ANNUAL PROGRESS REPORT
FOR
TEXAS CLIPPER REEF BIOLOGICAL MONITORING AND EVALUATION PROGRAM - YEAR 1

October 15, 2007 – October 31, 2008

Contract No. 183089

Project Managers:

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1. Project Objectives:

The goal of the Texas Clipper Reef biological monitoring and evaluation program is to provide the TPWD supplementary data for evaluating the project in terms of its capacity for increasing area recreational fishing, diving, and tourism thereby allowing for adaptive management and enhancement actions. The specific objectives of the biological monitoring program are: (1) to document development and transformations in community composition of Texas Clipper Reef biofouling and fish assemblages; (2) to delineate biological zones as they develop; (3) to stimulate ancillary research projects; and (4) to evaluate and synthesize monitoring data in order to assess change and provide recommendations to managers.

The monitoring program utilizes four survey approaches to achieve the objectives: (1) water quality measurement systems for water column habitats (i.e., structural monitoring); (2) biofouling community surveys (diversity and biomass); (3) nekton community surveys (roving diver surveys) and (4) general site assessments (video transects). Survey data is repeated quarterly.

2. Status of Tasks:

2.1. Sampling Effort:

A total of 14 site visits were scheduled during the first year; six were cancelled due to weather. The reef site was sampled eight times in 2008 including February 9 (9 divers / 3 dives each), May 3 (10 divers / 3 dives each), August 1 (8 divers / 3 dives each), September 7 (11 divers / 3 dives each), October 10 (3 divers / 2 dives each), October 19

(10 divers / 3 dives each), October 25 (4 divers / 2 dives each), October 26 (2 divers / 1 dive each). Those site visits with 4 or less UTB/TSC divers coincided with previously scheduled recreational dive trips as necessary to complete tasks.

2.2. Establishing a Scientific Diving Program at UTB/TSC:

A Diving Control Board was established in October 2007 consisting of five Core Members and a number of Advisory Members to approve and monitor diving projects, and review, revise, and assure compliance with the first draft of the UTB/TSC diving safety manual. A Scientific Diving Standards and Safety Manual for the UTB/TSC Scientific Diving Program was drafted based upon examples provided by the American Academy of Underwater Sciences (AAUS), TPWD, Texas A&M University – Corpus Christi (TAMUCC), and Texas A&M University at Galveston (TAMUG). A draft of the Scientific Diving Standards and Safety Manual went out to the Core Members of the Diving Control Board in October 2008.

The grant supported the dive training of three UTB/TSC students (openwater training). These students are currently participating in our research diving activities. In addition, five UTB/TSC personnel (faculty/students) have been certified as Nitrox Divers.

2.3. Fish Assemblage Monitoring:

2.3.1. Fish Surveys:

In each of the eight site visits at least one diver was able to complete a fish survey using the Roving Diving Technique (RDT; Schmitt & Sullivan 1996). During the first sampling quarter (February 9, 2008) seven RDT fish surveys were conducted yielding 12 species (Table 1, Fig. 1). During the second sampling interval (May 03, 2008), four surveys were conducted yielding 15 species (Table 1, Fig. 1). While the number of fish species recorded between the first and second sampling intervals were similar, the cumulative species richness shows a near doubling of the number of species recorded (Fig. 2). During the third sampling interval (Quarter 3 = August 1 & Sep. 7, 2008) seven RDT surveys were conducted yielding 29 species (Table 1, Fig. 1). The cumulative number of species observed to date is 35 (Table 1, Fig. 2). Commonly encountered species (abundance category 4, > 100 individuals) include Red Snapper (*Lutjanus campechanus*), Gray Snapper (*Lutjanus griseus*), Tomtate (*Haemulon aurolineatum*), Atlantic Spadefish (*Chaetodipterus faber*), Seaweed Blenny (*Parablennius marmoreus*), Gray Triggerfish (*Balistes capriscus*), Spottail Pinfish (*Diplodus holbrooki*), and Blue Runner (*Caranx crysos*). The latter were observed in the water column above the reef (~20 – 30 ft depth).

Table 1. List of fish species found during the three sampled quarters on the Texas Clipper Reef. Quarter designation is as follows: 1 = Feb. 09, 2008; 2 = May 03, 2008; and 3 = Aug. 01 and Sep. 07, 2008.

