological productivity on the East China Sea continental shelf. Starting in 2007, this was a three-year joint research project funded by Special Coordination Funds for Promoting Science and Technology ("Environmental research on the East China Sea aimed at building harmonious seas")¹⁾. There, we set out the scientific objectives mentioned above. But over and above this, through the joint research, we aimed to share an understanding of the marine environment in this sea area, at least among researchers, and to demonstrate an awareness from the perspective of oceanography as to how humans should be involved in this sea.

Where land and sea meet: Changjiang Diluted Water

With South Korean researchers, we repeatedly conducted joint observations on the behavior of Changjiang Diluted Water in the South Korean economic zone on the East China Sea continental shelf. One of the results was that the ratio of dilution is small when sea conditions are calm, and that dilution mainly occurs through mixture with a lower layer resulting from the passage of low pressure. The fact that dilution mainly results from mixture with a lower layer shows, at the same time, that nutrients (including many originating in open seas) are supplied from a lower layer.

Another finding is that relatively small plankton distributed in low-salinity water are carried along the continental shelf while recycling nutrients from terrestrial sources and repeatedly reproducing there; they have even traveled as far as the Tsushima Strait. This shows that the biological envi-



Observation of vertical mixing processes on the continental shelf

ronment on the East China Sea continental shelf depends on nutrients originating both from the Changjiang and from open seas. In other words, Changjiang Diluted Water is, in the truest sense, a place where land and sea meet. We need to make it clear that this is on a scale that goes beyond individual countries drawing lines around their territories.

Balance of water and matter distributed on the continental shelf

With researchers from Taiwan, we have started monitoring currents passing through the Taiwan Strait, using the regular ferry service that crosses the Strait. Water enters and exits the East China Sea continental shelf at the Taiwan Strait, the Tsushima Strait and edges of the continental shelf where the Kuroshio Current flows. In view of this, we can calculate net flow from the Kuroshio Current into the continental shelf by comparing the flow passing through the two Straits. Even in terms of the water balance, phenomena in individual locations are not independent of each other. This tells us that we should consider the East China Sea continental shelf as a single receptacle.

In the joint research with China, we have repeatedly exchanged opinions on our understanding of the circulatory structure of the continental shelf, mainly using numerical models, since there are difficulties in exchanging data from direct joint observation, etc. We have reached a point where we can share an understanding between researchers on issues such as flow fields crossing the continental shelf and the process of vertical transport. In future, we hope to achieve closer exchanges in researching the behavior of land-derived substances and the balance of these substances, in particular.

The points of access and exit for substances that govern the environment of the East China Sea, including the

Changjiang, lie in the territories, territorial waters, or exclusive economic zones of different nations; there are thus many stakeholders to consider. On the continental shelf of the East China Sea, moreover, a complex environment is sustained by a combination of physical, chemical and biological processes, besides these national frontier conditions.

The East China Sea as a shared asset

This environment is all maintained within a continuous flow of water, and we need to perceive the whole of it as a single system, since it is meaningless to divide it up with boundary lines unrelated to nature. In this respect, there would be meaning in setting up provisional waters or half-way waters where mutual access is permitted by fishing agreements. If anything, this should be further promoted, and the sea managed as a joint asset in a way that follows nature. Here, proper controls would be required to ensure that fish catches are kept to a level whereby eco-systems are maintained by natural regeneration functions, and a more scientific understanding of the ocean environment is needed. We now need to reappraise how the bounty of nature should be incorporated in human society. The same would also apply to seabed resources. We clearly need to reconsider an economy in which we compete to plunder natural resources, and how to treat natural things that exist in spaces not originally within our sphere of habitation.

My hope is that the science that sets out to understand the ocean, as an arena for testing human knowledge, should be harnessed to create a “sea of cooperation.” ■

1) <http://scfdb.tokyo.jst.go.jp/pdf/20071490/2009/200714902009pp.pdf>

In Memory of Fish — Respect for Life in the Sea

[KEYWORDS] fish monuments / life view / oceans as a source of culture

Rie TAGUCHI

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(Ship & Ocean Newsletter No.256 April 5, 2011)

All over Japan, we find monuments dedicated to marine life in the form of graves, burial mounds and stone monuments. If anything, these monuments have been erected with greater enthusiasm since the start of the modern era; and in erecting these monuments, both the reasons for doing so and perceptions of the memorial act have become more diverse, in line with the development of Japanese fisheries. The existence of monuments for marine creatures holds a clue to understanding the unique relationship of the Japanese with the sea.

Bounty from the sea

In February 2010, I went to the island of Lombok in eastern Indonesia to see a festival called “Bau Nyale”. *Nyale* is a kind of sea worm in the Eunicidae family. Once a year, it rises to the surface of the ocean to reproduce. And at around this time, people flock to the beaches from the middle of the night until daybreak, scooping up *nyale* in nets called *sarok*. The collected *nyale* are then boiled in a big pot, wrapped in banana leaves and grilled, or salt-dried then deep-fried and eaten. According to legend, *nyale* are reincarnations of the Princess Mandalika¹⁾, who cast herself into the sea in an act of self-sacrifice to keep her country at peace. Her body was transformed into thousands of *nyale*, which return once a year as an eagerly awaited delicacy for her people.

As illustrated by Bau Nyale, the significance given to the bounty of the seas differs from region to region, from people to people and from epoch to epoch. The more we understand the diversity of the relationships between humans and marine creatures, the more we realize that the sea is a source of culture that stimulates the human imagination.

The Japanese are no exception; since ancient times, we have cherished the world under the sea and the creatures that live there. In ancient legend, for example, we hear of Yamasachihiko or Urashima Taro and their visits to the sea deity’s palace. In Medieval times, the collection of Buddhist tales known as “Nihon Ryoiki” showed marine creatures appearing as reincarnated from human beings, or repaying someone for saving their lives. In one of the sto-

ries, a mullet that was being carried to be eaten by a Buddhist priest was likened to the Lotus Sutra scroll.

Owing partly to the influence of Buddhism, Japanese tradition holds that all living things, including plants and sea creatures, have a soul just as humans do. Funeral rites and memorial services have been held for dead creatures since ancient times. Senzaki in Yamaguchi Prefecture is the birthplace of the poet Misuzu Kaneko, famous for her poems *Tairyo* (“A Big Catch”) and *Kujira-hoe* (“Memorial Service for Whales”). Nearby, there are known to be graves of whales, and even mortuary tablets and death registers. This is true not only of Senzaki; tombs, burial mounds and stone monuments built for whales and various other marine creatures can be found all over Japan. The existence of these monuments for marine creatures holds a clue to understanding the unique relationship of the Japanese with the sea.

In memory of fish

Memorial services for living creatures are also a research theme that has received much attention recently, as they show the unique Japanese view of life and nature. A look at research carried out so far, however, shows quite a broad scope of subjects, including memorials for plants and inanimate objects. Consequently, memorials for fish or shellfish have only been sporadically introduced. Therefore, I started a research study on memorials and services for aquatic creatures, under the title “Research on Fish Memorials”²⁾. So far, we have been creating basic data by gathering infor-

Era	Total monuments	Number of monuments by object of monument		
		Whale monuments	Sea turtle monuments	Numbers and names of collective monuments
Before Edo (-1601)	4	0	1	1 13-tiered pagoda
Edo (1601-1867)	131	74	13	16 Temple / 5-tiered pagoda / types of fish / fish and scaly fish / fisheries / myriad fish / various fish / Gyoran Kannon (the Avalokitesvara Bodhisattva, the Buddhist deity of compassion, carrying a fish basket)
Meiji (1868-1912)	98	39	14	6 Scaly fish / fish and scaly fish / crabs, octopus and fish / Gyoran Kannon
Taisho (1912-1925)	49	2	17	5 Types of fish / myriad fish / Gyoran Kannon
Showa (1925-1989)	Prewar	79	7	8 Fish spirits / small fish / types of fish, shellfish and seaweed / fish, shellfish and seaweeds / Gyoran Kannon
	Postwar	240	19	50 79 Fish / fish spirits / fish souls / fish families / types of fish / various types of fish / fish and scaly fish / types of scaly fish / shoals of scaly fish and colonies of shellfish / fishing spirits / fish and shellfish / types of fish and shellfish / fish, shellfish and sea worms / types of fish, shellfish and seaweed / large whales, types of fish and shellfish / sea creatures and types of fish / Gyoran Kannon / luring fish Kannon / fish-luring Kannon
Heisei (1989-present)	87	2	12	42 Fish / fish spirits / fish souls / fish families / fish and scaly fish / types of fish, shellfish and laver seaweed / Gyoran Kannon / 5-tiered pagoda

mation on memorials for aquatic species, combining documentary research with a questionnaire survey and a field survey. In the questionnaire survey, in particular, we sent forms to 2,141 related organizations all over the country, including ocean fishery cooperatives, inland fishery cooperatives and fishery research institutes. Replies from 893 of these had been received by the end of September 2010. The results obtained so far (introduced in more detail in a separate paper³⁾, reveal that more than 1,100 monuments honoring aquatic creatures, until now only introduced in fragmentary fashion, exist in various parts of the country.

The construction dates of 688 of these monuments are known. They reveal that such monuments gradually increased in number from the beginning of the Edo period (1601), and moreover that they continued to be erected all over the country right up to modern times. In fact, the number erected in Meiji or later periods (since 1868) amounts to 523, showing that the erection of monuments has actually become more prevalent in modern times, not less.

