Applied Biodiversity Sciences Perspectives Series
Advancing Conservation with innovative ideas from the future generation

A community-based approach to the management of an aggregating reef fishery in the Mesoamerican Reef

Pablo Granados-Dieseldorff
Department of Geography
Texas A&M University

Carmen G. Montaña
Department of Wildlife and Fisheries Sciences
Texas A&M University

Office:	**Mailing address:**
Email: absigert@tamu.edu	Applied Biodiversity Science NSF-IGERT
Phone: (979) 845-7494	Texas A&M University
Fax: (979) 845-4096	216 Old Heep Bldg.
Room: 110G Old Heep	2258 TAMU College Station, TX, 77843

Applied Biodiversity Sciences Perspectives Series No. 2(1)
May, 2012

By Pablo Granados-Dieseldorff and Carmen G. Montaña

Summary

Small-scale fisheries supply most of the seafood the entire world eats (Food and Agricultural Organization of the United Nations [FAO], 2010). They employ more than 98% of the fishers of the world, most of them from developing countries in extreme poverty (Berkes et al., 2001; FAO, 2010). Faced with degrading marine ecosystems (Botsford et al., 1997; Jackson et al., 2001; Pauly et al., 2003; Worm et al., 2006) and in the midst of the controversy around the legitimate decline rates of fishery stocks (cf., Branch et al., 2011; Worm et al., 2006, 2009), conservation scientists continue to advocate for the establishment of Marine Protected Areas (MPAs) as a global precautionary approach to the sustainability of world fisheries (Foley et al., 2010; Lubchenco et al., 2003; Pikitch et al., 2004; Roberts et al., 2001). However, the effectiveness of MPAs in benefitting both the protected resource and its users remains largely untested (cf., McCay & Jones, 2011; Mascia et al., 2010). This dilemma has frequently led to discussions about whether fisheries conservation and management have actually yielded the expected benefits to fish, fishers, and society, and has often ignited social and political conflicts at community, national, and regional levels (Berkes, 2006; Mascia & Claus, 2008). The frequent piecemeal governance of commons management (Armitage et al., 2009; Berkes, 2006; Hardin, 1968), geographically misplaced fishery legislation (St. Martin, 2001), and underrepresentation of key stakeholders in management strategies continue to jeopardize the fate of fisher-fish relationships within socio-ecological systems (Johannes, 1998; Johannes et al., 2000).

In addition to its key role in the food and economic securities of many rural-poor coastal communities, mutton snapper, *Lutjanus analis* (Cuvier, 1828), has been a highly attractive, regionally shared coral-reef fishery across the Caribbean since the European colonial period (Allen, 1985; Burton, 2002; Claro & Lindeman, 2008; Craig, 1966; Fiedler et al., 1943; Thompson, 1944). Their spawning aggregations, very predictable in space and time, have made them vulnerable to commercial overfishing in some locales of their home range, such as the Atlantic coast of USA and Brazil (Claro & Lindeman, 2008; Burton, 2002).

In the extreme western Caribbean, Belize shares with Guatemala and Honduras the southern Mesoamerican Reef (SMR), a biogeographic region of global conservation importance (Roberts et al., 2002; Spalding et al., 2007). Mutton snapper occur in waters accessed by fishers from the three SMR countries (Craig, 1966; Graham et al., 2008; Heyman & Graham, 2000; Thompson, 1944) and constitute the most prominent group within the transient multi-species reef fish spawning aggregations of Gladden Spit (Heyman & Kjerfve, 2008). Gladden Spit, an iconic MPA in the SMR, was legally declared in 2000 (Cho, 2005) and since 2003, it has been co-managed by the Belize Fisheries Department and the Southern Environmental Association (SEA) (Heyman, 2011).

