

Post-settlement events influence on coral population structure:  
A multi-scale analysis along a latitudinal gradient  
(PSICoPopS)

Albeit recruitment processes are known to influence spatial patterns of adult coral assemblages, the relative influence of recruitment processes vs. post-settlement events in population maintenance remains poorly known. Yet, understanding how populations are maintained is prerequisite for efficient management. This program proposes to study the influence of post-settlement events on adult population structure in several habitats and islands of three regions following a latitudinal gradient: Australian Great Barrier Reef, New Caledonia, and French Polynesia. This will allow to better understanding influence of early post-settlement events on population maintenance at local, insular and regional scale. In this goal, recruit and juvenile mortality and growth of several coral taxa with different life-history traits were assessed as well as adult population structure, following a hierarchical sampling design. This program was a collaborative project between UMR CNRS EPHE UPVD 5244 “Tropical and Mediterranean Biology and Ecology” in Perpignan (France) and ARC Centre of Excellence for Coral Reef Studies in Townsville (Australia). Both of these teams are at the cutting edge of coral reef ecology, respectively ranked 1st in Europe and 1st in the world.

The distribution and abundance of most marine organisms show strong spatial heterogeneity at multiple scales, which is governed by a variety of physical and biological processes that vary in frequency, intensity and scale (Done 1983; Adjeroud 1997; Connolly et al. 2005). Larval supply is widely recognized as one of the major factors structuring adult assemblages (Caley et al. 1996; Armsworth 2002). However, there are often strong dissimilarities between settlement patterns and the distribution and abundance of adult corals (Bak and Engel 1979; Hughes et al. 1999; Miller et al. 2000). This suggests that distribution patterns established at settlement may be highly modified by spatial and temporal variation in post-settlement growth and mortality (Smith 1997; Edmunds 2000; Hughes and Tanner 2000; McClanahan et al. 2005). One of the key questions for ecologists is then to determine the degree to which spatial heterogeneity in the abundance of adult corals are influenced by pre- versus post-settlement processes (Caley et al. 1996; Fraschetti et al. 2002).

Coral recruitment fluctuations and their effect on adult coral assemblages has been extensively studied over the last few years (Glassom et al. 2004; Vermeij 2005; Nozawa et al. 2006; Adjeroud et al. 2007a; Penin et al. 2007). Nevertheless, the relative contribution of pre-settlement processes (e.g. habitat selection by larvae, larval mortality and hydrodynamic process) and post-settlement events (e.g. competition, predation, facilitation and disturbance) on distribution and size of adult populations is still unclear (Fig.1). The importance of larval choice or supply in the structure of adult communities is evident in some situations (Baird and Hughes 1997; Mundy and Babcock 2000; Baird et al. 2003; Baird and Morse 2004; Glassom and Chadwick 2006; Norström et al. 2007), while post-settlement events, in particularly differential rates of early post-settlement growth and survivorship, are important in others (Connell 1973; Smith 1997; Baird and Hughes 2000; Miller et al. 2000; Vermeij 2006), however, the relative importance of pre-and post-settlement events has never been tested.

Regions where adult abundance and percent cover are comparable can present profound differences in terms of functioning and particularly different recruitment and mortality rates (Hughes et al. 1999). As a consequence, there is a need to investigate implication of early post-

settlement mortality in population size (i.e. the number of adults) and structure (i.e. their distribution in size classes) for different habitats and ecosystems.

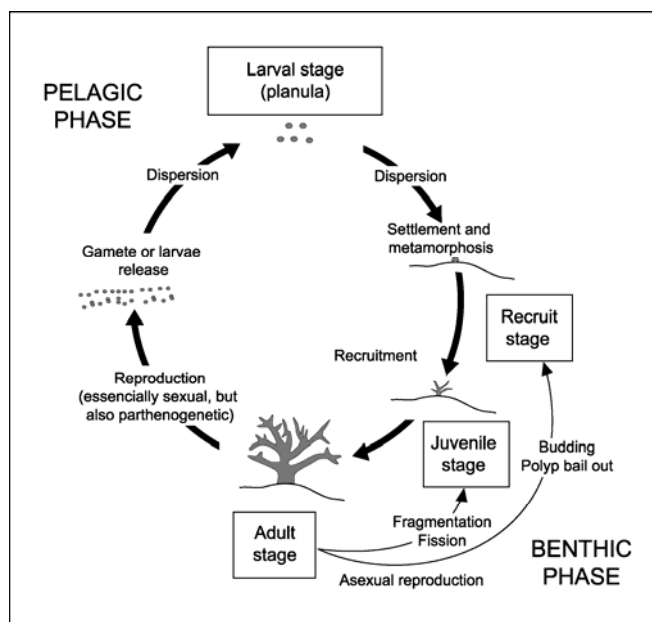


Figure 1: life cycle of corals. Sexual reproduction leads to the emission of gametes or larvae. These planulae have a pelagic larval stage after which they settle and metamorphose. At this moment, they are called recruits. After about one year, recruits become visible to the naked eye and become juveniles. After 3 or 4 years, they become sexually mature and are considered as adults.

Moreover, different biological and physical processes act at variable scales (Edmunds and Bruno 1996; Hughes et al. 1999; Hughes et al. 2000; Hughes et al. 2002). Consequently, studies conducted at small spatial scale provide a limited understanding of processes occurring at regional or geographical scale. Similarly, studies at regional scale may not allow the detection of local processes. It is thus fundamental to address questions relative to population dynamics at several spatial scales, and in different habitats. To explore proportion of the total variation among samples that is attributable to several spatial scales, a hierarchical sampling seems to be the more suitable.

Comprehension of population maintenance mechanism is essential for an effective management of coral reefs. Natural resources management has been shown to be more efficient when based on mechanisms governing population and assemblage dynamics rather than on mere ecosystem monitoring (Hughes et al. 1999). Spatial variability of early mortality may strongly influence recolonisation after disturbances, maintenance processes, and though, resilience of coral reef ecosystems (Quinn and Kojis 2003). Studying these mechanisms is even more crucial in the present context of global increase of disturbances faced by coral reefs (Wilkinson 2004).

In this context, the purpose of this study was to investigate early post-settlement growth and survivorship of scleractinian (reef-building) corals and assess the importance of post-settlement processes in determining the distribution and abundance of adult corals in different regions and habitats.

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