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Northeast Asian Marine Environmental Quality and Living Resources: Transnational Issues for Sustainable Development

by
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Introduction

Northeast Asian Seas comprise the semienclosed Sea of Japan, the Yellow Sea, and the East China Sea (Figure 1). Both the environmental quality and living resources of these Seas are threatened. Yet cooperation on managing these Seas is incipient at best, and so far insufficient to sustain environmental quality and the harvest of the living resources. The extension of jurisdiction out to 200 nm and the coming into force of the Convention on the Law of the Sea give new impetus for regional cooperation in ocean management, particularly in Northeast Asia's semienclosed seas (Figure 2). Obviously fish, polluters and pollutants will still move across these artificial lines in the sea. The Convention serves as a framework within which Northeast Asian nations can carry out their ocean management rights and responsibilities. Indeed, with its advent, the venue for addressing issues of ocean law and policy has moved from the global to the regional level.

The importance of enclosed or semienclosed seas in the management of marine regions is emphasized in Article 123 of the Convention, which holds that:

> States bordering an enclosed or semi-enclosed sea should cooperate with each other in the exercise of their rights and in the performance of their duties under this Convention. To this end they shall endeavor, directly or through an appropriate regional organization:
> (a) to coordinate the management, conservation, exploration and exploitation of the living resources of the sea;
> (b) to coordinate the implementation of their rights and duties with respect to the protection and preservation of the marine environment;
> (c) to coordinate their scientific research policies and undertake, where appropriate, joint programs of scientific research in the area;
> (d) to invite, as appropriate, other interested States or international organizations to cooperate with them in furtherance of the provisions of this article.

The problem lies in identifying, agreeing on, and implementing specific joint programs of scientific research that will best contribute to the sustainability of Northeast Asia's marine environmental quality and living resources. This paper attempts to delineate critical relevant areas for cooperative scientific research and regulatory action.

Environmental Quality

The Present State of Marine Pollution

The most polluted areas in the region are (Figure 3) (1) the Inland Sea; (2) Tokyo Bay; (3) the southern Korean peninsula, which has experienced many oil spills and hydrocarbon pollution, moderate Chemical Oxygen Demand (COD), and frequent red tides; (4) the west coast of South Korea near Inchon, which suffers from oil spills, oil pollution, and red tides; (5) the Bo Hai, which suffers most widely from hydrocarbon pollution but which also has specific coincident concentrations of oil pollution, moderate COD, industrial waste, and red tides; (6) the Yangtze and Yellow river mouths and deltas, which have oil and industrial pollution, high COD, and red tides; and (7) the Pearl River mouth and estuary, which also suffers from all pollution types. The coastal rim of the Sea of Japan is relatively free of pollution, with the exception of the area around Peter the Great Bay and the Noro Peninsula of Japan. Of course the recent revelations of Russian dumping of nuclear waste in this Sea over many years has severely eroded the myth of a pristine Sea of Japan.

The most obvious conflict areas are close to shore where aquaculture and various pollutants coincide (Figure 4). The inner shores of the Bo Hai are clear examples, as are numerous places on the coasts of Japan, where aquaculture activities and shore-based pollution are both widespread. In the more open reaches of the Yellow, East China, and Japan Seas, there is potential conflict between whale calving areas, spawning grounds for both pelagic and demersal species, and oil pollution, as manifested by tar balls at the surface.

The regions of greatest possible conflict between living resources and shipping are in the relatively narrow Korea Strait, where there are major routes into the Korean ports of Pusan and Ulsan and cross-strait traffic between the Korean ports and the entrance to the Inland Sea. The Korea Strait also harbors two whale calving areas and spawning areas for both demersal and pelagic fish. The heavy concentration of major shipping routes near the Japanese ports of Nagoya and Tokyo bays, coupled with a large whale calving area and spawning grounds for pelagic fish, indicates another large area where uses of the sea may conflict with living resources. The Sea of Japan, on the other hand, which has quite productive fisheries, is remarkably free of shipping. Only two minor routes (from the Korea Strait to Nakhodka and to the Tsugaru Strait) might possibly interfere with calving or spawning activities.

