

Chapter 9

Synthesis and Proposal

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SYNTHESIS OF THIS INTERDISCIPLINARY RESEARCH DOCUMENT

The results of this interdisciplinary study on the marine environment of the Seto Inland Sea are summarized as follows.

The averaged primary production in the Seto Inland Sea is estimated to be 731 mgC m⁻²/day and secondary production is estimated to be 206 mgC m⁻²/day, though they vary significantly both seasonally and spatially. The transfer efficiency from primary production to secondary production is 26%. This figure is higher than the value (20%) usually accepted for the marine food chain. The tertiary production rate is estimated to be 58 mgC m⁻²/day resulting in a transfer efficiency from secondary to tertiary production of 28%. As far as the transfer efficiency from primary production to planktivorous fish production is concerned, we cannot detect any deleterious effect due to excessive eutrophication in the Seto Inland Sea.

We can find deteriorated environmental conditions at the sea bottom in stagnant areas such as Osaka Bay, Harima-Nada and Hiroshima Bay where benthic hypoxia or anoxia occurs during the summer. This summer destruction of benthic communities may lead to a large reduction of the production rate of benthic animals. Proper environmental measures such as the reduction of nitrogen and phosphorus loads from the land should be undertaken in these areas to assist the recovery of demersal fish populations. We propose that the environmental standards for each region of the Seto Inland Sea shown in Fig. 4.13 should be adopted for the sustainability of fisheries. In order to realize the standards shown in Fig. 4.13, we have to reduce the nitrogen and phosphorus loads from the land to 10–80% and 30–65% of the respective loads especially in the eastern part of the Seto Inland Sea from Hiuchi-Nada to Kii Channel.

The current areal fish catch in the Seto Inland Sea is 23 tons/km². Furthermore, the present rate of fishing activity is assessed to be three times than the optimum rate with the result that the stocks of some commercially important fishes such as red sea bream have decreased. Suitable fishery management such as a gear with coarse mesh size, and regulations of fishing periods and fishing areas, must be adopted.

The rate of aquaculture production in the Seto Inland Sea is nearly the same as that of fishing. However, the aquaculture grounds are heavily polluted by the continuous organic load of unconsumed feed and fecal pellets from the cultured fish. Aquaculture fishermen should carefully maintain the carrying capacity of their

aquaculture grounds on the basis of scientific knowledge.

Fish farming has been around for 30 years in the Seto Inland Sea and is very popular there. However, at this time we have no quantitative data on the relation between the fish released and fish caught. We need to promote basic scientific and technological studies on the relation between the fish released by fish farming and the natural ecosystem of the Seto Inland Sea.

The man-made structure for inducing upwelling is a very promising technology for increasing primary production in nutrient-poor fisheries grounds in the Seto Inland Sea.

The Seto Inland Sea has value not only as a ground for fisheries but also as an industrial area, a recreational area, and a region with great historical-meaning. Harmony is needed between the various kinds of human activities conducted there. Fisheries activity has played a key role in the environmental preservation of the Seto Inland Sea though its economic status is not high. However, in order to involve the other interested parties, we have to develop some kind of environmental assessment system that evaluates the total environmental values of the Seto Inland Sea including not only economic use but also recreation use, historical heritage, and symbolic meaning.

The sections of Japan's legal system concerning environmental preservation and the fisheries industry do indeed provide us with beneficial guidance relating to the governance of coastal management. In particular, "The law concerning special measures for the environmental conservation of the Seto Inland Sea" has played a very important role in the environmental conservation of the Seto Inland Sea both integrally and fundamentally. However, there still remain many issues that must be addressed from the viewpoint of designing a legal system to enable more useful and powerful environmental management. For example, water use other than by fisheries including industrial uses such as effluents, reclamation, sand and gravel extraction, and shipping lanes, residential sewage, and a variety of recreational uses such as sport fishing, yachting, jet skiing, board sailing and scuba diving must be regulated. Water use by such land-based industries and the public should be coordinated with the fisheries in the Seto Inland Sea.

PROPOSAL

Based on the results of our study, we recommend that the following measures should be carried out.

- 1) Elimination of the oxygen-deficient water masses in Osaka Bay, Harima-Nada and Hiroshima Bay occurring in summer by lowering the nitrogen and phosphorus loads from the land.
- 2) Adoption of suitable fishery management such as a fishing gear with coarse mesh size, and regulations of fishing periods and fishing areas for the preservation of fish stocks.
- 3) Development of scientific management methodologies for aquaculture to keep the aquaculture grounds clean.
- 4) Promotion of basic scientific researches for the sustainable development of fish farming in the Seto Inland Sea.

- 5) Set up of man-made structures for inducing upwelling in the nutrient-poor fisheries grounds.
- 6) Development of a total ecosystem numerical model of the Seto Inland Sea to evaluate the necessary reduction of nutrients loads from the land for the realization of sustainable fisheries activity.
- 7) Development of a total environmental assessment system which can evaluate not only economic use but also recreational use, historical heritage, and symbolic meaning in the Seto Inland Sea.
- 8) Establishment of a permanent monitoring system of ocean environment of the Seto Inland Sea especially from the viewpoint of ecological aspect.
- 9) Recognition of fishery operators as major players in the protection of the coastal environment.
- 10) Assessment of new legal systems in which water use by land-based industries and the public is coordinated with the fisheries.