Institut des Récifs Coralliens du Pacifique

Ecology and Distribution of *pocillopora* genus on the reefs of Moorea Island (French Polynesia)

Report

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Acknowledgements:

This report summarizes my stay in the research station CRIOBE, Moorea, French Polynesia in December and January 2015 that was **sponsored by the French Embassy** here in Fiji and the activities that I carried out while in CRIOBE. Coral ecology was my main focus as I was given the opportunity by Dr. David Lecchini and Dr. Laetitia Hédouin to assist Antoine Puisay, in his research and work on corals, which has further broadened my knowledge of corals and marine science in general. The knowledge I have gained will surely be very useful as I would like to pursue a career in the conservation of Marine life.

Introduction

Coral reefs are diverse underwater ecosystems that harbor a unique biodiversity. Coral reefs are held together by calcium carbonate structures secreted by corals. These corals are colony composed by thousands of polyps and belong to a group of animals known as Cnidaria, which also includes sea anemones and jellyfish. Unlike sea anemones, corals secrete hard carbonate exoskeletons which support and protect the coral polyps (Barnes, 2014). Reefs grow best in tropical and sub-tropical region (broadly between 30° north and 30° south latitude) with warm, shallow and clear waters. Reefs provide protection from coastline erosion, habitat for many species, nutritional resources for fishes and humans, and money incomes via tourism. However, coral reefs are threatened by stressors that act at a global scale (global warming, ocean acidification) and at a local scale. Indeed reefs located near coastal populations and subjected to increasing human pressures are showing increasing signs of stress (Faure, 2013).

The human population is increasing all around the world and this is also the case in French Polynesia and notably on Moorea Island. As both global climate changes and local anthropogenic pressures may have severe impacts on coral reef ecosystems and corals especially, it appears important to monitor the health of these reefs since most of the Polynesian economy and peoples livelihoods depend on the continued viability of healthy reefs.

This project has two main objectives:

1. Identifying the factors affecting the distribution and the health of the genus *Pocillopora* on the reefs of Moorea

2. Identifying the different species of *Pocillopora* found on the reefs around Moorea

Materials and Methods

The survey method consisted of a 3 belt transects 30m × 1m on each side covering a total area of 180m^2. The 30m transect was laid out and each of the two snorkelers swam along the transect and took note of the *Pocillopora* species, length, width and bleaching activity on the reefs. Observations were also made of the amount of *Acantherstar planci* and other potential predators seen on the reefs.

