Threats to Marine and Coastal Biodiversity in the NOWPAP Region

Northwest Pacific Action Plan

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PREFACE

To enhance the understanding of key regional and global issues related to marine biodiversity conservation, UNEP Regional Seas Programme started to compile data and information on the threats to marine and coastal biodiversity as well as on management responses, in accordance with the set of common indicators. The global outlook report, based on this data and information, will contribute to the discussions on marine and coastal biodiversity at the Tenth Conference of the Parties to the Convention on Biological Diversity in October 2010. NOWPAP has contributed to the UNEP global outlook report along with other regions around the world.

This brochure was prepared based on the report compiled in April 2010 by a NOWPAP consultant, Dr. Mark Walton. It contains information on the pressures to marine and coastal biodiversity in the NOWPAP region (overfishing, pollution, invasive species and climate change) and responses from NOWPAP member states (e.g., establishing marine protected areas and reducing fishing fleets).

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TABLE OF CONTENTS

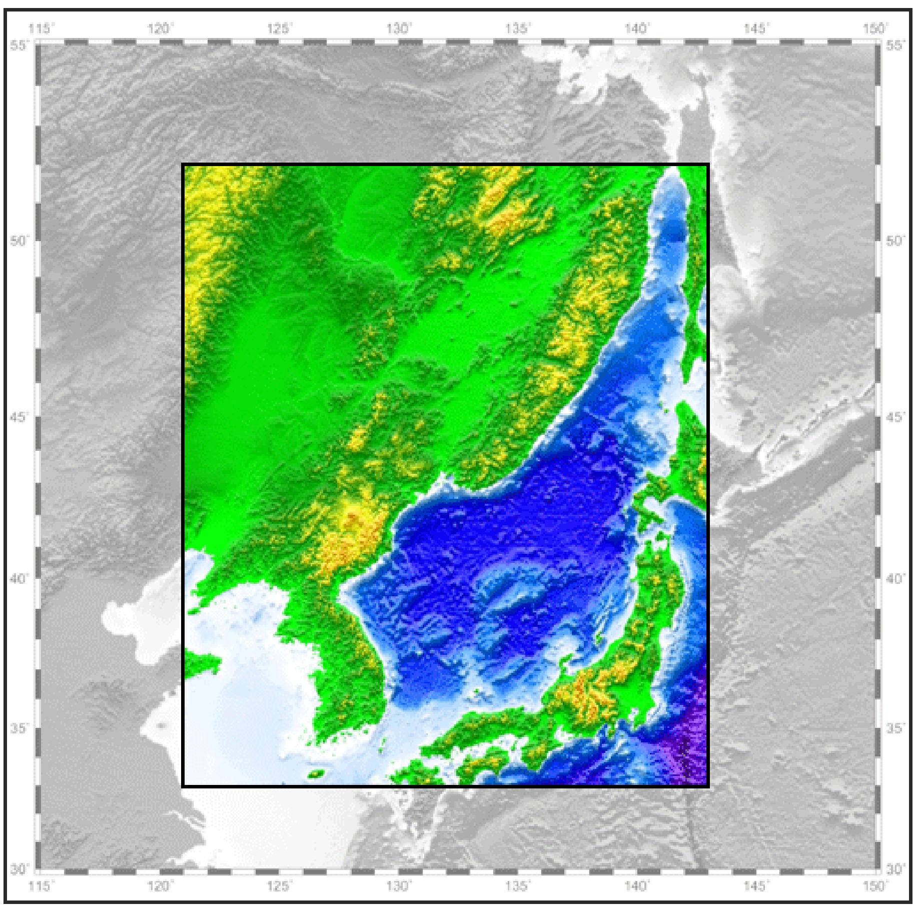
BACKGROUND

The Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the Northwest Pacific Region (NOWPAP) was adopted in September 1994 as a part of the Regional Seas Programme of the United Nations Environment Programme (UNEP). NOWPAP member states are People's Republic of China, Japan, Republic of Korea and Russian Federation.

As shown below, the geographical scope of NOWPAP covers the marine environment and coastal zones from about 33^{o} to 52^{o}N, and from approximately 121 to 143^{o}E. The whole sea area of NOWPAP can be divided into western part (between China mainland, Korea and Japan) and eastern part (between Russia mainland, Korea and Japan).

The Northwest Pacific region features coastal and island ecosystems with spectacular marine life and commercially important fishing resources. The region is also one of the most densely populated parts of the world, resulting in enormous pressures and demands on the environment, including marine and coastal biodiversity.

In the subsequent text, information on biodiversity threats and status is given for the western and eastern parts of the NOWPAP region as well as on member states response to those threats.



