

## **Fish and Fisheries in Guantánamo Bay, Cuba: Recommendations for Their Protection**

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### **ABSTRACT**

The Guantánamo Bay has unique geographical and ecological values: it is one of the only two large bays in the most southeastern end of Cuba: the exuberant mangroves that fringe great part of the Guantánamo river and the bay, patch and well-developed high-relief fringing reefs, and extensive shallow-water seagrass beds and muddy bottoms combine to provide a diverse and relatively-extensive-for-the-region mosaic of habitats for coastal fauna. In July-August, 1996, the research team of The Nature's Conservancy Marine Conservation Science Center conducted a rapid ecological assessment of the marine resources of the Naval Station area after the Navy recognition of the biological and conservation values and this unique region of Cuba.

Recreational fisheries is the most popular entertainment among military and civilian personnel. As part of the marine ecological assessment, juveniles fish surveys were conducted in the bay nearshore area (with a seine) and reefs (visual transects and RDT). In addition, creel surveys were done as spear and hook-and-line fishing are the main recreational activity in the base. A species checklist, and distribution of the bay nearshore fish were obtained. Snapper juveniles were found in fairly large numbers in all stations. In the reef sites, no large grouper species were observed at all in the high-relief reef transects. Creel surveys yielded 25 fish species (q-32 cm length); the number of fishermen per site was 1-5 (within one boat or a site in the bay shore). Snappers dominated in the catches (60% of the total fish surveyed) and were fished mostly in the middle channel (Bay Entrance area). Lane snapper (33%), and mutton snapper (19%) were the most fished species; jacks followed with 6%. Mutton snapper of varied size (18-49cm) was the only species fished in all sites. Changes in fisheries regulations were recommended, such as fish spearfishing and lobster fishing ban, snappers' seasonal closures during reproduction period, etc. A coastal management plan in progress will include the data collected in the RAE.

**KEY WORDS:** Reef fish, recreational fisheries, Cuba, fisheries management

## INTRODUCTION

The Guantánamo Bay has unique geographical and ecological values. It is one of the only two large bays in the most southeastern end of Cuba, otherwise rocky and cliffed with a shallow shelf that drops down to about 6,000 m deep in the Oriente Trench. The exuberant mangroves that fringe a great part of the Guantánamo river and the bay coastline and keys, extensive shallow-water seagrass beds and muddy bottoms, and patch and well-developed high-relief fringing reefs combine to provide a diverse and relatively-extensive-for-the-region mosaic of habitats for coastal fauna.

