

Topographic Complexity Survey Protocol for the Atlantic, U.S. Caribbean and Flower Garden Banks National Marine Sanctuary: 2016

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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.*, Florida, 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.

The following protocol pertains to NCRMP topographic complexity surveys conducted in conjunction with Line Point-Intercept (LPI) surveys using a 15m x 2m belt transects (Refer to *Line Point-Intercept Survey Protocol for the Atlantic, U.S. Caribbean and Gulf of Mexico: 2016*; Appendix I).

The 2016 Topographic Complexity protocols have substantial differences than previous versions (years) as a result of NCRMP standardization throughout the project's regions (*e.g.* Florida and Pacific regions). Specific differences in methodologies between regions, where applicable, are noted within the protocols.

Goal of Topographic Complexity Surveys

The purpose of this survey is to provide information on the topographic complexity (substratum rugosity) of survey locations where LPI and Coral Demographic 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 15m benthic transect (Appendix I):

1. *Slope* - Minimum and maximum depth along each 15m transect;
2. *Vertical relief* - Amplitude of substratum relief, recorded as the maximum vertical relief in a 15m x 2m belt transect; and
3. *Surface area topography* - An estimate of the relative proportion of different relief categories for the sample unit (*i.e.*, 30m² belt transect), using six different categories ranging from <0.2m to >2m.

Topographic Complexity Survey Protocols

Minimum/maximum depth and maximum vertical relief measurements are made within the entirety of the 15m x 2m transect. The 15 relief frequency measurements occur along **BOTH** transect sides (starting at meter 15 and 1m out on each transect side).

Data are collected on the following (Appendix II):

1. *Substratum slope* – Using a digital depth gauge, record the maximum and minimum depth of the substratum encountered within the 15m x 2m belt transect (recorded in feet). 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.
2. *Maximum vertical relief* – Using a digital depth gauge or a 0.5 or 1m measuring device, record the maximum vertical relief present in the 15m x 2m belt transect area (recorded in centimeters).
 - a. 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.

3. *Surface area topography (relief frequency)* – An estimate of the surface topography of the sample unit (*i.e.*, 15m x 2m fish belt transect) can be accomplished in many ways.
 - a. In locations where a 15m x 2m belt transect is used to conduct benthic surveys, the entire transect cannot be easily viewed all at once. Therefore, one approach is to subdivide the 30m² area into smaller subplots (*e.g.*, 1m long x 2m wide areas, n=15 per sample unit in this example), with each subplot scored for the highest hard-bottom relief feature (Figure 1).
 - b. Each 1m x 2m sub-plot is scored for vertical relief using one of the following six categories: <20cm, 20–<50cm, 50–<100cm, 100–<150cm, 150–<200cm and 200cm (Appendix II).
 - c. 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.
 - d. Estimate the relative area of the entire sampling unit represented by the six relief categories shown in section 3b.

Example data along a 15m x 2m belt transect, subdivided into 1m x 2m subplots (for ease of sampling; 15 marks recorded on the underwater datasheet)

Category		Frequency (# of 1m x 2m units)	
<20 cm	2	100–<150 cm	3
20–<50 cm	3	150–<200 cm	2
50–<100 cm	5	200 cm+	0
		15	

In this example, an estimated 20% of the sample unit had <20cm of relief, 24% had 20–50cm of relief, and so on.