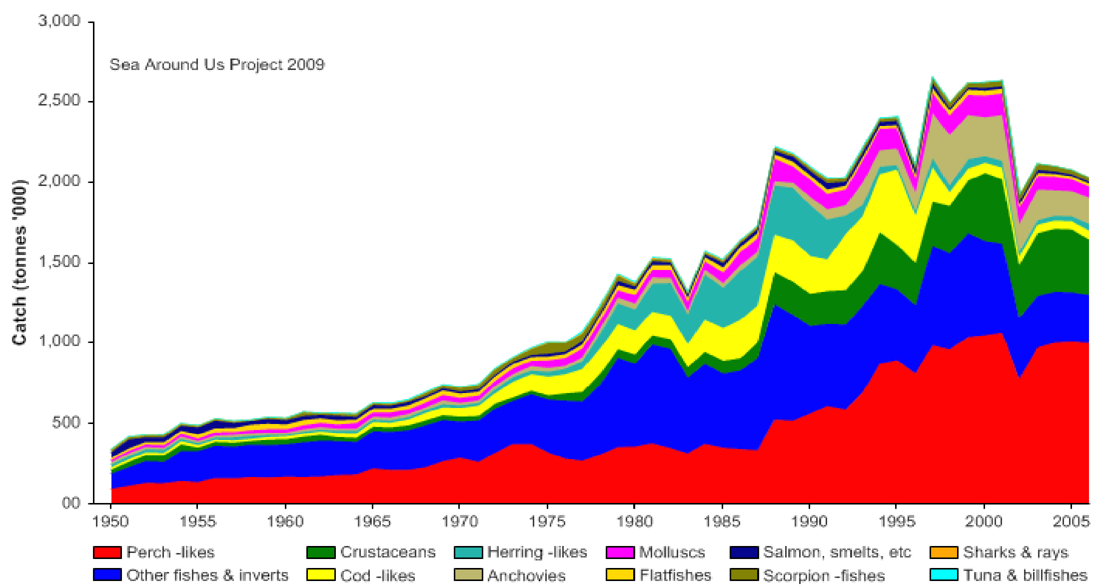
PRESSURE

Fish Catches

Western part of the NOWPAP region

The data from the Sea Around Us project (SAU 2009) suggests that there has been irregular but sustained growth in fisheries harvests from the Yellow Sea until 2002 when a significant decline in catch occurred (Figure 1); catches in the Yellow Sea increased from 400,000 tonnes in 1950s to more than 2.5 million tonnes around 2000, which indicate that fishing effort has exceeded Ecosystem Carrying Capacity (UNDP/GEF 2009). Change in the species composition of the landings has also been reported (UNDP/GEF 2007). Large valuable demersal fish species appear to have been replaced by smaller, less valuable invertebrates and pelagic fish species such as anchovy and sandlance (Jin and Tang 1996; Jin 2004; UNDP/GEF 2007). Similar changes are reported from Korean landings (Yeon et al. 2007). However recent surveys have indicated a decline in pelagic fish and a sustained recovery of yellow croaker stocks since 1991 (Tang 2009).

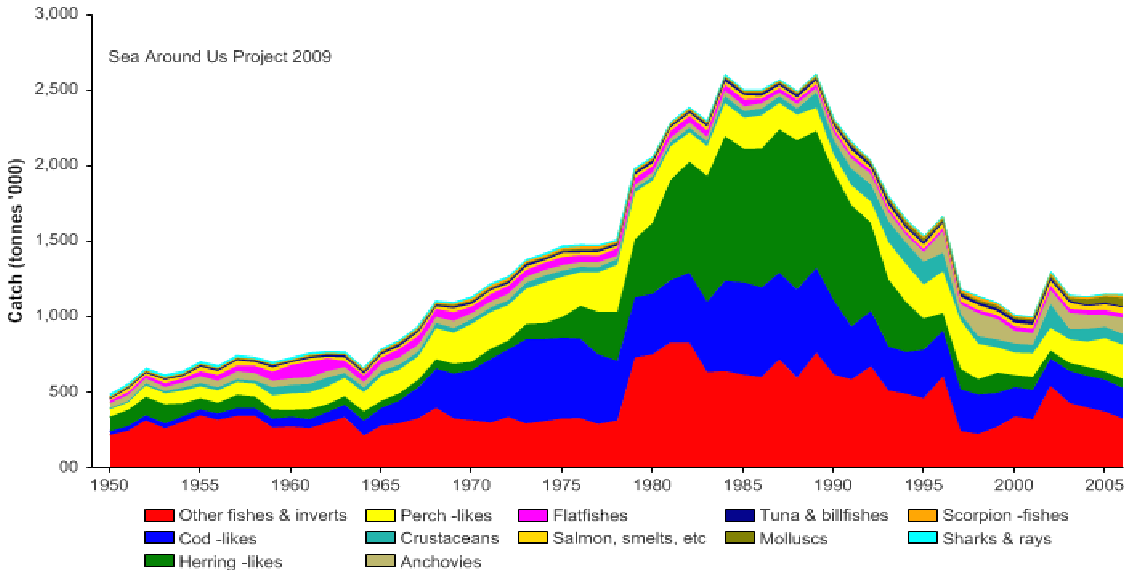
Figure 1: Annual fisheries landings (tonnes) by commercial groups from 1950 to 2006 for the western part of the NOWPAP region (SAU 2009)



Eastern part of the NOWPAP region

The composition and quantity of fish catches in the eastern part of the NOWPAP area also varied with time, with herring-like fishes dominating in the 1980's (Figure 2). The large increase in catch during this time is primarily due to the increase in sardine catches that occupied up to 60% of all Japanese catches from this region (Tian et al. 2006). As the status of fisheries for various species differed in this region, for most species, the long-term trend in abundance is either declining or unknown in this region (PICES 2008).

Figure 2: Annual fisheries landings (tonnes) by commercial groups from 1950 to 2006 for the eastern part of the NOWPAP region (SAU 2009)



Nutrient Loading

From 27 to 84% of total dissolved inorganic nitrogen (DIN) and from 37 to 64% of total dissolved inorganic phosphorus (DIP) in the western and eastern parts of the NOWPAP sea area, respectively, is being deposited from the atmosphere (Table 1). Nevertheless, in the coastal zone, the riverine input of nutrients is predominant. Table 2 provides a summary of nutrients input with major rivers within the NOWPAP region (NOWPAP 2009).

