## Mission Report

# NOAA/NOS/NCCOS/CCMA/Biogeography Team 

July 16 - July 30, 2006

A strategy to inventory, characterize, and monitor the marine region within and around the National Park and Monument boundaries of St. John, USVI
A cooperative investigation between NOAA, National Park Service, US Geological Survey, Virgin Islands Department of Planning and Natural Resources, University of Hawaii, and the Oceanic Institute

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# Mission Report: A strategy to inventory, characterize, and monitor the marine region within and around the National Park and Monument boundaries of St. John, USVI 

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## Mission Purpose:

The intent of this field mission was to continue ongoing efforts: (1) to spatially characterize and monitor the distribution, abundance and size of both reef fishes and conch within and around the waters of the Virgin Islands National Park (VIIS) and newly established Virgin Islands Coral Reef National Monument (VICR), (2) to correlate this information to in-situ data collected on associated habitat parameters, (3) to use this information to establish the knowledge base necessary for enacting management decisions in a spatial setting and to establish the efficacy of those management decisions.

Information collected thus far is being extensively utilized by NOAA, NPS, DPNR, University of the Virgin Islands (UVI) and others. Examples include UVI's use of NOAA-produced habitat maps for site selection to evaluate coral bleaching effects on coral communities, NOAA/University of Hawaii's use of habitat maps and fish data for analysis on the "wedge" between VICR boundaries, NOAA's use of data collection methodology for the design of NPS protocols, and NOAA's use of habitat characterizations from sites in the mid-shelf reef (MSR) for ground truthed multi-beam habitat classification.

A highlight of the successes of this mission was the continuation of data collection around the MSR inside and outside the boundaries of VICR. The data collected from these surveys will be analyzed together with data collected from previous years to investigate the possibility of a park boundary shift. NPS is considering a shift of the VICR MSR boundary eastward to include the narrow area that is now excluded. The narrow wedge area currently excluded appears to have a high percentage of live, healthy coral cover, although NOAA/NPS have sampled few sites in this area. This potential shift would create a cohesive, uninterrupted marine protected area that may be more ecologically sound and more enforceable as a no-take zone than the current boundary.

A week prior to the commencement of this field mission, the Biogeography Team, in partnership with NPS in St. John, began work on a new project of acoustically tracking fish movements in the coral reef systems of the VIIS and VICR. This investigation will examine the habitat utilization and movement of fish species among diel time periods, spatial scales, trophic guilds and life histories (Appendix A).

## Operational Accomplishments:

- 167 sites were surveyed (Figure 1), and information on benthic habitat composition (Tables 1 \& 2), fish distribution, abundance and size (Tables $3,4 \& 5$ ), and conch abundance and distribution was collected. The project team consisted of 2 NPS, 1 University of Hawaii, 1 Oceanic Institute and 9 NOAA scientific divers. NPS and NOAA dive logs were maintained.
- Two to three NPS boats were used each day of the mission. The number of boats used depended upon the type of sites surveyed that day. Approximately 3 divers per boat.
- Divers were able to conduct surveys on all days required.
- Both air and Nitrox $\left(32-34 \% \mathrm{O}_{2}\right)$ tanks were used.

Figure 1. Map of Virgin Islands Coral Reef National Monument and Virgin Islands National Park detailing benthic composition characteristics, park boundaries and selected survey points for the July 2006 mission


## Summary of Surveys:

## Fish

- Fish species abundance, size and distribution were characterized using the belt transect survey method (http://ccma.nos.noaa.gov/ecosystems/coralreef/reef fish/protocols.html) at 167 sites. The fish data are separated and weighted according to habitat strata and location (Table 1 and 2).

Table 1. Fish abundance, richness, biomass and diversity (all per 100 ${ }^{2}$ ) from MSR and Coral Bay around St. John using the belt transect method. Data are from the July 2006 St. John mission.

| Habitat Location | Habitat Strata | \# of Surveys | \# indiv / 100m² |  | biomass (g)/100m ${ }^{2}$ |  | \# species / 100m ${ }^{2}$ |  | Diversity* |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | $( \pm$ SE) | Mean | ( $\pm$ SE) |
| Mid Shelf Reef | Inside | 20 | 210.8 | 25.2 | 5356.0 | 1664.4 | 23.20 | 1.10 | 2.38 | 0.05 |
|  | Outside | 15 | 391.1 | 94.9 | 4410.5 | 610.0 | 27.80 | 1.58 | 2.23 | 0.10 |
|  | OVERALL | 35 | 316.3 | 36.85 | 4802.6 | 495.18 | 25.89 | 0.73 | 2.29 | 0.04 |
| $\begin{gathered} \text { Coral } \\ \text { Bay } \end{gathered}$ | Inside | 27 | 209.7 | 25.2 | 2170.6 | 317.2 | 22.63 | 0.96 | 2.13 | 0.10 |
|  | Outside | 25 | 407.4 | 90.1 | 10041.4 | 6292.0 | 22.92 | 0.99 | 1.76 | 0.13 |
|  | OVERALL | 52 | 341.3 | 42.74 | 7409.4 | 2822.93 | 22.82 | 0.55 | 1.88 | 0.07 |
| Both | Inside | 47 | 210.3 | 12.7 | 3933.9 | 573.2 | 22.9 | 0.5 | 2.3 | 0.0 |
|  | Outside | 40 | 399.7 | 46.3 | 7406.5 | 1914.8 | 25.2 | 0.6 | 2.0 | 0.1 |
|  | OVERALL | 87 | 328.8 | 19.9 | 6105.9 | 829.5 | 24.4 | 0.3 | 2.1 | 0.0 |

*Shannon Diversity Index

Table 2. Fish abundance, richness, biomass and diversity (all per $100 \mathrm{~m}^{2}$ ) from hard and soft bottom sites around the Virgin Islands National Park using the belt transect method. Data are from the July 2006 St. John mission.

