

Title: The length of the larval phase in corals: new insights into patterns of reef connectivity.

Introduction: Amongst reef ecologists there remains some controversy as to whether coral larvae are primarily retained on the reef of origin or are dispersed between reefs (reviewed in Harrison & Wallace 1990). Opinion is also divided on the potential of corals for long distance dispersal, particularly with respect to the origin and maintenance of coral assemblages in remote and isolated regions (Rosen 1988). This study aims to help resolve these issues by 1. determining the likelihood of localised recruitment by quantifying the number of larvae from single cohorts settling over time & 2. testing whether species geographical distributions are influenced by the capacity of coral larvae to delay metamorphosis

Methods: To test whether the geographical distributions of corals are influenced by dispersal ability I compared the competence periods of the larvae of species with widespread and restricted distributions. Species were chosen following a search of the literature on species distributions in the Indo-Pacific (see below). Larvae of *A. valida*, *A. millepora* & *A. aculeus* were cultured & maintained in 0.2 µm filtered sea water. On days 4, 7, 10, 14, 21, 28, 60 & 90 after spawning larvae were pipetted from the cultures and introduced into replicate aquaria containing conditioned clay tiles. After another 72 hours the tiles were removed and the number of larvae successfully completing metamorphosis counted. To establish the potential for localised recruitment I quantified the proportions of larvae settling over time from single cohorts of these species. Larvae were introduced into replicate aquaria containing conditioned clay tiles as a settlement substratum. The tiles were removed and replacements introduced on days 4, 7, 10 & 14. The tiles were censused microscopically to count the number of larvae settling within each time interval.

Preliminary Results: A number of interesting patterns emerged from the literature on species distributions. Isolated locations, such as the Hawaiian Archipelago, have a higher proportion of species from families such as the Poritidae, Fungiidae, Agariciidae, Siderastreae & Pocilloporidae when compared to areas closer to the Indo-Pacific centre of diversity, such as the Philippines (Fig. 1). Furthermore, while species from the Acroporidae constitute a similar proportion of the total diversity in both regions, *Acropora* from isolated locations are a distinct subset of the genera with *A. valida*, *A. cytherea* & *A. humilis* regular members of these coral assemblages. In the Acroporidae this pattern appears to be driven by pronounced differences among species in the capacity to delay metamorphosis. After 60 days 35% of *A. valida* remain competent compared to only 5% of *A. millepora*, after 90 days 10% of *A. valida* larvae are still competent while no *A. millepora* larvae settled (Fig. 2). Furthermore, the larvae of species characteristic of isolated regions settle more rapidly with peak settlement in *A. valida* occurring on (or before) day 4 compared to day 7 for *A. millepora* (Fig. 3).

Preliminary Conclusions: Patterns in the geographic distribution of the Scleractinia suggest that the species found in remote locations are not a random subset of the species pool, as has been suggested for other marine taxa with long-distance dispersal (e.g. Palumbi *et al.* 1997). Interestingly, among the families that dominate isolated locations, the poritids and pocilloporids have maternal zooxanthellae, and the larvae of at least one fungiid species can acquire zooxanthellae in the plankton (Krupp 1983). Consequently, the larvae of these families may be autotrophic, a phenomenon already described in *Pocillopora damicornis* (Richmond 1987), which may increase the dispersal capacity of these larvae. The reproductive biology of the Agariciidae and Siderastreae is poorly known, at least in the Indo-Pacific. In the Acroporidae this pattern can be explained by species differences in the capacity to delay metamorphosis. Furthermore, species differences in settlement rates suggest that successful colonisation of remote locations also depends on rapid settlement to enable populations to become established. While the colonisation potential of *A. millepora* may restrict it from the more remote locations in the Indo-Pacific, the ability to delay metamorphosis for 60 days is still extraordinary and far exceeds Richmond's (1982) prediction of 20 days for *A. tenuis*, a coral with a similarly restricted geographical distribution. Regular long-distance dispersal between populations within the Indo-Pacific will result in levels of gene flow sufficient to prevent divergence and may explain why the Order Scleractinia contains so few species when compared to other marine invertebrate taxa.

Future work: Having established differences between these species, I need to repeat the experiments with other widespread and restricted species. Using material already collected I aim to quantify ontogenetic changes in biochemical composition and morphology of these larvae to test i. whether greater initial energy reserves, or a slower rate of utilisation, account for the observed differences in the planktonic duration and ii. whether morphological changes influence pre-competent and competence periods.

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References

- Harrison, P.L., Wallace, C.C. 1990. pp. 133-207. in Z. Dubinski (Ed.) *Ecosystems of the world*. Vol. 25. Elsevier Press, New York.
- Hoeksema, B.W., 1989. *Zool. Verh. Leiden* 254: 1-295.
- Krupp, D. A., 1983. *Coral Reefs* 2: 159-164
- Maragos J. E. 1995 pp 45-6 in Evenhuis E. & Miller S. Ed. Bishop Museum Occasional Papers 42
- Palumbi SR et al. 1997. *Evolution* 51(5) pp 1506--1517
- Richmond, R.H., 1982. *Proc. 4th. Int. Coral Reef Sym., Manila* 2:153-156.
- Richmond, R.H., 1987. *Marine Biology* 93:527-533.
- Rosen, B. R. 1988. *Helgolander Meeresunters.* 42: 269-301
- Veron, J.E.N. 1993. *A biogeographic database of hermatypic corals*. AIMS, Townsville p. 433

