

Belt Transect Fish Survey Protocol for the U.S. Caribbean and Flower Garden Banks National Marine Sanctuary

National Coral Reef Monitoring Program (NCRMP)

Coral Reef Conservation Program (CRCP), National Oceanic and Atmospheric Administration

Introduction

The National Coral Reef Monitoring Program (NCRMP) provides a biennial ecological characterization at a broad spatial scale of general reef condition for reef fishes, corals and benthic habitat (*i.e.*, fish species composition/density/size, benthic cover, and coral density/size/condition). Data collection occurs at stratified random sites where the sampling domain for each region (*e.g.*, Puerto Rico, U.S. Virgin Islands, Flower Garden Banks National Marine Sanctuary [FGBNMS]) is partitioned by habitat type and depth, sub-regional location (*e.g.*, along-shelf position) and management zone. NCRMP will provide broader geographic context to supplement local monitoring efforts and studies of tropical reef ecosystems.

Goal of Fish Surveys

The goal of the fish community surveys is to collect and report information on species composition, density, size, abundance, and derived metrics (*e.g.*, species richness, diversity) using a 25m x 4m belt transect in a stratified random sampling design in hardbottom and coral reef habitats in the U.S. Caribbean (U.S. Virgin Islands and Puerto Rico) and FGBNMS.

General Task Description

The diver collecting fish information is the lead diver for the dive team. The diver will lay the initial transect for fish surveys which also serves as the transect for the line point-intercept (LPI) and coral demographic surveys (Appendix I; Refer to *Line Point-Intercept Survey Protocol for the U.S. Caribbean and Flower Garden Banks National Marine Sanctuary* and *Coral Demographic Survey Protocol for the U.S. Caribbean and Flower Garden Banks National Marine Sanctuary*).

General Transect Information

Navigating to site

Once in the field, the boat captain navigates to a selected site using a handheld GPS unit.

1. At the site, the Captain puts the boat in neutral and divers are immediately deployed.
2. Divers immediately site substrate bottom and swim down at a safe descent rate, deploying a surface float to mark the diver and transect location.
3. Divers maintain contact with each other throughout the entire census.

Establishing the transect

The Fish diver establishes the direction of the transect. This transect will also be used by the LPI diver and Coral Demographic diver (if present; Appendix I).

1. Prior to entering the water, the fish diver selects a random heading from a predetermined list (located in the Field Operation Handbook).
 - a. The Fish diver ascertains presence of hardbottom in the predetermined heading.
 - i. Hardbottom is **present** at survey site
 1. If the starting point is on hardbottom, conduct the survey from the starting point using the predetermined heading.
 2. If the starting point is in sand, use the following **DECISION RULE** below to determine transect direction (Figure 1). **Do not swim around searching for hardbottom.**
 - ii. Hardbottom is **absent** at survey site
 1. As the team descends, if it becomes apparent that no hardbottom is in the vision of the dive team (*i.e.*, only continuous sand or seagrass is visible, limited visibility), then the dive will be terminated and an alternate site selected.

DECISION RULE (Figure 1):

- If the starting point of the transect is on hardbottom then the dive proceeds along the predetermined heading. **In the rare instance that hardbottom ends before the end of the transect, the dive still proceeds as planned.**
- If the start of the transect is not on hardbottom **AND** the predetermined heading causes the transect survey area (25m x 4m) to continue over sand away from or not coming into contact with hardbottom, the diver should alter the heading.
- **Do not alter the starting point** - the diver should determine the shortest route to hardbottom while maximizing hardbottom area within the transect. Add the new heading to the datasheet, circle “HB Rule” to note reason for the change in heading, and begin the transect on this new heading (Figure 2).

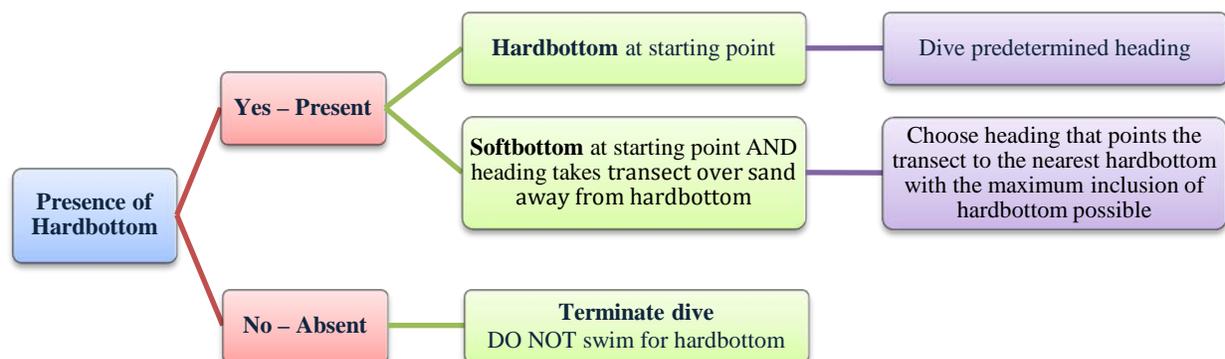


Figure 1. Decision Rule.