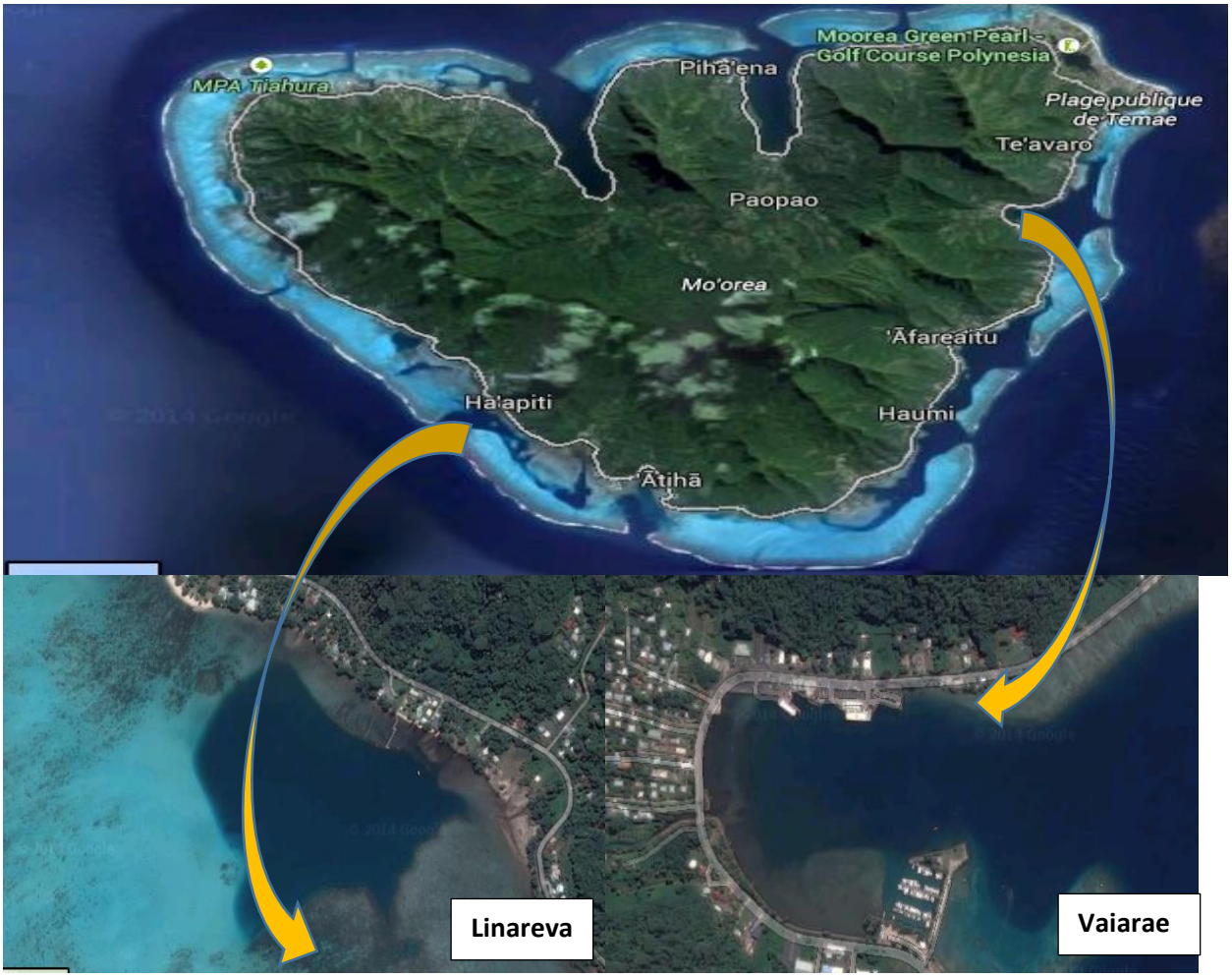

Figure 1: Map of study areas around Moorea

The above maps show the two study sites where the survey was conducted in Moorea, French Polynesia. The Linareva site was a back- reef considered as a controle site, located 300m for the shore and characterized by clear waters. The second study site called "Vaiare" was located in the bay of Vaiare and was defined as a degraded fringing reef due to the human activities occuring in the bay (e.g. boat and ferry traffic, river discharges) and the severe turbidity and sedimentation observed in the reef.

Results and Discussion

Pocillopora is one of the most abundant and widely distributed coral genera, with a geographic range spanning the entire tropical Pacific and Indian Oceans as well as the Red Sea and Arabian Gulf. It is a major reef builder (second in importance and abundance after *Acropora*) that can dominate a wide variety of habitats, including marginal environments occupied by only a few other coral genera. Despite the ecological importance of this genus, species boundaries remain poorly understood. Species identification is extremely challenging in many corals, and *Pocillopora* is often cited as a prime example. Around 40 species in the genus have been named, while approximately 14 are considered valid and one (*P. elegans*) is currently under consideration for protection under the US Endangered Species Act. However, the evaluation and conservation of coral species remains problematic due to taxonomic uncertainty (Forsman, et al., 2013). Only 4 species *P. damicornis, P. eydouxi, P. verrucosa and P. meandrina* are found in Moorea, however the surveyed indicated that there were no colonies of *P. eydouxi* found at any of the sites. The *Pocillopora* species were identified by the distinctive verrucae (wart-like growth) with multiple polyps on each verrucae.

Figure 2: P. meandrina

These are the *P. meandrina* specimens collected from the site in Linareva. This species was seen to be a uniform sprawling branches with small verrucae. The density of it found on linareva was $0.01m^2$ while the density found on Vaiare was $0.07m^2$.

Figure 3: P. verrocosa

The *Pocillopora verrucosa* colonies were seen to be present in quantity compared to *P. damicornis*. It was seen to be a uniform, upright branches distinct from verrucae but verrucae irregular in size. The density of it found on linareva was $0.02m^2$ while the density found on vaiare was $0.39m^2$.

