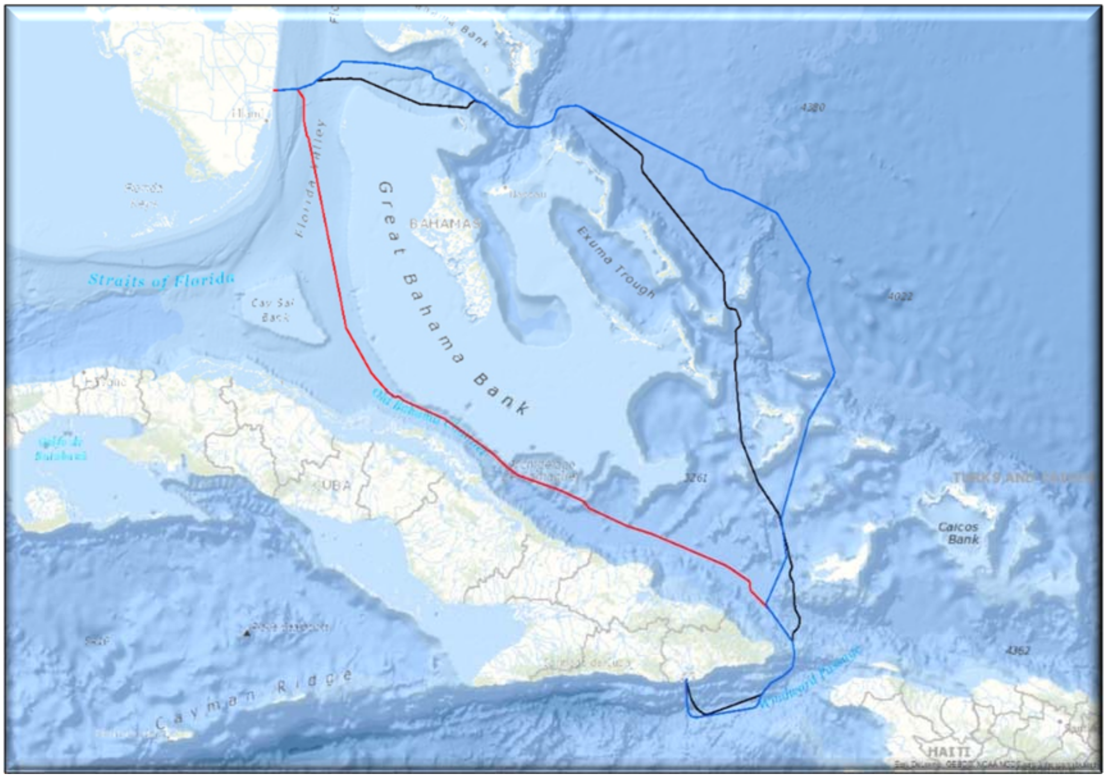

Environmental Assessment

Guantanamo Bay to Dania Beach Submarine Fiber Optic Cable System

January 28, 2015

Prepared For

Defense Information Systems Agency

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DEFENSE INFORMATION SYSTEMS AGENCY
DEPARTMENT OF DEFENSE

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Acronyms

AFTT	Atlantic Fleet Training and Testing
BCO	Beach Communications Office
BMH	Beach Manhole
BMP	Best Management Practices
BPC	Bahamas Petroleum Corporation
CCCL	Coastal Construction Control Line
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CLS	Cable Landing Station
CM	Centimeter
CONUS	Continental Unites States
CTB	Cable Termination Building
DISA	Defense Information Systems Agency
DISN	Defense Information System Network
DoD	Department of Defense
DP	Dynamic Positioning
DPS	Distinct Population Segment
DTS	Desktop Study
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ENC	Electronic Navigation Charts
EO	Executive Order
ESA	Endangered Species Act
FGS	Final Governing Standards
IWS	In-Water System
KM	Kilometer
LCE	Linear Cable Engine
M	Meter
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MRA	Marine Resource Assessment
MSFCMA	Magnuson-Stevens Fishery Conservation & Mgmt. Act
NAP	Network Access Point
NAVSTAGTMO	American Naval Station Guantanamo Bay
NEPA	National Environmental Policy Act
NM	Nautical Miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRHP	National Register of Historic Places
OEA	Overseas Environmental Assessment
OEBGD	Overseas Environmental Baseline Guidance Document
OEIS	Overseas Environmental Impact Statement
OPAREA	Operation Area
RDT&E	Research Design Testing and Evaluation
RFI	Request for Information
RFP	Request for Proposal
ROV	Remotely Operated Vehicle
RHIB	Rigid Hull Inflatable Boat

FDEP	Florida Department of Environmental Protection
FFWCC	Florida Fish and Wildlife Conservation Commission
FMP	Fisheries Management Plan
FT	Feet
GBS	Global Broadband Solutions
GGE	Greenhouse Gas Emissions
GPS	Global Positioning System
GTMO	Guantanamo Bay
HA	Hectare
HAPC	Habitat Area of Particular Concern
HDD	Horizontal Directional Drilling
ICW	Intracoastal Waterway
ROW	Right of Way
SAFMC	South Atlantic Fishery Management Council
SFOC	Submarine Fiber Optic Cable
SFOMF	South Florida Ocean Measurement Facility
SHPO	State Historic Preservation Office
SOP	Standard Operation Procedure
SWPPP	Storm Water Pollution Prevention Plan
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service

Executive Summary

The Defense Information Systems Agency (DISA) is proposing the installation of a submarine fiber optic cable (SFOC) system to develop communication services connecting the Defense Information System Network (DISN) node located at Guantanamo Bay (GTMO), Cuba to the DISN node located in Miami, FL to substantially improve the long-haul communications between the continental U.S. (CONUS) and GTMO. Long-haul communications requirements at GTMO are currently provided by commercial satellite services. SFOC's provide significantly more bandwidth than satellite services, exhibit very low latency, and are not subject to adverse atmospheric conditions, such as severe weather (for example, tropical rain storms and hurricanes). Therefore, the SFOC is proposed to increase the level and reliability of communication service between CONUS and GTMO.

Collectively, the Proposed Action would involve two existing, shore-based naval facilities where the GTMO SFOC system is planned to be landed end-to-end. From Dania Beach, Florida the proposed submarine cable alternatives will span the entirety of Florida's Territorial Waters (3 nautical miles [nm]), extending through the U.S. Territorial Sea (12 nm) and Contiguous Zone (24 nm), with the majority of the cable system alternatives passing through a combination of the U.S. Exclusive Economic Zone (EEZ), the Bahamian EEZ, Cuban EEZ, to the nearshore landing within U.S. controlled waters at GTMO (**Figure 1**). DISA will lease commercial dark fiber to facilitate the terrestrial connection between SFOMF and the Network Access Point (NAP) of the Americas in Miami, Florida to provide DISN node to node connection.

Two action alternatives and the no action alternative were analyzed in this EA for the nearshore installation route proposed at Dania Beach, Florida within the 12 nm limit of NEPA applicability.

Alternative 1 (Chapter 2.4.1) evaluates a new cable route that would maintain an offset from existing cables through an extensive nearshore system of reef tracks.

Alternative 2 (Chapter 2.4.2), or the Preferred Alternative, evaluates co-locating the new cable along an existing cable route that has been previously permitted with the state and federal agencies. The proposed cable would be bundled to the existing CS-125 cable which has already been laid through the nearshore reef tracks.

Three alternatives and the no action alternative were analyzed in this EA for the nearshore installation route proposed at Guantanamo Bay, Cuba within the 12 nm limit of NEPA applicability.

Alternative 1 (Chapter 2.5.1) evaluates Windmill Beach as an alternative landing which included two nearshore cable route approaches.

Alternative 2 (Chapter 2.5.2) evaluates Ferry Landing as an alternative landing site.

Alternative 3 (Chapter 2.5.3), or the Preferred Alternative, evaluates Glass Beach as the preferred landing site. The Glass Beach landing site already has a concrete landing station the supports two subaqueous utility lines that come ashore at this location. The new cable route is proposed to be co-located along the existing utility route as close as possible.

For the deepwater portion of the SFOC subject to Executive Order (EO) 12114, "Environmental Effects Abroad of Major Federal Actions", this EA evaluates three alternative routes between 1,223 and 1,431 km in length. All deepwater routes have the same point of divergence from the nearshore route alternatives discussed in Section 2.4 outside the U.S. Exclusive Economic Zone (EEZ) and in Section 2.5 outside of territorial waters.