Red Tides

Red tides are phytoplankton blooms of such intensity that the sea becomes discolored (not always red, but also yellow or brown), and many animals (most important, commercial fish species) are excluded from the area or contaminated. The phytoplankton comprising the blooms are often toxic and become a health hazard to humans who consume contaminated fish and shellfish. Death can occur. Red tides are associated with a large input of nutrients (Figure 5). Red tides have been reported in Japan (near Tokyo, along the southwest and the southeastern coasts of Honshu, in the Inland Sea, and at several locations on Shikoku), in Russia (in Peter the Great Bay), in South Korea (Yongul Bay, Ulsan Bay, Onsan Bay, all along the southern coast and in Inchon Bay), and in China (in Bohai Bay and in and around Hong Kong).

Indeed, red tides have now become a normal occurrence in the region. For example, the number of red tide incidents reported in the Inland Sea increased markedly from a low of 61 in 1968 to a peak of 299 in 1976 before leveling off to a rather constant 150-175 incidents per year. In 1988, 107 incidents were reported; 12 damaged fisheries. In South Korea, red tides have been reported every year since 1982, predominantly along the southern coast of the peninsula; more than 100 occurred in seaweed and fish culture areas and local fishing grounds between 1972 and 1979. Mass mortalities of the hard clam Meretrix lusoria populations in the Jeonbug Farming Area of Gyewharis and Naechodo, in western South Korea, were coincident with high densities of the pathogenic bacteria Vibrio anguillarum, the parasitic cercaria Bacciger harengulae, and a high concentration of pesticides. In Jinhae Bay, red tides were first recorded in 1962; they became more frequent, and since 1982 have appeared every year in April, lasting until October. They cause severe damage to fisheries resources, cultured oysters, mussels, and ark shells. Cooperative comparative research is required to determine the cause, and the effect of red tides in Northeast Asia and the best means of mitigating their occurrence and adverse effects.

Hydrocarbon Pollution

Petroleum hydrocarbons are one of the most threatening pollutants in Northeast Asian Seas since their input is not only increasing rapidly, but these Seas are also especially vulnerable to oil. Cold temperatures retard oil evaporation and dissolution. And strong tidal mixing and a high residual current could spread the spilled oils rapidly and widely. Potential pollution sources include oil and natural gas exploration and production areas, oil terminals, coastal refineries, and major oil tanker casualties and routes (Figure 6).

East Asian continental shelves have been moderately explored for oil, and Bo Hai Bay, the shelf around Taiwan Strait, and the shelf off Sakhalin Island produce hydrocarbons. Some minor gas and petroleum are also produced from the Japanese offshore. The produced oil is mostly consumed domestically, requiring less marine transportation and thus lower probability of an oil spill during this phase than if all oil were exported. Oil refineries are concentrated on the southeast coast of Japan, the south of South Korea, in China along the Bo Hai and in Shanghai, and at Taichung and Kaohsiung in Taiwan.

There is very heavy oil tanker traffic in Northeast Asian Seas, mainly to Japan, Taiwan, and South Korea from the Persian Gulf through the Strait of Malacca and Singapore (Figure 6). About 4,000 million barrels of crude oil a day is imported by these three, representing 23 percent of the global total. New oil shipping routes running from the Bo Hai to Japan, South Korea, and southern China were opened recently.

Routine discharge of oil from ships other than tankers is also a problem, because the ship traffic in the region is becoming increasingly dense due to rapprochement and export- oriented economic and industrial development. The burgeoning commercial trade between China and Japan, and China and South Korea has significantly increased marine transportation, especially in the Yellow and East China Seas.

The actual amount of oil entering Northeast Asian Seas from natural and human sources is unknown. Representative partial information includes 890 spills in eastern South Korean coastal waters from 1979 to 1987 comprising 62 percent of national spills, and 54 oil spills along Japan's Sea of Japan coast in 1985. Based on oil spill incidents reported by the Northeast Asian countries, little oil was apparently spilled there from 1970 to 1985. However, the oil input from other sources is not included (e.g. tank washings and deballasting, land runoff, natural seepage, and unreported spills from vessel accidents). In addition to the known quantity of oil spilled from ships, oil is dumped annually into Northeast Asian Seas from tank washings and deballasting, contributing tar residues. The quantity of oil entering the Northeast Asian Seas from Chinese coasts alone in municipal and industrial wastes is estimated at 115,000 mt/yr, a surprisingly high value.