Taxa (#)	Common Name	Scientific Name	Quarter
1	Red Snapper	*Lutjanus campechanus*	1,2,3
2	Tomtate	*Haemulon aurolineatum*	1,2,3
3	Gray Snapper	*Lutjanus griseus*	1,3
4	Atlantic Spadefish	*Chaetodipterus faber*	1,2,3
5	Seaweed Blenny	*Parablennius marmoreus*	1,2,3
6	Redlip Blenny	*Ophioblennius atlanticus*	2,3
7	Yellowtail Hamlet	*Hypoplectrus chlorurus*	1
8	Sergeant Major	*Abudefduf saxatilis*	1,2
9	Gray Triggerfish	*Balistes capriscus*	1,2,3
10	Lane Snapper	*Lutjanus synagris*	1,2
11	Gag	*Mycteroperca microlepis*	1
12	Spottail Pinfish	*Diplodus holbrooki*	1,2,3
13	Pinfish	*Lagodon rhomboides*	1,2,3
14	Spotfin Butterflyfish	*Chaetodon ocellatus*	3
15	Bar Jack	*Caranx ruber*	2
16	Sheepshead	*Archosargus probatocephalus*	2,3
17	Reef Butterfly	*Chaetodon sedentarius*	2,3
18	Yellow Jack	*Caranx bartholomaei*	2
19	Almaco Jack	*Seriola rivoliana*	2,3
20	Blue Runner	*Caranx crysos*	3
21	Amberjack	*Seriola cf. dumerili*	3
22	Cocoa Damselfish	*Pomacentrus variabilis*	3
23	Barracuda	*Sphyraena barracuda*	3
24	Rockhind	*Epinephelus adscensionis*	3
25	Scamp	*Mycteroperca phenax*	3
26	Ling	*Rachycentron canadum*	3
27	Belted Sandfish	*Serranus subligarius*	3
28	Planehead File	*Monacanthus hispidus*	3
29	Lookdown	*Selene vomer*	3
30	Purple Reef Fish	*Chromis scotti*	3
31	Sharpnose Puffer	*Canthigaster rostrata*	3
32	Queen Angel	*Holacanthus ciliaris*	3
33	Scombridae	*Scomberomorus* sp.	3
34	Vermillion Snapper	*Rhomboplites aurorubens*	3
35	Dusky Damselfish	*Pomacentrus fuscus*	3

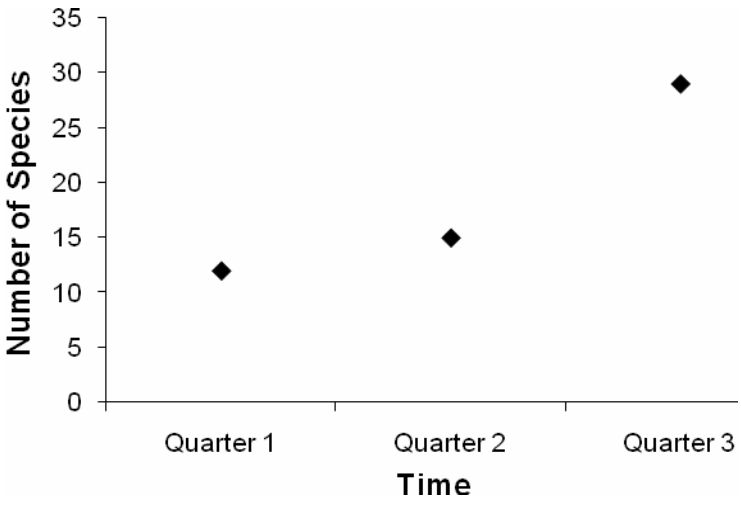


Fig. 1. Number of species observed (species richness) by quarter on the Texas Clipper Reef. Quarter 1 = Feb. 09, 2008; Quarter 2 = May 03, 2008; Quarter 3 = Aug. 01 & Sep. 07, 2008.

