Chapter 19

Ecosystem-based Management in the Asia-Pacific Region

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Abstract

In this chapter, we derive several indicators of the fisheries sectors on a country-by-country basis, and clarify the social and ecological conditions in the Asia-Pacific area. These are summarized as financial, industrial profile, marine resource diversity, food security, social security, and human resource conditions. Then, with a case from an UNESCO World Natural Heritage site in Japan, we propose a socially and ecologically compatible ecosystem-based management framework in the Asia-Pacific area. Under this framework, the local fishers are the core of the management. The most important policy measure is the human capacity building and legal protection of each fishery.

Keywords: Ecosystem-based management, fisheries co-management, Asia-Pacific area, social conditions, ecological conditions, Shiretoko World Natural Heritage, Japan

Introduction

Ecosystems provide a variety of services (World Research Institute, 2005), including fish, for humans. Since fisheries harvests are only a small portion of all ecosystem services from marine environments (Costanza *et al*., 1997), fisheries operations should not jeopardize the wide range of goods and services from marine ecosystems that provide food, revenues, and recreation (US National Research Council, 1998). This thinking is central to what is called ecosystem-based fisheries management, or an ecosystem approach to fisheries.[1] A closely related but broader concept is ecosystem-based management. Its focus is not limited to a single sector, i.e., the fisheries sector, but encompasses holistic, regionally integrated, and multiple use management of the oceans (UNEP GPA, 2006).

In this chapter, we discuss resilient ecosystem-based management for the countries in the Asia-Pacific area.[2] We pay particular attention to 11 countries in the Asia-Pacific,

World Fisheries: A Social-Ecological Analysis, First Edition. Edited by Ommer, Perry, Cochrane and Cury.

i.e., Cambodia, China, Chinese Taipei, Indonesia, Japan, Korea, Malaysia, Myanmar, Philippines, Thailand, and Vietnam. These countries are ranked within the top 40 fisheries production countries, in terms of production volume (tonnes) for 2002 to 2006, based on the FAO FISHSTAT. The top 40 countries globally cover 90%, and the above 11 countries in the Asia-Pacific area cover 42%, of global fish production.

The situation and performance of fisheries and the characteristics of the surrounding ecosystem are closely linked (Worm *et al*., 2006). In the next section "Global comparison of fisheries sectors", we derive several indicators representing the social and ecological conditions of fisheries on a country-by-country basis, and clarify the features of the fisheries sectors in the Asia-Pacific area. Then, based on these results, we propose an approach for building resilient ecosystem-based management in the Asia-Pacific areas, with a case study from an UNESCO World Natural Heritage site in Japan.

Global comparison of fisheries sectors

Figure 19.1 shows the global comparison of *per capita* GDP (in Purchasing Power Parity) on a country-by-country basis. It covers OECD countries[3] and the top 40 fisheries production countries. The vertical axis shows the latitude of the capital of each country. The North-South divide is clearly observable. With the exception of Japan and Korea, all the fisheries countries in Asia-Pacific area are positioned in the left side of the figure (<US$ 12,000/capita). If *per capita* GDP is taken as a rough index of financial capacity of the government, Fig. 19.1 means that the appropriate and feasible management measures for ecosystem-based management would be different in the high-*per capita* GDP countries than in most of the Asia-Pacific countries. Specifically, some effective policy measures require considerable amounts of public funds and/or a high standard of scientific infrastructure, and are thus very often not applicable in the latter countries. It follows that the policy measures developed to support ecosystem-based management need to be affordable for these places.

To elaborate more on the characteristics of suitable policy measures for ecosystem-based management in the Asia-Pacific area, the rest of this section clarifies the social and ecological characteristics of the fisheries sector.

Table 19.1 shows fisheries production volume, total number of fishers, and per-fisher production in the top 40 fisheries countries. The shaded countries in the table are the Asia-Pacific area. The per-fisher productions are remarkably high in Iceland, New Zealand, Denmark, and The Netherland, all of which use the Individual Transferable Quota (ITQ) system. Norway, Faroe Islands, Peru, and Argentina are also high (>100 tonnes per fisher). On the other hand, all the fisheries countries in the Asia-Pacific area are much below the average. This means that fisheries operations in the Asia-Pacific area are conducted at a small scale.

