U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Center for Coastal Fisheries and Habitat Research
101 Pivers Island Road
Beaufort, North Carolina 28516

Comparative analysis of the functioning of disturbed and undisturbed coral reef and seagrass ecosystems in the Tortugas: Phase I- Establishing a baseline

Progress Report # 1

September 1, 2000

and Cruise Report for

NOAA Ship FERREL Cruise FE-00-09-BL
10 July 2000 - 04 August 2000

Submitted By:

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September 1, 2000

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INTRODUCTION

The Tortugas Ecological Reserve may be implemented in the year 2000. If implemented as it is currently proposed, it will include two components: Tortugas North and South (Figure 1). Tortugas North will be approx. 151 nm^2 and cover the northern half of Tortugas Bank, Sherwood Forest, the pinnacle reefs north of the bank and extensive low relief areas in the 15-40 m depth range. The latter low relief areas have received little assessment. Tortugas South will be approx. 60 nm^2 and encompass Riley's Hump as well as deep water habitats to the south which are reported to provide critical habitat for several snapper species, snowy grouper, tilefish, and golden crab. The implementation of this reserve provides an excellent opportunity for NOAA to investigate the effects of human disturbance (e.g., elimination of consumptive sampling and physical impacts) on the functioning of coral reef and deepwater algal and seagrass ecosystems. Specifically, the determine the efficacy of this management action, several long-term monitoring actions must be taken, including evaluating the local and regional areas in terms of larval fish export, changes in adult fish biomass, and especially, changes in ecosystem structure and associated ecological processes.

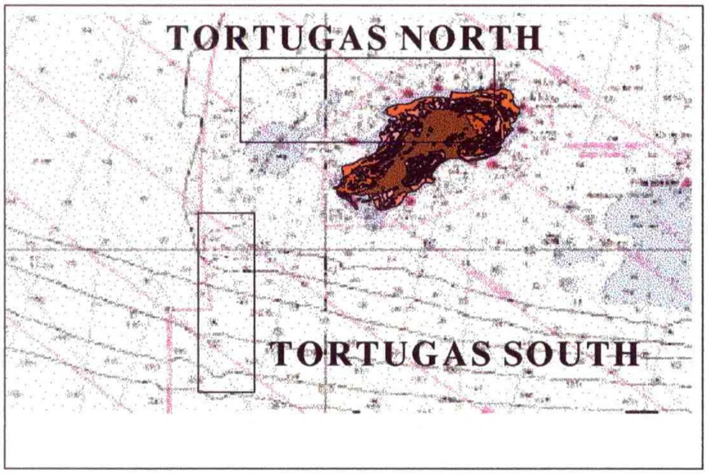

Figure 1. Proposed boundaries of the Tortugas Ecological Reserve.

The National Centers for Coastal Ocean Science, here headed by the Center for Coastal Fisheries and Habitat Research (CCFHR) and our colleagues both in and out of NCCOS (Center for Coastal Monitoring and Assessment, Coastal Services Center, Florida Marine Research Institute, National Undersea Research Center, and the University of South Florida)are uniquely poised to provide critical mission support to habitat characterization and marine reserve questions that are facing the proposed Tortugas Ecological Reserve (TER) within the Florida Keys National Marine Sanctuary (FKNMS). CCFHR has researched fishery-habitat interactions in south Florida and the Keys since the early 1980's and brings a wide range of scientific expertise to bear on fisheries and habitat issues. Moreover, we are coordinating this work with the research approach and philosophy of applied studies of our other studies in the region - including injury recovery experiments, monitoring and modeling in the FKNMS, linkages among coral reefs and adjacent habitats in Puerto Rico, EFH funding on the contribution of deepwater primary producers to coastal fisheries and gear impact studies, and long-term studies of icthyoplankton distribution, development and transport mechanisms.

The need for detailed habitat characterization is inextricably linked with the reserve issue. Many reef fishes leave the structure of the reef at night to forage in the adjacent sand, algal and seagrass flats, thereby importing significant amounts of nutrients onto the reef environment, contributing to its high productivity. This mass transfer also ultimately contributes to energy requirements of small grazers that cannot themselves access the adjacent, non-coral reef resources. The adjacent seagrass beds are also significant settlement areas for post-larval reef fishes. Over-fishing of the diurnally migrating fishes and/or physical damage to the foraging/settlement environment could significantly alter the reserve's productivity and biological diversity. Therefore, habitat characterization is critical to determine the distribution of sessile resources that are susceptible to injury and which may be poised to rebound once any injury activity is relaxed through implementation of the reserve. Habitat characterization is also crucial to ultimately determine an ecologically optimal size of the reserve complex (i.e., the reef and the adjacent areas upon which reef fauna are dependent) to yield optimum fishery production and maintain the ecological health of the reef ecosystem. Finally, conducting work in the proposed TER provides a unique opportunity to compare the structure and function of a relatively undisturbed system with those elsewhere in the FKNMS and adjacent waters. This comparative approach has significant potential for translating the findings of these studies so as to apply them directly to management issues in other NOAA trust resources.

In support of this research, the NOAA Ship FERREL arrived in Key West, FL on 07 July 2000 to support research objectives of the CCFHR and collaborators (CCMA, CSC, FMRI, NURC, USF - see cruise compliment, pages 8-9)on the southwest Florida continental shelf. and the proposed Dry Tortugas Ecological Reserve. Four operational legs were completed: Leg 1) 10-14 July, Leg 2) 16-21 July, Leg 3) 23-28 July and Leg 4) 30 July - 04 August.. A total of 24 scientists representing six federal, State and academic institutions participated in the month - long cruise.

OBJECTIVES

Programmatic: Over the three year period of this work, we have proposed:
1) a preliminary characterization and inventory of the benthic habitat and fish communities in the extreme depths of the Tortugas South reserve component;
2) characterization of spawning aggregations and initiating the development of a probabilistic model of the fate of snapper larvae, focusing on Riley's Hump;
3) beginning comparative characterization of shallow and deepwater seagrass communities and their contribution to fishery resources in disturbed (outside the reserve) and undisturbed sites (inside the reserve);
4) establishment of a baseline for benthic nutrient composition and flux in disturbed and undisturbed sites;
5) determination of the accuracy of existing habitat delineations within the proposed ecological reserve as a function of depth and disturbed and undisturbed sites;
6) examination of how high resolution ecological data of a given habitat type can be scaled to the larger spatial context of the proposed ecological reserve.

Cruise FE-00-09-BL: Here, our objectives were to:
1) collect comparative data of resident invertebrate, fish, and plant populations as part of ongoing Essential Fish Habitat (EFH) research on the west Florida shelf and as part of the Florida Keys National Marine Sanctuary (FKNMS) effort to assess the efficacy of the institution of an Ecological Reserve at the Dry Tortugas;
2) conduct extensive habitat characterizations of the Reserve areas in comparison with areas outside the proposed Reserve using both direct survey and sonar-based seafloor classification systems.
3) ground truth digital video tows of the seafloor using various sampling mechanisms, including Remotely Operated Vehicles (ROV) and Tow Operated Vehicles (TOV);
4) conduct Tucker trawl and Bongo net surveys of larval fish populations;
5) begin our determination of food web linkages and the functional extent of the coral reef / soft bottom community via multiple stable isotope analysis;
6) conduct observations of snapper spawning and deploy ARGOS drifters at Riley's Hump;
7) evaluate sampling sites for subsequent gear impact studies; and
8) conduct collections and primary production measurements of various seagrass species.

Cruise Components: 10 July 2000 Departed Key West, FL morning

-conducted benthic surveys of previously delineated stations running offshore from the latitude of Cape

Sable to ~30M depth using diver surveys, ROV, TOV and trawling

15 July 2000	Arrived Key West early morning
16 July 2000	Departed Key West evening

-began mapping using TOV, biological monitoring of seafloor through point sampling and fish censuses taken during diver surveys, crepuscular and nighttime beam trawling in Tortugas North

22 July 2000	Arrived Key West early morning
23 July 2000	Departed Key West evening

-continued mapping using TOV and sonar-based seafloor classification systems (Quester-Tangent SeaView and RoxAnn sonar systems), biological monitoring of seafloor through point sampling and fish censuses taken during dive operations, crepuscular and nighttime beam trawling in Tortugas North

29 July 2000	Arrived Key West early morning
30 July 2000	Departed Key West evening

-crepuscular and nighttime Bongo tows, fish censuses during diver surveys, ROV surveys of deepwater benthic habitats, ARGOS drifter deployment on Riley's Hump in Tortugas South.

