

#### **D-4.2.4 Utilization of Indicator Organisms for Evaluating the Health of Coral Reef Ecosystems**

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**Total Budget for FY 1995 - FY1996 ;** 5,956,000 Yen (FY 1996; 2,974,000 Yen)

**Abstract** To ascertain whether butterflyfishes (Chaetodontidae) can be utilized as indicators for the health of coral reef ecosystems, relationships between live coral cover and chaetodontid species richness and abundance were investigated by censusing fish from a series of reefs with different proportions of live coral at the Sekisei Lagoon and Iriomote Island, Ryukyu Islands. There were highly positive relationships between live coral cover and mean numbers of fish species and individuals per 10 min observation, probably because many representatives of this fish family are obligative or facultative coral feeders. In addition, the abundance of *Chaetodon trifasciatus*, which is an obligative coral feeder and the most common chaetodontid species at the study sites, rose with increasing live coral cover. These results suggest that chaetodontid fishes, especially obligative coral feeders, are candidates as indicator organisms for the health of coral reef ecosystems.

**Key Words** *Chaetodon trifasciatus*, Chaetodontid fishes, Indicator organisms, Live coral cover, Obligative coral feeders

##### 1. Introduction

Coral reef ecosystems are characterized by the occurrence of hermatypic corals, as dominant inhabitants of their bottom biotopes. Corals often cover 70-100% of bottom surface of reefs.<sup>1)</sup> Changes in live coral cover, therefore, are thought to reflect the health of coral reef ecosystems.

Butterflyfishes of the family Chaetodontidae are conspicuous and numerous members of fish assemblages on coral reefs.<sup>2)</sup> Many species are known to feed mostly or partly on corals (i. e., obligative or facultative coral feeders).<sup>3, 4)</sup> This fish family may show a rapid response to changes in the health of coral reef ecosystems, because some workers have found that the species richness and abundance of coral feeders in reef fish assemblages are profoundly affected by reduction in live coral cover.<sup>5, 6)</sup>

The primary purpose of this study is to ascertain whether chaetodontid fishes can be utilized as indicators for the health of coral reef ecosystems, by analyzing relationships between live coral cover and chaetodontid species richness and abundance.

##### 2. Methods

This study was carried out in the reefs of the Sekisei Lagoon (24° 18' N, 124° 00' E) situated between Ishigaki Island and Iriomote Island, Ryukyu Islands of Japan, in October 1995 and 1996, and in the fringing reefs of Sakiyama and Amitori bays (24° 20' N, 123° 42' E) on the western side of Iriomote Island in October 1996. Maps of the study sites appear in Sano et al.<sup>6)</sup> and Mori.<sup>7)</sup> The reefs consisted mostly of staghorn coral *Acropora* spp.

Prior to fish censuses I selected 3 reefs of differing percentage live coral cover at each study site (Sekisei Lagoon: <5%, 40-50%, and 70-80% live coral cover; Iriomote Island: <5%, 60%, and >95%). A visual census involved a 10 min swim (using a mask and snorkel) on the reef, swimming at a speed of about 25 m per min in a nonoverlapping zigzag pattern and recording the presence of chaetodontid species and their abundance within approximately 3 m of each side of the diver. Five censuses were made on each reef. Each 10 min swim covered approximately 1500 m<sup>2</sup> of reef area. Census data are expressed as the mean numbers of species and individuals per 10 min observation at each reef (n = 5).

### 3. Results

The mean numbers of species and individuals per 10 min observation increased remarkably in the following order of reefs with different live coral cover at the Sekisei Lagoon in both 1995 and 1996: <5% living reef, 40-50% living reef, and 70-80% living reef (Fig. 1). Similar increasing trends in species richness and abundance were found among the reefs at Iriomote Island in 1996 (Fig. 2).

Among chaetodontids observed on the 70-80% living reef at the Sekisei Lagoon (total 11 spp. in 1995 and 13 spp. in 1996) and on the >95% living reef at Iriomote Island (14 spp.), *Chaetodon trifasciatus* was the most dominant species (63-86% of all individuals at both sites). The density of this species increased distinctly along a gradient toward higher coral cover at the 2 sites (Fig. 3).

