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

National Coral Reef Monitoring Program
Coral Reef Conservation Program, National Oceanic and Atmospheric Administration
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Belt Transect Fish Census
Once in the field, the boat captain navigates to previously selected sites using a handheld GPS unit. On-site, divers are deployed and maintain contact with each other throughout the entire census. One diver is responsible for collecting data on the fish communities utilizing the belt-transect visual census technique over an area of $100m^2$ (25m length X 4m width). The belt-transect diver obtains a random compass heading for the transect prior to entering the water and records the compass bearing (0-360°) on the data sheet. Where appropriate, the boat can drop a weighted float that will mark the start of the transect. The boat can drop the divers near the float and the team descends down the float line. Dropping a float in the VINP and VICR is not an option so divers are dropped as close to the GPS position as possible. The divers will descend as rapidly, yet safely, as possible to maintain relative proximity to the centroid position. If it becomes apparent that no hardbottom is in the vision of the dive team (i.e., continuous sand or seagrass or limited visibility), then the dive will be terminated and an alternate selected. If hardbottom is observed in the vicinity of the site, then the dive continues as planned- starting on the centroid, or close approximation, and on the predetermined random bearing. Do not alter the predetermined course if the centroid is not on hardbottom or the bearing does not cover hardbottom.

Visibility at each site must be sufficient to allow for identification of fish at a minimum of 2m away. Once reasonable 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.

Although the habitat should not be altered in any manner by lifting or moving structure, the observer should record fish seen in holes, under ledges and in the water column. 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 back along area already covered. 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).

On-site, no attempt to avoid structural features within a habitat such as a sand patch or an anchor should be made as these features affect fish communities and are "real" features of the habitats. The only instance where the transect should deviate from the designated path is to stay above 99 ft.

The transect should take 15 minutes regardless of habitat type or number of animals present. This allows more mobile animals the opportunity to swim through the transect and standardizes the samples collected to allow for comparisons.

Data are collected on the following:

1. Logistic information - diver name, dive buddy, station, transect bearing, date, time of survey.

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. 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. In the rare case that two species have the same four-letter code, letters are added to the species name until a difference occurs. 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. As the fish diver proceeds down the transect, they need to attach an ankle weight to the tape so the tape is relatively immovable for the LPI diver. The tape could also be tied around a hard feature but with minimal tape usage as the LPI diver is making measurements every 20cm.

4. Abundance & size - the number of individuals per species is tallied in 5cm size class increments up to 35cm using visual estimation of **fork length** (Figure 1). If an individual is greater than 35cm, then an estimate of the **actual fork length** is recorded. Actual size (cm FL) is recorded for certain managed species. These include:

Cephalopholis cruentata	graysby
Cephalopholis fulva	coney
Dermatolepis inermis	marbled grouper
Epinephelus adscensionis	rock hind
Epinephelus guttatus	red hind
Epinephelus morio	red grouper
Epinephelus striatus	nassau grouper
Lutjanus analis	mutton snapper
Lutjanus apodus	schoolmaster
Lutjanus buccanella	blackfin snapper
Lutjanus cyanopterus	cubera snapper
Lutjanus griseus	gray snapper
Lutjanus jocu	dog snapper
Lutjanus mahogoni	mahogany snapper
Lutjanus synagris	lane snapper
Mycteroperca bonaci	black grouper
Mycteroperca interstitialis	yellowmouth grouper
Mycteroperca tigris	tiger grouper
Mycteroperca venenosa	yellowfin grouper
Mycteroperca phenax	scamp
Ocyurus chrysurus	yellowtail snapper
Lachnolaimus maximus	hogfish

5. When Fish diver has completed the fish survey and is at m 25, s/he begins the swim back to m 0 while conducting the Topographic Complexity Survey (Appendix 1).

6. Photos - individuals too difficult to identify or unique in some manner may be photographed for later clarification.

7. At end of survey, when divers are on boat, the LPI diver reviews fish datasheet for completeness and legibility. LPI diver checks, at a minimum, the following:
    a. Legibility of all logistic information
    b. Legibility of all species codes, bin size class marks and size numbers
    c. Legibility of all rugosity measure numbers

8. When LPI diver has certified Fish datasheet has met this quick qa/qc check, LPI diver initials sheet in “check by diver” box.