Figure 19.2 shows the diversity of fish taxa caught (as the diversity index H') calculated for OECD countries over the period 2002–2006, and arranged by latitude of their capital city. To calculate H', the Shannon Function (MacArthur and MacArthur, 1961) for diversity was applied to the FAO FISHSTAT data. Because the details of fisheries statistics reported to FAO largely depend on the domestic statistics system in each country, only the OECD countries are compared. This figure shows that in mid-low latitudes, in which

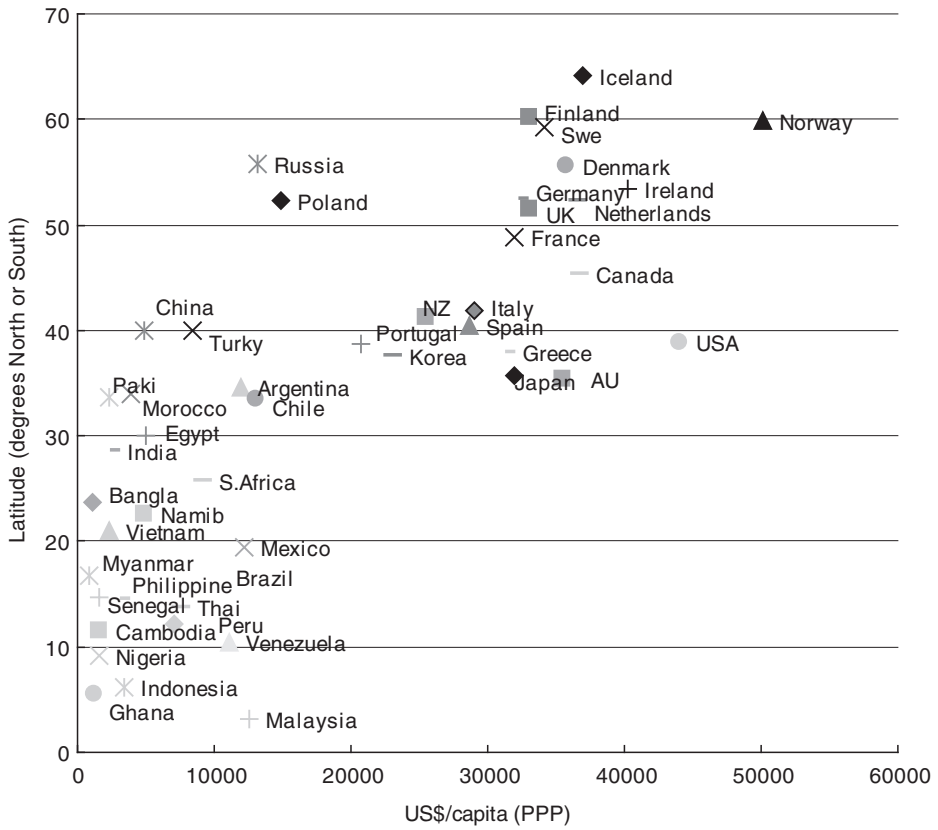

Fig. 19.1 Global distribution of *per capita* GDP, arranged by latitude of the capital city (*Source*: The World Bank 2008).

fisheries countries in the Asia-Pacific area are located, a wider range of species is utilized than at higher latitudes. This can be understood as reflecting the high biodiversity as well as varieties of seafood culture in these lower latitude areas. Related to this, Fig. 19.3 shows the percentage of seafood as a source of animal protein in the top 40 fisheries countries. It shows that countries in the Asia-Pacific area have a larger reliance on seafood than other sources of animal protein, reflecting the importance of seafood to their food security.

Figure 19.4 shows the percentage of fishers in the total population, demonstrating the importance of the fisheries sector as a source of employment. For many countries in the Asia-Pacific area and Northern Europe, the fisheries sector is more important as a source of jobs than in other countries. It is worth pointing out that in many developing countries, it is often the poorest social class that work in the fisheries sector, which serves as a kind of social security net for landless people.

Finally, Fig. 19.5 shows the average number of marine fishers per kilometer of coastline. The appropriate balance between the number of fishers and the biological productivity of an area is an important theme for further research, because excess numbers of fishers could easily lead to overfishing. However, the people living along the coast are the most direct stakeholders and recipients of the marine ecosystem services (UNEP CBD, 2000), and we

Table 19.1 Fisheries production, number of fishers, and average production per fisher in the top 40 fisheries countries (*Source*: FAO, 1999, FAO FISHSTAT). Shaded cells represent those countries in the Asia-Pacific region.