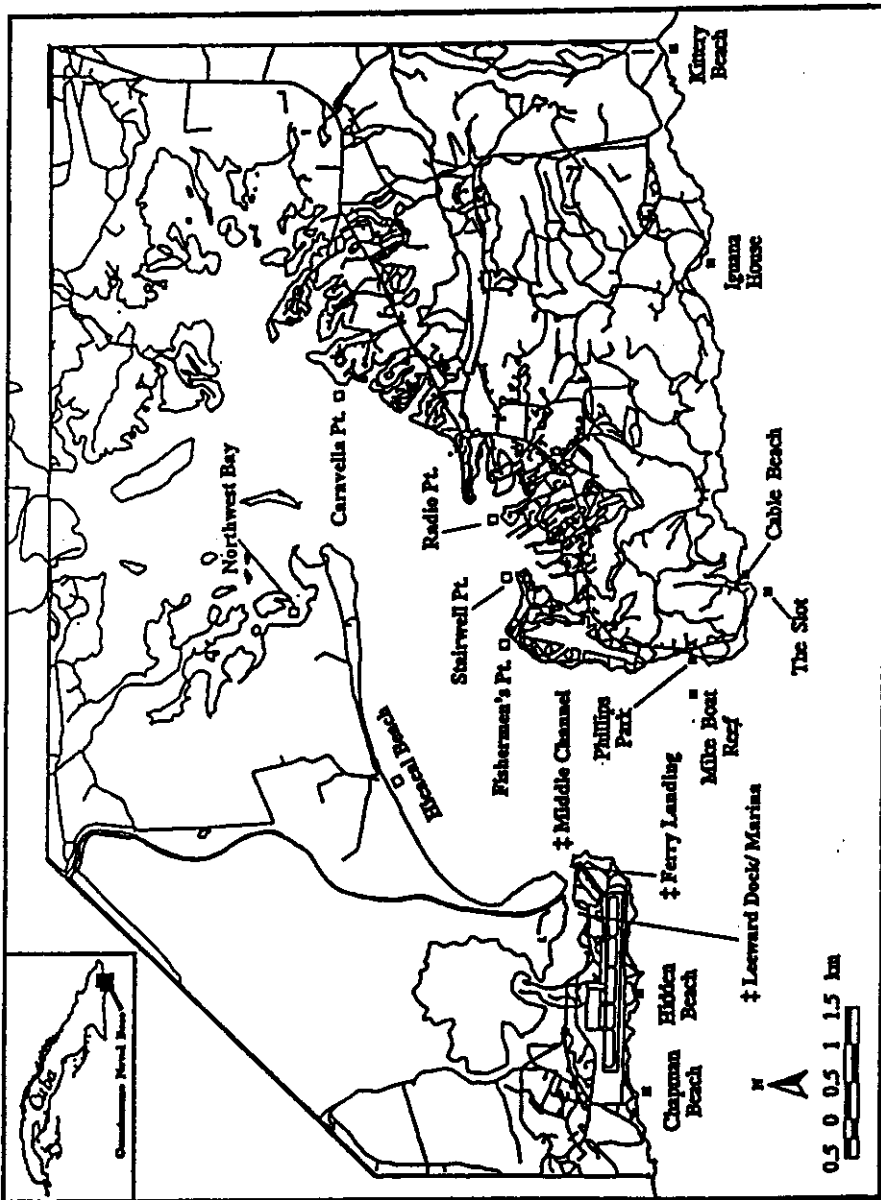
In recognition of the biological value of the natural resources on the Naval Station (which comprises the southern half of sheltered hourglass-shaped bay facing the Caribbean Sea) and the increasing land stewardship role of U.S. military services, the Department of Navy identified a need to conduct ecological surveys of the natural areas. The Nature Conservancy was contracted to conduct a Rapid Ecological Assessment of both terrestrial and marine resources of this territory. Mangrove, coral reef, rocky shore, and nearshore bay seagrass habitats were surveyed in July-August, 1996 in order to describe and assess the ecological status of their natural communities and several target species, and formulate recommendations for their conservation and restoration.

As part of the ecological assessment, the reef and nearshore shore bay fish communities were surveyed to obtain information on species richness, and the abundance and distribution of key species. These, together with creel survey and interviews, allowed us to formulate recommendations for resource protection.

## STUDY AREA

The U.S. Naval Station Guantanamo Bay, Cuba is situated at the southeastern tip of the island at 19° 15'N and 75° 9'W. Shaped like an hourglass, the Base in the southern half of the bay, occupying 125 km<sup>2</sup> of Cuban territory (Figure 1). The climate in the Guantanamo Bay region is exceptionally hot and dry compared to other Caribbean areas including the majority of Cuba. Air temperature and annual precipitation range 28-30°C and 400-837mm year round respectively (Nuevo Atlas Nacional de Cuba 1989).

Mangroves fringe most of the coast and are healthy and exuberant, especially in the river mouth and northwest part of the study area (south of the US-Cuba border). Localized deterioration of mangroves are due to landfills and dumping of building material extensive shallow-water seagrass beds and muddy bottoms.



**Figure 1.** Location of fish survey sites and some of the fishing locations at Guantánamo Bay Cuba. Symbols: ■ reef fish stations, □ nearshore bay fish stations, ± fishing locations.

The reefs comprise a fringing reef system with a lack of reef crest development by elkhorn coral (*Acropora palmata*), but well-developed spur and groove formations on the shallow and deeper fore reef slope 4-20 m (Alcolado 1981, The Nature Conservancy 1998). The reefs appear to be in good condition relative to other Caribbean areas. This is reflected in the amount of live coral cover, species diversity, and abundance of recruits. However, they appear to or likely have been impacted by the mass mortality of the echinoid *Diadema antillarum* in 1983-84, storm damage, dieback of *Acropora cervicornis* from disease, and increases in algal coverage due to a reduced abundance of herbivores, possibly including both urchins (disease) and fishes (fishing; The Nature Conservancy 1998).

Seagrass and muddy areas with sparse patch reefs near the bay entrance, cover most of the in the bay bottom. Bottom types and mangroves were mapped during the ecological assessment (The Nature Conservancy 1998).

