F-5.3.2. Analysis of Biodiversity on Coral Reefs by Using Aerial Digitized Image

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Total Budget for FY 1997-FY1999 23,509,000 Yen (FY1999; 7,063,000 Yen)

Abstract

Aerial photographs of coral reefs were taken by a digital camera suspended in a small remote-controlled helicopter at the Sekisei Lagoon, Okinawa. In order to analyze digitized image, coverage of coral communities of corymbose *Acropora* at 2.5m deep and branching *Montipora* at 2.0m deep was surveyed using quadrat method. Mean coverage of the *Acropora* community dominated by *A. millepora* and *A. nasuta* was 24.1 % and of vegetation dominated by *Dictyota*, Cyanophyceae, encrusting and filamentous Rhodophyceae was 75.9 %. *Montipora* community dominated by *M. digitata* had 51.1 % coverage and 25.7 % in vegetation dominated by encrusting Corallinaceae. Digitized image was divided at each quadrat by image analyzer. Then mean gray value of each RGB specter bands at each quadrat was measured.

Relation between coral coverage and standard deviation/mean of RGB gray value of image was examined. The regression equation represented almost negative tendency because image of low coral coverage dominated by vegetation indicates high sd/mean. It is suggested that seaweed blade is fluctuant for water movement so image dominated by vegetation occurs unfocused image which shows high sd/mean.

Key Words Coral reef, Aerial photography, Digitized image, Image analysis, Coral coverage

1. Introduction

Moat of the fringing reef supports rich diversified habitats such as coral community and sea-grass bed widely but exists under environmental condition affected by terrestrial disturbance because of almost closed topography. Recently coral communities in Okinawa have degraded their naturalness by run-off. Because coral reefs play an important role as place for food, tourism and education, it is important to conserve them for the society. To conserve coral reefs, wide information on distribution of reef communities and monitoring of them are required. Since remote sensing is well known as a tool for acquiring wide environment, authors tried to develop analyzing method of coral community using digitized image of aerial photograph.

2. Method

a. Study sites

Study area was located at the Sekisei lagoon where diversified coral assemblages occurred (Fig. 1). Corymbose *Acropora* community in the east of Kohama I. (St. 1) and branching Montipora community in the moat of western Kuroshima I. (St.2) were chosen as study sites by quick snorkeling survey using aerial color photographs. Study sites were set by following arrange.

St.1: A rope was stretched from a base point to the north for 30 m and another rope was

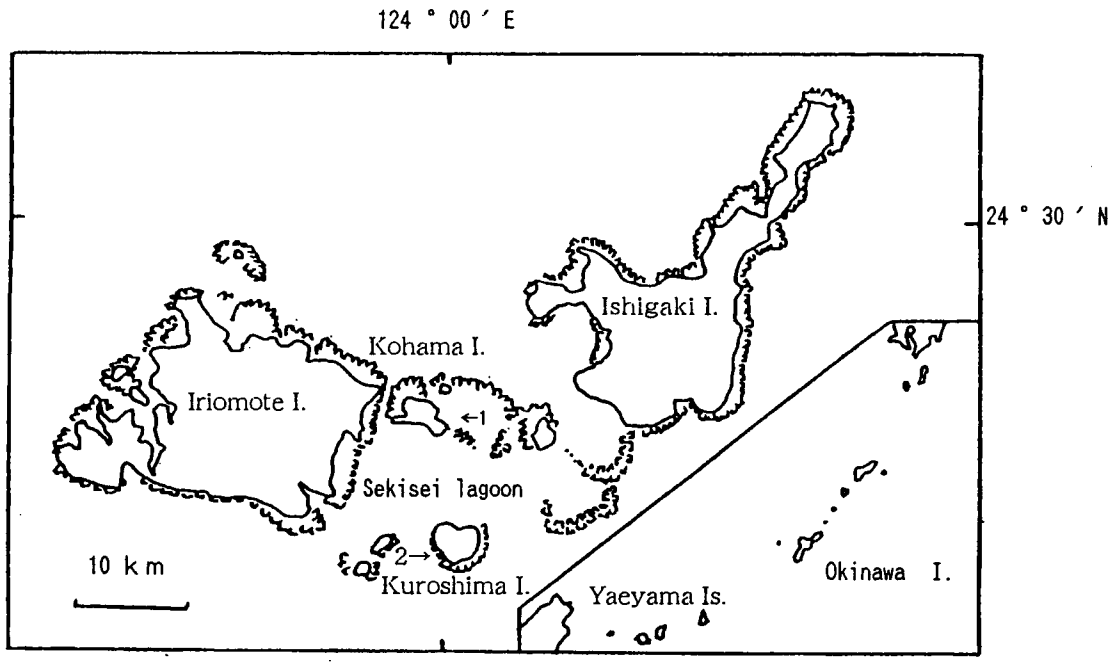


Fig. 1 Location of the study sites

set east-west for 30 m at the center for forming cross using underwater compass. Cross marks of 1m by 1m made by wood board for aerial photographs were moored at the center and terminals of the ropes during flight.

