

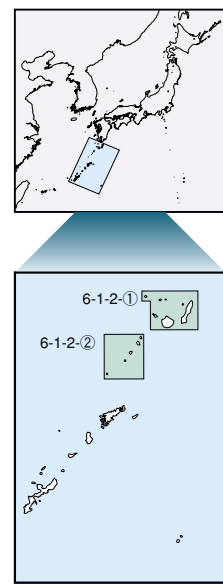
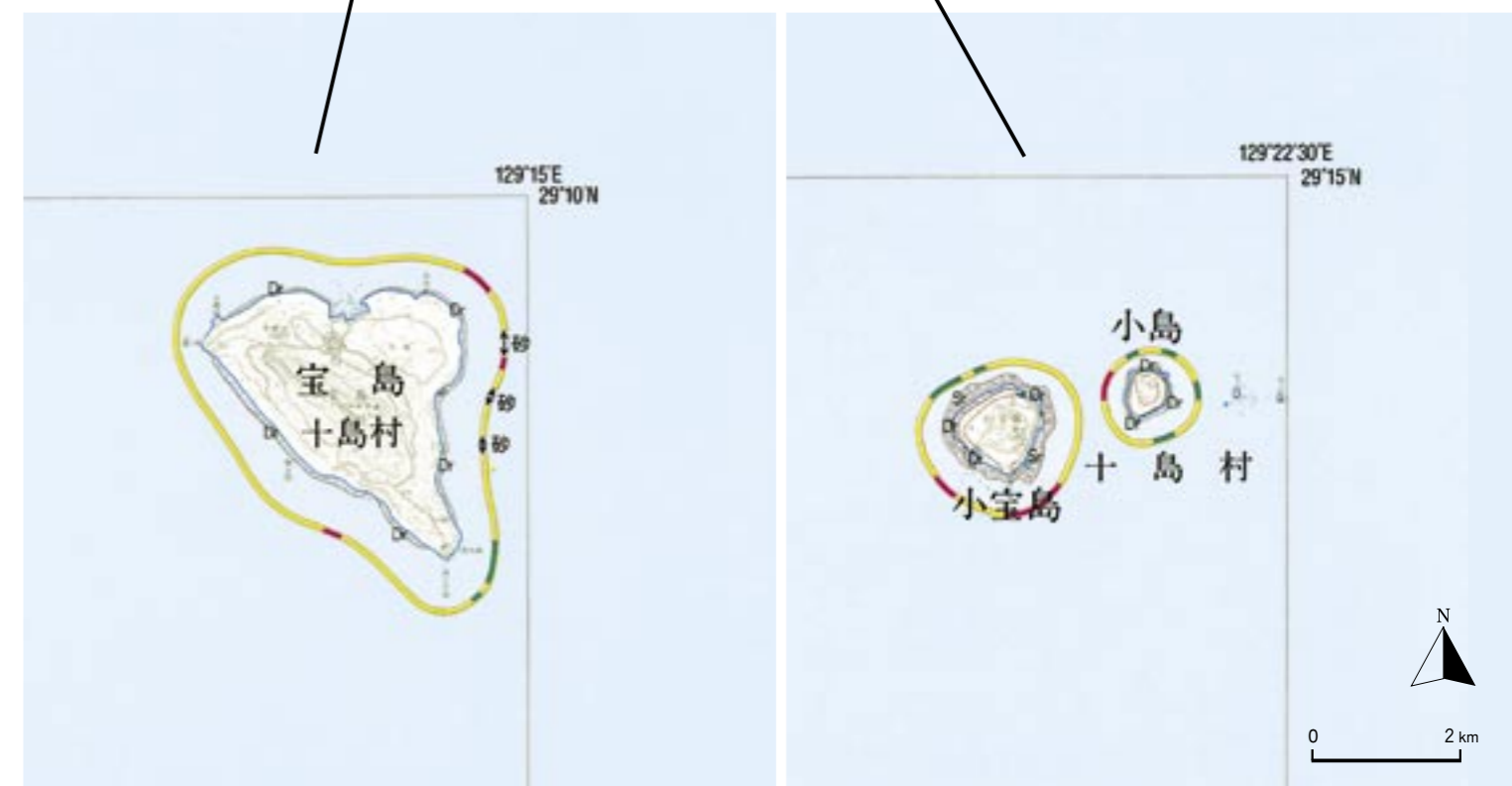
6-1-2 Osumi Islands and Tokara Archipelago