Country or area name	Fisheries production by volume (tonnes)*	Total number of fishers**	Per-fisher production (tonnes/fisher)***
China	17,190,201	1,286,799	0.1
Peru	8,178,363	65,290	120.7
USA	4,959,275	290,000	20.5
Indonesia	4,639,326	4,649,153	1.0
Chile	4,593,475	75,367	84.5
Japan	4,440,150	278,200	26.6
India	3,680,819	5,958,744	0.8
Russia	3,241,117	n.a.	n.a.
Thailand	2,824,466	438,934	8.0
Norway	2,649,158	22,916	149.3
Philippines	2,197,587	990,872	2.8
Vietnam	1,885,598	3,030,000	0.5
Iceland	1,789,424	6,300	353.8
Republic of Korea	1,666,571	180,649	18.1
Myanmar	1,590,768	580,962	1.4
Mexico	1,362,649	258,850	6.1
Malaysia	1,285,864	100,666	12.4
Bangladesh	1,240,546	1,320,480	1.0
Canada	1,120,344	84,775	13.1
Denmark	1,069,481	4,792	359.7
Chinese Taipei	1,028,689	297,523	n.a.
Argentina	986,820	12,320	104.8
Morocco	934,065	96,708	8.2
Spain	878,002	75,434	18.8
South Africa	798,481	10,500	52.3
Brazil	748,663	290,000	2.2
United Kingdom	654,503	19,044	51.8
France	653,596	26,113	35.6
Faroe Islands	586,950	2,761	127.4
Namibia	579,760	2,700	99.4
New Zealand	540,382	2,227	325.9
Turkey	516,896	33,614	19.4
Nigeria	499,395	481,264	0.9
Netherlands	499,299	3,711	148.2
Venezuela	489,487	39,621	12.7
Pakistan	485,791	416,405	1.5
Senegal	423,009	51,197	9.9
Egypt	394,985	61,977	7.4
Cambodia	388,571	73,425	1.6
Ghana	384,018	230,749	2.1
Average	2,101,914	560,283	58.2

* The average production volume (tonnes) for 2002 to 2006 from FAO FISHSTAT.
** Based on the total employment recorded by FAO (1999).
*** The production data are from FAO FISHSTAT for the year when the employment data were collected by FAO (1999).

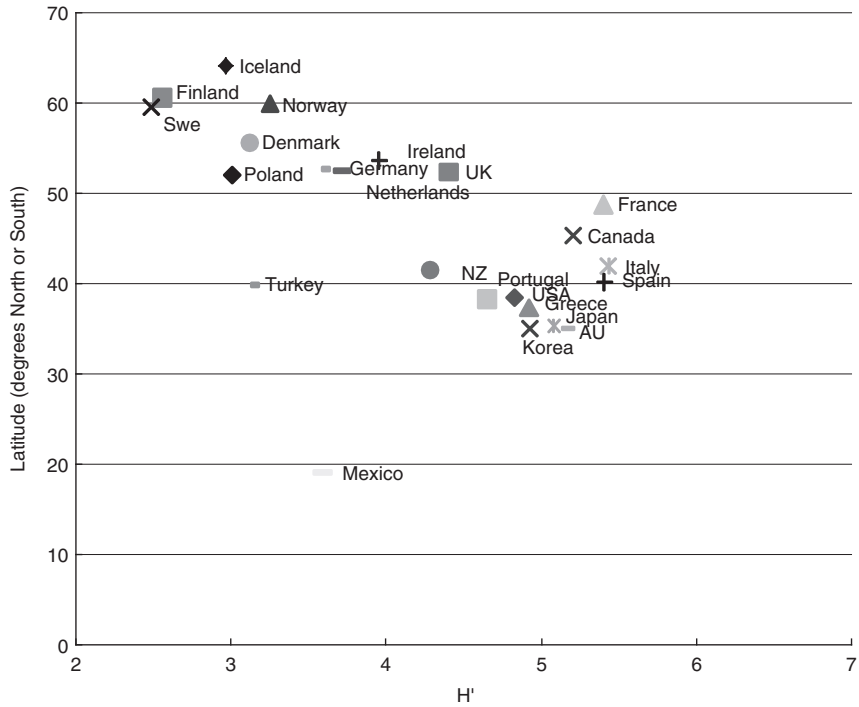

Fig. 19.2 Diversity of fish taxa caught, with diversity calculated using the Shannon function H′, for OECD countries arranged by latitude of their capital city (*Source*: FAO FISHSTAT).