As summarized in the Table, memorial stones for whales were by far the most numerous in the Edo period. In those days, monuments seem to have been erected in various places out of gratitude to beached whales that saved people from poverty, while others are related to whale catches. It was only after this, from the 1800s onwards, that monuments began to be erected to express gratitude for big catches as well as for the comfort of souls. In the Meiji period (1868-1912), examples also emerge of monuments being erected to commemorate successful enterprise, such as increased sales due to big catches or an increase in sales. In the Showa period (1925-1989), monuments erected by aquaculture operators working in pearls, smelt, rainbow trout, edible frogs and others also began to appear. From the Showa period onwards, monuments appear to have been erected by various operators in the fisheries industry

– not only the productive sectors of fishing and aquaculture but also fish trading, wholesale markets and other sectors of distribution, as well as cookery cooperatives, processed food companies and other businesses in the processing sector. The increase in monuments from modern times onwards has progressed in line with a diversification of people erecting monuments.

After the war, monuments based on a collective approach to the objects of enshrinement also appear, as illustrated by “fish spirit monuments” and “fish soul monuments.” Since the war, 121 of these collective monuments have been erected. Collective names are thought to have been chosen as a way of dealing collectively with larger numbers of fish. This might include the targets of fish catches, experimental fish handled by fishery research institutes, lives lost during development work or disasters, etc. In other words, both the reasons for erecting monuments and perceptions of the objects of monuments have become more diverse as time goes by. Monuments have been erected all over the country in line with the development of Japan’s fisheries. However, the solemn memorial services held in front of many of these monuments are still only attended by the people involved, and are not widely known. In interviews with those involved, we learned that each monument is imbued with the feelings of gratitude for nature and life that supported the livelihoods of the people who erected them, as well as the circumstances of the eras in which they were erected.

Nourished by the bounty of the ocean

Monuments to fish and shellfish in various parts of the country teach us that people connected with seas and rivers have held memorial services for thousands or millions of living things, out of respect for their lives. In Japan, there is a deep-rooted mentality of gratitude and respect for the lives that we take for our own nourishment. For many of us, however, our only image of the reality of seas and rivers, as well as the creatures that live in them, is from the fish and shellfish we see in aquariums, on our dinner tables or in shops. Precisely now that food education and the “act of eating” are being reexamined, we should spare a thought for the hard work and feelings of people who have been involved with seas, rivers, fish and shellfish, as well as the weight of their history, all of which lie behind our current good fortune in “being able to eat.” ■



Memorial stones for mullet (“mullet mounds”), brought together in one place to make way for construction work in a corner of reclaimed land in Tenno-cho, Katagami, Akita Prefecture. The oldest is dated Ansei Year 6 (1859), the five others dating from Meiji 28 (1895), Meiji 44 (1911), Taisho 7 (1918), Showa 21 (1946) and Showa 26 (1951).

1) The legend of Princess Mandalika (Princess Nyale), passed down on the island of Lombok, Indonesia. Princess Mandalika, wooed by princes from neighboring countries, sacrificed her life by drowning in the sea when their rivalry threatened the peace of her country.
2) This research consists of “Use of and Changes in Marine Resources Seen Through Fish Spirit Monuments – Creating a database of fish spirit monuments”, FY2009 Grants-in-Aid for Scientific Research; “Japanese Environmental Thought and Problems of the Global Environment – Proposals for the future from knowledge of humanities”, a humanities and social science research promotion project by the Japan Society for the Promotion of Science, and “A Historical Elucidation of the Multilayered Relationship Between Nature and Culture in Asia,” collaborative research with the National Institutes for the Humanities.
3) R. Taguchi, I. Seki and N. Kato, 2011, “A Study of Monuments to Pray for Life in Water,” Bulletin of the Institute of Oceanic Research and Development, Tokai University: No. 32, p53-97.

The Great East Japan Earthquake and Achieving Comprehensive Ocean Management

— Reconstruction and Comprehensive Management of Coastal Areas —

[KEYWORDS] the Great East Japan Earthquake / incorporating sea areas in municipal jurisdictions / local allocation tax

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(Ship & Ocean Newsletter No.257 April 20, 2011)*

Local development based on comprehensive management of coastal areas and oceans will be important for reconstruction after the Great East Japan Earthquake. Until now, the sea has not entered into the jurisdiction of local authorities. In the efforts towards reconstruction, however, local authorities will need to undertake local development as if the sea were within their boundaries. I propose that contiguous sea areas of municipalities affected by the disaster be incorporated into municipal jurisdictions up to a fixed distance from the shore, and that this should be done by reforming the standards for calculating the local allocation tax.

Introduction

The Great East Japan Earthquake (earthquake off the Pacific coast of Tohoku) struck at 2:46 on the afternoon of March 11th, 2011, its epicenter lying 130km east-southeast of the Oshika Peninsula. The earthquake had a magnitude of 9, an intensity never before experienced in the history of Japanese earthquake observation. The tsunami induced by the earthquake claimed a huge number of lives in the blink of an eye, mainly on the Pacific coast of the Tohoku region; the total number of fatalities is not yet finalized but is said to be more than 27,000.

I would like to express my heartfelt sympathy and condolences to all those who suffered in this terrible disaster. Coming at this time, the intention of this paper is to make a broad appeal for the importance of placing local and national development based on “comprehensive management of coastal areas and oceans” at the center of a concerted national effort for disaster reconstruction in the future. In this paper, I will raise the problems of disaster reconstruction and comprehensive management of coastal areas (Part 1). From the next issue, I will make new proposals on the rebuilding of fisheries and fishing rights related to the reconstruction (Part 2), and the problems of comprehensive management in the exclusive economic zone and continental shelf (Part 3)¹⁾.

Expansion of municipal areas into the sea and comprehensive management as a special measure for earthquake reconstruction

My proposal is that, as a basis for reconstruction and local development in future, contiguous sea areas of municipalities affected by the disaster should be incorporated into municipal jurisdictions up to a fixed distance from the shore, and that this should be done by applying the existing law on local allocation tax. Generally speaking, the sea has not entered into the jurisdiction of local authorities until now. It is also not included in the basis for calculating local allocation tax, although there are some exceptions. This is one of the reasons why local authorities have found it dif-

icult to include sea areas within their own jurisdiction and place them at the center of local development.

Reconstruction following this disaster has been calculated to require a massive injection of public funds, to the tune of 13-20 trillion yen²⁾. Part of this will take the form of local allocation tax. The Table in Article 12 paragraph 1 (Section 6 General Administration Expenses, Subsection 3 Regional Development Expenses) of the Local Allocation Tax Act requires that population and land area should be the units used for calculating allocations with respect to municipalities.

The huge loss of life in this major tsunami has left several municipalities with sharply reduced populations. For these municipalities, it would be of great importance to adopt a measure whereby this population loss would be offset by calculating a fixed section of contiguous sea within the municipal area, thus making it possible to continue the increased allocation. Such a measure would be indispensable not only in terms of revenue, but also because an administrative problem when rebuilding municipalities in future lies in radically revising our relationship with the sea.

As local governments use their own capabilities to study reconstruction from this major disaster – which, it is feared, could lead to the complete dissolution of some local gov-



Kesennuma (2007)

ernments— none of them will be able to avoid the problem of how best to regard the sea, which, though the main economic driving force for reconstruction, at the same time requires re-installation of facilities to prevent future disasters. What is necessary is a reconstruction plan that balances natural marine disaster prevention, local economic activity, and the securing of a healthy environment, and then combines these with reconstruction plans for land areas. This is precisely what is meant by comprehensive management of coastal areas in disaster-stricken areas. And it is precisely a political process whereby each local authority integrates, coordinates and judges the value of residents' wishes concerning the sea. To achieve this, strong leadership will be essential. Shinpei Goto, President of the Imperial Capital Reconstruction Institute after the Great Kanto Earthquake of 1923, adopted the latest western techniques of urban planning, and set about reconstruction with a strong wish to create a new capital befitting Japan. The leaders of each local authority should learn from Goto and work towards a new regional development under strong leadership. Recalculating contiguous sea areas within municipal jurisdictions would be a meaningful and effective way of doing this.

Prospects for redevelopment of fishing ports and the potential for sustaining fisheries

At the stage when the immediate recovery is complete, the government will most likely revise the standards for disaster prevention facilities in coasts, harbors, fishing ports, etc., based on the damage incurred in this disaster. In any case, given the increasingly harsh fiscal situation, the basis of local development by each local authority will be determined by the outcome of this and the resultant increase in investment.

Owing to limits on the government's ability to invest, it will most likely be impossible to simply revive traditional villages. In particular, how to develop fishing ports as production bases for fisheries in future will be a major national challenge, but at the same time a central issue for comprehensive management in each region.

At present, the overall fishing population in Japan is declining sharply. This population is progressively ageing and fishery production is also falling³⁾. In FY1996, the Board of Audit pointed out that no effects on business

were seen as a result of the use and management of land for fishing ports and other facilities created as a result of fishing port renovation projects. Depending on a revision of standards for disaster prevention facilities, the amount of investment needed for development will increase, and given harsh fiscal constraints the government will be forced to consolidate locations for fishing port investment. Without improvements to fishing ports, it will not be possible to operate efficient fisheries as a stable 6th industry.

