Rep. Mar. Ecol. Res. Inst., No.22 (Supplement), 47-53, 2017

Special Report: “Radioactivity in the Marine Environment and in Fishery Products during the Five Years after the Fukushima Dai-ichi Nuclear Power Plant Accident”

Panel Discussion Concerning the Program of Further Monitoring of Radioactive Substances in the Ocean

Chairperson: Takashi Ishimaru*1§
Panelists: Yoshiharu Nemoto*2, Masashi Kusakabe*3,
Hyoe Takata*3 and Mizurou Yokota*3

Mr. S. Fujii (MC):

Let us begin the panel discussion session. Dr. Takashi Ishimaru, an honorary professor of the Tokyo University of Marine Science and Technology, is the chairperson. After the accident at the Fukushima Daiichi Nuclear Power Plant (FDNPP), he began surveys of radioactivity in the coastal area off Fukushima using training ships from the University. Presently, he is actively working on the front line of marine surveys as a specially appointed professor at the University. Now, I will give the floor to Dr. T. Ishimaru.

Panel discussion

Dr. Ishimaru:

Thank you for the introduction.

We had four presenters today. First, Dr. M. Kusakabe from the Marine Ecology Research Institute (MERI) introduced us to the subject of naturally occurring radioactive substances in the ocean and the behavior of radioactive substances that enter the ocean due to nuclear power plant accidents and nuclear tests. He also provided us with basic information and the history of research related to radioactivity in the ocean. Second, Dr. H. Takata from MERI presented the changes in the activities of radionuclides in seawater and marine sediments that MERI has been monitoring for the last five years. He compared those changes to changes of activities reported since 1983 along shorelines near nuclear facilities, and he discussed those long-term changes. He was followed by Mr. M. Yokota, also from MERI, who presented the changes in activities of radioisotopes in commercial marine fish harvested outside of Fukushima Prefecture. Finally, Mr. Y. Nemoto of the Fukushima Fisheries Experimental Station presented an outline for monitoring of radioactivity in commercial fish captured in Fukushima Prefecture from the accident until the present time. He

(Received 14 February 2017; accepted 18 May 2017)
∗1 Professor Emeritus, Tokyo University of Marine Science and Technology (4-5-7 Konan, Minato-ku, Tokyo 108-8477, Japan)
§ E -mail: ishimaru@kaiyodai.ac.jp
∗2 Fishing Ground Environment Division, Fukushima Prefectural Fisheries Experimental Station (13-2 Matsushita, Onahamashimokajiro, Iwaki, Fukushima 970-0316, Japan)
∗3 Central Laboratory, Marine Ecology Research Institute (300 Iwawada, Onjuku-machi, Isumi-gun, Chiba 299-5105, Japan)

also described the efforts being made to resume fishery operations.

All lecturers discussed monitoring of radioactivity. Therefore, in this panel discussion, we would like to discuss "the program of further monitoring of radioactive substances in the ocean". First, let us hear from our speakers.

Dr. T. Ishimaru

Dr. Kusakabe:

In my presentation, I focused on marine radioactivity prior to the accident. However, since the accident, I have wondered if the data collected for more than 30 years by MERI were still useful for analyzing the activities of radioactive substances in the ocean following the accident. They constitute essential data for analyzing temporal changes and current conditions accurately and predicting future changes.

Dr. M. Kusakabe

Dr. Takata:

I presented mostly the changes in activities of radioactive substances before and after the accident. Monitoring data before and after the accident were used to predict future changes and the time required for the activities to return to pre-accident levels. I intended to explain possible future changes in the activities of radioactive substances in the ocean based on scientific evidence, especially in a way easily understood by laypersons.

Dr. H. Takata

Mr. Yokota:

The program of radioactivity monitoring of commercial fish that I presented has gained attention from the fishing industry and general public, and it has become popular worldwide in the context of food safety and security. Many people came from around the world to visit our laboratory. Seeing the analytical procedures and directly exchanging information with researchers provided a good opportunity for visitors to gain peace of mind. However, some countries are still restricting the importation of fish and other seafood harvested in eastern Japan because not all negative rumors have been dispelled. Therefore, we will continue to analyze samples of commercial fish for radioactivity as part of the monitoring program. There will be no reduction in the number of samples analyzed, and the monitoring will not be interrupted.