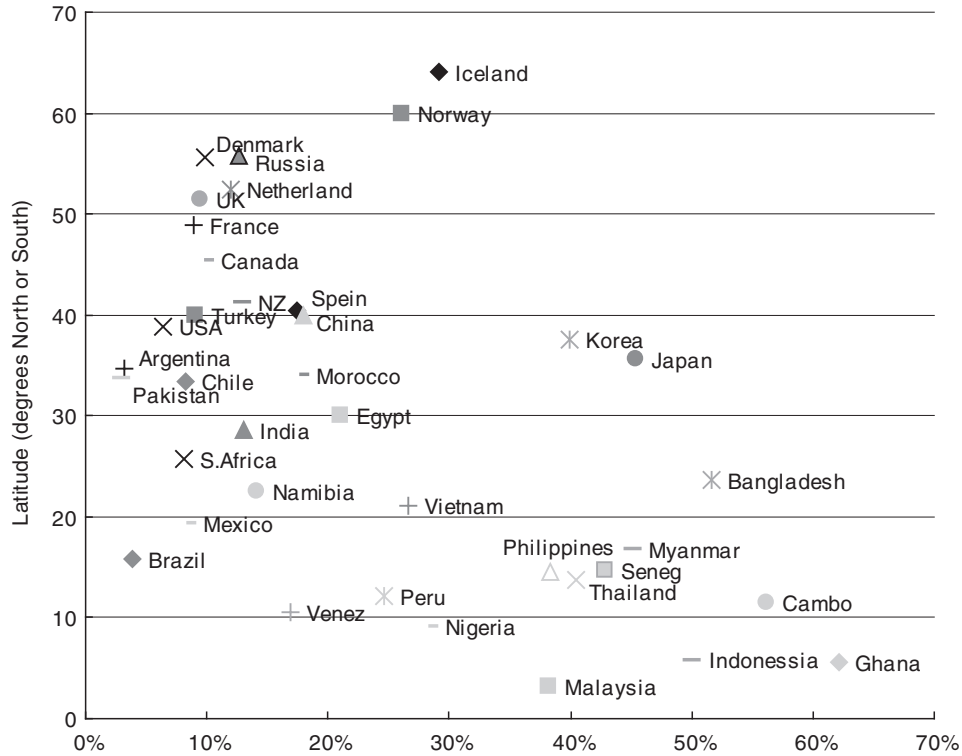

Fig. 19.3 Percentage of seafood as a source of animal protein in the top 40 fisheries countries, arranged by latitude of their capital city (*Source*: FAO Food Balance Sheet)[4].

