

Present State and Subjects on Marine Ecosystem Conservation in Japan

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Abstract

The Ministry of the Environment has surveyed marine natural environments, such as tidal flats, seaweed beds, coral reefs, the situation of coastlines, the status of several marine animals, etc. However these surveys are highly limited compared with surveys of land areas. And the systems of National Parks, Nature Conservation Areas, Wildlife Protection Areas are not enough to contribute to marine ecosystem conservation. Under the circumstances that marine ecosystem conservation is one of the global environmental key issues, though each study of fishing resources has been made progress, marine ecosystem study or marine ecosystem conservation has not been enough in Japan.

Fishing has been performed from ancient times, and fishing rights have been intricately developed in marine areas around the Japanese coast. Therefore it is very difficult to designate marine protection areas where fishing is prohibited. The new measures that integrate marine ecosystem conservation and sustainable development are strongly expected. A community-based marine management plan is considered a realistic selection, taking into account the actual conditions of Japanese coastal fishing. The plan will be achieved in agreement with local fishermen, residents and organizations, marine recreational sectors, relevant official agencies and research institutions. I believe that marine ecosystem conservation under the plan can lead to sustainable fishing that maintains and cultivates fishing resources.

Key words: marine ecosystem, marine management plan, national survey on the natural environment, Shiretoko World Natural Heritage Site

1. Introduction

Japan is surrounded by the sea, and has tackled 'conservation and management of marine organism resources' on a local level, which is the theme of this special edition number, for many years, in order to conserve fishing resources. Since other writers have introduced this matter, I would like to summarize in my manuscript the present state of marine ecosystem conservation that the Ministry of the Environment of Japan has so far tackled, and describe marine ecosystem conservation issues in Japan.

2. Understanding the Marine Ecosystems

Surveys of marine areas by the Ministry of the Environment are highly limited compared with surveys of land areas. This is thought to be the main reason that the objects of administrative measures are clearly based on land areas and relations with marine scientists are also restricted. In this situation, the main surveys of marine areas, which the Ministry of the Environment has tackled so far, are outlined as follows.

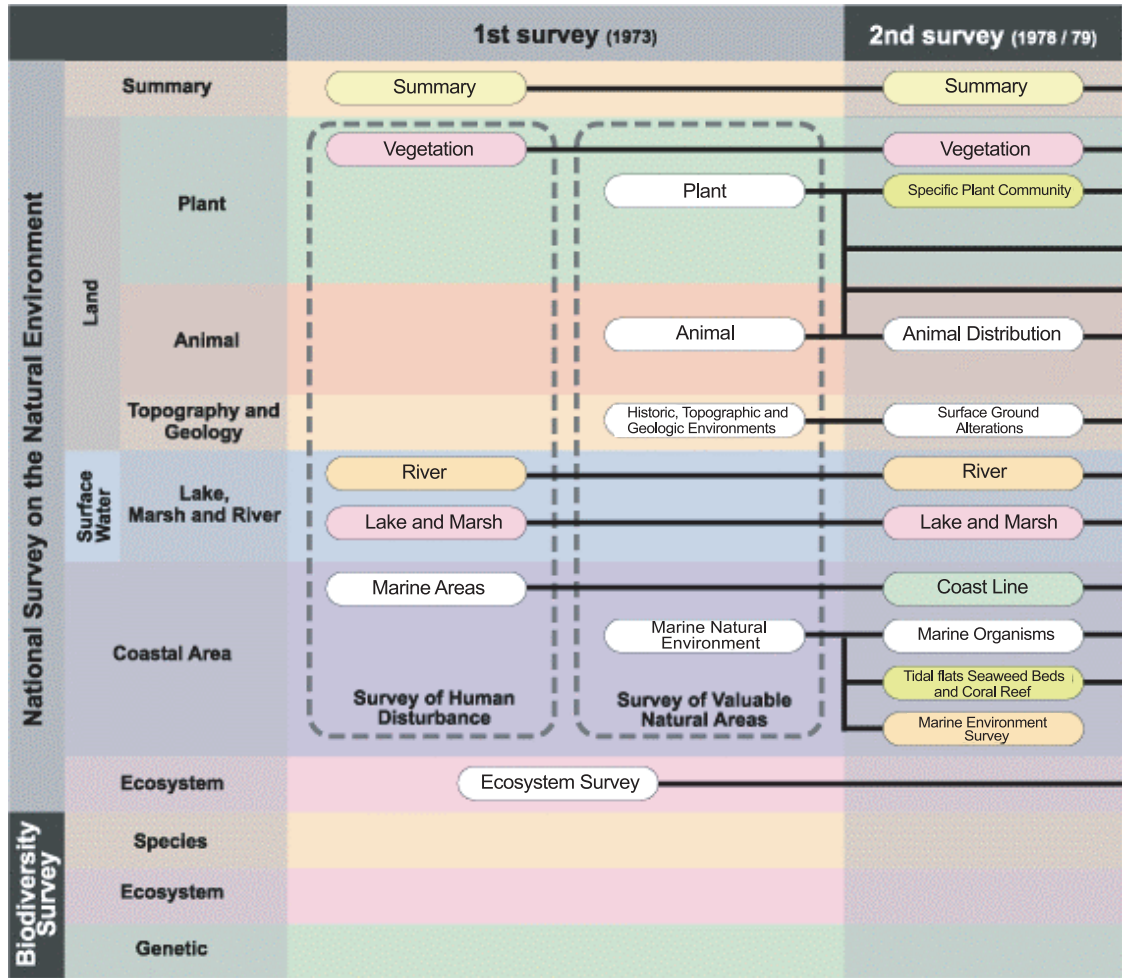
2.1 National Survey on the Natural Environment