04 August 2000Arrived Key West and disembarked

WEST FLORIDA SHELF

Station Location and General Survey Work: During the first leg of the cruise we returned to the 10 x 10 m plots within the three central 1 square km stations that were established in 1999 (Figure 1, Table 1). This site serves several purposes that overlap with three funding sources. First, resampling these stations completes a one-year cycle of investigation initiated last year (1999) under EFH funding which supported the examination of the role that deepwater primary producers (benthic macro and micro algae, phytoplankton and the seagrass *Halophila decipiens*) play in the support of the highly productive fisheries of the west Florida shelf. Second, this sampling provides an important comparative context for the work in the Tortugas. We have now achieved a similar kind of ecosystem analysis here as is planned for the Tortugas and that the similarities and differences in the habitat linkages, structure and functions among these two adjacent ecosystems will aid us in deducing just how common these results might be in this region - and whether each of these two adjacent geographic areas has attributes that are divergent from the other. The level of convergence or divergence in how these systems function will tell us the degree to which we can generalize expected results from management decisions regarding the role and utility of putting portions of marine ecosystems under protection. Third and finally, this area will be the site of our upcoming EFH-funded gear impact studies to hard bottom, seagrass and algal communities. The extra mapping effort we have put in here serves to not only

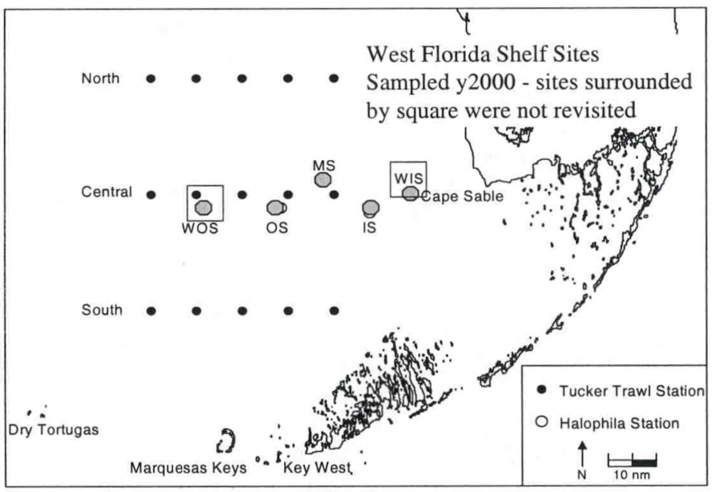

Figure 2. OS = outer shelf, MS = mid shelf, IS = inner shelf.

choose study sites, but aid us in determining the spatial scale over which we might extrapolate our findings (e.g., geostatistical analyses of habitat organization). As with our ongoing studies in the FKNMS on seagrass and now coral injury recovery, the response of these sites to gear impacts is directly applicable to the Tortugas environment and gives us some sense of how fast we might expect to see responses to the imposition of the Reserve status.

Approach (General): *Halophila* habitat located within the three central 1 square km stations were re-mapped using a towed video sled. Detailed plant and animal collections were made via diver-based sampling.

Macroflora, Microflora and Meiofauna: The biological resources associated with the *Halophila* habitat were re-assessed. Divers randomly surveyed the seafloor within 10 x 10 m plots to determine seagrass cover at 0.0625 m^2 resolution. As before, replicate plant samples (both quadrat and video frame) from each of the 3, 10 x 10m plots per 1 square km station. *(Supports SRD/NCCOS Task 3, Appendix I, and EFH funded research on benthic community contributions to fishery resources and gear impacts)*

Benthic Survey: We conducted georeferenced video mapping of each 1 square km station on transects spaced 200m apart and run in two sets, each normal to the other (Figure 2). *(Supports SRD/NCCOS Tasks 3,5, & 6, Appendix I and EFH funded research on benthic community contributions to fishery resources and gear impacts)*

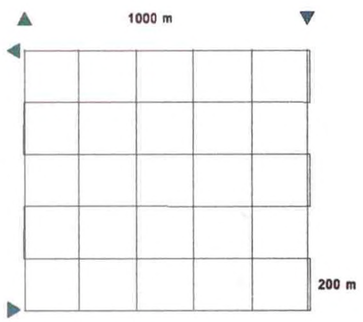

Figure 3. Layout of 1 square km permanent station and associated video transect.

Haemulid/Lutjanid Recruitment: Icthyoplankton was sampled with a Tucker Trawl sled at 15 stations along three transects. A CTD profile was made at each station. (Supports SRD/NCCOS Task 2, Appendix I)

Approach (Specific): We returned to the study areas established in 1999. The study areas are located along a ~ 30 mile inshore - offshore (east - west) transect, extending to about 45 miles offshore. The stations are located in ~35, 45, and 65 feet of water - all have mixtures of sand, hard bottom and extensive seagrass *(Halophila decipiens)* beds, as well as macroalgae. We towed the video sled with its associated camera about 21,000 m along the seafloor, showing a 1 m swath along that distance with < 1 cm resolution, all within the 1 square km stations.

At each station, the video transects were run perpendicular at approximately 200m spacing in order to provide a spatially accurate assessment of the seafloor for choosing locations for subsequent fishing gear impact studies (EFH funds). All video was geographically referenced both in our onboard Geographic Information System and on each frame of the video. We logged several dives, mostly breathing Nitrox at the two deeper sites as a safety precaution and to extend bottom time (Table 2). At each of the 10 x 10 m quadrats within each station, divers conducted random assessments of seagrass and algal cover using visual assessment methodology (Braun-Blanquet) mapped the area with 0.0625 m^2 accuracy for cover. By using DGPS, we were able to place divers back on these sites often within a meter of the permanent marker on the seafloor. Divers conducted sampling for seagrass biomass, seagrass morphology, seagrass life history, seed production, sediment seed bank, and benthic microalgae.

A total of 45 depth-stratified icthyoplankton samples were collected from 15 stations on three transects on the southwest Florida continental shelf via diel Tucker trawls. Sorting and identification of samples is in progress at CCFHR. Hydrographic profiles were obtained at each station with a SBE-19 CTD.

***DRY TORTUGAS PROPOSED ECOLOGICAL RESERVE* (North)**

Station Location and General Survey Work: During the second and third legs of the cruise, extensive benthic mapping within the north side of the reserve was conducted using a mini-bat TOV housing a camera and sonar system and using a ROXANN sonar system. We transferred the video-based record of seagrass cover (presence/absence) at 1 m resolution into a GIS. We used the GIS to develop maps of seagrass cover and to guide the subsequent placement of fish trawls. Fish video censuses were made during dive operations and detailed plant and animal collections were made via trawling and diver-based sampling.

On the fourth leg, we used the NURC ROV and a drop camera to search for vegetated and hard bottom communities outside of the coral areas using a stratified random point sample design. Fish visual censuses were made by divers. Fish larvae samples were taken via Bongo tows. Seven ARGOS drifters were deployed and CTD samples were taken to characterize the water column.

Approach (General): Habitat Characterization: We conducted searches (using NURC ROV and drop camera) for vegetated and hard bottom habitats outside of the coral areas using a stratified random point sample design. The sample universe was composed of two classes of strata: use and depth. Use (see Figure 3) was broken down into the existing Dry Tortugas National Park, the proposed reserve not falling

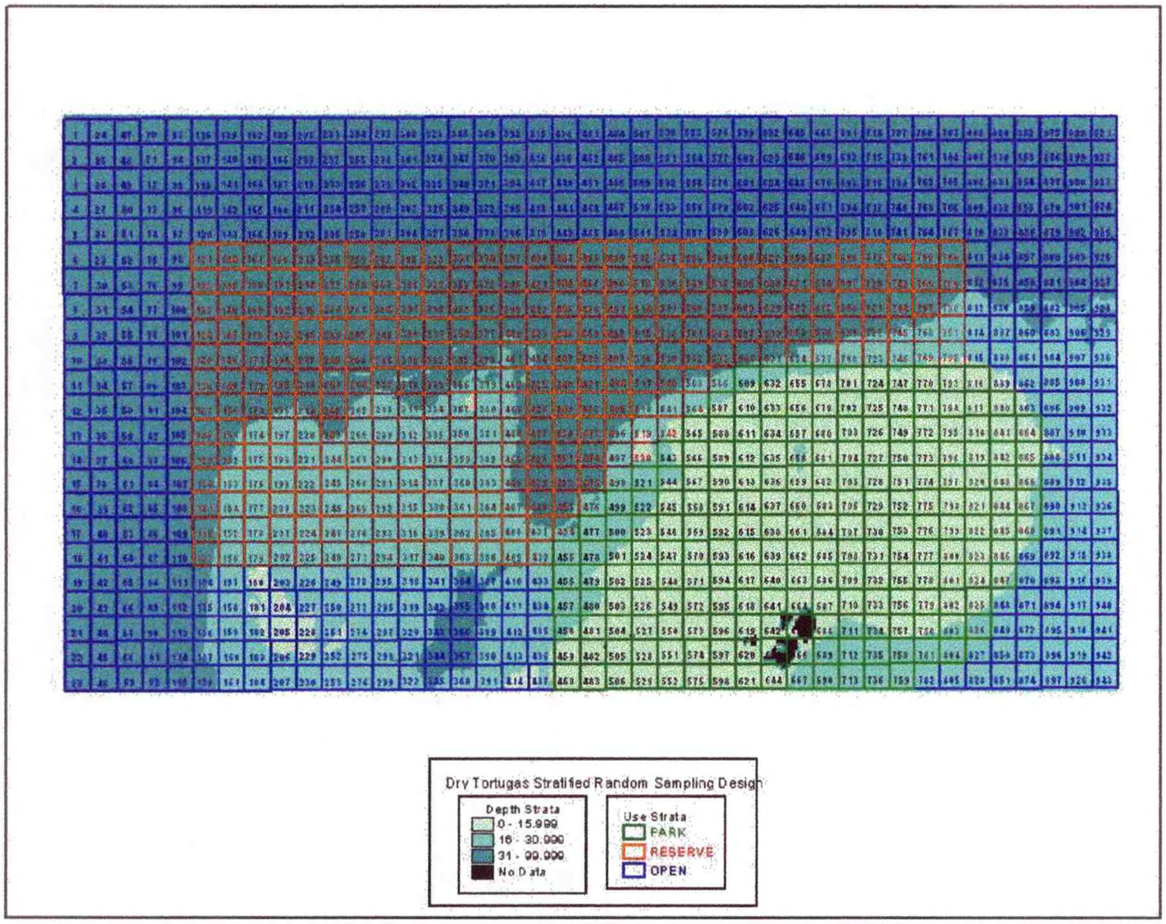

Figure 3. Stratified random sampling design for Tortugas North - by depth and Use Zone.

within the existing jurisdiction of the DTNP, and a 5 km buffer around the proposed reserve for before/after comparisons, again not within the DTNP (Figure 3). Within each use category, three depth strata were arbitrarily defined as: 0-15 m (shallow) 15.1-30 (medium), 30.1 + (deep). The entire sample universe was broken into 1 km square grids which were randomly chosen from within each strata for sampling. Precise sample locations from within each square km were also randomly chosen at a 1 m resolution through additional sub-sampling and locating of the coordinates in the field by use of a survey-grade DGPS (Trimble Pro XR).