The actual oil concentration in the region has been measured by several national and international organizations (Figure 6). Oil concentrations in the open ocean are generally low--in the range of less than 10 g/l--and are high--sometimes as much as 100 g/l--in enclosed bays with concentrations of industrial and shipping activities. Bays with elevated concentrations are Tokyo and Osaka in Japan; Ulsan, Masan, and inner Kyunggi bays in South Korea; Keelung and Kaohsiung harbors in Taiwan; and major Chinese harbors in the Bo Hai.

Oil content appears significantly elevated in Chinese coastal waters, but it is possible that variations in oil measurement techniques account for these high values. One-third of China's coastal waters are polluted by oil, and the average oil concentration in seawater along China's entire coast is 0.053 ppm, which is higher than permitted for first-class sea-water quality. The main source of oil pollution of the sea in Chinese waters is from rivers (60 percent), and the second is from ships and coastal oil fields. Only 0.3 percent of the oil pollution results from sea platform operations. Oil was detected in 97.9 percent of surface samples (average concentration is 0.056 g/l) and 99.6 percent of bottom samples (average concentration is 0.063 g/l). The average oil concentration is higher in the nearshore area but may be decreasing. High concentrations are apparent in the Yalu River estuary (0.4 g/l) and in Dalian Bay, Liaoning Province, and Jiaozhou Bay, Shandong Province (0.1 g/l). This distribution pattern is related to the land-based pollution sources and, to a certain extent, controlled by the prevailing winds, i.e., the average concentration is higher in May than in August and October.

The concentration of tar balls ranges from 0.15 to 1 mg/m3. A high concentration is found along the sealanes, particularly south of Honshu. The different distributions of tarball concentrations in summer and winter can be explained by seasonal shifts in the monsoon regime. During summer when the wind blows onshore from the southeast, the tar balls are concentrated against Honshu. In winter when the wind blows from the northwest, the tar balls are dispersed to the southeast. This seasonal regime can also explain the high concentration of tar balls against Honshu in the Sea of Japan in winter. No data are available on tar balls in the Yellow Sea, but there could be high concentrations there. Measurements by South Korean and Soviet scientists did not find significant tar-ball concentrations in their coastal waters.

The concentration of dissolved hydrocarbons is high southeast of Hokkaido in the Tsugaru Strait. Dissolved hydrocarbon concentrations in the Sea of Japan and in the southern Yellow Sea are about twice that of the open ocean. Elsewhere, dissolved hydrocarbon concentrations are low, although the coincident tar-ball concentration is often high.

Hypothetical Oil Spill Trajectories

A major concern is the possibility of a catastrophic spill. The first major oil pollution incident in the Japan Sea was the 6,400 tons spilled from the wrecked tanker Juliana. Many organisms were killed and fisheries products were unmarketable for 3 months; clean-up costs were significant. The extreme sensitivity and vulnerability of the region was demonstrated by a South Korean spill in 1987. A tanker carrying 2,000 tons of refined oil, diesel fuel, and bunker-C oil, was wrecked 40 miles off Inchon harbor and spilled 80 tons of bunker-C oil. The strong tidal current with the prevailing spring northwesterly wind spread the oil over 40 km of coastline contaminating numerous mariculture sites and damaging more than US$10 million worth of seaweed, shellfish, and shrimp. Total economic loss of South Korean resources due to oil spilled from 1983 to 1987 was estimated at more than 17 million won (see Table 1).

