The role of mesophotic corals to shallow reef recovery: studies on sexual reproduction and physiology of Seriatopora hystrix

Form 3

Abstract

Title: **The role of mesophotic corals to shallow reef recovery: studies on sexual reproduction and physiology of *Seriatopora hystrix***

Mesophotic Coral Ecosystems (MCEs, between 30 and 150 m depth) are hypothesized to contribute to recovery of degraded shallow reefs through recruitment of sexually produced larvae, referred to as Deep Reef Refuge Hypothesis (DRRH). This hypothesis remains untested since little is known about MCEs. Here, I assess the validity of this hypothesis by: (1) examining genetic diversity of coral host and its *Symbiodinium* from shallow to mesophotic reefs in the Ryukyu Archipelago; (2) investigating reproductive periodicity of mesophotic corals and subsequent settlement of released planulae; (3) assessing the effect of different light intensity on mesophotic coral larval behavior, settlement and survivorship; and examining physiological acclimation of mesophotic coral (4) juveniles and (5) adult colonies under shallow-water environmental conditions. For all of these studies, the mesophotic brooding coral *Seriatopora hystrix* (a depth-generalist coral) was selected as a model species. In addition, the mesophotic broadcast spawning coral *Acropora tenella* (a deep-specialist coral) was used to assess spawning timing and gamete characteristics. Genetic studies demonstrated that no clear partitioning related to depth was observed between shallow and mesophotic *Seriatopora* for both host and *Symbiodinium* genotypes suggesting that MCEs in Okinawa may act as a refuge in preserving genetic diversity of *S. hystrix* (Chapter 2). I also found that mesophotic brooding *S. hystrix* has a 4-month shorter reproductive season and smaller planula size compared to shallow conspecific colonies in the region with most of the planulae settled rapidly following release suggesting limited direct recruitment to shallow reefs. For mesophotic spawning *A. tenella*, gamete release timing was similar to shallow acroporids in the region and the eggs were positively buoyant implying that fertilization may happen on the surface. However, this would also imply considerable challenges for fertilization success and raise some questions on how planulae can successfully swim down and find suitable habitat for settlement (Chapter 3). Moreover, I found that light conditions representing the depth of shallower than 20 m (5 and 10 m) significantly reduced settlement rate, survival and fitness of mesophotic *S. hystrix* larvae (Chapter 4). In contrast, both juveniles and adult colonies of mesophotic *S. hystrix* survived at the depth shallower than 20 m, particularly at shaded habitat, where light/depth acclimation was facilitated by algal symbiont (Chapter 5 and 6). Overall, the results found in this thesis confirm that depth-generalist corals found in MCEs have potential to contribute to shallow reef recovery. However, the recovery might occur slowly through multigenerational recruitment with 20 m depth reef habitat as a stepping stone.

Name Rian Prasetia