#### MATERIAL AND METHODS

Nearshore fish surveys were conducted on 6 stations along the bay shore. All surveyed sites shared the following features: shallow depths (0-1.5m), seagrass bottom type, feasibility for seining operations. Two stations were located at the bay entrance channel (Stairwell Point and Fishermen's Point), one at a middle point of the urbanized area (Radio Point), and another one at the northern extent of this area (Caravella Point; see Figure 1). Six surveys were conducted along Hicacal Beach, and another station was surveyed in the northwest lobule of the bay, near the Naval Station boundary. Fish captures were performed at different times during the day from July 24 through August 1, 1996.

The sampling was conducted with a customized fish seine with a cod end (0.4 cm mesh size) and two 15 m wings (1cm mesh size) for catching small juveniles. The net was launched and trawled by 2-3 people pulling the line at both sides. The area covered by each seine cast was about 1000-1400m<sup>2</sup>, mostly over sandy or sand-muddy areas covered by seagrass. Number of fish per trawl were used for a comparative analysis. Fish were identified, measured (up to 1mm length) and weighed (0.1 g accuracy) on site and those that could survive this examination were returned to the sea.

Density and lengths of fisheries targeted species (groupers and snappers) were visually estimated using the line transect method as described by Sluka (1995) up to 20 m depth. Transect lines of 20 m in length were laid haphazardly along high relief reefs at each study site. Observers carefully searched an area 2.5 m to either side of the transect line paying close attention to caves, crevices and holes. Length and number on individuals of all study species was recorded on underwater paper.

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Five sites on the windward coast of the base and three on the leeward side were surveyed by divers using SCUBA. Sixteen 100m<sup>2</sup> transects of 20x5 m were performed at each site. For fish density calculations, two of the windward sites were randomly dropped (Phillip's Park and Cable Beach); each transect served as a replicate. Patch reefs located off of Phillip's Park Pier were also sampled; however, due to the small size of these reefs, no complete transects could be completed. Each entire patch was surveyed for groupers and snappers.

In addition to surveying fisheries targeted species, researchers made some preliminary surveys of overall reef fish occurrence and abundance using the Roving Diver Technique, as described by Schmitt and Sullivan (1996). In the RDT method, buddy teams of divers swim freely about the reef while recording all of the species of fish that they see. Each diver keeps a separate list. Data on abundance (by category) can be found in The Nature Conservancy (1998).

Creel surveys were conducted both for shore fishermen and boating fishermen at the marinas. They were designed for gathering quantitative information on the species, size and location of finfish and lobsters taken by recreational fishermen. All fish caught were identified and measured and most of them were weighed. Data on fishing sites, fishing gear, as well as site depth and bottom type were collected.

Information on patterns of human use (recreational fishing, among them) was captured additionally by means of individual interviews. A Marine Resource Use Questionnaire was designed according to previous knowledge of the base area. The questionnaire allowed us to gain information on how the marine resources at the Guantanamo Bay Naval Station are utilized by base residents, to identify different user groups and their effects, to discover how having these resources available affect the daily lives of the residents, and to determine the current extraction and harvesting practices on the Guantanamo Bay Naval Station (this paper contains part of this information due to volume constraints). The interviewees included military personnel as well as their dependents, government service employees, and civilians from other countries notably Jamaica and the Philippines. A total of 204 questionnaires were conducted at the base.

### RESULTS AND DISCUSSION

#### **Nearshore Bay, Fish**

A total of 3544 individuals belonging to 43 species and 21 families were caught during the survey (Table 1). The entire species checklist can be found in The Nature Conservancy (1998). Two species have not been recorded previously in Cuba (Rodriguez et al. 1984; Claro and Reshetnikov 1994): the mojarra *Eucinostomus melanopterus*, and the ballyhoo *Hyporhamphus roberti*. The former was the only mojarra species found in the samples. Table 1 shows a

summary of the fish surveys in each site (total number of fish per trawl, total number of species and snappers, number of species and families).

About half of all fish families were found in each site (10 - 13 per site) with the exception of Hicacal Beach (only six), whose low family richness can be explained by the bottom type (bare mud with scarce vegetation). This habitat lacks adequate shelter against predators for demersal fishes such as snappers and grunts.