Oil spill trajectories have been projected from five locations in East Asian Seas: South Korea's Dolgorea-1 (35o25'N, 130o10'E), a hypothetical point at 37o30'N, 131o30'E in the center of the Tsushima Basin; Gulf's 11H-1X (35o30'32"N, 124o06'12"E); China's Longjiang-1 (30o10'N, 126o05'E); and Taiwan's CPC YDF-1 (26o50'N, 121o50'E). Actual and possible maritime jurisdiction boundaries are superimposed on these trajectories (Figures 7a-h).

Sea of Japan (Figures 7a-d)

During winter, heavy concentrations of a spill at the Dolgorea-1 well would move directly southeast and strike the extreme southwest coast of Honshu within 12 days. The slick would continue to spread both northeast and southwest along the coast. During summer, heavy concentrations of a spill at this site would move north-northeast and strike the southeast coast of South Korea within 6 days. The slick would continue to spread north, tangential to the coast of the Korean peninsula.

During winter, heavy concentrations of spill at hypothetical point x would move directly southeast into undisputed Japanese waters and strike Oki Gunto in 15 days. The slick from the spill would reach southwest Honshu within 18 days and then move east along the coast. During summer, heavy concentrations of a spill at this hypothetical site would move almost due north into undisputed South Korean waters striking Ullungdo within 9 days. It would then spread laterally east and west in the open sea without reaching land.

Yellow Sea (Figures 7e-f)

A spill at the Gulf 11H-1X well site during winter would move southeast staying within South Korean waters. After 18 days the spill would enter South Korean territorial waters and strike Cheju island, eventually surrounding it with oil. Perhaps more important, the spill would then also cross the equidistant line between South Korea and China, thus entering unequivocally Chinese waters. During summer, heavy concentrations of a spill at this site would spread northwest and within 6 days cross the equidistant line and enter Chinese waters. The spill would continue moving into Chinese waters, ultimately brushing North Korean claimed waters.

East China Sea (Figures 7g-h)

Heavy concentrations of a spill at China's Longjing-1 well site in winter would move southeast into Japanese-claimed waters, brushing the Japan-South Korean joint development zone. The spill would reach islands in the Ryukyu archipelago in 21 days and, subsequently, the northern tip of Okinawa itself. In summer, heavy concentrations of a spill at China's Longjing-1 well site would move north toward Cheju, quickly entering the Japan-South Korea joint development zone. The spill would strike the south coast of Cheju within 12 days and then move mainly northeast, reaching the southeast coast of the Korean peninsula in 18 days.

Heavy concentrations of a spill at Taiwan's YDF-1 well site in winter would spread south and east, quickly crossing Taiwan's claimed EEZ and enter waters claimed by China and Japan. The slick would continue moving southeast, eventually impacting the Tiao Yu Tai/Senkaku islands. A spill at this site in summer would move northeast, staying almost entirely within Chinese waters without striking land.

The three main types of commercial damage from oil pollution are fisheries, tainting, and decreased tourism. An oil slick drifting through the ubiquitous fish-farming cages in the region may inflict commercial damage often incommensurate with the amount of spillage. Tainting of commercial fish may cause as much damage as outright death of fish and shellfish. Tainted fish may be unmarketable or reduced in value.

Cooperative research is clearly needed on the sources, actual and potential distribution, and effects of oil pollution, as well as appropriate measures for its mitigation.

Ocean Waste Disposal

Landfill and direct discharge into rivers and coastal seas have been used until recently to dispose of waste simply because they are cheaper, if environmental impacts are neglected. However, this practice has resulted in severe pollution of some rivers, estuaries, and seas. The ever-increasing premium of land and the quantity of waste material have led China, Japan, South Korea, and Taiwan to look for an alternative method--ocean dumping. Indeed, South Korea and Japan have both established and used dump sites in the Sea of Japan, which are located in areas of overlapping claims. And at the end of 1986 the State Council in China had approved three areas as possible waste disposal sites--two in the East China Sea and one in the Yellow Sea.

China is rapidly expanding its requirement for energy, with coal as a major source of fuel. With increased combustion of coal comes increased quantities of fly ash, requiring disposal. China is considering disposal of its fly ash in the Yellow Sea, as well as calcium carbonate residue from the production of fertilizer. However, before fly-ash disposal at sea can be considered acceptable, criteria for dump-site selection should be established and scientific studies carried out to determine, for example, dispersion of the waste. Fly-ash disposal may also become a serious problem in the future for other countries, as coal is substituted for other fuels.