In the days when the Environment Agency was established (1971), the marine pollution problem was aggravating, and measures to prevent sea pollution were mainly regulations to control of contaminant discharge. However, it was not enough to conserve the marine ecosystem.

The Environment Agency's grasp of the marine ecosystem in which it was concerned systematically started with the National Survey on the Natural Environment since fiscal year 1973 as a forerunner, with the coast and the inland sea regions the main objects of these Surveys, and this is still the tendency. An outline of the Surveys done so far is shown in Fig. 1.

2.1.1 Tidal Flats, Seaweed Beds and Coral Reefs Surveys

Surveys of tidal flats, seaweed beds and coral reefs are carried out continuously by the National Survey on the Natural Environment in marine areas. The survey is carried out in accordance with measures that the Ministry of the Environment entrusts to prefectures to monitor the situation of tidal flats, seaweed beds and



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Fig. 1 The outline of the National Survey on the Natural Environment.

coral reefs through cooperation with local universities, local fisheries research institutes, museums, etc., based on the Ministry’s operational guidelines. Each prefecture ascertains the distribution of tidal flats, seaweed beds and coral reefs through research of existing references (topographical maps, aerial photos, etc.) or field investigations. The budget for the second survey (1978-1982) was approximately 140 million yen, and the budget for the fourth survey (1988-1992) was approximately 200 million yen, but the number of staff who were involved in this survey throughout Japan is unknown. The Ministry of the Environment compiled each prefecture’s results and completed both surveys. By the second survey, the regions of tidal flat, seaweed bed and coral reef distribution were clear, and changes in the regions of distribution in comparison with the results of the two surveys were clarified by the fourth survey. (The area transition of tidal flats, seaweed beds and coral reefs based on the results of the two surveys is shown in Table 1.) By the fifth survey (1993-1998), detailed investigation of species compositions, etc., was conducted in some

Table 1-1 Transition of tidal flats. (ha)

	2nd Survey			4th Survey		
	1945	1978	Reduced %	1978	1994	Reduced %
Tidal flats	82,621	53,856	34.80%	55,300	51,443	7.00%

Notes: The reason the number for 1978 in the 2nd Survey differs from that for the 4th Survey, is use of different investigation measures.

Table 1-2 Transition of seaweed beds. (ha)