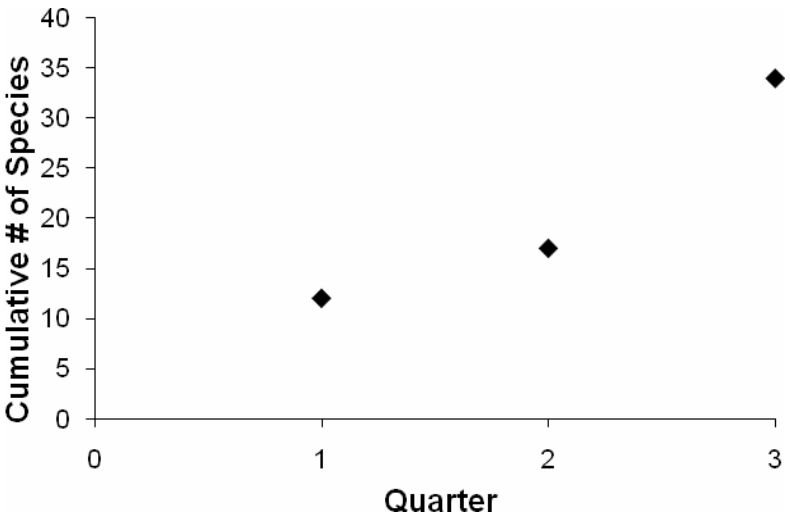


Fig. 2. Cumulative number of fishes observed by quarter on the Texas Clipper Reef. Quarter 1 = Feb. 09, 2008; Quarter 2 = May 03, 2008; Quarter 3 = Aug. 01 & Sep. 07, 2008.

2.3.2. Fish Census Training:

Researchers from the University of Texas Marine Science Institute (John Williams and Rick Kline) and Texas A&M Galveston (Kevin Buch) have assisted us in training UTB/TSC students in fish census and identification techniques. One UTB/TSC graduate student supported on this contract has been assigned this responsibility.

2.4. Biofouling Community Monitoring:

2.4.1. Phototransects:

Phototransects were utilized to estimate large scale diversity of the biofouling community (i.e. sessile invertebrates and algae) in each sampling interval. Our original experimental design included five permanent 10 m transects (each consisting non-overlapping photographs) established on the upper portion of the port and starboard topsides and oriented in a bow-to-stern direction. However, the realized final resting position of the ship (lying on its port side) necessitated modifications to our original sampling design. Accordingly, our first site visit (Quarter 1 = February 9, 2008) was a planning and assessment trip whereon the decision was made to establish 3 permanent transects on the upper starboard topsides (Fig. 3; T2STS, T3STS, T4STS). Three additional photostations (short transects consisting of 2 – 4, 0.25 m^{-2} sampling areas), were established including the bow and stern starboard topsides (T1STS & T5STS) and the outermost edge of the starboard navigation deck wing (T6SNW, Fig. 3).