Jacks, snapper, grunts, herrings and parrotfish families showed the greatest number of species per family (4-6). Some families were poorly represented, with only a single species (e.g., Belonidae, Labridae, Acanthuridae, Serranidae, Sparidae). More detailed data on all species and their size can be found in The Nature Conservancy (1998).

Snappers were found in all stations, but were dominant in Fishermen's and Caravella Points (11-12% of the total fish caught). The yellowtail snapper (*Ocyurus chrysurus*) juveniles appeared in lower numbers, since they prefer a more pelagic life habit in comparison with the other snappers that are more related to the bottom. The schoolmaster (*Lutjanus apodus*) appeared in large numbers in Caravella Point (about 12 ind./seine). The highly valuable mutton snapper (*Lutjanus analis*) was captured in all locations along the east side of the bay. Lane snapper (*Lutjanus synagris*) was particularly abundant in Fishermen's Point (6 ind./trawl), while mutton snapper (3.5 ind./seine) and schoolmaster (11.9 indiv./seine) were abundant at Radio Point and Caravella Point, respectively. All these locations seem function as nursery grounds for lane snappers and schoolmasters juveniles ranging 3-12 cm.

**Table 1.** Summary data of the fish surveys conducted at the nearshore shallow-water habitats within the Guantanamo Bay, Cuba.

Site	No. samples (seine)	Total No. fish	Total snappers No. (%)	Mean No. fish/seine	No. fish families	No. fish species
Fishermen's Pt.	4	241	31 (12.9)	60	11	20
Stairwell Pt.	4	199	4 (2.0)	50	11	15
Radio Pt.	2	1379	17 (1.3)	689	10	19
Caravella Pt.	3	369	41 (11.1)	123	12	18
Northwest Bay	2	838	7 (0.8)	419	13	17
Hicacal Beach	6	518	1 (0.1)	86	6	10
<b>Total</b>	<b>21</b>	<b>3544</b>	<b>101 (2.9)</b>	<b>295</b>	<b>21</b>	<b>43</b>

**Reef Fish**

Rover Diver Technique surveys yielded 92 fish species (belonging to 29 families; see Table 2) during five surveys, totaling 220 minutes, at the Phillip's Park reef site.

This species richness is higher than those recorded by in the southwestern reefs of Cuba and is about a fourth of the total number of reef fish species recorded in Cuba (Claro and Reshetnikov 1994).

Very few fish were found of the target species (snappers and groupers). No large grouper species were observed at all in the high-relief reef transects. Just one small Nassau grouper (27cm) was found. Mean number of snappers per transect varied from a low of 0.69 to a high of 5.25 (Table 3). Censused snapper species were predominantly schoolmaster (*Lutjanus apodus*) and mahogany snapper (*L. mahogony*). The greatest densities of snappers were actually found on the small patch reefs off of Phillip's Park (12.90 individuals/100m<sup>2</sup>), however only 4 patches were surveyed so this may be a misleading figure. The patches were the only reefs in Guantánamo on which schools of snapper were found. All other snapper censused were either single or in small groups of 2 or 3 individuals (data on fish size can be found in The Nature Conservancy, 1998).

**Table 2.** Fish species recorded in the reefs of Guantánamo Bay

<b>Scientific Name</b>	<b>Common Name</b> US	<b>Common Name</b> Cuban
<b>Acanthuridae</b>		
<i>Acanthurus bahianus</i>	ocean surgeonfish	barbero
<i>Acanthurus chirurgus</i>	doctorfish	barbero rayado
<i>Acanthurus coeruleus</i>	bluetang	barbero azul
<b>Aulostomidae</b>		
<i>Aulostamus maculatus</i>	trumpetfish	trompa
<b>Balistidae</b>		
<i>Cantherhines pullus</i>	orangespotted filefish	lija colorada
<i>Melichthys niger</i>	black durgon	negrito
<b>Belonidae</b>		
<i>Tylosurus crocodilis</i>	houndfish	none
<b>Bothidae</b>		
<i>Bothus ocellatus</i>	eyed flounder	lenguado ocelado
<b>Carangidae</b>		
<i>Caranx hippos</i>	crevalle jack	jiguagua
<i>Caranx ruber</i>	bar jack	cibi carbonero
<b>Chaetodontidae</b>		
<i>Chaetodon aculeatus</i>	longsnout butterflyfish	parche narizon
<i>Chaetodon capistratus</i>	four-eye butterflyfish	parche ocelado
<i>Chaetodon ocellatus</i>	spotfin butterfly	parche ocelado amarillo