Roughly speaking, there are 3,000 fishing ports along 35,000 kilometers of coastline in Japan, with 5,000 fishing villages in the areas behind them. Until now, the government has protected coasts over a stretch of around 6,300km within the area of fishing ports (about 20% of the national total). It has pursued coastal development while protecting the fishing villages lying behind these coasts from tsunamis, storm surge and other coastal disasters, and ensuring harmony between the environment and utilization⁴⁾. In future, it will surely be impossible to maintain the present luxury of a fishing port for every 12.1km or so and a fishing village for every 5.6km of the coastline.

Given this situation, the central issue in political decision-making for many local authorities will probably be how they regard fishing ports and fisheries within overall future planning, and how they allocate reconstruction investment related to these, bearing in mind the possibility that surviving fishery workers may move away or switch professions.

Until now, local lives have been based on the assumption that there will be a small fishing port for each dispersed village. The basic structure of these lives is about to undergo huge changes, leading to the problem of how to tackle economic and social issues arising from a reorganization of living infrastructure caused by the consolidation of fishing ports. Large and serious problems now await the comprehensive management of coastal areas, on which the future of the regions depends. Whatever the case, there will be no tomorrow for disaster-stricken local authorities unless these problems are tackled. I think now is the time for concerted effort by the whole nation, with a concentration of know-how, effort and determination in order to turn disaster into something positive. ■

1) See No.258 http://www.sof.or.jp/jp/news/251-300/258_2.php (Japanese) and No.259 http://www.sof.or.jp/jp/news/251-300/259_1.php (Japanese) or <http://www.sof.or.jp/en/news/list11.php> (English)

2) T. Hayashi, "Revise legal constraints on reconstruction", in 'Keizai Kyoshitsu', Nihon Keizai Shimbun, March 21st, 2011.

3) The peak for fishery production volume was in 1984 and that for the value of production was in 1982, these registering 12.82 million tons and 2,977.2 billion yen, respectively. The population working in fisheries was 510,730 in 1983. These had fallen to 5.59 million tons and 1,627.5 billion yen in FY2008 and 211,810 workers in FY2009. The number of workers is taken from the general portal for government statistics and production volumes from the FY2009 White Paper on Fisheries.

<http://www.e-stat.go.jp/SG1/estat/List.do?lid=000001068006>

http://www.jfa.maff.go.jp/j/kikaku/wpaper/h21/pdf/g_2.pdf

4) See Fisheries Agency website http://www.jfa.maff.go.jp/j/gyoko_gyozyo/g_genkyou/sub10.html

Marine Pollution Threats Following the Great East Japan Earthquake

[KEYWORDS] cesium / PCBs / dioxins

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(Ship & Ocean Newsletter No.261 June 20, 2011)

The Great East Japan Earthquake caused damage on a scale previously unknown in Japan; accidents at nuclear power stations, in particular, triggered an environmental pollution crisis caused by cesium-137 and other radioactive elements. However, this is not the only concern over chemical pollution. There are numerous chemicals whose impact on marine pollution need to be monitored closely; among others, these include emission of PCBs from stockpiled transformers and capacitors washed away by the tsunami, and dioxins caused by the incineration of disaster waste.

Marine pollution by radioactive elements

The magnitude 9 earthquake that struck on March 11, 2011 induced a 37.9-meter tsunami, devastating the coasts of eastern Japan. At the Fukushima No. 1 nuclear power plant, the disaster caused a nuclear power accident of level 7 severity, on par with Chernobyl. The Nuclear Safety Commission estimates that radioactive substances in excess of 630,000 TBq (terabecquerel) were emitted from the plant in the process. Judging from its geographical location and the haphazard accident response, a considerable proportion of this is bound to have been discharged into the sea. Radioactive substances released into oceans pollute seawater, infiltrate ecosystems, bioconcentrate and accumulate in both lower and higher trophic organisms. While discussing the bioaccumulation of toxic substances, we generally require information on discharge volume, half-life and bioconcentration. In this nuclear power accident at Fukushima, the substances of greatest concern are ¹³⁷Cs (cesium-137) and ¹³¹I (iodine-131), which were discharged in large volumes. Of these, ¹³¹I is considered less likely to cause long-term, chronic biotic contamination and impact, as its half-life is short. In contrast, ¹³⁷Cs has a long half-life and a propensity to bioconcentrate. It is predicted to remain in the environment for a very long time, and will thereby accumulate in many marine species via food chain. The bioconcentration factor from water to fish and shellfish is several hundred times, increasing up to few thousand times in higher organisms. Although the bioconcentration factor of ¹³⁷Cs is three to four orders lower than other chemicals such as polychlorinated biphenyls (PCBs, to be discussed later), because of the large discharge volume, the concentration in seawater may be higher in some sea areas. Even with a factor of around a thousand, there is a danger that its concentration could reach the threshold of ecological risk. To understand the state of pollution and how it is changing, we have to conduct long-term monitoring of seawater, as well as a wide variety of organisms ranging from plankton to sea birds and marine mammals.

The diagram below is taken from a paper on ¹³⁷Cs pol-

lution in marine mammals in the second half of the 20th century, written by the author and his colleagues (Environ. Sci. Technol., 37, 4597-4602 [2003]). The pollution levels in marine mammals distributed in eastern Japan were extremely low, and the seas off Tohoku were among the world's cleanest at that time. This should be monitored continuously, since there is grave concern over changes in biotic contamination in seas off Tohoku as a result of radioactive substances emitted by the nuclear power plant accident. The diagram also reveals high levels of ¹³⁷Cs pollution in aquatic mammals inhabiting the North Sea and landlocked lakes in Eastern Europe and Russia (Lake Baikal, the Black Sea, etc.). Inadequate management of radioactive substances in these areas in the second half of the 20th century, when there were also many accidents may be one among the possible causes for this. Another factor may be the release of ¹³⁷Cs into aquatic environments from pollution sources over a lengthy period of time. Therefore, measures to prevent such release following the Fukushima nuclear power accident are urgently needed.

Other toxic substances causing concern

Besides radioactive contamination, the disaster is also thought to have caused the release of various chemicals. Of these, pollution by PCBs from stockpiled transformers and capacitors is particularly worrying. In the past, Japan produced about 60,000 tons of PCBs, the majority being used as insulating oil for transformers, capacitors and other electrical equipments. Following a series of human disasters such as the outbreak of "Yusho Disease", however, PCBs contamination and its implications became a social problem. As a result, PCBs were designated as a Class 1 specific chemical in 1974, whereupon its manufacture and use were prohibited. Obsolete transformers and capacitors containing PCBs have been stored by electric companies and business operators for many years since then. With the enactment of the Law Concerning Special Measures against PCB Stockpiles in 2001, treatment plants were built in five locations across the nation and steps were gradually taken to detoxify

coast of Ibaraki Prefecture. We took nine of these to Ehime University, where we kept their whole bodies in frozen storage at the Environmental Specimen Bank for Global Monitoring (es-BANK: see Ship & Ocean Newsletter No. 128 [Dec. 05, 2005]). We then dissected these specimens in mid-May with the cooperation of research institutes including the National Museum of Nature and Science, Tokyo, Japan, and obtained the necessary organs and tissues for chemical analysis. Since dolphins and other cetaceans are frequently found stranded on Japanese coasts, it may be possible to obtain more specimens like this in future from eastern Japan. This leads to our hopes that we can elucidate the trends and effects of chemical pollution caused by this disaster, by comparing these two sets of specimens of the melon-headed whales. Meanwhile, the International Atomic Energy Agency (IAEA) in Monaco has asked us to provide organ and tissue samples from the melon-headed whales, and this request has been accorded by the es-BANK at Ehime University.

Conclusion

After the Great Eastern Earthquake, Japan, the efforts by the Japanese people working together calmly to confront the disaster was praised both at home and abroad. Japan's measures against toxic substances following this disaster have also received attention from research institutes and governments of many countries. These efforts are expected to culminate in a "grand design" combining wisdom from various fields. While taking measures against toxic substances following a disaster, we should be able to act wisely and flexibly from an objective standpoint. If a similar natural disaster were to occur in future, I hope that the measures against toxic substances implemented after the Great Eastern Earthquake, Japan would be widely used and become a global norm, known as the "Japan model". ■

No Ill Feeling toward the Sea, Despite Tsunami Damage

[KEYWORDS] No Japan without sea / Chief Facilitator of the Follow-up Working Group on the Basic Act on Ocean Policy / promoting the development and use of marine energy

Tatsuo KAWABATA

Member, House of Representatives; Chief Facilitator of the Follow-up Working Group on the Basic Act on Ocean Policy
(Ship & Ocean Newsletter No.263 July 20, 2011)

Despite the terrible damage wrought by the tsunami, no one in Japan holds any ill feeling toward the sea. Japan depends on the sea for food, and has acquired the products of civilization from far across the ocean. While continuing our reconstruction after the disaster, we must not lose respect for nature or disregard harmony between man and nature. Offshore wind farms and wave power generation should not remain in the realms of fantasy; instead, we must promote their development and use.

Lives that depend on the sea

The massive earthquake off the Sanriku coast in March caused damage previously unknown in Japan and claimed many human lives, mainly in the Tohoku region.

The main cause of damage was the tsunami caused by the earthquake. It was as if the sea, upon which we depend so much, had momentarily bared its teeth.

