

## Data Collection Guide for Nearshore Fisheries



EDF. 2013

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## Introduction

The goal of this document is to provide both an overview of fishery data collection programs and a data collection manual for priority finfish. The collection and accurate interpretation of both fishery dependent and fishery independent data are of fundamental importance to our understanding of fished species. Both are needed to gain an understanding the magnitude of localized changes in fish communities, landings and productivity of the resource. This understanding is important for ensuring that management is based on reality: inaccurate data or poor interpretation of data leads to inaccurate assessments of stock status (for example is the stock depleted, rebuilding, healthy) which in turn leads to management measures that impose unjustified costs for no benefit.

While this manual provides identification criteria for selected species, observers should mainly rely on the field guides issued in training for species identification.

Data collection is a challenge. However by following the simple guidelines in this document, the data collected can be used for stock assessments (i.e., estimates of how the stock is doing), which allow managers to implement good management measures aimed at ensuring good yields for years to come.

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## Materials Needed

Clip board/storage box  
Reef Fish Identification  
Water Proof paper  
otolith/dorsal spine supplies (2ml centrifuge tubes, coin envelopes)  
Fish Scale  
Fish Measuring Board  
fillet knife/ bone knife  
Camera /cell phone to take pictures of gonads /species/general photos for questions  
forceps, scalpels, dissection kits, pencils/rubber bands

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## Target Species

*Fish Identification Guide* – The goal is to accurately and quickly identify distinguishing characteristics for each target species, including the differences between very similar species (**Appendix A**). In many places, common names vary; therefore a list of scientific names along with local name variations is critical. In addition to the priority targets, we have identified additional fish to monitor. This manual is intended to facilitate data collection for other nearshore finfish fishery targets, in addition to priority species. Below is the list of priority and secondary species for monitoring, and the associated species code for data collection and entry. The species code is the first letter of the genus and first three letters of the species. For example, the species name for Nassau Grouper is *Epinephelus striatus*. The first letter of the genera is E and the first three letters of the species are STR, so the species code is ESTR. Using the species code instead of species name will standardize the data collection across observers.

### Priority targets

Nassau Grouper (*Epinephelus striatus*)  
Lane Snapper (*Lutjanus synagris*)  
Mutton Snapper (*Lutjanus analis*)  
White Grunt (*Haemulon plumieri*)

### Data Entry Code

ESTR  
LSYN  
LANA  
HPLU

### Secondary targets

Goliath Grouper (*Epinephelus itajara*)  
Black Snapper (*Apsilus dentatus*)  
Cubera Snapper (*Lutjanus cyanopterus*)  
Dog Snapper (*Lutjanus jocu*)  
Mangrove Snapper (*Lutjanus griseus*)  
Red Snapper (*Lutjanus campechanus*)  
Silk Snapper (*Lutjanus vivanus*)  
Schoolmaster (*Lutjanus apodus*)  
Yellowtail Snapper (*Ocyurus chrysurus*)  
Hogfish (*Lachnolaimus maximus*)

EITA  
ADEN  
LCYN  
LIOC  
LGRIS  
LCAM  
LVIV  
LAPO  
OCHR  
LMAX

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## Fishery Dependent Sampling Protocols

Direct fishery monitoring involves subsampling the fishermen’s catch or landings. This is accomplished by posting researchers onboard fishing vessels, landing sites and in markets to sample the catch from various fishing methods (diving, traps, trawls). Researchers should collect data on what species are caught, the sizes of animals, reproductive status, and the proportion of the catch that meets the fishery’s “legal size” criteria. Such data are influenced by many variables specific to how fishermen harvest their catch, including: area fished, number of fishermen, intensity of fishing effort, gear specifications, level of expertise of the fishermen, and the availability of the fish (conch or lobster).

Sampling consists of two levels of surveys, biological and fishing effort observations.

## Biological Surveys

Biological surveys (see below for descriptions) result in biometric data, reproductive data, and biological samples. Biometric data describe the individual characteristics of fish, including length and weight. The reproductive data describe attributes of the population that are important for reproduction, such as the age or size at first maturity, reproductive output at different sizes, and sex ratio. The biological samples include collection of otoliths for determining the ages of fish. Common inputs for a stock assessment include.

- Average weight by length class;
- Age composition in each length group;
- Percentage of mature individuals in each length group;
- Percentage of sexes in each length group;
- Other biological characteristics (stomach contents, gonad somatic index, etc.) by size groups.

## Landings Survey

**Landings Surveys** are conducted at landing sites with the purpose of collecting sample data on total catch and species composition, associated effort, and other data such as prices and fish size (in both length and weight units).

Data collected in a landings surveys commonly include ([Appendix B](#)):

- Length and weight of target species, catch composition;
- Number of species in catch;
- Total weight of catch
- Sex and maturity;
- Collection of biological samples such as otoliths and gonads;
- Gear and total fishing time;
- other biological characteristics (otolith collection, gonad somatic index, etc.) by size groups.

## At-sea Survey

**At-sea surveys** are used to collect information on catch and discards while aboard a fishing vessel. Data include the size and power of the vessel, the types of gear used, the places where catch is landed, length-weight of catch and discards, and catch composition.

Data collected in an at-sea survey ([Appendix C](#)) include:

- Length and weight of target species;
- Catch composition;
- Number of species in catch;
- Total weight of catch
- Sex and maturity;

- Gear and total fishing time;
- Species composition of the discards

## Fishing Effort

*Fishing data* — Detailed trip-level catch and effort data, similar to data in the managed access logbooks, but including fish lengths. This will serve as data to develop an index of catch per unit effort (CPUE), to validate self-reported logbook data, and to serve as inputs into length-based assessment models. These data will be collected in both the at-sea and landings surveys.

Commonly collected fishing data include:

- Boat identification, included permit #;
- Area fished, including latitude/longitude;
- Number of fishermen;
- Intensity of fishing effort;
- Gear specifications;
- Level of expertise of the fishermen; Hook/traps
- Hours at sea
- Availability of the fish (conch or lobster)
- Lengths of fish

## Market surveys

A **market survey** is the collection of information on catch being sold or traded through a fish market, stall or shop. In general, market surveys are not used to evaluate the status of the resource, since the data collected are even more filtered than those obtained in landings surveys – buyers could have rejected small fish, for example, resulting in a biased sample. In many markets, part of the catch is processed (salted, smoked, cut in pieces, or combined with other food products), making it difficult to relate catch sold and wild populations. As in landings surveys, the information collected can include biological information.

Market surveys provide a way to verify and validate the data collected in landings surveys, particularly on the value of the catch. They also give a broader view of the fishery than landings surveys, as it is almost impossible to survey all fishers at all landing sites.

Data collected in a market survey ([Appendix D](#)) include:

- Nature of the market and its operations.
- Fisheries extension service in the markets.
- Fishing operators, processors and traders.
- Other occupations practiced by fish traders.
- Prices of fish and other competing products.
- Gender and age participation.
- Length-frequency of the catch that is for sale.
- Biological samples.

## Sample Size and Schedule

The sampling schedule should be set up in advance, with vessels chosen at random. On each visit, the observer records the following:

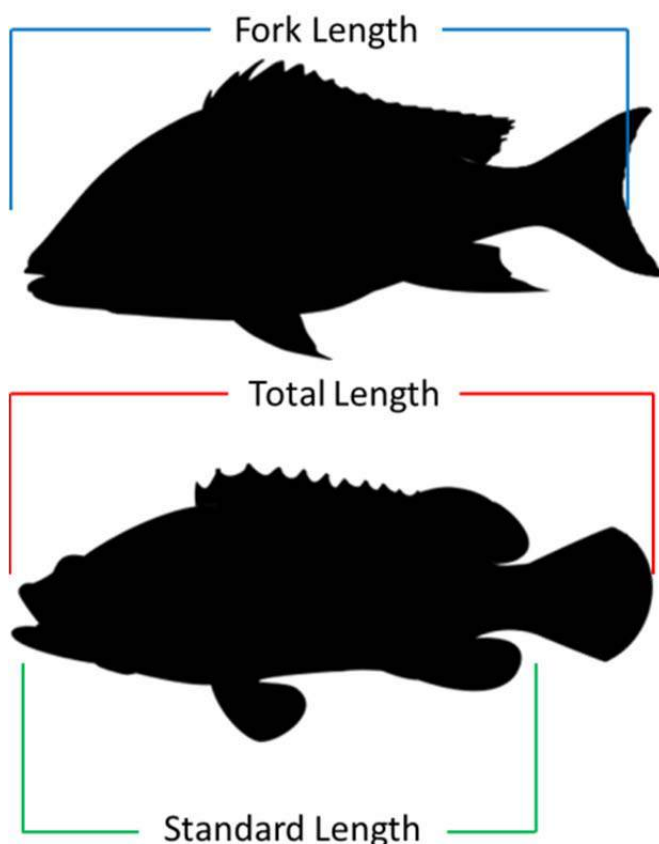
- Boat identification
- Biological observation (Length-weight of catch, sex and maturity, biological samples)
- Fishing effort (e.g., number of crew, area fished, latitude/longitude of fishing area, hook/traps set, hours at sea)
- Days since last fished
- Boats not fishing, to estimate the local fishing effort
- Market data (prices, etc.)

Ideally, monitoring activities would take place every day of the week that fish area landed and markets are open, considering monetary restraints it is likely sampling will only take place only once a week. We recommend a minimal sample size of monitoring landing, market and at-sea once per week.

## Biological Observations- *biometric*

**Length-weight**— Spread out sampling effort to different sectors of the fishery (e.g. different vessels, captains, gears, landing sites, etc.) throughout the year. Indicate when entire catch has been sampled and specifics of gear used (e.g. hook size, mesh size; factors that would affect selectivity).

In Belize, both length and weight of each target species will be recorded by observers. Weight will be recorded in kg using portable fish scales; observers will record whether the sample is a whole fish, fish fillet or a portion (i.e., no head or tail) of the fish. Total fish length and fork length will be recorded to the nearest mm using a standard fish board.