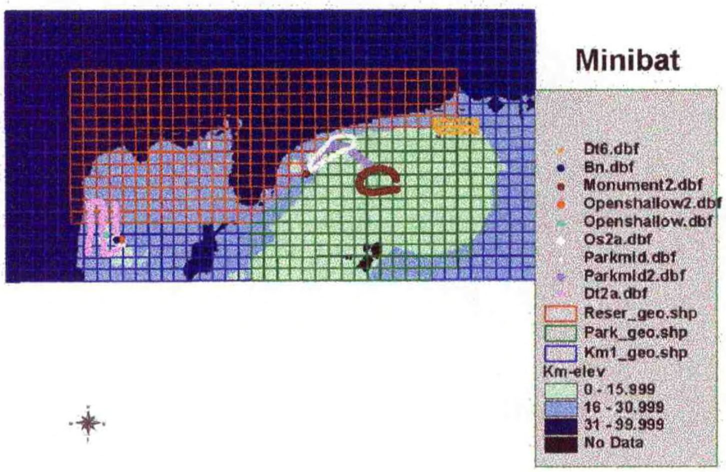

Figure 4. Minibat video tracks overlain on sample strata.

We conducted benthic mapping using a mini-bat® TOV housing a vertially-mounted camera and in some cases a sonar-based seafloor classification system (Quester Tangent C View ® - these were the first sea trials for us with this unit)). An additional sonar unit (ROXANN) was deployed from a launch on the third leg and followed the QTC view path for cross-calibration via the video as all these data collections are georeferenced and time-stamp coordinated. We will transfer the video-based record of seagrass cover (presence / absence) from each transect (Figure 4) by randomly sub-sampling positions at 1 m resolution, inspecting the georeferenced video tape and recording the seafloor composition into a Geographic Information System (GIS: ArcVIEW). We then used the GIS to develop maps of seagrass cover and guide the subsequent placement of fish trawls after inspection by either divers or additional TOV deployment, depending on depth. *(Supports SRD/NCCOS Tasks 3, 5 & 6 Appendix I, and EFH funded research on benthic community contributions to fishery resources and gear impacts)*

<u>Macroflora and Fauna</u>: The biological resources of randomly selected points (Figure 5, Table 3) were selected from the aforementioned stratified random grid. Replicate plant, sediment, microflora and meiofauna samples were collected using traps and core tubes from each of the random coordinates. *(Supports SRD/NCCOS Task 3 Appendix I, and EFH funded research on benthic community contributions to fishery resources and gear impacts)*

<u>Stable Isotope (SI) Sampling</u>: Divers collected seagrass, macroalgae, benthic microalgae and associated biota for stable isotope analysis (see Figure 5 and Table 4). Tissue samples were stored frozen and plant material was dried in a drying oven and stored in a desiccator. Fishes previously not encountered were collected to be utilized for stable isotope analysis. *(Supports SRD/NCCOS Tasks 3 and 4, Appendix I)*

<u>Phytoplankton collection</u>: Periodically, at sites where operations called for a full stop of the vessel, we collected seawater from the surface and near bottom. Water was filtered for phytoplankton SI, chlorophyll, and biomass (Table 5). *(Supports SRD/NCCOS Task 3, Appendix I)*

<u>Vagile Macrofauna</u>: We sampled the larval and juvenile fishes and meiofauna utilizing the seafloor beyond the coral reef (Figure 5 and Table 6).

A: <u>2m beam trawl</u>: At randomly located stations we conducted five minute tows. Samples were

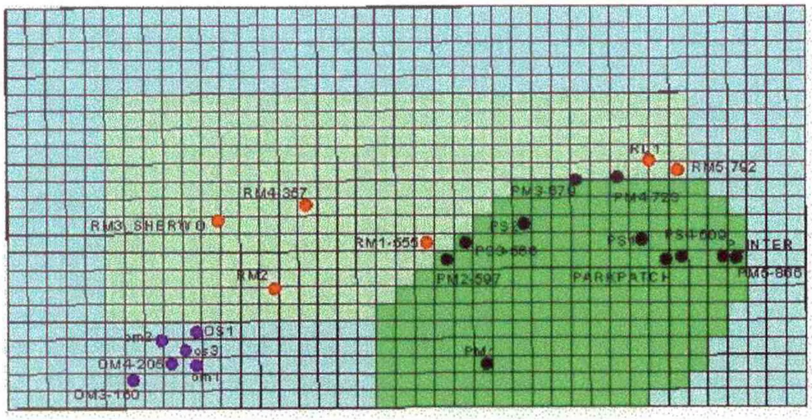

Figure 5. Locations of stratified random samples for biological sampling - leg IV has not yet been appended. See Tables 3 - 6 at end of document for a description of work done at each sample station.

preserved initially in formalin (24 hr) and later transferred to ethyl alcohol.

B: Diver towed seine: At randomly located stations we conducted diver towed seines along 20m transects. Samples were preserved initially in formalin (24 hr) and later transferred to ethyl alcohol. *(Supports SRD/NCCOS Task 3, Appendix I)*

Ancillary Data: We collected continual incident PAR, measures of water clarity, GIS track of beam trawls, water temperature and irradiance data, especially irradiance at the sediment surface. Continuous navigation and meteorological data provided by the ship's SCS system. Hydrographic data were collected in association with Bongo nets using a SBE-19 CTD (Table 5). *(Supports SRD/NCCOS Tasks 2-5, Appendix I)*

Approach (Specific): In the second leg of the cruise, we used a mini-bat TOV housing a camera and sonar system to characterize habitat in areas located within the current Reserve and areas located outside the proposed Reserve. Figure 6 shows an example of how the mini-bat TOV was run so as to survey several use zones for subsequent comparative analysis. We towed the unit approximately 75,000m over the seafloor, showing at least a 1m swath along that distance. Numerous dives were made often breathing Nitrox as a safety precaution and to extend bottom time (Table 7 and Appendix II). Divers also conducted visual and video fish censuses along 20m transects and at representative stations conducted video transects, visual census transects and the Bohnsack method for cross-comparison. Divers took samples for sediment particle size and organic content, seagrass, invertebrate, and fish stable isotope analysis, benthic microalgae, and benthic macroalgae.

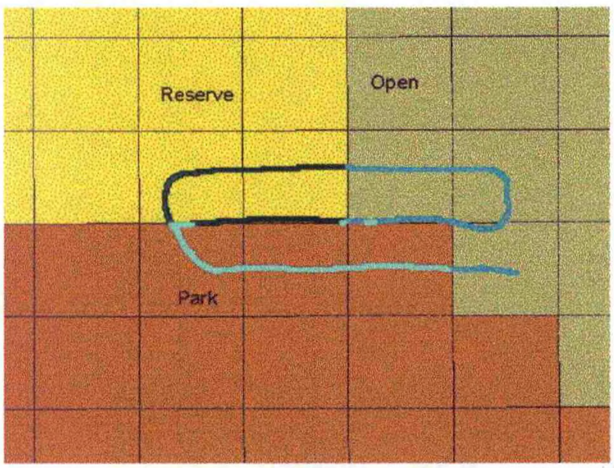

Figure 6. Zoom-in of mini-bat TOV transect showing the distribution of sampling among adjacent use zones.

In the third leg of the cruise, we continued mapping the benthos using the mini-bat TOV housing a camera and sonar system in addition to a ROXANN sonar unit. Divers continued taking samples, and conducting visual and video fish censuses. A total of 5 crepuscular and nighttime beam trawls were made (Table 6). Sorting and identification of the samples is in progress at CCFHR.

***DRY TORTUGAS PROPOSED ECOLOGICAL RESERVE* (South)**

Station Location and General Survey Work (Tortugas South (TS) and Riley's Hump): We conducted georeferenced mapping of this area by ~100 ft depth increments using the large NURC ROV. Launches were dispatched to Tortugas North to conduct drop camera surveys of points in the southeast corner of the National Park.

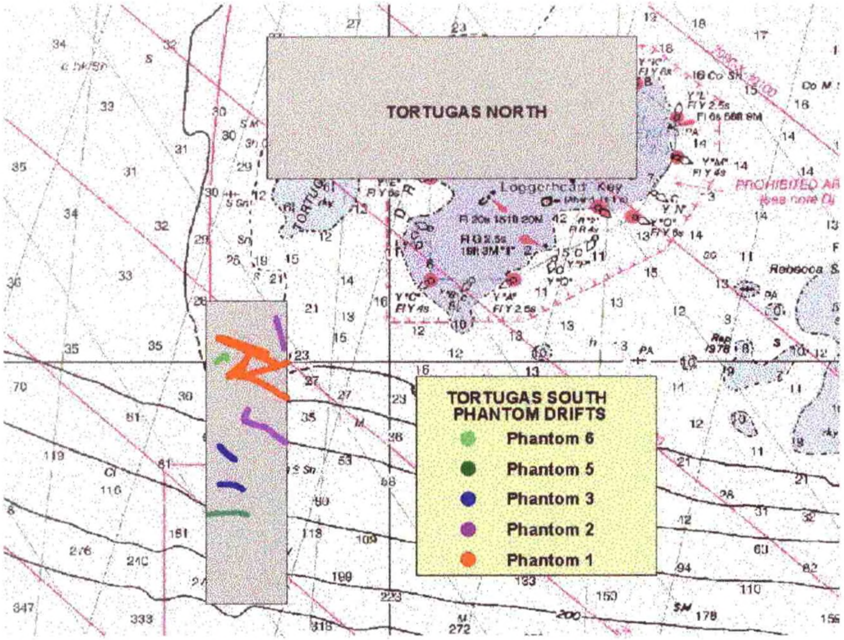

Figure 7. Location of NURC ROV transects in Tortugas South.

