Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

BBG21-P01 Room:Convention Hall Time:May 27 18:15-19:30

Diversity index of coral distributions and its relation to physical variables in Amitori Bay, Iriomote Island, Japan.

SHIMOKAWA, Shinya[1*] ; MUKARAMI, Tomokazu[1] ; UKAI, Akiyuki[2] ; KOHNO, Hiroyoshi[3] ; MIZUTANI, Akira[3] ; NAKASE, Kouta[2]

[1]NIED, [2]Penta-Ocean Construction. Co. Ltd., [3]Tokai Univerisity

The relationship between coral distributions and physical variables was investigated in Amitori Bay, Iriomote Island, Japan. Amitori Bay is located in the northwest region of Iriomote Island, Japan. Broad areas of coral have developed in the bay, and their life forms, coverages, sizes, and species vary depending on their locations. In addition, Amitori Bay has no access roads, and the bay perimeter is uninhabited. Thus, this small bay, with its variety of environments and lack of human impact, is considered to be one of the most suitable areas for studying the relationship between coral distribution and physical variables.

Field observations were conducted to obtain data on coral distributions, sea temperature, sea salinity, wind speed, and river flow rate [Shimokawa et al., 2014]. Ocean and wave model numerical simulations and soil particle tracking analysis were conducted to obtain the spatial and temporal distributions of wave height and the numbers of soil particles with the observed physical data. Our results showed that the life forms and sizes of corals significantly varied depending on their locations in the bay, because the physical variables differed significantly among these locations.

From the results of the above observations and simulations, we calculated diversity index of coral distributions and its relation to physical variables. The diversity index, DI [Shannon, 1948; MacArthur and MacArthur, 1961, Clark & Warwick, 2001, McCune and Grace, 2002] is defined as

$DI=-\sum ci \log_2 ci$,

where ci is the ratio of i-th type coverage to total coverage. DI is a quantitative measure for the degree in which a dataset includes different types and is related closely to entropy concept in Thermodynamics. The value of DI increases when both the number of types and the evenness increase. For a given number of types, the value of DI is maximized when all types are equally abundant.

The results show that Averages of diversity index of the coral types at the mouth and inner parts of the bay are lower than average of the whole region, but average of diversity index at the intermediate part of the bay with the intermediate physical disturbances is higher than it. This seems to support the intermediate disturbance hypothesis demonstrated by Connell [1978] which states species diversity in local area is maximized when environmental disturbances is neither too weak not too strong.

References:

Clarke, K. R. and R. M. Warwick (2001), Changes in marine communities: an approach to statistical analysis and interpretation, 2nd ed., PRIMER-E, Plymouth, pp. 176.

Connell, J. H. (1978), Diversity in Tropical Rain Forests and Coral Reefs, Science, 199, 1302-1310.

MacArthur, R. H. and J. W. MacArthur (1961), On bird species diversity, Ecology, 42, 594-598.

McCune, B. and J. B. Grace. (2002), Analysis of Ecological Communities, MjM Software Design, Oregon, pp.300.

Shannon, C. E. (1948), A mathematical theory of communication. The Bell System Technical Journal, 27, 379-423 and 623-656.

Shimokawa S., T. Murakami, A. Ukai, H. Kohno, A. Mizutani and K. Nakase, 2014, Relationship between coral distributions and physical variables in Amitori Bay, Iriomote Island, Japan, J. Geophys. Res.: Oceans, 119, 8336-8356 (doi: 10.1002/2014JC010307).

Keywords: Coral, Diveristy index, Wave height, Soil particle, Intermediate disturbance hypothesis