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Direct impacts of coastal development

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1 Introduction

The major sources of disturbance modifying and/or destroying coral reefs are civil engineering works, which include dredging and reclamation. These are clearly premeditated, direct, artificial disturbances. Contractors should be made aware of their moral responsibility with respect to the possible future effects of such development on the site concerned and on neighboring regions. Details of discussions carried out by concerned parties during the planning process, and notes of the consensus reached, should be kept; the points made in these instances should be found to have been adhered to when the project is subsequently evaluated. However, there have been very few cases in which those who carried out the work have also carried out the post-construction evaluations. Recently, increasing public awareness of the natural environment has led to terms like 'coexistence with nature' and 'sustainable development' becoming widely used. In order to achieve the goals indicated by these terms, it is necessary to develop a feedback mechanism that evaluates the success of development projects in adhering to preset guidelines, not only with respect to environmental impacts, but also in relation to economic, societal and cultural effects. When these factors come together, greater flexibility in the setting of planning guidelines in response to the changing needs of the environment will be facilitated, as will the implementation of more sustainable development.

2 Coastal landforms and development works on coral reefs

The most developed coral reefs in Japan are found in the Ryukyu Islands; most of the reefs south of Yakushima Island are fringing reefs. On these fringing reefs, especially in the lagoons where people walk at low tide, various resources have been used for many years, not only in fisheries but also with respect to the local residents' livelihoods. Therefore, these areas have been more finely par-

tioned by local residents than their geological zonation would suggest (Toguchi and Yoshikawa 1990).

Modern development takes place, in the main, on the reef flats of fringing reefs, in surrounding shallow-water areas, and on coastal land sites that are closely connected to coral reefs. The civil engineering projects undertaken in shallow lagoons generally involve basic engineering works and are, therefore, implemented and used intensively on islands with weaker economic bases. Therefore, the modification of coral reef coastlines takes place relatively easily. The mangrove forests that occur in river mouths and the tidal flats where seagrasses grow are also often integrated into development plans; these biotopes, therefore, can be treated as an integrated system, both ecologically, and with regard to the threat posed to them by development.

3 Development projects and activities in the vicinity of lagoons

The issues relating to coral reef conservation have been addressed only relatively recently in Japan. In the 1980s, the Japanese version of the White Paper on the Environment included statistics detailing the disappearance of tidal flats, but coral reef degradation and destruction were not addressed. Fujiwara (1994) detailed the decline of the coral reef south of Amami Oshima in the period between the 2nd Natural Environmental Preservation Base Investigation by the Nature Conservation Bureau, the Ministry of the Environment in 1978 and the most recent 4th investigation (Table 1). By 1992, the total area of lagoonal coral reef that had disappeared (2,308.9 ha) corresponded to 2.4 % of the total estimated area of coral reefs south of Amami-Oshima (96,023.3 ha). The largest areas of reef lost were around Okinawa Island (1,672.2 ha), where 6 % of the total estimated area of coral reefs near the island (27,770.7 ha) were destroyed. The main cause of this disappearance was thought to be reclamation, with dredging for the shipping lane and harbor constructions (Table 2) being a secondary cause. The main

Table 1. The area of coral reef destroyed south of Amami Oshima in Japan (unit: ha).

* represents an area that was newly identified as being destroyed during the latest survey (after 2nd survey), and therefore does not indicate total coverage destroyed before 1978 (modified from Fujiwara 1994).

Prefecture	Location	Disappeared time					Date unknown	Sum of 1979-1992	Sum total
		-1978*	1979-1980	1981-1983	1984-1989	1990-1992			
Kagoshima	Tokara Archipelago	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.6
	Amami Archipelago	0.0	0.0	0.0	100.5	8.4	0.0	311.5	420.4
Okinawa	Okinawa Island	290.3	36.2	595.3	85.1	498.7	8.7	157.9	1672.2
	Miyako Island	31.0	0.0	0.6	3.6	16.3	49.2	2.5	103.2
	Yaeyama Archipelago	6.4	0.0	0.0	0.0	5.4	98.7	0.0	110.5
Sum		327.7	36.2	595.9	189.2	528.8	156.6	474.5	2308.9

Table 2. The areas of coral reef destroyed by different factors (unit: ha; modified from Fujiwara 1994).

Prefecture	Location	Reclamation	Reclamation by drainage	Dredging	Others or unknown	Sum
Kagoshima	Tokara Archipelago	1.6	0.0	1.0	0.0	2.6
	Amami Archipelago	371.0	0.0	49.1	0.3	420.4
Okinawa	Okinawa Island	1592.3	0.0	73.8	6.1	1672.2
	Miyako Island	94.4	0.0	0.0	8.8	103.2
	Yaeyama Archipelago	106.5	0.0	0.0	4.1	110.5
Sum		2165.8	0.0	123.9	19.3	2308.9

Table 3. Case studies of coral reef destruction by construction works.

Years indicate completion dates of construction works. * indicates under construction.