<i>Chaetodon striatus</i>	banded butterflyfish	parche rayado
<b>Cirrhitidae</b>		
<i>Amblycirrhitus pinus</i>	redspotted hawkfish	rayadito
<b>Clinidae</b>		
<i>Lucayablennius zingaro</i>	arrow blenny	blenido
<b>Gerreidae</b>		
<i>Gerres cinereus</i>	yellowfin mojarra	mojarra blanca
<b>Gobiidae</b>		
<i>Gnatholepis thompsoni</i>	gold spot goby	gobio puntidorado
<i>Gobisoma chancei</i>	shortstripe goby	
<i>Gobisoma genie</i>	cleaner goby	gobio limpiador
<i>Coryphopterus</i>	bridled goby	gobio con brida
<i>glaucofraenum</i>		
<i>Coryphopterus lipernes</i>	peppermint goby	gobio linterna
<b>Grammidae</b>		
<i>Gramma loreto</i>	fairy basslet	loreto
<b>Grammistidae</b>		
<i>Rypticus saponaceus</i>	greater soapfish	jaboncillo máximo
<b>Haemulidae</b>		
<i>Haemulon aurolineatum</i>	tomtate	jeniguano bocón
<i>Haemulon flavolineatum</i>	french grunt	ronco condensado
<i>Haemulon macrostomum</i>	spanish grunt	ronco español
<i>Haemulon plumieri</i>	white grunt	ronco arará
<i>Haemulon sciurus</i>	bluestriped grunt	ronco amarillo
<i>Anisotremus virginicus</i>	porkfish	catalineta
<b>Holocentridae</b>		
<i>Myripristis jacobus</i>	blackbar soldierfish	candil barreado
<i>Holocentrus ascensionis</i>	squirrelfish	carajuelo de ascension
<i>Holocentrus marianus</i>	longjaw squirrelfish	carajuelo mariano
<i>Holocentrus rufus</i>	longspine squirrelfish	carajuelo rufus
<i>Holocentrus vexillarius</i>	dusky squirrelfish	carajuelo oscuro
<b>Kyphosidae</b>		
<i>Kyphosus sectatrix</i>	incisor chub	chopa blanca
<b>Labridae</b>		
<i>Clepticus parrai</i>	creole wrasse	rabirrubia genizara
<i>Halichoeres bivittatus</i>	slippery dick	doncella radiata
<i>Halichoeres garnoti</i>	yellowhead wrasse	doncella cabeziamarilla
<i>Halichoeres radiatus</i>	puddingwife	doncella pudín
<i>Thalassoma bifasciatum</i>	bluehead	cara de cotorra
<b>Lutjanidae</b>		
<i>Lutjanus analis</i>	mutton snapper	pargo criollo
<i>Lutjanus griseus</i>	gray snapper	caballerote
<i>Lutjanus apodus</i>	schoolmaster	cají
<i>Lutjanus mahogoni</i>	mahogany snapper	pargo ojanco
<i>Ocyurus chrysurus</i>	yellowtail snapper	rabirrubia