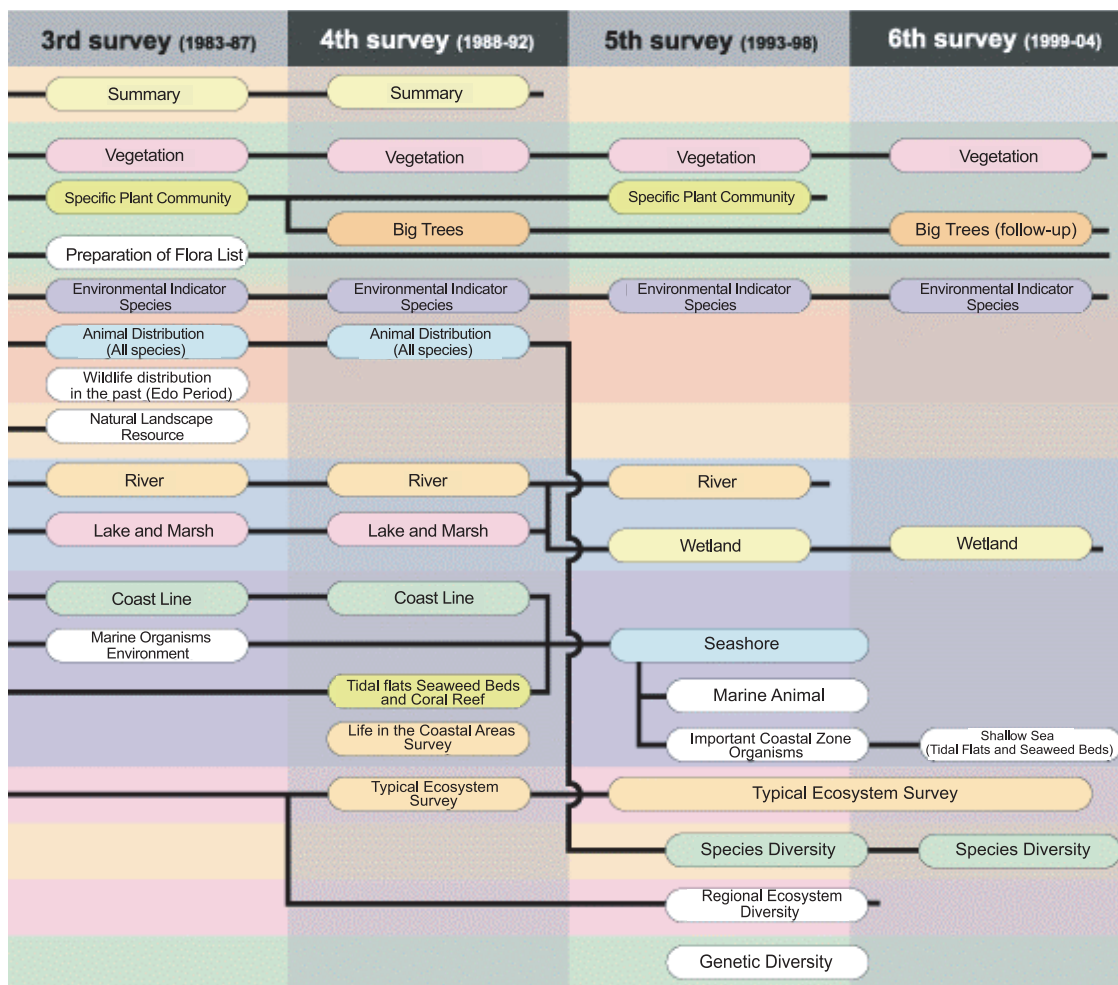
	2nd Survey			4th Survey		
	1973	1978	Reduced %	1978	1994	Reduced %
Tidal flats	184,776	182,727	1.10%	207,615	201,212	3.10%

Notes: The reason the number for 1978 in the 2nd Survey differs from that for the 4th Survey, is use of different investigation measures.

Table 1-3 Transition of coral reefs. (ha)

		4th Survey		
		1978	1994	Reduced %
Tokyo Metro.	Ogasawara Islands	461	456	1.08%
Kagoshima Pref.	Amami Islands	6,060	5,951	1.80%
	Okinawa Island	8,270	7,046	14.80%
Okinawa Pref.	Miyako Islands	2,027	1,957	3.45%
	Yaeyama Islands	19,336	19,232	0.54%

National Survey on the Natural Environment, Ministry of the Environment.



typical marine areas aiming at classification of tidal flats, seaweed beds and coral reefs by biological type.

2.1.2 Coastline Surveys

In the Coastline Survey, classifying the coastline into ‘natural coast,’ ‘half-natural coast,’ ‘artificial coast’ and ‘river mouth,’ is considered fundamental data for conservation together with determining transitions of each classified coastal length since the second survey. Comparing the results of the fourth survey with those of the second survey, we found artificial coasts increased by approximately 1,340 km and natural coasts decreased by approximately 860 km (refer to Table 2).

2.1.3 Marine Animals Surveys

In the Marine Animals Survey conducted by the 5-6th surveys, the present condition, such as distributions, was grasped for large-sized marine animals (loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), finless porpoise (*Neophocaena phocaenoides*), sea otter (*Enhydra lutris*) and seals)

Table 2 Transition of the coastline of Japan (km)

	2nd Survey 1978	3rd Survey 1984	4th Survey 1993
Total	32,170 (100%)	32,472 (100%)	32,779 (100%)
Natural coastline	18,967 (59.0%)	18,402 (56.7%)	18,106 (55.2%)
Half-natural coastline	4,340 (13.5%)	4,511 (13.9%)	4,467 (13.6%)
Artificial coastline	8,599 (26.7%)	9,295 (28.6%)	9,942 (30.3%)
River mouth	264 (0.8%)	264 (0.8%)	264 (0.8%)

National Survey on the Natural Environment, Ministry of the Environment.

which inhabit coastal seas. For example, for sea turtles, the numbers landing, laying eggs, and hatching in sands throughout Japan have been determined, and a distributional map was created.