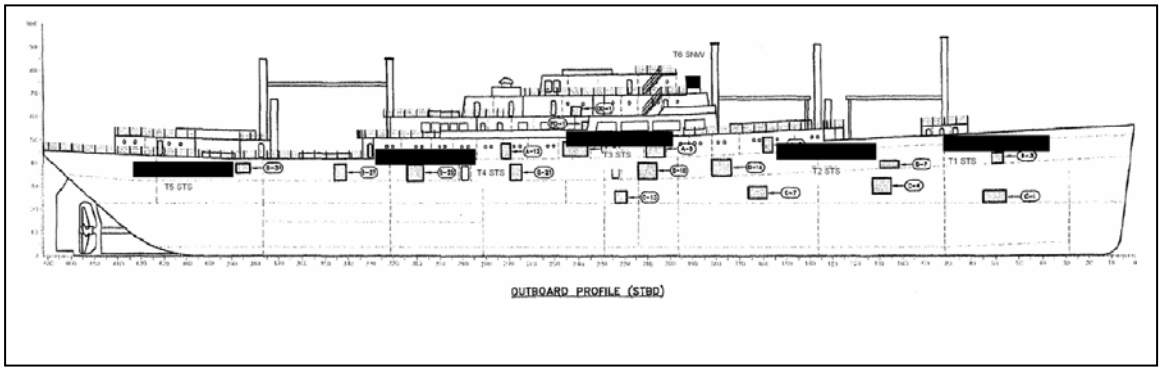
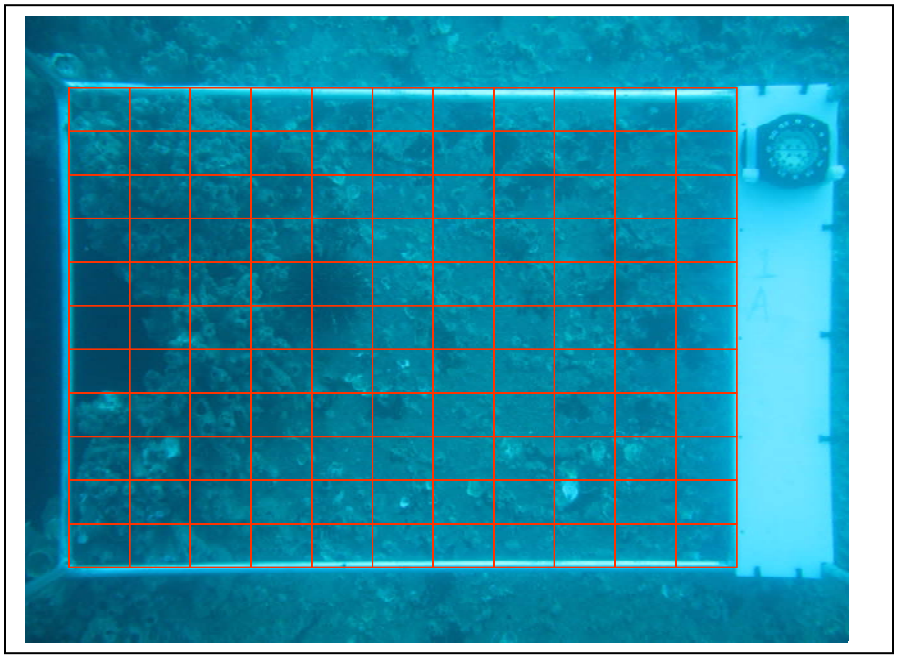


Fig. 3. Starboard view of the USTS Texas Clipper showing the approximate locations of the five permanent phototransects. The stations from bow to stern are T1STS, T2STS, T3STS, T4STS, and T5STS. Also shown is the photostation on the navigation deck (T6SNW).

Transect sampling was initiated during the second quarter sampling interval (Quarter 2 = May 3, 2008). Two transects were sampled (T4STS [Starboard Top-Side] and T5STS, Fig. 3; 11 and 5 photographs per transect, respectively) using an "L-shaped" rod (95 cm camera to subject distance) attached to the camera which captured a surface length of approximately 1 meter. While this technique produced adequate results, it was difficult to consistently position the camera perpendicular to the hull surface. Thereafter, two rectangular framers (quadrapods, 60.3 x 41.5 cm = 0.25 m^{-2}) were custom built allowing for more consistent photographs. Use of these framers was initiated during the third quarter sampling interval over two site visits (Quarter 3 = August 1 & Sep. 7, 2008). Four transects were sampled (T1STS, T2STS, T4STS, T5STS) each consisting of 3, 18, 5 and 15 photographs, respectively. In addition, a photostation was established on the starboard side of the navigation wing (2 photos, T6SNW). During the fourth quarter (October 19, 2008), transects T3STS and T4STS were sampled with 8 and 16 photos each.

In the laboratory, each photoquadrat is overlain with an electronic grid consisting of 100 intersecting points (Fig. 4). The biota or substrate at each point is categorized and represented as a percentage of the total 100 points. These data will ultimately be utilized to extrapolate the fouling community as percent cover and density (e.g., individuals per square meter).