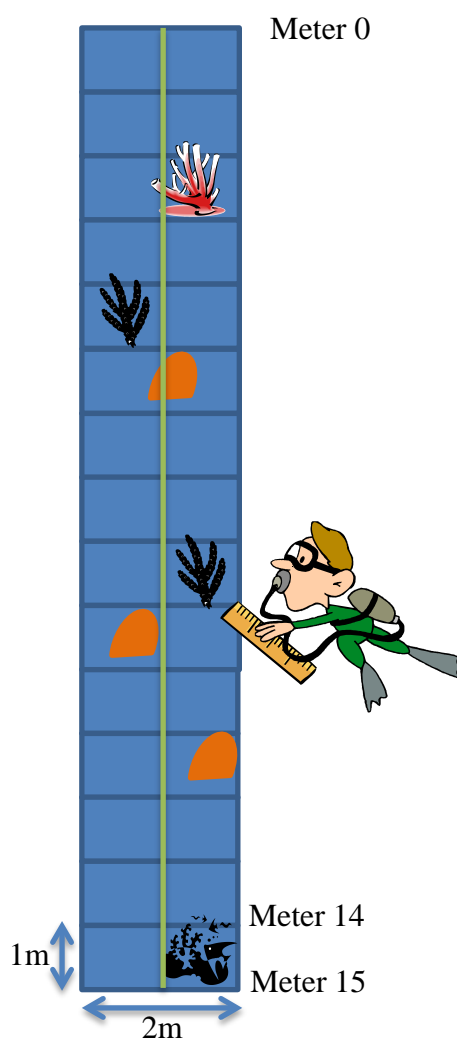


Figure 1. Example of the 1m x 2m grids for measuring topographic complexity along a 15-m x 2-m belt transect survey area for reef fishes in the Atlantic, Caribbean and Gulf of Mexico.

Appendix I. Illustrations of survey placement and survey areas

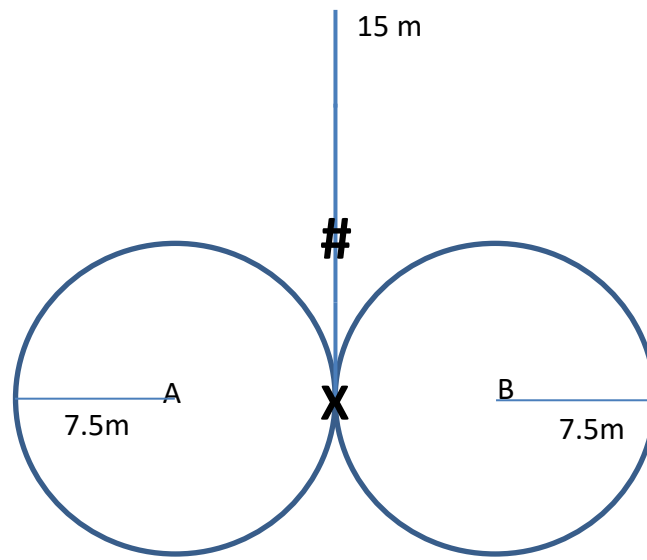


Figure A. Suggested placement of survey areas if continuous hardbottom. A and B represent two fish divers. The fish team tie off surface buoys at X. Benthic team starts tape at #, to minimize interference with fish surveys, and extends perpendicular to fish team.

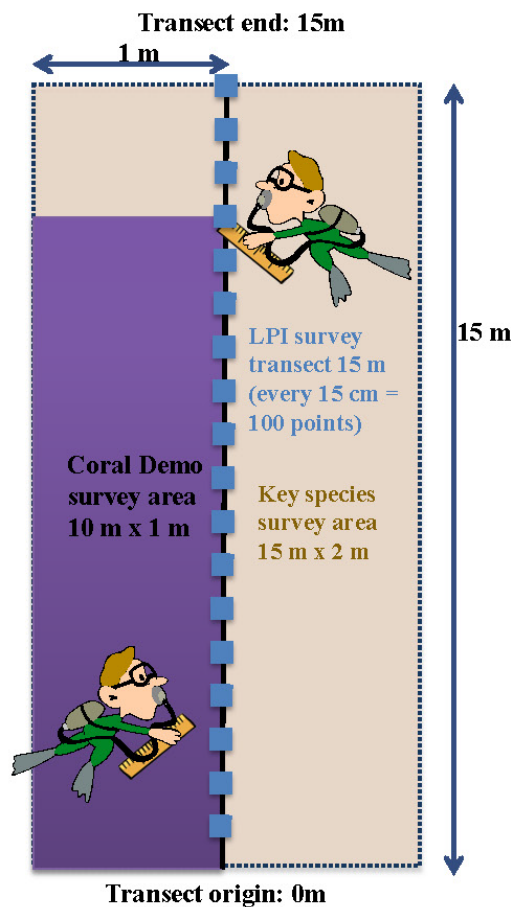


Figure B. Diagram of benthic surveys indicating size of each respective survey area.