Because of the emerging common interest in waste disposal, the coastal countries should agree to work together on investigating ocean disposal as a waste management option, keeping in mind that the seas are shared by all. Japan, China, and Russia are already members of the London Dumping Convention (LDC), and China has developed twenty-five regulations on the dumping of wastes at sea. A first goal should be that all countries become members of the LDC in order to take advantage of the information available through it. Members also have an obligation to report ocean-dumping permit activity so that all countries are aware of the kind and quantity of wastes that enter their shared area.

Nuclear Waste Disposal in the Sea of Japan

The news that the former Soviet navy dumped 18 decommissioned nuclear reactors and 13,150 containers of radioactive waste from 1978 to the present, most of it in the Sea of Japan, created an uproar in the world environmental community.

It particularly jolted nuclear-sensitive Japan and South Korea, and even drew a rare comment from North Korea. Adding fuel to the fire, a Russian naval vessel dumped nearly a thousand tons of low-level waste in the Sea of Japan shortly after Russian President Boris Yeltsin's visit to Japan.

Japanese Foreign Minister Tsutomu Hata warned his counterpart Andrei Kozyrev that if Russia proceeded with its plans to dump another 900 tons of similar waste, "the foundation of a new Japan-Russia relationship _ _ _ will crumble." But in a stunning case of the "pot calling the kettle black," Japanese Science and Technology Agency Chief Satsuki Eda admitted that Tokyo Electric Power Co. dumps 10 times more radioactive waste each year into the Sea of Japan than the 900 tons dumped by the Russian navy. South Korea strongly protested the dumping by both countries.

Although most scientists agree that the dumped waste provides no immediate threat to the environment or humans, the longer term effects are unknown, particularly after the containers corrode. Regardless of the facts, consumers may avoid marine products taken from the Sea of Japan. Indeed the fisheries union in Hakodate said it feared consumers would boycott their squid, a favorite delicacy in Japan.

This shock may be the critical spur needed to forge cooperation in marine environmental protection among the coastal countries. The initial report of Russian dumping has prompted cooperation to deal with this specific issue at hastily arranged bilateral Japan/Russia meetings of relevant ministers and experts, proposals for joint South Korea/Japan/Russia surveys at specific dump sites, and a call by Japan for an international cooperative fund to help Russia treat its nuclear waste. North Korea even offered to host an international seminar on regimes for pollution control.

In March 1994 a joint Japan-South Korea-Russia-International Atomic Energy Agency expedition began a search for signs of radioactive waste contamination in the Sea of Japan. The scientists used a Russian vessel and shared the costs of the expedition equally. More recently, it has been revealed that chemical munitions were also dumped up until the mid-1980s in the Seas of Japan and Okhotsk. Obviously a long-term cooperative research program is required to monitor the waste and its effects, and to determine the best methods of dealing with it.

The Regional Environmental Regulatory and Institutional Setting In many respects, East Asian Seas are a "no-man's land" as far as marine environmental protection is concerned. Sensitive political relations and uncertain boundaries have engendered an atmosphere of mistrust not conducive to information-sharing and cooperation on environmental matters. This makes it difficult to evaluate scientifically the state of the marine environment; the nature and extent of national and international environmental activities; and the place of environmental concerns in unsettled disputes over maritime boundaries, fishing rights, and offshore petroleum development.

In general, national laws and regulations are not developed with specific reference to natural features or processes that may affect pollutant transport, circulation, transformation, and dispersion. Laws and policies are couched in terms that separate legal justification and intent from the reality of people, ecosystems, and place. This is not unique to this region but is more important here, because the apparent failure to relate law more directly to nature through improved scientific understanding supports a general impression of regional disinterest in marine environmental issues.

