6-1-1 Ogasawara Islands
(Map 6-1-1)

Province: Metropolis of Tokyo **Location:** ca. 1,000 km south off the Tokyo urban center **Features:** Consists of some 30 islands (including Mukojima, Chichijima and Hahajima Archipelago). Chichijima and Hahajima are the only manned island. Okinotorishima (Is.) locates at southern most and Minamitorishima (Is.) at eastern most of Japanese territory **Population:** ca. 3,000 **Air temperature:** 23.0˚C (annual average, at Chichijima) **Seawater temperature :** 24.8˚C (annual average, at east off Hahajima) **Precipitation:** 1,276.8 mm (annual average, at Chihijima) **Total area of coral communities:** 456.0 ha **Protected areas:** Minami Iwojima Wildness Areas: whole Minami Iwojima (Is.); Ogasawara National Park: whole islands of Mukojima, Chichijima and Hahajima Archipelago as special zones, and their coastal areas (~1 km) for ordinary zones; Ogasawara Marine Park Zone: in Chichijima and Hahajima Archipelago.

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Ogasawara Islands

(Maps 6-1-1-①～③)

Makoto Inaba

1 Corals and coral reefs

Ogasawara Arcipelago

1. Geographical features

The Ogasawara Archiperago ware formed by submarine volcanic activities in the first half of the Tertiary period (about 50 million years ago). Shortly after the formation of the islands there was a widely distributed shallow zone that included some well-developed coral reefs, judging by the fossils and the accumulated strata. Ancient influences are apparent in the drowned karst topography of Minamijima (Is.), the karst topography of the Sekimon area of Hahajima (Is.), and the fossil of extinct foraminifera, *Nummulites boniensis*, found on Miyukinohama, Hahajima (Kaizuka 1979).

Discontinuous apron-like reefs surround Ogasawara Archipelago, but their size is locality dependent. The topographic features of only three of these reefs have been thoroughly assessed at Nagasaki, Tatsuminishi, and Kitahatsune beach on Chichijima (Is.) (Nakai *et al.* 1988). Clearly, the wave-eroded shelves that surround the islands and the existing coral reef features (< 20 m) were formed through the Holocene (Wada *et al.* 1979).

2. Coral distribution

Approximately 200 species of hermatypic corals (here after, corals) are reported for the Ogasawara archipelago (Tachikawa *et al.* 1991). Information on coral community structure and distribution are extremely limited, except for some parts of Chichijima. The main coral areas include Futami and Tatsumi Bay, Chichijima, the coast facing strait and Takinoura Bay, on Anijima (Is.), and Higashi and Kita Port on Hahajima (Inaba 2003).

Acropora (staghorn and tabulate) colonies are relatively scarce, yet massive and encrusting coral colonies are plentiful (Fig. 1). At localities were coral cover is high, the following coral species are dominant: *Porites lutea*, *Galaxea fascicularis*, *Lobophyllia hemprichii*, *Platygyra deadarea*, and *Cyphastrea* spp. Among the *Acropora*, *Acropora florida*, encrusting morphs of *A. gemmifera*, and tabulate *A. hyacinthus* are common. Branching corals,