| Habitat Location | Habitat Strata | \# of Surveys | \# indiv / 100m² |  | biomass (g) /100m ${ }^{2}$ |  | \# species / 100m² |  | Diversity* |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) |
| Other | Hard | 29 | 307.0 | 42.1 | 2752.3 | 441.3 | 24.34 | 1.06 | 1.93 | 0.10 |
|  | Soft | 51 | 52.9 | 7.2 | 296.4 | 158.6 | 6.67 | 0.57 | 1.25 | 0.09 |
|  | OVERALL | 80 | 161.3 | 10.01 | 1343.8 | 132.42 | 14.21 | 0.38 | 1.54 | 0.05 |

*Shannon Diversity Index

- The Bohnsack-Bannerot point-count method (see protocol link above) for characterizing fish species abundance, size and distribution was used to collect data at 87 RHA sites (Table 3). Due to poor visibility, 11 CB point-count surveys were not conducted. NOTE: Due to a high number of Coryphopterus personatus ( $\mathrm{n}=1200$ ) at one CB site and Decapterus sp. $(\mathrm{n}=1000)$ at another CB site, these values were removed from the abundance and biomass values reported below.

Table 3. Fish abundance, richness, biomass and diversity (all per $100 \mathrm{~m}^{2}$ ) from MSR and CB sites using the point-count method. Data are from the July 2006 St. John mission.

| Habitat Location | Habitat Type | \# of Surveys | \# indiv / 100m ${ }^{2}$ |  | biomass(g) $/ 100 \mathrm{~m}^{2}$ |  | \# species / 100m ${ }^{2}$ |  | Diversity* |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) |
| Mid Shelf Reef | Inside | 20 | 142.1 | 16.8 | 6279.2 | 769.0 | 19.4 | 0.7 | 2.4 | 0.1 |
|  | Outside | 15 | 227.9 | 41.4 | 6740.5 | 984.4 | 20.5 | 1.1 | 2.2 | 0.1 |
|  | OVERALL | 35 | 192.3 | 17.08 | 6549.2 | 469.52 | 20.1 | 0.52 | 2.3 | 0.03 |
| Coral Bay | Inside | 21 | 197.2 | 50.4 | 3435.1 | 725.8 | 15.8 | 0.9 | 1.8 | 0.2 |
|  | Outside | 20 | 121.8 | 22.7 | 3509.2 | 624.3 | 16.4 | 1.0 | 2.0 | 0.1 |
|  | OVERALL | 52 | 147.0 | 15.69 | 3484.4 | 357.75 | 16.2 | 0.55 | 1.9 | 0.08 |
| Both | Inside | 47 | 166.7 | 15.2 | 5009.5 | 380.3 | 17.8 | 0.8 | 2.1 | 0.1 |
|  | Outside | 40 | 171.5 | 15.5 | 5021.2 | 392.3 | 18.3 | 1.1 | 2.1 | 0.1 |
|  | OVERALL | 87 | 169.7 | 8.2 | 5016.8 | 206.8 | 18.1 | 0.3 | 2.1 | 0.0 |

* Shannon Diversity Index


## Habitat

- Data were collected at 167 sites for benthic composition characterization. Surveys at 87 sites were conducted within and around the waters of Coral Bay (CB) and the Virgin Islands Coral Reef National Monument Mid-Shelf Reef (MSR) locations. Below is a summary of RHA data weighted based on area sampled (Table 4). Methodology of RHA and full-scale collection can be found at http://ccma.nos.noaa.gov/ecosystems/coralreef/reef fish/protocols.html.

Table 4. Average percent cover for 87 hard bottom sites in and around MSR and CB for the July 2006 St. John mission.

| Habitat Location | Strata <br> Type | \# of Surveys | $\begin{gathered} \text { \% Coral / } \\ 100 \mathrm{~m}^{2} \end{gathered}$ |  | \% Macroalgae / $100 \mathrm{~m}^{2}$ |  | $\begin{gathered} \text { \% Turf- } \\ \text { crustose/100m² } \end{gathered}$ |  | $\begin{gathered} \text { \% Gorgonian / } \\ 100 m^{2} \end{gathered}$ |  | $\begin{gathered} \text { \% Sponge / } \\ 100 \mathrm{~m}^{2} \end{gathered}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) |
| Mid Shelf Reef | Inside | 20 | 2.3 | 0.3 | 48.5 | 4.7 | 22.4 | 3.3 | 16.7 | 2.8 | 10.2 | 1.5 |
|  | Outside | 15 | 12.3 | 2.4 | 56.5 | 4.4 | 18.1 | 3.3 | 7.5 | 0.9 | 5.5 | 1.0 |
|  | OVERALL | 35 | 8.2 | 0.86 | 53.2 | 2.31 | 19.9 | 1.71 | 11.3 | 0.80 | 7.5 | 0.59 |
| Coral Bay | Inside | 27 | 4.1 | 1.1 | 36.6 | 5.5 | 43.8 | 5.7 | 14.3 | 3.3 | 1.1 | 0.2 |
|  | Outside | 25 | 5.3 | 0.8 | 35.1 | 3.8 | 36.8 | 4.4 | 17.3 | 3.1 | 5.5 | 0.8 |
|  | OVERALL | 52 | 4.9 | 0.50 | 35.6 | 2.29 | 39.1 | 2.60 | 16.3 | 1.75 | 4.0 | 0.39 |
| Both | Inside | 47 | 3.1 | 0.3 | 43.2 | 2.5 | 32.0 | 2.2 | 15.6 | 1.5 | 6.2 | 0.5 |
|  | Outside | 40 | 8.6 | 0.8 | 45.1 | 2.0 | 28.1 | 2.0 | 12.7 | 1.1 | 5.5 | 0.5 |
|  | OVERALL | 87 | 6.5 | 0.3 | 44.4 | 1.2 | 29.5 | 1.1 | 13.8 | 0.6 | 5.7 | 0.2 |

- Full-scale surveys at 80 sites were conducted on hard and soft bottom sites within and around the waters of the Virgin Islands National Park. The weighted hard and soft bottom data are summarized in Table 5. Methodology on full-scale benthic composition data collection can be found using the methodology link (mentioned above).