Mr. M. Yokota

Mr. Nemoto:

Fukushima Prefecture was severely affected by the earthquake and the nuclear accident. As a result of the nuclear accident, commercial fishing had to begin at a time when there was much concern about the risk associated with eating fish from the part of the ocean impacted by the accident. To earn the trust of consumers, Fukushima Prefecture has been analyzing as many specimens as possible and has published all the data. Five years have now passed since the accident, and the activities of radioactive substances have decreased significantly; in fact, they have almost returned to the levels prior to the accident. The Prefecture plans to continue monitoring the radioactivity of commercial fish in the future to assure consumers that the fish are safe to eat.

Mr. Y. Nemoto

Dr. Ishimaru:

Thank you so much. I have been told that continued long-term monitoring is important. It is also important to share our knowledge worldwide to gain the trust of consumers. If anyone in the audience has any questions, please go ahead.

General participant:

Mr. Yokota from the MERI told us in detail about the sample processing associated with the monitoring program, and so on. However, is this method the same as the one used as a part of the monitoring conducted in Fukushima Prefecture?

Mr. Nemoto:

It is essentially the same. In the case of Fukushima Prefecture, a fish that is used as a specimen is brought to the experiment station, and samples for analysis are taken from edible parts of the fish once the species is determined. Which parts of the fish are consumed depends on the species of fish. For example, Japanese flounder is usually eaten as sashimi, and therefore only the muscle tissue is analyzed. Round greeneyes and other fish that are deep-fried whole were analyzed in their entirety. We adjust the sample processing and analytical method to reflect the way the commercial fish are eaten.

General participant:

The activity of radioactive substances in commercial fish from Fukushima Prefecture is only that of ^{137}Cs. However, the data from MERI are the combined activities of ^{134}Cs and ^{137}Cs. Is Fukushima Prefecture measuring the activity of ^{134}Cs?

Mr. Nemoto:

The radioactivity of cesium monitored in commercial fish samples is the sum of the activities of ^{134}Cs and ^{137}Cs. Substances such as smaller prey fish and seawater, which are analyzed for other scientific programs, are assayed for only ^{137}Cs to document the decreasing trend in ^{137}Cs activity.

Dr. Ishimaru:

When measuring radioactivity with a germanium semiconductor detector, ^{134}Cs and ^{137}Cs are measured

simultaneously. Therefore, I believe that Fukushima Prefecture has all the data for both radioisotopes.

General participant:

When changes in the activities of radioactive substances in seafood and seawater before and after the accident are presented at gatherings and conferences concerned with risk management and communication, the results are explained to consumers in the context of changes in attenuation curves and mean values. It is argued that these are approaching values prior to the accident. However, whether or not the values of something are similar before and after the accident must be determined with a statistical test. For example, can you detect the difference before and after the accident if a nonparametric significance test is used? How do you feel about the need for scientific determination and prediction?

Dr. Ishimaru:

Are these projects using statistical analyses?

Dr. Kusakabe:

As you pointed out, statistical analysis of the activities of radioactive substances before and after the accident is necessary. There are some candidate specific methods to be used. We are examining this issue. However, statistical analysis is not easy. For example, there are large variations in the activities of radioactive substances in the marine sediments that I am working on. Even if I considered the activities in the sediment from a single location, the change is not constant. In any case, statistical analysis is indeed necessary.

General participant:

Saying, "The mean activity of radioactive substances before and after the accident is approximately the same, or it is generally decreasing" is not scientific or professional. I was also wondering what scientific analytical methods were available for these data.

Dr. Ishimaru:

For example, the activity of radioactive substances in the ocean around a nuclear power plant would be variable, because the leak from an accident would be intermittent. In addition, ocean currents do not flow from upstream to downstream similar to the flow in a river; instead, ocean currents are complex and variable, and they have vortex structures. An analysis that took these issues into consideration would require a very long-term monitoring program. In the case of radioactive substances in marine sediments, the grain size of the sediments (e.g., sand or clay) and the median grain size of the sand create variations in the radioactivities. Furthermore, there are differences in the depths of the sampling points. To perform a highly reliable data analysis, more data would be required. Are there any other questions?

Dr. Akira Wada(Honorary Professor, Nihon University):

MERI has been conducting various monitoring surveys in the ocean adjacent to nuclear power plants throughout Japan. MERI is a research institution rich in experience. In the case of the present nuclear power plant accident, MERI has been conducting surveys based on their expertise. For example, with much effort, MERI has been monitoring strongly nonlinear phenomena. An example is the exchange of radioactive substances between seawater and marine sediments, as presented by Dr. Kusakabe. There are consequently some convincing research results. Although it has been five years since the accident, monitoring should continue. The scale, however, may change. Recently, MERI presented the radioactivity monitoring results in a very skillful manner. In the future, it will be important to continue the survey, but it will also be important to improve the presentation of results. For example, visual aids such as publication-quality graphs should be used to help the general public understand the current status of radioactivity in the marine environment and in seafood. For example, the figure showing the distributions of ^{137}Cs and ^{134}C activities in the ocean on page 28 of the proceedings and the figure showing the activity of ^{137}Cs remaining in seawater on page 29 can lead to misunderstanding if presented individually. These figures need supportive explanations. In addition, the analysis of monitoring data needs to be scrutinized.