For details of each above survey, please refer to the homepage of the Biodiversity Center, Ministry of the Environment (<http://www.biodic.go.jp/>).

2.2 Individual Surveys

Although several marine surveys were conducted for investigating the natural environment when ex-

tending a natural park or a wildlife protection area to include a marine area, I would like to introduce briefly in this section some surveys which have fixed purposes, such as preservation of certain species or conservation of important ecosystems, and which also cover a wide area.

2.2.1 Seal Surveys

Five kinds of seals have been newly listed under the Wildlife Protection and Regulation of Hunting Law from 2002. The Ministry of the Environment has surveyed the habitation of the seals (mainly spotted seal (*Phoca largha*), kuril harbor seal (*Phoca vitulina stejnegeri*) and others), in cooperation with the Hokkaido Prefectural Government from fiscal years 2003 to 2005, in order to study conservation and management policies for seals.

2.2.2 Dugong Surveys

The dugong (*Dugong dugon*) inhabits marine areas around the Okinawa main island, but the extent of its actual habitation is not known, and it is feared to be facing extinction. Therefore, in order to study conservation policies for dugongs, the Ministry of the Environment has made visual check surveys by airplane, investigated traces of grazing in main seaweed beds from fiscal year 2001, and is striving to get an understanding of the extent of dugong habitation.

2.2.3 500 Important Wetlands List

The Ministry of the Environment has selected 500 important wetlands in Japan based on existing references, word from related organizations and specialists, and other sources in 2002. Shallow marine areas, such as tidal flats, seaweed beds and coral reefs are included on this list. This list is useful in studying conservation policies or selecting additional wetlands under the Ramsar Convention site.

3. Systems Relating to Marine Ecosystem Conservation

Although the present systems for conserving marine ecosystems in Japan cannot be called sufficient, I would like to introduce below several measures being taken for conservation of marine ecosystems.

3.1 Natural Parks

Natural Parks are designated in accordance with the Natural Parks Law in order to conserve outstanding natural landscapes representing Japan. There are three types: National Parks, designated and managed by the government, Quasi-National Parks, designated by the government and managed by the prefectures where they are located, and Prefectural Natural Parks, designated and managed by the respective prefecture. National Park and Quasi-National Park areas are usually classified as Special Protection Zones, Marine Park Zones, Class1 – Class3 Special Zones and Ordinary Zones, depending on the characteristics of the natural environment and the necessity for conservation. Various kinds of development are regulated in accordance with the zone classification from the

point of view of conservation of the landscape.

In case of marine areas, Natural Parks, fronting coastal parks or inland sea regions are usually designated as Ordinary Zones, from the point of view that marine park areas are buffer zones for land park areas. In performing the reclamation work beyond a certain scale, new construction of large-scale structures, etc., require notification to the Secretary of State for the Environment or the prefectural governor.

Marine Park Zones are designated at coral reefs or seaweed beds with especially beautiful scenery among National Parks or Quasi-National Parks. In Marine Park Zones, various development work and collecting or damaging specific animals and plants are prohibited. As of April 2005, a total of 64 zones, comprising 2,664 ha had been designated as Marine Park Zones in National Parks and Quasi-National Parks.

3.2 Nature Conservation Areas

Nature Conservation Areas are designated in accordance with the Nature Conservation Law in order to conserve areas almost untouched by human beings or having outstanding nature. As of April 2005, five Wilderness Areas and ten Nature Conservation Areas had been designated. Sakiyama Bay Nature Conservation Area (128 ha), located in Okinawa Prefecture, is the only marine Nature Conservation Area in Japan aimed at conservation of coral reefs. In this area, various development work and collecting or damaging specific animals and plants are prohibited.

3.3 Wildlife Protection Areas

Wildlife Protection Areas are designated in accordance with the Wildlife Protection and Regulation of Hunting Law in order to conserve wildlife habitat. There are two types of Wildlife Protection Areas: one designated by the Secretary of State for the Environment and the other designated by the prefectural governor. Capture of wildlife in Wildlife Protection Areas and development work, such as constructing structures, reclaiming aquatic areas and cutting trees in Special Protection Zones, are regulated. It is possible for Wildlife Protection Areas and Special Protection Zones to be designated in marine areas. As of April 2005, there were 60 National Wildlife Protection Areas (totalling 518,153 ha) in Japan and ten areas (totalling 22,346 ha) designated which included marine areas and six of these had Special Protection Zones.