Appendix II. Line Point-Intercept Datasheet

1. Location to record topographic complexity (rugosity, relief) data is indicated on datasheet. Example of Florida datasheet

NCRMP Line Point Intercept Datasheet									
Diver: _____		Boatlog/Manger: _____							
Buddy: _____		Field ID: _____		Date : _____		Sample Time: _____			
Habitat: _____		Contiguous S&G		Contiguous Other		Isolated		Rubble (Matrix) (Sand)	
Habitat code: H - Hardbottom S - Soft R - Rubble								eters Complete: _____ m	
Record biotic and abiotic code every 15 cm									
Meter	Cover	Hab	Meter	Cover	Hab	Meter	Cover	Hab	Rugosity 15x2m
0.15			5.70			11.25			Min depth (ft)
0.30			5.85			11.40			Max depth (ft)
0.45			6m			11.55			Max vert ht (cm)
0.60			6.15			11.70			Relief
0.75			6.30			11.85			15x2m (bin by 1x2 m; 15 total ticks)
0.90			6.45			12m			0 - 19 cm
1.05m			6.60			12.15			20 - 49 cm
1.20			6.75			12.30			50 - 90 cm
1.35			6.90			12.45			100 - 149 cm
1.50			7.05			12.60			150 - 199 cm
1.65			7.20			12.75			≥ 200 cm
1.80			7.35			12.90			Macrobenthos count
1.95			7.50			13.05m			15x2m
2.1m			7.65			13.20			<i>P. argus</i>
2.25			7.80			13.35			<i>S. gigas</i>
2.40			7.95			13.50			<i>D. antillarum</i>
2.55			8.1m			13.65			Precense(1)/Absence(0)
2.70			8.25			13.80			15x2m
2.85			8.40			13.95			<i>A. palmata</i>
3.0m			8.55			14.1m			<i>A. cervicornis</i>
3.15			8.70			14.25			<i>D. cylindrus</i>
3.30			8.85			14.40			<i>M. ferox</i>
3.45			9m			14.55			<i>O. annularis</i>
3.60			9.15			14.70			<i>O. franksi</i>
3.75			9.30			14.85			<i>O. faveolata</i>
3.90			9.45			15m			
4.05m			9.60						Categories Data Entry Counts
4.20			9.75						Corals (sp) H S R H S R
4.35			9.90						Bare
4.50			10.05m						Turf w sed
4.65			10.20						Turf w sed
4.80			10.35						Dict
4.95			10.50						Hali
5.1m			10.65						Lobophora
5.25			10.80						Macro - fleshy
5.40			10.95						Macro - calc
5.55			11.1m						CCA
Notes									Peysonnellia
									Gorg - upright
									Gorg - encrust
									Sponge - other
									Sponge - Clionna
									Cyano/Diatom
									Millipora
									Palythoa
									Seagrass
									Other
Circle method type						Combined	Separate		

2. Location to record topographic complexity (rugosity, relief) data is indicated on datasheet. Example of Caribbean and Gulf of Mexico datasheet

NCRMP Line Point Intercept Datasheet													
Diver: _____		Boatlog/Manger: _____											
Buddy: _____		Field ID: _____		Date: _____		Sample Time: _____							
Habitat: <i>Bedrock</i> <i>Pavement</i> <i>Agg. Reef</i> <i>Patch Reef</i> <i>Scat. Coral/Rock in Sand</i>						Meters Complete: _____ m							
Habitat code: H - Hardbottom S - Soft R - Rubble													
Record biotic and abiotic code every 15 cm													
Meter	Cover	Hab	Meter	Cover	Hab	Meter	Cover	Hab					
0.15			5.70			11.25							
0.30			5.85			11.40							
0.45			6m			11.55							
0.60			6.15			11.70							
0.75			6.30			11.85							
0.90			6.45			12m							
1.05m			6.60			12.15							
1.20			6.75			12.30							
1.35			6.90			12.45							
1.50			7.05			12.60							
1.65			7.20			12.75							
1.80			7.35			12.90							
1.95			7.50			13.05m							
2.1m			7.65			13.20							
2.25			7.80			13.35							
2.40			7.95			13.50							
2.55			8.1m			13.65							
2.70			8.25			13.80							
2.85			8.40			13.95							
3.0m			8.55			14.1m							
3.15			8.70			14.25							
3.30			8.85			14.40							
3.45			9m			14.55							
3.60			9.15			14.70							
3.75			9.30			14.85							
3.90			9.45			15m							
4.05m			9.60										
4.20			9.75										
4.35			9.90										
4.50			10.05m										
4.65			10.20										
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5.1m			10.65										
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5.40			10.95										
5.55			11.1m										
Notes													
						Categories Data Entry Counts							
						Corals (sp)	H	S	R	H	S	R	
										Bare			
										Turf w sed			
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										Dict			
										Hali			
										Lobophora			
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						Cyano/Diatom							
						Millepora							
						Palythoa							
						Seagrass							
						Other							
Circle method type						Combined Separate							