

Report Documentation Page

*Form Approved
OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 01 SEP 2003	2. REPORT TYPE N/A	3. DATES COVERED -	
4. TITLE AND SUBTITLE Movement patterns and site utilization of fishes as determined by acoustic telemetry: implications for the design of marine reserves		5a. CONTRACT NUMBER	
		5b. GRANT NUMBER	
		5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)		5d. PROJECT NUMBER	
		5e. TASK NUMBER	
		5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NOAAs Stellwagen Bank National Marine Sanctuary, 175 Edward Foster Rd., Scituate, MA, 02139		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited			
13. SUPPLEMENTARY NOTES See also ADM002146. Oceans 2003 MTS/IEEE Conference, held in San Diego, California on September 22-26, 2003. U.S. Government or Federal Purpose Rights License			
14. ABSTRACT			
15. SUBJECT TERMS			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	UU
			18. NUMBER OF PAGES 3
			19a. NAME OF RESPONSIBLE PERSON

Movement patterns and site utilization of fishes as determined by acoustic telemetry: implications for the design of marine reserves

James Lindholm ^{1,2}, Peter Auster ², Les Kaufman ³, Steven Miller ⁴, and Greg Stone ⁵

- 1) NOAA's Stellwagen Bank National Marine Sanctuary, 175 Edward Foster Rd., Scituate, MA, 02139. James.Lindholm@noaa.gov
- 2) National Undersea Research Center at the University of Connecticut at Avery Point, Groton, CT
- 3) Boston University Marine Program, Boston, MA
- 4) National Undersea Research Center at the University of North Carolina at Wilmington, Key Largo, FL
- 5) New England Aquarium, Boston, MA

Summary

Marine reserves (MRs), also known as no-take reserves, represent one of the primary tools for conservation and management of the marine environment currently available to managers. While the theoretical justification for MRs is extensive (see National Research Council 2001), and mounting evidence demonstrates the effectiveness of MRs as a management tool (Halpern, 2003), empirical data on the utility of MRs for mobile taxa such as fishes is still needed (Lindholm and Auster, 2002). Information on the movement of individual fish relative to landscape features, in both tropical and temperate seas, is critical for the design of successful MRs. A number of studies have demonstrated that many fish species exhibit statistically significant but facultative associations at various life history stages with specific microtopographic structures (=microhabitats) in low topography environments (e.g., Auster et al. 2003; Auster et al. In Press). Less is known, however, about the movement patterns and site utilization of individual fish relative to these features of the landscape.

Whether the goal of an MR is the protection of the diversity of fishes overall (Bohnsack and Ault, 1996; Agardy, 1999; Hastings and Botsford, 2003) or the management of particular exploited fish populations (Bohnsack, 1993; Dayton et al., 2000; Gell and Roberts, 2003), the siting and design of MRs will be improved by data on the movement of fishes of different species relative to landscape features and patterns. Results are presented for two on-going telemetry studies in the western North Atlantic: Stellwagen Bank National Marine Sanctuary (SBNMS) in the Gulf of Maine and in the northern Florida Keys.

At SBNMS, site utilization by Atlantic cod (*Gadus morhua*) in gravel habitat and piled boulder reefs was quantified throughout the summers of 2001 and 2002. At the Florida Keys National Marine Sanctuary (FKNMS), acoustic receivers were first deployed on the seafloor at five sites extending

across Pickles, Conch and Davis reefs in November 2001. Site utilization and movement between sites was quantified for Yellow tail snapper (*Ocyurus chrysurus*) and black grouper (*Mycteroperca bonaci*) tagged with coded, acoustic pingers. In August and December 2002, the receiver array was expanded to include 27 sites and an additional 90 fish were tagged from a variety of fish species.

In the Gulf of Maine Lindholm and Auster (2003) showed that more than 1/3 of the benthopelagic Atlantic cod tagged with acoustic pingers showed high site fidelity to pebble/cobble habitat. Though the movement behavior of individual fish varied considerably, 37% of the tagged cod were present within an area of 0.5 km² for more than 80% of their time at large (4 months). Observed cod site fidelity increased significantly over piled boulder reef features, where more than 50% of the cod showed strong site attachment to particular reefs over a similar period (Lindholm and Auster, in prep). In the upper Florida Keys, site fidelity of yellowtail snapper and black grouper was quantified within the Conch Reef Research Only Area (Lindholm et al., in review). Individual fish from both species showed strong site attachment to the landscape within the reserve.

These results underscore the importance of working from actual data rather than speculation: each of the fish species tagged moved much less than expected.

List of References

Agardy, T. 1999. Creating Havens for Marine Life. Issues Sci. Tech. Fall 99: 37-44.

Auster, P.J., J. Lindholm, S. Schaub, G. Funnell, L.S. Kaufman, and P.C. Valentine. 2003. Use of sand wave habitats by silver hake *Merluccius bilinearis* (Mitchill). J Fish Biol 62: 143-152.

Auster, P., J. Lindholm, and P. Valentine. In Press. Primary and secondary habitats of juvenile Acadian redfish (*Sebastes fasciatus*). Environ Bio Fishes.

Bohnsack, J.A. 1993. Marine reserves: they enhance fisheries, reduce conflicts and protect resources. Oceanus Fall: 63-71.

Bohnsack, J.A. and J.Ault. 1996. Management strategies to conserve marine biodiversity. Oceanography 9: 73-82.

Dayton, P.K, E Sala, M.J. Tegner and S. Thrush. 2000. Marine reserves: parks, baselines and fishery enhancement. Bull Mar Sci 66: 617-634.

Gell, F.R. and C.M. Roberts. 2003. The fishery effects of marine reserves and fishery closures. WWF-US, 1250 24th Street, NW, Washington, DC 20037, USA.

Halpern, B.S. 2003. The impact of marine reserves: do reserves work and does size matter? Ecol Appl. 13 (Suppl.): 117-137.

Hastings, A. and L.W. Botsford. 2003. Comparing designs of marine reserves for fisheries and for biodiversity. *Ecol. Appl.* 13 (Suppl.): 65-70.

Lindholm, J. and P.J. Auster. 2002. Marine protected area design: toward a generalized life history approach. Pages 1126-1136 in Bondrup-Nielsen, S., N.W.P. Munro, G. Nelson, J.H.M. Willison, T.B. Herman and P. Eagles, eds. *Managing Protected Areas in a Changing World*. SAMPAA, Wolfville, Nova Scotia.

Lindholm, J. and P.J. Auster. 2003. Site utilization by Atlantic cod (*Gadus morhua*) in off-shore gravel habitat as determined by acoustic telemetry: implications for the design of marine protected areas. *Mar. Technol. Soc. J.* 37: 27-34.

Lindholm, J., L. Kaufman and S. Miller. In Review. Site utilization and movement of black grouper (*Mycteroperca bonaci*) and yellowtail snapper (*Ocyurus chrysurus*) in the Florida Keys. Submitted to *Bull of Mar Sci*.

Lindholm, J. and P.J. Auster. In Prep. Movement behavior of Atlantic cod (*Gadus morhua*) on piled boulder reefs in the southern Gulf of Maine (northwest Atlantic).

National Research Council. 2001. *Marine Protected Areas: Tools for Sustaining Ocean Ecosystems*. National Academy Press, Washington, DC.