Approach (General):
Habitat Characterization:. We video mapped depth-stratified transects across the TS area using the NURC ROV S-2. This was accomplished by drifting the vessel or lightly powered tows to the operational depth of the equipment (~ 800 feet). Day and night surveys were conducted - daytime for resource distribution and nights for nighttime observations of faunal behavior and their utilization of the resource. *(Supports SRD/NCCOS Tasks 1, 2 & 6, Appendix I)*

Snapper Spawning Aggregations: We deployed seven satellite-tracked drifters within the TS to track the possible fate of locally-spawned fish larvae. This involved steaming through the deployment location and deploying drifters off the stern. Numerous dives for visual census of fish again using video, visual census transects and the Bohnsack method were conducted, albeit limited to ~ 110', a small fraction of the reserve depth range.

Three 8 hour nights of Bongo tows and CTD sampling were conducted in the vicinity of TS. Habitat coverage and fish observations taken by the ROV were used to guide the deployment of divers for fish censuses and observations of snapper spawning aggregations. *(Supports SRD/NCCOS Task 2, Appendix I)*

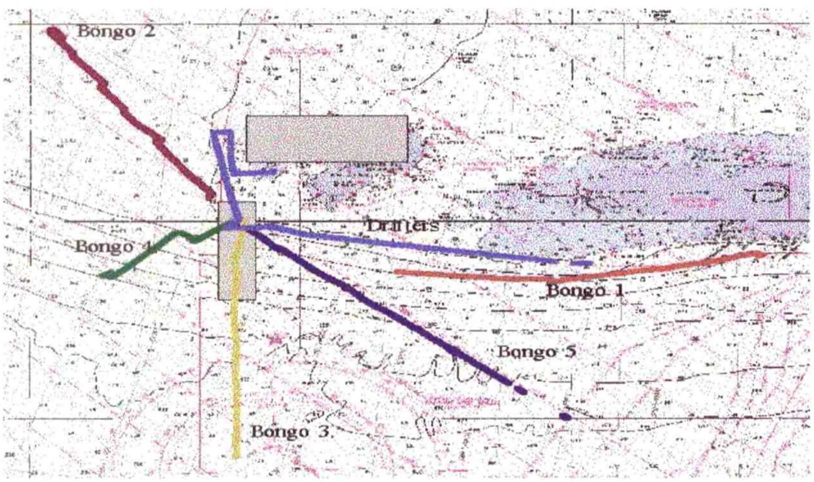

Figure 8. Tracks for bongo net tows and the track taken for drifter deployment are shown overlain on the local chart and proposed reserve locations.

Ancillary Data: As before, we collected the following: continual incident PAR, measures of water clarity, GIS track of ROV deployments, water temperature and irradiance data down to 20 m. Continuous navigation and meteorological data were provided by the ship's SCS system. Hydrographic data were collected in association with Bongo nets using a SBE-19 CTD.

Approach (Specific): In the fourth leg of the cruise, the NURC ROV was used to characterize the benthos in deepwater areas (down to ~ 800 ft). A total of 9 tows were made over a distance of roughly 15,000 m, with depths ranging and including a depth range from 94 to 807 ft. Habitat and fish observations taken from the ROV were used to place divers in areas were habitat was conducive to snapper aggregations or in areas where aggregations were observed (<110 ft). In these areas visual and video fish censuses were made by the divers. On three nights, 8-hour Bongo tows were made to collect larval fish. In conjunction with the tows, CTD casts were made to characterize the water column.

CRUISE PARTICIPANTS

Leg 1: 10 - 14 July 2000

Name	**Title**	**Affiliation**
Jud Kenworthy	Fishery Biologist/Chief Scientist	NOS, Beaufort
Paula Whitfield	Biological Technician/ Field Party Chief	NOS, Beaufort
Craig Bonn	Biological Technician	NOS, Beaufort
Ron Dean	Graduate Student	UNC Wilmington
Mike Greene	Biological Science Technician	NOS, Beaufort
Kamille Hammerstrom	Fishery Biologist	NOS, Beaufort
Larry Settle	Fishery Biologist	NOS, Beaufort
Christian Shaw	Graduate student	Cape Fear Community College Wilmington, NC

Leg 2: 17-21 July 2000

Name	**Title**	**Affiliation**
Jud Kenworthy	Fishery Biologist/Chief Scientist	NOS, Beaufort
Kamille Hammerstrom	Fishery Biologist/Field Party Chief	NOS, Beaufort
Craig Bonn	Biological Technician	NOS, Beaufort
John Burke	Fishery Biologist	NOS, Beaufort
John Christensen	Senior Marine Biologist	NOS, Silver Spring
Carolyn Currin	Microbiologist	NOS, Beaufort
Mark Monaco	Marine Biologist	NOS, Silver Spring
Brian Swafford	volunteer	NOS, Beaufort

Leg 3: 24-28 July 2000

Name	**Title**	**Affiliation**
Jud Kenworthy	Fishery Biologist/Chief Scientist	NOS, Beaufort
Mark Fonseca	Ecologist/Field Party Chief	NOS, Beaufort
John Burke	Fishery Biologist	NOS, Beaufort
Rebecca Conroy	Marine Scientist	FLDEP, St. Petersburg
Mark Finkbeiner	Geographer	NOS, Charleston
Penny Hall	Marne Scientist	FLDEP, St. Petersburg
Jitka Hynova	Marine Scientist	FLDEP, St. Petersburg
Amy Uhrin	Biological Technician	NOS, Beaufort

Leg 4: 31 July - 04 August

Name	**Title**	**Affiliation**
Jon Hare	Fishery Biologist/Chief Scientist	NOS, Beaufort
Mark Fonseca	Ecologist/Field Party Chief	NOS, Beaufort
Mike Burton	Fishery Biologist	NOS, Beaufort
Tom Potts	Science Director	NURC, UNC Wilmington
Dave Score	Marine Scientist	Gray's Reef NMS
Glenn Taylor	Marine Scientist	NURC, UNC Wilmington

Amy Uhrin	Biological Technician	NOS, Beaufort
Paula Whitfield	Biological Technician	NOS, Beaufort

Other participants in the planning and post-mission assessments:

Name	**Title**	**Affiliation**
Susan S. Bell	Assistant Professor	Univ. South Florida, Tampa
Lisa Wood	Biological Technician	NOS, Beaufort

Table 1. Summary dive statistics for west Florida shelf- see Appendix II for complete data).

# Divers	Total # Dives	Total Bottom Time (all dives)	Average Bottom Time	Average Depth
8	50	24.53 hr	49 min	47 ft

Table 2. Summary dive statistics for Dry Tortugas (North and South combined - see Appendix II for complete data).

# Divers	Total # Dives	Total Bottom Time (all dives)	Average Bottom Time	Average Depth
18	164	64.16 hrs	39 min	64 ft

Table 3. Sample Summary of Total Stable Isotope Samples.

Station	Date	Stratified grid sq. km ID #	Stable Isotope (SI) Benthic Microalgae	SI Phytoplankton	SI Seagrass	SI Macroalgae	SI Fish	SI Invertebrates
om1	7/17/00	830		1		4	1	1
om2	7/17/00	746	4	1		4		1
os3	7/17/00	788	4	1		1	7	3
ps1	7/18/00			1				
pm1	7/18/00			1	3	5	6	1
ps2	7/18/00							
pm2	7/19/00	566	8			3	2	1
ps3	7/19/00	557	6			2		
ps4	7/19/00	609						
rm1	7/20/00	555		1		1		11
rm2	7/20/00					2		2
os1	7/20/00		2			1	1	3
rm3	7/21/00					2		1
p-patch	7/19/00				1	2		
pm3	7/24/00	679		1				1
pm4	7/24/00	723		1				
open 1	7/24/00						1	10
om3	7/25/00	160		1				
om4	7/25/00	205		1				
rm4	7/25/00	357						1
Reserve 1	7/25/00							
pm5	7/26/00	866		1				
rm5	7/26/00	792		1				
rd1	7/27/00							
pm5a	7/27/00	866				1 bag		1 bag gast
Open 2	7/27/00						2	1
park interface	7/28/00	866						
bongo1	7/30/00	n/a						
RH "snapper agg"	7/31/00					5	2fishshot	
RH on the Hump	7/31/00							
sw out mid "edgepatch"	7/31/00						2fishshot	
bongo2	7/31/00							
RH "snapper agg"	7/31/00							
edgplat	8/1/00							
RH 300	8/1/00							
sprkomid	8/1/00							
sprkintfce	8/2/00							
sprkmid	8/2/00					1		
sprkmdwst	8/2/00							
sprkptch	8/2/00							
snap2off	8/2/00							

Table 3 contd. Station	Date	Stratified grid sq. km ID #	Stable Isotope (SI) Benthic Microalgae	SI Phytoplankton	SI Seagrass	SI Macroalgae	SI Fish	SI Invertebrates
RH off	8/2/00							
RH 550'	8/2/00							
bongo3	8/2/00							
RH 717-770'	8/3/00							
RH ledge	8/3/00				1 (sfc drift)	1(sfc drift)		

Table 4. Samples Taken for Benthic Habitat Characterization

Station	Date	Stratified grid sq. km ID #	Minibat Tows	ROV Phantom S-2	Drop Camera	Braun-Blanquet Assess-ment	Benthic Chlorophyll Cores
om1	7/17/00	830				1	4
om2	7/17/00	746				1	4
os3	7/17/00	788				1	4
ps1	7/18/00					1	0
pm1	7/18/00					1	4
ps2	7/18/00					1	4
pm2	7/19/00	566	yes			1	4
ps3	7/19/00	557	yes			1	4
ps4	7/19/00	609				1	4
rm1	7/20/00	555	yes			1	4
rm2	7/20/00					1	4
os1	7/20/00					1	4
rm3	7/21/00					0	0
p-patch	7/19/00					0	
pm3	7/24/00	679				1	4
pm4	7/24/00	723	yes			1	4
Open 1	7/24/00				2		
om3	7/25/00	160	yes			1	4
om4	7/25/00	205				1	4
rm4	7/25/00	357	yes			1	4
Reserve 1	7/25/00				1		
pm5	7/26/00	866	yes			1	4
rm5	7/26/00	792	yes			1	4
rd1	7/27/00					1	0
pm5a	7/27/00	866					
Open 2	7/27/00				1		
park interface	7/28/00	866	yes			1	4
bongo1	7/30/00	n/a					
RH "snapper agg"	7/31/00						
RH on the Hump	7/31/00			3 total all over hump with one at crepuscl uar back over the 2nd of the day			
sw out mid "edgepatch"	7/31/00					1	
bongo2	7/31/00						
RH "snapper agg"	7/31/00						
edgplat	8/1/00						

Table 4 contd.