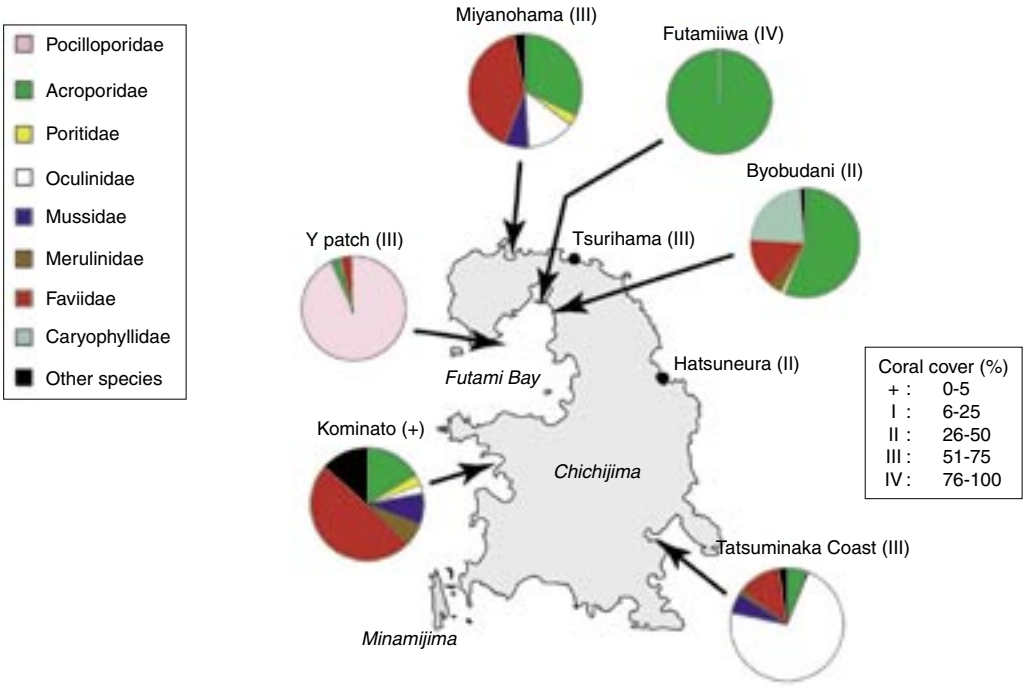

Fig. 1. Coral community composition and hermatypic coral coverage on Chichijima (Is.). The number in bracket indicates mean coral cover of the area (from Inamba 2003).

such as *A. formosa*, are found in Futami Bay, Chichijima (Inaba 2003).

Well developed reefs supporting extensive coral communities are evident on Hahajima, especially in the western bays. Coral community structures are similar to those on Chichijima, however *Acropora donei* (identified by Wallace 1999), which is rarely seen in Chichijima is prolific on Hahajima.

Along the sheer cliffs of Chichijima and Hahajima, reef development is poor and coral communities are sparse. Small encrusting colonies inhabit the slopes and coral coverage is only 0–10 % (Nature Conservation Bureau, Environment Agency 1994). Most of the coral colonies are small encrusting mussids and faviids.

3. Water quality and physical environment

While the Ogasawara Archipelago are not directly influenced by the Kuroshio Current, the regional and local hydrodynamic patterns have received little attention and are largely unknown.

The surface water temperatures range from 19.0 to 28.8 ˚C (Futami Bay) and average of salinity is 34.8 PSU (according to Tokyo Metropolitan Government Ogasawara Fisheries Research Center) – the amount of nutrient is equivalent to other subtropics seas (Ogasawara Village of Tokyo 2002).

There are a few rivers that have steady discharge on these islands, but the Yatsuse and Otaki rivers of Chichijima have comparatively large amount of flow.

4. Notable species and ecosystems

About 1,000 fish species have been reported for the Ogasawara Archipelago, which originate both from the north and south (Randall *et al.* 1988). Several researchers have been compiled species checklists of marine invertebrates, especially on shellfish, crustaceans, sea urchins, and polychaetes (for example, Fukuda 1995), but information on other taxa is unknown, therefore the concept of introduced species is problematic.

There are no mangrove forests on the Ogasawara Archipelago, and macroalgae coverage is extremely low. In recent years, however, macroalgae have increased especially *Sargassum duplicatum* and *Dictyota spinulosa*. *Hydroclatharus clathratus* are now found year round with coral assemblages, which used to disappear in summer.

The Volcanic Islands, and Okinotorishima and Minamitorishima (Marcus)

1. Geographical features

The Volcanic Islands (Kitaiwojima, Iwojima and Minamiiwojima) were formed by submarine volcano activities in the Quaternary Era. Kitaiwojima has a fringing-like reef, which is on a wave-cut platform made of bedrock, supporting only sparse coral communities (Kikuchi *et al.* 1980). Around Iwojima and Minamiiwojima, there are wave-eroded platforms at 10-15 m, but no coral reef features (Kaizuka *et al.* 1981).

Okinotorishima (Is.) is a platform reef (9.44 km^2) formed in the last interglacial period. While the reef does not emerge at low-spring tides, there are two rocks that Minamitorishima (Is.) (1.51 km^2) is composed of karst that formed prior to the last interglacial period and a emerged table reef that formed in the last interglacial period. Modern fringing reefs develop around the island.

2. Coral distribution

The coral community on Kitaiwojima is extremely sparse, only supporting small massive colonies, except along the east coast where some massive *Porites* spp. communities are evident (Nishimura *et al.* 1988). On Iwojima the corals are mainly *Pocillopora* colonies along on the cliff slopes and rocky promontories, which is also the case in eastern Kangokuiwa. In contrast, the southwestern and northwestern coasts of Minamiiwojima support more diverse communities (Tokyo Fisheries Experiment Station 1994).

Kurata (1997) suggested that the steady influence of high waves reduces coral community diversity and coverage in Okinotorishima, but these speculations are not verified. Minamitorishima appears to support well developed fringing reefs but there is no detailed information available (Ogasawara Marine Station, Tokyo Metropolitan Goverment 1995).

3. Others

Except for some data from fisheries resources, information is extremely limited with regard to the physical environmental characteristics of these islands (Tokyo Metropolitan Fisheries Experiment Station 1994).

2 Situation of usages

1. Tourisum

There are 30 tourism businesses on Chichijima and 3 on Hahajima. Activities include scuba diving, swimming with dolphins, and whale-watching tours. In popular areas, mooring buoys have recently increased to reduce damage to corals from boat anchors. Snorkeling from beaches, sea kayaking tours and water skiing are also popular.

