

Pattern of Recovery in a Multi-species Grouper Spawning Aggregation: Lessons Learned and Implications for Monitoring and Management

Restablecimiento de una Agregación Reproductiva de Tres Especies de Mero: Lecciones y Implicaciones para Manejo y Monitoreo

Retablissement D'un Rassemblement de Fraie de Trois Especies de Merou: Lecons Apprises et les Implications pour la Gestion et Surveillance

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EXTENDED ABSTRACT

Effective management of the spawning aggregations of exploited reef fish species calls for appropriate interventions, enforcement and monitoring to be successful and to evaluate outcomes. Many reef fishes are most effectively monitored using underwater visual census (UVC) methods, i.e. fishery independent methods, rather than relying on catches in the fishery (i.e. fishery-dependent methods). However, UVC conducted on spawning aggregations can be challenging and must be properly designed to provide meaningful measures of fish numbers over time (Colin et al. 2003). We provide an example of a consistently monitored multi-species grouper spawning aggregation in Palau, western Pacific, over a 5-year period that showed an interesting and unexpected pattern of apparent initiation of recovery.

A multi-species grouper spawning aggregation of squaretailed coral grouper (*Plectropomus areolatus*), camouflage (*Epinephelus polyphekadion*) and brown-marbled (*E. fuscoguttatus*) groupers is located in a no-take marine protected area (MPA) known as Ebiil, an outer reef channel in western Palau. Fisher interviews (Sadovy 2007) had indicated declines in many of the grouper aggregations in the country. The Ebiil MPA had been variously under protection for many years with occasional enforcement, and had been monitored sporadically since the 1990s. Inconsistent and inappropriate monitoring protocols, however, made it impossible to meaningfully follow changes in numbers of groupers aggregating over time, and the outcomes of protection, while limited enforcement meant that poaching continued. Seasonal fisheries management (i.e. months during which the groupers could not be caught) covered all of the aggregating months from the camouflage and brown-marbled groupers, and all but one, being August in Palau, for the squaretailed coral grouper.

A robust underwater visual sampling protocol was introduced in 2009 through collaboration between the organization 'Science and Conservation of Fish Aggregations' (www.scrfa.org) and the Palau Conservation Society (PCS and SCRFA 2010) with support from the Coral Reef Research Foundation. This protocol ensured that the aggregations of all three species that share the Ebiil site were monitored in their entirety. In 2014, five years after the initial and baseline survey of 2009, a second survey was conducted during the major spawning months, June and July. Enforcement at the MPA during the grouper reproductive months improved considerably during the 5 year interim period and protection from fishing was also introduced for the month of August for the squaretail coral grouper. During the second UVC, it was determined that numbers of the two *Epinephelus* species had not changed since 2009, while those of the squaretail coral grouper had increased by about 60%.

The different responses of the three species was unexpected but is of interest while being fully consistent with differences in their biology. The squaretailed coral grouper lives less than 15 years and matures in 2 - 4 years (Rhodes et al. 2013), the camouflage grouper lives more than 20 years and takes > 4 years to mature (Rhodes et al. 2011), while the brown-marbled grouper lives more than 40 years and takes > 9 years to fully mature (Pears et al. 2006). Given these time frames, it is expected that the squaretail coral grouper should be the first of the three species to show signs of recovery. The study shows the importance of understanding aspects of reproductive life history for interpreting results and also highlights the need for a long-term commitment to protection to achieve results. A follow-up, third, survey is planned for about 2020.

LITERATURE CITED

- Colin, P.J., Y. Sadovy, and M.L. Domeier. 2003. *Manual for the Study and Conservation of Reef Fish Spawning Aggregations*. http://www.scrfa.org/images/stories/pdf/methodsmanual/MM_documenting_aggregations.pdf. 98 pp.
- Pears, R.J., J.H. Choat, B.D. Mapstone, and G.A. Begg. 2006. Demography of a large grouper, *Epinephelus fuscoguttatus*, from Australia's Great Barrier Reef: implications for fishery management. *Marine Ecology Progress Series* **307**:259-272.
- Rhodes, K.L., B.M. Taylor, and J.L. McIlwain. 2011. Detailed demographic analysis of an *Epinephelus polyphekadion* spawning aggregation and fishery. *Marine Ecology Progress Series* **421**:183-198.
- Rhodes, K.L., B.M. Taylor, C.B. Wichilmel, E. Joseph, R.J. Hamilton, and G.R. Almany. 2013. Reproductive biology of squaretail coral grouper *Plectropomus areolatus* using age-based techniques *Journal of Fish Biology* **82**:1333-1350.
- PCS & SCRFA. 2010. Enhanced Monitoring of Grouper Spawning Aggregation at Ebiil Channel: Final Technical Report. http://www.scrfa.org/images/stories/pdf/scrfa/ebiil_final_report_2010_without_section_2_educational_materials.pdf. 31 pp.
- Sadovy, Y. 2007. Report on current status and exploitation history of reef fish spawning aggregations in Palau. http://www.scrfa.org/images/stories/pdf/scrfa/palau_interview_report.pdf. 40 pp.