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Results from a Consciousness Survey of Marine Science Education ; Marine Educators in Japan and the US

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Abstract: Survey of the differences of understanding towards marine science education between USA and Japanese marine educators was conducted using questionnaire method. Both sides think that marine science education is important for citizens to have a concern of the ocean, K-12 educations are also needed, but both citizens don't concern about the ocean and marine science education. And I found also that USA marine educators have a strongly consciousness about environment conservation, and think that the ocean is a good field of scientific searching activity or leisure activity. On the other hand, Japanese marine educators have a strongly expectation that the ocean is a place of seafood production (e.g. not only fish but seaweed), and think the ocean is not a place of leisure activity. These results suggest that USA and Japanese marine educators have difference thinking towards the ocean.

Key words: Marine science education, Ocean literacy

Introduction

As an island country, Japan has long benefited from the ocean as an essential resource for daily life. Japanese are known as the world's greatest fish consumers per person. The ocean has always been important for Japanese people¹⁾.

Nevertheless, K-12²⁾ textbooks in Japan almost entirely ignore oceans. Japanese people have almost no chance to study the ocean systematically, except at 46 fisheries high schools²⁾. In stark contrast, President G. W. Bush submitted the "U.S. Ocean Action Plan" to Congress in response to the recommendation made by the U.S. Commission on Ocean Policy in December 2004³⁾. The "U.S. Ocean Action Plan" includes the observation that the United States is endowed with the largest Exclusive Economic Zone and with the greatest system of freshwater lakes in the world; it has benefited enormously from oceans, coasts, and the Great Lakes. The plan is to employ the best science and data to inform decision-making to advance the next generation of ocean, coastal, and Great Lakes policies. The administration is compelled to continue to work toward an ecosystem-based approach in making decisions related to water, land, and resource management, and supports promoting ocean literacy and ocean education.

In October 2004, a virtual workshop was sponsored by the National Geographic Society's Oceans for Life Initiative in cooperation with the National Oceanic and Atmospheric Administration (NOAA), the COSEE Network, NMEA, and their partners. The community agreed on an ocean literacy definition, tagline, ocean concepts, and an alignment matrix to promote ocean liter-

acy. The seven essential principles and 44 fundamental concepts were identified as those necessary to support the definition of ocean literacy in November 2005⁴⁾. At the National Marine Educators Association held in New York, NMEA members presented their marine science education enforced at their facilities or their field study at each of seven principal categories.

In Japan, ocean literacy is necessary for promotion of marine science education in formal or informal K-12 studies. However, it is necessary to know the readiness and needs of citizens in Japan about the ocean before enhancing the concept of ocean literacy.

Materials and Methods

The survey was conducted to clarify differences between US and Japanese marine educators towards marine science education with the aim of boosting future ocean literacy in Japan.

This survey clarified differences between the U.S. and Japanese marine educators' understanding of marine science education. The U.S. survey was conducted in July 2006 at the National Marine Educators Association (NMEA) held in New York. The NMEA participants were not only K-12 and university educators, but also aquarium educators and scientists. The survey used a questionnaire that comprised 27 questions. Respondents were 33 people. In Japan, the survey was conducted to fisheries high schoolteachers. Japan has 46 fisheries high schools, which are the only schools that include compulsory marine science education in K-12 education. The questionnaire was translated into Japanese; responses were received from 37 people. The questionnaire

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*2 Elementary and secondary education

responses were tabulated using a Likert scale: strongly agree, 4; agree, 3; disagree, 2; strongly disagree, 1. Statistical processing was done using analysis of variance.

Results and Discussion

i. Teaching environment

Table 1 Questionnaire items referring "Teaching environment" in Section B

- ④ I teach marine science as a lecture.
- ⑤ in the school laboratory.
- ⑥ in the outdoor field.
- ⑦ in external institutions like an aquarium.

		④	⑤	⑥ **	⑦ **
JAPAN	N	37	37	37	37
	Average	2.649	2.919	2.27	1.838
	SD	0.978	0.924	1.071	0.8
USA	N	31	30	33	31
	Average	3.065	3.433	3.606	2.968
	SD	0.998	0.935	0.704	1.224

** : Significant difference between Japan and USA,(ANOVA, p<0.01).

Appendix table shows the questionnaire items. Table 1 shows comparisons of teaching environment between U.S in Section B. and Japanese marine educators. Both American and Japanese marine educators teach " in school laboratories more than in lectures (B- ④ , ⑤) ". However, vast differences exist in teaching " in the outdoor field and in external institutions such as aquarium (B- ⑥ , ⑦)", because Japanese marine science teaching is biased toward fisheries industries. These outside-of-school studies are not clarified as a Japanese science standard curriculum. Outside-of-school studies (e.g., teaching in external institutions like field studies for example with Hudson River estuaries institution or outreach study in New York Aquarium, or Atlantis Aquarium) are not conducted often in Japan; much Japanese high school teaching is done within school facilities.

ii. Citizen's understanding of marine science education

Table 2 Questionnaire items referring to "Citizen's understanding of marine science education" in Section B

- ⑧ Marine science education in K-12 schools enhances the ocean literacy.
- ⑨ Citizens concern about marine science education.
- ⑩ Citizens concern about the ocean.