Prefecture	Location Sea area	Local authority	Objective of construction	Area cover (ha)	Year
Kagoshima	Amami Archipelago	Kasari Town	New Amami Airport	100.0	1985
Okinawa	Okinawa Island	Itoman City	Urban development	532	1982
		Okinawa City, Gushikawa City	Port & harbor	242	1988*
	Miyako Island	Hirara City	Port & harbor	41	1991*
	Yaeyama Archipelago	Ishigaki City	Ishigaki Port	97	1991*

types of development leading to the destruction of tidal lands and lagoons were urban site, airport, and port developments (Table 3).

In the Ogasawara Islands, 3 ha of the reef were destroyed by reclamation and dredging between 1982 and 1991, and an additional 2 ha were destroyed by the resulting influx of terrestrial earth and sand.

The most recent, major coastal land reclamation project in Okinawa Prefecture is now being undertaken in Nakagusuku Bay (Reclamation in Nakagusuku Bay Port (Awase District) Public Water Area). A coastal area of 7.2 ha has been designated for prefecture business and 177.4 ha for state affairs. This was licensed and certified in 2000 and reclamation is now underway. This project will reclaim an area offshore from Awase, in Okinawa City, for the purpose of constructing a harbor, marina facilities, meeting and exhibition facilities, and residential accommodations. It is expected that the project will take about six years to complete. During the course of this reclamation, the 266 ha area of the Awase tidalflat, the largest are of tidalflats in the Nansei Islands, will be destroyed.

There is, however, opposition to this reclamation project; this opposition is fuelled by concerns about the disappearance of rare species of algae, the disturbance of a stopover point for migratory birds, and the destruction of the northern limit of the dugong's habitat, due to the removal of seagrasses.

Another major reclamation project is planned at the U.S. military base at Henoko, in the city of Nago, in northern Okinawa. The project will construct 2,200 meters of airstrip and extend the area of the base by 184 ha; it will also involve the reclamation of an area that includes a coral reef. The selected site of Camp Schwab has been designated as a Strictly Protected and Conserved District of Natural Environment (evaluation rank I) by the Guiding Principle of Maintenance of the Natural Environment¹, formulated by Okinawa Prefecture in 1998. In pushing forward with the project, it is requested to commit the Guiding Principle. In connection with this, data are lacking on the necessity for the conservation of seagrass beds, which are used as dugong habitat. The ecological survey of this area is currently being conducted by groups of the NPO.

Table 4. The administrative division of coastal management in Okinawa (from the Okinawa prefectural government homepage). The governor specifies the maintenance area under the Coastal Law, and the administrator is defined in each division, as below.

Division of coastal maintenance area	Administrator	Competent minister
General locations	Prefectural governor, city and town mayor, or mudir of villages	Minister of the Ministry of Land, Infrastructure and Transport
Locations overlapped with harbor area or harbor adjacent area	Director of the harbor's administrator	Minister of the Ministry of Land, Infrastructure and Transport
Locations overlapped with public notification water area	Prefectural governor	Minister of the Ministry of Land, Infrastructure and Transport
Locations overlapped with fishery harbor	Director of the fishery harbor's administrator	Minister of the Ministry of Agriculture, Forestry and Fishery (Fisheries Agency)
Locations where coastal maintenance facilities exists which is managed under Land Improvement Law, or where land improvement plans have already been defined	Prefectural governor, city and town mayor, or mudir of villages	Minister of the Ministry of Agriculture, Forestry and Fishery (Fisheries Agency)
Locations where there is a coastal maintenance facilities for maintaining agricultural land, and where it is managed irrespectiely of Land Improvement Law	Prefectural governor, city and town mayor, or mudir of villages	Minister of the Ministry of Agriculture, Forestry and Fishery (Fisheries Agency)

4 Conservation and the administrative division of the coast

The coastal policy in Japan is based on the Coastal Law, established in 1954, and is aimed at the 'protection' of land areas from coastal disasters such as tsunamis. However, in recent years new problems, such as water pollution and coastal resource management, have arisen. The Coastal Law was revised for the first time in 1999 with the addition of sections on 'environment' and 'usage' to the former section on 'protection'; the aim was to integrate these factors into existing coastal administration*2. Under the new planning system, formulated in April 2000 from the revised Coastal Law and enforced by the Ministries of Agriculture, Forestry and Fisheries, Transport, and Construction, it was stated that coastal conservation, including the protection of the environment and resource use, should be promoted. The action program for the implementation of the revised Coastal Law has been designated by the national government as Coastal Conservation Basic Policy*3; prefectural governments will create and enforce the Coastal Conservation Basic Plan by following this policy. The department in charge of implementation is generally the civil engineering department and/or the River Section. In Okinawa Prefecture, the Harbor Section of the Civil Engineering and Construction Division formulated the Coastal Conservation Basic Plan for the Ryukyu Islands in 2003*4. Individual projects have been enforced by several provinces separately (Table 4). In Okinawa, the Agriculture, Forestry and Fishery Division, and the Civil Engineering and Construction Division are the main administrative units involved in the implementation of the Act, since the project is presided over by both the Ministry of Agriculture,

Forestry and Fisheries, and the Ministry of Land, Infrastructure and Transport.