**Fork length (FL)** refers to the length from the tip of the snout to the end of the middle caudal fin rays and is used in fishes in which it is difficult to tell where the vertebral column ends.

**Total length (TL)** refers to the length from the tip of the snout to the tip of the longer lobe of the caudal fin, usually measured with the lobes compressed along the midline. It is a straight-line measure, not measured over the curve of the body.

**Standard length (SL)** refers to the length of a fish measured from the tip of the snout to the posterior end of the last vertebra or to the posterior end of the midlateral portion of the hypural plate. Simply put, this measurement excludes the length of the caudal fin.

## Biological Observations- *reproductive*

*Identification of Sex* — In general, female gonads are rounded, grainy with coloration ranging from pink to orange. Male gonads are white, smooth, flat and are smaller in size than the gonad of a female. In some cases it is difficult to perceive the gonads; if this happens, classify the fish as indeterminate.

Secondary sex characteristics are differences between the sexes in structures or features other than the reproductive organ (see [Appendix E](#)); this includes variation in coloration and unique markings.

*Maturity Staging and Scoring Guide* — With a small incision, the maturity stage of individual fish can be determined visually and information on the size at maturity and spawning frequency can be captured. This can be done very quickly and scored as: Immature, Mature, Mature and Ripe, etc. (additional levels for mature animals can be added to pinpoint seasonality of spawning). In most cases, minimal training of data collectors will be required. See [Appendix E](#) for a complete guide that includes scoring criteria. Photographs of the species of interest at the different maturation stages should be used to develop a photographic and criteria based guide for scoring.

***In the case that data collection is occurring after peak spawning periods ([Appendix A](#)), use the maturity scoring guide for spent gonads ([Appendix E](#)).***

***Take a cell phone with the sample ID next to the gonads, this will help clarify any questions and develop a local database of gonad maturity.***

Note that determining sex and maturity may be possible without inspecting gonads if secondary sexual characteristics are present ([Appendix E](#)).

## Biological Observations- *biological samples*

*Biological Samples* – Biological samples are used by stock assessors to gauge the age composition of the population, the length to age relationship (to convert length data into age data), the potential spawning population, and the male to female ratio. Reproductive tracts are collected for histology and fecundity measurements), and hard parts (e.g. otoliths, spines, bone) are collected for development of age/growth relationship.

One of the most important parameters of interest to a fisheries biologist in the study of a sample or catch of fish is the age of the fish taken. Again, observer samples provide this information through the collection of otoliths, or “fish ear bones”. When cut (or whole) and placed beneath a microscope, the annuli, (or growth rings) reveal a distinct pattern, allowing the scientist to count the fish's age, in much the same way as a cross section of a tree trunk can reveal a tree's age. In order to get a better idea of fish growth and age length relationships, a representation of the ages of all length groupings that may occur in a population will be collected. This is achieved through a length stratified sampling of otoliths, the number of samples per target depends on the max age of the species. For example if a targets max age is 30 years old with a 60 cm max size, then we need 10 samples for each age class. That means sample size should be 10 fish in 5 cm size increments—[10 fish between 5-10cm, 10 fish between 10-15 cm, 10 fish between 15-20cm, etc.] that would total 110 fish.



Sample Size –

Nassau Grouper: 29 max age, 122.0 cm max length; **10 fish from each 5 cm length class**. For example, 0-5cm, 5-10cm, 10-15cm, etc.], for a total of 240.

Mutton Snapper: 29 max age, 94.0 cm max length; **10 fish from each 3 cm length class** [3-6 cm, 6-9 cm, etc], for approximately 330 fish.

Lane Snapper: 10 max age, 60.0 cm max length; **10 fish every 2 cm** [2-4, 4-6, 6-8, etc], for approximately 310 fish.

White Grunt: 26 max age, 53.0 cm max length; **10 fish from each 3 cm length class** [3-6 cm, 6-9 cm, etc], for approximately 330 fish.

**The object is to sample each size-class, if a size-class is not represented in the catch, we will have to arrange to sub-sample the unfished populations.**

**Otoliths** – For the research in Belize, we are collecting otoliths for all priority fish targets, this include Nassau grouper, Lane and Mutton snapper. Please follow the procedure outlined in **Appendix E**. *Sample ID is determined by location of sample, data sampled (month and year) and the number of fish sampled in the month. For example, if you are sampling the FIRST otolith and it is a Lane Snapper in the month of July at Port Honduras on July 08, 2013. **You would label it sample ID # 01-JUL0813** (10 to indicate that this was the tenth fish collected, 07 for the month, 08 for the day AND 13 FOR THE YEAR) the site code and species code will be transcribed on the biological sample label.*

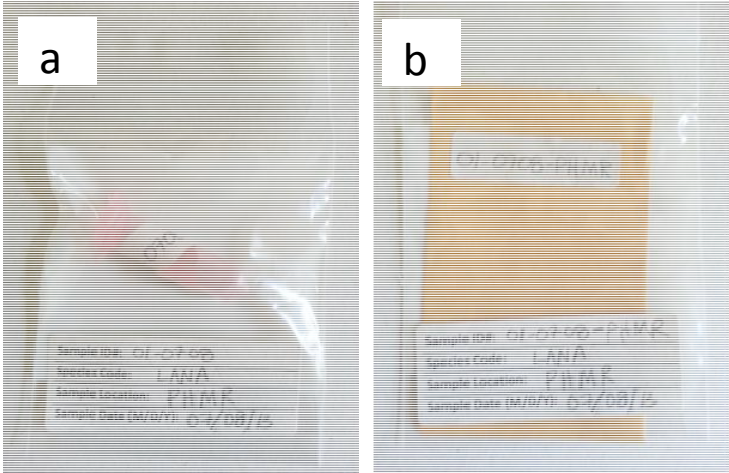
Fill out each label with the appropriate fishery information. Use a soft lead pencil on the label. Alcohol and water will dissolve ink and sample information will be lost. Note: **Information on each label is critical to maintaining the integrity of each sample! Never place otoliths from more than a one sample in a single tray.**

**Otolith cleaning and storage** – Wash otoliths off with water, using the supplied spray bottle and dry each otoliths before placing them in sample centrifuge tube **Note: Be careful to not lose the otoliths while rinsing!** Each sample will receive a label with the sample ID, also each sample will be place inside of an envelope with the biological sample label filled out on the outside.

Biological Sample Label:

Sample ID #:	
Species Code:	
Sample Location:	
Sample Date (M/D/Y):	

If the otoliths is small enough to fit into a 2ml centrifuge tube, place a sample ID label on the



tube with only the number, place a biological sample label on the other bag the holds the tube and sample (a). If the otoliths is from a larger individual, it is likely the otolith will not fit into the 2 ml centrifuge tube. Instead, place the otolith in a manilla coin envelope, with the sample ID label. This coin envelope will go into the larger sample bag with associated biological sample label (b).

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## Fishery Independent Sampling Protocols

The goals of fishery independent surveys are to monitor and analyze the viability of a fished population and the local fish community in order to determine population trends. Methodology should be harmonized across partner sites, with the following objectives:

- 1) To gather data on the number of animals in each size class of the population,
- 2) To gather data on the number of adults that are reproducing
- 3) To determine any major changes in habitat quality from that required by the species.
- 4) To compare the effectiveness of the different management zones in the reserve
- 5) Based on the results of the data gathered make recommendations for management decisions on fishing quotas, length of season, size limits, and other regulations that can be modified to make the fishery both profitable and sustainable.

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## Data and Databases

There are several options that are available to store data and each has its own benefits and associated issues. This data collection program will utilize Microsoft Excel for printing of the datasheet and daily data entry and Microsoft Access as a database. Microsoft Access has a built in option to conduct quality control of the database organization and accessibility.

**Data Entry** – For the time being, fishery dependent data (specify) will be entered into the excel spreadsheet (design based on Appendix : Biological-Samples-datasheet excel file) . Any time data are entered into the spreadsheet, save the spreadsheet for your sample region (i.e. Biological-Samples-datasheet excel file.exl) with the associated date, i.e., Biological-Samples-datasheet\_07-13-13.xls. Data entry will continue from the most recent file.

Data entry rules or data validation should be created in the Biological-Samples-datasheet excel file, and these rules are the same for market, at-sea and landing surveys. The rules ensure the standardization of data entry. To standardize data entry, each data column that is not numeric or the name of a person has been validated with a set of associated data, for example the column of species codes allows the user to scroll among species codes for data entry. The same goes for the other data types, common name, species name, species code, length unit, maturity, sex and biological sample.