A



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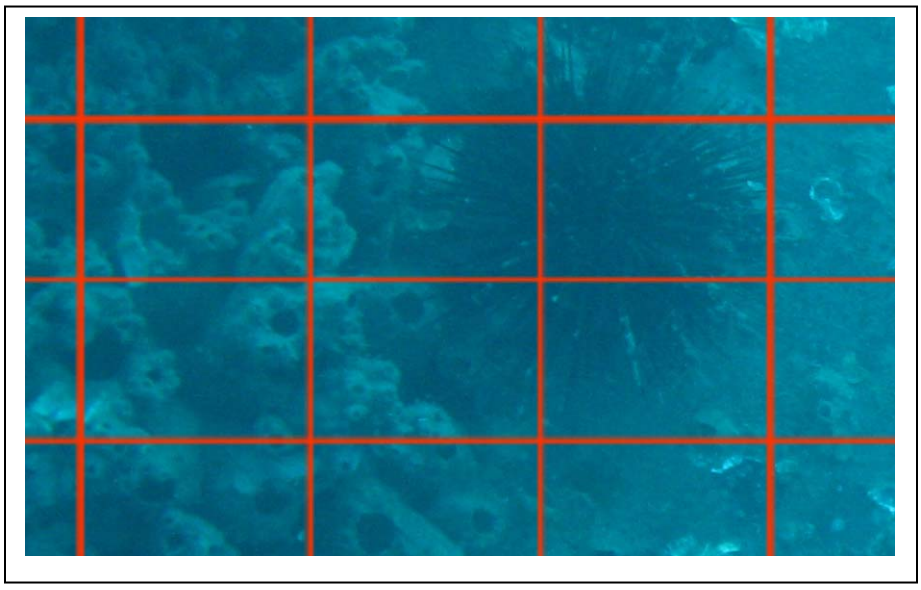

Fig. 4. **A**. Example of photoquadrat with overlying electronic grid consisting of 100 intersecting points at 1x magnification. **B**. Example of photoquadrat with overlying electronic grid at 2x magnification.

2.4.2. Collecting Plates:

Hull surface fouling colonization rates and productivity were originally to be monitored through the use of collecting plates deployed along the length of the ship. A total of 27 racks (18 total vertical surface racks and 9 total horizontal surface racks) each accommodating eight, 25 x 25 cm, square collecting plates were welded to the ship prior to reefing. However, during our initial site visit (Quarter 1 = February 9, 2008) it was determined that only 6 of the 27 racks were both accessible and able to hold plates due to the position of the ship (lying on its port side). Further, we had stored all 216 collecting plates in a deck box on the port side, which was now at a depth of approximately 125 ft. The six available starboard-side racks included three on the Officer's deck and three on the Navigation deck at depths of 85 – 90 feet (Fig. 5). It was decided the available racks were no longer suitable for achieving our original objective, however, they were later employed for an ancillary project (see Ancillary Projects – 'testing the intermediate disturbance hypothesis for artificial reef management' below).

As it was still desirable to quantify hull-fouling biomass and diversity of the smaller fouling species not detectable in the phototransects, an alternative methodology was developed. During our initial site visit (February 9, 2008) we attempted to use a 75 mm wide putty knife to scrap an area of approximately 25 x 25 cm directly from the hull into a 500 µm mesh bag. While this proved appropriate for collecting a qualitative sample, too much of the sample was lost during collection to be of quantitative value. Nonetheless, a species diversity value of 0.88 (Shannon's log base 10) was calculated for this sample. Species captured included one hydroid species (unidentified), one polychaete species (*Hydroides protulicola*), four species of bivalves (*Pteria colymbus*, *Pinctada imbricata*, *Barbatia candida*, and an unidentified scallop), two species of gastropods (*Stramonita haemastoma* and an unidentified nudibranch), three species of amphipods (one caprellidean – suborder Caprellidea – and two gammaridean species – suborder Gammaridea), one species of barnacle (*Balanus trigonus*), one unidentified malacostracan, one larval tunicate, and two species of bryozoans (unidentified) (Table 2).

Prior to the second sampling interval (Quarter 2 = May 3, 2008) we developed an airlift sampler that incorporated a photo framer with a detachable 25 x 25 cm magnetic quadrat for quantifying hull-fouling organisms/biomass. Prior to scraping the hull, a photograph of the 25 x 25 cm area was taken. This was done to relate our scraped areas to the larger (0.25 m^{-2}) photoquadrats. The area within the quadrate was scraped using a 75 mm wide putty and the sample sucked into a 500 µm mesh bag using the airlift sampler. While this proved a promising method for obtaining a quantitative sample, some modifications to the airlift sample were required prior to the next sampling interval. Specimens collected in the second sampling interval (May 3, 2008) included one sponge species (unidentified), two polychaete species (*Neanthes succinea* and *Hydroides protulicola*), one caprellidean amphipod (suborder Caprellidea), seven gammaridean amphipods (suborder Gammaridea; families Corophiidae, Podoceridae, Ischyroceridae, Stenothidae, and two species of Gammaridae), one isopod (Order Isopoda), one crab species (Xanthidae), one barnacle species (*Balanus trigonus*), four gastropod species (*Stramonita haemastoma*, pyramidellid, columbellid, and an unidentified juvenile specimen), and four bivalve species (*Pteria colymbus*, *Barbatia candida*, *Petricola typica* & an unidentified pectinid), one unidentified malacostraca, and one bryozoan

(unidentified) (Table 2). A species diversity value of 1.01 (Shannon's log base 10) was calculated for this sample.