Station	Date	Stratified grid sq. km ID #	Minibat Tows	ROV Phantom S-2	Drop Camera	Braun-Blanquet Assess-ment	Benthic Chlorophyll Cores
RH 300	8/1/00			2 - one north of hump and one at 300-270'			
sprkomid	8/1/00					1	
sprkintfce	8/2/00						
sprkmid	8/2/00					1	
sprkmdwst	8/2/00						
sprkptch	8/2/00						
snap2off	8/2/00						
RH off	8/2/00						
RH 550'	8/2/00			3 all at depth of ~ 550'			
bongo3	8/2/00						
RH 717-770'	8/3/00						
RH ledge	8/3/00			1 at this depth range			

Table 5. Sample Summary for All Data Collected on Fish

Station	Date	Stratified grid sq. km ID #	Diver Point Count	Diver Band Count	Video Tran-sect	SCUBA Seine	Diver Visual Census	2M Beam Trawl	Bongo Tows
om1	7/17/00	830	2	2		3			
om2	7/17/00	746	2	2		0			
os3	7/17/00	788	2	2		0			
ps1	7/18/00		2	2		2			
pm1	7/18/00		2	2		3			
ps2	7/18/00		2	2		0			
pm2	7/19/00	566	2	2		0			
ps3	7/19/00	557	2	2		0			
ps4	7/19/00	609	2	2		0			
rm1	7/20/00	555	2	2		0			
rm2	7/20/00		2	2		0			
os1	7/20/00		2	2		0			
rm3	7/21/00		3	0		0			
p-patch	7/19/00								
pm3	7/24/00	679	1	1	1				
pm4	7/24/00	723	1	1	1				
Open 1	7/24/00							2	
om3	7/25/00	160	1	1	1	1			
om4	7/25/00	205	1	1	1	1			
rm4	7/25/00	357	1	1	1	0			
Reserve 1	7/25/00							1	
pm5	7/26/00	866	1	1	1	1			
rm5	7/26/00	792	1	1	1	0			
rd1	7/27/00		0	1	0	1			
pm5a	7/27/00	866							
Open 2	7/27/00							2	
park interface	7/28/00	866	1	1	1	1			
bongo1	7/30/00	n/a							3
RH "snapper agg"	7/31/00		2		2		2		
RH on the Hump	7/31/00								
sw out mid "edgepatch"	7/31/00						1		
bongo2	7/31/00								
RH "snapper agg"	7/31/00								4
edgplat	8/1/00		2		2		2		
RH 300	8/1/00								
sprkomid	8/1/00						1		
sprkintfce	8/2/00								
sprkmid	8/2/00				1				
sprkmdwst	8/2/00								
sprkptch	8/2/00								
snap2off	8/2/00								
RH off	8/2/00		2		2				
RH 550'	8/2/00		2		2				
bongo3	8/2/00								3
RH 717-770'	8/3/00								
RH ledge	8/3/00		3		3				

Table 6. Sample Summary of Water Column Data

Station	Date	Stratified grid sq. km ID #	Water Column Chloro-phyll	Inci-dent Light	Light Profiles	CTD
om1	7/17/00	830	2	yes		
om2	7/17/00	746	2	yes		
os3	7/17/00	788	2	yes	1	
ps1	7/18/00		2	yes	1	
pm1	7/18/00		2	yes		
ps2	7/18/00		2	yes		
pm2	7/19/00	566		yes	1	
ps3	7/19/00	557	2	yes	1	
ps4	7/19/00	609		yes		
rm1	7/20/00	555	2	yes	1	
rm2	7/20/00			yes		
os1	7/20/00			yes		
rm3	7/21/00			yes		
p-patch	7/19/00			yes		
pm3	7/24/00	679	2	yes		
pm4	7/24/00	723	2	yes	1	
Open 1	7/24/00					
om3	7/25/00	160	2	yes	1	
om4	7/25/00	205	2	yes		
rm4	7/25/00	357		yes	1	
Reserve 1	7/25/00					
pm5	7/26/00	866	2	yes		
				yes	1	
rm5	7/26/00	792	2	yes		
rd1	7/27/00			yes	1	
pm5a	7/27/00	866				
Open 2	7/27/00					
park interface	7/28/00	866	2	yes		
bongo1	7/30/00	n/a		yes		3
RH "snapper agg"	7/31/00			yes		
RH on the Hump	7/31/00					
sw out mid "edgepatch"	7/31/00					
bongo2	7/31/00					6
RH "snapper agg"	7/31/00					
edgplat	8/1/00			yes	1	
RH 300	8/1/00					
sprkomid	8/1/00					
sprkintfce	8/2/00					
sprkmid	8/2/00					
sprkmdwst	8/2/00					
sprkptch	8/2/00					
snap2off	8/2/00					
RH off	8/2/00					
RH 550'	8/2/00					
bongo3	8/2/00					
RH 717-770'	8/3/00					
RH ledge	8/3/00					

APPENDIX I: Specific task of work submitted to SRD by NCCOS for fy 2000-2003. Text in [bold] are suggested revisions to the project statement based on our initial survey of the site. Text in [*bold italics*] indicates deletion.

STATEMENT OF WORK: The project consists of 6 tasks designed to meet information gaps in the assessment of the effectiveness of the ecological reserve:

Task 1. CCFHR shall conduct a preliminary investigation into the technical and logistic difficulties in preparing a numerically accurate and spatially precise characterization and inventory of the fish and benthic communities of the Tortugas South reserve component, focusing on the Riley's Hump area. While the area boundaries have been delineated, the structure of the benthos has not been tightly linked with its function as fishery habitat. Therefore, bathymetric delineation alone is not sufficient - a direct examination is required to determine the amount of living sessile and motile resources, their kind (taxonomy) and spatial organization and distribution. However, the depth ranges involved in this examination exceed NOAA diving safety standards and remote means or piloted submersibles are needed to conduct the study correctly. CCFHR will utilize its videographic technology within the depth ranges of its equipment (< 200') to conduct random point-grid surveys, stratified by depth of portions of the reserve where NOAA ships can maneuver. We will also utilize NURC ROV technology to expand this search on a as-available basis. From the interpretation of these videographic images, correlated with their geographic position, we will build GIS data layers of species distributions and conduct statistical analyses to project and plan further characterization efforts. **[We will also attempt to utilize historical videography of this site from other programs and recruit other programs utilizing technology with greater deep ranges into the delineation process].**
Product: At the end of year 1, CCFHR will provide a characterization report describing challenges in performing an accurate benthic and fish communities characterization with taxonomic lists for fish, stony corals, soft corals, sponges, and algae. CCFHR will also provide a preliminary assessment of these communities in the form of GIS data layers within the depth ranges addressable with current technology.

Task 2. CCFHR shall characterize the mutton snapper spawning aggregations on Riley's Hump by documenting the approx. size of the aggregation, its timing and duration, and other species involved. Aggregations of four other species of snappers also occur on Riley's Hump. Management strategies have not sufficiently limited fishing pressure at this site, nor decreased the potential damage to coral reefs through fishing activities. There remains real concern about the viability of the population of mutton snapper that uses this site for spawning, and more generally, about the viability of large spawning aggregations of groupers and snappers once spawning aggregations are found. To better protect spawning aggregations, research into the special characteristics of the specific spawning sites is needed. In addition, knowledge of the fate of larvae spawned from these sites in crucial to evaluate a site's larger importance to populations throughout the southeastern United States. We will attempt to identify specific spawning sites of mutton snapper via SCUBA surveys during the spawning months of May and June, with limited work in July. Characteristics of specific spawning sites (e.g. benthic cover, bathymetry) will be recorded. During spawning site characterization, satellite tracks drifters will be released to estimate the potential fate of larvae spawned at the site. These drifter tracks will be used in the development of a probabalistic model to assess the regional importance of mutton snapper spawning at Riley's Hump.
Product: A spawning characterization chapter shall be produced as part of the overall site characterization document for Tortugas South. (Interim report in each of years 1-2; final in 3-5 years).

Task 3. CCFHR shall begin to characterize the deepwater seagrass **[and other non-reef benthic]** communities and its contribution to sustaining the fishery resources in the proposed ecological reserve and compare this contribution to a disturbed site (e.g., nearby site not within the reserve designation). This work is an examination of the geographic extent and offshore depth limit of the various seagrasses within the reserve, including the deeper *H. decipiens* bed and a study of how these seagrasses and other habitats (macroalgae, live bottom) sustain the fishery resources of the TER. We would attempt to locate the offshore limit of forage areas of hard bottom/coral reef resident fishes of the TER proper within the

ranges of our divers and remote technology. We will measure the flux of fishes between hard bottom and seagrass habitats in both disturbed and undisturbed representative habitats by documenting their movement, particularly during crepuscular hours. The offshore limit of the distribution of resident reef fishes would delineate the areal extent of their habitat utilization in both areas. This area would also define that required to support the current reef fish population - the functional area of the reef ecosystem which is critical in order to evaluate effectiveness of the reserve, both in a disturbed and undisturbed state. We would accomplish this by creating a georectified sampling grid encompassing the TER and sampling (in partnership with NURC and other investigators) using ROVs to locate the habitat extent. Within this grid, habitat structure and function will be examined within replicate, representative one km2 study areas using a variety of remote and direct sampling techniques that have proven successful in our work on the west Florida shelf. As in our ongoing work, stable isotope analyses (C, N, S) will be taken of plants and animals comprising these communities to more precisely define food webs and linkage among habitats.
Product: Preliminary comparative analysis of the structure of faunal-habitat linkages among disturbed and undisturbed portions of the reserve as an indicator of reserve effectiveness. (Interim report in each of years 1-2; final in 3-5 years).