Table 1. Contribution (%) of atmospheric and riverine sources of nutrient inputs to the marine environment in the western and eastern part of the NOWPAP sea area

	Eastern part of the NOWPAP sea area		Western part of the NOWPAP sea area	
	Atmospheric deposition	Rivers	Atmospheric deposition	Rivers
DIN	83.6	16.4	26.9	73.1
DIP	64.3	35.7	36.8*	63.2

*(Tsukuda et al. 2006)

Table 2. Input of total nitrogen (T-N) and phosphorus (T-P) with major rivers in the NOWPAP region (2005 data)

Rivers	Water discharge (km^3)	T-N (t/year)	T-P (t/year)
China, without Yangtze*	221.0	815,086	3,196
Japan, west coast	126.0	98,812	5,811
Rep. of Korea	56.6	161,023	6,953
Russian Fed., without Amur**	43.6	9,022	553

*DIN and DIP, recalculated from (Liu et al. 2003); **DIN

In spite of governments efforts to treat and reduce wastewater discharges (both industrial and domestic), excessive input of nutrients in the NOWPAP region still leads to eutrophication of coastal waters (with limited water exchange) and changes in phytoplankton communities (from diatoms to flagellates). For example, from 1999 to 2003, 304 red tide events were recorded in the coastal areas around Korea (NOWPAP 2005). In Japan (Seto Inland Sea), though the overall number of red tides decreased comparing with 1970s, every year about 100 red tide events are still being registered. Observation data from the Yellow Sea have shown slight increase of DIN concentrations in recent years associated with decrease in phosphate and silicate concentrations (Lin et al. 2005), leading to increased N/P and N/Si ratios (Figure 3a, b). As a result of excessive nutrients input affecting coastal phytoplankton communities, the whole food chain is affected, causing changes in coastal and marine biodiversity.

Figure 3a: Annual mean DIN and Si concentrations and Si:N ratio in the Yellow Sea from annual surveys (averaged for the water column) between 1976 and 1999 along a transect at 36ºN (Lin et al, 2005)

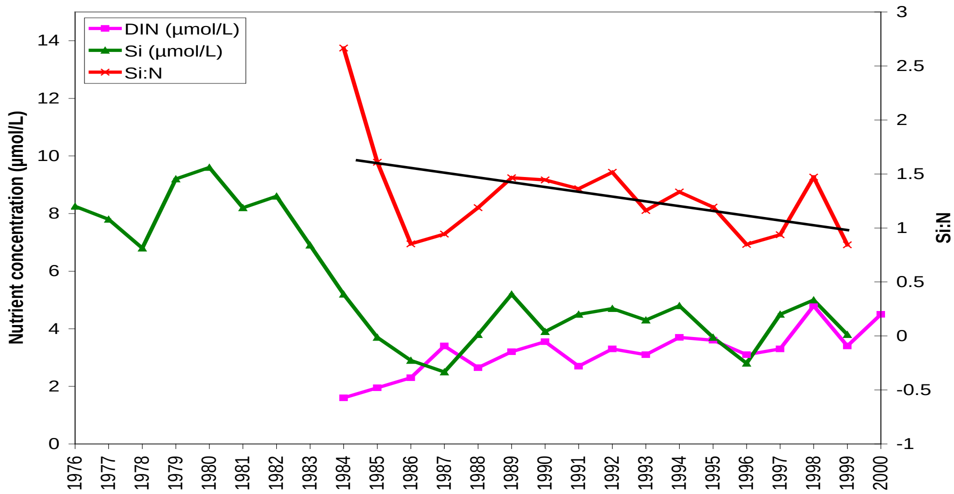
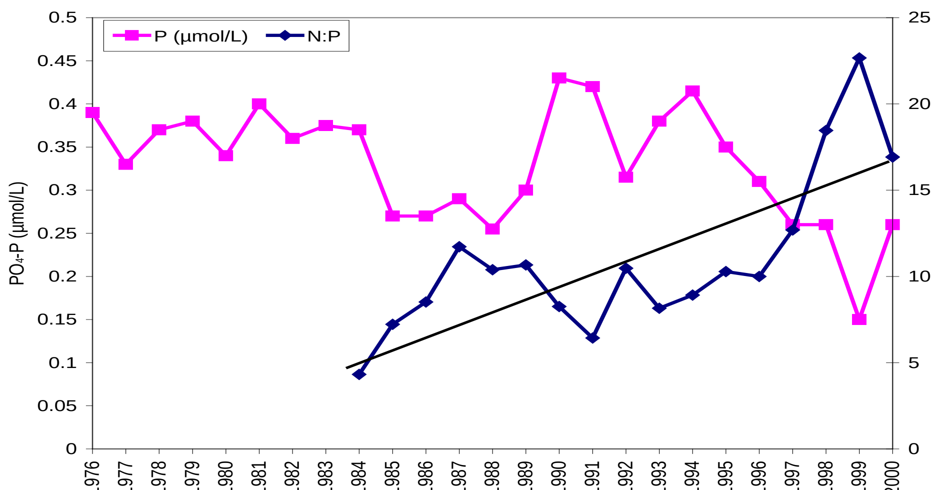