St.2: A rope was stretched from a base point to the north for 30 m. Cross marks were moored every 10 m.

They were placed on almost same depth and had flat bottom for acquiring aerial photographs under the same condition on the attenuation.

b. Aerial photographs

Small remote-controlled helicopter suspending digital camera (Fujix DS-505A with 24 mm, 1.3 million pixels) was used for taking vertical aero-photographs of study sites (Fig. 2).

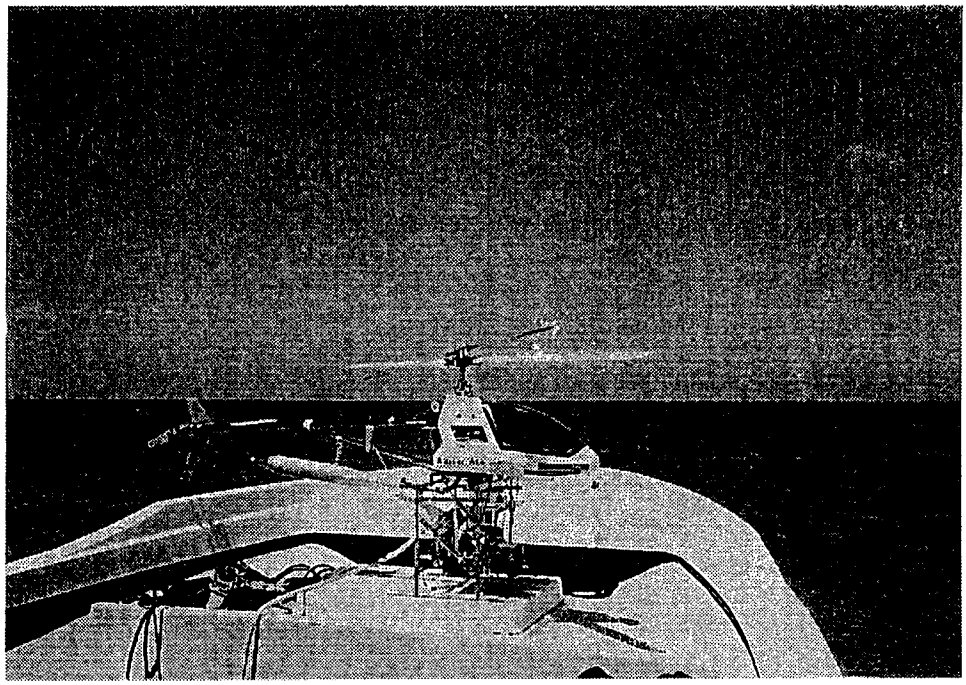


Fig. 2 Helicopter suspending camera

c. Field survey

To analyze image of aerial photographs, study sites were surveyed using quadrat method. Along the rope lines, 1 square m quadrat was repeated at both sides of the lines. Following items were observed at each quadrat.

- Coral coverage and dominant species
- Invertebrates coverage other than corals
- Vegetation coverage and dominant species
- Naked substratum coverage
- Substratum

- Depth at the time of flight

d. Measuring image of aerial photographs

Image taken was divided at each quadrat (Fig. 3) by the image analyzer (Kontron Elektonik, KS400) and then mean gray value at each RGB bands of each quadrat was measured by the analyzer.

3. Results

a. Coral coverage

St.1: Substratum was coral gravel sediment and covered by vegetation such as *Dictyota*, .Cyanophyceae and encrusting Rhodophyceae other than coral cover. Mean coral coverage was 24.1 % and dominant species were *Acropora millepora* and *A. nasuta*. Mean vegetation coverage was 75.9 %.