The analysis of impacts (Chapter 4) associated with the GTMO SFOC system installation considered and evaluated applicable Protective Measures (Chapter 6) that would be implemented to avoid or minimize environmental effects on the natural and human environment resources relevant to the GTMO SFOC alternatives considered. A summary of impacts associated with the Preferred Alternative, as mitigated with Protective Measures, are as follows:

Resource areas not expected to be affected sufficiently by the Proposed Action to warrant further discussion in this EA

Air Quality. The proposed installation activities would not impact the surrounding air quality due to short installation period and limited generation of fugitive dust and by-products of fuel combustion from construction and short-term vessel emissions which would be rapidly dispersed and negligible.

Water Quality. There are no surface waters or wetlands within the onshore project areas at Dania Beach, Florida or Guantanamo Bay, Cuba. The adjacent Class III waters in the Atlantic currently meet state water quality standards. Small scale increases in turbidity from a one-time cable installation has been previously demonstrated at this location to not have more than a minor and temporary effect in which the sediments would rapidly disperse and/or settle back to the seabed and as such, would have an insignificant and negligible effect.

Noise. Temporary heavy equipment associated with construction are the only terrestrial noise sources associated with the proposed installation. Similarly, vessel operations are commensurate with the high level of commercial and recreational vessel transiting the channel and coastal waters so collectively, both marine and terrestrial noise activities have been considered insignificant.

Hazardous Materials and Waste. Other than petroleum-based fuel and lubricants onboard vessels engaged in the installation, there are no hazardous materials associated with the proposed installation and as such, would have an insignificant and negligible effect.

Health and Safety. The proposed installation poses no risk to public health or safety. The Navy identified an area of potential unexploded ordinance located approximately 4.7 km offshore from Dania Beach, Florida. The GTMO SFOC alternatives were designed to safely avoid this area and as such, would not pose any risk to health and safety.

Socioeconomic Issues. The proposed installation is a short-term, one-time installation of a SFOC system using existing Department of Defense (DoD) facilities which would not have any socioeconomic effects on the surrounding communities. Due to the project location within existing DoD installations and offshore waters, no parks, agricultural lands, or public transportation would be affected. The proposed installation does not pose any threat or loss of park usage for the adjacent John U. Lloyd State Park.

Environmental Consequences of the Proposed Action

Terrestrial Soils. Less than 0.5 acres of soils would be impacted during onshore burial of the cable and trenching within the SFOMF facility between existing cable trenches, the OGB and CLS. A National Pollutant Discharge Elimination System (NPDES) permit would not be required due to the small area of disturbance. With the implementation of a Stormwater Pollution Prevention Plan (associated with final CLS design and permitting), and associated BMP's, there would be minor, temporary impacts on terrestrial soils from the onshore cable installation activity.

Marine Geology. The maximum area of disturbance to sediments is 0.2 acre (exclusive of hardbottom) out to 12 nm. Impacts would be limited to the temporary disruption of sediment as the cable settles to the seafloor. Therefore, the placement of the SFOC on the seafloor would result in short-term negligible impacts to surface sediments within the immediate vicinity of the SFOC, and there would be no significant impacts to marine sediments. The installation of structures on the seafloor within 12 nm would require a Section 10 Rivers and Harbor Act permit from the USACE, which would be acquired prior to installation activities.

Coral and Hardbottom Habitat. The GTMO SFOC is proposed to be bundled to the existing CS-125 cable that has already been reviewed, permitted and laid on the seafloor through the nearshore reef tracks. The total length of bundled CS-125 and proposed GTMO SFOC traverses the entire reef track for a distance of 1.6 km (5,482 ft.). Once the cable is diver-assisted on the seafloor it is attached to the existing cables, thereby anchoring the GTMO SFOC system to the seafloor and adding additional stability to the bundled cable system to further abate any potential secondary impacts from lateral cable movement.

Federally Threatened Corals. The distribution and relative abundance of the currently listed coral species (staghorn coral, elkhorn coral, pillar coral, Caribbean star coral, Mountainous star coral, boulder star coral, and rough cactus coral) were recently documented during an extensive in-water survey and reported in the *Benthic Habitat Characterization for the South Florida Ocean Measurement Facility* (SFOMF) – Protected Stony Corals Species Assessment (DON 2011). The resulting data has provided DISA with a high level of confidence in understanding the specific locations of Federally-threatened coral species proximal to the existing cable infrastructure. The existing CS-125 cable has already been installed with any corals in the direct path already relocated. Bundling the GTOM SFOC to the existing cable would reasonably preclude any impacts to ESA-listed corals.

Seagrasses. No seagrasses are known to exist in the immediate vicinity of Dania Beach, Florida and therefore, no impacts on seagrasses would result in state waters of Florida. However, based on seagrass bed information presented in DON 2014 for Guantanamo Bay, Cuba, it is estimated that the cable will traverse approximately 135 m of discontinuous seagrass bed habitat. Given the overall large area of seagrass coverage throughout GTMO (1,072 ac) relative to the area that will be preempted by the cable, no significant impacts to seagrass resources are anticipated as a result from the Proposed Action.

Artificial Reefs. The proposed cable route avoids the nearest known artificial reef (105' sailing vessel "*Te Amo*") by more than 100 meters (360 feet). Therefore, no significant impacts on artificial reefs would result from the Proposed Action.

Essential Fish Habitat (EFH). The designated EFH within the project area includes nearshore benthic habitat, pelagic habitat, and coral reef habitat. The Proposed Action is designed and configured to avoid sensitive nearshore habitat entirely by bundling to an existing cable system (CS-125) and utilizing established BMP measures developed by the SFOMF at Dania Beach. The installation would avoid impacting live coral by co-locating the GTMO SFOC to existing SFOC cable through the reef track. Temporary and minor turbidity and sedimentation during installation would not affect the ability of EFH to support healthy fish populations. The Proposed Action would not adversely impact coral reef habitat or other EFH components. In the offshore water column EFH, the Proposed Action would have no effect and would entail temporary activity on the surface and in the water column during the installation. The activity would have no more than temporary and minimal impacts, and therefore would not adversely affect EFH.

Birds. The remote potential for adverse impacts (strike) on birds is possible during vessel transit, but is considered highly unlikely. The implementation of specific Protective Measures would further minimize any potential effects on birds, therefore, no significant impacts on birds from the Proposed Actions would occur.

Marine Mammals and Sea Turtles. Potential impacts on marine mammals and adult sea turtles include vessel strike and entanglement. Shore-based cable trenching activities may impacts sea turtle nesting and hatching activities if performed during the sea turtle nesting season. With the implementation of specific Protective Measure actions, however, any direct, indirect, or cumulative effects on federally-protected marine mammals and sea turtles have been determined to be insignificant. Additionally, the Proposed Action is not located within any designated Critical Habitat and therefore, would not adversely modify any Critical Habitat.

Cultural Resources. National Oceanic and Atmospheric Administration's (NOAA) Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) indicated the nearest shipwreck (105' sailing vessel "*Te Amo*") to the Proposed Action is greater than 100 meters (360 feet). None of the listed shipwrecks are included in the National Register of Historic Places, therefore, they are not protected by the National Historic Preservation Act. However, they are protected under the Abandoned Shipwreck Act. No significant impacts on historic properties or cultural resources from the Proposed Action would be expected.

Coastal Zone Resources. The Florida Clearinghouse coordinated a review (completed January 12, 2015) of the Proposed Action in conjunction with review and intent to issue of the Environmental Resource Permit (ERP) application. This process verifies consistency with the Florida Coastal Management Program. Therefore, there are no significant impacts on Florida's coastal zone resources from the Proposed Action.

Cumulative Impacts. The past, present, and reasonably foreseeable future projects analyzed under the SFOMF EA/OEA included the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS), Florida Atlantic University's proposed energy generating technologies utilizing/transferring wave or current energy into usable power, Port Everglades inlet maintenance (widening and dredging), and Broward County beach renourishment activities. The SFOMF EA/OEA determined that cumulative impacts resulting from the activities proposed under the Preferred Alternative combined with the past, present, and reasonably foreseeable future projects would be less than significant as long as applicable Protective Measures implemented by SFOMF are employed by these projects to avoid and minimize natural resource impacts.