Figure 3b: Annual mean PO_4 concentrations and N:P ratio in the Yellow Sea from annual surveys (averaged for the water column) between 1976 and 1999 along a transect at 36ºN (Lin et al, 2005)



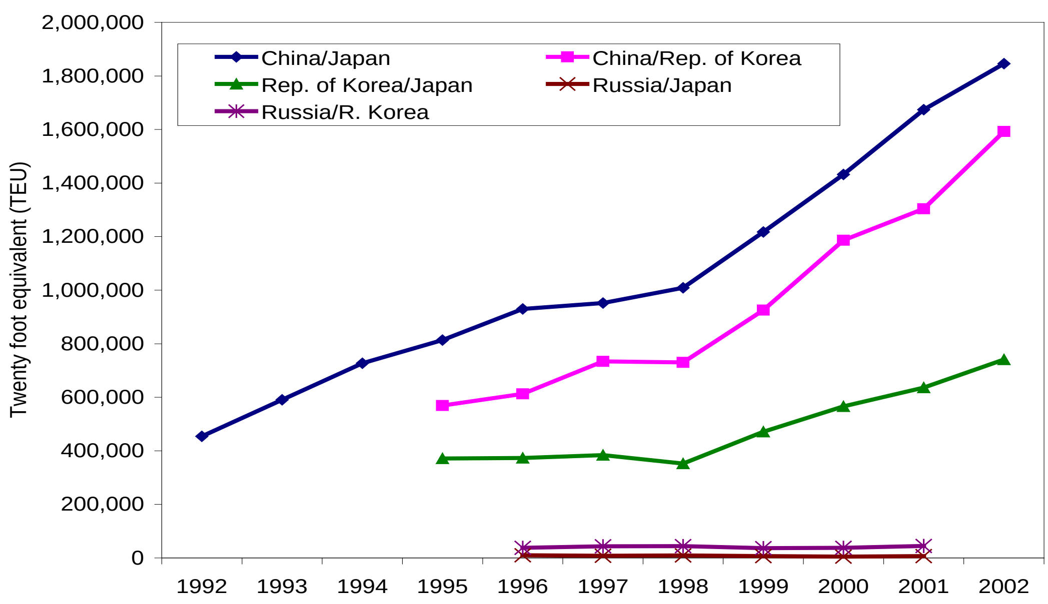
Shipping

Eight of the top twenty busiest ports in terms of metric tonnes shipped in 2006 are in the NOWPAP region. Combined, they account for 1,778.3 million metric tonnes of shipped goods (AAPA 2007), however there will be some double counting using this method as goods will be shipped between these busy ports. By 2007 this had increased to 2,125.3 million metric tonnes for the same eight ports (AAPA 2008).

Looking at the historical trade between the NOWPAP countries in terms of shipping using TEU (twenty foot equivalents: a measure used for estimating container transport) can provide an indication as to the change in volume of traffic, though this has some problems as well, as the world's busiest port, Shanghai, and Japan's largest ports are all outside the NOWPAP area. However, most of Japan's regional trade comes from ports within the NOWPAP area (UNESCAP 2003). There has been a significant increase in the volume of regional trade between 1995 and 2002 driven mostly by trade with China (Figure 4).

As shipping industry has developed, an issue on ballast water has received much attention as a source of aquatic invasive species likely to invade aquatic habitats. Invasive species are now generally recognized as one of the greatest threats to marine and coastal biodiversity (Carlton and Geller 1993). Unfortunately, there are still gaps in documenting impacts of invasive species on marine and coastal biodiversity in the NOWPAP region (Pacific Ocean Synthesis 2009). With the Ballast Water Convention nearing the ratification level at which it comes into force, there is hope that the region will be spurred into action.

Figure 4: Shipping volumes between four of the countries in the NOWPAP region (UNESCAP 2003)



Sea Surface Temperature

As a result of climate change, the warming of water bodies can result in significant biological changes, such as northwards migration of habitats, earlier spawning/hatching/migrations, which can result in the mistiming of biological events such as the spring bloom and associated zooplankton production with the dietary requirement of migrating fish and birds (Gitay et al. 2002; UNDP/GEF 2009). Warming of oceans may also be associated with an increase in disease outbreaks (Harvell et al. 2002). Recently published results classified the sea in the eastern part of the NOWPAP region as a super fast-warming large marine ecosystem and the western portion as fast-warming (Belkin 2009). In this analysis of changing sea surface temperatures of the LMEs, that authors report that between 1982 and 2006 there was a warming of 0.67ºC and 1.09ºC in the Yellow Sea LME and the eastern part of the NOWPAP sea area, respectively (Figures 5 & 6). However this warming is not uniform either temporally or spatially and research has suggested that warming accelerated after 1985 and is possibly linked to intensification of the North Pacific High and Aleutian Low Weather systems that drive water circulation in the North Pacific (Zhang et al. 2000; Yeh 2010).