Prospects for improved transnational cooperation in resource development and use may depend upon better understanding of the potential for improved marine environmental protection in both coastal and open-sea areas. The most successful efforts to deal with marine environmental problems are carefully nurtured with simultaneous institution-building, scientific, and treaty- drafting activities at the regional level, but this can come about only with strong and sustained littoral state support for international organizational leadership.

Consideration should be given to a number of possible measures to enhance overall maritime safety and environmental protection beyond the International Maritime Organization (IMO)- coordinated international conventions. Mitigating or precautionary actions might include the establishment of tanker exclusion zones to protect coastal environments, or moving safety zones with escorts, around LPG/LNG tankers. Another could be the formation of regional pollution response teams, multinational in composition and authorized to act immediately, regardless of the national jurisdiction of the water affected.

Harmonizing National Policies, Laws, and Regulations

The Convention on the Law of the Sea provides that states should endeavor to harmonize their policies regarding protection of the marine environment. The countries in the region have similar wastes and a similar level of technology for disposing of the waste. Theoretically, they might adopt similar or uniform standards. The fact that they do not reflects a lack of communication as well as real differences in national priorities for environmental protection in general and for specific pollutants and pollutant sources in particular (see Tables 2 and 3). For example, Russia's water quality and effluent standards are, on paper, generally much stricter than those of its neighbors. South Korea has apparently not yet developed comprehensive specific standards, and China has apparently not yet promulgated effluent standards. Taiwan's effluent standards are considerably weaker than those of Japan, and China's water quality standards are the weakest of all. Of course, enforcement of these standards is another matter.

These differences are consistent with the Convention, since it provides that states "shall use the best practicable means at their disposal and within their capabilities to prevent, reduce and control pollution." Yet, a mosaic of different pollution regulations could inhibit transnational shipping of oil and their hazardous substances. Should standards be uniform or be harmonized among these countries? If so, which standards, where, and at what common base?

Scientific Cooperation

Marine science is increasingly influenced or restricted by politics because it produces knowledge which can give a country a competitive edge. The nature of the geological, physical and biological oceanography of Northeast Asian Seas, the incomplete understanding thereof, and the necessity of continuous and synoptic measurements for achieving understanding, mandate cooperation in scientific research and sharing of information between the coastal countries.

All countries are members of the 19-nation Working Group for the Western Pacific (WESTPAC), which was established by UNESCO at its Tenth Assembly in 1977 to plan and coordinate multilateral ocean science programs. WESTPAC has focused on intercalibration exercises, with the collaboration of the Global Investigation of Pollution in the Marine Environment (GIPME) and the International Oceanographic Commission (IOC) Group of Experts on Methods, Standards, and Intercalibration (GEMSI). At the WESTPAC III meeting (September 1983), it was concluded that a major emphasis of initial WESTPAC program activities should address the overall need for training in bioindicator sampling techniques and contaminant analysis, particularly for organochlorine and hydrocarbons, and that national centers should be identified. The Program Group also recommended that the WESTPAC Task Team on Marine Pollution Research and Monitoring Using Commercially Exploited Shellfish as Determinants should participate actively in the IOC's Marine Pollution Monitoring Programs (MARPOLMON).

However, there is still a general lack of a formal infrastructure to bring about international collaboration and cooperation in monitoring and research activities that would delineate the spatial distribution of a contaminant and its subsequent effects and, in particular, whether it would cross national boundaries. The lack of a formal structure prevents the development of well-coordinated cooperative baseline studies and coordination in emergencies (such as a spill of oil or other toxic and hazardous materials). Monitoring and research programs are not as effective as they should be, because they stop at some politically determined border, rather than at some physical or chemical border.

For example, for the Yellow and East China Seas, there is a wide discrepancy among the countries in the level and effectiveness of marine pollution monitoring and research in support of regulation. China has carried out extensive surveys and research in its "off-shore" areas since the early 1970s. South Korea's and Taiwan's programs apparently are more recent, whereas information is lacking on North Korea's activities. Effective study of transboundary contamination requires excellent cooperation and timing of sampling to enable integration of data across a region. Through the auspices of the LDC or the incipient UNEP Regional Seas Programme, or both, the region's countries could organize and carry out a program of joint research in which goals, facilities, and information are shared equally. The countries bordering particular seas may also consider establishing a regional compensation fund for damage caused by polluting accidents. However, it may take a major accident to spur such cooperation.