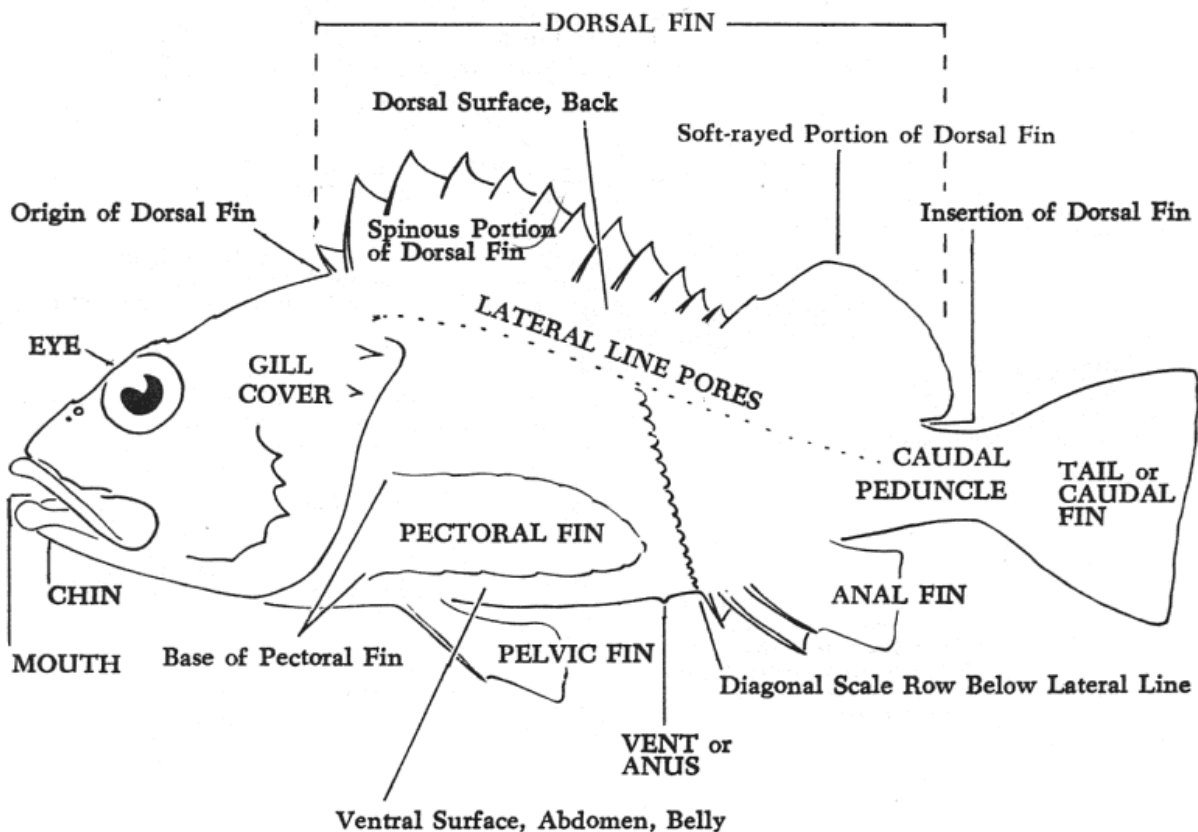
**QA/QC** – Secondary quality checks are used to establish format and normalization of the data, and to validate the actual data contained within the tables. The secondary check of data entered compares data entered versus data from the data sheets; this will be done periodically.

# Appendix A

## Identification and Biology of Target Species

## Target species characteristics and basic biology

This is a guide to help identify nearshore coral reef fish based on external features of shape, size, proportion, coloration and lateral lines. This guide does not serve as a dichotomous key or overarching fish identification guide for coral reef fishes, examples for fish id guides and keys are in the references. Use the below figure<sup>1</sup> to help guide the identification of key attributes of fish anatomy for identification.



A spiny-rayed fish, *Sebastes*, naming fins and general body areas.

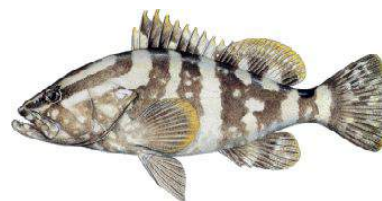
<sup>1</sup> Guide to the Coastal Marine Fishes of California. California Fish Bulletin Number 157, by DJ miller and RN Lea. Department of Fish and Game, Sacramento, 1972.

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## Priority Species

### Nassau Grouper (*Epinephelus striatus*)

Distinctive Features: **1) black saddle spot on base of tail; 2) dorsal fin notched between forward spines**



#### Description:

- Color light background with five irregular brown or red-brown bars on sides
- Stripe in shape of tuning fork on forehead
- Third spine of dorsal is longer than second
- Pelvic fins are shorter than pectoral
- Black dots located around the eyes
- Large black saddle on caudal peduncle
- Can change from pale to almost black
- 

Dorsal spines (total): 11 - 12; Dorsal soft rays (total): 16-18; Anal spines: 3; Anal soft rays: 8. Caudal fin rounded in juveniles. Dorsal fin notched between forward spines; 3rd or 4th spine the longest. Bases of soft dorsal and anal fins covered with scales and thick skin; scales small and greatly overlapping.

The Nassau Grouper is buff-coloured, with five dark brown vertical bars and a large black saddle blotch on top of the caudal peduncle, and a row of black dots below and behind the eye. It has a distinctive dark tuning-fork mark beginning at the front of the upper jaw, extending dorsally along the interorbital and bifurcating on top of the head behind the eyes. It has another dark band from the tip of the snout through the eye and then curves upward to meet its fellow just before the dorsal-fin origin. Some fish have irregular pale spots and blotches all over the head and body. The colour pattern can change in a few minutes from almost white to uniformly dark brown depending on the 'mood' of the fish. The third and fourth bars branch above the lateral line and form a "W". *E. striatus* can be distinguished from its congeners by several characteristics: 1) the third spine of the dorsal fin is longer than the second; 2) the interspinous membrane is slightly indented; and 3) the caudal fin is slightly emarginated<sup>1</sup>. During spawning, most fish



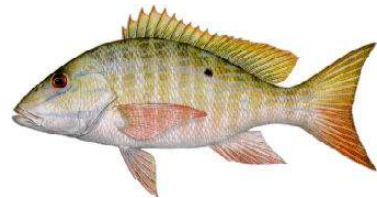
(males and females) display the bicoloured (non-aggressive) pattern and hover above the bottom. See photo of bicolor female distended with eggs, above. Some females remain in the barred pattern, becoming very dark as mating approaches and are closely followed by bicoloured fish during courtship.

Groupers are protogynous hermaphrodites. After spawning as a female for one or more years, the grouper changes sex, functioning as a male during future spawning events. Individuals of the Nassau grouper have been discovered to be male without previously going through a female stage and are smaller than the secondary males. It is believed by some that the sex change is triggered when the fish aggregate in preparation for spawning.

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### Mutton Snapper (*Lutjanus analis*)

Distinctive Features: **1) Fine blue lines below eye. 2) Pointed anal fin. 3) Black spot on midbody line below rear dorsal fins**



Description:

- Silver to gray, reddish brown and maroon; fins have a reddish tint
- Color olive green on back and upper sides
- All fins below the lateral line having reddish tinge
- Bright blue line below eye, following contour of operculum
- Anal fin pointed
- Small black spot below dorsal fin
- V-shaped tooth patch on roof of the mouth
- Adults develop a high back profile
- May lighten or darken dramatically; occasionally display dark bars

Dorsal spines (total): 10 - 11; Dorsal soft rays (total): 13-14; Anal spines: 3; Anal soft rays: 7 - 8. Preopercular notch and knob weak. Pectoral fins are long, reaching level of anus. Scale rows on back rising obliquely above lateral line.

Mutton snapper, or king snapper, is distributed in the western Atlantic, ranging from United States south to Brazil including Bermuda, the Gulf of Mexico, and the Caribbean. It occurs on the continental shelf areas as well as in clear waters around islands. The species forms small aggregations or schools which disband during the night. Mutton snapper has an average length



of 50 cm (FL), while the maximum size can reach 94.0 cm TL (male) and 15.6 kg in weight. The maximum recorded age is 40 years.

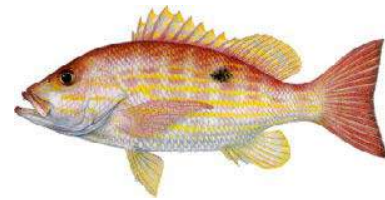
The mutton snapper has a distinct black spot on the upper back and blue stripes on the cheek region below the eye. It shows both plain and barred colour phases, with olive green on its back and upper-side and a red tinge on the lower side and underside. It is a relatively deep-bodied fish, with an almost lunate-shaped tail. It has a moderately bi-lobed dorsal fin, and a sharply pointed anal fin. The pectoral fin is long, reaching just past the anal origin. Mutton snappers are active diurnally and nocturnally.



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### Lane Snapper (*Lutjanus synagris*)

**Distinctive Features: 1) Several faint yellow to pink body stripes**



Description:

- Color silvery-pink to reddish with short, irregular pink and yellow lines on its sides
- Pectoral, ventral and anal fins often yellow
- Dorsal and tail fins often reddish
- Diffuse black spot, about as large as the eye below rear dorsal fin
- The dorsal fin centered above the lateral line
- The outer margin of caudal fin blackish

Dorsal spines (total): 10; Dorsal soft rays (total): 12-13; Anal spines: 3; Anal soft rays: 8 - 9. Preopercular notch and knob weak. Pectoral fins short, not reaching level of anus. Scale rows on back rising obliquely above lateral line.

The lane snapper spawns March through September; it is sexually mature at 6 inches (15 cm). Lane snapper are more typically caught in shallower (20-60 ft) waters than many of their other snapper counterparts, most commonly yellowtail snapper and mangrove snapper. Larger specimens can be found in somewhat deeper waters, but are typically less plentiful.

Lane snapper are generally caught on hook and line, and are considered to be more aggressive and easier to catch than most of their snapper counterparts, as they tend to be less wary of hooks and lines. Generally, lane snapper are not specifically targeted by anglers, but many are caught as a bycatch by anglers fishing for grouper or other species of snapper, as well as other shallow to mid-depth bottom fish. Similar fish are the mutton snapper, *Lutjanus analis*, and the mangrove snapper, *Lutjanus griseus*.

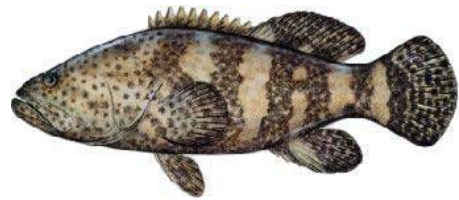


## Secondary Targets

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### Goliath Grouper (*Epinephelus itajara*)

Distinctive Features: **1) largest fish observed on the reefs.**  
**2) Small dark spots over body and fins.**



Description:

- Yellowish brown to olive-green
- Irregular dark and vertical bars present on the sides of body, more apparent in the young up to two feet
- Pectoral and caudal fins rounded
- First dorsal fin shorter than and not separated from second dorsal
- Adults huge, up to 800 pounds
- Eyes small
- Can pale and darken

Dorsal spines (total): 11; Dorsal soft rays (total): 15-16; Anal spines: 3; Anal soft rays: 8. Head long. Opercle with 3 flat spines, middle one the largest.