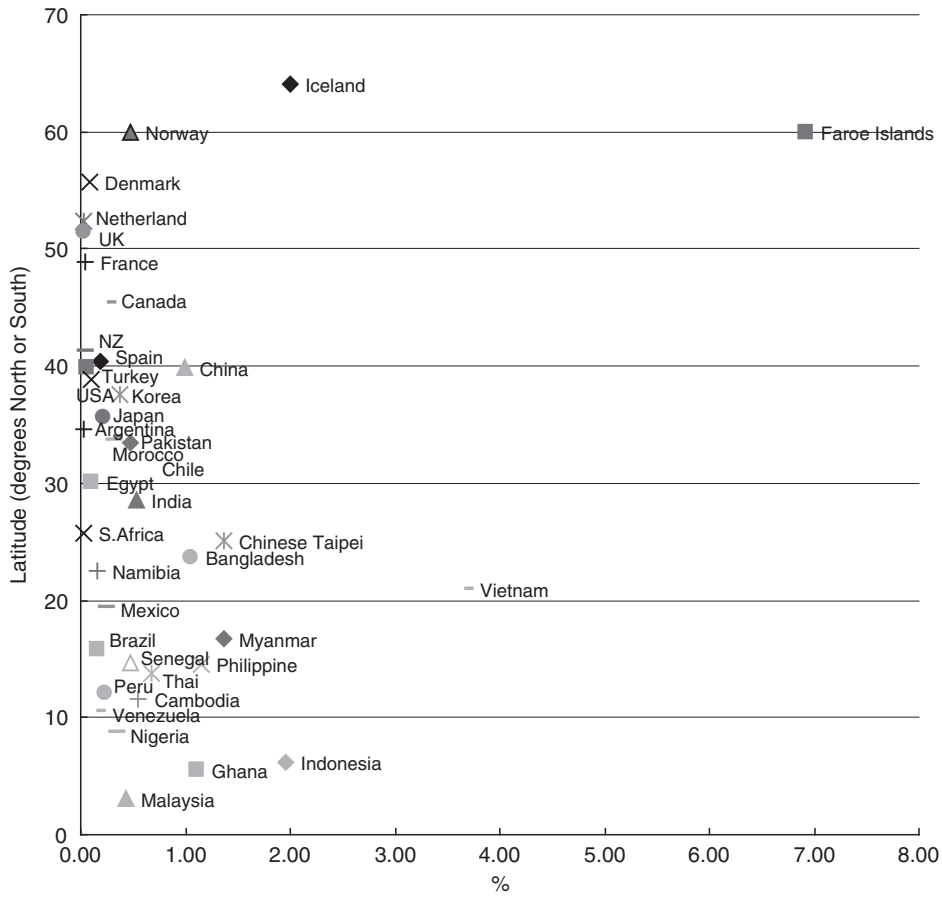

Fig. 19.4 Percentage of fishers in the total population in the top 40 fisheries countries, arranged by latitude of their capital city (*Source*: FAO 1999, CIA 1997).

presume that they could therefore play the most important role in coastal co-management. From this perspective, Fig. 19.5 suggests that in the Asia-Pacific areas, local people can potentially play an important role in local ecosystem management, i.e., those areas are rich in potential human resources.

The summary of the fisheries sectors in the Asia-Pacific area is in Table 19.2. When we create ecosystem-based management in the Asia-Pacific area, all these conditions should be clearly taken into account. In addition, other social aspects, which cannot be quantified, must be considered. For example, anthropological studies point out that in many parts of the world, especially in tropical areas, a redistribution of wealth through social inter-dependence and a traditional credit system is the norm (Ruddle, 2008). That may bind fishers to their communities and occupation, as embodying a sense of cultural identity. For example, crew sizes may be determined more by social imperatives, or obligations to share economic benefits, than by economically rational choices. It is important to consider these societal norm conditions in order to facilitate effective co-management of local natural resources (Ostrom, 1990, Armitage *et al*., 2007).