The airlift sampler was redesigned prior to the third sampling interval (Quarter 3 = August 1 & Sep. 7, 2008). Two samples were taken near phototransects T2STS and T4STS. The samples from this quarter have not been processed.

Table 2. List of biofouling taxa found during the first two sampled quarters from the Texas Clipper Reef. Numbers in "Quarter" indicate the abundance (individuals or number of colonies depending on solitary or colonial organism) present during that quarter (Quarter 1 = Feb. 09, 2008 and Quarter 2 = May 03, 2008).

Taxa (#)	Taxonomic group	Scientific Name	Quarter 1	Quarter 2
1	Amphipod	Caprellidea sp. 1	6	4
2	Amphipod	Corophiidae sp. 1	0	1
3	Amphipod	Gammaridean sp. 1	1	5
4	Amphipod	Gammaridean sp. 2	25	21
5	Amphipod	Ischypoceridae sp. 1 male	0	1
6	Amphipod	Ischypoceridae sp. 1 female	0	8
7	Amphipod	Podoceridae sp. 1	0	10
8	Amphipod	Stenothoidae sp. 1	0	61
9	Barnacles	*Balanus trigonus*	22	13
10	Bivalve	*Barbatia candida*	9	34
11	Bivalve	*Pteria colymbus*	2	2
12	Bivalve	*Petricola typica*	0	4
13	Malacostracan	Malacostraca sp. 1	1	3
14	Bryozoan	Unidentified sp. 1	1	1
15	Bryozoan	Unidentified sp. 2	1	0
16	Decapod	Xanthidae	0	10
17	Hydrozoan	Unidentified sp. 1	2	0
18	Isopod	Unidentified sp. 1	0	5
19	Nudibranch	Unidentified sp. 1	2	0
20	Pearl Oyster	*Pinctada imbricata*	1	0
21	Polychaete	*Hydroides protulicola*	3	1
22	Polychaete	*Neanthes succinea*	0	4
23	Scallop	Unidentified sp. 1	1	1
24	Gastropod	*Stramonita haemastoma*	1	1
25	Gastropod	Columbellidae sp. 1	0	1
26	Gastropod	Pyramidellidae sp. 1	0	1
27	Gastropod	Unidentified sp. 1	0	1
28	Poriferan	Unidentified sp. 1	0	2
29	Tunicate Larvae	Unidentified sp. 1	2	0

2.5. Video Transects:

Video recording of the reef site was initiated during the second sampling interval (Quarter 2 = May 3, 2008) and continued in each sampling interval thereafter. Copies of all videos were provided to Bruce Biermann (TPWD) on DVD.

2.6. Linking to Environmental Variables:

There has been some internal problems that have forced the delay in acquisition of the data sondes for measuring water quality variables at the reef site. Thus, deployment of the environmental sampling equipment will be accomplished during the second year.

2.7. Ancillary Tasks:

Two graduate student projects related current sampling of the Texas Clipper Reef have been initiated: 1) One student project will test the intermediate disturbance hypothesis on recruitment and diversity of biofouling communities, and 2) another will test the effects of surface contour structures on recruitment of biofouling invertebrates. Both projects are applied and aimed at providing information to managers of artificial reefs that may lead to future enhancement actions for increasing productivity at reef sites.

2.7.1. Testing the Intermediate Disturbance Hypothesis:

To test the intermediate disturbance hypothesis, physical disturbances consisting of biomass removal treatments of 11% (low disturbance level), 28% (intermediate disturbance level), and 44% (high disturbance level) will be applied to experimental plates (25 X 25 cm). A fourth, undisturbed treatment will serve as a control. Forty-eight collecting plates were deployed across six plate racks (Fig. 5) over three dives (Oct 19, Oct 25, and Dec 7, 2008). Within each rack, experimental plates were randomly assigned to one of each of the three disturbance treatments and undisturbed control treatments. All four treatments are replicated once within each experimental block (rack). The design includes a total of 12 replicates of each treatment across the six racks which is experimentally referred to as a complete randomized block design with within-block replication.

