

Evaluation of effects of tide on recreational activities on coral reefs  
(潮汐がサンゴ礁におけるリクエーション活動に及ぼす影響評価)

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## 1. Introduction

Recent degradation of coral reefs is a consequence of comprehensive impacts combined of global factors such as global warming and ocean acidification, and various local anthropogenic factors. Therefore, effective procedures are considered to differ among the situations. The annual number of tourists of Miyako Islands has been maintained to be as many as around 400,000 since 2012, which is considered to negatively influence the local coral condition. Due to expected future growth in tourism in Miyako Islands, especially by encouraging snorkeling and diving, the coral health is further concerned by massive recreational utilization on coral reefs. The recreational damage on coral reefs has been studied from multiple perspectives. The tide is also considered to affect the recreational activities and subsequently the coral reefs but has not yet been well studied by previous studies. Considering the current situation, this study aims to verify the relationship between reef breakage and recreational behaviors in relation to the tidal condition.

## 2. Methodology

The study site was specified at 7 points of Kayafa Beach of Shimoji Island of Miyako Mainland, Okinawa Prefecture, Japan. The *in situ* survey of the condition of coral damage and behaviors of recreationalists among the 7 points were conducted. Inquiry surveys to an owner and staffs of a local diving shop (Eco Guide Café) were carried out to understand the conceptual background of recreational activities in the survey area.

## 3. Results and Discussion

- 1) Behavior of standing upon reef colonies of *Porites rus* was often observed at low tide and when the tourists were not accompanied by instructors. .
- 2) Across the 7 points, *P.rus* was the most heavily damaged species followed by *Porites cylindrica*. The damages were found mainly in the center and the edge of the *P.rus* colonies.
- 3) According to the inquiry survey, recurrent behaviors of standing upon *P.rus* colonies between July and August were witnessed by the staffs. Damages occurred on *P.rus* in mid July caused by such behaviors were verified by photographs taken at the same spot in early August. The other useful information was acquired based on analyzing the process of the generation of coral breakage
- 4) During the time when beaches are thronged by recreationalists, standing behaviors on reefs were frequently found when the tide-modified depth of coral breakage occurrence was between 50 to 150cm from the sea surface.
- 5) The damages occurred on *P.rus* colonies are considered as a result of sequential destructive behaviors. The primitive damages on reefs are hypothesized to be caused by aggressive kicking when they tread in the water. Such behaviors weaken the resistant capacity of coral reefs towards external forces. As a result, further damages can easily be caused by standing behaviors on reef colonies.

## 4. Recommendations

Based upon the findings, this study suggests that enlightenments such as setting notice boards in order to raise recreationalists' awareness towards their behaviors and recommends reef-friendly recreational manners by equipping proper gears and taking pre-training courses.