Table 5. Average percent cover for habitat types for 80 full-scale sites for the July 2006 St. John mission.

| Habitat Location | Strata Type | \# of <br> Surveys | $\begin{gathered} \text { \% Coral / } \\ 100 \mathrm{~m}^{2} \end{gathered}$ |  | \% Macroalgae / $100 \mathrm{~m}^{2}$ |  | \% Turfcrustose $/ 100 \mathrm{~m}^{2}$ |  | $\begin{gathered} \text { \% Gorgonian / } \\ 100 \mathrm{~m}^{2} \end{gathered}$ |  | \% Sponge / 100m |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Mean | $( \pm$ SE) | Mean | $( \pm S E)$ | Mean | ( $\pm$ SE) | Mean | ( $\pm$ SE) | Mean | $( \pm$ SE) |
| Other | Hard | 29 | 4.5 | 0.8 | 24.9 | 5.0 | 42.2 | 5.9 | 3.5 | 0.7 | 2.2 | 0.4 |
|  | Soft | 51 | 0.03 | 0.02 | 25.1 | 3.5 | 9.2 | 2.7 | 0.0 | 0.0 | 0.4 | 0.1 |
|  | OVERALL | 80 | 2.0 | 0.16 | 25.0 | 2.05 | 23.3 | 1.97 | 1.5 | 0.12 | 1.1 | 0.11 |

## Equations

- Overall habitat and fish mean values for each stratum (locations and substrate type) and combined strata were calculated using the following equations (Menza et al., 2006):

Mean density for the stratified survey domain is obtained by summing the weighted averages of sample strata means,

$$
\begin{equation*}
\bar{y}_{s t}=\sum_{h=1}^{L} W_{h} \bar{y}_{h} \tag{4.6}
\end{equation*}
$$

where $L$ is the number of strata, and strata weighting factors $\left(W_{h}\right)$ are given by

$$
\begin{equation*}
W_{h}=\frac{N_{h}}{\sum_{h=1}^{L} N_{h}}=\frac{N_{h}}{N} \tag{4.7}
\end{equation*}
$$

where N is the total number of possible sample units in all strata. The weighting factor $W_{h}$ represents the proportion of the overall survey domain (or sampling frame) contained within stratum $h$.

Two examples of calculations are provided below:
o For one stratum type (e.g. MSR strata),

$$
y_{\text {MSRI }}=\left(\begin{array}{c}
\text { mean \# indiv } \\
\text { inside MSR }
\end{array} \times \frac{\text { area inside MSR }}{\text { total MSR area strata }}\right)+\left(\begin{array}{c}
\text { mean \# indiv } \\
\text { outside MSR }
\end{array} \times \frac{\text { area outside MSR }}{\text { total MSR strata area }}\right)
$$

0 All strata types combined (e.g. MSR, Coral Bay and Other),


- The overall and combined standard error values for fish and habitat data were calculated using the estimated variance of the mean (Menza et al., 2006). The variance of $\bar{y}_{\text {st }}$ is estimated as

$$
\begin{equation*}
\operatorname{var}\left[\bar{y}_{s t}\right]=\sum_{h=1}^{L} W_{h}^{2} \operatorname{var}\left[\bar{y}_{h}\right] \tag{4.8}
\end{equation*}
$$

## Conch

- A total of 39 conch, Strombus gigas, (11 immature, 28 mature) were observed along transects on soft bottom sites.


## Events of Note:

- There were several fish recorded on transects for the first time in St. John during the July 2006 mission:
- Chain moray (Echidna catenata)
o Cubera snapper (Lutjanus cyanopterus)
o Greater amberjack (Seliola dumerili)
o Rock hind (Epinephelus adscensionis)
- Spotlight goby (Elacatinus louisae)
o Triplefin species (Enneanectes sp.)
- Increased mean abundance of red hinds (Ephinephelus guttatus) recorded


Figure 2. Mean number of red hinds (Epinephelus guttatus) across all size classes recorded per year (error bars represent standard error).

- A gravid queen conch (Stombus gigas) was observed with its egg mass exposed.
- General observations made at the Mid-Shelf Reef suggest an increase number of recently dead corals, most likely a result from secondary infections after the October 2005 bleaching event.


Images of a living and grooved brain coral (Diploria labrinthiformis) at an MSR site. The white section of the coral may be due to snail predation.

## Logistics of Note:

- Point-counts were unable to be conducted at several sites ( $n=11$ )in Coral Bay due to poor visibility.
- St. John dive shops no longer filled nitrox tanks due to cost. Nitrox tanks were filled on St. Thomas resulting in one boat stopping dive operations/data collection early each day.
- Three divers were taken out of commission for a few days due to illnesses.
- For one day, two boats worked at the MSR and finished Coral Bay sites.


Foureye butterflyfish (Chaetodon capistratus) and massive starlet coral (Siderastrea siderea)


Juvenile Nassau grouper (Epinephelus striatus) in a patch of turtle grass (Thalassia testudinum)

## References

Menza, C., J. Ault, J. Beets, J. Bohnsack, C. Caldow, J. Christensen, A. Friedlander, C. Jeffrey, M. Kendall, J. Luo, M. Monaco, S. Smith and K. Woody. 2006. A Guide to Monitoring Reef Fish in the National Park Service's South Florida / Caribbean Network. NOAA Technical Memorandum NOS NCCOS 39. 166 pp.