The Atlantic goliath grouper, as known as the jewfish, is a large saltwater fish of the grouper family found primarily in shallow tropical waters among coral and artificial reefs at depths from 15 to 165 ft (4.6 to 50 m). They may reach extremely large sizes, growing to lengths of 16 feet and can weigh as much as 800 pounds (363 kg). They are





usually around 400 pounds when mature. They also tend to spawn in large aggregations, returning like clockwork to the same locations, making them particularly vulnerable to mass harvesting. Goliath grouper are believed to be protogynous hermaphrodites, with individuals first maturing as females and only some large adults becoming males. Most grouper follow this pattern, but it has not yet been verified for the goliath.

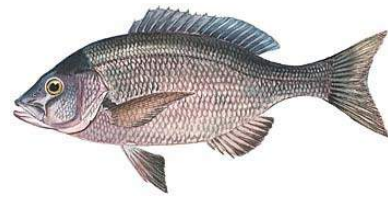
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### **Black Snapper (*Apsilus dentatus*)**

Distinctive Features: **1) Solid dark blue to violet**

Description:

- Basic snapper body profile without markings
- The snout is relatively short and pointed.
- Anterior teeth in upper jaw enlarged, canine-like.
- Dorsal and anal fin bases without scales.
- Pectoral fins long reaching level of anus.
- Scale rows on back parallel to lateral line.
- The back and upper sides violet or dark brown becoming lighter ventrally. Juveniles are mainly blue in color.



Dorsal spines (total): 10; Dorsal soft rays (total): 9-10; Anal spines: 3; Anal soft rays: 8.

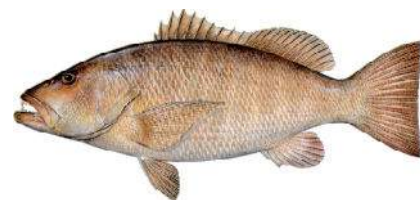
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### **Cubera Snapper (*Lutjanus cyanopterus*)**

Distinctive Features: **1) Thick lips. 2) Occasionally have pale bars on back**

Description:

- Color dark brown or gray, may have a reddish to purplish tint
- Broad-based triangular tooth patch on roof of mouth without a posterior extension
- Despite its specific name, which translates to "blue-fin," the fins have only a slight tint of blue; canine teeth in both jaws very strong
- Anal fin rounded
- One pair of canines are enlarged and visible even when the mouth is closed
- The dorsal and caudal fins are grayish; the anal and pelvic fins reddish; the pectoral fins translucent or grayish.



Dorsal spines (total): 10; Dorsal soft rays (total): 14; Anal spines: 3; Anal soft rays: 7 - 8.

Cubera snappers are the largest of the snappers, ranging to 125 pounds. They are not common anywhere in its range. These snapper feed on fishes and larger crustaceans. Spawning occurs in the late summer in the Keys. Often called dogtooth snapper, which is also the name given to dog snappers.

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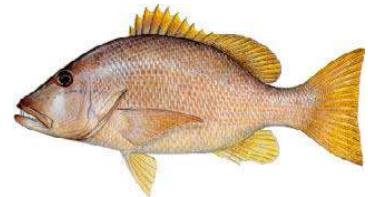


### **Dog Snapper (*Lutjanus jocu*)**

Distinctive Features: **1)**

Description:

- Color brown with a bronze tinge, lighter on sides
- Canine teeth are very sharp and one pair is notably enlarged, visible even when the mouth is closed
- In adults, a pale triangle and a light blue interrupted line are below the eye
- No dark spot is found on the body underneath dorsal fin



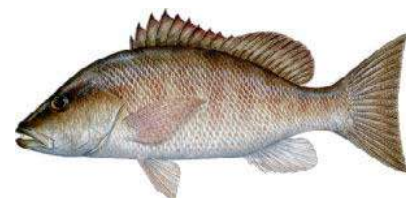
Its average length is 24 in (60 cm); adults may reach a maximum length of 30 in (74 cm). The maximum weight known for this snapper is 20 lb (9.1 kg). Sexual maturity is obtained at lengths of 12-16 in (30-40 cm).



### **Mangrove Snapper (*Lutjanus griseus*)**

Distinctive Features: **1) Darkish band occasionally runs from lip across eye**

Description:



- Generally greenish brown on back, grading to reddish on side and ventral parts
- Occasion faint body bars
- Tail may have a dark margin
- Two conspicuous canine teeth are present at front of upper jaw
- Dorsal fins have dark or reddish borders
- No dark spot is present on side underneath dorsal fin

Dorsal spines (total): 10; Dorsal soft rays (total): 13-14; Anal spines: 3; Anal soft rays: 7 - 8.

The mangrove snapper also known as the gray snapper can be confused with the cubera snapper or black snapper. Mangrove snapper are typically much smaller than cubera, but when they are of similar size, the two species can only be distinguished by examining a patch of teeth (tooth patch) on the inside roof of the mouth. Many specimens caught are actually misidentified dogtooth or dog snapper. The best way to distinguish between the two species is dog snapper has a lighter triangle of color with a blue band under the eye and large, sharp fangs in the front (canines), hence its common name. These fangs can deliver a painful bite, even in a small fish.




---

### Red Snapper (*Lutjanus campechanus*)

Distinctive Features: **1) Red iris. 2) Pointed anal fin.**

Description:

- Color pinkish red over entire body, lower body fades to silvery
- Long triangular snout
- No dark lateral spot
- Young (1-10 inches) have a dusky spot below soft dorsal fin at and above midline



Dorsal spines (total): 10; Dorsal soft rays (total): 14; Anal spines: 3; Anal soft rays: 8 - 9. Scale rows on back rising obliquely above lateral line.

The red snapper commonly inhabits waters 30 to 200 feet deep, but some are reported to be caught at 300 feet deep. All feature a sloped profile, medium-to-large scales, a spiny dorsal fin and a laterally compressed body. The maximum published age of a caught red snapper was reported to be 57 years. Coloration of the red snapper is light red, with more intense pigment on the back. A red snapper attains sexual maturity at two to five years old. An adult snapper can live for more than 50 years and weigh 50 pounds.

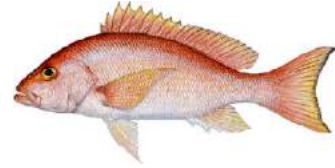
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## Silk Snapper (*Lutjanus vivanus*)

Distinctive Features: **1) Yellow iris. 2) Red-color.**

Description:

- Back and upper sides pinkish red, shading to silvery sides with undulating yellow lines
- Pectorals are pale yellow
- Back edge of caudal fin is blackish
- Anal fin pointed
- No dark lateral spot



Dorsal spines (total): 10 - 11; Dorsal soft rays (total): 13-14; Anal spines: 3; Anal soft rays: 7 - 8. Preopercular notch and knob weak.

The silk or silky snapper is also known as yellow-eyed snapper. The yellow iris identifies the silk snapper from its close relatives. The body of the silk snapper is red overall, darker above and lighter below with fine wavy longitudinal yellow lines. The caudal fin has a dusky margin. In studies, the smallest sexually mature silk snappers were a 9-inch female and an 11-inch male. Spawning occurs from late spring through the summer.

Similar fish with red bodies are the red snapper and the blackfin snapper, both of which possess a red iris. The blackfin also has a very distinctive black spot at the base of the pectoral fin. Another red-colored snapper, the vermilion snapper, is distinguished by its more streamlined body and deeply forked tail.

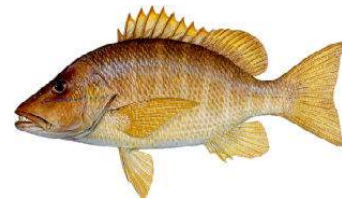
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## Schoolmaster (*Lutjanus apodus*)

Distinctive Features: **1) Fins yellow. JUVENILE: 2) Bars on back.**

Description:

- Silver to copper
- Color olive gray on upper sides with yellow tint, sometimes with reddish tint around head
- Long triangular snout
- Eight pale vertical bars on the side of the body
- Yellow fins
- Blue stripe below eye, becoming interrupted in adults
- No dark lateral spot



Dorsal spines (total): 10; Dorsal soft rays (total): 14; Anal spines: 3; Anal soft rays: 8. Snout long and pointed, mouth large. One of the upper pairs of canine teeth notably enlarged, visible when mouth is close.

Occurs in shallow coastal waters over coral reefs, down to 63 m. Often near the shelter of Elkhorn corals (*Acropora palmata*) and gorgonians (*L. apodus*). Juveniles are often found above sand bottoms with or without sea grass and over muddy bottoms of lagoons or mangrove areas. Young specimens may enter brackish waters. Sometimes form resting aggregations during the day.



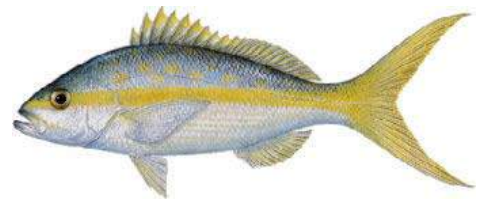
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### Yellowtail Snapper (*Ocyurus chrysurus*)

Distinctive Features: **1) Brilliant yellow midbody stripe and tail**

#### Description:

- Silvery to white, often tinged blue
- Back and upper sides olive to bluish with yellow spots
- Lower sides and belly with alternating narrow, longitudinal pink and yellow stripes
- Prominent midlateral yellow stripe begins at mouth and runs to tail, broadening as it passes the dorsal fins
- Caudal fin yellow and deeply forked; no dark lateral spot



Dorsal spines (total): 10; Dorsal soft rays (total): 12-14; Anal spines: 3; Anal soft rays: 8 - 9. Head relatively small, lower jaw projecting slightly beyond the upper. Scale rows on back rising obliquely above lateral line.

Yellowtail snapper are typically caught in 30-120 feet of water on and around reefs and other structure. The most common method of catching them is with hook and line. Usually seen well below the bottom, frequently in aggregations. Feeds mainly at night, on a combination of planktonic and benthic animals, including fish, crustaceans, worms, gastropods and cephalopods. Young individuals are usually found over weed beds. They feed primarily on plankton.