(Map 6-1-2)

Province: Kagoshima Prefecture **Location:** Osumi Islands: ca. 100 km south off Kagoshima City, including Tanegashima (Is.), Yakushima (Is.), Kuchinoerabujima (Is.) and Magejima (Is.); Tokara Archipelago: Island chain of 12 islands stretching for ca. 160 km between Yakushima and Amami Oshima (Is.) **Air temperature:** 19.2°C (annual average, at Yakushima) **Seawater temperature:** 24.3°C (annual average, north off Yakushima) **Precipitation:** 4,358.8 mm (annual average, at Yakushima) **Total area of coral communities:** 118.0 ha **Total length of reef edge:** 19km (around Takarajima, Kodakarajima, and Koshima) **Protected areas:** Kirishima-Yaku National Park: 44% of Yakushima (20,989 ha); Yakushima Wilderness Area: 1,219 ha on Yakushima; World Natural Heritage site: 10,747 ha (designated in 1993) on Yakushima; Kurio Marine Park Zone in Yakushima.



6-1-2-②



* “号” on this map means “site”.

Osumi Islands and Tokara Archipelago

(Maps 6-1-2-①, ②)

Tatsuo Nakai, Satoshi Nojima

1 Corals and coral reefs

1. Geographical features

The most outstanding feature of the region that includes the Osumi Islands and the Tokara Archipelago is that it is located near the northern limits of coral reef distribution. Figure 1 shows the distribution of coral reefs in this region.

The Osumi Islands comprise Tanegashima, Yakushima, Kuchinoerabujima, and Mageshima, and sometimes include Takeshima, Iwojima, and Kuroshima. Iwojima and Kuchinoerabujima are volcanic islands along the Kirishima volcanic belt, and there is an evidence of current volcanic activity. Saito *et al.* (1980) reported that the line along Tanegashima, Mageshima, and Takeshima represents the northern limit of coral reef development, and Nakai (1990) suggested that the northern limit lies near Tanegashima. Yamano *et al.* (2001) identified a coral reef at Iki Island (33°48' N) to be located in 350 km north from Tanegashima/Yakushima area. However, for reasons of the following, it is thought that there is some limiting line on coral reef distribution in this area. One of the reason is that there is no coral reefs between Iki Island and Tanegashima/Yakushima area, and there is discontinuity in distribution. Another reason is that main coral species forming reefs are different between Iki Island and the areas of south of Tanegashima/Yakushima.

The coral reefs in this region are composed of reef limestone covering flat shore platforms; this reef limestone layer can be up to several meters thick. The reef flat south of Tanegashima appears to be about 1 km wide, which is a result of the wide shore platform. Moreover, speaking two-dimensionally, coral reefs tend to develop in indented areas or on the lee side of islands rather than in high-energy, wave-exposed areas (Fig. 2). Such characteristics can be observed in the northern

Tokara Archipelago. In addition, reef development on Tanegashima is limited to the eastern coast, and continuous development of reefs is not readily observable. On Yakushima, hermatypic coral communities can be observed in a few places around the island, and coral reefs with well-defined reef flats and reef slopes are limited to the north of the island (Nakai and Wada 1983). Nakata (1978) reported the existence of Holocene coral reefs in Anbou in southeastern Yakushima.