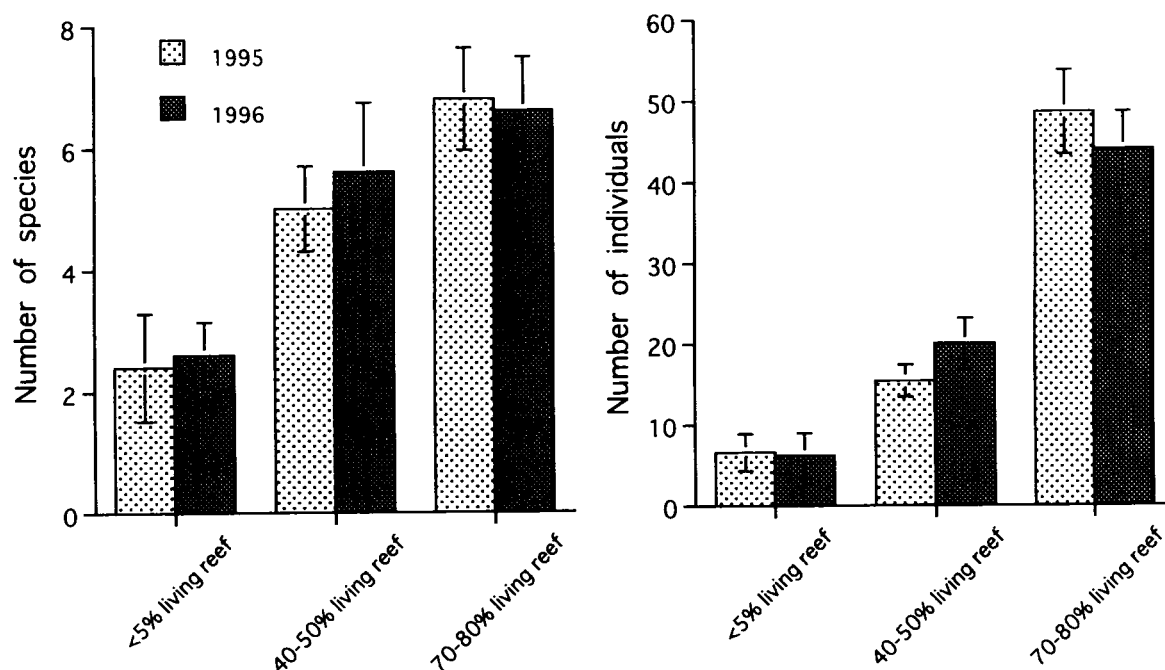


Fig. 1. Mean numbers of species and individuals of chaetodontid fishes per 10 min observation on each reef at the Sekisei Lagoon in 1995 and 1996. Vertical lines indicate SD.