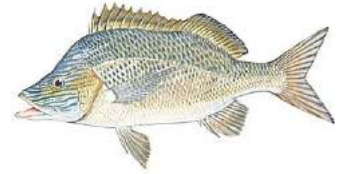
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### White Grunt (*Haemulon plumieri*)

Distinctive Features: **1) Stripes only on the head.**

Description:

- Numerous blue and yellow stripes on the body and head.
- On some individuals the scales are tipped with bronze.
- Large scales on upper body from checkered pattern of yellow and bluish silver, often with a pearly iridescence.
- The pectoral fins are chalky and the other fins are gray. The lining of the body cavity, or peritoneum, is black.



Dorsal spines (total): 12; Dorsal soft rays (total): 17; Anal spines: 3; Anal soft rays: 9.

White grunts are sexually mature during their third year, or when they reach about 10 inches long. Spawning occurs in the late spring and summer. The species is reported to live as long as 13 years, attaining a length of 25 inches and weight of 8 pounds. White grunts are carnivores that feed on bottom-dwelling invertebrates by rooting around in the sand and shell hash between rocky ledges and at the bases of coral formations.



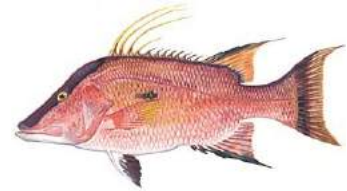
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### Hogfish (*Lachnolaimus maximus*)

Distinctive Features: **1) First three spines of dorsal fin are long. 2) Black blotch near end of dorsal fin.**

Description:

- large laterally compressed body shape;
- a very elongated snout, a "pig-like" snout;
- the caudal, or tail fin, is somewhat lunate and the pectoral fins are along the lateral sides of the body with the paired pelvic fins directly below;
- The first three spines of the dorsal fin, as well as the upper and lower tips of the caudal fin, are extended into long filaments;
- A prominent black spot behind the pectoral fins differentiates male from females. The dorsal fin, usually is composed of three or four long dorsal spines followed by a series of shorter dorsal spines.



Color is highly variable and changes with size. The scales on the back are often edged in yellow, and a dark spot is at the rear base of the dorsal fin. This spot disappears with age. Males possess a dark oblique band that covers the top portion of the head, extending to the tip of the snout. Juveniles are much lighter in color overall, usually of a pink or gray with white mottling along the sides.

Like many wrasses, the hogfish is a sequential hermaphrodite, which means it changes sex during different life stages. The hogfish is a protogynous, “first female” hermaphrodite: juvenile hogfish start out as female and then mature to become male. The change usually occurs around 3 years of age and about 14 inches in length. Females and juveniles will usually start out as pale gray, brown, or reddish brown in coloring, with a paler underside and no distinct patterns. Males

are distinguished by a deep dark band spanning from the snout to the first dorsal spine, as well as by a lateral black spot behind the pectoral fins. Hogfish reach a maximum size of about 3 feet and approximately 22 pounds and have been recorded to live up to 11 years.

---



Top: terminal phase, bottom: immature phase



## Reference

Coral reef fishes: Caribbean, Indian Ocean, and Pacific Ocean: including the Red Sea (1999) by Ewald Lieske and Robert Myers.

Florida Fish and Wildlife Conservation Commission,  
<http://myfwc.com/wildlifehabitats/profiles/fish/saltwater/>. Accessed May 8, 2013. Image Credit: Diane Rome Peebles,

Reef fish identification : Florida, Caribbean, Bahamas (2002) by Paul Humann, Ned DeLoach

REEF. <http://www.reef.org/resources/galleries/caribbean>. Accessed May 8, 2013.

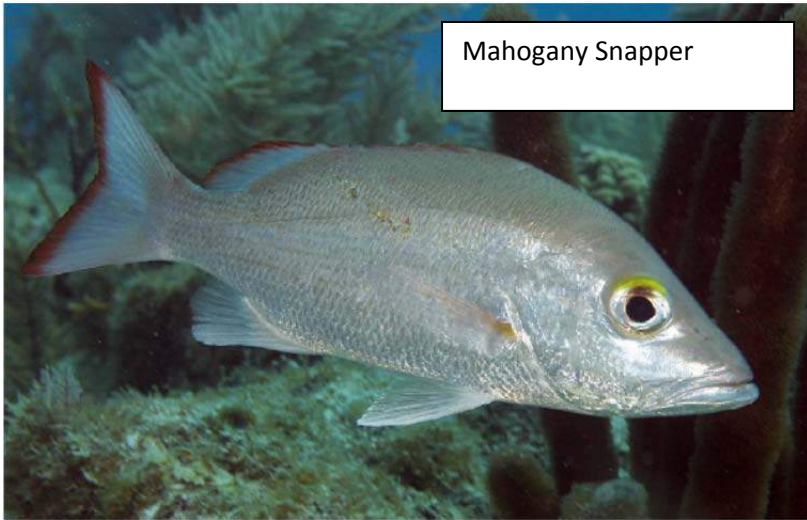
South Atlantic Fishery Management Council.  
<http://www.safmc.net/fishidandregs/fishgallery/>. Accessed May 8, 2013.



Mahogany Snapper (juv)



Mahogany Snapper



**Appendix B**

**Landings Survey: datasheet and instructions**

LANDINGS SURVEY

Port/Landings Name: \_\_\_\_\_

Departure time: \_\_\_\_\_

Date (M / D/ Y) : \_\_\_\_\_

Arrival time: \_\_\_\_\_

observers: \_\_\_\_\_

Fishing Area: \_\_\_\_\_

Species Name (CODE)	Fork Length (mm)	Total Length (mm)	Weight (g)  gutted (g) whole (w)	Maturity  Undetermined= U Immature = IM Mature=M Gravid=G Spawning= SW Spent=S	Gonad Weight (g)	Sex  Female= F Male=M	Biological  Otolith = O Fin Clip = F	Sample ID  number of otoliths sampled- Date (M/D/Y)	Fishing Vessel/ Captain	Number of Crew	Hours of Fishing (gear used fishing)	Fishing Gear

COMMENTS: \_\_\_\_\_

QA/QC (Initials/ Date): \_\_\_\_\_

## Data Description and Instructions: Landings Surveys

**Port/Landings Name:**

**Calendar date** (month/day/year) of market survey

**Observers:**

**Arrival Time:** arrival time of observer

**Departure Time:** departure time of observer

**Captains Name:** Name of Captain and boat

**Fishing Area:** general location of fishing activities

**Fishing Vessel ID/Captain:** Vessel identification number as recorded on permit.

**Number of Crew:**

**Hours of Fishing:** length of fishing trip

**Species CODE:** Enter species CODE.

**Length (cm):** Enter the Length of each fish in centimeters and indicate length type recorded by circling either FL (Fork Length), TL (Total Length), SL (Standard Length).

**Weight (kg):** Enter the weight of each fish in kilograms and indicate weight type recorded by circling either gutted or whole weight.

**Abundance:** count the number of individuals

**Maturity:** Enter the stage of maturity observed by indicating M (Mature), IM (Immature), G (Gravid), or S (Spent) in the box provided.

**Sex:** Enter the sex of the species sampled by indicating F (Female) or M (Male) in the box provided.

**Biological Samples:** Enter the type of biological samples taken by indicating O (Otolith). Note multiple samples will likely be taken and should all be indicated on form and

**Sample ID:** A unique identifier should be designated by scientific personnel. **Photo ID:** any photos, note photo numbers and download photos in a folder with sample date.

**Comments:** Any comments deemed important can be made note of here.

Appendix C

At-sea Survey

## AT-SEA SURVEYS

Captains Name:

Depature data (M / D/ Y) :

Departure time: \_\_\_\_\_

Vessel ID:

Arrival data (M / D/ Y) :

Arrival time: \_\_\_\_\_

Permit/License No.:

Latitude / Longitude:

Fishing Area: \_\_\_\_\_

Number of Crew:

Fishing Depth:

Days since last fished:

Site:

Date (M / D / Y):

observers Name:

[illegible]

## Data Description and Instructions: At-Sea Surveys

**Calendar date** (month/day/year) of market survey

**Captains Name:** Name of Captain and boat

**Vessel ID:** Vessel identification number as recorded on permit.

**Permit/License No.:** fishing permit ID

**Number of Crew:**

**Days since last fished:** date of last fishing trip, if the trip was longer than 1 day, please note time frame

**Site:** port of departure

**Departure Date:** (Month/ Day/ Year)

**Arrival Date:** if longer than one day (Month/ Day/ Year)

**Latitude/Longitude:**

**Fishing Depth:** depth at which the majority of fishing tookplace

**Departure Time:** departure time of fishing vessel

**Arrival Time:** arrival time/ end of fishing end of fishing vessel

**Fishing Area:** general location of fishing activities

**Observers Name:** Name observer collecting data for the fishing trip (First, Last).

**Date Recorded:** Enter the numerical date (month, day and year)

**Species CODE:** Enter species CODE.

**Length (cm):** Enter the Length of each fish in centimeters and indicate length type recorded by circling either FL (Fork Length), TL (Total Length), SL (Standard Length).

**Weight (kg):** Enter the weight of each fish in kilograms and indicate weight type recorded by circling either gutted or whole weight.

**Abundance:** count the number of individuals

**Maturity:** Enter the stage of maturity observed by indicating M (Mature), IM (Immature), G (Gravid), or S (Spent) in the box provided.

**Sex:** Enter the sex of the species sampled by indicating F (Female) or M (Male) in the box provided.

**Discard species/quantity:** note fish discarded and the quantity

**Gear:** type of fishing gear used during the trip

**Total Landings:**

**Comments:** Any comments deemed important can be made note of here. Including the collectionof

**Biological Samples:** Enter the type of biological samples taken by indicating O (Otolith). Note multiple samples will likely be taken and should all be indicated on form and **Sample ID:** A unique identifier should be designated by scientific personnel. **Photo ID:** any photos, note photo numbers and download photos in a folder with sample date.