# Acoustic Tracking of Reef Fishes to Elucidate Habitat Utilization Patterns and Residence Times Inside and Outside Marine Protected Areas in the US Virgin Islands 

Preliminary Report<br>December 12006

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## Introduction

VIIS Resource Management Division has been working closely with NOAA, USGS, and academic partners to characterize benthic habitats to document resource utilization among habitats in VIIS and VICR. An important complementary component to resource characterization and monitoring is an understanding of the movement (behavior) of organisms among habitats, between VIIS and VICR, and across those boundaries into Territorial and Federal waters. Documentation of movement of reef fish species is extremely important to NPS resource managers, particularly, the knowledge of species movements of fish residents within park boundaries and of those species which frequently move across park boundaries. Understanding habitat utilization patterns, residence time, ontogenetic and diel movement patterns of organisms is critical to defining essential fish habitat (EFH) as well as designing and evaluating marine protected areas (MPAs). Results of this investigation will not only be of importance for Resource Management in VIIS and VICR, but will provide important information on resource characterization and movement throughout NPS. Additionally, results on the effectiveness of management strategies and MPAs will be valuable to several government agencies.

## Methods

Field work for the initial phase of the acoustic tracking study was conducted in Lameshur Bay, St. John between 8 and 27 July 2006.

Fish capture and handling methods
A total of 46 fishes, representing 11 species and 8 families were acoustically tagged around Lameshur Bay, St. John during July 2006 (Table 1). Fish species were captures using fish traps and handlines and represented a diversity of taxonomic, feedings, and mobility guilds.

Acoustic transmitters were implanted internally into the gut cavity of fishes using standard surgical procedures (Figure 1).
Table 1. Species composition, number, and sizes of fishes acoustically tagged in Lameshur Bay, St. John during July 2006.

| Scientific name | Common name | Family | N | Mean total length (cm) | StdDev <br> of TL | $\begin{gathered} \text { Max } \\ \text { of } \\ \text { TL } \\ \hline \end{gathered}$ | $\begin{gathered} \text { Min } \\ \text { of } \\ \text { TL } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Lutjanus synagris | lane snapper | Lutjanidae | 18 | 27.14 | 4.31 | 36.0 | 20.0 |
| Haemulon sciurus | bluestriped grunt | Haemulidae | 10 | 27.75 | 1.72 | 30.5 | 25.0 |
| Ocyurus chrysurus | yellowtail snapper | Lutjanidae | 8 | 30.13 | 5.87 | 38.0 | 22.5 |
| Calamus calamus | saucereye porgy | Sparidae | 3 | 29.33 | 5.13 | 35.0 | 25.0 |
| Balistes vetula | queen triggerfish | Balistidae | 1 | 29.00 | - | 29.0 | 29.0 |
| Caranx ruber | bar jack | Carangidae | 1 | 47.00 | - | 47.0 | 47.0 |
| Epinephelus guttatus | red hind | Serranidae | 1 | 29.50 | - | 29.5 | 29.5 |
| Ginglymostoma cirratum | nurse shark | Rhincodontidae | 1 | 70.00 | - | 70.0 | 70.0 |
| Haemulon flavolineatum | french grunt | Haemulidae | 1 | 20.00 | - | 20.0 | 20.0 |
| Haemulon plumieri | white grunt | Haemulidae | 1 | 25.00 | - | 25.0 | 25.0 |
| Lutjanus analis | mutton snapper | Lutjanidae | 1 | 45.00 | - | 45.0 | 45.0 |
| Total |  |  | 46 |  |  |  |  |



Figure 1. Surgical procedures used for implanting acoustic transmitters in fishes.

A shore-based holding tank (ca. 750 gallons) was constructed at VIERS (Figure 2) and fishes were held in this holding tank to allow for recovery from capture and surgery to ensure that fishes were released in healthy condition. After recovery, fishes were released at a location in close proximity to the capture site.


Figure 2. Shore-based holding tank (750 gallons) at VIERS.

## Continuous data loggers

Nine continuous data loggers were deployed in the Lameshur Bay complex using sandscrews, steel cable, and submerged buoys (Figure 3). These receivers record the identification number and time stamp from acoustic transmitters as the animal being studied travels within receiver range.


Figure 3. Acoustic transmitters, hydroacoustic receivers, and mooring design.

## Range testing and receiver deployment

Range testing was conducted to determine the range of detection of transmitters for individual receivers. Receivers deployed at Yawzi Point, inside Great Lameshur Bay, and off Tektite Reef were able to detect transmitters from between 250 and 350 meters away. Based on these detection distances, we deployed nine receivers in the Lameshur Bay complex as shown in Figure 4. With a minimum effect detection range of 250 meters, the array provided overlap among multiple receivers and allowed for the detection of individual transmitters by multiple receivers (Figure 5). Receiver locations are given in table 2.


Figure 4.Locations of VR2 receivers in Lameshur Bay.


Figure 5. Locations of VR2 receivers in Lameshur Bay. Circles depict a detection range of 250 meters.

Table 2. Locations of VR2 hydroacoustic receivers in Lameshur Bay, St. John.

| VR2_station | Location | Latitude | Longitude |
| :---: | :--- | :---: | :---: |
| 1 | Eupora | 18.31140 | 64.73278 |
| 2 | Lameshur_offshore | 18.30571 | 64.72423 |
| 3 | Lameshur_offshore | 18.30900 | 64.72842 |
| 4 | Eupora | 18.31517 | 64.72942 |
| 5 | Yawzi | 18.31352 | 64.72686 |
| 6 | Tektite | 18.31088 | 64.72433 |
| 8 | Great_Lameshur | 18.31379 | 64.72356 |
| 9 | Inner_Lameshur | 18.31638 | 64.72284 |
| 10 | Little_Lameshur | 18.31736 | 64.72681 |

## Preliminary Results

Date from VR2 acoustic receivers were downloaded on 27 July 2006 to examine initial results.
Station 1. This station was located 0.3 km off Europa. Five tags were detected at this location.
None of these tagged fishes were present for long periods of time and fish \#3182 appeared on the $17^{\text {th }}$ of July and not again until the $27^{\text {th }}$.