The Preferred Alternative analyzed under this EA, within territorial waters, includes bundling the GTMO SFOC to an existing cable (CS-125) within a previously-permitted cable corridor where coral impacts have already been mitigated through relocation. Using an established cable route is a significant avoidance and minimization measure that was made part of the Protective Measures for both the SFOMF EA/OEA and this project. Considering the much larger scale of activities, both in time and space, analyzed under the SFOMF EA/OEA, including 71.15 km of cable to be installed or repaired annually within the OPAREAS, and a cumulative impacts determination of less than significant with the implementation of Protective Measures by both SFOMF and other agency/organization projects, it is reasonable to determine that installation of the GTMO SFOC system, with implementation of Protective Measures (Chapter 6) would result in insignificant cumulative impacts.

Chapter 1

Introduction

1.1 Overview

The Defense Information Systems Agency (DISA) is proposing the installation of approximately 1,450 kilometers (km) of 39 millimeter (mm) (1.5-inch) diameter submarine fiber optic cable (SFOC) connecting the Naval Surface Warfare Center, Carderock Division located at the South Florida Ocean Measurement Facility (SFOMF), Dania Beach, Florida (Broward County) to the American Naval Station Guantanamo Bay (NAVSTAGTMO), Cuba. Colloquially, this submarine cable system is referred to as GTMO SFOC. The GTMO SFOC system will be a government-owned transmission system that facilitates long-haul communications between Defense Information System Network (DISN) nodes in Miami, Florida and NAVSTAGTMO, Cuba, of which the GTMO SFOC represents the submerged portion to complete this system. Specifications of the cable are provided in **Appendix A**.

Collectively, the Proposed Action would involve two existing, shore-based naval facilities where the GTMO SFOC system is planned to be landed end-to-end. From the SFOMF, the proposed submarine cable alternatives will span the entirety of Florida's Territorial Waters (3 nautical miles [nm]), extending through the U.S. Territorial Sea (12 nm) and Contiguous Zone (24 nm), with the majority of the cable system alternatives passing through a combination of the U.S. Exclusive Economic Zone (EEZ), the Bahamian EEZ, Cuban EEZ, to the nearshore landing within U.S. controlled waters at NAVSTAGTMO (**see Figure 1**).

In accordance with the National Environmental Policy Act (NEPA) of 1969 (42 USC §§ 4321-4347), Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] §§ 1500-1508), this Environmental Assessment (EA) was prepared to consider the potential consequences to the human and natural environment that may result from implementation of the GTMO SFOC system.

The GTMO SFOC system would involve onshore and offshore project segments at both U.S. Naval facilities and within the 12 nm limit of the U.S. territorial seas and U.S. controlled waters at NAVSTAGTMO, referred to as the "tackle box". These segments of the Proposed Action are subject to the requirements of the NEPA. Although this nearshore section falls within the review jurisdiction of NEPA out to 12 nm, the majority (99 percent) of the Proposed Action is almost entirely in the deep ocean environment transiting a combination of the Bahamian and Cuban EEZ's and Territorial Waters. These components are subject to the requirements of Executive Order (EO) 12114, "Environmental Effects Abroad of Major Federal Actions", that directs federal agencies to assess the impacts of their activities beyond the 12 nm limit of the U.S. territorial seas.

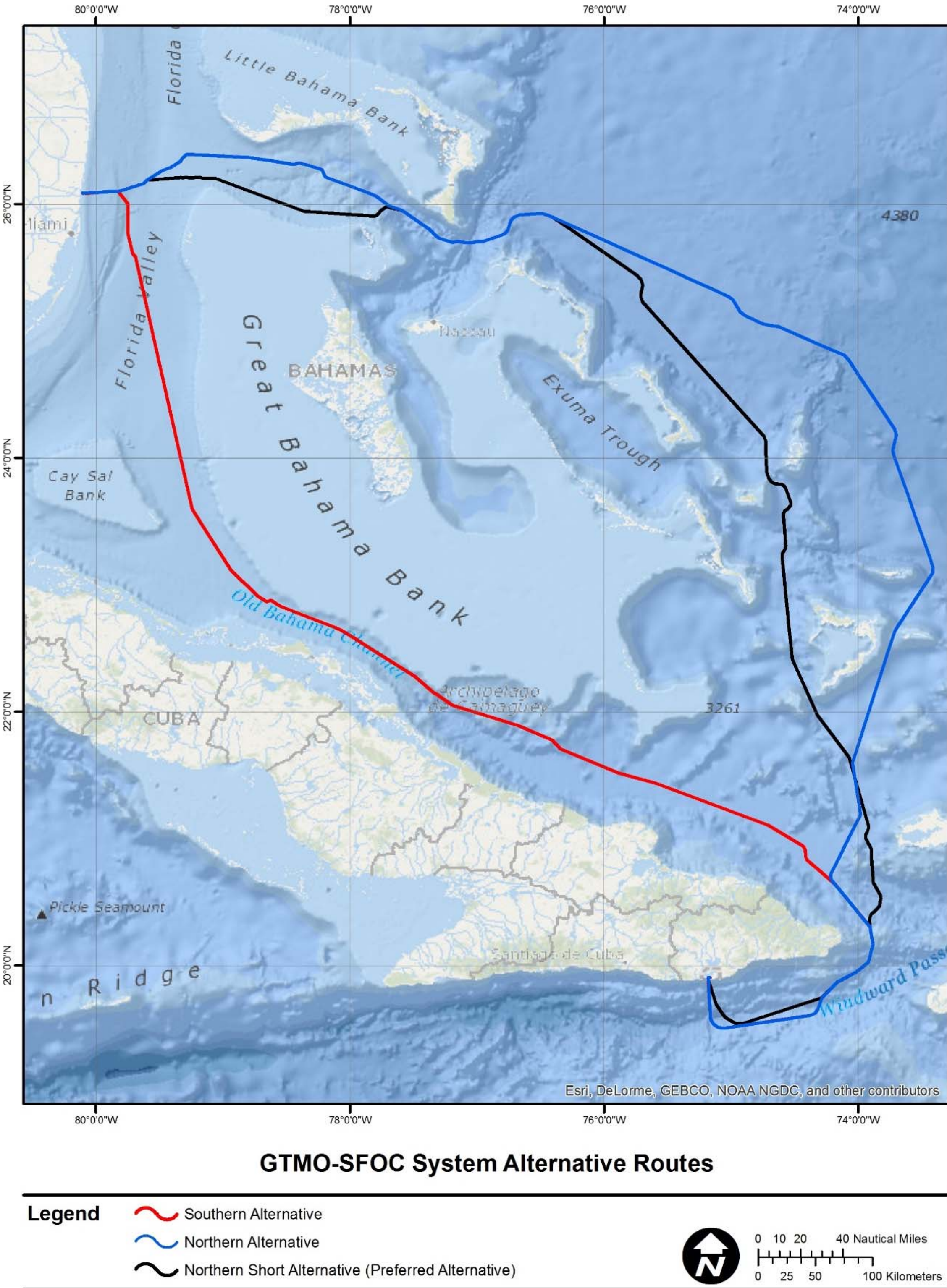

Figure 1 GTMO SFOC System Alternative Routes

1.2 Background

South Florida Ocean Measurement Facility (SFOMF) has housed an active, continuously operating Navy test site for over 40 years. While SFOMF supports various research, design, testing and evaluation (RDT&E) program requirements, it also supports a variety of communication equipment essential to the DISN. The facility is located at the closest point to deep water on the eastern seaboard and offers easy access to the Gulf Stream. The combination of shallow and deep water in proximity to shore and an existing Navy test site supports both SFOMF's mission and the development of future ocean technology. For these reasons, a variety of SFOMF infrastructure, maintenance and communication activities support the Navy's training and testing conducted at the SFOMF.

The proposed GTMO SFOC route emanates from the SFOMF into the Atlantic Ocean traveling in an eastward direction through the existing SFOMF Operations Area corridor that already contains numerous other submerged cables. At present, the SFOMF currently maintains approximately 130,000 meters (70 nm) of permanently installed cable on the seabed as depicted in **Figure 2**.