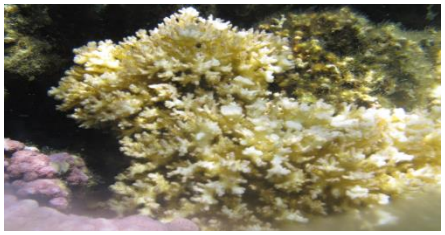

Figure 4: P.damicornis

P. damicornis branches and verrucae intergrade. Pale brown, greenish, pink. It is widely used as a model organism for research (a "lab rat") because it is abundant, fast growing, and recognized as a brooder (spawning ciliated and free-swimming larvae every months) (Schmidt-Roach, et al., 2013). The survey indicated that the species was more common in the first site with a density of $0.56m^2$ compared to the second where the density was $0.18m^2$ hence it thrives better in clear, well lit environments.

Table 1: table showing the abundance of the different pocillopora species found on the two reefs

Pocillopora	**Vaiare**	**Linareva**
P. darmacornis	101	33
P. meandrina	13	2
P. verrucosa	71	4
Total	185	39
Area	180	180
Density	1.027778	0.216667

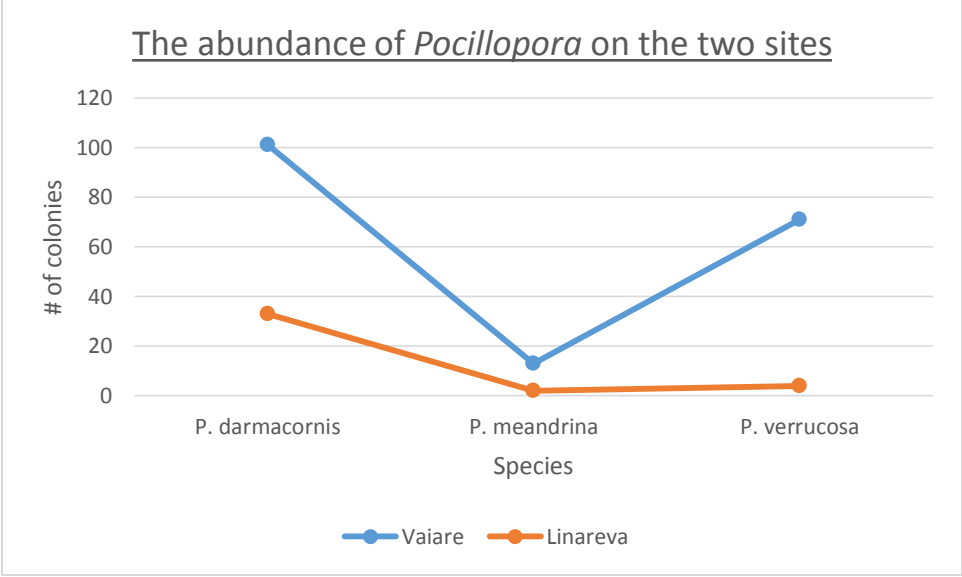

Figure 5: graphical analysis of the different species of Pocillopora

This study explores changes in the structure of coral reef habitats, specifically changes in *Pocillopora* cover, species composition, health status in Moorea, French Polynesia, to assess the

independent and combined effects of different natural and human disturbances such as pollution, cyclones and *Acantherstar planci* outbreaks.

Previous studies (Faure, 2013) show that *Pocillopora* cover varied significantly among years, showing marked declines during some, but not all, disturbances. The greatest rates of coral loss coincided with outbreaks of *A. planci* (Kayal, et al., 2012). Moreover, successive disturbances have had differential effects among coral genera, leading to strong directional shifts in coral composition. *Acropora* is declining in abundance and coral assemblages are becoming increasingly dominated by *Pocillopora* and *Porites* (Faure, 2013). These observed changes are likely to have further significant impacts on the reef fish assemblages. Given that significant disturbances have been mostly associated with outbreaks of *A. planci*, rather than climate change. The survey indicated that there was evidence of *A. planci* grazing on the *Pocillopora* species found at both the sites.