2. Fishery

The Fishery Cooperatives at Chichijima and Hahajima are mandatory for all fishers. These same fishers also undertake fishing expeditions (with tourists):

- Fisheries: Bottom line fishing (ruby snapper and groupers), Long line fishing (swordfish and bigeye tuna), trolling (saury pike and Spanish mackerel), stick-held dip net fishing (mackerel scad), gill net fishing (flying fish), spiny lobsters fishing, and green sea turtle fishing.
- Mariculture: Small cultivation (striped jack, red sea breams, amberjacks, groupers, and tunas).

3. Others

Recently, the salt industry, which dries out coastal seawater, is gaining local prominence as a viable business.

3 Threats and disturbances

1. Crown-of-thorns starfish

Crown-of-thorns starfish (*Acanthaster planci*) have been found on Chichijima (Kurata 1984), but not since 1994 (Tachikawa, personal communication). There have been no records of outbreaks in the past and it appears that their density is low in the region.

2. Bleaching

Minimal bleaching and mortality was reported in 1998 on Chichijima and Hahajima. Yet, in September 2003, a mass coral bleaching event was evident at Hahajima and remained evident until November 2003 (at the time of this reporting). Many *A. donei*, one of the dominant coral species, died in 2003 – while *Porites* colonies recovered. In other regions, bleaching has been minimal (Inaba, in prep.).

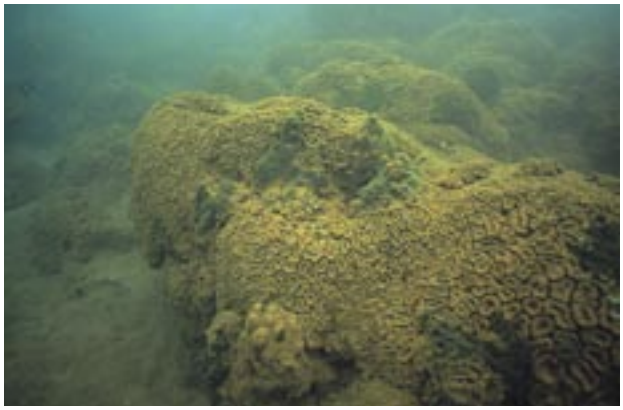

Photo. 1. Dead colonies of *Lobophylla hemprichii* by red soil influx in Fukuro Bay, Nakodojima (Is.).

3. Sedimentation

Because of the open nature of most reefs, red soil that runs of the land rarely accumulates and is rapidly diluted, except in Futami Bay, Kopepe Beach (Chichijima), and Fukuro Bay (Nakodojima), which has led to some reef destruction. In Fukuro Bay, which supported well developed reefs up until the 1970s, has accumulated some 3 m of red soil. Red soil runoff has supposedly led to the death of many *Lobophyllia hemprichii* colonies that were prolific in the bay (Photo. 1) (Inaba and Horikoshi 2002). Red soil runoff stems from cleared lands, primarily farmland and road construction. Red soil runoff on Nakodojima is thought to stem from goats clearing native vegetation.

4. Development

Higashi Port, on Hahajima, is thought to have once supported well developed coral communities that have disappeared through harbor development. But there have been no studies associated with this development project.

5. Others

There is recent evidence of coral mortality on Chichijima, but the cause is uncertain. At the same time, the macroalgae *Hydroclatharus* and *Sargassum* have increased. This tendency may be related to the thermal stress anomalies in 1998 and 2003, but cause-and-effect relationships are unclear. The current status of the Volcanic Islands, Minamitorishima and Okinotorishima remain mostly uncertain.

4 Monitoring

Monitoring on the Ogasawara Islands has been fragmen-

tary using a diverse array of techniques (e.g., Kurata *et al.* 1969; Nature Conservation Bureau Environment Agency 1999b; Inaba 2003). Moreover, monitoring for *A. planci* and bleaching of corals has not been systematic. Clearly a monitoring program is necessary using a rigorous method. 'Reefcheck' has been conducted on Hahajima since 1999 and on Chichijima since 2002.

5 Conservation

The Tokyo Metropolitan Government has conducted a vegetation recovery project since 1994, including wild goat extermination (completed in 1999), soil detainment, and vegetation recovery. However, the conditions in the abovementioned bays have not changed (Ogawara Branch Office, Tokyo Metropolitan Government 2003). There has been no preventive action against red soil runoff on Chichijima and Hahajima.

6 Necessary measures

The Ogasawara Islands are isolated from other coral reef regions of Japan. Ecological research on these islands has just begun. Some serious bleaching damage has been reported regarding on Hahajima in 2003, and red soil erosion is common on Nakodojima. The decline in corals and concomitant increase in macroalgae due to unknown reasons are observed.