[Task 4. TER waters are oligotrophic and particularly sensitive to changes in light attenuation and nutrients. Such changes lead to alterations of benthic habitats that feed back into water column water quality through a variety of processes, including nutrient uptake, respiration rate, and release of dissolved inorganic nutrients from sediments. We propose to determine the diel rates and directions of benthic-pelagic nutrient flux, thereby establishing a baseline for benthic nutrient fluxes in disturbed vs. undisturbed sites which can be used as an indicator of reserve effectiveness.
Product: Comparative analysis of benthic-pelagic nutrient flux in disturbed vs. undisturbed sites.(Interim report each in years 1-2; final in 3-5 years).] *As this was not strongly endorsed by then-science manager B. Haskell, we suggest that this be modified to conduct comparative surveys of benthic sediment nutrients as a measure of the response of diatom and benthic microalgal (and potentially macroalgal and seagrass) response to the alleviation of trawling pressure, particularly along the northern edge of Tortugas North.*

Task 5. The CCFHR will initiate a comparative analysis of the delineation of habitats based on depth will be performed by conducting a georectified towed video transects ***[technology development section deleted - vendor found]*** of the seafloor within and outside of the reserve at various depths and within previously delineated habitat boundaries. Statistical analyses will be performed after interpretation of the video as to the probability of habitat type occurrence by depth using the existing delineations vs. those of the towed video. Data will be compiled in [ArcVIEW] GIS.
Product: Preliminary report on comparative analysis of error in habitat delineation within and outside of the reserve as a function of water depth. (Interim report in each of years 1-2; final in 3-5 years).

Task 6. Examine how well ecological data collected at high resolution can be scaled to the larger spatial extent of a given habitat type within the proposed ecological reserve. Georectified videographic records of habitat distribution and bathymetric data will be examined using geostatistical methods to determine the scale dependency of the benthic structure.
Product: A statistical analysis of the minimum spatial scales that should be utilized to conduct unbiased parametric assessments of habitat-linked resources in and out of the reserve. (Interim report in years 1; final in 2 years)

General: At the end of FY 2000 CCFHR will provide a summary document describing what goals have been met over the course of the cruises in the form of these combined progress and cruise reports to SRD and NOAA ship operations.

APPENDIX II - Dive log for cruise FE-00-09-BL. RG= repetetive group, PD = plan depth, PT = plan time, RNT=residual nitrogen time, MaxT =maximum bottom time, TD = time down, TU = time up, Depth (D) is in feet, ABT/ESDT= acutal bottom time/equivalent single dive time, NG= new RG, TBT = total bottom tome.

DIVER	DATE	% O2	PSI in	PSI out	RG	PD (ft)	PT	RNT	Max T	TD	TU	D (ft)	ABT/ESDT	NG	TBT
Ron Dean	10-Jul-00	36	3000	700		70	50		100	1309	1344	63	0.32	F	0.32
Craig Bonn	10-Jul-00	36	3000	500		70	50		100	1309	1344	63	0.32	F	0.32
Kamille Hammerstrom	10-Jul-00	36	3000	700		70	50		100	1337	1425	63	0.48	G	0.48
Paula Whitfield	10-Jul-00	36	3100	700		70	50		100	1337	1425	63	0.48	G	0.48
Ron Dean	10-Jul-00	36	3100	450	C	70	50	0.21	79	1738	1812	63	0.30	H	0.51
Craig Bonn	10-Jul-00	36	3000	500	C	70	50	0.21	79	1738	1818	63	0.37	H	0.58
Kamille Hammerstrom	10-Jul-00	36	3000	1100	C	70	50	0.21	79	1801	1839	63	0.34	H	0.55
PaulaWhitfield	10-Jul-00	36	3000	1400	C	70	50	0.21	79	1801	1839	63	0.35	H	0.56
Jud Kenworthy	10-Jul-00	36	3100	500	C	70	50	0.21	79	1801	1839	63	0.34	H	0.55
Craig Bonn	11-Jul-00	36	2900	750		70	60		100	958	1033	66	0.35	F	0.35
Ron Dean	11-Jul-00	36	3000	1100		70	60		100	958	1033	66	0.35	F	0.35
Kamille Hammerstrom	11-Jul-00	36	3000	600		70	60		100	1022	1119	66	0.53	H	0.53
Paula Whitfield	11-Jul-00	36	3000	900		70	60		100	1022	1119	66	0.53	H	0.53
Craig Bonn	11-Jul-00	36	3100	600	B	60	60	0.13	87	1452	1527	49	0.32	E	0.45
Ron Dean	11-Jul-00	36	3250	600	B	60	60	0.13	87	1452	1527	49	0.32	E	0.45
Kamille Hammerstrom	11-Jul-00	36	2850	1200	C	60	60	0.21	79	1514	1601	48	0.45	G	0.66
Paula Whitfield	11-Jul-00	36	3000	1200	C	60	60	0.21	79	1514	1601	50	0.41	G	0.62
Jud Kenworthy	11-Jul-00	36	3300	500		60	60		100	1514	1601	48	0.42	E	0.42
Craig Bonn	12-Jul-00	36	2900	1000		50	60		310	849	922	51	0.34	F	0.34
Ron Dean	12-Jul-00	36	2900	600		50	60		310	849	922	51	0.34	F	0.34
Kamille Hammerstrom	12-Jul-00	36	3000	500		50	60		310	915	1016	52	0.60	H	0.60

Paula Whitfield	12-Jul-00	36	3000	800		50	60		310	915	1016	52	0.60	H	0.60
Craig Bonn	12-Jul-00	36	3000	600	C	60	60	0.25	285	1302	1336	49	0.31	F	0.56
Ron Dean	12-Jul-00	36	3100	500	C	60	60	0.25	285	1302	1336	49	0.31	F	0.56
Kamille Hammerstrom	12-Jul-00	36	3200	700	D	60	60	0.37	273	1330	1424	48	0.50	H	0.87
Paula Whitfield	12-Jul-00	36	3200	1000	D	60	60	0.37	273	1330	1424	49	0.49	H	0.86
KamilleHammerstrom	12-Jul-00	36	3000	1200	C	50	60	0.25	285	1759	1838	47	0.37	G	0.62
Paula Whitfield	12-Jul-00	36	3000	1500	C	50	60	0.25	285	1759	1838	47	0.38	G	0.63
Craig Bonn	12-Jul-00	36	3000	1000	B	50	60	0.17	293	1749	1831	47	0.41	F	0.58
Jud Kenworthy	12-Jul-00	36	3100	500		50	60		310	1749	1831	47	0.41	E	0.41
Ron Dean	12-Jul-00	34	3100	1100	B	50	60	0.17	183	1817	1848	47	0.27		0.44
James Bunn	12-Jul-00	21	3100	800		50	60		100	1817	1848	47	0.30		0.30
Jeff Judas	12-Jul-00	21	3100	800		50	60		100	1817	1848	47	0.30		0.30
Craig Bonn	13-Jul-00	32	3000	1100		40	60		405	906	933	36	0.27	B	0.27
Ron Dean	13-Jul-00	32	3000	700		40	60		405	906	933	36	0.27	B	0.27
Kamille Hammerstrom	13-Jul-00	32	3000	1100		40	60		405	928	1027	37	0.59	D	0.59
Paula Whitfield	13-Jul-00	32	3100	1250		40	60		405	928	1027	36	0.59	D	0.59
Craig Bonn	13-Jul-00	34	3000	1600	A	40	60	0.07	405	1406	1433	35	0.26	C	0.33
Ron Dean	13-Jul-00	34	3100	1200	A	40	60	0.07	405	1406	1433	35	0.26	C	0.33
Scott Kuester	13-Jul-00	21	2950	1750		40	60		200	1406	1433	35	0.26	B	0.26
Kamille Hammerstrom	13-Jul-00	34	3300	1400	B	40	60	0.17	405	1430	1528	34	0.56	E	0.73
Paula Whitfield	13-Jul-00	34	3100	1300	B	40	60	0.17	405	1430	1528	35	0.56	E	0.73
Craig Bonn	13-Jul-00	21	3000	1550	B	40	60	0.17	183	1748	1823	33	0.35	G	0.52
Ron Dean	13-Jul-00	21	3000	1000	B	40	60	0.17	183	1748	1823	32	0.35	G	0.52