Figure 6. Tag detections at Station 1.
Station 1 tag detections

|  | July |  |  |  |  |  |  |  |
| :--- | ---: | :--- | :--- | :---: | :--- | ---: | ---: | ---: |
| Tag_ID | 17 | 18 | 21 | 23 | 24 | 25 | 27 | Total |
| 3182 | 1 |  |  |  |  |  | 1 | 2 |
| 3183 |  |  | 19 | 1 | 8 | 2 | 2 | 32 |
| 3184 |  | 4 |  |  |  |  |  | 4 |
| 3193 |  |  |  |  |  |  | 5 | 5 |
| 3200 | 2 |  |  |  |  |  | 2 |  |
| Total | 3 | 4 | 19 | 1 | 8 | 2 | 8 | 45 |

Station 2 was located 0.35 km off Cabritehorn Point. A total of 15 tagged fishes were detected at this station. Several fish showed continual residence while others were intermittent.


Figure 7. Tag detections at Station 2.
Station 2 tag detections.

| Tag_ID | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | July20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3187 |  |  |  |  |  |  |  |  |  |  |  |  |  | 19 | 10 | 14 | 43 |
| 3200 |  |  |  |  |  |  | 1 | 18 | 24 | 6 | 5 | 11 | 15 | 21 | 2 | 6 | 109 |
| 3240 |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  | 1 |
| 3241 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| 3245 |  | 2 |  | 2 | 1 |  | 1 | 2 | 3 |  | 2 | 4 | 2 | 3 | 3 | 4 | 29 |
| 3246 |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 4 |  | 6 |
| 3248 |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| 3249 |  | 3 | 10 | 4 | 6 | 3 | 8 | 6 | 6 | 3 |  | 12 | 7 | 9 | 4 | 1 | 82 |
| 3250 |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 3251 |  |  |  |  |  |  |  |  |  |  |  | 6 |  |  |  |  | 6 |
| 3254 |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 3255 | 6 | 19 | 7 | 12 | 18 | 31 | 26 | 44 | 41 | 98 | 33 |  |  |  |  |  | 335 |
| 3260 |  |  |  |  | 6 | 5 |  |  |  |  |  |  |  |  |  |  | 11 |
| 3263 |  | 1 |  |  | 5 | 1 | 2 | 1 |  |  |  |  |  | 1 | 1 |  | 12 |
| 3264 | 1 | 3 | 8 | 6 | 2 | 5 |  | 2 | 4 | 1 | 5 | 3 | 2 | 3 | 4 | 2 | 51 |
| Total | 7 | 31 | 26 | 24 | 38 | 45 | 38 | 74 | 78 | 108 | 45 | 36 | 27 | 58 | 28 | 27 | 690 |

Station 3 located 0.5 km off Yawzi Point. 22 tagged fishes were detected at this station.


Figure 8. Tag detections at Station 3.
Station 3 tag detections.


Station 4 located 0.36 km of Yawzi Point between Little Lameshur Bay and Eupora Bay. 23 tagged fishes were detected at this station.


Figure 9. Tag detections at Station 4.
Station 4 tag detections.

|  | July |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tag_ID | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total |
| 3182 |  |  | 2 | 2 | 15 | 24 | 32 | 24 | 26 | 28 | 36 | 17 | 25 | 9 | 13 | 253 |
| 3183 |  |  |  | 57 | 7 | 23 | 23 | 14 | 18 | 25 | 15 | 3 | 3 | 8 | 9 | 205 |
| 3184 |  |  | 27 | 124 | 138 | 158 | 100 | 124 | 78 | 58 | 109 | 98 | 63 | 66 | 37 | 1180 |
| 3185 |  |  |  |  |  |  |  |  |  |  |  | 62 | 281 | 104 | 28 | 475 |
| 3187 |  |  |  |  |  |  |  |  |  |  |  | 8 |  |  |  | 8 |
| 3190 |  |  |  |  |  |  |  |  |  |  |  | 28 | 85 | 109 | 19 | 241 |
| 3192 |  |  |  |  |  |  |  |  |  |  |  | 59 | 119 | 77 | 61 | 316 |
| 3193 |  |  |  |  |  |  |  |  |  |  |  | 8 | 5 | 90 | 96 | 199 |
| 3194 |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| 3196 |  | 4 | 7 | 1 |  |  |  |  |  |  | 2 |  |  | 5 |  | 19 |
| 3197 |  |  | 48 | 78 | 100 | 99 | 101 | 123 | 113 | 96 | 90 | 81 | 71 | 55 | 51 | 1106 |
| 3198 |  |  |  |  |  |  |  |  |  |  |  | 27 | 1 | 4 | 1 | 33 |
| 3199 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 2 |
| 3200 |  |  |  |  | 11 |  |  |  |  |  |  |  |  |  |  | 11 |
| 3236 |  | 1 | 2 | 1 | 2 | 1 | 1 | 1 |  | 1 | 1 |  |  | 1 | 1 | 13 |
| 3237 | 1 |  |  |  |  |  | 3 |  | 1 |  |  |  |  |  |  | 5 |
| 3243 |  |  |  |  |  |  |  | 1 | 3 | 4 | 6 |  |  |  |  | 14 |
| 3244 |  |  | 1 |  | 1 |  |  |  |  |  |  |  |  |  |  | 2 |
| 3248 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| 3250 |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 |
| 3251 |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 3258 | 3 | 12 |  | 1 | 2 | 4 | 2 | 4 | 2 | 1 |  | 1 | 1 |  | 1 | 34 |
| 3262 |  |  |  |  |  |  |  |  | 3 | 1 |  | 1 | 1 | 3 |  | 9 |
| Total | 6 | 21 | 88 | 264 | 276 | 309 | 262 | 291 | 244 | 214 | 259 | 394 | 655 | 531 | 319 | 4133 |

Station 5. This station was located 0.25 km directly south of Yawzi Point. 39 species were detected at this station.