## Appendix D

### Market Survey



MARKET SURVEY

Market Location/ Name: \_\_\_\_\_

Date (M / D/ Y) : \_\_\_\_\_

observers: \_\_\_\_\_ Fishing Area: \_\_\_\_\_

Fish Stall ID	Species Name (CODE)	Fork Length (mm)	Total Length (mm)	Weight (g) gutted (g) whole (w)	Sex	Maturity	Percent of ca	Price	Photo ID

COMMENTS:

\_\_\_\_\_

Fish Stall ID	Species Name (CODE)	Length TL FL SL	Length (cm)	Weight (kg)	Sex	Maturity	Abundance	Price	Photo ID

COMMENTS:

Data Entry (Name/Date): \_\_\_\_\_

QA/QC (Name/ Date): \_\_\_\_\_

## Data Description and Instructions: Market Surveys

**Calendar date** (month/day/year) of market survey

**Fish Stall ID/ Description:** Vender Name, species sold (targets), photos

**Date Recorded:** Enter the numerical date (month, day and year)

**Observers Name:** Name observer collecting data for the fishing trip (First, Last).

**Species CODE:** Enter species CODE.

**Length (cm):** Enter the Length of each fish in centimeters and indicate length type recorded by circling either FL (Fork Length), TL (Total Length), SL (Standard Length).

**Weight (kg):** Enter the weight of each fish in kilograms and indicate weight type recorded by circling either gutted or whole weight.

**Abundance:** count the number of individuals

**Maturity:** Enter the stage of maturity observed by indicating M (Mature), IM (Immature), G (Gravid), or S (Spent) in the box provided.

**Sex:** Enter the sex of the species sampled by indicating F (Female) or M (Male) in the box provided.

**Photo ID:** any photos of fish or stall, note photo numbers and download photos in a folder with sample date

**Comments:** Any comments deemed important can be made note of here. Including the collection of

**Biological Samples:** Enter the type of biological samples taken by indicating O (Otolith). Note multiple samples will likely be taken and should all be indicated on form and **Sample ID:** A unique identifier should be designated by scientific personnel.

## Appendix E

### Biological Samples and Maturity Determination: Instructions

#### References used:

Cook, M. (2010). *Description of gonad macroscopic classes for training purposes*. NOAA Fisheries Service, Mississippi Laboratories.

Lombardi, L. and M. Cook. (2009). *Teleost sampling procedures*. NOAA Fisheries Service, Panama City Laboratories.

MER Consultants. 2012. Developing a fisheries data collection strategy to support stock assessments in Indonesia. Stuart, Florida.



# NOAA Fisheries Shark Observer Training

## Teleost Sampling Request And Procedures

NOAA Fisheries Service  
3500 Delwood Beach Road  
Panama City, FL 32408

### Contact Information:

Phone: 850-234-6541 (Linda x213, Melissa x205)  
Email: [Linda.Lombardi@noaa.gov](mailto:Linda.Lombardi@noaa.gov), [Melissa.Cook@noaa.gov](mailto:Melissa.Cook@noaa.gov)

## List of Requested Teleost Samples by Species

### Sampling Protocol:

For red grouper randomly sub-sample 5 out of every 100 fish to collect otoliths, *no* red grouper gonads are requested.

For all other groupers, snappers, and tilefish, collect as many otoliths and gonads as time permits.

Only collect samples from these regions:

GOM - Gulf of Mexico

E FL - east coast of Florida

Common Name	Scientific Name	Sp. Abbr	Code	Otolith	Gonad	Region
GROUPEr BLACK	<i>Mycteroperca bonaci</i>	BLG	1422	Yes	Yes	GOM
GROUPEr GAG	<i>Mycteroperca microlepis</i>	GAG	1423	Yes	Yes	GOM
GROUPEr GOLIATH	<i>Epinephelus itajara</i>	GOL	1850	Yes	Yes	GOM
GROUPEr GRAYSBY	<i>Epinephelus cruentatus</i>	GSG	1428	Yes	Yes	GOM
GROUPEr MARBLED	<i>Epinephelus inermis</i>	MBG	1417	Yes	Yes	GOM
GROUPEr MISTY	<i>Epinephelus mystacinus</i>	MSG	1420	Yes	Yes	GOM
GROUPEr RED	<i>Epinephelus morio</i>	RGR	1416	Yes	<b>NO</b>	GOM
GROUPEr SCAMP	<i>Mycteroperca phenax</i>	CGR	1424	Yes	Yes	GOM
GROUPEr SNOWY	<i>Epinephelus niveatus</i>	OGR	1414	Yes	Yes	GOM
GROUPEr WARSAW	<i>Epinephelus nigritus</i>	WGR	4740	Yes	Yes	GOM
GROUPEr YELLOWEDGE	<i>Epinephelus flavolimbatus</i>	YEG	1415	Yes	Yes	GOM
GROUPEr YELLOWFIN	<i>Mycteroperca venenosa</i>	YFG	1426	Yes	Yes	GOM
GROUPEr YELLOWMOUTH	<i>Mycteroperca interstitialis</i>	YMG	1425	Yes	Yes	GOM
HIND RED	<i>Epinephelus guttatus</i>	REH	1413	Yes	Yes	GOM
HIND ROCK	<i>Epinephelus adscensionis</i>	RHI	1412	Yes	Yes	GOM
HIND SPECKLED	<i>Epinephelus drummondhayi</i>	SHI	1411	Yes	Yes	GOM
SNAPPER BLACK	<i>Apsilus dentatus</i>	BSN	3755	Yes	Yes	GOM
SNAPPER BLACKFIN	<i>Lutjanus buccanella</i>	BFS	3757	Yes	Yes	GOM
SNAPPER CARDINAL	<i>Pristipomoides macrophthalmus</i>	CRS		Yes	Yes	GOM
SNAPPER CUBERA	<i>Lutjanus cyanopterus</i>	CSN	3759	Yes	Yes	GOM
SNAPPER DOG	<i>Lutjanus jocu</i>	DSN	3754	Yes	Yes	GOM
SNAPPER GRAY	<i>Lutjanus griseus</i>	SNG	3762	Yes	Yes	GOM
SNAPPER LANE	<i>Lutjanus synagris</i>	LUL	3761	Yes	Yes	GOM
SNAPPER MAHOGANY	<i>Lutjanus mahogoni</i>	MHS	3772	Yes	Yes	GOM
SNAPPER MUTTON	<i>Lutjanus analis</i>	MSN	3763	Yes	Yes	GOM
SNAPPER RED	<i>Lutjanus campechanus</i>	RSN	3764	Yes	Yes	GOM
SNAPPER QUEEN	<i>Etelis oculatus</i>	QSN	3770	Yes	Yes	GOM
SNAPPER SCHOOLMASTER	<i>Lutjanus apodus</i>	SMS	3771	Yes	Yes	GOM
SNAPPER SILK	<i>Lutjanus vivanus</i>	SNS	3758	Yes	Yes	GOM
SNAPPER VERMILLION	<i>Rhomboplites aurorubens</i>	SNV	3765	Yes	Yes	GOM
SNAPPER WENCHMAN	<i>Pristipomoides aquilonaris</i>	WNS	3756	Yes	Yes	GOM
SNAPPER YELLOWTAIL	<i>Ocyurus chrysurus</i>	YTS	3767	Yes	Yes	GOM
TILEFISH BLACKLINE	<i>Caulolatilus cyanops</i>	BKT	4476	Yes	Yes	GOM, E FL
TILEFISH BLUELINE (GRAY)	<i>Caulolatilus microps</i>	BLT	4474	Yes	Yes	GOM, E FL
TILEFISH	<i>Lopholatilus chamaeleonticeps</i>	TIL	4470	Yes	Yes	GOM, E FL
TILEFISH GOLDFACE	<i>Caulolatilus chrysops</i>	GFT	4472	Yes	Yes	GOM, E FL
TILEFISH SAND	<i>Malacanthus plumieri</i>	MAL	4478	Yes	Yes	GOM, E FL

## **List of Supplies for Teleost Otolith and Gonad Sampling**

### **Otolith Collection**

- ☐ 1 plastic storage bin
- ☐ 100 Otolith Envelopes
- ☐ 10 freezer proof quart Zip-loc bags
  - Use to group otolith envelopes per haul, label with Haul #

### **Gonad Collection**

- ☐ 1 5 gallon bucket
- ☐ 100 Gonad tags
- ☐ 10% Formalin (see accompanying procedures for mixing powered formalin)
- ☐ 100 Whirl-paks for gonad storage (45 each: 18 oz, 24 oz; 10 55 oz)

### **General Supplies:**

- ☐ 2 Chisels different sizes - medium, large
- ☐ Roe Knife

## Sagittal Otolith Removal Procedures

1. Cut the operculum to fold forward and open it wide towards the anterior end of the fish.
2. Cut away the gill arches at their insertion.
3. Use a chisel to scrape away tissue from the otolith capsule, the capsule will feel like a large knob or protrusion.
4. Open the capsule with a chisel, the large sagittal otoliths can be easily removed with forceps.
5. Rub off any attached membranes from the otolith, rinse with fresh water and pat dry.
6. Place otolith in the provided coin envelope.
7. Please write the following information on the provided coin envelopes:

OBS/TRIP ID:

Haul #:

Species Abbreviation: (see attached list)

Specimen #:

Date:

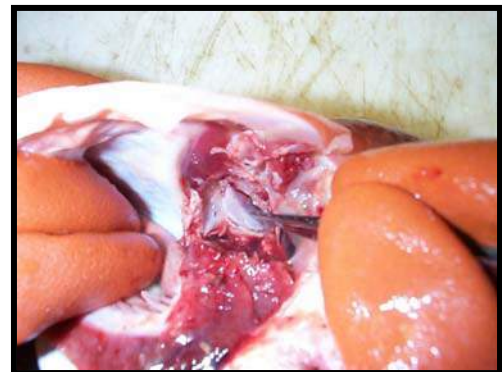
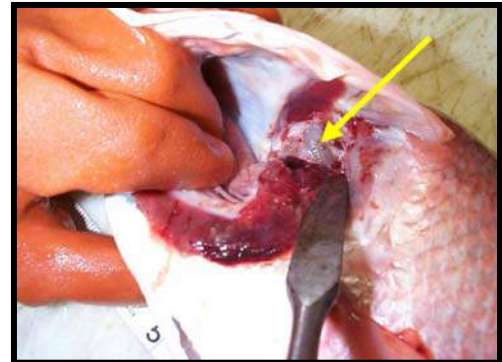
Samples: Otolith and/or Gonad\*

\*circle sample(s) taken

8. Please store all otoliths in the provided quart zip-lock bags, labeled with:  
Vessel Name  
Haul #

Keep all otoliths dry.