The Tokara Archipelago consists of 12 small islands (the largest of which, Nakanoshima, is only 34 km²) that are scattered over some 160 km between Tanegashima, Yakushima, and Amami Oshima. Modern coral reefs can be seen on six of these islands (Kuchinoshima, Nakanoshima, Hirashima, Kogajyajima, Kodakarajima, and Takarajima). Reefs are underdeveloped on the other islands as a result of volcanic activity; these new volcanic islands have been active from the late Pleistocene of the Quaternary to the present. Half of Kuchinoshima and half of Nakanoshima belong in this category. Coral reefs in the Tokara Archipelago are well developed in terms of reef continuity as compared to both northern and southern islands, including Tanegashima and Yakushima to the north and Amami Oshima to the south. For example, 80–90 % of the coastlines of Hirashima, Kodakarajima, and Takarajima are surrounded by coral reefs. This is thought to be a result of the flow route of the warm Kuroshio Current.

Figure 2 depicts a model illustrating the latitudinal transition of coral reefs near the geographical limits of reef development, based on an analysis of the two-dimensional developmental state of the reefs from Tanegashima and Yakushima through the Tokara Archipelago down to Yoron Island (Nakai 1990). Changes in sea level and reef development are discussed based on the fact that some uplifted coral reefs of the late Holocene were discovered at Kuchinoshima and Nakanoshima, and late Pleistocene and late Holocene uplifted reefs were found at Kodakarajima and Takarajima (e.g., Koba *et al.* 1979). Moreover, the foraminiferan *Baculogypsina sphaerulea* was found in Kuchinoshima, Nakanoshima, Hirashima, Suwanosejima, Kodakarajima, and Takarajima; and, the composition of the sediment layer has also been examined with respect to reef development (Saito *et al.* 1980).

2. Coral distribution

One-hundred-and-fifty-one hermatypic coral (hereafter, coral) species have been confirmed in the sea around

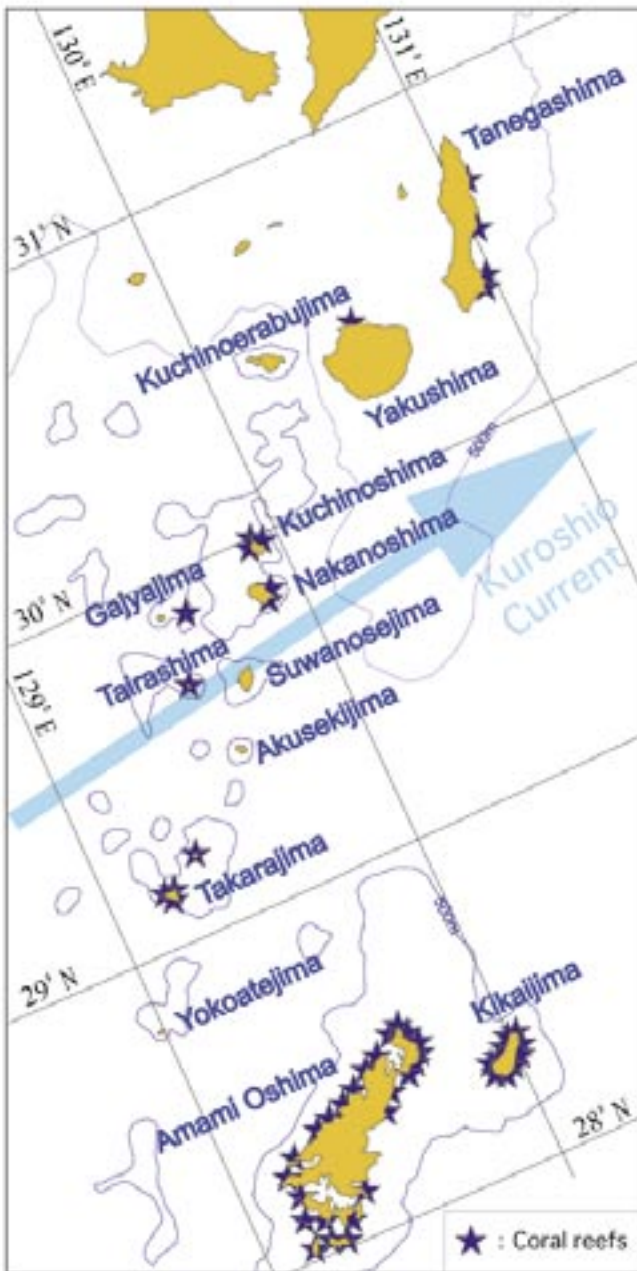


Fig. 1. Distribution of coral reefs from the Osumi Islands to Amami Oshima.