Fish Census Datasheet							
Fish Diver		Site ID		DEMO Diver 2		Heading	Reason (circle)
LPI Diver		Date		Checked by		Orig. 160	Depth Current
Demo Diver		Time		Entered by		Alt. 270	HB Rule

Figure 2. Example of station information and recording a heading change on the fish datasheet. In this example, 160° was the original heading, 270° is the altered transect heading. In addition, the Fish diver must circle the reason for the heading change.

2. Visibility at each site must be sufficient to allow for identification of fish at a minimum of 2m away.
 - a. Once reasonable, safe visibility is ascertained, the diver attaches a tape measure to the substrate and allows it to roll out for 25m while s/he collects data.
3. The Fish diver collects the following information (Appendix II):
 - a. *Fish census* – taxa presence and abundance along 25m transect and 2m width on either side of the tape.
 - b. *Topographic complexity information* – The Fish diver will also collect topographic relief information (Refer to *Topographic Complexity Survey Protocol for the U.S. Caribbean and Flower Garden Banks National Marine Sanctuary*).
4. Fish transects start at 0m from the beginning of the transect tape and continue to 25m.
 - a. The Fish diver secures the start of transect tape and continues to keep the transect tape relatively taut.
 - i. The Fish diver proceeds down the transect and periodically clips weights to the tape to keep the tape relatively immovable for the LPI and Coral Demographic divers (Figure 3).



Figure 3. Example of weight attached to transect tape.

- ii. The Fish diver will avoid wrapping the tape around substrate or biotic object, as this will distort sampling distances and locations for all divers.

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- b. **The only instances where the transect should deviate from the designated path is to stay above 99 ft or presence of strong currents.**
- i. If at the start of a deep transect, it is evident that the random compass heading will proceed to depths greater than 99', the diver will alter the heading upslope. Ensure new compass heading is written on datasheet and "depth" is circled to note reason for change in heading (Figure 2).
 - ii. If strong currents might prevent a steady and appropriate pace along the transect, alter the compass heading into the current. Ensure new compass heading is written on the datasheet and "current" is circled to note reason for change in heading (Figure 2).
 - iii. Alternatively, terminate the transect and select an alternate site.
- c. The Fish diver searches thoroughly for fish in the 25m x 4m survey area.
- i. On-site, the Fish diver will make no attempt to avoid structural features within a habitat, such as a sand patch or an anchor, as these features affect fish communities and are "real" features of the habitats.
 - ii. The habitat should not be altered in any manner by lifting or moving structure.
 - iii. The Fish diver should record fish seen in holes, under ledges and in the water column.
 - iv. To identify, enumerate, or locate new individuals, divers may move off the centerline of the transect as long as s/he stays within the 4m transect width and does not look beyond the 4m width or back along area already covered.
 - v. The diver is allowed to look forward toward the end of the transect for the distance remaining (*i.e.*, if the diver is at meter 15, s/he can look 10 meters distant, but if s/he is at meter 23, s/he can only look 2 meters ahead).
- d. The transect will take 15 minutes regardless of habitat type or number of animals present. This standardizes the samples collected to allow for comparisons and allows more mobile animals the opportunity to swim through the transect.

Field Equipment

- Fish survey datasheet, clipboard, pencil (and backup pencil)
- Transect tape
- 0.5 or 1 m measuring stick
- 3 – 0.45kg weights with clips
- Camera/housing (optional)

Fish Survey Protocols

Data are collected on the following:

1. *Logistic information* – Names of all divers, station, date, time of survey, diver checks and heading. If alternate heading is used, diver must circle the reason for the heading change (Figures 2 and 4). Orig.=original predetermined heading; Alt.= alternate, if necessary.

Fish Census Datasheet							
Fish Diver		Site ID		DEMO Diver 2		Heading	Reason (circle)
LPI Diver		Date		Checked by		Orig.	Depth Current HB Rule
Demo Diver		Time		Entered by		Alt.	

Figure 4. NCRMP fish datasheet header with logistic, station and heading information.

2. *Taxa presence* – As the tape roles out at a relatively constant speed, the diver records all fish species to the lowest taxonomic level possible that come within 2m of either side of the transect (Figure 5).

fish ID	<5	5-10	10-15	15-20	20-25	25-30	30-35	>35
1								
2								
3								

Figure 5. NCRMP fish survey datasheet with identification and size bins.