National parks, quasi-national parks, marine park zones, national environmental preservation areas, and protected water areas are designated by the National Parks Law and authorized by the Ministry of the Environment, and by the Law for the Conservation of Aquatic Resources, authorized by the Ministry of Agriculture, Forestry and Fisheries. The modification and exploitation of these coastal areas are restricted to various levels, and these restrictions are also included in the Coastal Conservation Basic Plan.

Okinawa Prefecture is composed of 160 islands, including 40 that are inhabited. The total length of the coastline is 1,748 km, most of which consists of coral reef coasts. According to the maintenance plan of coastal areas of the Ryukyu Islands (Okinawa Prefecture 2003), coastal maintenance operations in Okinawa Prefecture have progressed as follows:

Coastal maintenance was not kept up-to-date under U.S. military rule, but was made a priority at the time of the handover to Japan in 1972. Until 1985, operations for coastal security were undertaken according to the guidelines of the Coastal Law. Coastal maintenance was performed through the application of 'linear protection' methods, which included the construction of simple structures such as upright bank protection and breakwaters. In the 1980s, methods that were more 'water friendly' began to gain recognition. Coastal maintenance methods have now shifted from those aimed at protection to those aimed at improving the 'environment' and 'usage', through the application of such measures as sloping

shore protections. Recently, improvements to operations relating to seashore use and landscaping have advanced, and coastal maintenance programs have begun to adopt more 'spatially protective' measures, such as artificial reefs and the designation of sections of coast for recreational use. The stretch of coastline for which disaster prevention is particularly vital is about 379 km in length, in total, i.e., about 22 % of the total coastline; the prefectural government is maintaining these areas, based on the Coastal Law. In other regions, management practices have been the same as those used in relation to government-owned land but now, due to the revision of the Coastal Law, appropriate management changes are thought necessary with respect to the general public coast. In many parts of the arterial road along the coast the landscape is deteriorating; road use is being restricted, and the natural coast is being lost because so many upright bank protections were constructed to defend the road from wave erosion. A number of projects, including the reconstruction of lost beaches, enhancement of access, and landscape improvements are anticipated for the protection of existing roads. Future road and bank protection methods must consider the natural environment, its use, and landscape.

According to the 5th National Survey on the Natural Environment, conducted in 1998, the greatest increase in artificial coastline (coast where artificial structures exist in the intertidal zone) after 1993 (Nature Conservation Bureau, Environment Agency 1994b, 1998), when the 4th investigation was carried out, occurred in Okinawa Prefecture, where the length of artificial coastline was extended to 102.95 km, an increase rate of 47.99 %. The decrease in the length of natural coast (where no artificial structures occur) was 39.37 km in Okinawa Prefecture, behind Hokkaido's decrease of 96.58 km and Aomori Prefecture's decrease of 47.53 km.

5 Future development planning

According to the survey results of the Aerial Coverage of Local Authorities Across the Nation, taken in the fiscal year 2003, and published by the Geographical Survey Institute in February, 2004, the total land area of Japan (including northern territories and the Senkaku Archipelago) was 377,899.20 km². This represents an increase of 11.95 km² from October 1, 2002. Within prefectures, Okinawa Prefecture had an increase of 128 ha, second only to Aichi Prefecture (431 ha). Both of these

increases were due to coastal reclamation.

A vast fallow land can be seen on the shore at Nishizaki, near the city of Itoman, in Okinawa Prefecture. This is the largest scale coral reef reclamation project in Japan (Table 3; 532 ha of coral reefs disappeared in 1982). In contrast, commercial activities have been developed on the reclaimed land at Kuwae, near the town of Chatan (49 ha of coral reefs disappeared in 1986; Fujiwara 1994). By looking at these two contrasting examples, it is clear that good planning and thorough analyses of forecasted economic effects are essential for the creation of successful development plans.

Plans to develop a new airport by reclaiming the Shiraho reef in Ishigaki were abandoned after a protest campaign was staged by local residents and domestic and foreign nature conservation groups. A new, on-land location for the airport was agreed upon in 2000.

Okinawa Prefecture has adopted the Guideline for Natural and Environment Conservation for the preservation of these natural environments. However, in some extent, there are inadequacies in applying the Guideline to development plans. In addition, although Ryukyu Islands was selected as one of the candidates to be nominated as World Natural Heritage site by the domestic commission, yet to be nominated because its conservation is not guaranteed. As you can see those facts, some important natural environment which should be protected is not fully guaranteed.

In order to conserve the precious natural environment in Okinawa, it is required to take the point of view of nature conservation into fully consideration in making various development plans.

Cited websites:

- *1: http://www.pref.okinawa.jp/okinawa_kankyo/shizen_hogo/hozen_chiiki/shishin/index.html
- *2: <http://law.e-gov.go.jp/htmldata/S31/S31HO101.html>
- *3: <http://www.jfa.maff.go.jp/gyokogyojo/subx8.htm>
- *4: <http://www3.pref.okinawa.jp/site/view/contview.jsp?cateid=220&id=1375&page=1>