**Do not store otoliths in gonad bucket.**





### Gonad Removal Procedures

1. Use a sharp knife and insert its tip just inside the anus.

2. Make a shallow cut through the ventral abdomen up to the base of the pelvic fin.

3. The gonad will be the only bi-lobed organ in the abdominal cavity dorsal to the anus, and will be attached to the upper-rear abdominal wall.

4. Grab the two lobes and carefully pull them away from the abdominal wall.

5. Cut the posterior end from the abdominal wall without cutting any of the lobes.

6. Depending on the size of the gonad, poke multiple holes in the ovarian membrane in both lobes of the gonad to allow for faster preservation.



7. Place the gonad (both lobes) in a whirl-pak bag (small or medium size) in a 10% formalin solution, make sure both lobes are *immersed* in the solution. Remove as much air as possible from the whirl-pak bag by rolling until air is removed before sealing both ends of the wire ties together.

Write the following on the whirl-pak bag (use BLACK sharpie):

Haul #

Species Abbreviation

Specimen #

8. Please write the following information on the provided gonad label:

OBS/TRIP ID:

Haul #:

Species Abbreviation: (see attached list)

Specimen #:

9. Please place the entire sample in the provided 5-gallon buckets.

Please label the buckets:

Observer Last Name

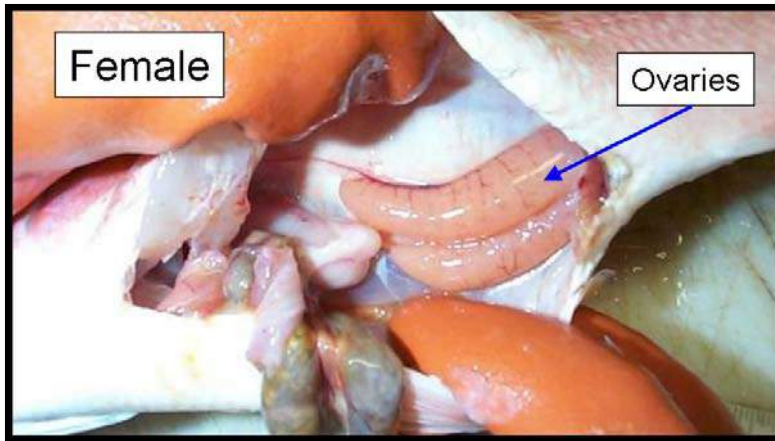
OBS/TRIP ID

Haul #s

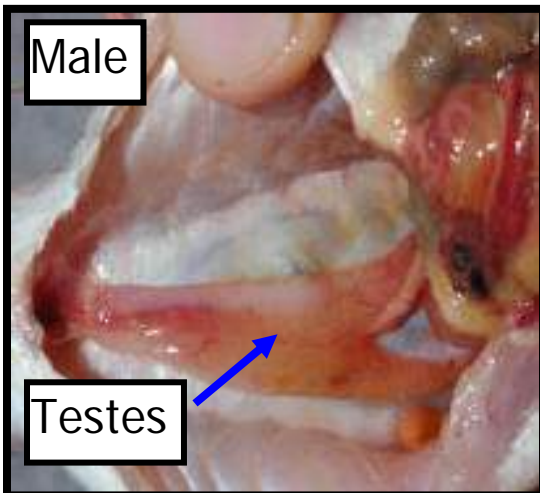
Trip dates

## Examples of Gonads

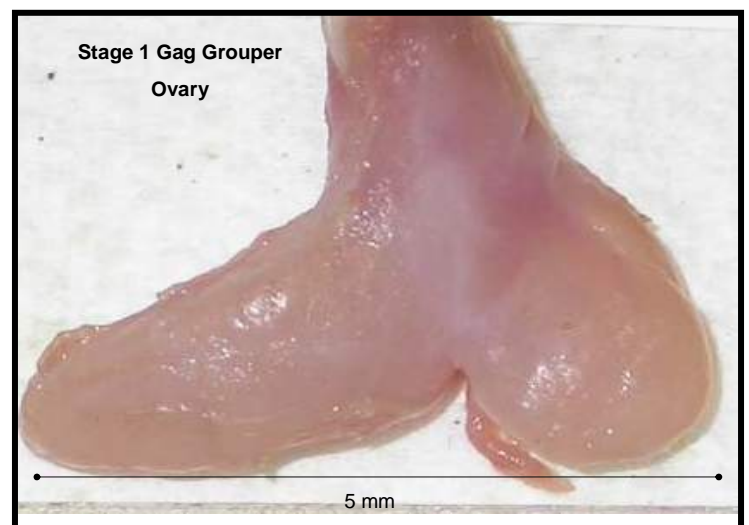
Snapper

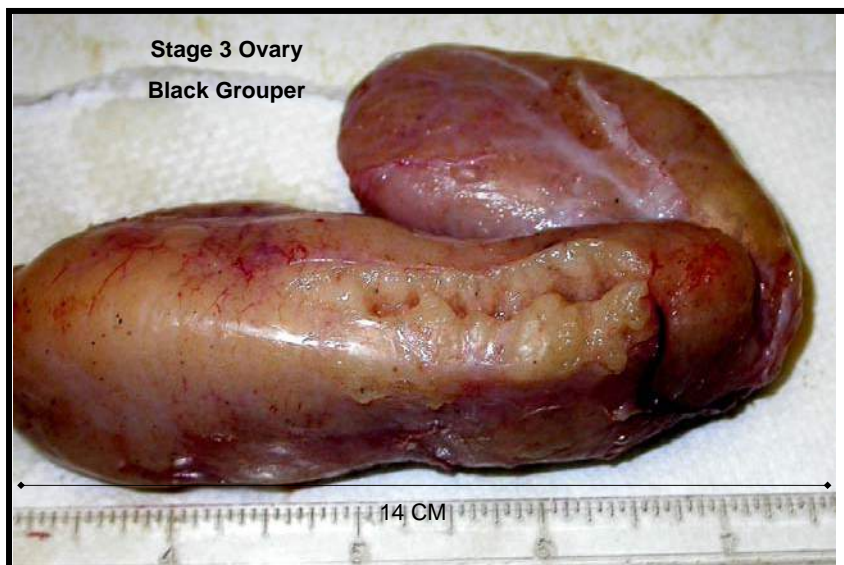
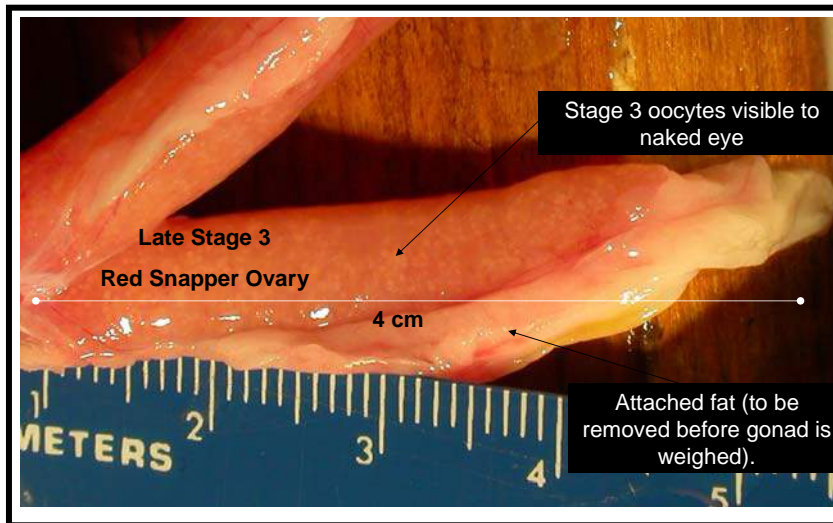


Tilefish



Depending on sexual stage and maturity the gonads may not look like the above pictures. Grouper gonads outside of the spawning season can be very small, especially in males.