- a. To decrease the total time spent writing, four letter codes are used that consist of the first two letters of the genus name followed by the first two letters of the species name (*e.g.*, A*cantherus* c*oeruleus* = ACCO).
 - i. In the rare case that two species have the same four-letter code, a modified code is used. The construct remains unchanged for the two genus letters and the first letter of the species name; however, the last letter of the code is comprised of the letter where the first spelling difference occurs.
Example: L*actophrys* t*rigonus* (LATG) and L*actophrys* t*riquet* (LATQ)
 - b. If the fish can only be identified to the family or genus level, then this is all that is recorded. If the fish cannot be identified to the family level, then no entry is necessary.
3. *Abundance and size* – The number of individuals per species is tallied in 5cm size class increments up to 35cm using visual estimation of **fork length** (FL; Figures 5 and 6).

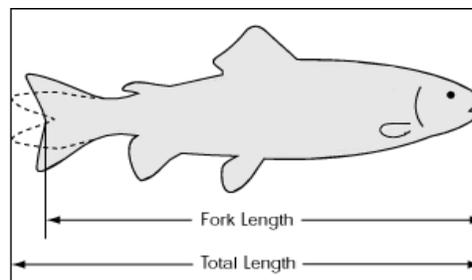


Figure 6. Fork length measurement compared with total length measurement. Fork length is recorded.

- a. If an individual is greater than 35cm, then an estimate of the **actual fork length** is recorded.
- b. Actual size (cm FL) is recorded for certain key species (Table 1).

Table 1. List of fish species requiring actual size measurement (FL).

<i>Species Name</i>	<i>Common Name</i>
<i>Cephalopholis cruentata</i>	graysby
<i>Cephalopholis fulva</i>	coney
<i>Dermatolepis inermis</i>	marbled grouper
<i>Epinephelus adscensionis</i>	rock hind
<i>Epinephelus guttatus</i>	red hind
<i>Epinephelus morio</i>	red grouper
<i>Epinephelus striatus</i>	Nassau grouper
<i>Lutjanus analis</i>	mutton snapper
<i>Lutjanus apodus</i>	schoolmaster
<i>Lutjanus buccanella</i>	blackfin snapper
<i>Lutjanus cyanopterus</i>	cupera snapper
<i>Lutjanus griseus</i>	gray snapper
<i>Lutjanus jocu</i>	dog snapper
<i>Lutjanus mahogoni</i>	mahogany snapper
<i>Lutjanus synagris</i>	lane snapper
<i>Mycteroperca bonaci</i>	black grouper
<i>Mycteroperca interstitialis</i>	yellowmouth grouper
<i>Mycteroperca tigris</i>	tiger grouper
<i>Mycteroperca venenosa</i>	yellowfin grouper
<i>Mycteroperca phenax</i>	scamp
<i>Ocyurus chrysurus</i>	yellowtail snapper
<i>Lachnolaimus maximus</i>	hogfish
<i>Pterois volitans</i>	red lionfish

4. *Photos* – If a fish is difficult to identify or is unique in some manner, it may be photographed for later clarification.

Data sheet review

At end of survey, when divers are on boat, the dive team exchanges datasheets for review by checking for completeness and legibility. A diver cannot review his/her own datasheet. After the datasheet has been reviewed, the reviewer initials the “checked by diver” box (Appendix II).