Figure 10. Tag detections at Station 5.

Station 5 tag detections.

|  | July |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tag ID | 10 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |  | Total |
| 101 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  | 1 |
| 154 |  | 4 | 4 | 8 | 6 | 4 | 1 | 1 | 3 | 3 | 2 | 6 | 2 | 7 | 6 | 1 | 2 | 60 |
| 162 |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  | 1 |
| 169 |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  | 1 |
| 187 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 | 3 |  | 5 |
| 956 |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 971 |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 1406 |  |  |  |  |  |  |  | 2 |  |  | 1 | 1 |  |  | 1 |  |  | 5 |
| 1407 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| 1481 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 |
| 2201 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  | 1 |
| 3085 |  |  |  |  |  | 1 |  | 4 | 1 | 1 | 1 |  | 4 |  |  |  |  | 12 |
| 3182 |  |  |  |  | 193 | 340 | 390 | 400 | 379 | 363 | 393 | 367 | 377 | 370 | 351 | 276 | 191 | 4390 |
| 3183 |  |  |  |  | 136 | 302 | 362 | 382 | 376 | 369 | 339 | 377 | 355 | 338 | 315 | 302 | 162 | 4115 |
| 3184 |  |  |  |  | 208 | 339 | 416 | 450 | 388 | 424 | 284 | 374 | 350 | 380 | 366 | 268 | 198 | 4445 |
| 3185 |  |  |  |  |  |  |  | 1 | 1 |  |  |  |  |  |  |  |  | 2 |
| 3187 |  |  |  |  |  |  |  |  |  |  |  |  |  | 140 | 87 |  |  | 227 |
| 3192 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| 3194 |  |  |  |  |  | 1 |  |  | 1 |  |  |  |  |  |  |  |  | 2 |
| 3197 |  |  |  |  | 229 | 385 | 436 | 420 | 400 | 406 | 387 | 376 | 378 | 379 | 382 | 347 | 226 | 4751 |
| 3198 |  |  |  |  | 1 |  |  |  |  |  |  | 1 |  | 11 | 172 | 39 | 67 | 291 |
| 3199 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 82 | 183 | 265 |
| 3228 |  |  |  |  |  |  |  |  |  |  |  |  | 2 |  | 1 |  |  | 3 |
| 3236 |  |  |  | 472 | 591 | 656 | 659 | 697 | 668 | 637 | 593 | 630 | 717 | 687 | 646 | 660 | 306 | 8619 |
| 3237 |  |  | 316 | 287 | 228 | 180 | 194 | 108 | 295 | 431 | 407 | 390 | 288 | 231 | 240 | 228 | 126 | 3949 |
| 3242 |  |  |  |  | 6 |  |  |  |  |  |  |  |  |  |  |  |  | 6 |
| 3244 |  |  |  | 270 | 236 | 201 | 278 | 299 | 261 | 310 | 254 | 259 | 249 | 281 | 250 | 183 | 142 | 3473 |
| 3247 | 30 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 30 |
| 3248 |  |  |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| 3250 |  |  | 42 | 6 | 8 |  |  |  |  |  |  |  |  |  |  |  |  | 56 |
| 3251 |  |  |  |  | 178 |  |  |  |  |  |  |  |  |  |  | 124 | 123 | 425 |
| 3257 | 65 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 65 |
| 3258 |  | 579 | 621 | 713 | 621 | 444 | 508 | 631 | 535 | 484 | 539 | 486 | 414 | 364 | 494 | 375 | 274 | 8082 |
| 3259 |  |  |  |  |  |  |  |  |  | 1 |  |  | 1 |  |  |  |  | 2 |
| 3261 |  |  |  |  |  |  | 33 | 36 | 15 | 13 | 67 | 90 | 157 | 143 | 266 | 81 | 120 | 1021 |
| 3273 |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  | 1 |
| 3484 |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 3491 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  | 1 |
| 3498 |  |  |  |  |  |  | 1 |  |  |  |  | 1 |  |  |  |  |  | 2 |
| Total | 95 | 583 | 983 | 1759 | 2642 | 2854 | 3279 | 3431 | 3323 | 3442 | 3269 | 3358 | 3295 | 3334 | 3578 | 2971 | 2121 | 44317 |

Station 6 - This station was located off Tektite Reef. 34 tagged fishes were detected at this location.


Figure 11. Tag detections at Station 6.