One would expect, then, to find some kind of ill feeling or resentment toward the sea. But nothing could be further from the truth. In one memorable scene captured on our TV screens, fishermen from the disaster area, their expressions full of vigor, set out for their next catch in a boat that had escaped damage. Another to suffer damage was Shigeatsu Hatakeyama, an oyster farmer who organizes the “Mori-wa umi-no koibito” (Forests are Lovers of the Sea) campaign to nurture rich seas through rich forests. He said:

“Although we were struck mightily by the sea, no one bears a hatred for it. I certainly don’t.”

The Japanese have lived with the sea since ancient times. Without the sea, there would be no Japan. And living in this island nation, the Japanese welcome the arrival of imported goods. In ancient times, we enjoyed the products of civilization from the Chinese mainland and the Korean peninsula; in more recent times, those products have come from western countries. This characteristic is actually on the wane now, but nevertheless, the tendency to revere anything that comes from across the sea remains deeply imbedded in the Japanese mentality.

Food production in Japan basically consists of cultivating rice and catching fish. In many other parts of the world, lives revolve around cereal crops and livestock farming; the patterns of life and thought are different. In any case, it’s fair to say that in Japan, lives have been nurtured by the produce of the oceans.

After the Meiji Restoration of 1868, Japan embarked on a single-minded path of westernization. The country then went through two world wars before growing into one of the world’s leading economies. The basic structure of this success involved importing resources from abroad, processing and transforming them into manufactured products, and

finally exporting them back to the world. In other words, much of our wealth depends on the other side of the ocean. From now on, for Japan to retain her place in the world, one of the most important challenges will be to promote correct ocean policies.

Reconstruction measures from the viewpoint of the maritime nation Japan

Last fall, following Yoshiaki Takagi’s appointment as Education Minister in Prime Minister Kan’s second Cabinet reshuffle, I succeeded him as Chief Facilitator for the “Follow-up Working Group on the Basic Act on Ocean Policy.” Since its launch in 2006, the Working Group has played an important role in promoting Japan’s marine policies (including, notably, the enactment of the Basic Act on Ocean Policy). It was therefore a very great honor to be given this weighty position in the Working Group, and I aim to leave no stone unturned in fulfilling my duties.

In May, the Working Group drew up emergency proposals for Japan’s reconstruction after the Great East Japan Earthquake from the perspective of Japan as an oceanic state¹⁾, and submitted them to the Chief Cabinet Secretary.

The emergency proposals covered issues including the



The 12th Meeting of the Follow-up Working Group on the Basic Act on Ocean Policy was held on May 27th. The Working Group drew up “Proposed Action Plans with Regard to the Great East Japan Earthquake and Tsunami Disaster Reconstruction from the Perspective of a Maritime State – Urgent Proposals,” which were then submitted to Chief Cabinet Secretary Yukio Edano.

recovery and reconstruction of coastal zones, establishing earthquake and tsunami early warning systems, establishing a sustainable marine survey system for eco-systems, etc., reconstructing fisheries, promoting the development and use of renewable energies in the sea, and developing floating structures that can be used in multiple sites. I aim to make full use of the capabilities we have to restore our oceans to their former richness as soon as possible. However, these efforts need to be pursued in a spirit of respect for the power of nature. We must proceed steadily with reconstruction, though with an awareness of the distinction between the respective preserves of man and nature.

The immensity of damage caused by the tsunami may have been partly due to an overconfidence in our manmade disaster prevention measures. Levees constructed by human hands were no match for the fury of nature. We should not forget this when planning countermeasures in future.

Developing maritime energies

The Working Group drew up “Proposals Aimed at Establishing a New Maritime Nation Japan”²⁾ last June, and now has the basic task of steadily promoting these within Japan’s ocean policies. Policy issues involving the oceans cover a wide range of subjects from resources and scenery to industry, disaster prevention, diplomacy and defense, among others.

We have also made several proposals in the energy sector. Following the accident at TEPCO’s Fukushima No. 1 nuclear power plant, we urgently need to rebuild Japan’s energy policies in their entirety. While I think this will basically involve increasing the safety of nuclear power generation, natural energies are now receiving more attention than ever.

At the OECD and G8 summit meetings in Deauville near Paris earlier this year, Prime Minister Naoto Kan declared before the gathered world leaders that Japan would “increase its ratio of natural energies within all domestically generated power to 20% as early as possible in the 2020s”. This will certainly not be easy to achieve. It will require a tremendous effort from us.

As far as the oceans are concerned, it would be conceivable to develop and use offshore wind farms and wave-power generation, among others. A mountain of problems will need to be cleared before these can actually be promoted; as well as developing technology for observation, devices, etc., we will also need to consider costs and systems of management. The Follow-up Working Group on

the Basic Act on Ocean Policy, for its part, is proposing positive initiatives, but I would like to promote these in such a way that fanciful talk is eliminated and fruitful progress is made.

Let us amass our knowledge and capabilities, complete our disaster reconstruction and establish a new “maritime nation Japan.” ■

1) See <http://blog.canpan.info/oprf/archive/906> (Japanese) for details of the “Proposed Action Plans with Regard to the Great East Japan Earthquake and Tsunami Disaster Reconstruction from the Perspective of the Oceanic State – Urgent Proposals” (English: https://blog.canpan.info/oprf_en/category_1/).

2) For “Proposals Aimed at Establishing a ‘New Maritime Nation Japan’”, see <http://blog.canpan.info/oprf/img/754/teigen.pdf> (Japanese).

A View from What was Not Washed Away by the Tsunami

— “Tsunagari” with the Sea —

[KEYWORDS] the Great East Japan Earthquake / reconstruction support activity / reviving homelands

Yohei SASAKAWA

Chairman, The Nippon Foundation

(Ship & Ocean Newsletter No.263 July 20, 2011)

Immediately after the disaster struck, the Nippon Foundation set up the “Northeastern Japan Earthquake and Tsunami Relief Fund.” Through this, we have provided emergency support for those affected by the disaster and taken steps to restore livelihoods that depend on the sea. This is one of the focal points of our support activity. In future, we will develop this to include the support needed by disaster victims to recover their “homelands,” based on family and community bonds through the medium of the sea.

“Tsunagari¹⁾” with the sea

The Japanese have lived with the sea since ancient times; we are, after all, surrounded by the sea, as well as nourished and comforted by it. In particular, the lives of the people on the Tohoku coast could not be discussed without mentioning the sea. This is one of the busiest parts of Japan in terms of marine produce; many people here have their livelihoods in ocean-related work, either directly or indirectly. Their family business is fishing or making boats; their livelihoods are adapted to the diverse and complex natural environment of the Sanriku region. And they have sustained these livelihoods by maintaining “tsunagari¹⁾”: the tsunagari of family, in which wisdom and experience are passed down through generations as part of the family business, from grandparents to parents, from parents to children and from children to grandchildren; and the tsunagari of specialization and cooperation between individual *hama* (a word meaning ‘shore’, used affectionately to refer to the sea). It’s no exaggeration to say that the maritime life and culture preserved in this region is due to these two “tsunagari” of family and community, as they interact with the sea.

In the Great East Japan Earthquake, an area of Japan’s coast stretching 300km from north to south was struck by a massive tsunami that erased people’s livelihoods and the very basis of their daily lives in the blink of an eye. Marine industries, shipbuilding and other work dependent on the sea suffered a devastating blow. Even now, over four months later, the basis for reconstruction is not yet complete; many people are living uncertain lives, not knowing when they will ever return to their work on the sea. But in spite of this, these disaster victims, whose livelihoods are so dependent on the sea, are still waiting patiently, without giving up hope that they will return to the sea some day soon. Why? Because they have pride in living together with the sea; they have affection for their tsunagari with the sea. Indeed, the sea itself could be described as their “homeland.”

Even so, many areas are facing a crisis in which families



The tsunami dealt a direct blow to people who depend on the sea for their livelihoods.

and communities of long standing are being torn apart due to prolonged evacuation, plans to relocate to limited higher ground, or other problems, even though a feeling of tsunagari with the sea as their homeland remains. I think the government, local authorities, companies, NPOs, individuals and other people in various positions should, when considering this situation, never forget to consider the disaster victims and put themselves in their position. Above all, they should be sure to respect their pride in the seas of Tohoku when engaging in reconstruction support.

A Ray of hope – for the first step forward

The path to reconstruction will certainly not be smooth. But I think this very fact makes it even more important to light a “ray of hope,” enabling the victims to take a step forward. Immediately after the disaster, some found themselves in such dire straits that they had no money or possessions with which to continue their lives. The support needed then differs from the support needed now, several months after the disaster, which helps the disaster victims recover jobs and lives. It also differs from the support needed in future, which will help them recover their “homelands” through the tsunagari of family and community with the

sea.

As well as considering what the victims’ needs are at any one time, we have developed various programs aimed at lighting a ray of hope, to make sure they can always be taking a step forward. I would like this to serve as an aid in restoring the sea, through which family and community tsunagari have been built and nurtured; ultimately, I hope this will enable the disaster victims to make their own efforts to preserve their “homeland” for posterity.

Emergency support activities

For example, we set up the Northeastern Japan Earthquake and Tsunami Relief Fund in the immediate aftermath of the disaster. Through this, we provided aid to NPOs and voluntary organizations engaged in emergency support activities, and distributed condolence money to surviving families and relatives of those lost or missing in the disaster. Money donated by a very large number of people was taking a long time to reach the disaster victims, owing to the need for fairness. This meant that it was not being distributed to organizations engaged in emergency support activities, leading to a lack of immediate emergency support. It was for this reason that the Nippon Foundation started activities based on aid and condolence money; the aim was to give disaster victims hope that they could rebuild their lives and take a step forward on the road to survival.