Figure 5: Sea surface temperature in the western part of the NOWPAP region redrawn from Belkin (2009)

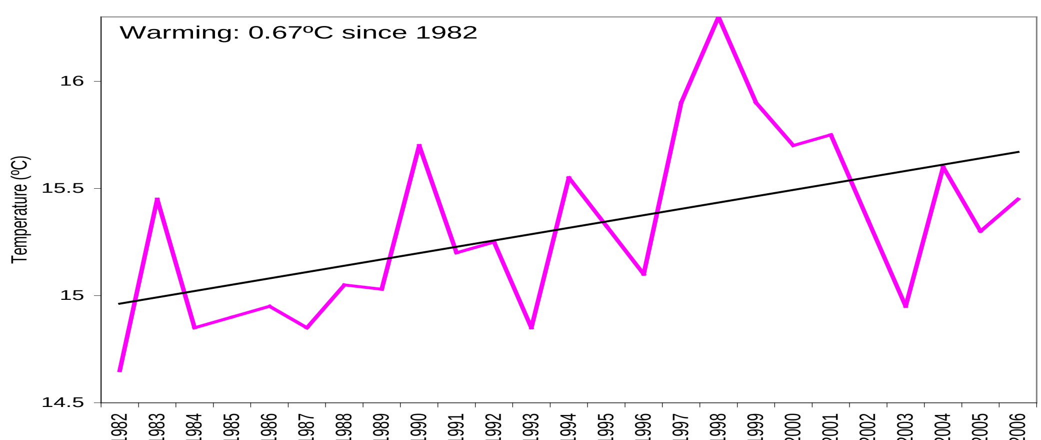
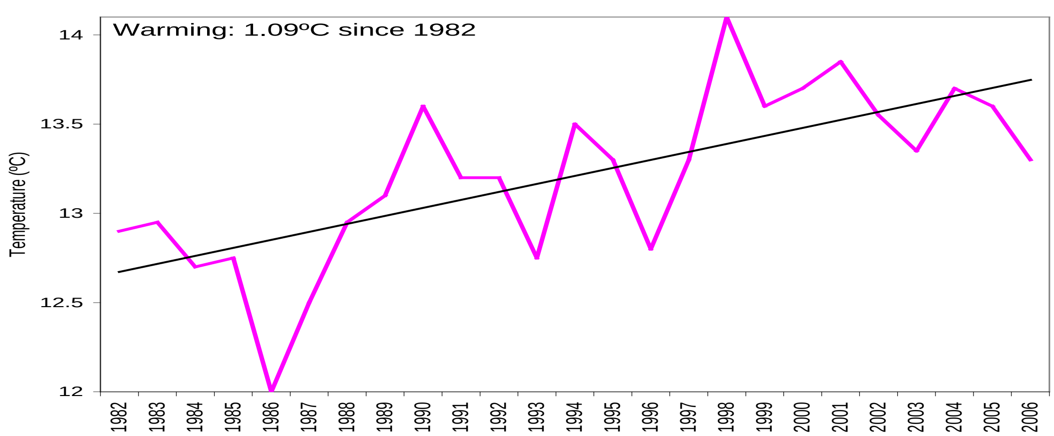


Figure 6: Sea surface temperature in the eastern part of the NOWPAP region redrawn from Belkin (2009)



STATE

Marine Trophic Index/Species Depletion Index

In the NOWPAP region there has been a marked decline in the mean trophic level of fish landed of about 0.1 in the last 56 years (Figures 7 & 8; SAU 2009). Studies in the eastern part of the NOWPAP region using Japanese fishery data suggest a similar decline in mean trophic level once the sardine catch has been excluded as almost 60% of the catch in the 1980's was dependent on this species (Tian et al. 2006). However, studies suggest that in the Yellow Sea this rate could be a good deal higher, as much as 0.14 decade^{-1} due to the replacement of picsivorous and omnivorous fish by planktivorous fish, with additional effects coming from individual fish species that are feeding lower on the trophic ladder possibly as a result of the decline in mean length at capture of many fish species (Zhang et al. 2007).

It is also important to note that the mean trophic level of the main commercial species in the Yellow Sea has decreased due to dietary changes, climate change induced changes in availability of dietary items and over-fishing of the prey items of carnivorous fish (UNDP/GEF 2009).

Figure 7: Trophic index of fish caught in the eastern part of the NOWPAP region between 1950 and 2006 (SAU 2009)

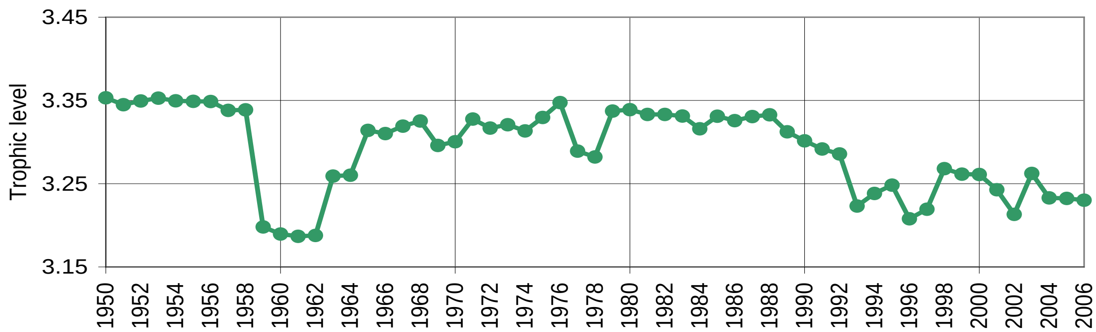
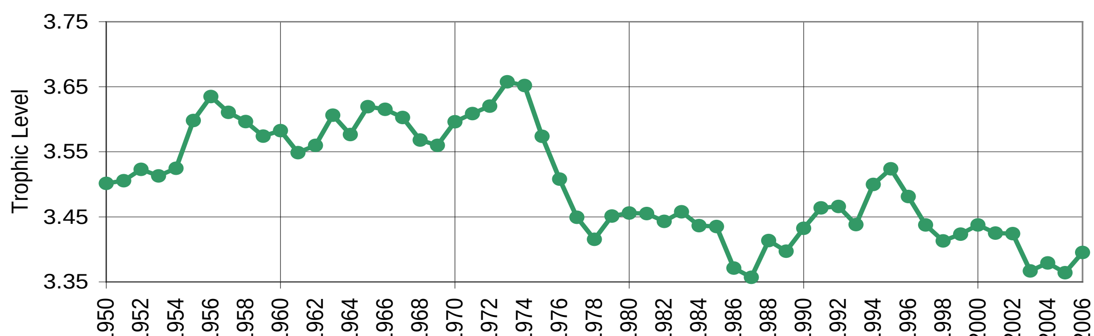


