

Doctoral Thesis

Ecological study on the sex change and reproductive tactic of the coral-dwelling damselfish *Dascyllus reticulatus* on reefs of Kuchierabu-jima Island, southern Japan

(Summary)

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Summary

The reticulated damselfish, *Dascyllus reticulatus* widely occurs on coral reefs of the Indo-Pacific. This coral-dwelling damselfish shows heterosexual cohabitation on branching corals and has been considered to maintain a harem mating system, where a few males monopolize mating within the group. *D. reticulatus* is also known as a protogynous hermaphrodite (females changing sex to males) through gonad histology of sampling specimens and rearing experiments. However, details of the social structure and mating system have not been investigated. Furthermore, it has never been revealed how females functionally demonstrate protogynous sex change in natural conditions. To clarify the reproductive ecology and life-history pathways including sex change of *D. reticulatus*, I conducted field observational surveys on a damselfish population on reefs of Kuchierabu-jima Island, southern Japan.

From data of spatial relationship and mating relationship, I confirmed that relatively large adults inhabited corals with long branches and wide gaps with a female-biased sex ratio, and they maintained harem groups where the largest male monopolized mating. In contrast, small adults and juveniles cohabited in higher individual densities on short branch corals, with no bias in individual sex ratio. Only nine of 26 adult males in the short branch coral groups showed mating activities. Nineteen of 35 adult females in the short branch coral groups spawned, and their spawning frequency was lower than that of the females on the long branch coral. Thus, I observed two contrasting social compositions and mating activities within harem-like cohabitation groups that depended on body size and sheltering coral structures. I observed inter-

harem moves by large non-breeding individuals from the short branch corals to the long branch corals, implying a conditional use of the two types of groups related to body size.

I confirmed 11 cases of protogynous sex change in *D. reticulatus* under natural condition. I confirmed a typically take-over sex change in the long-branch coral group where stable harem established. While in most 10 of 11 cases, sex change was confirmed to be conducted under the presence of males or large females in the short-branch coral groups where the reproductive success of individual-level was low. These sex-changed individuals did not perform any male sexual behavior and stayed cohabitation as a non-breeding male after the protogynous sex change. In the short-branch coral groups, males and sex-changed individuals tended high growth than females. Thus, I predict that “the cryptic sex-changed individuals” conduct a tactic to increase future reproductive success by investing in growth as the non-breeding male rather than the low-spawning female.

In this study, I present a new example of multiple forms of groups and sex change pattern in harem reef fishes. The physical structures of branching corals affected the group structure of *D. reticulatus*. As a conditional life-history pathway of this species, I predict that individuals will first settle and stay on short branch corals to prioritize survival when small, and then change groups after growth to achieve better reproductive status. In the environment where the habitat coral resources are dispersed, and the predation pressures are strong, this coral-dwelling damselfish must be aggregate into the limited resources. In the short-branch groups, the monopoly of females due to the largest male is weak and many non-spawning females confirmed. The reproductive success of both sexes was significant low if there is a growth difference between sexes, it is more advantageous to grow as a non-breeding male than to be a

female. It can be said that the cryptic sex change is a tactic for growth strategy of the small coral-dwelling fish rather than conventional reproductive strategy.

This sex change tactic for growth strategy is likely confirmed in other small coral-dwelling fish species. A further survey in the future is expected.