Dr. Ishimaru:

All speakers who presented today have published in international scientific journals, and they are highly respected for their achievements as scientists. However,

it is very difficult for them to explain the current results to laypersons; communicating to the public may not be their cup of tea. In the future, it may be necessary for someone who has experience presenting to the general public to prepare graphs and tables of research results to present to the general public. Are there any more questions?

General participant:

According to Mr. Nemoto, they evaluate safety with the goal of having the activities be lower than the national standard because they give high priority to the safety of consumers. I understood that well. The presentation by MERI excluded data for seafood from Fukushima Prefecture. What was the reason behind this? If possible, can you set up a system in which measured values can be crosschecked between MERI and Fukushima Prefecture?

Mr. Yokota:

The objective of our project was to monitor activities of radioactive substances in seafood sold in the market to ensure food safety and security. As you know, the fishery industry in Fukushima Prefecture was annihilated by the tsunami and nuclear power plant accident in the immediate aftermath of the disaster. Therefore, we examined seafood that was generally available in the market. Fukushima Prefecture measures the activities of radioactive substances in seafood in Fukushima Prefecture, whereas the MERI measures that of other fishery products. In that manner, we share our task load.

General participant:

Is there a plan to perform a crosscheck between the two organizations in the future?

Mr. Yokota:

MERI began measuring activities of radioactive substances in commercial marine fish captured off the coast of Fukushima Prefecture as of last year.

Dr. Ishimaru:

The monitoring survey conducted by MERI was commissioned by the Japanese government. Monitoring of seafood from Fukushima Prefecture has been performed by Fukushima Prefecture, whereas MERI monitors other seafood. The Fisheries Agency summarizes the results from both organizations and publishes the results on their website. The same measurement methods are used by both organizations. The methods are evaluated and verified by international organizations, and their reliability is assured.

Dr. Takata:

As far as crosschecking is concerned, there is a comprehensive skill test by the International Atomic Energy Agency (IAEA), in which seawater and marine sediments that have been analyzed by the IAEA are measured to evaluate the analytical skill of each facility. Only analytical facilities that have passed this test are analyzing the samples. Hence there is no difference between facilities, and reliability is assured.

The activity of radioactive substances in seawater varies near FDNPP. Based on the figure on page 28 of the proceedings, variation is great, and the activity of radioactive cesium is not clearly decreasing with time. Our monthly survey and daily data from Fukushima Prefecture and the Tokyo Electric Power Company (TEPCO) have been summarized to reveal trends, but in the future, more detailed scientific data should be combined to produce a simple model of changes that can be used to clearly explain the decreasing trend.

Dr. Ishimaru:

Are there any other comments?

Mr. Nemoto told us that various responses to negative rumors are being considered, because such rumors are expected to continue. I am wondering if someone from the Women's Forum could comment on that. How can you prevent negative rumors? Is there a policy for rumor prevention?

General participant:

I want to thank you for the opportunity to participate in an event like this as a consumer. Though consumers demand food safety and security, in fact most are unaware that various researchers are diligently conducting many different studies. Rumor is born out of ignorance. It would therefore be great if you could find a way to present your research results in a way that would be easier for the general public to understand.

Understanding would lead to peace of mind for consumers.

We, the Women's Forum for Fish, are a group of female fishery workers and consumers who consider the safety and security of food and food culture. We focus primarily on fish. We have been working for decades with female fishery workers from Hisanohama, Fukushima, who were severely affected by the earthquake disaster. We plan to contact homemakers in Hisanohama, hold study sessions on food safety while enjoying fish from Fukushima, and support the fishery industry of Fukushima. In these study sessions, I hope to share the results of the radioactivity research that I learned about today. I hope you will continue with these surveys and find a way to share your results that is easy for general consumers to understand. Thank you again for this opportunity.

Dr. Ishimaru:

Since we have an opportunity here, let us hear from the president.

President Kagawa:

We hope to continue with this radioactivity survey, because it is also necessary. As for the project, etc., we will continue the project as well as discussions with the government of Japan. In addition, we plan to publish the results of the project and related information in a way that is easy to understand.