Reconstruction support activity through the medium of the sea

Concern for disaster victims tends to wane among people outside a disaster area once emergency support in the immediate aftermath has finished. However, there can be



Work starts on repairing a small boat damaged by the tsunami

no reconstruction in the true sense until the disaster victims are in a position to resume their lives as they were before the disaster. Above all, we cannot talk of reconstruction unless we give thorough consideration to maintaining the way of life in the disaster area, just as it was before the disaster, both spiritually and materially. In order for people to be able to maintain their pride and their homeland as they were before, the tsunagari of family and community need to be passed on to the future. I believe it is the sea that will provide the medium for this. Based on this idea, we have now started support aimed at lighting a “ray of hope” for fisheries, shipbuilding and other ocean-related businesses in the disaster area to help them get back on their feet.

On June 10th, we started a base development project for repairing small boats. In this, with the cooperation of local shipbuilding businesses, fishery cooperatives and boat-makers, we plan to repair upwards of 1,000 boats by the autumn. The main focus will be on small fishing boats of around 1 ton that were damaged in the disaster. For fishermen, their boats are second in importance only to life itself, and so by making these seaworthy again we can help them fulfil their wish to return to the sea in their own boats. Moreover, by developing repair bases in about ten locations in Iwate and Miyagi Prefectures, we have also helped to create short-term employment for local engineers.

In early July, we started a



Mr Sasakawa distributing condolence money in Ishinomaki City



From July, underwater robots were used to examine sea conditions

A View from What was Not Washed Away by the Tsunami

—“Tsunagari” with the Sea—

project to survey the sea’s ability to regenerate itself, in cooperation with the University of Tokyo Ocean Alliance, the National Federation of Fisheries Co-operative Associations, and others. This will involve using underwater robots to take video footage under the ocean surface, as well as underwater visual surveys in about ten locations (mainly bays) in Iwate and Miyagi Prefectures. In this way, local fishery people will be able to see for themselves the state of the sea with which they have spent their lives. We hope this will help to create a blueprint for the resumption of fisheries and aquaculture.

Another issue of vital importance lies in training future leaders of fisheries and shipbuilding to ensure that the tsunagari based on the sea are preserved for the future. However, many young people now graduating from fisheries high schools and other senior high schools with ocean-related courses lack the necessary qualifications to work in the maritime sector. This is because their educational vessels and training boats were washed away or damaged by the tsunami. We are therefore supporting efforts to allocate educational vessels and training boats for aquaculture work, etc., as well as restoring an environment in which leaders can be trained as soon as possible. Through this, we want to help these schools give hope for the future and secure future prospects for the next generation.

Besides these efforts, we also think it important to focus on the various roles being played on the sea and the tsunagari that are based there, and provide the necessary support for each of them in turn. As with regeneration support projects for shipbuilding businesses that have a significant impact on the local economy through new employment, this includes the building or repairing of fishing and aquaculture boats

for the fisheries industry, fishery processing work (including on-shore oyster shelling), ice-making, chilling and other storage functions, fish markets, food processing and distribution, and the manufacture, storage and repair of fishing tackle, nets, etc.

Not all was lost – “reviving homelands”

As this shows, the Nippon Foundation not only provided emergency support immediately after the disaster, but also came up with ways of helping local disaster victims return to the sea, making this approach one of the pillars of our support operations. In future, we aim to develop this into the support needed by disaster victims to restore their “homelands,” which are based on the family and community tsunagari that have grown up through their lives on the sea.

In this earthquake and tsunami disaster, the sea caused calamitous damage to people and communities that had long lived together with it. The tsunami washed away families, relatives and neighbors; it washed away homes, boats and the lives people had known until then. But there was something that was not washed away. People’s affection for and pride in the sea, their love for their “homelands” on the sea, love for their families,... the tsunagari that connect people to their neighbors, community, and the sea remain in the hearts and lives of the disaster victims. For that very reason, we will continue to work hard to provide as much support as we can, keeping a clear focus on the needs of the disaster victims and making their “tsunagari” with the sea our key concern. ■



Reconstruction means reclaiming “homelands”. The Nippon Foundation aims to provide the necessary support for each one in turn.

1) The Japanese word “tsunagari” can be translated as networking with substantive collaboration and camaraderie.

Towards the Creation of an Iwate and Sanriku Homeland: Protecting Life and Living Together with the Sea and the Land

[KEYWORDS] the Great East Japan Earthquake / tsunami / reconstruction

Takuya TASSO

Governor of Iwate Prefecture

(Ship & Ocean Newsletter No.263 July 20, 2011)

The Great East Japan Earthquake and ensuing tsunami caused catastrophic damage; human and material damage in coastal areas of Iwate Prefecture alone went beyond all scenarios imaginable. Based on a resolve to “make this the last tsunami to claim human lives,” Iwate Prefecture has recently drawn up an “Iwate Prefecture Great East Japan Earthquake and Tsunami Reconstruction Plan: Basic Reconstruction Plan.” The principle aim of the Plan is “to protect life, to live together with the sea and land, and to create a homeland Iwate and Sanriku.”

The tsunami caused catastrophic damage in the Sanriku coastal area

Many precious lives were claimed and much property destroyed by the magnitude 9.0 earthquake that shook eastern Japan on March 11th and the giant tsunami that followed, as well as the subsequent intermittent aftershocks.

Coastal areas of Iwate Prefecture had already suffered tremendous damage in past disasters, particularly the 1896 Meiji-Sanriku earthquake and tsunami, the 1933 Sanriku earthquake and tsunami, and the 1960 Valdivia earthquake and tsunami in Chile. In the wake of these disasters, Iwate Prefecture implemented tsunami countermeasures such as developing coastal levees and other disaster prevention facilities, as well as local disaster prevention efforts.

However, the scale of this tsunami was much larger than previous ones; the damage it caused was on a scale that not even Iwate, a prefecture that has experienced many disasters in the past, had witnessed before. In the inland areas of the prefecture, meanwhile, not only did the earthquake and its aftershocks cause human casualties as well as damage to public engineering works, agriculture and forestry, but the disruption of supply lines and damage caused by rumor also had an impact on the whole of Iwate’s society and economy.

Now, faced with situations that defy description, the residents of Iwate are resolved to “make this the last tsunami to claim human lives.” They are determined to overcome the pain and sadness of the disaster and restore communities in which they can live and work safely.

A reconstruction plan based on scientific and technical expertise

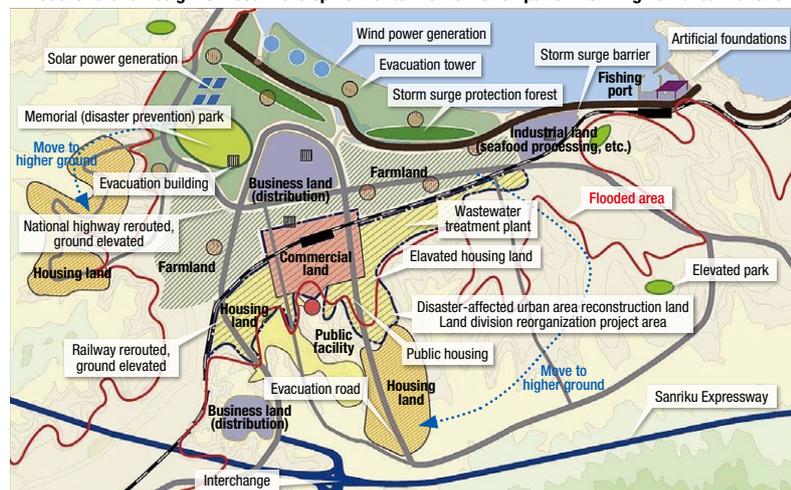
On June 9th, Iwate Prefecture drew up the “Iwate Prefecture Great East Japan Earthquake and Tsunami Reconstruction Plan: Basic Reconstruction Plan”¹⁾ to realize this determination. The aim of the Plan is for the whole of Iwate Prefecture, starting with coastal areas, to overcome the earthquake disaster and achieve robust reconstruction, while reflecting the opinions of representatives from all walks of life in the prefecture and of experts in tsunami disaster prevention, as well as the wishes of affected residents, cities, towns and villages. The Plan is based on scientific and technical expertise in tsunami disaster prevention and other issues, and has a rationale of providing long-term support for the reconstruction of affected cities, towns, and villages.

The Plan takes a stance of seeking “to protect life, to live together with the sea and land, and to create a homeland

Iwate and Sanriku.” Moreover, as its basic rationale on tsunami countermeasures, it aims to foster and maintain a culture of disaster prevention and multi-preventative community planning, so that no more human lives will be lost.

The Plan is built on three basic principles, with a view to reconstruction: “ensuring safety,” “rebuilding lives” and “regenerating industries.” Its lays out its basic rationale and steps towards reconstruction, from pressing issues to complete community reconstruction. Immediate concerns it addresses include building safe and secure disaster-resistant cities and regions, securing employment

■Model of Grand Design for Local Development Urban revitalization pattern forming new urban functions





The Kamaishi Dai-kannon (bottom left) and Kamaishi Bay

for its residents, developing residential environments so that disaster victims can quickly return to their daily lives, and reviving Iwate's key industry of fisheries. In terms of reviving fisheries, in particular, the aim is to promote the establishment of fisheries and aquaculture based on fisheries cooperatives, combined with the establishment of distribution and processing systems centered on fish markets in production regions. Based on these, moreover, the aim is to promote the restoration and improvement of coastal protection facilities and infrastructure for fishing harbors, fishing grounds and fishing village living environments.