Several recent (2010-2013) environmental assessments supporting permitted cable installations have been completed for the SFOMF. The results of these assessments were relied upon to inform the basis of our evaluation concerning the nature and type of impacts considered to be relevant and the anticipated degree of effect. Based on review of the cable installation permits at this location and their supporting studies (**Table 1**), the foremost resource of concern is the nearshore coral reef system. With the implementation of project-specific cable Best Management Practices (BMP) measures "*Laying Seafloor Cable Using Best Management Practices*" (**Appendix B**), the impacts are reasonably presumed to be minimal or negligible; this finding is further supported by past performance and resource agency permitting. Notably, all of the cables occurring within the same approximate cable corridor as the Proposed Action were installed and maintained under a categorical exclusion (CATEX) for NEPA.

Table 1 Recently Permitted Cable Systems at SFOMF

Project Name	Agency/Permit#	Date Issued	NEPA Class of Action
U.S. Naval Surface Warfare Center - Cable Installation	FDEP/06-0307167-001	Aug 19 2011	CATEX
Additional cable Small Craft Measurement Site (SCMS)	FDEP/06-0307167-002	Apr 5 2012	CATEX
U.S. Naval Surface Warfare Center - Cable Installation	FDEP/06-0307167-003	Jan 16 2013	CATEX
Cable lay installation (AIMS cable)	ACOE/SAJ-2011-01555 (LP-LCK)	Jul 15 2011	CATEX
Cable lay installation (AIMS cable)	ACOE/SAJ-2011-01555 (MOD-LCK)	Aug 23 2011	CATEX
Cable lay Small Craft Measurement Site (SCMS)	ACOE/ SAJ-2012 -00528 (LP-LCK)	Jun 21 2012	CATEX

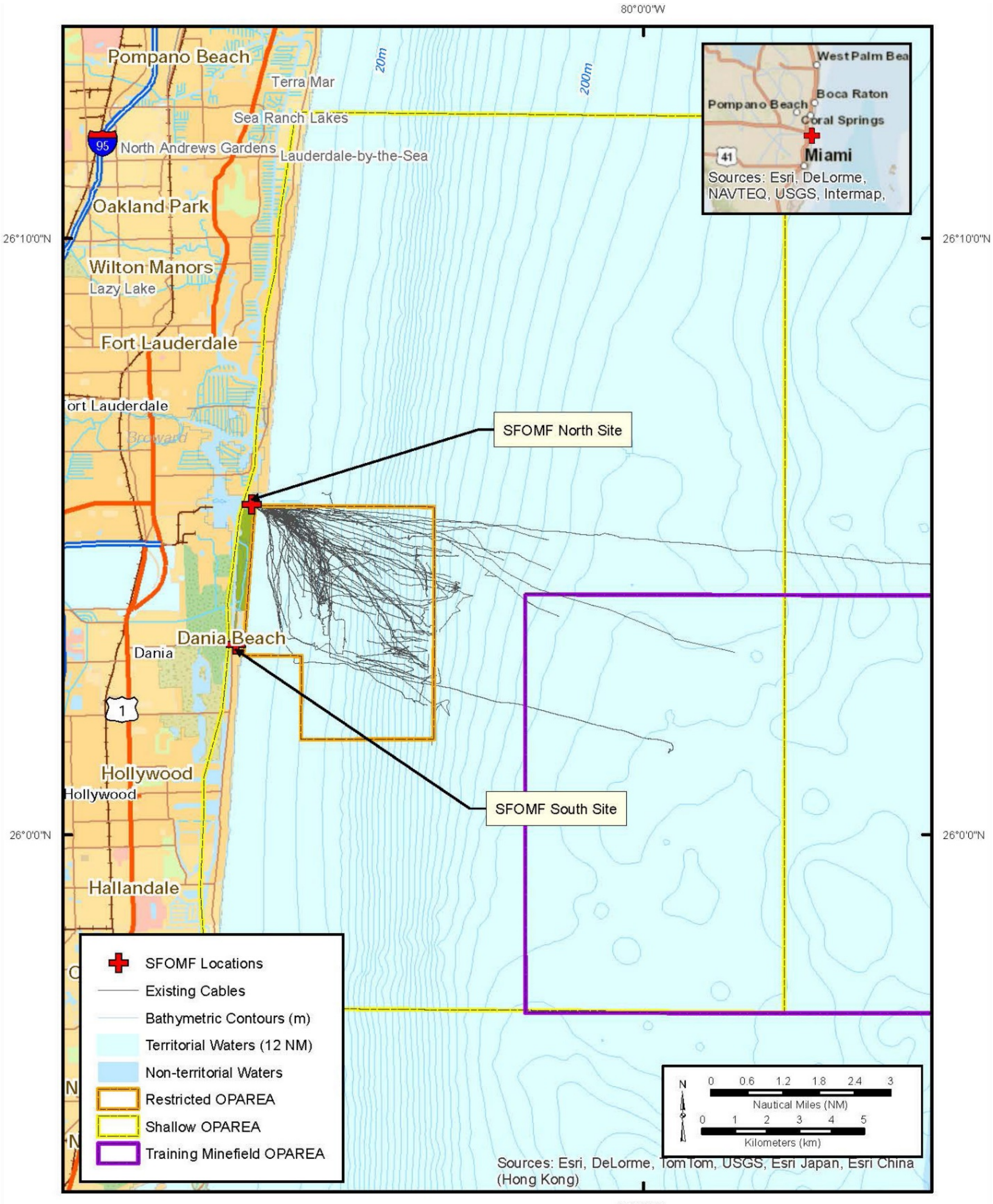

Figure 2 Existing Cable Systems at SFOMF

A number of issue areas were not carried forward for detailed analysis in this document since brief consideration is sufficient to conclude potential impacts would be negligible and/or clearly insignificant. Issues not addressed further are as follows:

- *Air Quality*. CEQ guidance for Greenhouse Gas Emissions (GGE) states that if the project would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers. Project-related emissions would be temporary and limited to the generation of fugitive dust and the by-products of petroleum fuels combustion from construction equipment and short-term vessel emissions from project-related activities would be rapidly dispersed. The anticipated emissions would be well below *de minimis* thresholds.

- *Water Quality*. There are no surface waters or wetlands within the onshore project area at the SFOMF, which consists mainly of well-drained beach sand. The adjacent Class III waters in the Atlantic currently meet state water quality standards. Small scale increases in turbidity from a one-time cable installation have been previously demonstrated at this location to not have more than a minor and temporary effect in which the sediments would rapidly disperse and/or settle back to the seabed, and as such, would have no significant impact on water quality.

- *Noise*. Temporary heavy equipment associated with construction and installation of backup generators are the only terrestrial noise sources associated with the Proposed Action, with the generators proposed to be operated once each month for operational integrity. Based on the manufacturer's noise specifications the generators would produce 60 decibel (dB) or less at 100 m. This is within the range of acceptable residential noise levels (not exceeding 65 dB) according to the U.S. Department of Housing and Urban Development (HUD). Vessel operations are commensurate with the high level of commercial and recreational vessels transiting the channel and coastal waters so collectively, both marine and terrestrial noise activities have been considered insignificant.

- *Hazardous Materials and Waste*. Other than petroleum-based fuel and lubricants onboard vessels engaged in the installation, there are no hazardous materials associated with the Proposed Action. Adherence to standard industry requirements for pollution prevention and for spill containment, cleanup, and reporting in the offshore waters minimizes the likelihood of a fuel or lubricant spill and any adverse consequences.

- *Health and Safety*. The Proposed Action poses no risks to public health or safety. The Navy identified an area of potential unexploded ordinance located approximately 4.47 km (2.41 nm) offshore from SFOMF; the GTMO SFOC route will safely avoid this area. The Proposed Action to install a one-time SFOC is a routine action that has been found to not involve the generation of hazardous materials or circumstances.

- *Socioeconomic Issues*. The Proposed Action is a short-term, one-time installation of a SFOC system using existing Navy facilities and existing distribution locations which would not have any socioeconomic effects on the surrounding communities. Due to the project location within an existing Navy coastal facility and offshore waters, no parks, agricultural lands, or public transportation would be affected. The Proposed Action does not pose any threat or loss of park usage for the adjacent John U. Lloyd State Park.

1.3 Purpose and Need for the Proposed Action

The DISA GTMO Cable System Project Management Office is developing communication services via SFOC connecting the DISN node located at GTMO to the DISN node located in Miami, FL to substantially improve the long-haul communications between the continental U.S. (CONUS) and GTMO. Long-haul communications requirements at GTMO are currently provided by commercial satellite services. A SFOC system will provide significantly more bandwidth than satellite services, exhibit very low latency, and not be subject to adverse atmospheric conditions, such as severe weather (e.g., tropical rain storms and hurricanes). Therefore, the SFOC system is proposed to increase the level and reliability of communication service between the CONUS and GTMO.

