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Keynote -3

Ecology of coral associated animals: Habitat island and species diversity

Makoto Tsuchiya

Faculty of Science, University of the Ryukyus, Nishihara, Okinawa 903-0213, Japan

Closely related taxa demonstrating niche overlap may show marked species interactions as they compete for resources, or show resource partitioning and character displacement. The diverse organisms of coral reefs interact in intricate ways, among which ecology of small animals associated with branching corals has been well studied. The resource limited system of a coral colony for its associated animals is an appropriate system for the study of community organizing processes or is a good tool for discussing the concept of island ecology as a habitat island.

In colonies of pocilloporid and acroporid corals, several obligate symbionts such as xanthid crabs, *Trapezia* spp. and *Tetralia* spp., a snapping shrimp, *Alpheus lottini*, and gobioid fishes, *Paragobiodon* spp, occupy limited resources. Because these species show similar characteristics of microhabitat, diet, and behavior, they are considered to be potential competitors, and their intra- and interspecific interactions must be interesting research topics. Since several species may be able to coexist within a large coral colony and underwater and laboratory observations of *Pocillopora damicornis* colonies have not revealed habitat segregation among different species of *Trapezia* adults on a colony, detailed analyses of the mechanisms of their coexistence are needed.

Species composition of *Trapezia* spp. associated with *Pocillopora damicornis* were analyzed for several populations collected at seven localities, i.e. Ushibuka (Kumamoto Prefecture), Sesoko, Itoman (Okinawa Island), and Shiraho (Ishigaki Island) in Japan, and Sichang, Samui, and Phuket in Thailand. One of the most conspicuous phenomena was found for the Sichang population of *Trapezia cymodoce* from the inner part of the Gulf of Thailand. This was the only species of *Trapezia* collected among the branches of *P. damicornis*, and specimens of this species were larger in comparison to those collected from other localities. This phenomenon was also observed off Samui in the Gulf of Thailand. In the localities surveyed, *Trapezia* were usually larger in size in larger coral colonies; however, different patterns in the relationship between colony size and crab size were observed, especially when small specimens occurred in conjunction with heterosexual pairs in a colony. The pattern in populations of *T. cymodoce* at Sichang was quite conspicuous and differed from those observed at other coral reefs. Only one heterosexual pair was collected even on the large colonies of *P. damicornis*.

It is well known that, if the starfish *Acanthaster planci* attacks the crab's host coral, *P. damicornis*, the crab will attempt to expel the starfish by snipping at its spines or tube feet. When we compared sizes among 10 large specimens of each species, *T. cymodoce*, *T. digitalis*, and *Trapezia lutea*, those specimens found in the presence of *A. planci* were significantly smaller than in its absence (t -test, $P < 0.05$). No *A. planci* have been found in Sichang.

We can therefore hypothesize about the coexistence of closely related *Trapezia* spp. on a large colony. The coral-eating starfish *A. planci* is an important force in controlling population traits and species composition of the obligate coral symbiont *Trapezia*. When a large population of *A. planci* forms at a coral reef, the crabs must protect their host corals from aggression by these starfish. In such situations, *Trapezia* species have no time to compete with each other; instead, they coexist on a colony because they must protect their host coral from a common enemy, *A. planci*.

In the summer of 1998, when mass coral bleaching occurred, the relationship between *Trapezia* and its host coral *P. damicornis* was investigated. Although six species of *Trapezia* were collected during this survey, bleached colonies harbored fewer individuals and species of obligate symbionts than unbleached colonies before the bleaching event. Even on the larger colonies, of which the volume of the interbranch space was considered to be enough for harboring several specimens of *Trapezia*, no obligate symbionts were found. Heterosexual pairs of symbionts such as *Trapezia* spp., *Alpheus lottini*, and *Paragobiodon* spp. were rather uncommon, and the abundance of ovigerous females of *Trapezia* was lower and clutch sizes were smaller than usual.

These four species or groups, i.e. coral, zooxanthellae, *Trapezia*, and *Acanthaster*, have coevolved together, and the extinction of one species would seriously disturb their interactive relationships. The relationships among them are discussed from the view point of biodiversity and species interactions.