Figure 8: Trophic index of fish caught in the western part of the NOWPAP region between 1950 and 2006 (SAU 2009)



RESPONSE

Fish Stock Agreements

Perhaps most important international agreements that affect fish stocks are:

i) The 1982 United Nations Convention on the Law of the Sea (UNCLOS), with regard to fisheries, states are required to manage fish stocks within the Exclusive Economic Zone (EEZ) of the country and cooperate with other countries on the management of migratory stocks. All NOWPAP members are parties to UNCLOS (EC 2009).
ii) The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks mainly deals with areas outside the EEZ. This agreement is known as the UN Fish Stock Agreement to which all NOWPAP members are parties (FAO 2010b).
iii) Also building on UNCLOS, the 1993 FAO Compliance Agreement seeks to address the threat to international fisheries management posed by vessels that do not abide by agreed fishing rules by making vessels flagged by states their responsibility. From the NOWPAP region only Japan is party to the convention (FAO 2010b).
iv) All countries in the NOWPAP region are also parties to the Convention of Biological Diversity (ratified in 1995) which shares a number of goals with the FAO Code of Conduct for Responsible Fisheries. All countries have prepared the 3rd National Report on the CBD, however only the Russian Federation had prepared the 4th National Report and only Japan has prepared the Voluntary Report on Implementation of the Programme of Work on Marine and Coastal Biological Diversity (FAO 2010a) and it is therefore difficult to assess the commitment of the countries to the CBD .
v) The FAO Code of Conduct for Responsible Fisheries is a voluntary agreement endorsed by all NOWPAP members which was built upon UNCLOS and the UN Fish Stocks Agreement. It has very clear targets which enable easier quantitative assessment of compliance with the code of conduct (Pitcher et al. 2006).

Overfishing in the NOWPAP region is being addressed through bilateral fisheries agreements between the member states, reductions in fishing fleets, limiting fishing time through seasonal closure of fishing areas during spawning times, and introduction of catch quotas; nutrients discharges are being reduced (UNDP/GEF 2009). In the western part of the NOWPAP sea area, both China and Republic of Korea are firmly committed to reducing fishing effort by at least 25% under the Strategic Action Plan for the Yellow Sea Large Marine Ecosystem (YSLME) endorsed in 2009. Both countries are currently spending millions of US dollars on boat buy-back, provision of alternative livelihoods, seasonal closures of fishing grounds and improving enforcement of fishing regulations (Walton and Jiang 2009).

MPA Establishment

Since the first MPA was established in the NOWPAP region in October 1916 there has been enormous progress in designating ecologically important areas as MPAs. Within the NOWPAP region there are a total 79 MPAs (Table 3 & 4) covering an area of 4,117,544 ha (NOWPAP 2010). The locations of the MPAs are listed individually (Figure 9).

Table 3: Number of MPAs in the NOWPAP region by country

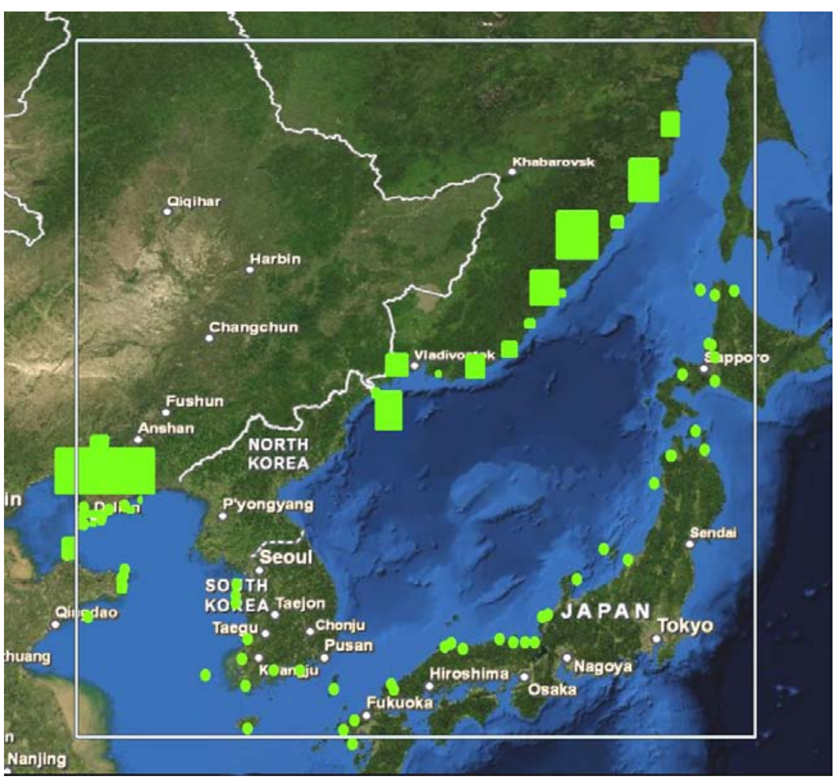
Country	Total number	Level			Protection type		
		National	Provincial	Municipal/ County	Natural ecosystem	Wild animals/plants	Nature heritage
China	20	9	5	6	15	17	17
Japan	23	23	0	0	23	23	19
R. Korea	22	22	0	0	22	20	13
Russia	14	7	7	0	14	14	7
Region	79	61	12	6	74	74	56