Tanegashima (Veron 1992a, c; Nishihira and Veron 1995). 100 species from Yakushima (Investigation Group on Marine Organisms in the Coast of Yaku Island 1992; Nojima *et al.* 1992) and 68 species from Kuchinoerabujima have also been reported. The composition of coral species in Tanegashima and Yakushima is significantly different from that in Amami Oshima (Nishihira and Veron 1995). Southward along the Tokara Strait, the number of species greatly increases; coral communities of the 'southern Japan coastal region type' and the 'Okinawan type' dominate in the north

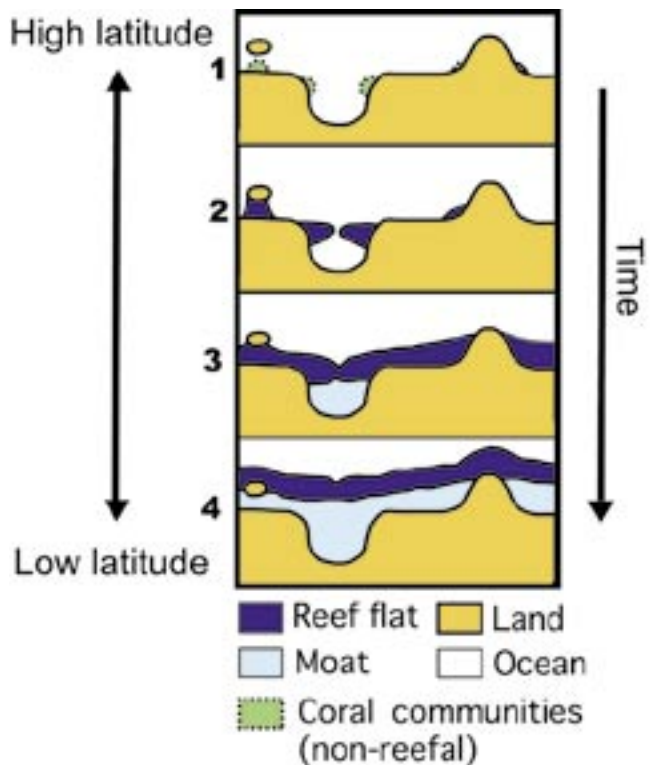


Fig. 2. Latitudinal transition model of coral reef development (partially modified from Nakai 1990).



Photo. 1. Underwater view at 20 m depth in Kurio, Tsukazaki, Yakushima (Is.).

and south, respectively (Fukuda *et al.* 1991). Although both types occur on Yakushima, the former type is more extensive in terms of coral cover (Investigation Group on Marine Organisms in the Coast of Yaku Island 1992; Nojima *et al.* 1992; Nojima and Yeemin 1999; Photo. 1).

In the Tokara Archipelago, the distribution of coral has been confirmed along the coastline, including an investigation of deposition (Saito *et al.* 1980). However, the identified species have not yet been organized into a comprehensive list. Tokioka (1953) identified ten coral spe-

cies (1 *Goniastrea*, 1 *Porites*, 4 *Acropora*, 1 *Psammocora*, 1 *Coeloseris*, and 2 *Pocillopora*) in Takarajima and two species (1 *Goniastrea* and 1 *Acropora*) in Nakanoshima. Hirata (1967) collected 21 major species (5 *Acropora*, 1 *Favia*, 1 *Favites*, 1 *Goniastrea*, 3 *Platygyra*, 1 *Hydnophora*, 3 *Pocillopora*, 1 *Porites*, 1 *Montipora*, 1 *Turbinaria*, 1 *Heliopora*, and 2 *Millepora*) around Takarajima and Kodakarajima. However, both surveys were fragmentary as the researchers did not use SCUBA equipment, and so systematic surveys have not been conducted in the Tokara Archipelago.