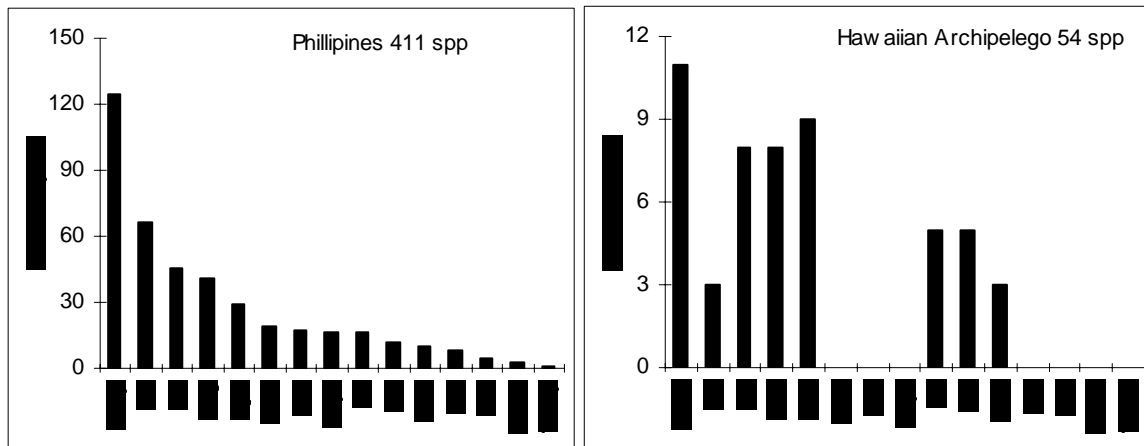


Fig. 1. Geographical variation in coral assemblages. Data for the Philippines from Veron 1993, for Hawaii from Maragos (1995) and Hoeksma (1989).

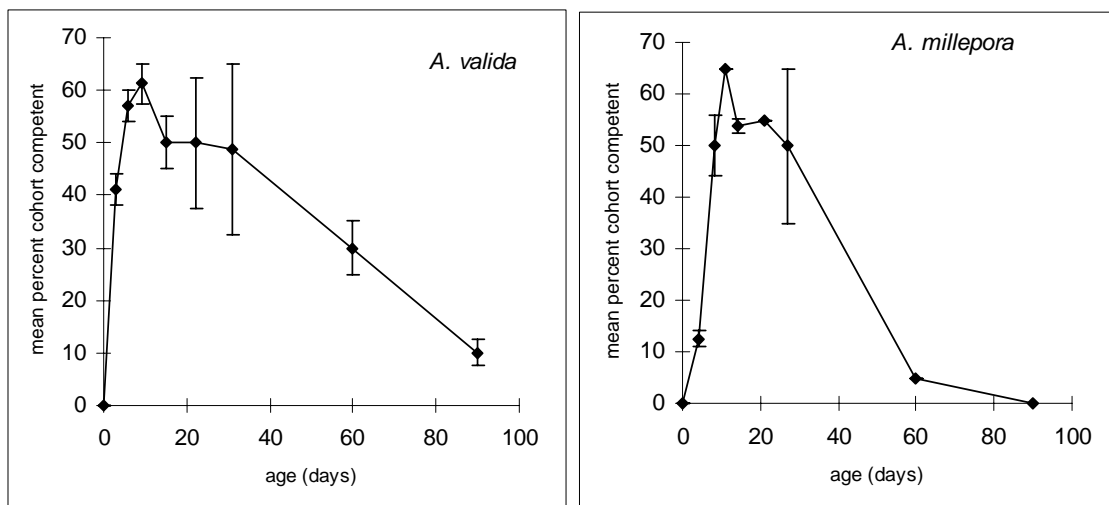


Fig. 2 Species difference in larval competence

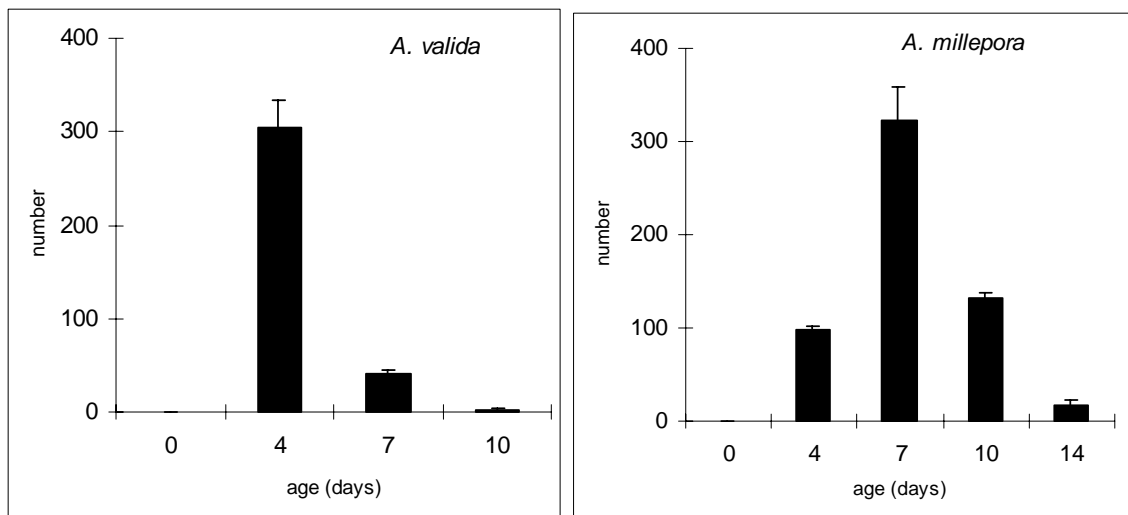


Fig. 2 Species difference in proportion of cohort settling through time