Policy issues for scientific cooperation include the following:

How can information and basic data on all issues regarding the sea best be compiled and exchanged? Could a dynamic interactive integrated database or atlas on the sea be built? What kinds of data should most urgently be included in such an atlas? What are the conditions--e.g., technical, institutional, diplomatic--which should be satisfied to build such a database?

How can an interdisciplinary network of institutions conducting research on the different issues regarding the sea be built? What kinds of research institutions exist in and out of the region? What kinds of scientific cooperation (bilateral and multilateral) exist among the countries bordering the sea? Is it better to organize networks, discipline by discipline, issue area by issue area, or in an interdisciplinary fashion?

How can systematic joint research be developed among the nations bordering the sea on jointly agreed priority issues?

Could a regional project be conceived? Would a joint survey cruise among all coastal States be feasible, say, using a Japanese or Russian research vessel? Is it sufficient to develop projects on specific issues in the different issue areas? Or is it necessary to examine issue linkages within an integrated regional system? How can this effort be opened to extra-regional scholarship while encouraging intra-regional cooperation?

Cooperative efforts might eventually lead to the establishment of a Regional Marine Science and Technology Center as called for in the Convention on the Law of the Sea. Such a research center might combine the efforts of NGOs, universities, the United Nations University, UNEP, IOC, IMO and industrial enterprises This center might initially be attached to a university and nurtured into independence. This center might assist in fulfilling the tasks delineated by UNEP's incipient Regional Seas Programme for the Northwest Pacific:

1. assess regional marine environmental conditions by coordinating and integrating monitoring and data gathering systems on a regional basis, making the best use of the expertise and facilities available within the region on a consistent and collective basis;
2. collate and record environmental data and information to form a comprehensive database and information management system which will serve as a repository of all relevant, available data, act as the sound basis for decision-making, and serve as a source of information and education for specialists, administrators, and others;
3. develop and adopt a harmonious approach towards coastal and marine environmental planning on an integrated basis, and in a pre-emptive, predictive and precautionary manner;
4. develop and adopt a harmonious approach towards the integrated management of the coastal and marine environment and its resources, in a manner which combines protection, restoration, conservation and sustainable use; and
5. develop and adopt a regional framework of legislative and other agreements for mutual support in emergencies, collaboration in the management of contiguous bodies of water, and cooperation in the protection of common resources as well as in the prevention of coastal and marine pollution.

Fish Distribution and Maritime Jurisdictions

The problems associated with regional fisheries management are complicated by the multiplicity of actual claims or hypothetical (assumed or possible) boundaries and the fact that fish migrate freely across boundaries and the spawning and wintering grounds straddle various jurisdictional lines (Figure 8).

In the southeastern Sea of Okhotsk, both demersal and pelagic stocks migrate within and across the territorial and EEZ waters attached to the disputed southern Kuril Islands/Northern Territories. Moreover, a spawning ground for mixed demersal species is situated within these territorial and EEZ waters, and another in the extreme southern Sea of Okhotsk extends across the equidistance line between Japan and Russia, as do migrating pelagic and demersal species.

In the northern Sea of Japan, demersal spawning grounds are shared by Japan and Russia, and both demersal and pelagic stocks migrate across an equidistance line between the two. In the southern Sea of Japan, the pattern is more complex. Pelagic spawning grounds occupy the southern part of the overlapping claims area around Tok Do/Takeshima (South Korea/Japan) and are also divided by the South Korea/Japan continental shelf boundary.

Pelagic species migrate through the disputed area and across the boundary. An extensive demersal spawning area reaches north and south of North Korea's possible EEZ, and both demersal and pelagic stocks migrate in and out of this zone and the Military Warning Zone. The Korea Strait is a confluence of demersal and pelagic spawning and wintering grounds and their migration routes, and the South Korea/Japan boundary artificially divides these natural fisheries distributions.