3.4 Red Data Book

In contrast with the above measures (1)–(3), which involve designation of conservation areas, the Red Data Book (RDB) clarifies the endangered species status of wild fauna and flora in Japan and explains conditions of their habitation, in order to avoid their extinction and to promote understanding of their situation in general. In Japan, the Ministry of the Environment has compiled an RDB, including wild

fauna and flora of inland areas and some marine mammals inhabiting coastal marine areas. The Fisheries Agency also compiled an RDB covering the sea less than 200-nautical miles from shore and inland water regions (note: the formal name of the Fisheries Agency's RDB is *The Data Book on the Endangered Aquatic Wildlife in Japan*). For your reference, the numbers of species by category classified in the Fisheries Agency's RDB are listed in Table 3.

3.5 Others

There are several laws described below whose purposes are not directly related to marine ecosystem conservation and whose jurisdiction does not belong to the Ministry of the Environment.

3.5.1 Cultural Properties Protection Law

Among the natural monuments or special natural monuments designated in accordance with the Cultural Properties Protection Law, there are two type monuments included from the viewpoint of the scientific importance. The first type includes habitat/location of important animals and plants, and the second type includes zones containing characteristic geological features or minerals. An example of the first type is the marine area habitat of the finless porpoise (*Neophocaena phocaenoides*) (Takehara-shi, Hiroshima Prefecture), and of the second type, Tojinbo just off a characteristic coast (Mikuni-cho, Fukui Prefecture). In natural monument zones, permission is required for human activities which could change the present condition of the zone, such as various kinds of development.

3.5.2 Law for Conservation of Aquatic Resources and the Fishing Law

Based on these laws, the Fisheries Agency or prefectural government can regulate capture of animals or plants, or designate marine areas which are important for spawning and growth of particular fishery animals from the viewpoint of maintenance and cultivation of marine resources. Based on the Law for Conservation of Aquatic Resources, as of April 2005, there were six marine areas in which the capture of the respective marine animal (olive ridley (*Lepidochelys olivacea*), leatherback turtle (*Dermodochelys coriacea*), blue whale

(*Balaenoptera musculus musculus*), bowhead whale (*Balaena mysticetus*), finless porpoise (*Neophocaena phocaenoides*), dugong (*Dugong dugon*)) is regulated. In addition, capture restrictions are individually prepared by Fishery Coordination Committees of each marine region, defined according to the Fishing Law.

4. Marine Ecosystem Conservation Issues

4.1 Understanding the Marine Ecosystems

A summary of the current understanding and conservation of marine ecosystems was given above, focusing on the measures by the Ministry of the Environment. Each survey, however, is limited to some species or some regions. Therefore the information is fragmentary, and cannot explain the structure of complicated marine ecosystems. The general grasp of marine ecosystems is vague, including the relationship between marine and land areas, and it is in a trial and error stage, using the scientific survey techniques and development of monitoring benchmarks for marine ecosystems.

Thus, while data on marine ecosystems are extremely limited, Fish Catch Statistics are considered to be effective as a barometer for marine ecosystems. Although these statistics include only commercially useful species as fishing resources and the data are influenced by the amount of fishing efforts and other factors, the accumulation of many years of statistics can provide important information on the situation in the marine ecosystem. Moreover, if an analysis based on the experiences of fishermen who are usually in contact with the ocean is added, it may be very effective to grasp the situation of the distribution, quantity and appearing time of each marine life other than fishery species. However, analyses based on experiences as above are usually explained with such remarks as, 'Their number is on the decrease compared with ancient times,' and cannot be called scientific data. Therefore, it is necessary to collect and accumulate information on marine changes, such as the distribution, quantity and appearing time of marine life, sea-water temperature, ocean currents, etc. through the cooperation with fishermen as scientific data.

Table 3 The number of species by category classified in the Fisheries Agency's RDB.*

	evaluated number (species, subspecies, subpopulation)	Endangered	Vulnerable	Near Threatened	Decreasing	Decreasing Trend	Normal
Molluscs	80 (77)	4	8	18	26	14	10
Marine fish	86 (67)	7	8	14	26	14	17
Fresh water fish	65 (64)	15	13	16	12	6	3
Amphibians and Reptiles	34 (31)	5	9	12	2	4	2
Aquatic mammals	57 (44)	7	4	16	8	3	19
Aquatic plants	38 (37)	14	4	14	0	4	2
Xiphosura and Crustacea	31 (30)	3	4	8	8	5	3
Water birds	25 (25)	10	2	8	1	2	2
Sponges, Coelentera and Echinoderms	15 (14)	0	0	2	6	5	2
Aquatic insects	1 (1)	1	0	0	0	0	0
Total	432(390)	66	52	108	89	57	60

* The Data Book on the Endangered Aquatic Wildlife in Japan.