Dr. Ishimaru:

I have been asked to give a lecture several times by groups associated with fish markets. I have also given lectures upon request by Fukushima Prefecture. I assume that other researchers who presented today have had similar experiences. We will not turn down any request for lectures. Not only would we be glad to accept requests, but we would also be grateful for the opportunity to present.

Mr. Nemoto:

Thank you for your support. Actually, I also have talked about radioactivity and the survey results in many different venues, and I am surprised that many people "heard" this information "for the first time". I have come to realize how inadequate our public relations have been. The most effective way to share information seems to be mass media: either we invite the media to come to Fukushima, or we head out to Tokyo for a press conference. In addition, the construction of a new fish market was completed in Onahama last year, and construction of another will be completed in Soma this year. We plan to hold fish festivals in these fish markets. In the future, we can communicate about issues like food safety and security to consumers through events like this. As for public relations, we would like to take your advice and welcome more comments.

Dr. Ishimaru:

Are there any other comments or questions?

General participant:

I presently belong to the Chuo-ku Kankyo-Hozen Network. It is my personal belief that fish in the market is safe. In the Consumers' Co-operative that we usually use, the food has stickers showing the results of radioactivity tests, and consumers can choose based on these stickers. If other retailers and markets employed this approach, consumers would feel safer with their purchases.

General participant:

The areas where fishing trials are being conducted are outside of the 20-km radius from FDNPP. Therefore, as long as this 20-km radius is set, we feel that the marine environment and fishery products within that area are unsafe. We would like you to have that 20-km radius removed and declare that the marine environment and ecosystem around the shores of Fukushima Prefecture are safe. If this 20-km radius continues to be used, consumers and the general public most likely will not feel safe.

Mr. Nemoto:

With respect to labeling food at the co-op with the radioactivity test results, Fukushima Prefecture itself adds test results when shipping fishery products from the market. We are actively encouraging supermarkets to add labels as well. As for the 20-km radius; in 2013, when TEPCO reported that contaminated water was leaking from the area around the nuclear plant, all trial

fishing operations were temporarily stopped, and when the trial fishing was resumed, the 20-km radius was voluntarily set up. Presently, a water barrier has been built, and the activities of radioactive substances around the nuclear plant have notably decreased. During the monitoring survey, seawater and seafood within the 20-km radius have been tested carefully, and safety is evaluated based on these results. Indeed, the 20-km radius may invite misunderstanding, and we are considering reducing this radius as well.

Dr. Ishimaru:

Is there anything else?

General participant:

I understood the importance of the monitoring project by MERI. Given that these monitoring results should be kept as a legacy, data must be shared widely with the general public. For example, I assume that there is a large amount of data other than the activity of radioactive substances, such as the coordinates of where a fish was collected and the size of the fish. MERI has been the first to analyze the data, but if there are limited human resources and time, sharing these other data with multiple institutions may allow modeling analysis to be performed smoothly. Furthermore, providing data to the IAEA will create an opportunity for foreign research institutions to participate in the analyses and thus accelerate data analysis.

Other than in cases where no part of a sample remained after the analysis, are you not able to negotiate with the government on a project so that monitoring samples are stored as assets to allow future generations to analyze the samples, as is the case with marine sediments?

Dr. Ishimaru:

On the one hand, because MERI is commissioned by the Japanese government, we must work with the government and other associated organizations. On the other hand, as long as we are commissioned by the government, the funding comes from taxes; therefore, the results must be passed on to future generations and must be scientifically evaluated. Furthermore, it is extremely important to properly explain the results to citizens and consumers.

Any comments from Mr. Kagawa, the president of MERI?

Mr. Kagawa:

If the general public strongly demands publication of data and sample storage, the government would likely consider it. We will keep the lines of communication open on this topic. However, radioactivity levels in commercial fish have already been published on the Fishery Agency homepage, along with an English summary of the data. Please go review those websites.

Dr. Ishimaru:

The website of each ministry publishes detailed results of the radioactivity surveys. If you are interested, please go to the websites of Fukushima Prefecture, Ministry of the Environment, Fisheries Agency, Ministry of Health, Labour and Welfare, and Nuclear Regulation Authority, among others. I think that there is a surprisingly large amount of information there. However, these data may not be easily comprehensible for those who are not specialists.

In addition, I get the impression that the efforts of various ministries and agencies are not directly connected, although, for example, the Ministry of the Environment and the Fisheries Agency have been conducting surveys to elucidate the cause of freshwater fish contamination with high levels of radioactivity. I look forward to cross-sectional efforts between ministries and agencies.

Well, our time is up, so let us conclude the panel discussion.

Mr. Fujii (MC):

I would like to thank the chairperson, Dr. Ishimaru, and all the panelists for their time.