The concentration of nutrients was significantly higher in Vaiare than Linareva, due to more sedimentation and land runoff the chemical concentration of nutrients of NO_3 was almost 3 times more, while the concentration of PO_4 was almost 10 times more at Vaiare when compared to Linareva (Rouzé, et al., 2015).

This study examines patterns of susceptibility and short-term recovery of corals from bleaching. A mass coral bleaching event began in March, 1991 on reefs in Moorea, French Polynesia and affected corals on the shallow barrier reef and to >20 m depth on the outer fore reef slope. On a subsequent survey in August, 1991 to determine rates of recovery and mortality it showed 76% of *Pocillopora* spp. Bleached, out of which only 38% recovered completely, and many suffered some partial mortality of the tissue (Forsman, et al., 2013). The vaiare site indicted more bleached specimens.

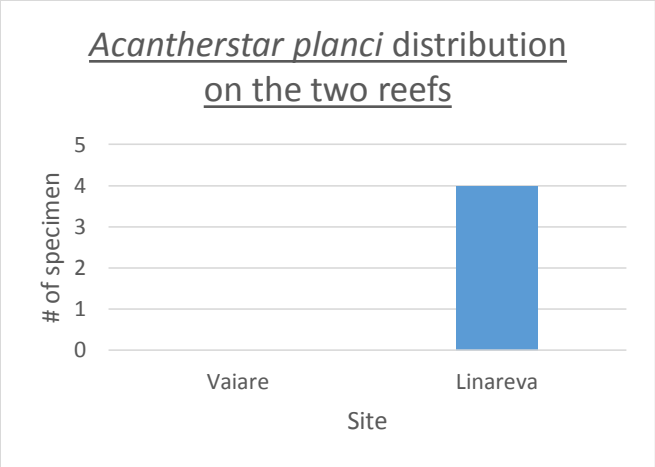

Figure 6: the abundance of Acantherstar planci on the reefs surveyed

It was also noted that there were no *A. planci* sighted there, while there were 4 adults seen on the Linareva reef.

Conclusion

Degradation and loss of critical coastal habitats has significant ramifications for marine fisheries, such that knowledge of changes in habitat quality and quantity are fundamental to effective ecosystem management as it contributes a lot to the national income. Therefore it is important to monitor the health and effects of disturbances on the reefs via study of the genus Pocillopora.

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Other Projects in which I could help the CRIOBE staff

Figure 7: extracting a blood sample from a blacktip shark

Shark Tagging

Gaining first-hand experience in the capture and tagging of lemon and blacktip sharks that have nurseries around Moorea. This involved assisting an intern in setting out beach seines with bait and waiting for the sharks <1m long, these were then captured and a blood sample and DNA was obtained. The fork length was also noted down before the shark was tagged and released. The methods used were very simple yet highly effective. This would also prove to be a very good survey to conduct in Fiji due to its dwindling shark populations and the fact that the survey methods are quite simple.

Figure 8: Pocillopora larval experiments

Pocillopora Larval Experiment

This involved assisting a phD student in his work that consisted of obtaining the larvae of 10 *P. darmacornis* colonies and exposing the green and red larvae to thermal stress and graphing the survival rate. It was interesting to study the behavior of larvae in response to the stress as this particular species is very susceptible to bleaching in both Moorea and Fiji.

Figure 9: Turtle Clinic

Turtle Clinic

The intercontinential hotel has a sanctuary for sick and injured turtles found all over Moorea. It is a very good conservation initiative that seems to have been implemented in the most viable way possible as it was sanctioned by the ministry and is regulated by a non-profit organization and is a popular tourist attraction due to its location. It would seem like a good idea to form a clinic like this in Fiji with the help of the University of the South Pacific and WWF as turtle killing is banned in Fiji but this would be a good initiative to promote more conservation.

It was thrilling to experience and talk about the different projects ongoing at the CRIOBE such as the mapping of mangroves and its zonation and the behavior of the great dolphins by listening to the echo sounds obtained by ships.

Expected Outcome

The field survey methods and the knowledge gained about the ecology and distribution of *Pocillopora* species on the reefs of Moorea, will be used in my master's thesis January 2015 to June 2016. The other information on survey methods and techniques such as those used in shark tagging and turtle clinics will be disseminated in seminars and guest lectures in University of the South Pacific.