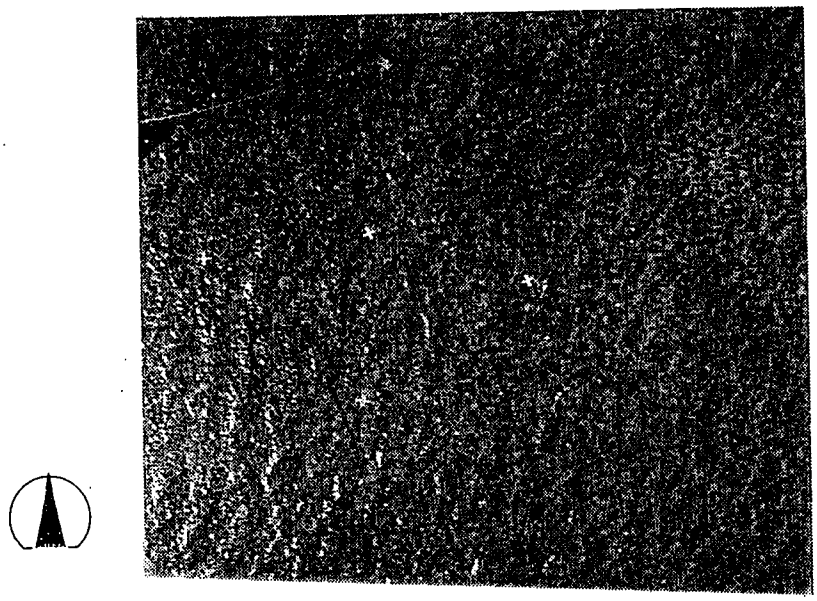
St.2: Substratum was coral gravel sediment. Mean coral coverage was 51.1 % and dominant species were *Montipora digitata* and *M. stellata*. Mean vegetation coverage was 25.7 % and dominant species was encrusting Corallinaceae. Mean naked substratum coverage was 11.5 %.

b. Correlation between gray value and coral coverage

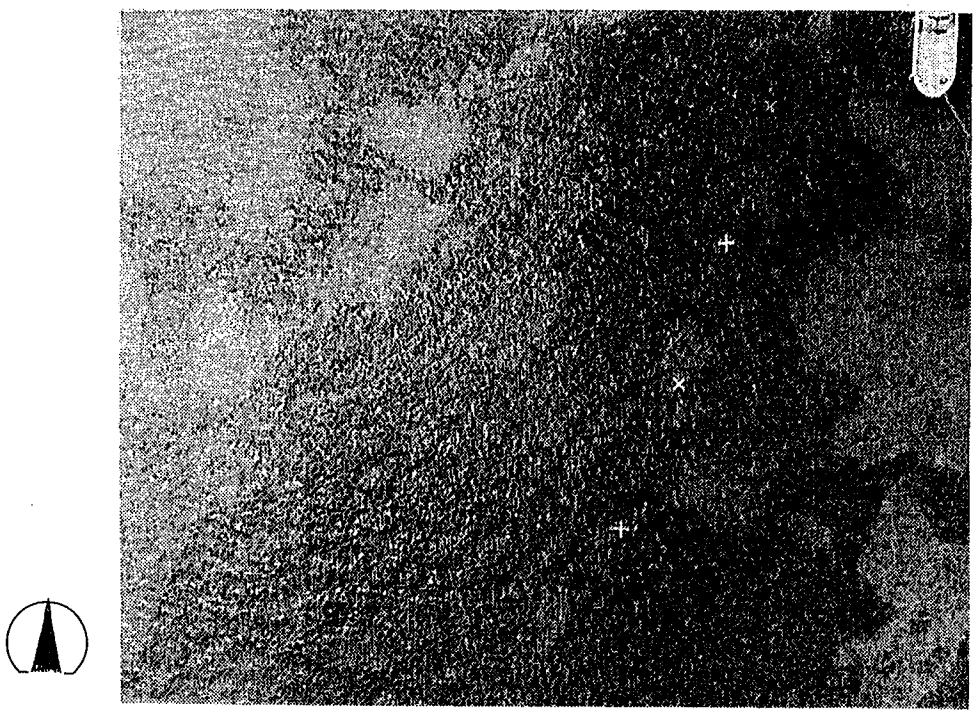
It was known that coral community with low coverage presented unfocused texture on the image. If unfocused texture is derived from fluctuation of gray value, it may be able to indicate by standard deviation (sd). Because authors assumed that unfocused texture indicated large sd, we calculated ratio of sd/mean of gray value of each RGB and examined correlation between the ratio and coral coverage. Results showed that the regression equation represented negative tendency at both sites. High coral coverage tended to indicate low ratio and high ratio in low coverage (Fig. 4).