Aiming to create a new Sanriku of global renown

Part of the Plan concerns the "Sanriku Creation Project," the aim of which is to create a new coastal area of global renown. The Project will stand as a symbol of reconstruction from a long-term perspective, with a view to achieving more robust reconstruction in coastal areas.

The Iwate coast lies at the northeastern end of Honshu Island. It is famous for its rich natural environment, including the Rikuchu Coast and natural harbors, with some of the most outstanding coastal scenery in Japan. Given these local features, fishing culture took root here as far back as the prehistoric Jomon age. Since then, steel-making, cement and other heavy industries, along with tourist industries including hotels and local produce stores have developed alongside fisheries, seafood processing and other sea-based industries. In coastal areas, the residents' lives and social and economic conditions have developed together with the sea of Sanriku. These coastal areas have a history richly imbued with the spirit of enterprise, including the worldwide trade in "Sanriku Tawaramono" (seafood products wrapped in straw bags) in Edo times. They are also blessed with abundant marine resources, including untold seabed and underwater resources. With these and other great fea-

tures, the Iwate coast has potential as a frontier open to the world and the future.

Moreover, the convergence of cold and warm currents, rich biodiversity, and other features of our coastal sea areas have attracted research institutions in a variety of marine fields to the area. Given that the eco-systems of these sea areas have changed considerably due the earthquake and tsunami, I see great value in this area as an arena for international ocean research aimed at analyzing current conditions, restoring ecosystems, etc.

I think these efforts to harness the ocean resources of Sanriku hold huge potential for achieving reconstruction, not only in Iwate Prefecture but also in Japan as a whole. In this "Sanriku Creation Project", therefore, we plan to launch projects in future aimed at making full use of the characteristics, resources and latent potential of Sanriku in fields such as environmental synergy and natural energies, promotion of industry, etc. We will seek broad-ranging proposals and participation in bringing these projects to fruition. A prime example will be the formation of an international ocean research hub through tripartite cooperation between industry, academia and government, aimed at creating new industries that utilize the marine resources of Sanriku.

In Iwate Prefecture, using this Plan as a blueprint for the future with a view to reconstruction, we aim to achieve a reconstruction rooted in local communities. Here, a wide range of stakeholders in the various communities will work together to become principal actors in the reconstruction, enabling our coasts and other disaster-affected areas to regain their importance in shouldering the future of Iwate. Benefitting from the momentum of the broad support and participation received from all over Japan and the world, we also plan to achieve an open reconstruction, using these connections as a driving force.

Reconstruction after the widespread and extensive damage caused by this major earthquake and tsunami is truly an issue of national importance, and the road to recovery will not be easy. However, my wish is that we should make steady progress on this road while embracing hopes of overcoming the damage caused by the disaster and creating a strong homeland of Iwate and Sanriku. In doing so, we will take encouragement from the support provided not only by the citizens of Iwate Prefecture but also from the rest of Japan and various countries and regions all over the world. ■

1) Iwate Prefecture plans to submit a bill for approval of the "Iwate Prefecture Great East Japan Earthquake and Tsunami Reconstruction Plan: Basic Reconstruction Plan (Proposal)" to the Prefectural Assembly in September, after carrying out public comment and local explanation sessions regarding the Plan as well as incorporating opinions and other findings. See Iwate Prefecture website. <http://www.pref.iwate.jp/view.rbz?cd=32806>

Simulating Ocean Dispersion of Radionuclides from the Fukushima Daiichi Nuclear Power Plant

[KEYWORDS] marine environment / numerical model / dispersion prediction

Yukio MASUMOTO

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(Ship & Ocean Newsletter No.267 September 20, 2011)

We know that radionuclides have been emitted from the Fukushima Daiichi nuclear power plant into the sea, but how have they spread from there? Attempts are now underway to reproduce and predict their distribution using numerical simulation. After introducing one example of these, I will consider some coming challenges.

Marine dispersion simulation

Since the accident at the Fukushima Daiichi nuclear power plant, radiation in the terrestrial atmosphere and soil has been observed extensively, and we have often seen spatial distribution charts and other data in the media. But although efforts to monitor and observe the spread and behavior of radionuclides discharged into the sea were started immediately after the accident, no overall image has emerged, owing to the limited geographical distribution of observation points. Now that five months have passed since the accident, radionuclides are thought to be dispersed over a wide area of the Pacific Ocean. Of course, we need to monitor the spread of radionuclides in coastal areas. Nevertheless, it is also an important task, in terms of evaluating the future impact of the radionuclides on marine eco-systems and providing information to fisheries, marine leisure, and other activities, to grasp the state of distribution over a wide area, and to understand the factors behind this distribution.

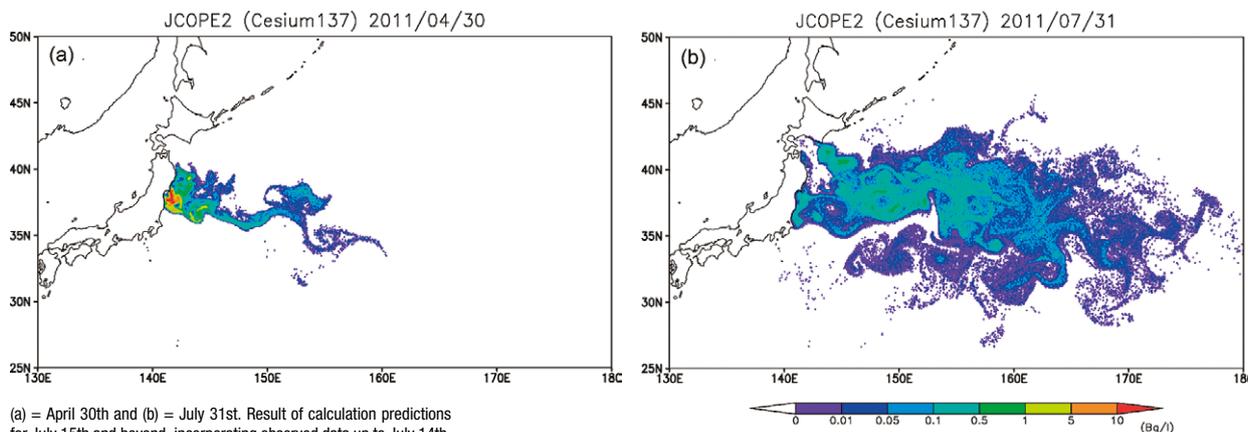
One method of providing useful information on this problem is marine dispersion simulation of radionuclides using a numerical model. This dispersion simulation consists of two parts: one that tries to estimate the currents that move and disperse radionuclides, and another that calculates the distribution and concentration of radionuclides.

The former uses an ocean circulation model that can reproduce changes in ocean currents, temperature, and salinity. By incorporating various observed data, it reproduces ocean conditions as realistically as possible, and predicts changes in ocean currents, seawater temperature and salinity over the next 1-2 months or so. Meanwhile, the part that deals with radionuclides divides into two methods. One is the method of releasing a stream of virtual particles and artificially calculating the distribution and concentration of radionuclides from the distribution and particle density (the particle tracking method). The other uses an equation to express the dispersion processes of a given substance (the advection-diffusion method). Combining these with the ocean circulation model enables us to reproduce and predict how radionuclides will move and spread in the ocean.

Attempts by JCOPE

At JAMSTEC, we have developed the Japan Coastal Ocean Predictability Experiment (JCOPE)¹⁾, a system for predicting ocean conditions near Japan. By adding a function for calculating radionuclide dispersion using the particle tracking method, JCOPE experimentally reproduces and predicts the distribution of iodine131, cesium 134, and cesium 137 directly emitted from the Fukushima No. 1 nuclear power plant into the sea. The results obtained so

■Simulation of cesium 137 distribution calculated by JCOPE (Japan Coastal Ocean Predictability Experiment)



(a) = April 30th and (b) = July 31st. Result of calculation predictions for July 15th and beyond, incorporating observed data up to July 14th.

far have been released to the press five times in all, via the Ministry of Education, Culture, Sports, Science and Technology²⁾, and the calculations are ongoing. The diagram shows the latest results of calculation by JCOPE.

The simulation results reveal that radionuclides near the coast of Fukushima have gradually spread eastwards while moving north-south under the strong influence of local winds. They also show that radionuclides flowing southwards some way off the coast have been picked up by the Kuroshio current and quickly carried eastwards. These and other findings demonstrate a distribution consistent with the results of monitoring observation. After that, the radionuclides seem to become diluted while spreading over a wider area. This is the result of two factors, namely the complex surface flow in the area between the Kuroshio and Oyashio currents, called the mixed-water region, and the flow associated with eddies measuring hundreds of kilometers in diameter, called meso-scale eddies. The results of numerical simulation enable us to interpolate monitoring data, both temporally and spatially, that have only been obtained at limited observation points. They also allow us to offer some suggestions for distribution in unobserved sea areas.