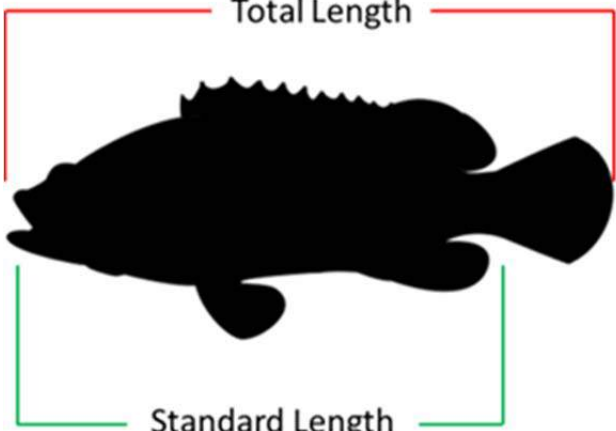
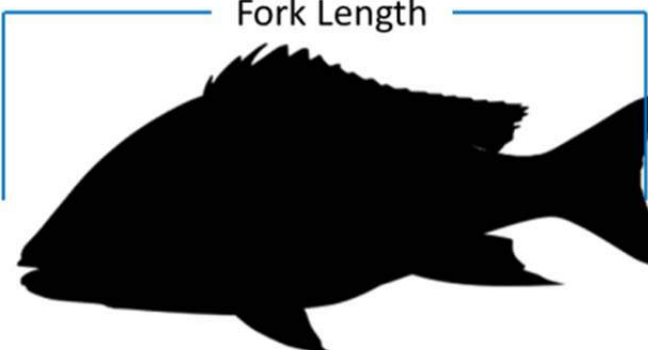
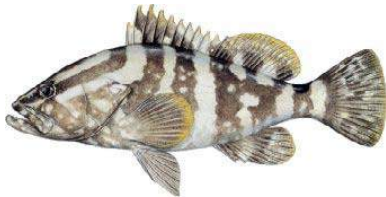
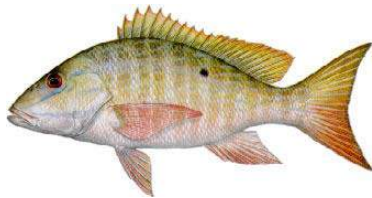
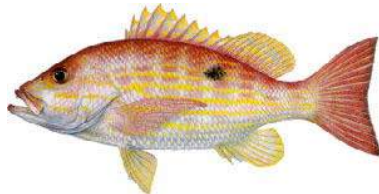
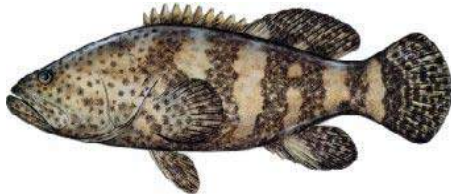



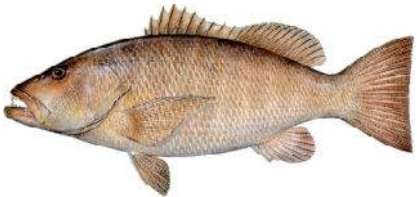
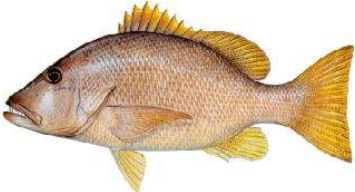
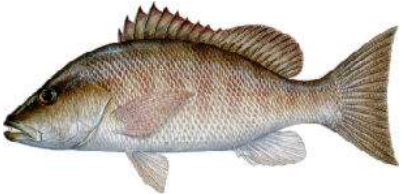


Appendix F

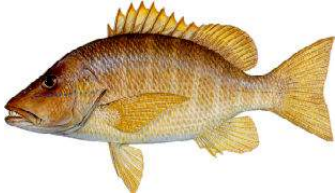

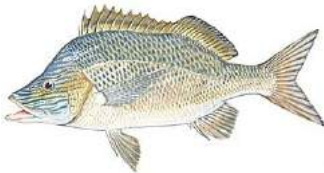
CHEAT SHEET

A handheld quick guide to target fish



Target Species	Distinct Features	Picture ID
<div><div><div>Total Length</div><div>Standard Length</div></div><div><div>Fork Length</div></div></div>		
<div>Priority Targets</div> <div>Nassau Grouper (<i>Epinephelus striatus</i>)</div> <div>ESTR</div>	<div>black saddle spot on base of tail; dorsal fin notched between forward spines.</div> <ul style="list-style-type: none"><li>•Color light background with five irregular brown or red-brown bars on sides.</li><li>•Stripe in shape of tuning fork on forehead.</li><li>•Third spine of dorsal is longer than second.</li><li>•Pelvic fins are shorter than pectoral.</li><li>•Black dots located around the eyes.</li></ul>	
<div>Mutton Snapper (<i>Lutjanus analis</i>)</div> <div>LANA</div>	<div>Fine blue lines below eye. Pointed anal fin. Black spot on midbody line below rear dorsal fins.</div> <ul style="list-style-type: none"><li>•Silver to gray, reddish brown and maroon; fins have a reddish tint.</li><li>•Color olive green on back and upper sides.</li><li>•All fins below the lateral line having reddish tinge.</li></ul>	
<div>Lane Snapper (<i>Lutjanus synagris</i>)</div> <div>LSYN</div>	<div>Several faint yellow to pink body stripes.</div> <ul style="list-style-type: none"><li>•Color silvery-pink to reddish with short, irregular pink and yellow lines on its sides.</li><li>•Pectoral, ventral and anal fins often yellow.</li><li>•Dorsal and tail fins often reddish.</li><li>•Diffuse black spot, about as large as the eye below rear dorsal fin.</li><li>•Dorsal fin centered above the lateral line.</li><li>•Outer margin of caudal fin blackish.</li></ul>	
<div>Secondary Targets</div> <div>Goliath Grouper (<i>Epinephelus itajara</i>)</div> <div>EITA</div>	<div>Small dark spots over body and fins.</div> <ul style="list-style-type: none"><li>•Yellowish brown to olive-green</li><li>•Irregular dark and vertical bars present on the sides of body, more apparent in the young up to two feet.</li><li>•Pectoral and caudal fins rounded.</li></ul>	

<p>Black Snapper (<i>Apsilus dentatus</i>)</p> <p><b>ADEN</b></p>	<p><b>Solid dark blue to violet.</b></p> <ul style="list-style-type: none"><li>•The snout is relatively short and pointed.</li><li>•Anterior teeth in upper jaw enlarged, canine-like.</li><li>•Dorsal and anal fin bases without scales.</li><li>•Pectoral fins long reaching level of anus.</li><li>•Scale rows on back parallel to lateral line</li></ul>	
<p>Cubera Snapper (<i>Lutjanus cyanopterus</i>)</p> <p><b>LCYA</b></p>	<p><b>Thick lips. Occasionally have pale bars on back</b></p> <ul style="list-style-type: none"><li>•Color dark brown or gray, may have a reddish to purplish tint</li><li>•One pair of canines are enlarged and visible even when the mouth is closed</li><li>•Often called dogtooth snapper, which is also the name given to dog snappers.</li></ul>	
<p>Dog Snapper (<i>Lutjanus jocu</i>)</p> <p><b>LJOC</b></p>	<ul style="list-style-type: none"><li>•Color brown with a bronze tinge, lighter on sides</li><li>•Canine teeth are very sharp and one pair is notably enlarged, visible even when the mouth is closed</li><li>•In adults, a pale triangle and a light blue interrupted line are below the eye</li><li>•No dark spot is found on the body underneath dorsal fin</li></ul>	
<p>Mangrove Snapper (<i>Lutjanus griseus</i>)</p> <p><b>LGRI</b></p>	<p><b>Darkish band occasionally runs from lip across eye</b></p> <ul style="list-style-type: none"><li>•Greenish brown on back, grading to reddish on side and ventral parts</li><li>•Occasion faint body bars</li><li>•Tail may have a dark margin</li><li>•Two conspicuous canine teeth are present at front of upper jaw</li><li>•Dorsal fins have dark or reddish borders</li><li>•No dark spot is present on side underneath dorsal fin</li></ul>	
<p>Red Snapper (<i>Lutjanus campechanus</i>)</p> <p><b>LCAM</b></p> <p>Confused with silk snapper, blackfin snapper and vermillion snapper</p>	<p><b>Red iris. Pointed anal fin.</b></p> <ul style="list-style-type: none"><li>•Color pinkish red over entire body, lower body fades to silvery</li><li>•Long triangular snout</li><li>•No dark lateral spot</li></ul>	
<p>Silk Snapper (<i>Lutjanus vivanus</i>)</p> <p><b>LVIV</b></p> <p>Confused with red snapper, blackfin snapper and vermillion snapper</p>	<p><b>Yellow iris. Red-color.</b></p> <ul style="list-style-type: none"><li>•Back and upper sides pinkish red to silvery sides with undulating yellow lines</li><li>•Pectorals are pale yellow</li><li>•Back edge of caudal fin is blackish</li><li>•Anal fin pointed</li><li>•No dark lateral spot</li></ul>	

<div>Schoolmaster (Lutjanus apodus)</div> <div>LAPO</div>	<div><b>Fins yellow</b></div> <div><ul style="list-style-type: none"><li>•Color olive gray on upper sides with yellow tint, sometimes with reddish tint around head</li><li>•Long triangular snout</li><li>•Eight pale vertical bars on the side of the body</li><li>•Blue stripe below eye, becoming interrupted in adults</li><li>•No dark lateral spot</li></ul></div>	
<div>Yellowtail Snapper (Ocyurus chrysurus)</div> <div>OCHR</div>	<div><b>Brilliant yellow midbody stripe and tail</b></div> <div><ul style="list-style-type: none"><li>• Silvery to white, often tinged blue</li><li>•Back and upper sides olive to bluish with yellow spots</li><li>•Lower sides and belly with alternating narrow, longitudinal pink and yellow stripes</li><li>•Prominent midlateral yellow stripe begins at mouth and runs to tail, broadening as it passes the dorsal fins</li><li>•Caudal fin yellow and deeply forked; no dark lateral spot</li></ul></div>	
<div>White Grunt (Haemulon plumierii)</div> <div>HPLU</div>	<div><b>Stripes only on the head, blue and yellow.</b></div> <div><ul style="list-style-type: none"><li>•Large scales on upper body from checkered pattern of yellow and bluish silver, often with a pearly iridescence.</li><li>•The pectoral fins are chalky and the other fins are gray. The lining of the body cavity, or peritoneum, is black.</li></ul></div>	
<div>Hogfish (Lachnolaimus maximus)</div> <div>LMAX</div>	<div><b>First three spines of dorsal fin are long.</b></div> <div><b>Black blotch near wend of dorsal fin.</b></div> <div><ul style="list-style-type: none"><li>•a very elongated snout, a “pig-like” snout;</li><li>•the caudal, or tail fin, is somewhat lunate and the pectoral fins are along the lateral sides of the body with the paired pelvic fins directly below;</li><li>•A prominent black spot behind the pectoral fins differentiates male from females. The dorsal fin, usually is composed of three or four long dorsal spines followed by a series of shorter dorsal spines.</li></ul></div>	