4.2 Conservation of Marine Ecosystems

Fishing has been done for many years, and fishing rights have developed intricately in marine areas near the Japanese coast. Coastal fishing methods have not been used for all marine products, but sustainable techniques have been chosen by designing fishing implements to catch useful marine products selectively. Because of these social and historical backgrounds, a Marine Protection Area (MPA) system that prohibits the capture of all marine life has not come into existence in Japan. The structures of conservation systems introduced above have not been intended to eliminate fishing fundamentally.

Taking into consideration appropriate zoning measures for marine ecosystem conservation in Japan, it is difficult to designate MPAs widely like so-called 'sanctuaries' which prohibit capture of all marine life. Rather it is important to formulate a community based a marine management plan which includes not only fishing but recreation, such as recreational fishing, marine animal watching, etc., through cooperation with the local stakeholders, such as administrations, scientists and fishery organizations. A marine management plan will be considered a realistic selection if it takes into account the actual conditions of Japanese coastal fishing, and I believe that marine ecosystem conservation under such a plan can lead sustainable fishing that maintains and cultivates fishing resources.

The marine ecosystem is influenced by various factors, such as climate, ocean currents and interaction with land ecosystems. We may therefore expect hypothesis about changes in monitoring indices to be made and evaluations for remedial measures performed while many indefinite elements remain. In order to reduce this uncertainty and to achieve suitable ecosystem management, the establishment of a monitoring system from a mid- to long-term viewpoint is crucial. Preparation of various kinds supports measures to back up the system and an adaptive management based on the monitoring results are also important issues. Furthermore, it will be desirable to develop a method of evaluating the economic effect on the local community brought on by the implementation of the marine management plan, in consideration of raising motivation for the plan, not only in the area concerned but also in other areas.

[Example of measures in Shiretoko]

The understanding and conservation of marine ecosystems using the above measures requires cooperation with related local governing bodies, fishermen, fishery organizations, etc., and these are difficult to achieve if a certain level of motivation cannot be created. I would like to introduce briefly below the example of one measure soon to be taken in Shiretoko.

In January 2004 the Shiretoko Peninsula was nominated by the Government of Japan as a World Natural Heritage Site based on the World Heritage Convention. The nominated site includes a marine

area for the first time as a natural heritage site in Japan. In the process of the examination for registration, the IUCN pointed out the need for the Government of Japan to extend the nominated marine site and expedite a Marine Management Plan (MMP) as well as strengthen the provisions within this plan so as to ensure the protection of marine species. The Government of Japan has answered that the nominated site will be extended from the current area of within 1 km of the coastline to the area within 3 km of the coastline, and the time frame for formulation of the MMP will be reduced to three years or less (refer to Fig. 2).

The MMP will identify proper and reliable measures for the conservation and management of marine life such as walleye pollack (*Theragra chalcogramma*) and other fish that are important fisheries resources and that support the food chain and material cycle in the marine ecosystem, as well as marine mammals (Steller sea lion (*Eumetopias jubatus*) and seals) and sea eagles (Steller's sea eagle (*Haliaeetus pelagicus*) and the white-tailed eagle (*Haliaeetus albicilla*)), by specifying necessary regulations in detail with regard to the following topics.

(1) Research and monitoring

The MMP will identify the targets, content, methods, priorities and other items relating to the research and monitoring activities. These items will be reviewed and adapted in accordance with scientific verification of the results of research and monitoring.

(2) Strategies to maintain fisheries resources for continuing sustainable fisheries and measures for conservation and management of marine life and ecosystems

The MMP will contain the following items, including methods to reflect the findings of future research and monitoring.