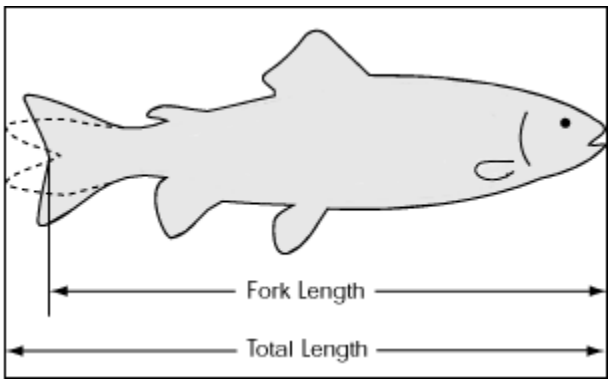

Figure 1: Fork length measurement compared with total length measurement. Fork length is recorded.

Appendix 1:

Topographic Complexity Survey Protocol for the Atlantic/ Caribbean

Introduction

NCRMP is a broad spatial snapshot for reef condition (*i.e.* fish species composition/density/size, benthic cover, and coral density/size/condition) to provide context for local-scale studies of tropical reef ecosystems. Data collection will occur at stratified random sites where the sampling domain for each region (*e.g.* Puerto Rico, USVI, Flower Garden Banks and Florida) is partitioned by habitat type and depth, sub-regional location (*e.g.* along-shelf position) and management zone. NCRMP is intended to supplement local monitoring efforts by providing large-scale data on reef fishes and the benthos.

The following protocol pertains to NCRMP topographic complexity surveys conducted in conjunction with reef fish surveys using a 25-m x 4-m belt transects, as well as RVC fish counts (roving visual counts). The purpose of this survey is to provide information on the topographic complexity (substratum rugosity) of survey locations where reef fish surveys and line point-intercept surveys are conducted. The data collection procedure described below captures basic information on the depth range, vertical relief, and surface topography.

Characterization of topographic complexity along a 25-m fish transect or 15-m diameter RVC cylinder consists of three separate elements:

- Minimum and maximum depth along each 25-m transect (or 15-m diameter RVC cylinder);
- Amplitude of substratum relief, recorded as the maximum vertical relief in a 25-m x 4-m belt transect or a 15-m diameter RVC cylinder; and
- An estimate of the relative proportion of different relief categories for the sample unit (i.e., 100-m^2 belt transect or 176-m^2 RVC cylinder), using six different categories ranging from < 0.2 m to > 2 m.

Minimum/maximum depth and maximum vertical relief measurements are made within the 25-m x 4-m portion of the transect (or 15-m diameter RVC cylinder). In locations where 25-m x 4-m belt transects are used, 24 relief frequency measurements occur along **BOTH** transect sides (starting at meter 24 and 2-m out on each transect side).

Step 1 (slope). **Substratum slope**: using a digital depth gauge, record the maximum and minimum depth encountered within the 25-m x 4-m belt transect or 15-m diameter RVC cylinder. This information provides the depth range of the sample unit, as well as the potential variability of the substratum in certain habitats such as spur and groove.

Step 2 (amplitude). **Maximum vertical relief**: using a digital depth gauge or a 0.5- or 1-m measuring device, record the maximum vertical relief present in the 25-m x 4-m belt

transect area or 15-m diameter RVC cylinder. This is accomplished by measuring the height of the most structurally complex feature in the sample unit, whether a coral head, barrel sponge, side of a coralline spur, or other topographic feature. Note that gorgonians, branching sponges, and branching *Millepora alcicornis* colonies are NOT included in this measurement.

