

Doctoral Thesis

**Ecological study on the spotted boxfish *Ostracion meleagris* (Ostraciidae)
on reefs of Kuchierabu-jima Island, southern Japan**

(Summary)

Yuki Koide

Graduate School of Biosphere Science

Hiroshima University

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Summary

Ostraciid boxfishes (trunkfishes or cowfishes) are common fish on reefs of tropical and subtropical waters. The family Ostraciidae comprises 25 species of eight genera, e.g. *Acanthostracion*, *Lactoria*, and *Ostracion*. The boxfishes are well known for the morphological characteristics as commonly maintaining protected hard armor plates as enclosing most of their body parts (Lobel 1985; Santini 2013; Nelson 2016). In contrast to the general popularity in morphology, however, there are very few field studies on the ecology of the boxfishes.

The only examples of a detailed field study of boxfish ecology are the observational underwater surveys conducted on two *Lactoria* species (*Lactoria diaphana* and *Lactoria fornasini*) on the reefs of Miyake-jima Island, Japan, over 30 years ago (Moyer 1979, 1984; Moyer & Sano 1987), revealing feeding and reproductive habits. Whereas, no ecological field surveys have ever been conducted in any *Ostracion* species, the most species-diversity genus (8 species) in Ostraciidae. To understand the ecological and behavioral characteristics of the family Ostraciidae, *Ostracion* species is expected to be surveyed in nature.

Therefore, I conducted a field survey on the white-spotted boxfish *Ostracion meleagris* on the reefs of Kuchierabu-jima Island (30°28'N, 130°10'E), Kagoshima, southern Japan for 3 years to clarify the feeding and reproductive ecology of the boxfish.

Firstly, I report our findings on the relationship between body color and the sexual pattern of the white-spotted boxfish, which has been previously ambiguous. I clarified it by histological observation and field research. I first found that some mature males maintained female-like body colorations (initial phase: IP) that were different from body colorations (terminal phase: TP) of territorial males, and confirmed sneaking behaviors by small IP colored males. It was suggested that male body colorations of the white-spotted boxfish would change from IP pattern to TP pattern with growth and the body color change would be associated with the switch of

behavioral tactics from a non-territorial male to a territorial male.

I also report the feeding habits of the white-spotted boxfish revealed by diet analysis, DNA analysis, and behavioral observation. Boxfishes are known to be benthivores and mainly consume sessile organisms on reefs, such as tunicates. Ascidian tunicates contain various toxins and seldom suffer from predation by reef fishes, except for boxfishes. However, the importance of ascidian tunicates has not been sufficiently examined in the feeding ecology of boxfishes. I found that photosymbiotic ascidians predominantly contributed to the boxfish diet, and observed colonies of ascidians were bitten frequently by the boxfish during the survey. During the day, the feeding boxfish moved within their home ranges in a rocky, shallow zone of the studied reefs, which harbored photosymbiotic ascidian colonies of the family Didemnidae at higher densities than in the surrounding zones. These results suggest that the boxfish strongly rely on the photosymbiotic ascidians as a less-competitive food resource.

I also report details of spawning migration patterns and mating systems of the white-spotted boxfish, with attention to home range distributions and mating relationship among individuals of the boxfish. Each individual of the white-spotted boxfish maintained feeding sites, spawning sites, and sleeping sites at different places on reefs. The migration distance between the near-shore feeding site and the offshore spawning site were ranging 182 m - 884 m and 138 m - 378 m in females and males, respectively. The boxfish produced pelagic eggs with spawning ascents. Water conditions on offshore reefs would promote egg survival as carrying eggs away from reefs, where many planktivorous fishes inhabit. In contrast, the main food items, photosymbiotic ascidians were concentratedly distributed in shallow waters near shore. It was suggested that the difference between the suitable place for feeding and the suitable place for spawning is a factor promoting the spawning migration of the boxfish on reefs of Kuchierabu-jima Island. In addition, I revealed that this species has the male territory-visiting (MTV) polygamy mating system, where territorial males maintained mating opportunities with multiple females.

In this study, I succeeded in clarifying the detailed ecology of *O. meleagris* in the field. This suggests that boxfish can flexibly change their behavior and life patterns according to their habitat. However, the study on the ecology of boxfish, including the history of their life in the field, is still limited to *Lactoria fornasini*, *Lactoria diaphana*, and *O. meleagris*. Therefore, further study is expected to understand the variations of boxfish ecology.