4. Discussion

Sea bottom features reflecting to image are formed by component of substratum and epibenthos. Substratum at moat is usually covered by corals and/or algae. If large algae dominate substratum, image will show unfocused texture. Therefore it becomes possible to detect coral coverage by ratio of sd/mean. According to the result of this study, however, correlation coefficient is not high. Image dominated by encrusting or small algae do not occur indicate high ratio of sd/mean even low coral coverage. But community covered by encrusting algae is understood healthy because they grow in the natural environment. In case of community covered by other algae, coral coverage can



St. 1 (Interval of cross marks is 15m)



St.2 (Interval of cross marks is 10m)

Fig.3 Aerial photographs

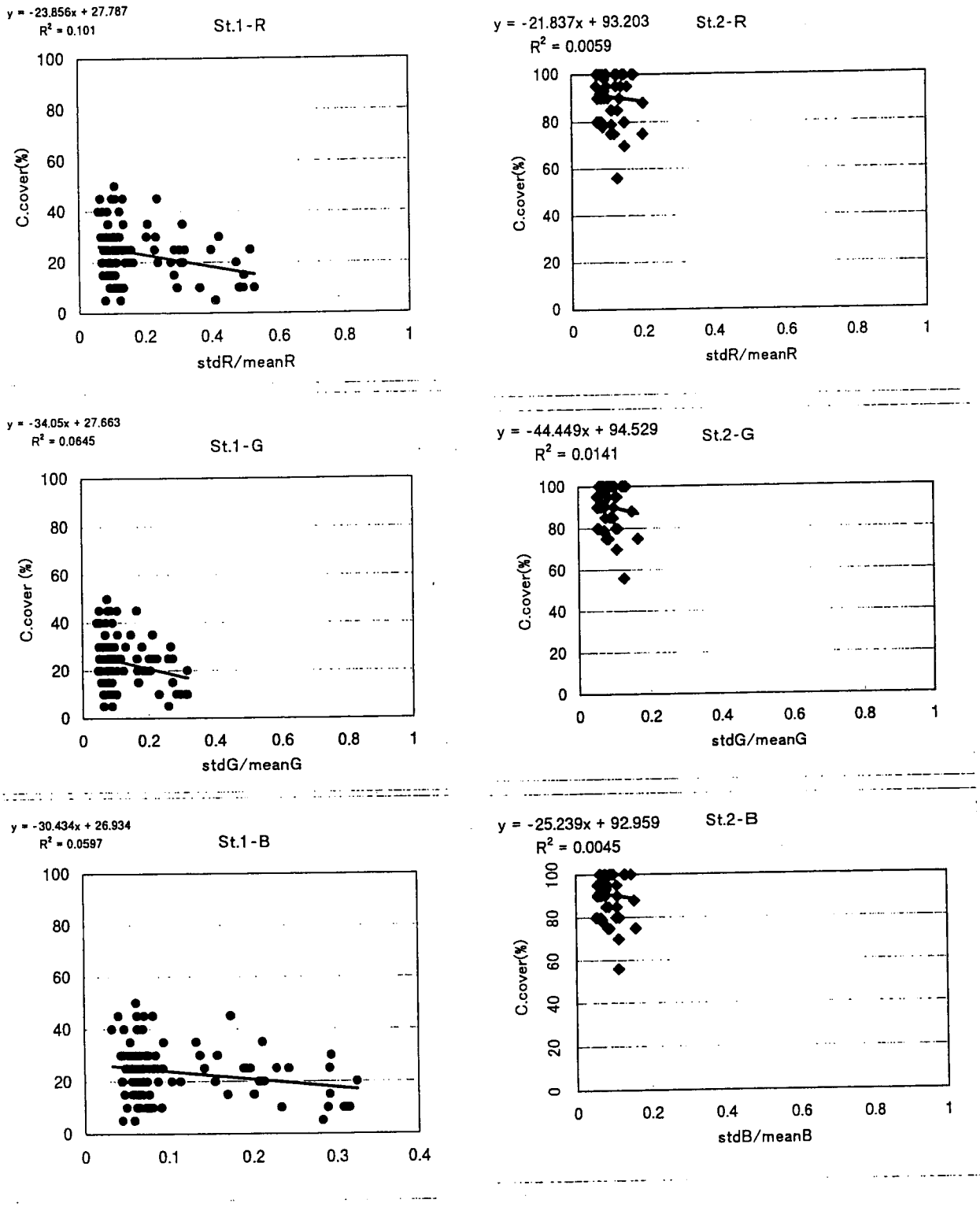


Fig. 4 Correlation between ratio of gray value and coral coverage

not be detected. If ratio of sd/mean of gray value at R band, however, exceeds over 0.4, we can detect it as community having low coral and high algal coverage.