Migration patterns in the Bo Hai and the northern Yellow Sea are extremely complex. Although this area is almost completely within the military zones of China and North Korea, it harbors many spawning grounds for both demersal and pelagic species that are distributed throughout the Sea. One such area off the Yalu River mouth is divided by these countries' respective claims. Further, these species migrate to and from the northern Yellow Sea and between the Chinese and North Korean zones. The central and southern Yellow Sea is ringed with spawning grounds for both species types, and pelagic spawning grounds and demersal wintering grounds occupy the central part of the Sea. Both demersal and pelagic species migrate between North and South Korean waters and across the hypothetical equidistance line between China and South Korea. Moreover, these species move back and forth across the declared Chinese fisheries zone and in and out of South Korea's fisheries zone (which coincides with its Territorial Seas), including that around Cheju-Do. Most transnational migrations in the southern Yellow Sea are by demersal species.

Like the central Yellow Sea, pelagic spawning grounds and wintering grounds in the East China Sea encompass the entire offshore. Extensive spawning grounds for both demersal and pelagic species occupy the eastern portion of the Senkaku/Tiao Yu Tai (Japan/China) overlap. A similar spawning area extends into the South Korea/Japan joint development area, as do wintering grounds for both types of fishes. Extensive movements of both species occur throughout the Sea--in and out of the Joint Development Zone and across the hypothetical equidistance line and China's special fisheries zones. Some demersal species also migrate between China and Taiwan-claimed waters.

Because there is no systematic understanding of the whole region, scientists cannot provide comprehensive advice to their governments. To improve the basis of rational utilization of fishery resources, each coastal State bordering the region should standardize its data on fishery resources and release them. Details of information covering all the major species currently utilized and its timely release are critically important to detecting any change occurring in the ecosystem of the living resources in the region. Frequent and reciprocal exchanges of scientists concerned with resources assessment between laboratories in different countries would intensify technical cooperation, primarily on a bilateral and ultimately on a regional basis. Each of the laboratories should encourage visits by scientists of other nations and make its own data and information available to them as they work together with national scientists. Working sessions in neutral locations by scientists from two or more nations dealing with specific species or species complexes should also be encouraged.

The major research actions needed by the countries concerned are as follows:

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Intensify research on fish resources.  This will provide
 scientific data for maintaining the fish stocks and
 fisheries.
Jointly investigate stocks which winter and spawn in the
 waters of the coastal countries.
Cooperate in management.  Each state must share the benefit
 and responsibility of conservation by limiting fishing
 effort and catch.  More closed fishing zones must be
 established to conserve the young fish and fry, and the use
 of gears, the size of the mesh, and the size of fish caught
 must be restricted.
Work with the FAO, IOC, and regional agencies.  They can
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help coordinate and ensure the conservation and development
of fish stocks in this region by organizing the exchange of
oceanographic data, fishing statistics and research on
marine resources and environment, and provide suggestions
and information to the governments concerned.
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Conclusion

The following areas are candidates for cooperative efforts to enhance the sustainability of Northeast Asian seas. cooperation in the study of transboundary pollution, intercalibration, baseline studies, coordination in emergencies, and possible ocean disposal;

the adjustment of national initiatives to be compatible with emerging international legal and technical obligations (e.g., the Convention on the Law of the Sea, the London Dumping Convention, UNEP's Regional Seas Programme) and with each other; and enforcement of environmental regulations near or across disputed boundaries.

A plan of action might include establishment of a computer-based, dynamic, interactive, integrated atlas of Northeast Asian seas; establishment of coastal and sea use management plans; assessment of priorities for marine resource management and areas of the coast and the Sea most at risk. related scientific research priorities might include red tides, heavy metals, chlorinated hydrocarbons, and tributyl tin;

creation of marine parks to protect fish spawning areas; establishment of estuarine and wetland protected areas for seabirds and juvenile fish which inhabit these areas; initiation of national and international workshops to discuss the shared resources, conduct research, and make available the findings to interested parties;

inclusion of land-based polluters at all stages of environmental management discussions; and identification of the social and economic benefits of sustainable development of Northeast Asian Seas

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