Population trends and density: a spatial modeling approach applied to the exploited giant clam *Tridacna maxima* in French Polynesia

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Abstract: The giant clam *Tridacna maxima* has been largely overexploited in many tropical regions over the past decades and is listed in appendix II of the Convention of International Trade in Endangered Species (CITES) since 1985. In French Polynesia, several atolls and islands harbor the world's highest densities of giant clams in very shallow and accessible areas. These stocks are vulnerable to fishing pressure and massive (but natural) mortality events, and management actions are required to sustain resource uses on the long term.
Here, we report on the use of a spatially-explicit population dynamics model applied to 1/ the clam population of Tubuai Island (Austral archipelago) affected by high fishing pressure (deterministic approach) and 2/ the population of Tatakoto (Tuamotu archipelago) affected by both fishing pressure and observed natural mortality events (stochastic approach). Giant clam abundances were estimated *in situ* in 2004/2010 and in 2004/2012/2013 in Tubuai and Tatakoto respectively. Growth, mortality, and recruitment were also estimated *in situ* in 2007 and alimented the model. When compared to field data, the model successfully predicted stock evolution from 2004 to 2010 and from 2004 to 2013 for Tubuai and Tatakoto respectively. The size-based population model also predicted future *T. maxima* abundances when populations were submitted to different management strategies (quotas, closure, rotational closure, size limits). For Tubuai, where abundances were primarily dependent on recruitment processes, spatial modelling suggested that reducing fishing effort (through fixed quotas) and banning fishing below the 12 cm size limit (as currently implemented) were the most effective management actions. By contrast, in Tatakoto where abundances were a trade-off between recruitment and random high mortalities, spatial modelling suggested that fishing effort had low impact on giant clam abundance. Management effects could be of secondary order for this atoll to maintain population when compared to natural stochastic processes.

References:

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