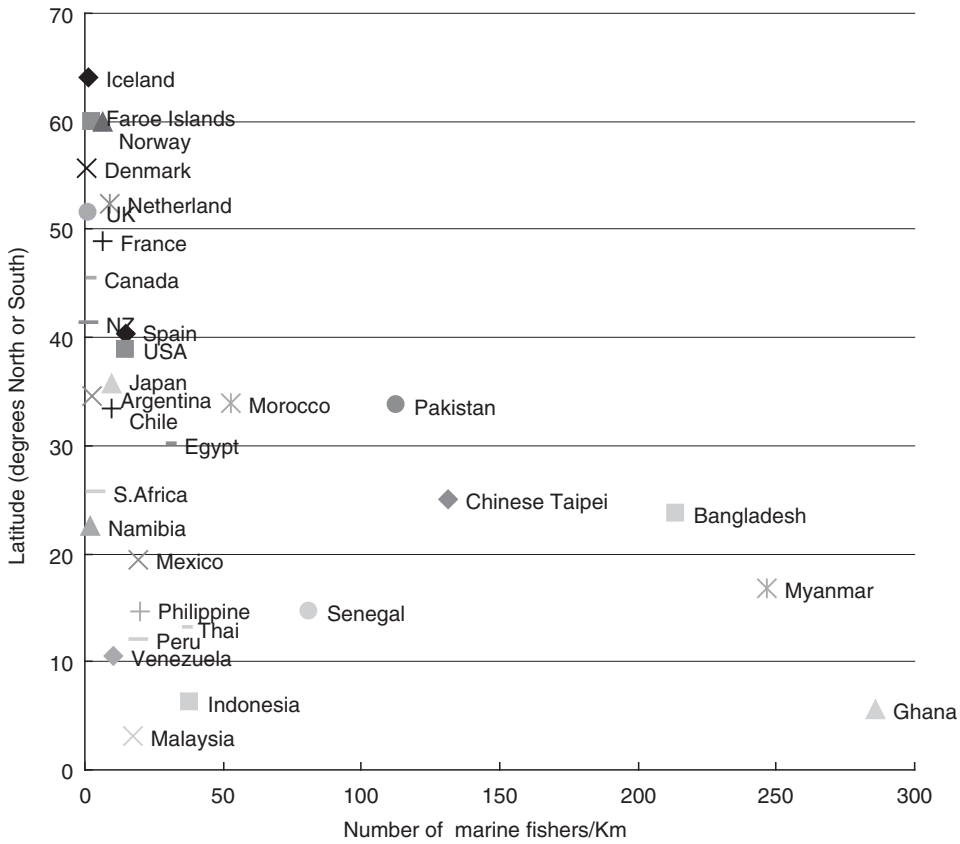

Fig. 19.5 Average number of marine fishers per km of coastline in the top 40 fisheries countries, arranged by latitude of their capital city (*Source*: FAO, 1999; CIA, 1997). Brazil, Cambodia, China, India, Korea, Nigeria, Russia, and Vietnam are not indicated in this figure because appropriate data for marine fishers are not available.

Table 19.2 Summary of the social and ecological conditions of the fisheries sectors in the Asia-Pacific area.

Condition 1	Expensive policy measures are impossible (financial condition).
Condition 2	Fisheries operations are small-scale (industrial profile condition).
Condition 3	Diversity in resource use is high, reflecting the high biodiversity of the surrounding sea (marine resource condition).
Condition 4	People largely rely on seafood as a source of animal protein (food security condition).
Condition 5	Fisheries sector is important as a source of employment (social security condition).
Condition 6	Rich in the potential human resource in the coastal area (human resource conditions).

How, then, can we build socially and ecologically resilient systems based on the social and ecological conditions listed in Table 19.2? How we can build an ecosystem-based management framework, which fits well to the Asia-Pacific area? In the section "Ecosystem-based management at the Shiretoko World Natural Heritage, Japan", a case from Japan is discussed as an example.

Ecosystem-based management at the Shiretoko World Natural Heritage, Japan

Shiretoko Peninsula is located in the northeast of Hokkaido Island, Japan. A distinguishing characteristic of this area is the interrelationship between its marine and terrestrial ecosystems. Many anadromous salmonids swim up the rivers in the peninsula to spawn. They serve as an important source of food for upstream terrestrial species such as the brown bear, Steller's sea eagle, and whitetailed eagle (Plate 11 in the color plate section). The peninsula is also internationally important as a stopover point for migratory birds (Ministry of Environment of the Government of Japan, Hokkaido Prefectural Government, 2007). At the same time, Shiretoko is also famous in Japan for fisheries production, and the fisheries and tourism sectors are the most important industries here. In 2006, 851 fishers were engaged in the fishing industry, yielding 73,641 tonnes for a cash value of 22,966 million yen (Hokkaido Prefectural Government, 2007).

To maintain sustainable fisheries, local fishers who possess fishing rights and licenses have implemented a wide range of autonomous measures under a fisheries co-management framework.[4] For example, they autonomously enlarged the mesh size of walleye pollack gillnets from 91–95 mm in the 1990s, in accordance with research results provided by the local research station. Gillnet fishers divided the fishing ground into 34 areas, based on their local knowledge and experience, and declared 7 of them protected in order to conserve resources. These protected areas include a portion of the scientifically identified spawning ground of walleye pollack. The protected areas are re-examined every year on the basis of the previous year's performance and scientific advice from the local research station. After nomination of the peninsula and its surrounding marine areas for UNESCO World Natural Heritage Listing in 2004, six other areas were also designated as protected, and the fishers implemented various autonomous measures for other species in the Shiretoko ecosystem. In addition, the fisheries cooperative associations fund their own monitoring programs and research vessel. Although these co-management measures are not well defined or described in documents, they regulate the impact of fishing on stock very strictly.

Since 2004, various additional measures have been implemented to conserve the outstanding ecosystems of this area. The approach taken was one that did not displace local fishers from the area, but placed their activities at the core of the management scheme to sustain ecosystem structure and function, while other sectors were integrated into the existing co-management framework. That is, fisheries co-management was expanded to ecosystem-based co-management to achieve ecosystem conservation. We call this the "Shiretoko Approach".