Holistic approaches to marine fisheries management, which integrate fisheries ecology and human dynamics, have long and frequently been proposed as alternatives to conventional methods for fisheries management in the Caribbean (Bohnsac & Ault 1996; Fanning et al., 2007; Lorenzen et al. 2010); yet they still remain far from being adopted. In stretch collaboration with SEA, a program of research is being conducted in response to 1) the ecological and food-security importance of the mutton snapper fishery in the SMR, 2) the underrepresentation of

fishers in its management strategies, and 3) the need for holistic approaches to fisheries management in the region (Granados-Dieseldorff, 2012). Following this approach, we reviewed for this class project the ecological dynamics of mutton snapper in Gladden Spit and the potential benefits of a transition from a commercially-motivated, artisanal fishery, to an ecotourism-driven, community-based recreational fishery (Granados-Dieseldorff et al., 2008).

Compared to the ecology of other transient reef fish spawning aggregation species, mutton snapper have relatively long life spans, low growth rates, and low natural mortality rates (Claro & Lindeman 2008). As previously suggested for the species (Claro & Lindeman 2008; Mason & Manooch, 1985; Watanabe et al., 1998) and validated through ecological simulations in this project (Granados-Dieseldorff et al., 2008), their life history traits might render mutton snapper populations resistance to small-scale, recreational harvest. Commercial fishing pressure, on the other hand, can have detrimental effects on the sustainable yield of mutton snapper (Burton, 2002; Burton et al., Claro & Lindeman, 2008; Graham et al., 2008). Artisanal fishers that recreationally harvest mutton snapper in the Gladden Spit have a great opportunity to maintain the population while benefiting from resource extraction, so long as active monitoring of the size of their catches continues to be conducted over time.

Because it promotes life quality of local communities while conserving the natural landscape, community-based ecotourism has often reconciled conservation with natural resources use (Mowfort & Munt, 1998). Ecotourism, when genuinely developed and managed by local communities, alleviates anthropogenic stresses on fragile environments (e.g., coral reef systems) that traditional tourism, currently common in the SMR, fails to achieve (Sheyvens, 1999). In particular, recreational fishing can be enhanced by appreciation and knowledge of

the natural history of target species (Arlinghaus, 2006), and through ecotourism activities, local fishers and tourists can develop stronger ties to the history and culture of the SMR.

Our research efforts suggest that artisanal fishing communities should be appointed as the central management agency of a prospective recreational mutton-snapper fishery in Gladden Spit. Local fishers possess unique knowledge and understanding of their ecosystems that could be harnessed to provide authentic and enjoyable ecotourism experiences (Heyman & Granados-Dieseldorff, 2012). These groups also maintain the presence necessary to immediately enforce any fishing regulation in the area. Our proposed community-based approach to the recreational management of the mutton snapper fishery of Gladden Spit binds fisher knowledge and local-user participation to fisheries ecology and management. This holistic approach to fisheries management also advocates for the empowerment of the local fishers of Gladden Spit and seeks to mitigate the current piecemeal governance that continues to threaten the fate of this socio-ecological system.

Acknowledgments

We appreciate preliminary comments from L. Fitzgerald, W.D. Heyman, A. Stronza, and the 2008 class of the graduate course “Applied Biodiversity Science 1” at Texas A&M University. The editorial review from C. van Riper also improved this synopsis.

References

Allen, G. R. (1985). *Snappers of the world: an annotated and illustrated catalogue of Lutjanid species known to date*. Rome: Food and Agriculture Organization of the United Nations.

Arlinghaus, R. (2006). Overcoming human obstacles to conservation of recreational fishery resources, with emphasis on Europe. *Environmental Conservation, 33,* 46-59.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., Diduck, A. P., Doubleday, N. C., Johnson, D. S., Marschke, M., McConney, P., Pinkerton, E. W. & Wollenberg, E. K. (2009). Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment, 7,* 95-102.

Berkes, F., Mahon, R., McConney, P., Pollnac, R., & Pomeroy, R. (2001). *Managing small-scale fisheries: alternative directions and methods*. Ottawa: International Development Research Centre.

Branch, T. A., Jensen, O. P., Ricard, D., Ye, Y. M., & Hilborn, R. (2011). Contrasting global trends in marine fishery status obtained from catches and from stock assessments. *Conservation Biology, 25,* 777-786.

Berkes, F. (2006). From community-based resource management to complex systems: The scale issue and marine commons. *Ecology and Society, 11,* 45-.

Bohnsack, J. A., & Ault, J. S. (1996). Management strategies to conserve marine biodiversity. *Oceanography, 9,* 73-82.