Kamille Hammerstrom	13-Jul-00	21	2900	1350	C	40	60	0.25	175	1814	1905	32	0.50	H	0.75
Paula Whitfield	13-Jul-00	21	3000	1400	C	40	60	0.25	175	1814	1905	32	0.50	H	0.75
Jud Kenworthy	13-Jul-00	21	3000			40	60		200						
Craig Bonn	14-Jul-00	21	2900	600		40	60		200	841	920	36	0.39	E	0.39
Kamille Hammerstrom	14-Jul-00	21	3000	1200		40	60		200	841	920	36	0.39	E	0.39
Jud Kenworthy	14-Jul-00	21	3000	750		40	60		200	841	920	36	0.39	E	0.39
Craig Bonn	17-Jul-00	36	3000	1200		60	50		100	1012	1053	53	0.40	F	0.40
Mark Monaco	17-Jul-00	21	2700	1500		60	50		60	1018	1041	52	0.23	E	0.23
John Burke	17-Jul-00	36	3100	1000		60	50		100	1012	1053	53	0.40	F	0.40
John Christiansen	17-Jul-00	21	3100	1100		60	50		60	1018	1041	52	0.23	E	0.23
Brian Swafford	17-Jul-00	36	3050	1150		60	50		100	1128	1211	53	0.39	G	0.39
Kamille Hammerstrom	17-Jul-00	36	3100	1400		60	50		100	1128	1211	53	0.39	G	0.39
Craig Bonn	17-Jul-00	35	3000	1250	C	60	50	0.21	79	1350	1435	57	0.41	I	0.62
MarkMonaco	17-Jul-00	21	2595	1015	C	60	40	0.17	43	1354	1426	57	0.27	H	0.44
John Burke	17-Jul-00	35	3200	900	C	60	50	0.21	79	1350	1435	57	0.41	I	0.62
John Christiansen	17-Jul-00	21	3000	1500	C	60	40	0.17	43	1354	1426	57	0.27	H	0.44
Brian Swafford	17-Jul-00	34	2950	750	C	60	50	0.21	79	1527	1615	56	0.44	I	0.65
Kamille Hammerstrom	17-Jul-00	34	3250	1350	C	60	50	0.21	79	1527	1615	56	0.44	I	0.65
John Burke	17-Jul-00	34	3000	1050	D	60	50	0.37	163	1754	1843	45	0.46	I	0.83
Craig Bonn	17-Jul-00	34	3000	1250	D	60	50	0.37	163	1754	1843	47	0.46	I	0.83
Kamille Hammerstrom	17-Jul-00	36	3100	1400	D	60	50	0.37	163	1907	1951	47	0.40	G	0.77
Jud Kenworthy	17-Jul-00	36	3200	1000		60	50		100	1907	1951	46	0.40	D	0.40
Mark Monaco	17-Jul-00	21	2850	1300	C	60	50	0.17	43	1912	1950	48	0.34	H	0.51
John Christiansen	17-Jul-00	21	2900	1300	C	60	50	0.17	43	1912	1950	46	0.34	H	0.51

Craig Bonn	18-Jul-00	36	3000	2000		50	60		310	1010	1032	41	0.22	C	0.22
John Burke	18-Jul-00	36	2900	2000		50	60		310	1010	1032	41	0.21	C	0.21
John Christiansen	18-Jul-00	21	2900	1850		50	60		100	1013	1040	42	0.25	D	0.25
MarkMonaco	18-Jul-00	21	2770	1925		50	60		100	1013	1040	42	0.25	D	0.25
Brian Swafford	18-Jul-00	36	2850	2000		50	60		310	1020	1042	41	0.21	C	0.21
Kamille Hammerstrom	18-Jul-00	36	3000	2200		50	60		310	1020	1042	41	0.21	C	0.21
Craig Bonn	18-Jul-00	36	3100	1600	B	50	60	0.17	293	1406	1449	49	0.42	F	0.59
John Burke	18-Jul-00	36	3200	1000	B	50	60	0.17	293	1406	1449	49	0.42	F	0.59
John Christiansen	18-Jul-00	21	3000	1350	B	50	60	0.13	87	1411	1440	50	0.29	G	0.42
MarkMonaco	18-Jul-00	21	2700	1450	B	50	60	0.13	87	1411	1440	50	0.29	G	0.42
Kamile Hammerstrom	18-Jul-00	36	3100	1400	B	50	60	0.17	293	1420	1516	49	0.55	G	0.72
Brian Swafford	18-Jul-00	36	3150	1000	B	50	60	0.17	293	1420	1516	49	0.55	G	0.72
Kamille Hammerstrom	18-Jul-00	36	2200	650	C	50	50	0.21		1836	1929	28	0.52		0.73
Jud Kenworthy	18-Jul-00	21	2900	850		50	50			1836	1929	27	0.52		0.52
Craig Bonn	18-Jul-00	36	2000	1000	C	40	60			1837	1922	28	0.43		0.43
Johnn Burke	18-Jul-00	36	2100	1500	C	40	60			1837	1922	25	0.43		0.43
John Christiansen	18-Jul-00	21	3000	1600		40	60			1837	1924	27	0.46		0.46
MarkMonaco	18-Jul-00	21	2760	1465		40	60			1837	1924	27	0.46		0.46
Brian Swafford	19-Jul-00	36	2950	600		70	50	0	100	948	1036	65	0.47	G	0.47
Kamille Hammerstrom	19-Jul-00	36	3150	1350		70	50	0	100	948	1036	65	0.47	G	0.47
Craig Bonn	19-Jul-00	36	3100	2000		70	50	0	100	935	1001	65	0.26	E	0.26
John Burke	19-Jul-00	36	3100	1400		70	50	0	100	935	1001	65	0.26	E	0.26
MarkMonaco	19-Jul-00	21	2700	1550		70	40	0	50	932	1000	65	0.27	F	0.27

John Christiansen	19-Jul-00	21	3100	1700		70	40	0	50	932	1000	65	0.27	F	0.27
Brian Swafford	19-Jul-00	36	3000	700	D	50	60	0.37	273	1314	1410	46	0.55	H	0.92
KamilleHammerstrom	19-Jul-00	36	3250	1300	D	50	60	0.37	273	1314	1410	46	0.55	H	0.92
Craig Bonn	19-Jul-00	36	2000	650	C	50	60	0.25	285	1313	1359	46	0.46	G	0.71
John Burke	19-Jul-00	36	3200	1200	C	50	60	0.25	285	1313	1359	45	0.46	G	0.71
Mark Monaco	19-Jul-00	21	2740	1319	D	50	50	0.3	71	1320	1403	45	0.43	J	0.72
John Christiansen	19-Jul-00	21	3100	1350	D	50	50	0.3	71	1320	1403	45	0.43	J	0.72
Jud Kenworthy	19-Jul-00	21	2950	1400		50	50		100	1825	1858	36	0.32	E	0.32
Kamille Hammerstrom	19-Jul-00	21	3050	2000	C	50	50	0.2	79	1825	1858	36	0.32	G	0.53
Mark Monaco	19-Jul-00	21	2770	2100	C	50	50	0.2	79	1818	1838	37	0.19	E	0.40
John Christiansen	19-Jul-00	21	2750	2000	C	50	50	0.2	79	1818	1838	37	0.19	E	0.40
Craig Bonn	19-Jul-00	21	3000	2000	C	40	60	0.2	100	1812	1850	36	0.33	G	0.58
John Burke	19-Jul-00	21	3100	1800	C	40	60	0.2	100	1812	1850	36	0.33	G	0.58
Mark Monaco	20-Jul-00	21	2740	913		70	40		50	1055	1135	60	0.39	G	0.39
John Christiansen	20-Jul-00	21	3000	1400		70	40		50	1055	1135	59	0.39	G	0.39
Craig Bonn	20-Jul-00	36	3000	1000		70	70		100	1058	1159	62	0.60	H	0.60
John Burke	20-Jul-00	36	2750	600		70	70		100	1058	1159	60	0.60	H	0.60
Brian Swafford	20-Jul-00	36	2900	550		70	70		100	1109	1205	59	0.56	H	0.56
Kamille Hammerstrom	20-Jul-00	36	3400	1100		70	70		100	1109	1205	59	0.56	H	0.56
Brian Swafford	20-Jul-00	35	3250	500	D	70	60	0.3	71	1507	1607	67	0.59	K	0.88
Kamille Hammerstrom	20-Jul-00	35	3500	900	D	70	60	0.3	71	1507	1607	66	0.59	K	0.88
Craig Bonn	20-Jul-00	36	3000	900	D	70	60	0.3	71	1512	1612	67	0.6	K	0.89
John Burke	20-Jul-00	36	3000	600	D	70	60	0.3	71	1512	1612	66	0.6	K	0.89

Mark Monaco	20-Jul-00	21	2900	1380	C	70	30	0.2	35	1516	1546	67	0.3	I	0.45
John Christiansen	20-Jul-00	21	3100	1550	C	70	30	0.2	35	1516	1546	66	0.29	I	0.44
Craig Bonn	20-Jul-00	36	3000	1700	D	50	60	0.4	273	1948	2040	47	0.51	H	0.88
John Burke	20-Jul-00	36	3000	1150	D	50	60	0.4	273	1948	2040	47	0.51	H	0.88
Mark Monaco	20-Jul-00	21	2800	900	C	50	60	0.2	79	1946	2036	47	0.5	J	0.71
John Christiansen	20-Jul-00	21	3000	1000	C	50	60	0.2	79	1946	2036	47	0.5	J	0.71
Jud Kenworthy	20-Jul-00	21	3000	500		50	60		100	1951	2040	47	0.48	F	0.48
Kamille Hammerstrom	20-Jul-00	33	3150	1100		50	60		100	1951	2040	47	0.48	F	0.48
Brian Swafford	20-Jul-00	34	3000	1100		50	60		100	1951	2040	47	0.48	F	0.48
Craig Bonn	20-Jul-00	36	3000	1500	A	90	46	4e-02	46	807	850	79	0.33		
John Burke	20-Jul-00	36	3100	1300	A	90	46	4e-02	46	807	850	79	0.33		
Mark Monaco	21-Jul-00	21	2800	1160	A	90	27	3e-02	27	806	840	76	0.33	I	0.36
Jeff Judas	21-Jul-00	21	3100	800	A	90	27	3e-02	27	806	840	74	0.33	I	0.36
Jud Kenworthy	21-Jul-00	36	3200	700	A	90	47	4e-02	47	807	850	79	0.33	G	0.37
Jud Kenworthy	24-Jul-00	36	3100	500		70	60		100	1044	1123	71	0.38	G	0.38
Rebecca Conroy	24-Jul-00	36	2900	750		70	60		100	1044	1123	71	0.38	G	0.38
John Burke	24-Jul-00	36	3000	500		70	60		100	1044	1140	67	0.51	H	0.51
Jitka Hynovia	24-Jul-00	36	3000	500		70	60		100	1044	1140	67	0.51	H	0.51
John Burke	24-Jul-00	36	3000	650	C	60	50	0.2	79	1519	1608	57	0.50	J	0.71
Jitka Hynovia	24-Jul-00	36	3000	600	C	60	50	0.2	79	1519	1608	54	0.50	J	0.71
Rebecca Conroy	24-Jul-00	36	3100	550	C	60	50	0.2	79	1520	1612	57	0.50	J	0.71
Amy Uhrin	24-Jul-00	36	3000	1500		60	50		100	1520	1612	57	0.50	G	0.50
Amy Uhrin	25-Jul-00	36	2900	500		60	50		100	919	1012	60	0.53	H	0.53