One of the most important new measures implemented in the Shiretoko area is a system for coordination among the wide range of sectors involved (Fig. 19.6). The Shiretoko World Natural Heritage Site Regional Liaison Committee is composed of officers from related ministries and departments, such as the Fisheries Agency, Coast Guard, Ministry of Environment, Forestry Agency, Ministry of Education, etc. Fisheries cooperative associations, the tourism sector, the Scientific Council (described later), and NGOs, also participate. The committee serves as the core arena for policy coordination among administrative

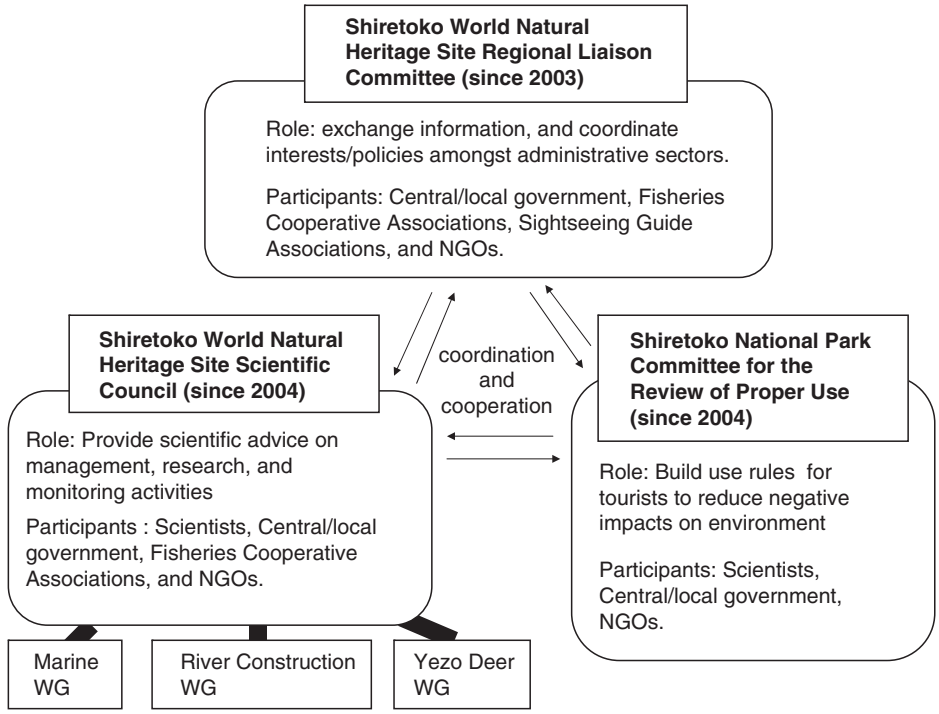

Fig. 19.6 Coordinating system in the Shiretoko World Natural Heritage site.

bodies. The Shiretoko World Natural Heritage Site Scientific Council is the scientific advisory body for the formulation of the management plan and for research and monitoring activities. The council has three working groups (WGs): for marine ecosystem management (Marine WG), for improvement of river constructions (River Construction WG), and for Yezo deer (*Cervus nippon yezoensis*) management (Yezo Deer WG). The Shiretoko National Park Committee for the Review of Proper Use has conducted research and discussions on proper-use rules for tourism, which is another important sector in this peninsula. These organizations and their interrelationships have helped to ensure participation, to exchange information and opinions, and to build consensus between the wide-ranging interests of multiple users of the ecosystem services, supporting the legitimacy of the management plans and rules.

The official management plan for the marine area of the World Heritage site, called the Multiple Use Integrated Marine Management Plan, was drawn up by the Marine WG in December 2007. Its objective is "to achieve both conservation of the marine ecosystem and stable fisheries through the sustainable use of marine living resources in the marine area of the heritage site" (Ministry of Environment of the Government of Japan, Hokkaido Prefectural Government, 2007). It defines management measures to conserve the marine ecosystem, strategies to maintain major species, along with monitoring methods, and policies for marine recreational activities. The fisheries sector has participated from the beginning of the drafting process. To monitor the Shiretoko marine ecosystem, the Marine Working Group drew up a food web (Plate 11 in the color plate section), identified indicator

species, and specified monitoring activities. Because the local fishers have caught a wide range of species in responsible ways (>50 species), the catch data has been compiled by local fishers and it includes many of the indicator species and other major marine species in the food web. This information is an important foundation for monitoring changes in the functions and structure of the Shiretoko marine ecosystem. Under the Shiretoko Approach, the local fishers are recognized as an integral part of the ecosystem, as indicated in Plate 11 in the color plate section, and their data are officially utilized to monitor the ecosystem cost-effectively. However, catch data are not enough for monitoring the entire marine ecosystem, because fishers are targeting only commercial species. Therefore, the Marine Management Plan specifies monitoring of non-commercial species, as well as basic environmental indices such as weather, water quality, sea ice, and plankton. Also, it is worth noting that the Shiretoko Approach can save considerable costs for ecosystem-based management. In 2006, the public expenditure from both the local and central governments, excluding fisheries management measures, was about 470 million yen, corresponding to about 2% of the fisheries production value in the area. For the full details of the ecosystem-based co-management in the Shiretoko area, see Makino *et al*. (2009).