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**Malacanthidae**

*Malacanthus plumieri* sand tilefish matejuelo blanco

**Mullidae**

*Pseudopeneus maculatus* spotted goatfish salmonete colorado

**Opisthognathidae**

*Opisthognathus aurifrons* yellowhead jawfish guardián cabeziamarillo

**Pempheridae**

*Pempheris schomburgki* glassy sweeper pemferis bandeado

**Pomacanthidae**

*Pomacanthus arcuatus* gray angelfish chivirica gris

*Pomacanthus paru* french angelfish chivirica francesa

*Holocanthus tricolor* rock beauty vaqueta de dos colores

**Pomacentridae**

*Abudefduf saxatilis* sergeant major pintano

*Abudefduf taurus* night sergeant pintano toro

*Chromis cyaneus* blue chromis cromis azul

*Chromis multilineatus* brown chromis cromis prieto

*Pomacentrus dienaecus* longfin damselfish

*Pomacentrus fuscus* dusky damselfish

*Pomacentrus leucostictus* beaugregory chopita de dorso violeta

*Pomacentrus partitus* bicolor damselfish chopita bicolor

*Pomacentrus planifrons* threespot damselfish chopita amarilla

*Pomacentrus variabilis* cocoa damselfish chopita cacao

**Scaridae**

*Sparisoma atomarium* greenblotch parrotfish loro de lunar verde

*Sparisoma aurofrenatum* redband parrotfish vieja lora

*Sparisoma chrysopterygion* redtail parrotfish loro colirojo

*Sparisoma rubripinne* redfin parrotfish loro aletirrojo

*Sparisoma viridae* stoplight parrotfish loro

**Serranidae**

*Epinephelus cruentatus* graysby enjambre

*Epinephelus fulvus* coney guatívere

*Epinephelus guttatus* red hind cabrilla

*Epinephelus striatus* nassau grouper cherna criolla

*Hypoplectrus indigo* indigo hamlet vaca afil

*Hypoplectrus nigricans* black hamlet vaca negra

*Hypoplectrus puella* barred hamlet vaca barreada

*Hypoplectrus unicolor* butter hamlet vaca blanca

*Hypoplectrus sp.* masked hamlet

*Hypoplectrus sp.* tan hamlet

*Liopropoma rube* peppermint bass guardia suizo

*Mycteroperca bonaci* black grouper aguají

*Paranthias furcifer* creole fish rabirrubia de lo alto

*Serranus tigrinus* harlequin bass serrano tigre

**Sphyraenidae**

*Sphyræna barracuda*

great barracuda

picúa

**Tetraodontidae**

*Canthigaster rostrata*

sharpnose puffer

tamboril narizón

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**Fisheries Landings**

Creel survey data (Table 3) shows that number of fish captured per sampling ranged from one through 32, and number of fishermen per site (or boat) from 1 to 5. Twenty-four species of fish were identified in the creel surveys. Snappers dominated the catch (62% of the total fish surveyed) and were fished mostly in the middle channel (Bay Entrance area). Lane snapper (33%), and mutton snapper (19%) were the most fished species; jacks followed with 6%. Mutton snapper of varied size (18-49 cm) was the only species fished in all sites. The Atlantic herrings are fished for bait and caught with cast net. No groupers were recorded in the creel surveys.

About 19 snappers were caught per day. Based on the data collected, we roughly estimated an annual catch of 1,200 individuals per year. All of the snappers recorded were taken in depths less than 28 m, but most of them (99%) were fished at night, with hook and line from boats; shore line and hook catches seemed to be limited. The overall amount of snappers recorded seems to be high, considering the small shelf area of the bay. No groupers were recorded in the creel surveys.

Local fishermen indicated that the only people catching large fish were going "far and deep." It was suggested that large grouper could still be located at distances greater than 500 m from shore and at depths of >30 m. In many ways, the situation at Guantanamo mirrors the fisheries of other locations Caribbean locations, as in southeastern Dominican Republic in which fishermen are being required to work at successively deeper depths in order to locate large fish.

Table 3. Mean density of snappers and groupers (number of fish/100m<sup>2</sup> transect) at different reef sites

Fishes	Leeward Reef Sites					Windward Reef Sites					Patch Reefs
	Buddy	Chapman	Hidden	Phillip's Park Spurs	The Slot	Cable	Windmill Beach	Kittery	Phillip's Park Patches <sup>a</sup>		
<i>Epinephelus cruentatus</i>	0.44	2.13	1.25	4.81	4.69	2.56	2.44	2.44	3.06		
<i>E. fulvus</i>	0.19	0.56	0.63	0.19	2.56	0.19	0.50	0.13	0.00		
<i>E. striatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13		
<b>Total grouper</b>	0.63	2.69	1.88	5.00	7.25	2.75	2.94	2.56	3.19		
<i>Lutjanus analis</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13		
<i>L. apodus</i>	0.69	0.63	0.88	0.81	0.44	1.00	4.38	1.63	0.13		
<i>L. jocu</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00		
<i>L. mahogoni</i>	0.13	0.06	0.00	0.44	0.00	0.50	0.13	0.38	6.80		
<i>Ocyurus chrysurus</i>	0.00	0.00	0.13	0.75	0.44	0.50	0.75	0.44	5.85		
<b>Total snapper</b>	0.81	0.69	1.00	2.00	0.88	2.00	5.25	2.50	12.90		

**Table 4.** Summary data of the creel survey conducted at marinas and shore sites of the Guantánamo Bay, from July 28 through August 4, 1996. Key: l- line, sp- speargun, cn- cast net; B- Bay entrance; L- Leeward ; R- Radio Point; M- Meadow Cay.