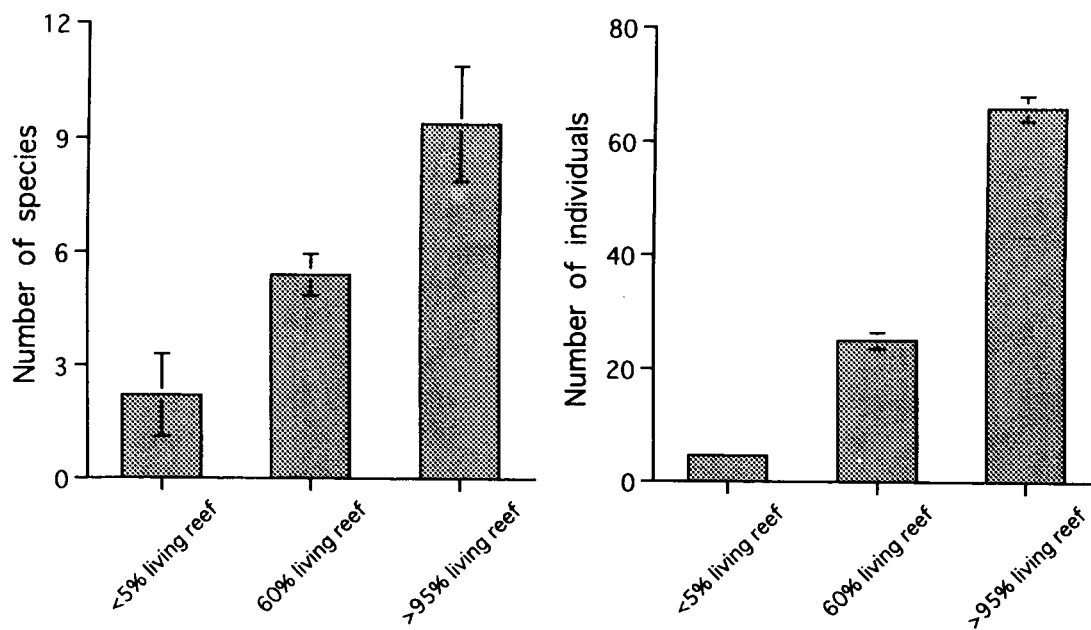


Fig. 2. Mean numbers of species and individuals of chaetodontid fishes per 10 min observation on each reef at Iriomote Island in 1996. Vertical lines show SD.

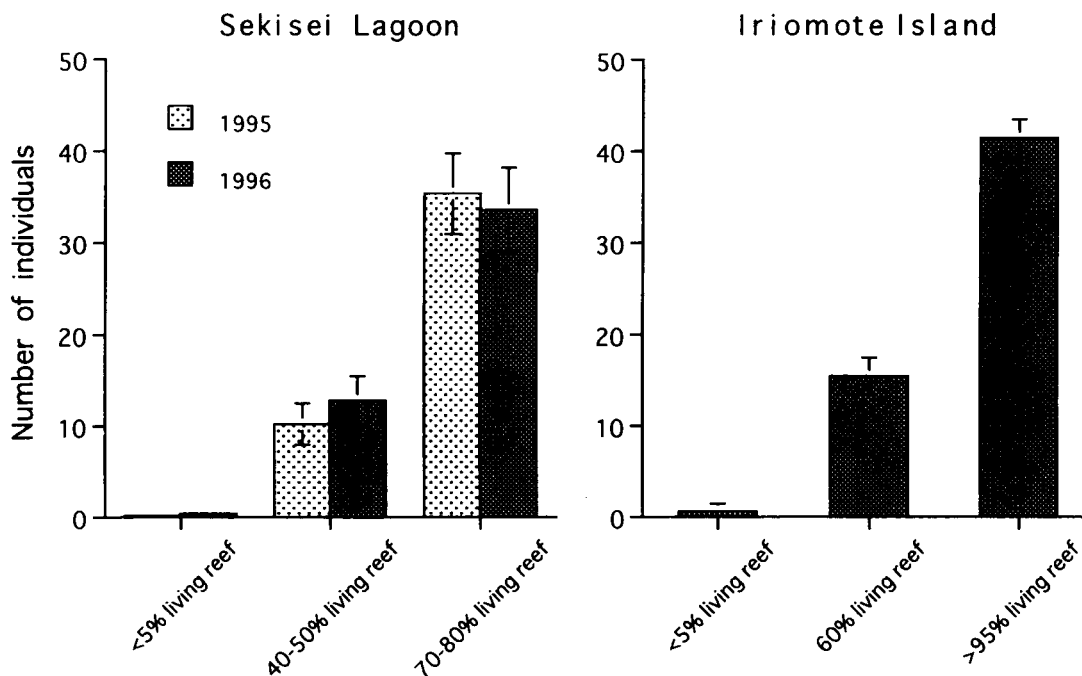


Fig. 3. Mean number of individuals of *Chaetodon trifasciatus* per 10 min swim on each reef at the Sekisei Lagoon in 1995 and 1996 and Iriomote Island in 1996. Vertical lines indicate SD.

#### 4. Discussion

The results indicate that the species richness and abundance of chaetodontid fishes are positively related to the amount of live coral cover. Similar findings have been recognized in the Tuamotu Archipelago<sup>8)</sup> and the Gulf of Aqaba, Red Sea,<sup>9)</sup> suggesting that chaetodontid species richness and abundance give some indication of the health of coral reef ecosystems. Some workers have claimed, however, that such relationships are not always close.<sup>10-12)</sup> Thus chaetodontid species richness and abundance need to be cautiously used as indicators.

Percentage live coral cover had a strong positive influence on the abundance of *Chaetodon trifasciatus*, which is an obligative coral feeder and the most common chaetodontid at the study sites. It may be more appropriate to utilize obligate corallivorous chaetodontids, rather than the entire assemblage of this fish family as indicator organisms.<sup>13-15)</sup>

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