Table 4: Area (hectares) of MPAs in the NOWPAP region by country

Country	Total Area	Level			Protected Type		
		National	Provincial	Municipal/ County	Natural ecosystem	Wild animals/plants	Nature heritage
China	1,367,206	1,150,525	194,149	22,532	1,355,210	1,343,716	1,359,955
Japan	436,235	436,235	0	0	436,235	436,235	421,000
R. Korea	357,333	357,333	0	0	357,333	353,710	333,718
Russia	1,956,770	1,121,850	834,920	0	1,956,770	1,956,770	756,000
Region	4,117,544	2,629,708	1,029,069	22,532	4,105,548	4,105,548	2,870,673

Note: In Japan, the data were collected only for the national, quasi-national parks and wildlife protection areas even though there are many other types of MPAs.

Figure 9: Location of MPAs in the NOWPAP region. The map shows the location of 75 of all 87 MPAs with the geographical coordinate information. The 'rectangle' marks the latitude and longitude of the border of the east, west, south and north. The 'point' marks the center of the MPA (NOWPAP 2010)



CONCLUSIONS

From this Pressure, State and Response assessment it is clear that while many of the factors documented here are still impacting ecosystems in the NOWPAP area, the region appears to be serious in confronting the issues.

Overfishing in the Yellow Sea is being tackled through bilateral fisheries agreements, reductions in fishing fleets, limiting fishing time through seasonal closure of fishing areas during spawning times, and introduction of catch quotas; nutrients discharges are being reduced (UNDP/GEF 2009). Both China and Republic of Korea are firmly committed to reducing fishing effort by at least 25% under the Strategic Action Plan for the Yellow Sea Large Marine Ecosystem (YSLME) endorsed in 2009, and both countries have allocated significant financial resources for boat buy-back, provision of alternative livelihoods, seasonal closures of fishing grounds and improving enforcement of fishing regulations (Walton and Jiang 2009).

The range and extent of MPAs in the NOWPAP region is encouraging for the future conservation of biodiversity in the region. However, now more effort needs to be placed on better management within these MPAs after designation. A recent MPA network workshop in Seoul hosted by the YSLME project suggests that there were problems in designating MPAs and in subsequent management due to the lack of strong legal arrangements and lack of funding.

Disappointingly, the latest national reports to the Convention of Biological Diversity show that the region is still some way off better control of introduction of alien species through ballast water exchange.

Marine biodiversity loss is increasingly affecting the ocean’s capacity to provide food, yet available data suggest that at this point, the trend is still reversible. It is also important to note that at stake is not just the biodiversity of the oceans, but a substantial chunk of the global economy and the livelihoods that depend on it.

REFERENCES

AAPA (2007) American association of port authorities. www.aapa-ports.org.

AAPA (2008) World port rankings 2007. American association of port authorities. http://aapa.files.cms-plus.com/Statistics/WORLDPORTRANKINGS2007.xls

Belkin I. M. (2009) Rapid warming of Large Marine Ecosystems. Progress in Oceanography 81: 207-213

Carlton J. T. and Geller J. B. (1993) The global transport of nonindigenous marine organisms. Science 267: 78-81

EC (2009) Treaties Office Database. European Commision, 14 April http://ec.europa.eu/world/agreements/prepareCreateTreatiesWorkspace/treatiesGeneralData.do?step=0&redirect=true&treatyId=588

FAO (2010a) Convention on Biological Diversity. FAO, 14 April. http://www.fao.org/fishery/topic/14906/en

FAO (2010b) FAO Compliance Agreement, 15 April 2010. http://www.fao.org/fishery/topic/14766/en

Gitay H., Suárez A., Watson R. T., Dokken D. J. (2002) Climate change and biodiversity. Intergovernmental panel on climate change (IPCC), Geneva, Switzerland. IPCC Technical Paper V, p. 85, http://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf

Harvell C. D., Mitchell C. E., Ward J. R., Altizer S., Dobson A. P., Ostfeld R. S., Samuel M. D. (2002) Ecology - Climate warming and disease risks for terrestrial and marine biota. Science 296: 2158-2162.

Jin X. S., Tang Q. S. (1996) Changes in fish species diversity and dominant species composition in the Yellow Sea. Fisheries Research 26: 337-352

Jin X. S. (2004) Long-term changes in fish community structure in the Bohai Sea, China. Estuarine Coastal and Shelf Science 59: 163-171

Lin C., Ning X., Su J., Lin Y., Xu B. (2005) Environmental changes and the responses of the ecosystems of the Yellow Sea during 1976-2000. Journal of Marine Systems 55: 223-234

Liu S. M., Zhang J., Chen H. T., Wu Y., Xiong H., Zhang Z. F. (2003) Nutrients in the Changjing and its tributaries. Biogeochemistry 62: 1-18.