## $\underline{\text { Station } 6 \text { tag detections }}$

|  | July |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tag_ID | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total |
| 152 |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |
| 969 |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 |
| 3182 |  |  |  |  | 37 | 67 | 85 | 77 | 67 | 103 | 69 | 86 | 84 | 62 | 59 | 47 | 29 | 872 |
| 3183 |  |  |  |  | 8 | 8 | 12 | 53 | 27 | 24 | 29 | 23 | 12 | 11 | 13 | 16 | 6 | 242 |
| 3184 |  |  |  |  | 18 | 57 | 109 | 36 | 53 | 57 |  | 52 | 50 | 57 | 63 | 7 | 14 | 573 |
| 3186 |  |  |  |  |  | 30 | 5 |  |  |  |  |  |  |  |  |  |  | 35 |
| 3187 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 9 | 1 |  | 10 |
| 3195 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 4 |  |  | 4 |
| 3197 |  |  |  |  | 22 | 30 | 45 | 46 | 18 | 16 | 24 | 24 | 13 | 13 | 10 | 16 | 13 | 290 |
| 3199 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | 19 | 24 |
| 3200 |  |  |  |  |  |  | 17 | 122 | 92 | 107 | 151 | 94 | 88 | 62 | 118 | 97 | 35 | 983 |
| 3236 |  |  |  | 3 | 1 | 1 | 1 |  |  | 1 |  |  |  |  |  |  |  | 7 |
| 3237 |  |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | 7 |
| 3238 |  |  |  | 60 | 62 |  |  |  |  |  |  |  |  |  |  |  |  | 122 |
| 3239 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  | 1 |
| 3240 | 13 | 3 | 2 |  | 2 | 2 |  |  |  |  |  |  |  |  |  |  |  | 22 |
| 3241 |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  |  |  | 1 |
| 3242 |  |  |  | 2 | 7 |  |  |  |  |  |  |  |  |  |  |  |  | 9 |
| 3244 |  |  |  | 1 | 3 |  | 3 |  |  |  |  |  |  |  |  |  | 1 | 8 |
| 3245 | 23 | 27 | 22 | 18 | 1 | 5 | 2 | 5 |  | 1 |  |  |  |  | 1 |  |  | 105 |
| 3246 |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  |  | 1 |
| 3248 |  | 1 |  | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  | 3 |
| 3249 |  | 200 | 238 | 211 | 233 | 177 | 214 | 176 | 203 | 214 | 212 | 205 | 218 | 242 | 225 | 207 | 105 | 3280 |
| 3250 |  |  | 2 | 12 | 2 |  |  |  |  |  |  |  |  |  |  |  |  | 16 |
| 3251 | 11 | 14 | 13 | 7 | 2 | 28 | 19 |  |  |  |  | 5 | 4 | 5 |  | 1 | 18 | 127 |
| 3252 |  |  |  |  | 5 | 1 |  |  |  |  |  |  |  |  |  |  |  | 6 |
| 3253 |  |  | 2 | 3 | 4 | 2 | 7 |  |  |  |  |  |  |  |  |  |  | 18 |
| 3254 |  |  | 3 | 11 | 42 | 18 | 37 | 54 | 96 | 124 | 119 | 91 | 81 | 75 | 93 | 116 | 25 | 985 |
| 3255 | 50 | 81 | 9 | 2 | 5 |  | 5 | 4 | 1 | 5 | 1 |  |  |  |  |  |  | 163 |
| 3256 | 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 7 |
| 3258 |  | 1 | 8 | 5 | 3 | 5 | 18 | 21 | 9 |  |  | 11 |  |  |  | 4 | 2 | 87 |
| 3260 |  |  |  |  |  | 3 |  |  |  |  |  |  |  |  |  |  |  | 3 |
| 3263 | 5 | 11 | 5 | 1 | 10 |  |  | 3 |  |  | 1 |  |  |  |  | 1 |  | 37 |
| 3264 | 1 | 7 | 3 | 3 | 12 | 5 | 7 | 3 | 3 | 1 |  |  |  |  |  |  |  | 45 |
| Total | 110 | 345 | 309 | 341 | 480 | 439 | 587 | 601 | 569 | 653 | 606 | 591 | 551 | 528 | 595 | 518 | 272 | 8095 |

Station 8 - Tektite north, 16 different tagged fishes detected.


Figure 12. Tag detections at Station 8.
Station 8. Tag ID and number of detections per day

| July |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tag_ID | 10 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total |
| 3182 |  |  |  |  | 4 | 2 | 31 | 13 | 48 | 76 | 91 | 86 | 58 | 45 | 40 | 48 | 19 | 561 |
| 3183 |  |  |  |  |  |  | 5 | 15 | 7 |  | 6 | 12 | 14 | 27 | 14 | 26 | 5 | 131 |
| 3184 |  |  |  |  | 1 | 9 | 35 | 15 | 23 | 52 |  | 26 | 46 | 67 | 67 | 3 | 26 | 370 |
| 3194 |  |  |  |  |  | 4 | 1 | 1 |  |  |  | 6 |  | 1 |  |  |  | 13 |
| 3195 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 2 |
| 3197 |  |  |  |  | 1 | 3 | 7 | 10 | 6 | 26 | 35 | 16 | 17 | 23 | 12 | 26 | 8 | 190 |
| 3198 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 | 10 |  | 12 |
| 3199 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 11 | 12 | 23 |
| 3200 |  |  |  |  |  |  |  |  |  | 3 |  |  |  |  |  |  |  | 3 |
| 3237 |  |  | 4 |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 | 9 |
| 3242 |  |  |  | 4 | 12 |  |  |  |  |  |  |  |  |  |  |  |  | 16 |
| 3248 |  | 1 | 1 | 3 |  |  |  |  |  |  |  |  |  |  |  |  |  | 5 |
| 3250 |  |  | 6 | 18 | 22 |  |  |  |  |  |  |  |  |  |  |  |  | 46 |
| 3253 |  |  |  | 2 | 3 | 5 |  |  |  |  |  |  |  |  |  |  |  | 10 |
| 3257 | 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 2 |
| 3258 |  |  | 6 |  | 2 |  |  |  |  |  | 1 |  |  | 1 |  |  |  | 10 |
| Total | 2 | 1 | 17 | 27 | 45 | 23 | 79 | 54 | 84 | 157 | 133 | 146 | 135 | 164 | 135 | 124 | 77 | 1403 |

Station 9 - no receiver was deployed until 28 July 2006
Station 10 - this station was located inside Little Lameshur Bay. 15 tagged fishes were detected at this location.


Figure 13. Tag detections at Station 10.