		⑧	⑨ **	⑩
JAPAN	N	37	37	37
	Average	3.568	2.081	2.568
	SD	0.603	0.547	0.647
USA	N	33	33	34
	Average	3.818	2.758	3
	SD	0.392	0.792	0.696

** : Significant difference between Japan and USA,(ANOVA, p<0.01).

Table 2 shows comparisons of citizen's understanding of marine science education in Section B. American and Japanese educators apparently believe that citizens are unconcerned about the ocean and marine science education (B- ⑧), and are willing to conduct marine science education during K-12 education. Perhaps that is true because educators sense the insufficiency of K-12 marine education.

iii. What is the effect of marine science?

Table 3 Questionnaire items referring to "Effect of marine science education" in Section B

- ⑪ Marine science education has a beneficial effect on student's physical development.
- ⑫ on student's psychological development.
- ⑬ on enhancing consciousness of environmental conservation.
- ⑭ on enhancing consciousness of the dignity of life.

		⑪	⑫ *	⑬ **	⑭ **
JAPAN	N	37	37	37	37
	Average	3.135	3.351	3.324	3.081
	SD	0.631	0.588	0.58	0.64
USA	N	34	33	34	33
	Average	3.471	3.727	3.912	3.818
	SD	0.615	0.452	0.288	0.392

* : Significant difference between Japan and USA, (ANOVA, p<0.1).

** : Significant difference between Japan and USA,(ANOVA, p<0.01).

Table 3 shows comparison of the effect of marine science in Section B. The effect that US marine educators expect most is that "marine science education has a beneficial effect on enhancing consciousness of environmental conservation (B- ⑬)", " Silent Spring ", written by Rachel Carson might have affected the US marine science education⁵⁾. Another questionnaire response was "enhancing consciousness of the dignity of life (B- ⑭)". On the other hand, in Japan, the two items of "environmental conservation (B- ⑬)", "Enhancing consciousness of the dignity of life (B- ⑭)" is too far reached from US.

iv. Needs of marine science studies

Table 4-1 Questionnaire items referring to "Needs of marine science studies " in Section C

- ① I think marine science educations are needed in k-12 education.
- ② It is important for citizens to have a concern for the ocean.

		① **	② **
JAPAN	N	37	37
	Average	3.243	3.514
	SD	0.641	0.559
USA	N	34	34
	Average	3.971	3.971
	SD	0.171	0.171

** : Significant difference between Japan and USA,(ANOVA, p<0.01).

Table 4-1 shows comparisons of seeds of marine science studies in Section C. Both groups of marine educators think that "

it is important for citizens to have a concern for the ocean (C- ②)".

Table 4-2 Questionnaire items referring to "Ten reasons of needs of marine science study" in Section C- ③

1) needed for human beings., 2) most important in science education.

3) a place of seafood production., 4) rich in many resources.

5) a good scientific field of searching activity., 6) is a good area of leisure activity.

7) significant for human being., 8) a lot of academic interests in the ocean.

9) environment issue is serious., 10) argely unexplored.

		1)**	2)*	3)	4)**	5)**	6)**	7)**	8)*	9)**	10)*
JAPAN	N	37	37	37	37	37	37	37	37	37	37
	Average	3.27	3.135	3.514	3.351	3.324	2.703	3.378	3.243	3.243	3.324
	SD	0.652	0.631	0.507	0.588	0.709	0.74	0.594	0.597	0.597	0.626
USA	N	33	33	34	34	32	34	34	33	34	32
	Average	3.818	3.576	3.794	3.912	3.906	3.824	3.912	3.727	3.941	3.75
	SD	0.392	0.561	0.41	0.288	0.296	0.387	0.288	0.574	0.239	0.508

*: Significant difference between Japan and USA, (ANOVA, $p < 0.1$).

** : Significant difference between Japan and USA, (ANOVA, $p < 0.01$).

Table 4-2 shows comparisons of ten reasons of needs of marine science study in Section C- ③. All of the 10 reasons that US marine educators selected are higher scores than those selected by Japanese educators. Particularly, "the ocean environment issue is serious (C- ③-9)" shows the highest score, meaning that they have a strong consciousness of environmental conservation. Next in succession are "the ocean is rich in many resources (C- ③-4)", "the ocean is significant for human being (C- ③-7)", "the ocean is a good scientific field of searching activity (C- ③-5)".