NOWPAP CEARAC (2005) Integrated report on harmful algal blooms in the NOWPAP region. North Western Pacific Action Plan (NOWPAP) CEARAC, UNEP, Toyama, Japan: pp 64

NOWPAP DINRAC (2010) Summary on marine and coastal protected areas in NOWPAP region. North West Pacific Action Plan (NOWPAP), Data and Information Network Regional Activity Center (DINRAC): pp 11, http://dinrac.nowpap.org/documents/NOWPAP_DINRAC_Summary_on_MPAs_in_NOWPAP.pdf

NOWPAP POMRAC (2009) Regional overview of river and direct inputs of contaminants to the marine and coastal environment in the NOWPAP region with special focus on the land based sources of pollution. North West Pacific Action Plan (NOWPAP) POMRAC, Technical Report No. 7, Vladivostok, Russia: pp 78

Pacific Ocean Synthesis (2009) Scientific literature review of coastal and ocean threats, Impacts and solutions. Center for Ocean Solutions, pp 170, http://www.centerforoceansolutions.org/sites/default/files/pdf/PacificSynthesis.pdf

Pitcher T., Kalikoski D., Pramrod G. (2006) Evaluations of compliance with the FAO (UN) Code of conduct for responsible fisheries. Fisheries center research reports 14 (2). The Fisheries Centre, University of British Columbia, Vancouver, Canada, pp 1191

PICES (2008) Marine ecosystems on the North Pacific: pp. 67, http://www.pices.int/publications/special_publications/NPESR/2005/npesr_2005.aspx
SAU (2009) Sea Around Us Project. Fisheries Center, University of British Columbia, 1 April 2010. http://www.seaaroundus.org/lme/
Shan X. J., Jin X. S. (2010) Fishery resources, fishery, and future prospect for the Yellow Sea ecosystem. In: Walton M. E. M (ed.) Second Yellow Sea Regional Science Conference "Towards a Science-Driven Ecosystem Approach to Management ". UNDP/GEF Yellow Sea Large Marine Ecosystem Project, Xiamen, China, pp 84
Stachowicz J., Whitlatch, B., and Osman, W. (1999) Species diversity and invasion resistance in a marine ecosystem. Science 286:1577-1578
Tang Q. S. (2009) Changing states of the Yellow Sea Large Marine Ecosystem: Anthropogenic forcing and climate impacts. In: Sherman K, Aquarone M. C, Adams S. (eds.) Sustaining the world's large maring ecosystems. IUCN, Gland, Switzerland, pp 77-88
Tian Y. J., Kidokoro H., Watanabe T. (2006) Long-term changes in the fish community structure from the Tsushima warm current region of the Japan/East Sea with an emphasis on the impacts of fishing and climate regime shift over the last four decades. Progress in Oceanography 68: 217-237
Tsukuda S., Sugiyama M., Harita Y., Nishimura K. (2006) Atmospheric phosphorus deposition in Ashiu, Central Japan – source apportionment for the estimation of true input to a terrestrial ecosystem. Biogeochemistry 77: 117-138
UNDP/GEF (2007) The Yellow Sea: Analysis of the environmental status and trends. Volume 1: National reports - China. UNDP/GEF project: "Reducing environmental stress in the Yellow Sea Large Marine Ecosystem", Ansan, Republic of Korea: pp 620
UNDP/GEF (2009) The Strategic Action Programme for the Yellow Sea Large Marine Ecosystem. UNDP/GEF YSLME project, Ansan, Republic of Korea: pp 52
UNESCAP (2003) Review of shipping and port development in North-East Asia. United Nations Economic and Social Commission for Asia and the Pacific. http://www.unescap.org/ttdw/Publications/TFS_pubs/pub_2354/pub_2354_ch2.pdf
Walton M. E. M., Jiang Y. (2009) Some considerations of fisheries management in the Yellow Sea Large Marine Ecosystem In: Sherman K., Aquarone M. C., Adams S. (eds.) Sustaing the worlds large marine ecosystems. IUCN, Gland, Switzerland, pp 89-100
Yeh S. W. (2010) Recent warming in the Yellow and East China Sea during the boreal winter. In: Walton M. E. M. (ed.) Second Yellow Sea Regional Science Conference "Towards a Science-Driven Ecosystem Approach to Management ". UNDP/GEF Yellow Sea Large Marine Ecosystem Project, Xiamen, pp 84
Yeon I., Whang H. J., Shon M. H., Im Y. J., Myoung J. G. (2007) Yellow Sea marine ecoregion for implementation of ecosystem-based management in marine capture fisheries. The Changing North Pacific: Previous Patterns, Future Projections and Ecosystem Impacts. North Pacific Marine Science Organization (PICES), Victoria, BC, Canada, pp 241
Zhang B., Tang Q., Jin X. (2007) Decadal-scale variations of trophic levels at high trophic levels in the Yellow Sea and the Bohai Sea ecosystem. Journal of Marine Systems 67: 304-311
Zhang C. I., Lee J. B., Kim S., Oh J. H. (2000) Climatic regime shifts and their impacts on marine ecosystem and fisheries resources in Korean waters. Progress in Oceanography 47: 171-190

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