Chapter 2

Proposed Action and Alternatives

2.1 Overview

The Proposed Action to install a new SFOC system consists of several project design components that together, form the complete and entire project to meet the intended purpose and need. The following chart (**Figure 3**) illustrates the relative position of each component within the overall design of the SFOC system, with more detailed descriptions about each component in the subsections that follow.

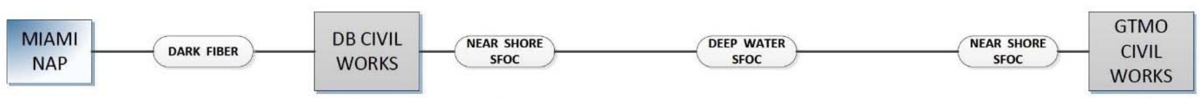

Figure 3 GTMO SFOC System Components

In summary, these elements include:

- Onshore Installation at Dania Beach, Florida: Onshore construction would be limited to the existing cable landing facility and work area at SFOMF.
- Dania Beach Nearshore Installation: The GTMO SFOC is proposed to be laid and bundled to an existing cable (CS-125) through the reef tracks to avoid and minimize any potential impacts to corals and hardbottom.
- Deepwater SFOC Installation: A one-time, direct lay of the GTMO SFOC on the ocean floor through existing cable corridors to Guantanamo Bay, Cuba.
- Guantanamo Bay Nearshore Installation: The GTMO SFOC is proposed to be laid along an existing cable corridor up to the existing beach head.
- Onshore Installation at GTMO, Cuba: Onshore construction would be located in a previously disturbed work area and tied into existing cable conduits and a new cable landing station adjacent to existing cable infrastructure.

2.2 Project Design

2.2.1 Dania Beach Nearshore Installation, Florida

Cable landing involves using a beach winch to pull the floated cable ashore using a well-established methodology employed and refined by SFOMF on past cable installations (**Appendix B**). This method involves the shore-end landing from the cable ship using a beach landing craft to bring the bitter end of the cable ashore using buoys to float the cable. The cable will be subsequently laid on the seafloor using diver-assisted positioning and systematic release of the buoys for a controlled release through the water column to avoid any damage to corals and hardbottom relief.

The shore-end portion of the Dania Beach landing is of a moderate length. The *IT Intrepid* cable laying ship (CS) will be able to safely come within 1.3 km from the beach landing point and using dynamic positioning will hold station. The *Intrepid's* deepest draft is approximately 7 meters (23 feet) and the charted water depth at a distance of 1.3 km from the beach is 18 meters (59 feet). Using established communications and previously employed landing methodologies, the cable will be passed to the beach using a messenger line by a smaller support craft. This line is a less dense floating line that is then attached to the beach pulling winch to begin the in-haul of the heavier SFOC. During the overboarding of the SFOC during the in-haul, the *Intrepid* deck crew will install A3 floats approximately every 10 meters (33 feet) as the cable is fed over the stern chute. This operation is under the control of the 18-wheel linear cable engine (LCE) to maintain the cable on the surface, accurately count the linear distance, and to monitor cable tensions.

The *Intrepid* is equipped with dynamic positioning (DP) mode that allows the vessel to maintain stationary position for precision shore landings. It is anticipated that the *Intrepid* will hold position in the DP mode in an approximate water depth of 25 meters (83 feet) or less as shown in **Figure 4**.

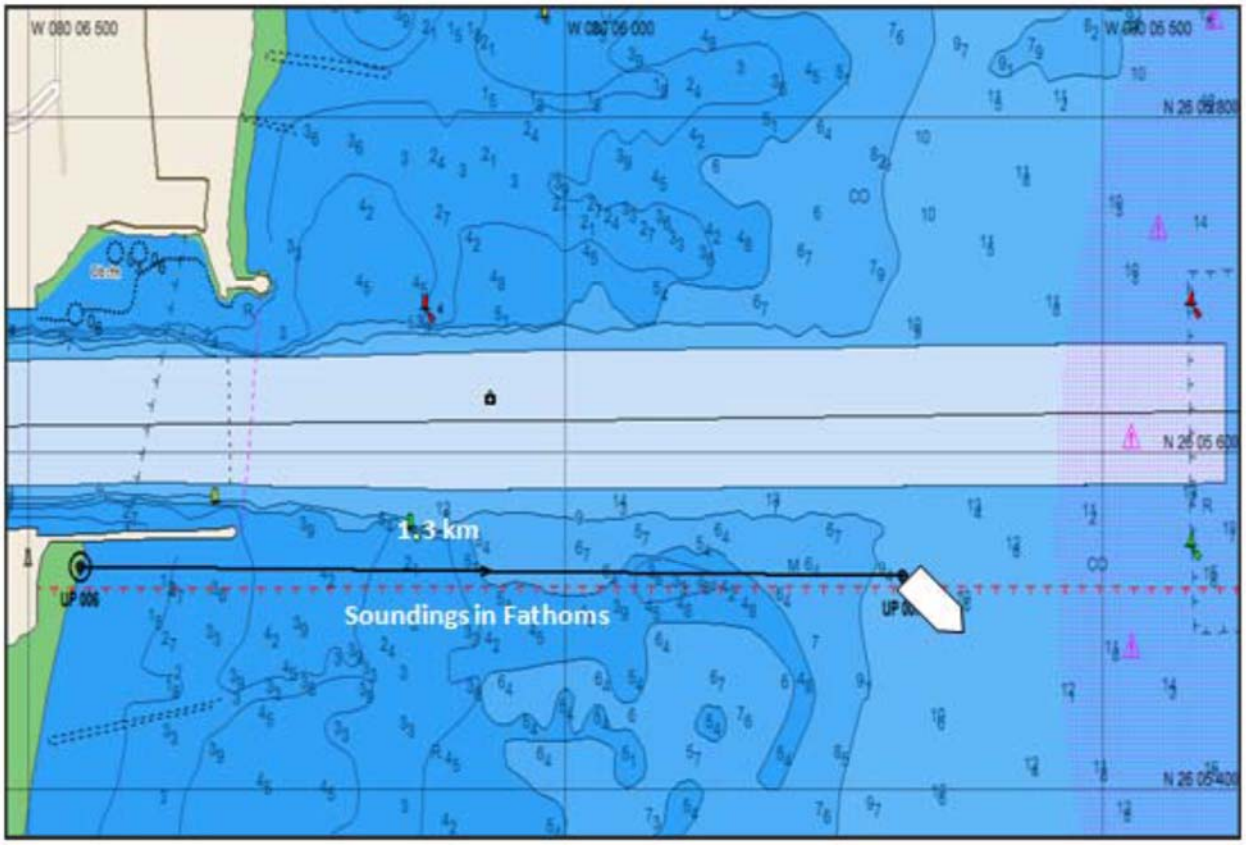

Figure 4 Approximate Cable Ship Holding Position for SFOMF Landing

The landing site is located on the beachfront of the SFOMF Navy installation (Landing Coordinate ≈N26 05.542 W80 06.493) and is depicted in **Figure 5**. The site is already populated with several cables (**Figure 6**) that coalesce at the same beach landing location and feed into the SFOMF installation trench.

As with all shore-end landing operations, all personnel associated with the landing operations will attend an environmental briefing prior to onset of any operations. During the briefing all environmental conditions or special conditions will be discussed and noted.

Figure 5 Approximate Cable Route across Beach at SFOMF

Figure 6 Existing Cables at SFOMF

Within the SFOMF installation route, a trench will be cut from the existing concrete trench and heading south across the paved area towards the grass before turning west again and heading to the Cable Landing Station (CLS) (**Figure 7**). The turn from the existing concrete trench to the direct bury trench will need to have a 2-m (6.5 ft.) minimum radius facilitated by a proposed concrete pillar or turning sector to be constructed for this purpose. This would insure that any force applied to the cable would be distributed evenly and make a smooth transition from the existing trench.

Figure 7 SFOMF Installation Route

The trench will carry on past the paved area into a grassed area that contains the existing Ocean Ground Bed (OGB). The OGB is located between N26 05.522 W80 06.496 which is closest to the existing tower and N26 05.517 W80 06.497 which is farthest from the tower. This OGB will also be used for the installation footprint of the CLS. Once past the OGB, the trench will make a turn to the west at approximately N26 05.506 W80 06.500, requiring a 2-m (6.5 feet) radius minimum turn similar to the first. The trench will carry on to the Beach Manhole (BMH) which will be installed at the CLS. The armor wires will be terminated in the BMH using a beach clamp and the slack cable stored in the BMH.