- With regard to fisheries resources, existing fishery restrictions and voluntary restrictions enforced by local fishermen and fishery organizations will be incorporated into the MMP as community-based marine resource management initiatives. Furthermore, the MMP will identify strategies and measures necessary for sustainable use of fisheries resources, and conservation and management of marine life and ecosystems, based on scientific verification of the research and monitoring findings and with the agreement of local fishermen, fisheries organizations and other stakeholders.
- With regard to marine mammals, the MMP will identify proper management strategies for Steller sea lion and seals in the marine area surrounding Shiretoko based on a survey currently being conducted on the visitation patterns, feeding behavior and food habits of these marine mammals, as well as a fact-finding survey on the impacts regarding fisheries, and with the agreement of local fishermen, fisheries organization and other stakeholders.
- With regard to sea eagles, the MMP will identify conservation and management measures including

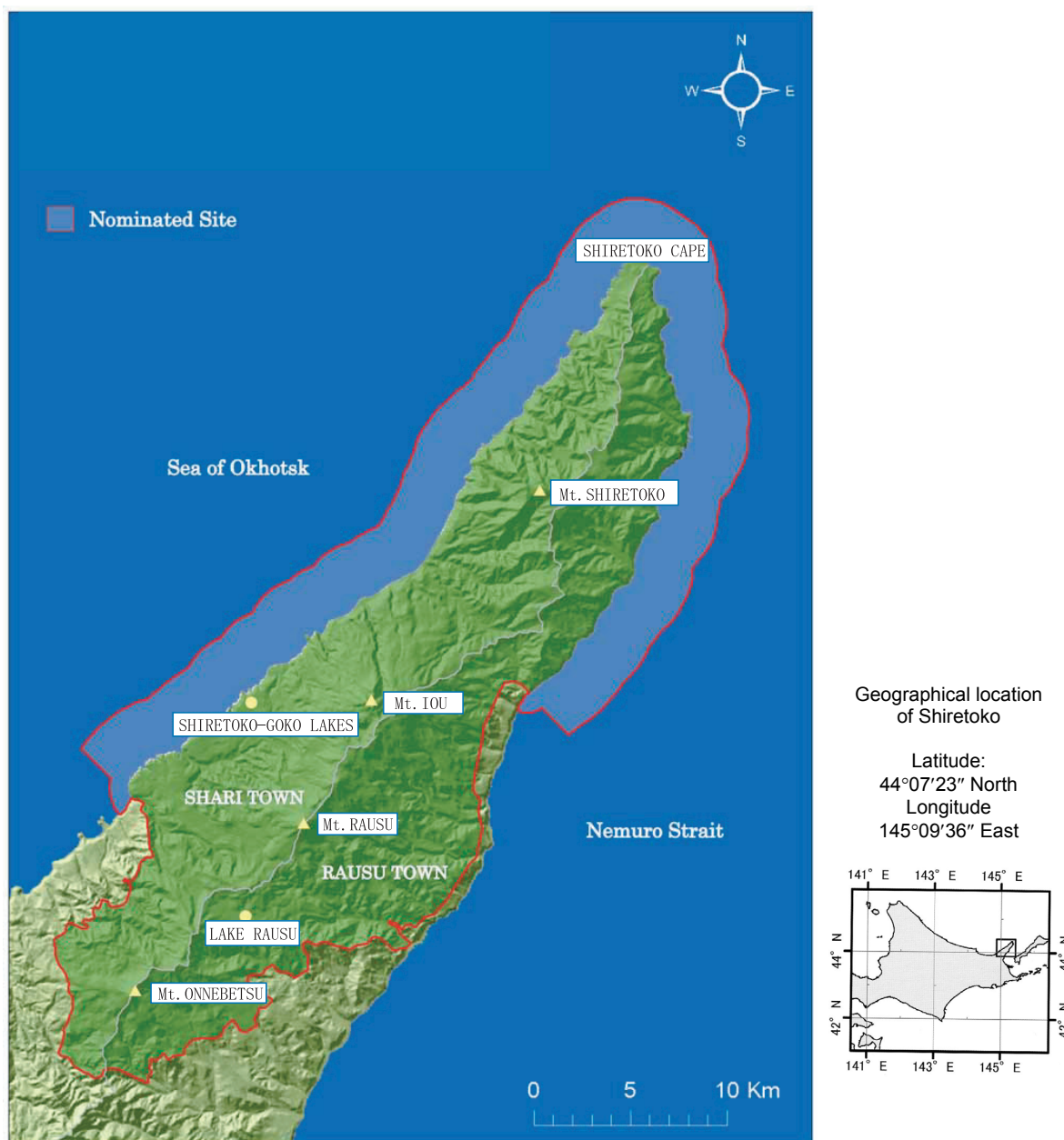


Fig. 2 Area nominated for the Shiretoko World Natural Heritage Site.

the protection of wintering sites and breeding sites, in conformity with the 'Program for the Rehabilitation of Natural Habitats and Maintenance of Viable Populations' targeting Steller's sea eagle and the white-tailed eagle currently under development.