Step 3 (frequency). **Surface area topography (relief frequency)**: An estimate of the surface topography of the sample unit (i.e., 25-m x 4-m fish belt transect or 15-m diameter RVC cylinder) can be accomplished in many ways. In locations where a 25-m x 4-m belt transect is used to sample fishes, the entire transect cannot be easily viewed all at once. Therefore, one approach is to subdivide the 100-m^2 area into smaller subplots (e.g. 2-m x 2-m areas, n=24 per sample unit in this example), with each subplot scored for the highest hard-bottom relief feature (Figure 1). Each 2-m x 2-m sub-plot is scored for vertical relief using one of the following six categories: < 0.2 m, 0.2-<0.5 m, 0.5-<1.0 m, 1.0-<1.5 m, 1.5-<2 m and 2+ m. Looking within each individual sub-plot, measure the highest relief feature (not including "soft complexity" features such as branching gorgonians, sponges, and fire corals) and place a mark in the appropriate relief category on the datasheet. In cases where RVC cylinders are sampled, either subdivide the 176-m^2 area into smaller subunits or estimate the relative area of the entire sampling unit represented by the six relief categories shown below.

Example data along a 25-m x 4-m belt transect, subdivided into 2-m x 2-m subplots (for ease of sampling):

(24 marks recorded on the underwater datasheet)

Category	Frequency (number of 2-m x 2-m units)
< 0.2 m	5
0.2-<0.5 m	6
0.5-<1.0 m	10
1.0-<1.5 m	2
1.5-<2.0m	2
2 m+	0

In this example, an estimated 20% of the sample unit had < 0.2 m of relief, 24% had 0.2-0.5 m of relief, and so on.

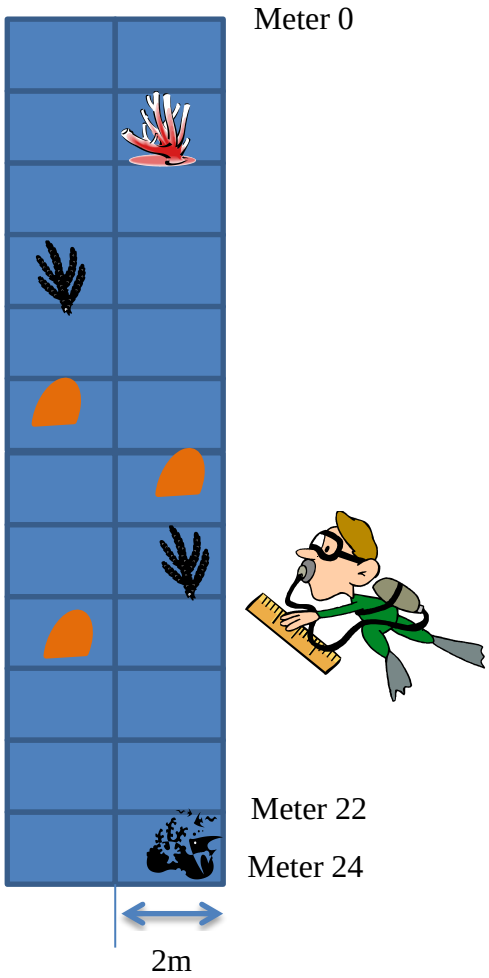

Figure 1. Example of the 2-m x 2-m grids for measuring topographic complexity along a 25-m x 4-m belt transect survey area for reef fishes in the U.S. Virgin Islands, Flower Garden Banks and Puerto Rico. In Florida, within the RVC cylinder dimensions (15-m diameter), the maximum and minimum depth, as well as the relative coverage of the six different relief categories, are visually estimated for the ~177 m^2 survey area.

Name:		Station:		Date:		check by diver	
Buddy:		Bearing:		Time:		check by qa/qc	

	fish ID	<5	5-10	10-15	15-20	20-25	25-30	30-35	>35
1									
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3									
4									
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Rugosity: 25 x 4m (feet)	
Min depth	
Max depth	
Max Vert Ht	

Rugosity: 24 x 4m (bin by 2m x 2m)			
<20 cm		100 - <150 cm	
20 - <50 cm		150 - <200 cm	
50 - <100 cm		200+ cm	