Discussion

Copes and Charles (2004) categorized Japanese co-management as a kind of "community-based co-management", which recognizes that fishers are the primary participants in management, and that involvement and support of the broader community is essential. The system is open to consideration of a wide range of human needs in the community, and therefore lends itself to the implementation of a balanced mix of biological, social, and economic objectives. The Japanese institutional background naturally leads to a different ecosystem-based management framework from, for example, that of Iceland or New Zealand, where market-based individual transferable quotas are the central policy tool. The Shiretoko Approach is an example of extension from community-based co-management to an ecosystem-based management approach.

Furthermore, based on the social and ecological conditions summarized in Table 19.2, we discuss the compatibility of the Shiretoko Approach to the Asia-Pacific area. First, under the Shiretoko Approach, due respect is paid to the local fishers' knowledge and to their autonomous activities, and local fishers are not excluded from the heritage area. Rather, they are the core of the ecosystem-based co-management. Therefore, local norms and livelihoods are not destroyed (Condition 5), and fisheries products are continuously supplied to the market (Condition 4). The importance of this requirement cannot be overemphasized, especially for the remote fishing communities on islands or peninsulas in the Asia-Pacific area.

Matsuda *et al.* (2008) pointed out that, based on their mathematical model of fisheries' impacts on an ecosystem, profit maximizing fisheries are likely to utilize only one or two highly-valued species from the food web. This means, from the ecosystem-based management point of view, that we can gain information about very limited aspects of the ecosystem through the fisheries sector. Government has to monitor the rest of the ecosystem, and these costs are beyond the budget of many countries in the Asia-Pacific area. In the

Shiretoko area, however, local fishers are utilizing a wide range of species from the ecosystem; they conserve species by various autonomous measures, and compile the catch data by themselves. Their data cover most of keystone species of the ecosystem, and government saves the cost of ecosystem monitoring. In other words, the Shiretoko case shows that diversity in fisheries can save costs in ecosystem monitoring (Conditions 1 and 3). Participation of local stakeholders in all the decision-making processes (Fig. 19.6) also helps to increase the legitimacy and applicability of management measures, and saves enforcement costs (Hilborn, 2007).

Conclusion

Because the Asia-Pacific area is potentially rich in human resources, the most important policy measure when applying the Shiretoko Approach is human capacity building in order to achieve community-based co-management (Condition 6). Legal protection of each fishery, such as the fishing rights and license system in Japan, is indispensable as it permits coordination of fisheries on equal terms. Without such legal guarantees, the co-existence of small-scale, artisanal fisheries and large-scale, efficient fisheries is difficult (Condition 2).

The analyses outlined in this chapter are still in their very early stages, and much can be done to improve them. The indicators discussed in the section "Global comparison of fisheries sectors" are just a snapshot, but trends in indicators could be calculated from the time series data, and would give more insight into macro changes in societies, as well as in ecosystem services. Also, large countries cannot be represented by a single latitude and value, so division by eco-region is the next fruitful analytical step.

Acknowledgement

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Endnotes

1. For more details in the terminologies, see Garcia *et al*. (2003).
2. In this chapter, the Asia-Pacific area refers to the East Asia and the Southeast Asia.
3. The term "OECD countries" refers to the member countries of Organization for Economic Co-operation and Development whose fisheries production volume (tonnes) for 2002–2006 were ranked within top 100 countries in the world. Therefore, OECD member countries with relatively small fisheries production, such as Belgium (ranked 111), Hungary (146), the Czech Republic (157), Slovakia (184), Switzerland (186), Austria (203), and Luxembourg (232) are excluded from the figure.
4. For the institutional features of fisheries co-management in Japan, see Makino and Matsuda (2005). Other case studies of Japanese fisheries co-management can be found in Townsend *et al.* (2008).

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