The alternative fiber route connection is the location of the interconnection to the dark fiber back haul to the Network Access Point (NAP) of the Americas in Miami, Florida which is needed to provide the overall DISN node to node connection. DISA will lease commercial fiber optic service to facilitate the terrestrial connection between the entrance at the SFOMF in Dania Beach, Florida to NAP of the Americas in Miami, Florida.

Table 2 provides the Global Positioning System (GPS) locations of the terrestrial cable path within the SFOMF installation that are illustrated in the accompanying **Figure 8**, which provides an overview of the proposed installation.

Table 2 GPS Coordinates of Terrestrial Cable Path at SFOMF

ID	DESCRIPTION	LATITUDE	LONGITUDE
A	Dania Beach exposed cable location	N26 05.537	W80 06.483
B	Dania Beach boardwalk (cable trench)	N26 05.542	W80 06.493
C	Dania Beach turn South from existing trench	N26 05.541	W80 06.497
D	Dania Beach turn West to CLS	N26 05.506	W80 06.500
E	Dania Beach OGB North end	N26 05.522	W80 06.496
F	Dania Beach OGB South end	N26 05.517	W80 06.497
G	Dania Beach Cable Landing Station	N26 05.505	W80 06.515
H	Dania middle of alternative dark fiber route	N26 05.504	W80 06.529
I	Dania end of alternative dark fiber route (fence line)	N26 05.499	W80 06.541

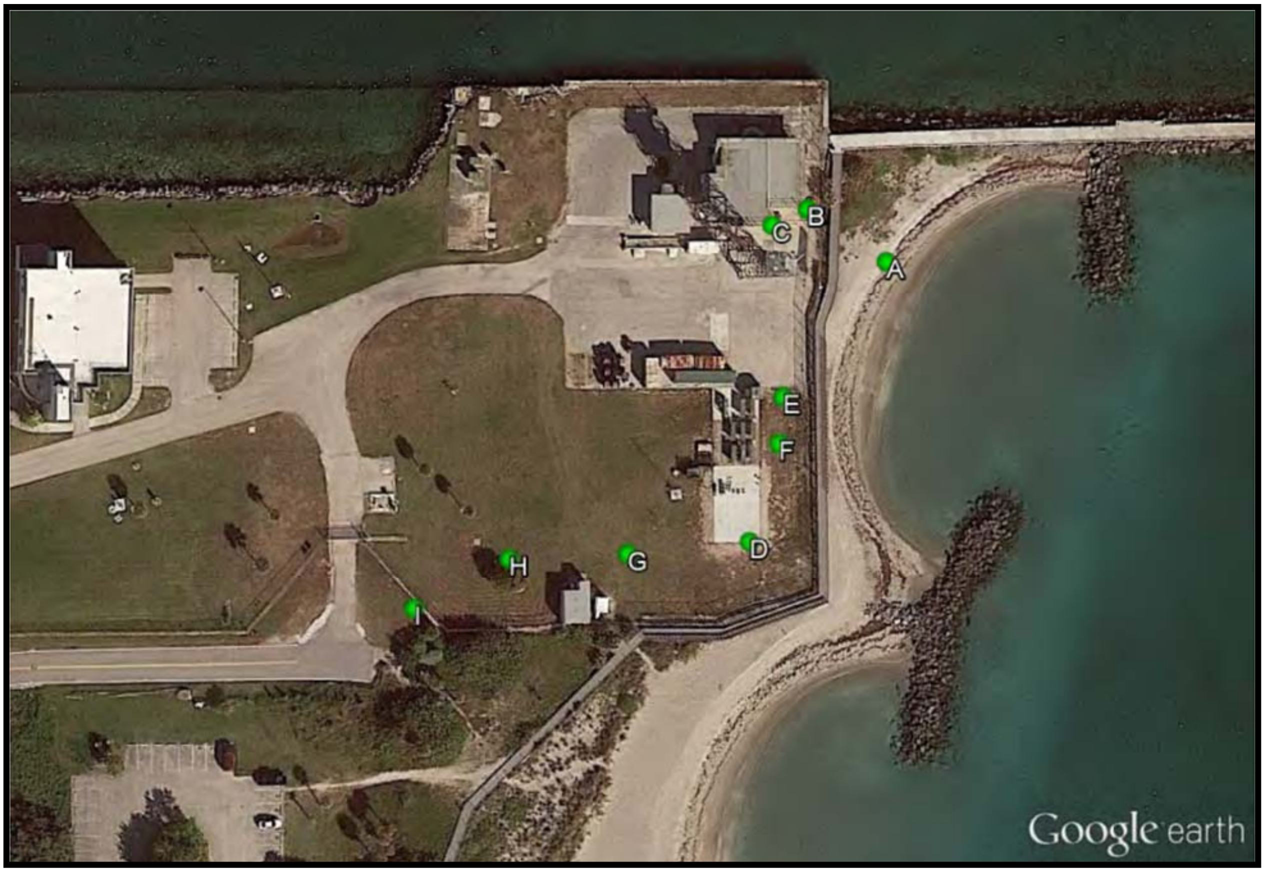

Figure 8 GPS Positions of Terrestrial Cable Path at SFOMF

2.2.2 Deepwater Cable Lay

The deepwater cable lay constitutes greater than 99 percent of the entire SFOC project footprint for which three alternative cable routes were evaluated. Preliminary route and cable engineering was evaluated based on industry recognized criteria relating to cable crossings which include:

- parallel cables and downslope routing wherever possible;
- Alter Course (AC) angles were limited to a maximum of 25 degrees and distances between AC's kept to a minimum of one water depth to facilitate future installation;
- Slopes greater than 10 degrees were avoided when possible and taken as close to perpendicular as possible where inevitable; and
- Cable crossing angles of 60 degrees or more were aimed at wherever achievable including separation of 2-3 times water depth maintained when possible.

Cable type selection is mainly based on water depth during this stage in planning with potential modifications depending on additional information about the seabed terrain and risks to cable damage that may require additional armoring (e.g. mass wasting, commercial fisheries). In general, Double Armor (DA) cable is used from the landing site to a water depth of 200 m, Single Armor (SA) cable to 1000 m, Lightweight Protected (LWP) cable to bottom of steep slope area and Lightweight (LW) cable in deeper, more benign seabed.

2.2.3 Guantanamo Bay Nearshore Installation, Cuba

The shore-end portion of the GTMO Beach landing is of a short length. The *IT Intrepid* will be able to safely come within 0.5 km (0.27 nm) from the beach landing point. The *Intrepid's* deepest draft is approximately 7 meters (23 feet) and the charted water depth 0.5 km from the beach is 12 fathoms (24 meters). The preferred method of landing the cable from the *Intrepid* to Glass Beach is with the *Intrepid*'s shallow draft craft, *Working Girl II* (WG II). The *Intrepid* carries the WG II on her forward deck and the craft is launched with the ship's crane. Should the *Intrepid* be required to be stationed further offshore from the beach, WG II can easily handle the additional cable length to the beach. The main difference for this landing vs. Dania Beach is that this landing would require that moorings be pre-placed by divers approximately 30 m offshore due to the high surf conditions. The moorings are necessary for the WG II to hold station after bringing in the messenger/cable end.

The IT *Intrepid* would arrive at the GTMO offshore position and maintain position in the DP mode (**Figure 9**). The WG II would be launched to conduct a trial run to the beach and provide divers with small mooring anchors for the WG II to secure to during shore landing. These mooring positions will have been identified during the shallow water survey. The WG II would lay the cable to the beach mooring position and moor-up with the assistance of the *Intrepid*'s Rigid Hull Inflatable Boat (RHIB). The cable end would be passed to the divers to deliver to the beach for an excavator pull up the hill to the BMH. Once the cable has been entirely pulled from the WG II a temporary stopper will be applied in the BMH and the divers will be asked to perform an inspection swim from the shore outwards to the 10-m (33 ft.) water depth. If any reason to move the cable is found then slack will be fed back from the BMH to allow the divers to move the cable, once the cable is reported as satisfactory, the beach clamp will be applied in the BMH. The cable will be armored and anchored at regular intervals from the shore landing out to 0.25 nm at which point it will be free and clear of any nearshore environmental resources such as corals and seagrass beds. The specific locations where anchoring or armoring with split pipe are needed will be determined based on the bottom conditions. Anchoring and application of split pipe will be in accordance with industry standard methods.