In the case of JCOPE, certainly, details like the location of the path of the Kuroshio current and the flow condition in the mixed-water region can be grasped very realistically. On the other hand, it should be borne in mind that these simulations depend on many assumptions and approximations, and are therefore limited. For example, there is not enough information on the timing and quantity of radionuclides from discharge sources, and discharge scenarios therefore have to be created from other limited information. In the case of JCOPE, again, calculations of flow rate and other values are obtained on grid points several kilometers apart; phenomena occurring on a scale smaller than this distance can only be incorporated as approximations. Moreover, even if the latest observed ocean data and wind products were incorporated, the observed values would still be limited in both space and time, and they also include observation error. There are some other constraints at the present stage in JCOPE; for example, radionuclides deposited from the atmosphere or those discharged via rivers and groundwater are not taken into account, nor are those that adhere to particles in seawater and are removed to the seabed. As a result, the actually observed distribution of radionuclides can sometimes differ from the simulation results. Since the error included in the results accumulates as the prediction period increases in length, it should be remembered that results more than about a month ahead will be accompa-

nied by a large error. Observation is essential in order to understand the actual situation. Given that the current situation must be considerably diluted, observation with a high degree of precision will surely be required from now on.

For more effective utilization

JCOPE was originally developed as a system for predicting changes in sea conditions around Japan's coasts. Calculations in response to this year's disaster started by attempting to predict how the various suspended solids released into the sea by the tsunami on March 11th would flow away. As this developed, we received a request from the Ministry of Education, Culture, Sports, Science and Technology for dispersion simulation of radionuclides. The initial reaction undeniably took time, as many supercomputers had shut down due to power shortages. Considering the present arrangement of so many nuclear power stations along the coast, a system that could estimate the volume of radionuclides emitted into the sea in the event of an emergency and simulate how they would spread through the ocean should already have been in place. The responsible agencies and chain of command need to be clarified and R&D aimed at improving the prediction skill promoted.

Another point of concern in providing these simulation results is that hardly any feedback has been obtained on the information provided. Hearing voices from the field – where and how the simulation results were used, whether they were useful, why the information was not useful, what other information is needed – would enable us to improve the system as a whole. In future, I strongly hope that a more precise, speedier response will be possible, and that we will be able to provide information of use to countermeasures in various quarters. ■

1) The latest current, temperature and salinity fields produced by JCOPE can be seen at <http://www.jamstec.go.jp/frcgc/jcope/>.

2) http://www.mext.go.jp/a_menu/saigajohou/syousai/1304938.htm

Using Ocean Bottom Observation to Elucidate the Mechanism of Earthquakes and Tsunamis

[KEYWORDS] ocean bottom pressure gauge / great earthquake / the Great East Japan Earthquake

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(Ship & Ocean Newsletter No.269 October 20, 2011)

The tsunami caused by the Great East Japan Earthquake was recorded by ocean bottom pressure gauges in the sea off Kamaishi, Iwate Prefecture, before it reached the Sanriku coasts of East Japan. Meanwhile, the mechanism of mega-scale earthquakes that only strike once in hundreds of years has been clarified from observation data on water pressure and seafloor movement. Installing an observation network of ocean bottom pressure gauges and seismometers using seafloor cables near the Japanese archipelago would enable us not only to detect impending tsunamis before they reach the coasts, but also to elucidate the mechanism and make long-term predictions of mega-scale earthquakes.

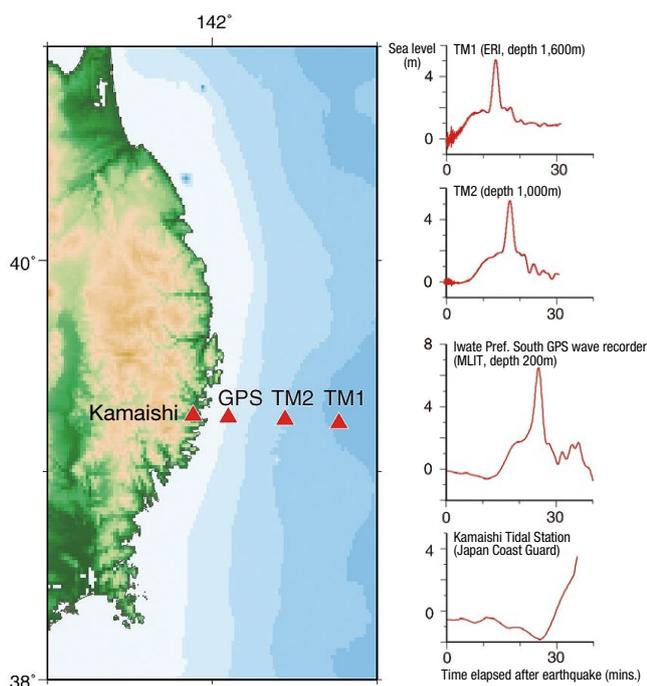
The tsunami was recorded before it happened

A giant earthquake beneath the Pacific Ocean off Tohoku occurred at 14:46 (Japan time) on March 11th this year. About a half hour later, a tsunami caused by the earthquake reached the coasts of Iwate, Miyagi and Fukushima Prefectures, causing a catastrophic disaster that left around 20,000 people dead or missing. This tsunami had already been recorded by ocean bottom pressure gauges in the sea off Kamaishi, Iwate Prefecture, immediately after the earthquake (see diagram). These ocean bottom pressure gauges are connected to seafloor cables laid by the Earthquake Research Institute, The University of Tokyo (ERI), one at a depth of 1,600m (TM1) some 76km out to sea and the other at 1,000m (TM2) 47km from the shore. Data from these gauges were sent in real time to the Japan Meteorological Agency and ERI, among others.

Gauge TM1 first recorded the seafloor movement caused by the earthquake, followed by a rise of about two meters in the sea surface over the next six minutes (tsunami wave 1), and a further rise of three meters over two minutes about four minutes after that (tsunami wave 2). In other words, a tsunami measuring up to five meters had been recorded in seas off Sanriku within about 15 minutes of the earthquake. This two-stage tsunami was recorded by ocean bottom pressure gauge TM2 on the landward side about five minutes later. Another seven minutes after that, it was also recorded by a GPS wave gauge (water depth 200m) installed by the Ministry of Land, Infrastructure, Transport and Tourism in the sea off Kamaishi.

The Japan Meteorological Agency issued major tsunami warnings of six meters for the coast of Miyagi Prefecture and three meters for Iwate Prefecture three minutes after the earthquake. However, it is difficult to estimate the entire size of a great earthquake in just three minutes, hence the predictions of tsunami height were underestimated. Since a large tsunami had been recorded out at sea as mentioned above, the Japan Meteorological Agency doubled its prediction of the tsunami height at 15:14. Unfortunately, this information was not adequately relayed, partly due to a power outage immediately after the earthquake, and partly because residents in coastal areas had already started evacuation.

■The March 11 tsunami recorded off Kamaishi



Observing tsunami

Conventionally, tsunamis have been observed by tide gauge stations installed on coasts (depending on the installing authority, these may also be called tidal stations or tidal observatories). Over the last ten years or so, however, wave recorders and offshore ocean bottom pressure gauges have been developed and installed. There are several types of these, as described below.

GPS wave recorders measure the height of the ocean surface and consist of a GPS receiver on a buoy floating in the sea. The Ministry of Land, Infrastructure, Transport

and Tourism has installed 15 of these GPS wave recorders around the coast of Japan, and uses them to observe surge waves caused by typhoons, etc., as well as tsunamis. Their weakness is that they cannot be installed more than about 20km from the shore, and therefore can only record a tsunami just before it hits the coast. Nevertheless, technology is now being developed to install them about 100km out at sea.

Ocean bottom pressure gauges record changes in pressure on the seafloor due to the passage of a tsunami. With this method, observation is possible not only on the coast but also in the middle of the Pacific Ocean. However, to receive their observed data in real time, data need to be sent via seafloor cables or via satellite from the ocean buoys. Ocean bottom pressure gauges using cables have been installed at nearly 20 points around Japan so far. The National Oceanic and Atmospheric Administration in the USA has developed the DART system for sending data to ocean buoys from the seafloor using acoustic waves, and for receiving data from the buoys via satellites. It has installed ocean bottom pressure gauges at about 40 points in the Pacific and Atlantic Oceans.

Mechanism of a massive tsunami

Analyses of tsunami waveforms recorded by ocean bottom pressure gauges in the sea off Kamaishi and elsewhere allow us to clarify the mechanism of this earthquake. Tsunami wave 1, recorded as a gradual rise in the offshore sea level, was caused by movement of the seafloor within about 100km from the coast. This closely resembles a tsunami caused by the Jogan Earthquake in the year 869, which flooded an area several kilometers inland on the Sendai Plain. Tsunami wave 2, recorded next as a sharp rise in sea level, was caused by movement of the seafloor near the Japan Trench, even further out to sea. This is similar to the Meiji-Sanriku tsunami of 1896, which claimed 22,000 lives. The 2011 tsunami, therefore, was a simultaneous occurrence of a Jogan earthquake-type tsunami and a Meiji-Sanriku earthquake-type tsunami, which is thought to explain the extensive tsunami damage across Iwate, Miyagi and Fukushima Prefectures.