In contrast, "the ocean is important as a place of seafood production (C- ③-3)" is selected by Japanese with the highest score among the 10 reasons listed. There is no significant difference in selection of this item between US and Japan groups, but the result indicates that Japanese marine educators value the seafood production features of the ocean. This response might show that Japanese people have special images about seafood. Next in succession were, "the ocean is significant for human being (C- ③-7)", "the ocean is rich in many resources (C- ③-4)", "marine science education is needed for human beings (C- ③-1)", "the ocean is a good scientific field of searching activity (C- ③-5)". However, "the ocean environment issue is serious (C- ③-9)" are not ranked as they are in the US. In addition, the item of that "the ocean is a good area for leisure activity (C- ③-6)" is lowest in rank among the 10 reasons. This result might show that Japanese think of the ocean as a place for work and the earning of subsistence. Recently, marine leisure sports (e.g., scuba diving, surfing, game fishing) are actively pursued in Japan, but fishermen's concern about marine recreation have increased concomitant with the increasingly frequent friction between fishermen and sports enthusiasts in Japan.

As described above, the marine educators' images towards the ocean have been raised. That is to say, US marine educators think that not only marine science education is needed for human beings and that the ocean is rich in resources, but also that the

ocean environment issue is serious. On the other hand, Japanese marine educators apparently believe that not only marine science education is necessary for human beings and that the oceans are rich in many resources, but also that the ocean is most important as a place of seafood production. In addition, the ocean is important as a place to earn subsistence, there are few concerns about environmental issues. The US marine educators apparently believe marine science education is needed to solve the environmental issues; Japanese marine educators think of marine science education as a subject for food production.

v. Fish-eating

Table 5 Questionnaire items referring to "Sea food eating" in Section C

⑭ I'm not shy about eating fish.

⑮ I'm not shy about eating seaweeds.

⑯ I prefer eating fish to eating meat.

⑰ I continue my life by reaping a benefit of the ocean.

⑱ I know as much about that the ocean is mother of creature.

		⑤	⑥*	⑦*	⑧	⑨
JAPAN	N	37	37	37	37	37
	Average	3.568	3.595	3.216	3.514	3.027
	SD	0.555	0.551	0.712	0.651	0.799
USA	N	34	34	33	32	28
	Average	3.265	3	2.576	3.469	3.536
	SD	1.024	1.044	0.969	0.803	0.576

*: Significant difference between Japan and USA, (ANOVA, $p < 0.1$).

Table 5 shows comparisons of seafood eating in Section C. Furthermore, vast differences are apparent related to the idea of seafood eating. Regarding the 10 items needed for marine science education, US marine educators show higher scores than Japanese marine educators, but the item score of seafood eating is inverted. Neither US nor Japanese marine educators are "shy about eating fish (C- ⑤)". Nevertheless, significant differences exist: "I am not shy about eating seaweed (C- ⑥)" and "I prefer eating fish to eating meat (C- ⑦)". Japanese people emphasize the ocean as a

place of food production, as described above. "I continue my life by reaping benefits of the ocean (C- ⑧)" is also a high score, meaning that the ocean is closely linked to human life in Japan.

vi. Needs for marine science education in inland areas

Table 6 Questionnaire items referring to "Need of marine science education in inland areas" in Section C

④		
	N	37
JAPAN	Average	1.324
	SD	0.53
	N	34
USA	Average	1.794
	SD	1.298

Table 6 shows comparisons of need of marine science education in inland areas in Section C. Both groups of educators apparently believe that "it is necessary for inland-dwelling people to learn ocean sciences (C- ④)". However, in Japan, marine science education has not been conducted during compulsory education; many Japanese teachers aside from those at fisheries high school think that it is difficult for inland dwellers to teach marine science. However, it is important to provide opportunities to teach marine science from the viewpoint that inland areas are connected to the ocean through rivers.

Conclusions

As described above, different attitudes of U.S. and Japanese marine educators towards marine and marine sciences education became apparent.

The US marine educators think of oceans as a place for science. Japanese marine educators regard oceans as a place for food production, although, both of educators think that there were few understandings of the citizens.

Such fundamental understandings of those groups have not been created in a short time, but rather over a long history. The understanding of Japanese people of oceans as a workplace or food supply area is an important perspective to support a cyclical society, a sustainable society, and education for sustainable devel-

opment. However, Japanese people have little opportunity to study oceans scientifically, and remain little concerned about ocean environmental issues. Japanese people are said that they have no concern about Science compared with other developed countries⁶). Japanese people must form a more scientific viewpoint towards oceans and promote marine science education.

Further studies will have improved survey precision and serve to promote ocean literacy and ensure protection of the world's oceans through establishment of a network of marine educators.