(3) Strategies to promote proper use of the nominated site for marine recreation

- The MMP will identify strategies to promote the proper use of the nominated site for marine recreation, which is forecasted to increase should the site be inscribed on the World Heritage list, based on the understanding of the current status of marine recreation activities such as kayaking in the nominated site and usage of the site's marine area for leisure fishing and powerboating.

- These strategies will include those to prevent and reduce the impact of marine recreation activities on seabirds, marine mammals and other marine life.

(4) Administrative structure

- The MMP will clarify the sharing of responsibility and the way of coordination among local residents and organizations, relevant governmental agencies and research institutions.

In formulating the MMP, the Marine Area Working Group which was established in March 2005 under the Shiretoko World Heritage Nominated Site Scientific Council will compile advice necessary to prepare a draft of an MMP within a period of one year. The MMP will include current fishery restrictions and the community-based voluntary restrictions enforced by

fishermen and fisheries organizations. Subsequently, relevant governmental agencies will, based on this advice, finalize the MMP on the premise of existing fisheries rules in consultation with relevant local organizations, such as fisheries, and research institutions, such as universities and fisheries research institutes. During that process, the governmental agencies will obtain advice from the Shiretoko World Heritage Nominated Site Scientific Council and also formulate a consensus by gathering opinions through public participation procedures, such as explanatory meetings for local fisheries organizations and stakeholders, and other opinion-submitting procedures.

5. Conclusion

The systems of Natural Parks, Nature Conservation Areas and Wildlife Protection Areas have been built from the measures focused on some beautiful scenery or specific species, and those are not enough to conserve the marine ecosystem sufficiently. In these days the new measures that integrate marine ecosystem conservation and sustainable development are strongly expected.

The marine ecosystem is related with the land ecosystem and economic activities complexly, so there are many stakeholders to conserve the marine ecosystem. Therefore prohibitive or hardly regulative measures are difficult to achieve the agreement. A community-based marine management plan is one of the useful and realistic measures to conserve the marine ecosystem. Of course scientific study of marine ecosystem other than fishing resources should be carried out widely and deeply to clarify the base for reaching a consensus with many stakeholders. The marine management plan will be achieved in agreement with local fishermen, residents and organizations, marine recreational sectors, relevant official agencies and research institutions. The plan includes the contents such as examples of Shiretoko and clarifies the sharing of responsibility and the way of coordination among the

above stakeholders in order to contribute the local development through the marine ecosystem conservation. I believe that marine ecosystem conservation under the plan can lead to sustainable fishing that maintains and cultivates fishing resources. It is important to establish a Japanese system of marine ecosystem conservation, through repeated trial and error.

References

- Fisheries Agency (1998) *The Data Book on the Endangered Aquatic Wildlife in Japan*, Japan Fisheries Resources Conservation Association, Tokyo. (in Japanese)
- Ministry of the Environment (2002) *The National Biodiversity Strategy of Japan*. (in Japanese)
- Nature Conservation Bureau, Environment Agency (1993) *The Outline of the National Survey on the Natural Environment*. (pamphlet in English)
- Nature Conservation Bureau, Environment Agency (1994) *The Report of the Coastline Survey in the 4th National Survey on the Natural Environment*. (in Japanese)
- Nature Conservation Bureau, Environment Agency (1998) *The Report of the Marine Animals Survey in the 5th National Survey on the Natural Environment*. (in Japanese)
- Nature Conservation Bureau, Environment Agency (1994) *The Report of the Marine Biotic Environment Survey in the 4th National Survey on the Natural Environment*. (in Japanese)
- Nature Conservation Bureau, Environment Agency (2002) *Threatened Wildlife of Japan – Red Data Book 2nd ed. – Vol.1, Mammals*. (in Japanese)
- Nature Conservation Bureau, Ministry of the Environment (2001) *For Coexistence of People and Nature*. (pamphlet in English)
- Nature Conservation Bureau, Ministry of the Environment (2002) *The 500 Important Wetlands in Japan*. (in Japanese)
- Nature Conservation Bureau, Ministry of the Environment (2005) *The Letter to UNESCO World Heritage Centre on Shiretoko World Natural Heritage Nominated Site*. (homepage of Ministry of the Environment in English)
- Nature Conservation Bureau, Ministry of the Environment (2004) *The Report of the Habitation Situation of Seals in Hokkaido*. (in Japanese)
- Wildlife Division, Nature Conservation Bureau, Ministry of the Environment (2002) *The Report of the Methods on Wide Range Survey of Dugongs*. (in Japanese)

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