Rebecca Conroy	25-Jul-00	36	3000	500		60	50		100	919	1012	60	0.53	H	0.53
John Burke	25-Jul-00	36	3000	700		60	50		100	917	1016	60	0.59	H	0.59
Jitka Hynovia	25-Jul-00	36	3000	800		60	50		100	917	1016	60	0.59	H	0.59
John Burke	25-Jul-00	36	2900	600	C	60	60	0.2	79	1422	1513	57	0.52	J	0.73
Jitka Hynovia	25-Jul-00	36	3200	1000	C	60	60	0.2	79	1422	1513	57	0.52	J	0.73
Jud Kenworthy	25-Jul-00	36	3150	600		60	60		100	1422	1508	57	0.44	G	0.44
Amy Uhrin	25-Jul-00	36	3300	1000	C	60	60	0.2	79	1422	1508	57	0.44	I	0.65
John Burke	25-Jul-00	36	3000	750	D	60	60	0.3	71	1857	1956	53	0.59		0.88
Jitka Hynovia	25-Jul-00	36	3100	1000	D	60	60	0.3	71	1857	1956	53	0.59		0.88
Rebecca Conroy	25-Jul-00	36	3000	1400	C	60	60	0.2	79	1856	1937	54	0.41		0.62
Mark Fonseca	25-Jul-00	36	2900	1700		60	60		100	1856	1937	54	0.41		0.41
Jud Kenworthy	26-Jul-00	36	2750	700		60	60		100	942	1041	56	0.58	H	0.58
Amy Uhrin	26-Jul-00	36	2800	750		60	60		100	942	1041	56	0.58	H	0.58
Jitka Hynovia	26-Jul-00	36	3000	500		60	60		100	941	1045	54	0.60	H	0.60
John Burke	26-Jul-00	36	2900	500		60	60		100	941	1045	54	0.60	H	0.60
Amy Uhrin	26-Jul-00	36	3000	600		60	60			1816	1907	60	0.49		0.49
Rebecca Conroy	26-Jul-00	36	3100	800		60	60			1816	1907	60	0.49		0.49
MarkFonseca	26-Jul-00	36	2700	700		60	60			1816	1907	60	0.49		0.49
John Burke	26-Jul-00	36	3000	500		60	60			1814	1915	60	0.57		0.57
Jitka Hynovia	26-Jul-00	36	3000	600		60	60			1814	1915	60	0.57		0.57
John Burke	27-Jul-00	36	3000	800		100	40		40	922	958	102	0.36	I	0.36
Jitka Hynovia	27-Jul-00	36	3300	1100		100	40		40	922	958	102	0.36	I	0.36
Rebecca Conroy	27-Jul-00	36	3400	1350		100	40		40	924	959	102	0.35	I	0.35

Amy Uhrin	27-Jul-00	36	3200	1500		100	40		40	924	959	102	0.35	I	0.35
Jud Kenworthy	27-Jul-00	36	3050	800		60	60			1804	1850	56	0.45		0.45
Mark Fonseca	27-Jul-00	36	2800	700		60	60			1804	1850	56	0.45		0.45
Mark Finkbeiner	27-Jul-00	21	3200	1700		60	60			1817	1850	55	0.31		0.31
James Bunn	27-Jul-00	21	3000	700		60	60			1817	1850	55	0.31		0.31
John Burke	28-Jul-00	21	3000	600		50	60		100	733	828	45	0.55	H	0.55
Jitka Hynovia	28-Jul-00	21	3100	1300		50	60		100	733	828	42	0.55	H	0.55
Mark Fonseca	28-Jul-00	21	3000	750		50	60		100	732	821	43	0.48	H	0.48
Mark Finkbeiner	28-Jul-00	21	3100	1100		50	60		100	732	821	42	0.48	H	0.48
Jud Kenworthy	28-Jul-00	21	3000	700		50	60		100	735	824	43	0.48	H	0.48
Amy Uhrin	28-Jul-00	21	2800	1100		50	60		100	735	824	42	0.48	H	0.48
Tom Potts	31-Jul-00	36	3000	800		100	30		40	848	928	96	0.3	G	0.30
Dave Score	31-Jul-00	36	3200	900		100	30		40	848	928	96	0.3	G	0.30
Paula Whitfield	31-Jul-00	36	3000	1000		60	60		100	1231	1320	50	0.49	G	0.49
Amy Uhrin	31-Jul-00	36	2800	1400		60	60		100	1231	1320	51	0.49	G	0.49
MarkFonseca	31-Jul-00	36	2800	700		60	60		100	1231	1320	51	0.49	G	0.49
Mike Burton	31-Jul-00	36	2800	750		100	30		40	1512	1555	98	0.29		0.29
Tom Potts	31-Jul-00	36	2200	800	B	100	30	8e-02	32	1512	1555	85	0.29		0.37
Dave Score	31-Jul-00	32	2900	800	A	100	25	3e-02	27	1828	1904	91	0.25		0.28
Paula Whitfield	31-Jul-00	36	3000	800	B	100	25	8e-02	32	1828	1904	95	0.25		0.33
Mark Fonseca	31-Jul-00	36	2900	600	B	100	25	8e-02	32	1828	1904	96	0.25		0.33
Amy Uhrin	1-Aug-00	36	2900	1250						935	1019	56	0.43		0.43
Mark Fonseca	1-Aug-00	36	2800	600						935	1019	56	0.43		0.43

Paula Whitfield	1-Aug-00	36	3000	500		100	30		40	1125	1205	98	0.29		0.29
Mike Burton	1-Aug-00	36	2950	700		100	30		40	1125	1205	98	0.29		0.29
Dave Score	1-Aug-00	36	3000	700		100	30		40	1304	1343	97	0.29		0.29
Tom Potts	1-Aug-00	36	3000	700		100	30		40	1304	1343	96	0.29		0.29
Paula Whitfield	1-Aug-00	32	3000	800	A	100	25	4e-02	26	2039	2115	96	0.24		0.28
Mike Burton	1-Aug-00	36	3000	800	A	100	25	4e-02	26	2039	2115	95	0.24		0.28
Tom Potts	1-Aug-00	36	2700	1100	A	100	25	4e-02	30	2141	2214	92	0.25		0.29
Glenn Taylor	1-Aug-00	36	2600	800		100	25		40	2141	2214	92	0.25		0.25
Amy Uhrin	2-Aug-00	36	2750	1300		60	30		100	1059	1131	60	0.28	E	0.28
Mark Fonseca	2-Aug-00	36	3000	1100		60	30		100	1059	1131	60	0.29	E	0.29
Dave Score	2-Aug-00	36	3000	800		100	30		40	1037	1116	89	0.29	F	0.29
TomPotts	2-Aug-00	36	3000	1000		100	30		40	1037	1116	89	0.29	F	0.29
Paula Whitfield	2-Aug-00	36	2750	700		100	30		40	1320	1354	105	0.25	G	0.25
Mike Burton	2-Aug-00	36	2800	500		100	30		40	1320	1354	104	0.25	G	0.25
Dave Score	2-Aug-00	36	2800	1000	B	100	30	8e-02	32	1745	1807	97	0.22	G	0.30
Amy Uhrin	2-Aug-00	36	2500	800	B	100	30	8e-02	32	1745	1808	96	0.22	G	0.30
Tom Potts	2-Aug-00	36	3100	1000	B	100	30	8e-02	32	1809	1831	93	0.28	H	0.36
Mark Fonseca	2-Aug-00	36	3000	500	B	100	30	8e-02	32	1809	1831	93	0.29	H	0.37
Paula Whitfield	2-Aug-00	36	2800	800		100	30			1945	2017	100	0.24	G	0.24
Mike Burton	2-Aug-00	36	2900	700		100	30			1945	2017	100	0.24	G	0.24
Tom Potts	3-Aug-00	36	2800	800		110	25		30	917	948	107	0.21	G	0.21
Paula Whitfield	3-Aug-00	36	2900	600		110	25		30	917	948	106	0.21	G	0.21
Amy Uhrin	3-Aug-00	36	2750	1100		110	25		30	1114	1144	109	0.23	G	0.23

Mark Fonseca	3-Aug-00	36	2650	500	110	25	30	1114	1144	110	0.23	G	0.23
Dave Score	3-Aug-00	32	2900	1000	110	25	30	1402	1436	97	0.28	H	0.28
Glenn Taylor	3-Aug-00	36	2600	500	110	25	30	1402	1436	97	0.28	G	0.28
Mike Burton	3-Aug-00	32	3000	1000	110	25	30	1402	1436	98	0.28	H	0.28
Paula Whitfield	3-Aug-00	32	2900	1260	100	30		1630	1704	98	0.23		0.23
Tom Potts	3-Aug-00	32	3000	1490	100	30		1630	1704	94	0.23		0.23
Mark Fonseca	3-Aug-00	32	3000	750	100	30		1832	1903	100	0.23		0.23
Amy Uhrin	3-Aug-00	32	3000	1100	100	23		1832	1903	100	0.23		0.23