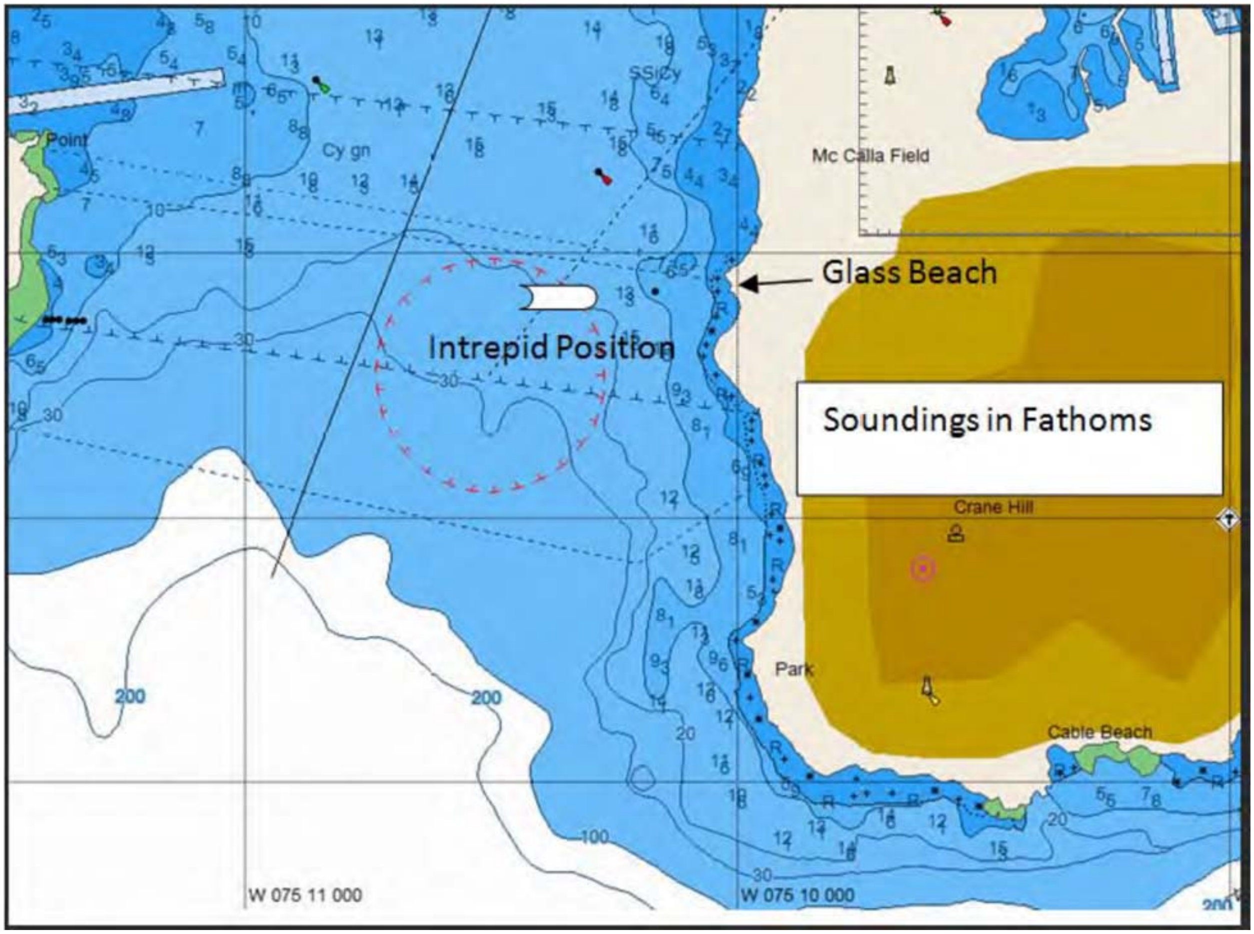

Figure 9 Approximate Cable Ship Holding Position for GTMO Shore Landing

The landing site at Guantanamo Bay U.S. Naval Base, Cuba will be Glass Beach (Landing Coordinate ≈N19 54.473 W75 10.008). The landing site is at the base of a steep slope that is also a landing point for two existing power cables and two existing pipelines (**Figure 10**).

Figure 10 Approximate Cable Route at Glass Beach, Guantanamo Bay, Cuba

For engineering feasibility and avoidance and minimization of environmental impacts, the proposed GTMO SFOC system will be installed along these existing cable and pipeline routes up to the existing pipeline landing pad at the shoreline. Proposed fortification (concrete ramp to smooth the transition) of the beach landing pad and placement of the beach cable anchor will be constructed at this location. From the beach cable anchor, a new cable trench with 4 conduits will be installed up the rock slope to the BMH which will be located in a large open area at the top of the slope (**Figure 11**).

Figure 11 Approximate Path up Slope to BMH

The BMH (**Figure 12**) will then connect in to an existing nearby duct work and manhole that would facilitate the cable routing further overland to another existing manhole and terminate where the CLS will be constructed.

Figure 12 Proposed BMH Location

Table 4 provides the GPS locations of the shore-end landing point and terrestrial cable path within the NAVSTAGTMO which are illustrated in the accompanying **Figure 13** that provides an overview of the proposed installation.

Table 3 GTMO GPS Positions

ID	DESCRIPTION	LATITUDE	LONGITUDE
A	GTMO Landing Point Waters Edge	N19 54.473	W75 10.008
B	GTMO Middle of Slope	N19 54.465	W75 10.002
C	GTMO Top of Slope	N19 54.468	W75 09.995
D	GTMO Fence	N19 54.466	W75 09.991
E	GTMO BMH	N19 54.463	W75 09.974

Figure 13 GPS Positions of Terrestrial Cable Path at GTMO

2.2.4 Back Haul (Dark Fiber)

The overall goal of the new system is to provide communication services between NAVSTAGTMO and the NAP of the Americas in Miami, Florida to provide DISN node-to-node connection. DISA's acquisition strategy is to lease commercial dark fiber and associated operations and maintenance services from commercial sources to facilitate the terrestrial connection between SFOMF in Dania Beach, Florida to NAP of the Americas in Miami, Florida. DISA will not own, operate or control the dark fiber.

Existing commercial fiber routes are located within close proximity in Dania Beach. Commercial vendors would need to install approximately 7.6 km of new fiber from the intersection of NW 4th Avenue/W. Dania Beach Boulevard along existing utility right-of-way (ROW) and utilize horizontal direction drilling (HDD) from upland to upland across the Intracoastal Waterway (ICW) to avoid any impacts to natural habitat or wetlands. The U.S. Army Corps of Engineers (USACE) does not regulate activities in uplands and as such, no permit would be required. The dark fiber would then transit existing ROW along N. Ocean Drive to the entrance of the SFOMF facility and connect to the proposed CLS installed under the Proposed Action. **Figure 14** depicts the logical connection of the dark fiber from existing transmission systems to SFOMF.

Figure 14 Back Haul Notional Route

2.3 No Action Alternative

CEQ Regulations (40 CFR § 1502.14[d]) specifically require analysis of the "No Action" Alternative in all NEPA documents.

The No Action alternative would be to not proceed with the GTMO-SFOC system project linking NAVSTAGTMO at Guantanamo Bay, Cuba with the SFOMF facility at Dania Beach, Florida providing DISN to DISN linkage with the Miami node of the Americas for forward connectivity in the CONUS. NAVSTAGTMO would continue to operate with existing satellite communication (SATCOM) capabilities which would not meet the operational need for reliability and additional bandwidth.

2.4 Dania Beach Nearshore Alternatives

The nearshore and offshore waters of Broward County contain a vast extent of ridge complex and inner reef coral habitat that are separated into inner, middle and outer reef tracks that extend from nearshore to the 60-m isobath. These reef tracts are within close vicinity of the SFOMF and represent the most important natural resource concern with regard to potential impact from the project action. Several large gaps in this reef tract have been identified by the State of Florida for telecommunication cabling that includes the South Broward Gap which is located approximately 11 km to the south of Dania Beach and the SFOMF landing site. Given the requirement for connecting existing government landing facilities, this option does not meet that requirement and as such, has been removed from further consideration. Two viable alternatives were explored during the preparation of this assessment to achieve the project purpose with a focused effort to avoid and minimize any potential impacts to coral reef habitat to the maximum extent practicable. Both alternatives emanate from the same shore landing location at SFOMF which is designed to receive SFOC's within an existing cable trench inside the confines of the facility.