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海洋科学教育の認識に関するアンケート調査 — アメリカと日本の海洋教育者を対象として —

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日米における海洋や海洋科学教育に対する認識の違いを明らかにするため、全米海洋教育者会議に参加した海洋教育者、水産高校教員を対象にアンケート調査を実施した。両国の共通点としては、国民の海洋や海洋科学教育に関する関心は低く、初等中等教育における海洋科学教育が必要であると考えている。相違点として、アメリカは海洋のイメージとして環境問題が深刻化しており重要な課題として解決しなければならぬとする反面、未だ開拓されていない未知の分野であり科学的にも興味深い要素を持っていると考えている。これに対して、日本は、海洋のイメージは科学教育の対象よりもむしろ生活を営むための場所である。また、環境問題はそれほど深刻ではなく、最も大切なのは食料生産の場として海洋から恵みを得ることである。さらに、魚食に関する項目では、海藻を食べる、肉より魚を好むが有意に高かった。以上のように、アメリカと日本とでは海洋や海洋科学教育に対する認識に大きな違いがあることが明らかとなった。

キーワード: 海洋科学教育, 海洋教育者, 海洋リテラシー

Appendix table
Dear Sir / Madam / Miss

The study of American teacher understanding towards marine science education

Thank you for agreeing to complete this questionnaire. My name is Tsuyoshi Sasaki, Tokyo University of Marine Science and Technology. In Japan, marine science education was not carried out in K-12 education, except only 46 fisheries high schools. Accordingly many Japanese people have nothing interests to the ocean science, although Japan is island country blessed with the ocean for long time. Purpose of this research is that make it clarified the differences of Japanese and American teacher understanding towards marine science education. On the future, I want to make a new curriculum in K-12 school in Japan.

Please answer all question. Once again thank you very much for your valuable time and effort in completing this questionnaire.

Questionnaire

Profile of respondents. All information will be kept strictly confidential.

Please mark (X) in front of the appropriate information about yourself.

1 School, State

(), ()

2 University subject

.....

SECTION A Profile of respondents. All information will be kept strictly confidential.

- Please mark (X) in front of the appropriate information about yourself.

2.Gender

	Male
	Female

3.Age

	Less than 30 years old
	40
	50
	60
	More than 60 years old

In each following sections, circle the number that best reflects how strongly you agree with the following statements.

SECTION B: Method, effect of marine education	Strongly Disagree	Disagree	Agree	Strongly Agree
① teach marine biology in my science class. Details () (for example: fish ecology or classification of sea weeds···)	1	2	3	4
② teach marine chemistry in my science class. Details ()	1	2	3	4
③ I teach marine physics in my science class. Details()	1	2	3	4
④ I teach marine science as a lecture.	1	2	3	4
⑤ I teach marine science in the school laboratory.	1	2	3	4
⑥ I teach marine science in the outdoor field.	1	2	3	4
⑦ I teach marine science in external institutions like an aquarium.	1	2	3	4
⑧ I'm sure that marine science education in K-12 schools enhances the ocean literacy.	1	2	3	4
⑨ United states citizens concern about marine science education.	1	2	3	4
⑩ United states citizens concern about the ocean.	1	2	3	4
⑪ Marine science education has a beneficial effect on student's physical development.	1	2	3	4
⑫ on student's psychological development.	1	2	3	4
⑬ on enhancing of a conscious of environmental conservation.	1	2	3	4
⑭ on enhancing of a conscious of the dignity of life.	1	2	3	4

SECTION B: Method, effect of marine education	Strongly Disagree	Disagree	Agree	Strongly Agree
① I think marine science educations are needed in k-12 education.	1	2	3	4
② It is important for citizens to have a concern of the ocean.	1	2	3	4
③ Reasons of the need of marine science education	1	2	3	4
1) Marine science education is needed for human beings.	1	2	3	4
2) Marine science education is most important in science education.	1	2	3	4
3) The ocean is important as a place of seafood production.	1	2	3	4
4) The ocean is rich in many resources.	1	2	3	4
5) The ocean is a good scientific field of searching activity.	1	2	3	4
6) The ocean is a good field of leisure activity.	1	2	3	4
7) The ocean is significant for human being.	1	2	3	4
8) There are a lot of academic interests in the ocean.	1	2	3	4
9) The ocean environment issue is serious.	1	2	3	4
10) The ocean is largely unexplored.	1	2	3	4
④ For inlanders it is unnecessary to learn the ocean science.	1	2	3	4
⑤ I don't shy about eating fish.	1	2	3	4
⑥ I don't shy about eating seaweeds.	1	2	3	4
⑦ I prefer eating fish better than meat.	1	2	3	4
⑧ I'm always living reaping a benefit of the ocean.	1	2	3	4
⑨ I know as much about that the ocean is mother of creature.	1	2	3	4