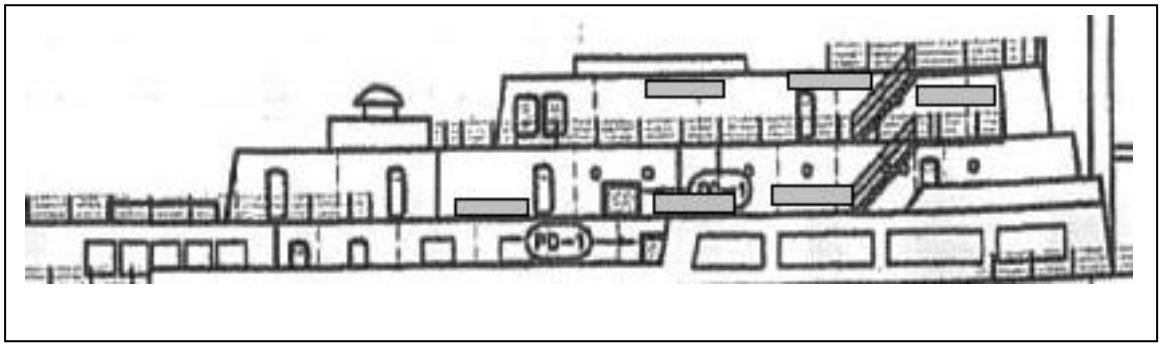

Fig. 5. Starboard view of the Promenade, Officer's, and Navigation decks showing the approximate locations of six collecting plate racks. Each rack holds eight 25 x 25 cm steel plates.

The first disturbance will commence following a maturation period of approximately two-three months (February 2009). Successive disturbances will be randomly applied to each experimental plate (excluding controls) at approximately two month intervals for a total of four disturbances. Random samples of the fouling communities will be collected during consecutive disturbances via scraping and the use of the airlift sampler described above for the biofouling assessments. All specimens will be identified in the laboratory to the lowest possible taxa. The Analysis of Similarity (ANOSIM) routine in PRIMER will be used to test the null hypothesis of no difference in community composition among treatments.

2.7.2. Testing the Role of Surface Contour Structures on Biofouling Recruitment (Invertebrates):

To test the role of surface contour structures on recruitment of biofouling invertebrates, pieces of ¾ inch angle iron will be attached to the hull using an epoxy resin to create positive (i.e., upward directed) surface contours. Existing cut-out sections in the hull will serve as negative contours. Adjacent flat surfaces of the hull will be used as a control. During each quarter, all treatments will be photographed as described above for the biofouling biomass assessments. At the end of 12 months, the fouling communities of all treatments will be collected using the airlift sampler. All specimens will be identified in the laboratory to the lowest possible taxa. The Analysis of Similarity (ANOSIM) routine in PRIMER will be used to test the null hypothesis of no difference in community composition among treatments.

3. Plans for the Next Year (by Task):

3.1. Fish Assemblage Monitoring:

We plan to conduct three-to-six roving diver fish surveys in each quarter in the upcoming year.

3.2. Biofouling Community Monitoring:

We plan to sample all six photo stations/transects in each quarter in the upcoming year. In addition, we anticipate collecting two scrapes for species composition and biomass determinations from each of the three permanent phototransects (T2STS, T3STS, T4STS) in each quarter.

3.3. Video Transects:

We plan to continue with video documentation. At least one video transect per sampling quarter.

3.4. Linking to Environmental Variables:

We plan to deploy the water quality sampling equipment (data sondes) in January 2009. One data sonde will be deployed during each quarter and will record physiochemical parameters on the reef between quarters. In each quarter thereafter, the deployed data sonde will be retrieved and replaced with a cleaned sonde.

3.5. Ancillary Tasks:

We plan to continue with the ancillary thesis projects related to the 'testing the intermediate disturbance hypothesis' and 'testing the role of surface contour structures on recruitment of biofouling invertebrates.'

References

Schmitt RF, Sullivan KM. 1996. Analysis of a volunteer method for collecting fish presence and abundance data in the Florida Keys. Bulletin of Marine Science 59 (2): 404-416.