Family and specie	No. fish caught	Length (cm)	Fishing gear	Location
<b>Snappers (Lutjanidae)</b>	117			
Mutton snapper ( <i>Lutjanus analis</i> )	38	18-49	l, sp	B,L,R,M
Lane snapper ( <i>Lutjanus synagris</i> )	65	15-32	L	B, R
Gray snapper ( <i>Lutjanus griseus</i> )	8	17-29	L	B, L
Yellowtail snapper ( <i>Lutjanus chrysurus</i> )	2	14-15	L	B, R
Schoolmaster ( <i>Lutjanus apodus</i> )	2	10-17	L	L, R
Red snapper ( <i>Lutjanus campechanus</i> )	1	46	L	L
Soap fish ( <i>Rypticus saponaceus</i> )	1	29	l	B
<b>Jacks (Carangidae)</b>	12			
Blue runner ( <i>Caranx crysos</i> )	5		l	B
Crevalle jack ( <i>Caranx hippos</i> )	6	13-46	cn	L
Atlantic bumber ( <i>Chloroscombrus chrysurus</i> )	1		l	L
<b>Herrings (Clupeidae)</b>	36			
Atlantic thread herring ( <i>Opistonema oglinum</i> )	36	7-17	cn	R
<b>Barracudas (Sphyraenidae)</b>	6			
Great barracuda ( <i>Sphyraena barracuda</i> )	6	33-60	l	B
<b>Mojarras (Gerridae)</b>	4			
Striped mojarra ( <i>Eugerres plumieri</i> )	1		l	L
Striped mojarra ( <i>Eugerres brasilianus</i> )	3		l	L
<b>Grunts (Haemulidae)</b>	4			
White grunt ( <i>Haemulon plumieri</i> )	2	21-22	l	B
Bluestripe grunt ( <i>Haemulon sciurus</i> )	1	23	l	B
Smallmouth grunt ( <i>Haemulon chrysargireum</i> )	1	21	l	R
<b>Bonefishes (Elopidae)</b>	1			
Bonefish ( <i>Elops saurus</i> )	1		l	L
<b>Chubs (Kyphosidae)</b>	1			B

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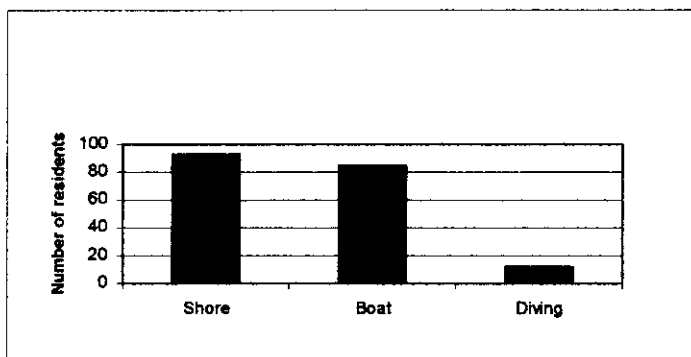
Chub ( <i>Kiphusus</i> sp.)	1	32	I	B
<b>Snooks (Centropomidae)</b>	<b>4</b>			
Snook ( <i>Centropomus undecimalis</i> )	3	39-54	I	L
Tarpon snook ( <i>Centropomus pectinatus</i> )	1	20	I	L
<b>Requiem sharks (Carcharinidae)</b>	<b>1</b>			
Blacktip shark ( <i>Carcharinus limbatus</i> )	1	60 <sup>a</sup>	I	L
<b>Stingrays (Dasyatidae)</b>	<b>1</b>			
Stingray ( <i>Dasyatis</i> sp.)	1	130 <sup>a</sup>	I	R
<b>Squirrelfishes (Holocentridae)</b>	<b>1</b>			
Longspine squirrelfish ( <i>Holocentrus rufus</i> )	1		I	B
<b>Lobster (Panilluridae)</b>				
Spiny lobster ( <i>Panulirus argus</i> )	2	14 <sup>b</sup>		B
<b>Total no. of finfish</b>	<b>188</b>			
<b>Total no. of finfish species</b>	<b>24</b>			
<b>Total no. of fish families</b>	<b>11</b>			
<b>Main fishing gear used</b>	<b>I</b>			
<b>Major species fished</b>			Mutton snapper	
<b>Major family fished</b>			Snappers (62%)	

Note: The areas include the following sites: Leeward- Ferry landing, Leeward Dock, Leeward Marina; Radio Point- across from Post Office, and at the beach by the floating barrack; Bay Entrance- bouys 1 and 2, Middle Channel, Leeward Point, Phillips Park; MCay- off Meadow Cay (at 6m depth).

