

# DR. VIVIAN CUMBO

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PhD 2006 to 2012

Marine and Tropical Biology

Supervised by:

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## The establishment and development of symbiosis in coral larvae

Vivian grew up in Sydney and completed her BSc (Hons) in Microbiology and Marine Biology at the University of NSW. Her honours thesis investigated the antimicrobial compounds in the scleractinian corals *Montipora digitata* and *Montipora tortuosa*. Having always been interested in corals and coral reef ecosystems, Vivian commenced her PhD research on corals and climate change in 2006.

Vivian's broad interests include coral reproductive biology, coral larval physiology and ecology, symbiosis, and coral systematics. Vivian's research to date has focused on the early life stages of coral and their response to climate change and ocean acidification.

Vivian's PhD research showed that climate warming will likely evoke an important acclimatory response in the early life stages of coral species with horizontal Symbiodinium transmission. At elevated temperatures, establishment and persistence of symbiosis was successful with thermal-tolerant Symbiodinium and not with thermal-sensitive Symbiodinium. However, when multiple Symbiodinium types were present, elevated temperatures resulted in a breakdown of symbiosis. Therefore, corals will likely respond to increased seawater temperatures by forming symbioses with more thermal-tolerant Symbiodinium types or locally adapted populations from one generation to the next. However the establishment of a stable symbiosis may be more difficult as symbionts compete for space and resources within the host.

In 2010, Vivian secured a postdoctoral research role at California State University, Northridge. Her work there elucidated the effects of rising temperature and ocean acidification on the physiology of larvae, spat and juvenile brooding corals. Broadly, it found the brooding larvae differ in their response to future predicted environmental conditions depending on their day of release from the adult colony. Further, larvae with longer pelagic larval durations are more affected by elevated temperature and pCO<sub>2</sub>. Once settled, new recruits calcified more readily under oscillating pCO<sub>2</sub> condition that typically occurs on reefs, when compared to stable ambient and high pCO<sub>2</sub>. Importantly, the effect of pCO<sub>2</sub> on new recruits is light-dependent. High pCO<sub>2</sub> inhibited calcification at intermediate light intensities, however this inhibitory effect disappears at both higher and lower light intensities.

Vivian is current a Research Associate at the ARC centre of excellence where she is investigating whether initial uptake of Symbiodinium by larvae of broadcast spawning species changes the larval competency dynamics, dispersal ability and post-settlement success.



## Publications

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- Bay, L.K. et al., 2011. Infection Dynamics Vary between Symbiodinium Types and Cell Surface Treatments during Establishment of Endosymbiosis with Coral Larvae. *Diversity*, 3(4), pp.356–374. Available at: <http://www.mdpi.com/1424-2818/3/3/356/>
- Cumbo, V.R. et al., 2013. Brooded coral larvae differ in their response to high temperature and elevated pCO<sub>2</sub> depending on the day of release. *Marine Biology*, 160(11), pp.2903–2917. Available at: <http://link.springer.com/10.1007/s00227-013-2280-y>
- Cumbo, V.R. et al., 2013. Chromera velia is endosymbiotic in larvae of the reef corals *Acropora digitifera* and *A. tenuis*. *Protist*, 164(2), pp.237–44. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23063731>
- Cumbo, V.R., Baird, a. H. & Oppen, M.J.H., 2012. The promiscuous larvae: flexibility in the establishment of symbiosis in corals. *Coral Reefs*, 32(1), pp.111–120. Available at: <http://link.springer.com/10.1007/s00338-012-0951-7>
- Cumbo, V.R., Fan, T.Y. & Edmunds, P.J., 2013. Effects of exposure duration on the response of Pocillopora damicornis larvae to elevated temperature and high pCO<sub>2</sub>. *Journal of Experimental Marine Biology and Ecology*, 439, pp.100–107. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0022098112003802>
- Cumbo, V.R., Fan, T.-Y. & Edmunds, P.J., 2012a. Physiological development of brooded larvae from two pocilloporid corals in Taiwan. *Marine Biology*, 159(12), pp.2853–2866. Available at: <http://link.springer.com/10.1007/s00227-012-2046-y>
- Cumbo, V.R., Fan, T.-Y. & Edmunds, P.J., 2012b. Scleractinian corals capture zooplankton within days of settlement and metamorphosis. *Coral Reefs*, 31(4), pp.1155–1155. Available at: <http://link.springer.com/10.1007/s00338-012-0940-x>
- Dufault, A.M. et al., 2012. Effects of diurnally oscillating pCO<sub>2</sub> on the calcification and survival of coral recruits. *Proceedings. The Royal Society Biological sciences*, 279(1740), pp.2951–8. Available at: <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3385465&tool=pmcentrez&endertype=abstract>

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Dufault, A.M. et al., 2013. The role of light in mediating the effects of ocean acidification on coral calcification. *The Journal of experimental biology*, 216(Pt 9), pp.1570–7. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23393271>

Edmunds, P.J., Cumbo, V. & Fan, T.-Y., 2011. Effects of temperature on the respiration of brooded larvae from tropical reef corals. *The Journal of experimental biology*, 214(Pt 16), pp.2783–90. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/21795577>

## **Publications cont.**

Edmunds, P.J., Cumbo, V.R. & Fan, T.-Y., 2013. Metabolic costs of larval settlement and metamorphosis in the coral *Seriatopora caliendrum* under ambient and elevated pCO<sub>2</sub>. *Journal of Experimental Marine Biology and Ecology*, 443, pp.33–38. Available at: <http://linkinghub.elsevier.com/retrieve/pii/S0022098113000841>