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Assessing the Impact of Marine Protected Areas in Moorea (French Polynesia)

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In the local (Moorea) and global (coral reef ecosystems) contexts of biodiversity decline, Marine Protected Areas (MPAs) have been promoted as effective management tools. Despite intensive study, there remains considerable scientific uncertainty about the effects of MPAs on species abundances and biodiversity. Recent papers tend to demonstrate positive effects of MPAs, but limitations of assessment designs still leave the door open to skeptics and critics. To quantify the effects of MPAs, an appropriate assessment design is needed. The most common designs used to study MPAs, Control-Impact designs, confound the effect of MPAs with spatial variations resulting from other processes (e.g. pre-existing site differences). Before-After designs confront this problem, but cannot distinguish MPA effects from processes producing temporal variation. Before-After-Control-Impact designs potentially deal with both spatial and temporal variations.

MPAs have been planned in 8 sites around the island of Moorea, as part of a larger management plan (PGEM). As a multi-partner scientific team, we have designed a monitoring plan that uses a BACI-Paired Series (BACIPS) design to quantify the effect of the MPAs. The biological communities (fish, corals, other benthic invertebrates) are monitored in three different habitats (fringing, barrier reef and outer slope) at 13 sites (8 in MPAs and 5 in non-MPAs) around Moorea. In each habitat at each site, three transects of 2 x 25 m are used to quantify fish and benthic communities, and three 25 m line transects are to characterize coral communities. We are monitoring the communities twice a year. Thus far, we have three complete years of samples (i.e., six sampling dates).

Preliminary results on fish data indicate pre-existing strong spatial differences, mainly between reef habitats, but also between fish communities of the north, the east and the west coast. However, Control and Impact sites do not differ significantly in their fish communities, suggesting the absence of pre-existing differences between protected and unprotected sites. This routine sampling is still underway, and will go on for 3 more years before an evaluation of the monitoring plan, on the base of preliminary results. We discuss our preliminary results to highlight our approach and the utility of BACIPS to assess local effects of MPAs. We also discuss limitations of our approach, in particular our inability to quantify regional effects (e.g., due to spillover effects). This is a common limitation of MPA studies, and we discuss the need for control islands, especially to quantify regional effects of MPA networks.