<sup>a</sup> Standard length; <sup>b</sup> Carapace length

Out of the 254 residents surveyed, it was found that 153 (60%) fished and 101 (40%) did not fish. A relationship was noted between residents who fished in Guantanamo and their length of stay at the Base: the longer the resident had been on the Base, the more likely the resident was to fish. Most of the surveyed residents who participated in fishing while at Guantanamo did so either from the shore (49%) or from a boat (45%). Many residents used both shore and boat methods to fish. Only 6% of the fishing population spearfish while SCUBA diving (Figure 2).

The frequency of fishing in Guantanamo varied from one time per week to five days a week. The fishing population was categorized by whether they fished >1/week or <1/week, and this ratio was found to be 1:1. The ranks of the fishing population were found to be extremely close to the make-up of the Base, the majority of the fishermen being civilians (54%). Seventeen percent of the Base residents surveyed SCUBA dive (Figure 2). Almost all of these divers are military personnel and dive more than once a week. Spearfishing was reported by 25% of the residents surveyed who SCUBA dive.



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**Figure 2.** Fishing methods used by the surveyed residents.

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Fishing is an important recreational activity at Naval Station Guantanamo Bay and enjoyed by a wide variety of people from both boats and from the shoreline. The bay has been described as important in the regional production of marine species, and can certainly support a well-managed recreational fishery. The three components of tropical fisheries management that need to be employed include:

- i) protection of fish spawners, particularly snappers near the mouth of the bay
- ii) **enforcement** of catch limits and size limits for fishermen, and
- iii) the designation of marine fisheries reserves within the bay for protection of the largest and most fecund individuals.

RECOMMENDATIONS

The data suggest that nearshore seagrass habitats should be protected as they function as a nursery ground for juvenile fish. In addition, recreational fisheries is very intensive at the Base. Snappers are intensively fished by hook and line and spearfishing, while groupers have been heavily fished by spearfishers. Three components were suggested as part of the overall recommendations on the management of recreational fisheries, namely:

- i) Ban all spearfishing at the Naval Station. This fishing practice, combined with the level of enthusiasm and effort of Base residents, *has had a devastating impact on reef fishes and lobsters*. This type of fishing is the most selective for large predators (snappers and groupers mostly). Perhaps after a period of several years, regulated spearfishing can be allowed without SCUBA in some areas. Currently, spearfishing is banned in the rest of the Cuban shelf.
- ii) Enforce fishing regulations for hook and line fishing, particularly size and catch limits. This can be done fairly easily, as there are only a few marinas or points of landing for hook and line catches. *The foremost requirement for effective management and rejuvenation of any coral reef is enforcement*. Local diving and boat landing sites should be regularly patrolled with security personnel instructed to ensure that fishing regulations are being observed. In order to effectively utilize enforcement, training programs should be provided to familiarize military personnel with reef fish identification. Support for this requirement is based on our direct observation of 2 separate instances in which divers were seen with speared parrotfish – despite regulations prohibiting the taking of reef fish.
- iii) Regulate the fishing of species during spawning periods. There can be seasonal closures on species known to spawn locally. Seasonal closures for snapper fishing during the peak of snapper reproductive periods will protect spawners from being caught before they produce offspring. Mutton, lane, yellowtail, and gray snappers are the most targeted species. Their mass spawning seasons occur during the following periods:  
Mutton snapper (*Lutjanus analis*): May-June;  
Lane snapper (*Lutjanus synagris*): Mid-April -May;  
Yellowtail snapper (*Lutjanus chrysurus*): June-July  
Gray snapper (*Lutjanus griseus*): July
- iv) Close some parts of the bay to fishing (perhaps an area off Phillips Pier where divers and snorkelers can enjoy seeing larger and more abundant fishes) and designate them as marine fishery reserves within the bay.
- v) Emphasize non-consumptive reef activities such as photography and fish identification.

- vi) Implement an on-going monitoring program including a creel survey of fishes caught and fisheries-independent surveys of important species (snappers and groupers).

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