Offshore observation of the 2011 earthquake has revealed an even more astonishing fact, besides that of the tsunami. Tohoku University had installed an ocean bottom pressure gauge on the seafloor before the earthquake, and when the gauge was retrieved after the earthquake, it became clear that this earthquake had lifted the seafloor by up to five meters. Other results of seafloor observations carried out before and after the earthquake by the Japan Coast Guard and the Japan Agency for Marine-Earth Science and Tech-

nology (JAMSTEC) proved that the seafloor had moved up to 20-50 meters horizontally. From these observation data, the reality of a giant earthquake in the magnitude 9 class, previously thought unimaginable, is gradually becoming clear. We now know that a major ground shift occurred near the Japan Trench, where it was previously thought that no large strain had accumulated.

To enhance offshore ocean observation

Large subduction-zone earthquakes occur repeatedly near the Japanese archipelago. The record of large earthquakes over the past several hundred years has been studied, mainly from old documents and other sources, and forecast of future earthquakes have been based on this. The 2011 earthquake has demonstrated that long-term earthquake forecast based on historical records has only addressed a very small part of the earthquake occurrence cycle, and that an earthquake super-cycle with a longer frequency exists. To elucidate the mechanism of giant earthquakes thought to occur only once in several hundred years, like this one, seafloor observation near trenches will be important.

By installing ocean bottom pressure gauges, seismometers and other observation equipment on the seafloor around the Japanese archipelago, we will be able to detect tsunamis heading towards the coast in advance and issue more precise tsunami warnings. This will also be of use in understanding the mechanism and forecasting the occurrence of mega-scale earthquakes.

Since the earthquake in southern Hyogo Prefecture that caused the Great Hanshin-Awaji Earthquake disaster of 1995, more than 1,000 seismometers and a GPS observation network have been installed around the Japanese archipelago. By contrast, only about 20 ocean bottom pressure gauges have been installed in seas surrounding the Japanese archipelago so far. In the Nankai Trough, where a Tokai-Tonankai-Nankai earthquake is expected to occur within the next few decades, an ocean-floor observation network based on cables (DONET) is gradually being installed off the Kii peninsula. This kind of seafloor observation network needs to be extended around the entire Japan. For example, if ocean bottom pressure gauges were arranged at intervals of around 30 km, we would be able to detect a tsunami about 10 minutes after an earthquake occurs, and predict the size of the tsunami 10-20 minutes before it hits the coast. Although several thousand kilometers of seafloor cables and several hundred ocean bottom pressure gauges will be needed for this, by doing so we will be able to prevent tsunami damage, such as that suffered in the Great East Japan Earthquake disaster, from ever happening again. ■

Start of the “NF-UBC Nereus Program — Predicting the Future Ocean” to Preserve Oceans for Posterity

[KEYWORDS] capacity building / sustainable fisheries / inter-disciplinary challenge

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(Ship & Ocean Newsletter No.270 November 5, 2011)

The “NF-UBC Nereus Program – Predicting the Future Ocean,” a joint program between the Nippon Foundation and the University of British Columbia, was formally established in autumn 2011.

There is only one sea, and we all share it.

The depletion of fishery resources is a problem shared by the whole of humanity. To achieve sustainable fisheries, we aim to train human resources in maritime fields who can deepen a shared understanding that transcends national frontiers and interests.

Introduction

The “NF-UBC Nereus Program,” the world’s first international ocean program of its kind, was formally established in autumn 2011. This is a collaborative project between the Nippon Foundation and the University of British Columbia, actively engaged in sustainable fisheries management and marine conservation. The Program is based on the philosophy that “The depletion of fishery resources is a problem shared by the whole of humanity; we must strive to solve it beyond our individual interests and viewpoints.” It is being implemented as part of “Capacity Building in the World of the Sea.” This is a Nippon Foundation project designed to give ocean researchers experience of understanding problems of the oceans comprehensively from different points of view, and to nurture interlinkage between people across many different sectors with connections to the future.



Nereus Program: <http://www.nereusprogram.org>

Background to the launch of Nereus — the depletion of fishery resources and the need for training of human resources in maritime fields for sustainable fisheries

The depletion of fishery resources is not only a problem concerning the marine environment, in terms of conserving marine eco-systems and biodiversity; it is also a social problem related to world food security and employment in coastal communities. The large fish we often eat (such as

tuna) move extensively across the oceans, while many other fish cross national borders as a result of international trade. To achieve sustainable fisheries and marine conservation, therefore, we need to promote these with a cross-sector, international approach. To address this demand, a new program in ocean science, the “NF-UBC Nereus Program – Predicting the Future Ocean,” has been launched. Its aim is to practice correct fishery resource management and utilization, with an eye on the future of the world’s oceans.

Fish are strongly linked to the lives and society of the Japanese, as living provisions for people connected with fishery industries (fishing, distribution, processing) and traditions cultivated through food. However, in addition to existing problems like the ageing of fishery workers and diminishing employment opportunities in fisheries, an increase in imports is reducing Japan’s self-sufficiency in marine produce. On top of this, the Great East Japan Earthquake dealt a heavy blow to Japan’s fish supplies, and we now find ourselves pressed to revise our relationship with fish and the oceans through our dietary habits.

Globally, fish catches have remained stagnant or tended to decline over the last 20 years. Although fishing capacity has improved dramatically due to advances in technology since the 1960s, the current fish supply volume has actually been decreased less than it was in the 1980s. In regional terms, for instance, fish catches per trawler in the North Atlantic have declined to 5-10% of their level a century ago, while in Southeast Asia catches have fallen by half in 40 years. In Western Africa, meanwhile, catches of large fish have slumped to 5-10% of their peak. The only sector to expand is aquaculture, with its heavy environmental burden. The depletion of natural fishery resources is thought to be destroying marine eco-systems on a global scale and poses a grave threat to the rich seas we should be preserving for posterity.

In Japan, as in the rest of the world, fishing is a very important productive activity that maintains a stable supply of food. Given the current situation outlined above, however, there is increasing concern amongst fishers, scientists and other fishery experts that our oceans will not be able to

supply enough fish for future generations. The depletion of fishery resources is a problem that must be solved through concerted action by experts and fishers. First of all, we should develop a correct awareness of elements that have an impact on the oceans, including human activity; we also need to determine the present state of the sea and predict trends in changes from various perspectives.

However, although fishery studies have developed worldwide with a focus on marine conservation and fishery resource management, there are few efforts based on an interdisciplinary approach integrating social and natural sciences. Indeed, as long-term initiatives on a global scale, interdisciplinary research on problems of fishery resources and ocean programs based on human resource training and enhancing public awareness have not existed until now.

The NF-UBC Nereus Program: Predicting the Future Ocean

The aims of the Nereus Program are to conduct research, train human resources and enhance public awareness, and to promote sustainable fisheries and marine conservation based on scientific research. The Program is a collaboration between the Nippon Foundation and the University of British Columbia in Canada, along with five other universities and research institutes (Cambridge University in the UK, Princeton University and Duke University in the USA, Stockholm University in Sweden, and the World Conservation Monitoring Centre in Cambridge, UK). These will implement the Program over a total research period of eight years (Phase One: 3 years, Phase Two: 3 years, Phase Three: 2 years) starting in September 2011. With the participation of researchers in ecology, economics, conservation, geography, biology, anthropology and other disciplines, the aim of the Program’s research is to predict “the state of the oceans in 2050,” including fishery resources and the state of marine eco-systems. Based on this, we will examine directions for systems of management and fishery distribution that will facilitate healthier, more sustainable fishery resource management. We will then conduct practical analysis on requisite systems of management and distribution, etc., and contribute to improving strategic global fishery resource management through concrete regional or international policy proposals.

Besides these initiatives, we will hold our own international seminars, symposia and workshops, etc., to answer general questions like “How far have fish stocks actually diminished?” and “What should international agencies,

countries and individuals do to conserve resources?” We will actively transmit information on the outcome of this research in Japan and abroad.

As for training human resources, the principal objective of the Program, young researchers from different areas of expertise will be assigned to the various partner institutions (1 Ph.D. student and 1 postdoctoral researcher in each case). There, they will conduct specialized research to resolve problems of fishery resources but keeping a wide view on entire sustainability of ocean globally. The outcome of this research will ultimately be integrated within Nereus, using marine eco-system and geographical space distribution models. By taking part in all processes of integrating the outcome of individual research, the participating researchers will accumulate experience in cross-sector debate and interdisciplinary research from a comprehensive and global perspective. Thus, the ultimate objective of the Nereus Program is to produce researchers who have an “interdisciplinary vision,” “communication skills” and “policy mindsets.” In this way, we hope to build a comprehensive ocean sciences network that will contribute to achieving sustainable fisheries.

Conclusion

Japan is a maritime country with wonderful traditions and expertise, and it is geographically connected to the rest of the world through the oceans. The participation of Japanese researchers will of course be indispensable to the Nereus network, and I am keen to seek support for the aims of the Program, i.e., “connections of knowledge and human resources.”

There is only one sea, and we all share it. Taking this as our philosophy, I hope the Nereus Program will work on a global scale to (1) train human resources who can enhance a shared understanding that transcends individual viewpoints, (2) conduct research in pursuit of future directions for local and global resource management, taking account of oceanic balance, and (3) encourage greater cooperation from those who make policy implementation possible. ■

Reference: Ship & Ocean Newsletter No. 241 (Aug. 20, 2010) “Capacity Building in the World of the Sea” by Mitsuyuki Unno, Director, Maritime Affairs Department, Nippon Foundation
http://www.sof.or.jp/en/news/201-250/241_1.php

●Yoshitaka Ota’s personal blog <http://blog.canpan.info/otanereus>