Burton, M. L. (2002). Age, growth and mortality of mutton snapper, *Lutjanus analis*, from the east coast of Florida, with a brief discussion of management implications. *Fisheries Research, 59,* 31-41.

Burton, M. L., Brennan, K. J., Munoz, R. C., & Parker, R. O. (2005). Preliminary evidence of increased spawning aggregations of mutton snapper (*Lutjanus analis*) at Riley's Hump two years after establishment of the Tortugas South Ecological Reserve. *Fishery Bulletin, 103,* 404-410.

Cho, L. (2005). Marine protected areas: A tool for integrated coastal management in Belize. *Ocean & Coastal Management, 48,* 932-947.

Claro, R., & Lindeman, K. C. (2008). *Biología y manejo de los pargos (Lutjanidae) en el Atlántico Occidental*. La Habana: Instituto de Oceanología.

Craig, A. K. 1966. *Geography of fishing in British Honduras and adjacent coastal waters*. Baton Rouge: Louisiana State University Press.

Fanning, L., Mahon, R., & McConney, P. (Eds.). (2011). *Towards marine ecosystem-based management in the wider Caribbean*. Amsterdam: Amsterdam University Press.

Fiedler, R.H., Lobell, M.J., & Lucas, C.R. (1943). *The fisheries and fishery resources of the Caribbean area; with the recommendation for their expansion and development.* US Department of the Interior, Fish and Wildlife Service.

Foley, M. M., Halpern, B. S., Micheli, F., Armsby, M. H., Caldwell, M. R., Crain, C. M., Prahler, E., Rohr, N., Sivas, D., Beck, M. W., Carr, M. H., Crowder, L. B., Emmett D. J., Hacker, S. D., McLeod, K. L., Palumbi, S. R., Peterson, C. H., Regan, H. M., Ruckelshaus, M. H., Sandifer, Paul A., & Steneck, R. S. (2010). Guiding ecological principles for marine spatial planning. *Marine Policy, 34,* 955-966.

Food and Agricultural Organization of the United Nations. (2010). *The state of world fisheries and aquaculture 2010.* Rome: Author.

Graham, R. T., Carcamo, R., Rhodes, K. L., Roberts, C. M., & Requena, N. (2008). Historical and contemporary evidence of a mutton snapper (*Lutjanus analis* Cuvier, 1828) spawning aggregation fishery in decline. *Coral Reefs, 27,* 311-319.

Granados-Dieseldorff, P. (2012). Conservation biogeography of mutton snapper (*Lutjanus analis*) in the western Caribbean: A dynamic geography approach. Doctoral Dissertation Research Proposal. Office of Graduate Studies. Texas A&M University.

Granados-Dieseldorff, P., Montaña, C. G., Riedle, D., Treglia, M., & Ziegler, K. (2008). Initiatives for conserving and managing spawning aggregations of mutton snapper (*Lutjanus analis*) in the southern Mesoamerican Reef. Group Report Applied Biodiversity Science 1 Graduate Course. Texas A&M University.

Hardin, G. (1968). Tragedy of Commons. *Science, 162,* 1243-1248.

Heyman, W. D. (2011). Elements for building a participatory, ecosystem-based marine reserve network. *Professional Geographer, 63,* 475-488.

Heyman, W. D., & Graham, R. T. (2000). The voice of the fishermen of Southern Belize. Punta Gorda, Belize: Trinational Alliance for the Conservation of the Gulf of Honduras - TRIGOH.

Heyman, W. D., & Granados-Dieseldorff, P. (2012). The voice of the fishermen of the Gulf of Honduras: improving regional fisheries management through fisher participation. *Fisheries Research, 125-126,* 129-148.

Heyman, W. D., & Kjerfve, B. (2008). Characterization of Transient Multi-Species Reef Fish Spawning Aggregations at Gladden Spit, Belize. *Bulletin of Marine Science, 83,* 531-551.

Jackson, J. B. C., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., … Warner, R. R. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science, 293,* 629-638.

Johannes, R. E. (1998). The case for data-less marine resource management: Examples from tropical nearshore finfisheries. *Trends in Ecology & Evolution, 13,* 243-246.

