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Marine Biodiversity and Ecosystems

Population Ecology of the *Pocillopora verrucosa* Species Complex

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跨領域科技研究大樓1樓演講廳
Host: Dr. Yoko Nozawa 野澤洋耕副研究員

Doctoral Dissertation Defense Presentation

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Abstract

Population ecology is the study of populations in relation to the environment that includes the influences on population structure, health and density. For centuries it has provided a means of evaluating why and how populations change over time, why some go extinct and why others flourish. However, we still lack information on specific foundational species, especially when it comes to corals, that promote the persistence, recovery and resilience of coral reefs worldwide. In this Ph.D. study, we explore mechanisms that support the survival of the *Pocillopora verrucosa* species complex, an abundant group of coral species in the Indo-Pacific. We examine abiotic factors on the larvae of *P. verrucosa* during dispersal (Chapter 2), use long-term monitoring and mathematical modelling to exemplify ecosystem resilience (Chapter 3) and reveal the demographic processes that drive population growth (Chapter 4).

Our results from Chapter 2 show that behaviour can have profound consequences for the dispersal potential of marine sessile organisms. We show that larvae of *P. verrucosa* are photo-sensitive and use this ability to dwell at the surface after spawning. Other coral species tested showed no preference towards or away from the light source, possibly using other mechanisms to regulate their vertical positioning. This reaction was consistently observed both in the laboratory at different light intensities and in the field at various depths. We hypothesise that photo-movement may have some influence on the wide geographical distribution of *P. verrucosa* larvae.

In Chapter 3, we explore *Pocillopora* populations in recovery in Lanyu, Taiwan after a catastrophic disturbance in 2009. We monitored individual colonies over a 9-year period (2012-2020), tracking growth, survival and reproduction.

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We used Integral Projection Models (IPMs) to extract demographic traits that drive population recovery following a disturbance. Our results exemplified resilience as the population in later years was able to absorb recurrent disturbances and continue on the trajectory of recovery. We show it is underlying mechanisms such as the transition of smaller immature individuals to sexually mature adults that ensure the progression of the population. Our results deepen our knowledge of the value of both empirical and theoretical methods to explore recovery of corals.

In Chapter 4, we examined the demographic processes of Pocillopora populations that regulate and facilitate population growth. We discovered, to our best knowledge, the first clear evidence of self-thinning of a coral population, a law in forest ecology whereby the number of trees (per unit area) decreases as average tree size increases over time. We highlighted what processes are driving this demographic phenomena, and concluding that density-dependent recruitment is exerting pressure on the population to shrink in number of individuals. Our understanding what factors regulate population growth of foundational organisms is essential for future predictions of coral reefs.

Further research is necessary to explore the recovery potential of coral reefs. From reproduction to population dynamics to interdisciplinary science. Population ecology has a place in the 21st century and can help to address new questions arising due to anthropogenic climate change. This Ph.D. study shows that mechanisms underpinning the survival of foundational organisms offer insight into how coral reefs will look in the future under more pressured environmental change.