Continuous acoustic tracking of fish within marine protected areas of St. John, U.S. Virgin Islands

A collaborative project between NOAA Biogeography Branch, University of the Virgin Islands and the National Park Service

INTRODUCTION

Very little is known about the individual movement patterns for even the most abundant and commercially important fish species in the Caribbean. This project uses acoustic transmitters implanted in snappers and grunts (lane snapper - *Lutjanus synagris* and bluestripped grunt - *Haemulon sciurus*), and an acoustic hydrophone mounted on a boat to track fish movements over periods of 24 to 48 hours. Spatially explicit data on individual fish movement patterns provides direct information on: 1) habitat utilization, 2) sun-synchronous and lunar migrations, 3) connectivity between patch types across the seascape, and 4) can be used to determine whether management strategies (i.e., marine reserves) offer adequate protection. Linking fish movement pathways to spatial patterns in benthic structure within a GIS (Geographical Information System) will provide valuable information on how fish respond to their environment.

Since 2006, NOAAs Biogeography Branch (Friedlander and Monaco 2007) have deployed an array of 36 passive acoustic receivers moored to the seafloor to describe fish movement patterns across the coral reef ecosystems south of St. John, U.S. Virgin Islands (Fig. 1). More than 130 fish from 20 species have been tagged using coded transmitters and detections have provided valuable broad scale data (i.e., presence/absence) on fish movements inside and outside of protected areas. The array has indicated that several species including lane snapper leave Lameshur Bay at sunset and return at sunrise, but their night-time destinations remain unknown.

The array, however, is unable to provide information on the exact location of fish within the sphere of detection and is unable to detect fish movements beyond the array. Therefore, a complementary technique of active continuous fish tracking is required to fill in the gaps for several individuals. Actively following fish and recording their location with a Geographical Positioning System (GPS) provides much finer scale information than can be acquired with a fixed array and allows us to more accurately determine the amount of time spent within a patch type, as well as the exact movement pathways between patch types. Our specific research questions include:

- What are the home range areas for *Lutjanus synagris* and *Haemulon sciurus*?
- Which patch types have the highest residence times?
- Where do these species travel to on nocturnal migrations and which patch types are used?
- Do home ranges and pathways coincide with benthic structural features?
METHODS

From July 2008, fish trapping and continuous 24-48 hour acoustic tracking is being conducted in Greater Lameshur Bay, an embayment with extensive fringing coral reefs and seagrass beds (Fig 1b). Lameshur Bay is located within the Virgin Islands National Park and is adjacent to the Virgin Islands Coral Reef National Monument. Target fish were captured using baited fish traps set for 24 hours over sandy areas within 5 meters of a fringing coral reef (Fig 2a). Lane snapper and bluestriped grunt greater than 20cm were tagged with Vemco V9 continuous transmitters and all other fish were released. Continuous transmitters “ping” once every two seconds and therefore allow real-time tracking. Acoustic transmitters were coated in a combination of beeswax and paraffin to reduce immunorejection. A 1 cm long incision was made between the pelvic fins and the anus and a small acoustic transmitter (22 mm) was placed within the visceral cavity and then closed with two surgical sutures (Fig 2b). Fish were kept overnight in a seawater flow-through holding tank and their recovery monitored. Tagged fish were then transported in aerated tubs and released at the site of capture and observed by a snorkeler as they descended to the substratum. Continuous tracking began the next morning to allow the fish to re-acclimate to the natural surroundings and resume normal behavior.

A Vemco VR100 ultrasonic receiver with directional hydrophone mounted on a pole was attached to a small boat allowing 180˚ tilting and 360˚ rotation of the hydrophone (Fig 2c). At fifteen minute intervals, latitudinal and longitudinal coordinates or “waypoints” were recorded using a handheld Global Positioning System (GPS) receiver. The project will be tracking a separate individual fish for durations of 24-48 hours, four times a year over two years, resulting in detailed day and night utilization patterns for a total of four grunts and four snappers.

A selection of home range estimators will be applied and comparatively evaluated and areas of high residence will be determined, as well as, the geometry and periodicity of movement pathways. The benthic composition and spatial structure of areas of high site fidelity and the major pathways will be characterized using various in-situ survey methods (video transects, diver surveys) in order to better understand the habitat factors that determine utilization patterns including site fidelity. Broader scale analyses of fish-habitat linkages will be undertaken using maps of seascape structure including USGS LiDAR bathymetry and NOAA benthic habitat maps. Additional metrics such as the amount of time spent inside and outside of habitat types and MPAs will be calculated with GIS tools.

PROJECT TEAM

Mr Steven Hitt (NOAA-UVI Research Assistant)
Dr Simon Pittman (Marine Spatial Ecologist, NOAA Biogeography Branch)
Dr Mark Monaco (Branch Chief, NOAA Biogeography Branch)
Dr Alan Friedlander (Fisheries Biologist, NOAA Biogeography Branch)
Dr Rafe Boulon (National Park Service)
Dr Rick Nemeth (Director, UVI Center for Marine and Environmental Sciences)

For further information contact:
Steven Hitt (772-475-1753)
Steven.hitt@gmail.com

Simon Pittman (340-693-1179)
Simon.pittman@noaa.gov