Johannes, R. E., Freeman, M. M. R., & Hamilton, R. J. (2000). Ignore fishers' knowledge and miss the boat. *Fish and Fisheries, 1,* 257-271.

Lorenzen, K., Steneck, R. S., Warner, R. R., Parma, A. M., Coleman, F. C., & Leber, K. M. (2010). The spatial dimensions of fisheries: putting it all in place. *Bulletin of Marine Science, 86,* 169-177.

Lubchenco, J., Palumbi, S. R., Gaines, S. D., & Andelman, S. (2003). Plugging a hole in the ocean: The emerging science of marine reserves. *Ecological Applications, 13,* S3-S7.

Mascia, M. B., & Claus, C. A. (2009). A property rights approach to understanding human displacement from protected areas: the case of marine protected areas. *Conservation Biology, 23,* 16-23.

Mascia, M. B., Claus, C. A., & Naidoo, R. (2010). Impacts of marine protected areas on fishing communities. *Conservation Biology, 24,* 1424-1429.

Mason, D. L., & Manooch, C. S. (1985). Age and growth of mutton snapper along the east coast of Florida. *Fisheries Research, 3,* 93-104.

McCay, B. J., & Jones, P. J. S. (2011). Marine protected areas and the governance of marine ecosystems and fisheries. *Conservation Biology, 25,* 1130-1133.

Mowforth, M., & Munt, I. (1998). *Tourism and sustainability: New tourism in the third world*. New York: Routledge.

Pauly, D., Alder, J., Bennett, E., Christensen, V., Tyedmers, P., & Watson, R. (2003). The future for fisheries. *Science, 302,* 1359-1361.

Roberts, C. M., Bohnsack, J. A., Gell, F., Hawkins, J. P., & Goodridge, R. (2001). Effects of marine reserves on adjacent fisheries. *Science, 294,* 1920-1923.

Roberts, C. M., McClean, C. J., Veron, J. E. N., Hawkins, J. P., Allen, G. R., McAllister, D. E., Mittermeier, C. G., Schueler, F. W., Spalding, M., Wells, F. Vynne, C., & Werner, T. B. (2002). Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science, 295,* 1280-1284.

Scheyvens, R. (1999). Ecotourism and the empowerment of local communities. *Tourism Management, 20,* 245-249.

Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdaña, Z. A., Finlayson, M. A. X., Halpern, B. S., Jorge, M. A., Lombana, A. L., Lourie, S. A., Martin, K. D., McManus, E. Molnar, J., Recchia, C. A., & Robertson, J. (2007). Marine ecoregions of the world: A bioregionalization of coastal and shelf areas. *Bioscience, 57,* 573-583.

St. Martin, K. (2001). Making space for community resource management in fisheries. *Annals of the Association of American Geographers, 91,* 122-142.

Thompson, E. F. (1945). *The fisheries of British Honduras*. Development and Welfare in the West Indies Bulletin 21.

Watanabe, W. O., Ellis, E. P., Ellis, S. C., Chaves, J., Manfredi, C., Hagood, R. W., Sparsis, M, & Arneson, S. (1998). Artificial propagation of mutton snapper *Lutjanus analis*, a new

candidate marine fish species for aquaculture. *Journal of the World Aquaculture Society, 29*, 176-187.

Worm, B., Barbier, E. B., Beaumont, N., Duffy, J. E., Folke, C., Halpern, B. S., Jackson, J. B. C., Lotze, H. K., Micheli, F., Palumbi, S. R., Sala, E., Selkoe, K. A., Stachowicz, J. J., & Watson, R. (2006). Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science, 314,* 787-790.

Worm, B., Hilborn, R., Baum, J. K., Branch, T. A., Collie, J. S., Costello, C., Fogarty, M. J., Fulton, E. A., Hutchings, J. A., Jennings, S., Jensen, O. P., Lotze, H. K., Mace, P. M., McClanahan, T. R., Minto, C., Palumbi, S. R., Parma, A. M., Ricard, D., Rosenberg, A. A., Watson, R., & Zeller, D. (2009). Rebuilding global fisheries. *Science, 325,* 578-585.