3. Water quality and physical environment

The main stream of the Kuroshio Current runs almost through the center of the Tokara Archipelago (28°–30° N latitude), from the East China Sea toward the Pacific. The mean surface water temperature during the coldest month is 18°C, which is generally considered to be the temperature limit of coral reef distribution, and the 18°C isothermal line occurs at the northern end of the Tokara Archipelago.

4. Notable species and ecosystems

Yakushima boasts one of the richest and most abundant fish fauna in Japan. In addition, sandy beaches on Yakushima represent important spawning grounds for loggerhead turtles (*Caretta caretta*).

Clear differences are evident in the distribution of terrestrial organisms between Tanegashima/Yakushima, located in the temperate zone, and Amami Oshima, located in the subtropics. The Tokara Archipelago, which is located in between, is considered the transition zone between temperate and subtropical regions. Saito *et al.* (1980) identified a discontinuous line of terrestrial organism distribution, which was termed 'Watase's Line'.

2 Situation of usages

1. Tourism

Tanegashima and Yakushima can be accessed by ferry and jetfoil from Kagoshima and by air from Kagoshima and Osaka. Yakushima is famous for its virgin forest, which has been classified as a World Heritage site; thus, many tourists visit the island. Two round trips connecting seven populated Tokara Islands and Kagoshima are offered regularly. Hundreds of people visit these islands each year, although the local population totals only 711

(each island supports 50–200 residents), and there are two to five hotels on each island. SCUBA diving and fishing (including trolling) are popular marine leisure activities.

2. Fishery

Fishing for *Haliotis diversicolor aquatilis* by skin diving and for *Spratelloides gracilis* by drift netting are common in Tanegashima, whereas fishing for *Scomber australasicus* by pole-and-line is popular in Yakushima. Yakushima boasts the top catch of *Cypselurus agoo agoo* by drift gill netting; *Renina renina* is also caught.

In the Tokara Archipelago, a handful of fishermen on each island catch *C. agoo agoo*, *Scomberomorus niphonius*, and *Katsuwonus pelamis* along the coast, and skin dive for *Panulirus japonicus*, cuttlefish, and *Turbo marmoratus*. The sea around the Tokara Archipelago is an excellent fishing ground because it intersects the path of the Kuroshio Current; thus, many fishermen, even those from remote islands, gather on these islands (e.g., Yakushima and Tanegashima).

3 Monitoring and conservation

The Yakushima Marine Organism Research Workshop, a local society, conducts surveys to monitor populations of fishes and corals. The entire Tokara Archipelago was designated a prefectural natural park for Kagoshima Prefecture in 1992. In addition, Kurio on Yakushima was designated a marine park zone. These areas are currently under active conservation and management programs.

According to a questionnaire targeted at local municipalities in Tanegashima and Yakushima concerning the 1998 coral bleaching event, the ratio of bleached to live corals was 60 % or greater off the Nishinoomote City in northern Yakushima and 20–60 % in other areas (Nature Conservation Bureau, Environment Agency 2000c). The crown-of-thorns starfish (*Acanthaster planci*) has not yet been recorded in Yakushima (Nature Conservation Bureau, Ministry of the Environment 2003d), and only one individual has been observed to date in Kuchinoerabujima (Nojima unpublished data).

4 Necessary measures

An outbreak of *A. planci* has not yet occurred in this

area, but *A. planci* has been recorded in the Amami Archipelago to the south. Therefore it is necessary to strengthen current monitoring efforts. Information on corals and coral reefs is lacking for the Tokara Archipelago. It may be difficult to conduct frequent monitoring considering the difficult access, but systematic surveys and monitoring on a regular basis are necessary.