Station 10 tag detections

| Tag_ID | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | Total |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 3182 |  |  |  |  |  |  |  | 4 |  |  |  |  |  |  |  |  |  | 4 |
| 3183 |  |  |  |  |  |  |  | 1 |  |  |  |  |  |  |  |  |  | 1 |
| 3184 |  |  |  |  |  |  |  | 2 |  | 2 |  | 1 |  |  | 1 | 2 | 1 | 9 |
| 3185 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |  |  | 1 |
| 3190 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 62 | 7 | 2 | 71 |
| 3193 |  |  |  |  |  |  |  |  |  |  |  |  |  | 52 | 631 | 85 |  | 768 |
| 3194 |  |  |  |  |  |  |  |  |  |  |  |  |  | 119 | 280 | 163 | 42 | 604 |
| 3195 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1 |
| 3196 |  |  |  |  | 139 | 145 | 280 | 60 | 250 | 214 | 317 | 150 | 222 | 330 | 232 | 127 |  | 2466 |
| 3198 |  |  |  |  |  |  |  |  |  |  |  |  |  | 18 | 1 | 4 |  | 23 |
| 3247 | 371 | 357 | 644 | 480 |  |  |  |  |  |  |  |  |  |  |  |  |  | 1852 |
| 3248 |  |  | 12 |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 12 |
| 3250 |  |  |  | 9 | 9 |  |  |  |  |  |  |  |  |  |  |  |  | 18 |
| 3258 |  |  |  |  |  |  |  | 2 |  |  |  |  |  |  |  |  |  | 2 |
| 3262 |  |  |  |  |  |  | 1 | 3 | 2 | 3 | 5 |  |  |  |  |  |  | 14 |
| Total | 371 | 357 | 656 | 489 | 148 | 145 | 281 | 72 | 252 | 219 | 322 | 151 | 222 | 519 | 1208 | 388 | 46 | 5846 |

## Movement Patterns of Individuals Fishes

## Lane snapper \# 3183

Movement patterns of a 31 cm TL lane snapper (Lutjanus synagris) appear in Figure 14. This fish was captured on the $14^{\text {th }}$ of July at Yawzi Point and released at the same location on the $15^{\text {th }}$ at 1100 . The fish left the reef off Yawzi Point at dusk on a daily basis and returned at dawn. It was detected off stations 4 and 1 during the night. The fish was not detected on the array for most nights from 2000 until the early morning hours. During the day the fish was detected primarily at stattion5 but was also detected at stations 4,6 , and 8 , a likely result of movement along various portions of the reef.


Figure 14. Lane snapper \#3183-31 cm TL.

## Lane snapper \# 3200

Movement patterns of this 27 cm TL lane snapper (Lutjanus synagris) appear in Figure 15. The fish was captured off Tektite Reef on the $16^{\text {th }}$ of July and released at 1000 on the $17^{\text {th }}$ off Europa Bay. At ca. 2200 it moved offshore and was detected at Station 1. It was detected at Station 3 during the night and was likely out in the seagrass. It was absent from the array at 600 the next day until just after 1200 where at was detected at Station 6 near Tektite reef. Or most of the remaining days, it was detected at Stations 6 and 2 and likkelt moving along the reef edge at Tektite. During the nighttime hours it moved away from the reef and was detected by the receiver at Station 3 and returned to the reef consistently near 600 each day.


Figure 15. Lane snapper \#3200-27 cm TL.

## Bluestripe grunt \# 3198

Movement patterns of this 28 cm TL bluestripe grunt (Haemulon sciurus) \# 3198 appears in Figure 16. The fish was caught and release at Europa Bay near receiver 4 at ca. 1700 on the $24^{\text {th }}$ of July. It was detected at receiver 4 and 10 (inside Little Lameshur Bay) on the $24^{\text {th }}$ and then moved to Yawzi Point (station 5) where it remained for most of the $25^{\text {th }}$. During the early hours of the $26^{\text {th }}$, it was detected on both the east (station 8) and west (station 4) sides of Yawzi reef but was not detected on any receivers during much of the morning of the $26^{\text {th }}$ from 500 to 1100. It was absent from the array from midnight on the $26^{\text {th }}$ until ca. 330 at station 4 on the $27^{\text {th }}$.


Figure 16. Bluestripe grunt \#3198-28 cm TL.

## Red Hind \#3258

A red hind (Epinephelus guttatus) 29.5 cm TL was captured and released at Yawzi Point. After release on the $12^{\text {th }}$, this fish was detected at Yawzi Reef (station 5) for nearly the entire sampling period. Gaps in detections may be attributed to low detection range when the fish was hidden inside the recesses of the reef. Detections by nearby receivers may reflect movement to different locations on Yawzi reef since the fish as also detected by the Yawzi receiver (station 5) at the same time that it was detected by other receivers.


Figure 17. Red Hind \#3258, 29.5 cm TL.

## Next Steps

## The next field deployment is scheduled for April 2007. The plan for this mission is to deploy 15 receivers and tag at least 60 fish.

## Analysis of Lameshur Bay data

We will examine telemetry data from the July 2006 Lameshur Bay data on an individual species and tag basis to determine movement patterns and habitat utilization over this short time duration.

## Continuation of fine-scale movement patterns

We will continue tagging and tracking of fishes in Lameshur Bay over the next phase of the study.

## Shelf-scale movement patterns

In order to examine movement patterns across the shelf, receivers will be deployed in a configuration to maximize spatial coverage and take advantage of know corridors of movement learned from decades of work in the area. Know spawning aggregation points and reefs that serve as navigational aids for migration will also be incorporated into the array design. A proposed receiver array for the next phase of the study appears in figure 3.


Figure 18. Potential VR2 array design to examine large-scale movement patterns of fishes inside and outside VI National Park, VI Coral Reef National Monument and outside areas ( $\mathrm{N}=36$ ). 250 $m$ detection radius as an example.