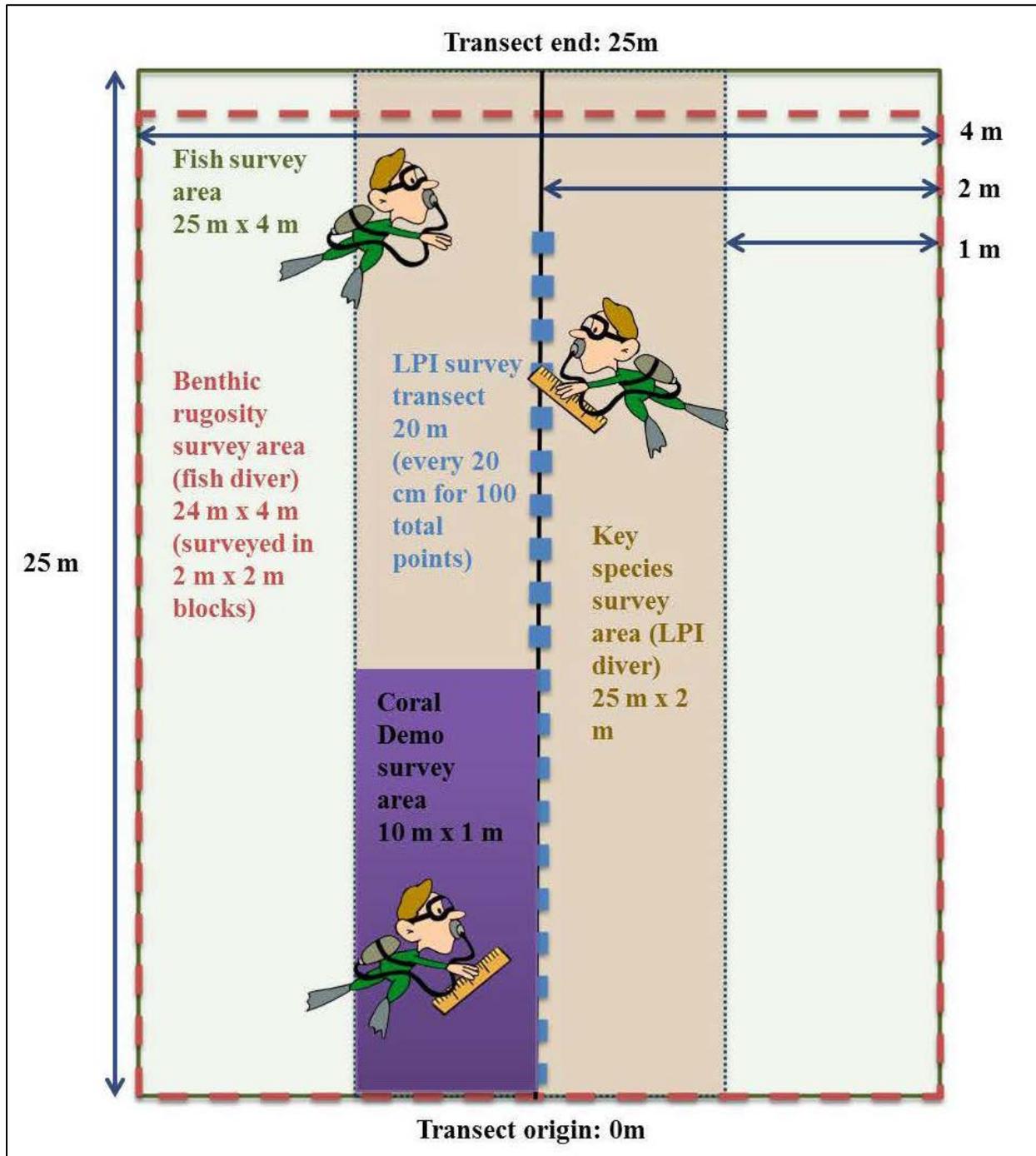
1. *Fish datasheet* – Review includes, at a minimum, verifying the following:
 - a. Completeness and legibility of all logistics information; including random heading(s) and that the reason for change in random heading is circled, where applicable.
 - b. Completeness and legibility of all species codes, bin size class marks and size numbers (for select species and individuals >35cm).
 - c. Completeness and legibility of all Topographic Complexity records.
 - i. Stratum slope – Minimum and maximum depth (recorded in ft).
 - ii. Maximum vertical relief (recorded in cm)
 - iii. Surface area topography – 24 total tick marks.

2. *LPI datasheet* – Review includes, at a minimum, verifying the following:
 - a. Completeness and legibility of all logistics information.
 - b. Confirmation of correct observed habitat type with dive team and is circled.
 - c. Completeness and legibility of macroinvertebrate records. NOTE: All boxes are to be filled out. If this component was not conducted, “X” through section is required.
 - d. Completeness and legibility of ESA-listed coral records. NOTE: All boxes are to be filled out. If this component was not conducted, “X” through section is required.

5. *Coral Demographic datasheet* – Review includes, at a minimum, verifying the following:
 - a. Completeness and legibility of all logistics information; including identification of second Demographic surveyor (if applicable).
 - b. Completeness and legibility of transect start and end locations (integer).
 - c. Completeness and legibility of percent hardbottom of survey component.
 - d. Annotation in “Notes” section reporting the presence of multiple datasheets utilized for data collection (if applicable).

Appendix I

Diagram of all surveys. Size of each respective survey area is also indicated. Fish, line-point intercept and coral demographic methodologies commence as the divers move off the transect origin.



Appendix II

Template of datasheet used for Belt Transect Fish Protocol.

Fish Census Datasheet									
Fish Diver		Site ID		DEMO Diver 2		Heading		Reason (circle)	
LPI Diver		Date		Checked by		Orig.		Depth Current HB Rule	
Demo Diver		Time		Entered by		Alt.			
	Fish ID	<5	5-10	10-15	15-20	20-25	25-30	30-35	>35
1									
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Topography: 25 x 4m		Rugosity: 24 x 4m (bin by 2m x 2m)							
Min depth (ft)		<20 cm				100 - <150 cm			
Max depth (ft)		20 - <50 cm				150 - <200 cm			
Max Vert Ht (cm)		50 - <100 cm				200+ cm			