2.4.1 Alternative 1

The initial alignment was based on the *GTMO-SFOC Desktop Study Phase II* (Global Broadband Solutions, LLC 2013) recommended route that targeted a nearshore reef gap, maintain a parallel offset from other existing cables, and avoided a disused explosives dumping ground. However, this option would require a direct-lay over the outer reef track outside any known cable corridor. The nearshore cable installation would follow the methodology in Section 2.2.1 that brings the cable ashore using buoys to float the cable. The cable would then be laid on the seafloor using diver-assisted positioning and systematic release of the buoys for a controlled release through the water column.

2.4.2 Alternative 2 (Preferred Alternative)

Based upon recent permitting guidance for past cable installations at SFOMF (refer to **Table 1** and Chapter 6 on Protective Measures), this alternative is proposed to be laid close to existing SFOC's to minimize impacts to the greatest extent possible. To accomplish this, the GTMO SFOC will be bundled to an existing cable (CS-125) that has already been planned, permitted and laid on the seafloor through the nearshore reef tracks. This methodology entails the pre-installation of floats to existing anchors on the bottom (CS-125 cable) prior to shore-end operations and subsequent movement of the floated SFOC cable into position along these floats then sinking of the cable using control cutting of the floats to free the cable and allow it to be dropped in a controlled manner to the sea floor. Once the cable is diver-assisted on the bottom it will be attached to the existing cable bundle, thereby anchoring the GTMO SFOC to the seabed. This method adds additional stability to the bundled cable systems to further abate any potential secondary impacts from lateral cable movement.

2.5 Guantanamo Bay Nearshore Alternatives

Three cable landing site alternatives were considered for the GTMO SFOC endpoint: Windmill Beach (Alternative 1), Ferry Landing (Alternative 2), and Glass Beach (Alternative 3), which are depicted in **Figure 15**. These alternatives were analyzed as part of the Desktop Study (DTS) and the Request for Information (RFI)/Request for Proposal (RFP) processes associated with this project. The DTS process is among the first stages of SFOC project planning and development. In a DTS, the cable system route, including landing point alternatives, onshore connectivity to communication infrastructure, environmental features, geology and oceanography, location of other SFOCs, permitting, and jurisdictional issues are discussed and analyzed to assist decision making with respect to developing a project plan that meets the project purpose and need while minimizing cost, risk, and adverse environmental consequences.

Figure 15 NAVSTAGTMO Landing Site Alternatives

2.5.1 Alternative 1 (Windmill Beach)

Under contract to the DISA, Global Broadband Solutions, LLC (GBS) finalized a DTS on 19 February 2013 (GBS, 2013) for the purpose of developing information to support project planning and budgeting. This DTS, along with previous project-related site visits to NAVSTAGTMO, identified Windmill Beach as a potential cable landing point. The GBS DTS analyzed two nearshore approaches to the same landing point at Windmill Beach, as shown in **Figure 16**; however, these are not carried forward for further analysis with respect to environmental impacts since this landing point was ultimately rejected as a viable alternative for the reasons discussed below.

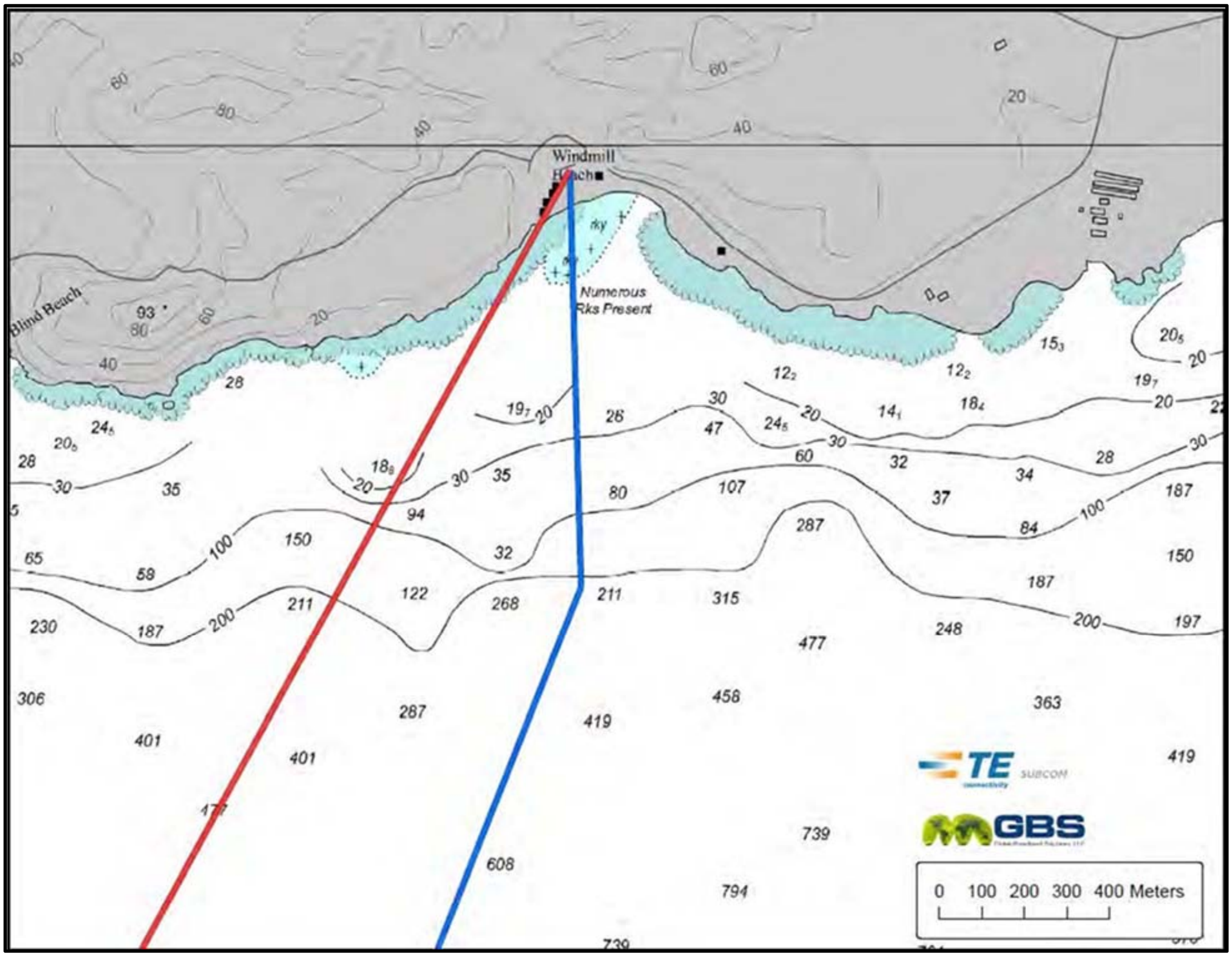

Figure 16 Alternative nearshore approaches to Windmill Beach

At the Windmill Beach landing site, the interface to base communications would be at the Base Communications Office (BCO), approximately 3.4 km long from the proposed BMH location. In order to connect to the BCO, a trench approximately 3 km trench long would need to be excavated along an existing road for the installation of conduit to carry the fiber. The inability to link up with buried terrestrial fiber at the landing site was considered a drawback to landing the cable at Windmill Beach. Local sources also noted the difficulties that would be encountered in excavating a 3-km trench through the coral bedrock, which would be necessary to connect to the existing fiber optic network and BCO. Prominent flooding was also observed at the areas around Windmill Beach during a site visit performed as part of the DTS, which created a concern for erosion and flooding of a BMH and cable substation. This concern was validated when Hurricane Sandy made landfall on Cuba as a Category 3 hurricane on October 25, 2012, which caused significant erosion and flooding at Windmill Beach. Despite the fact that Windmill Beach was significantly impacted by Hurricane Sandy, it continued to be the preferred landing site until an RFI was issued on February 19, 2013 and responses were received from potential vendors, which suggested an alternative landing point at Ferry Landing inside Guantanamo Bay.

2.5.2 Alternative 2 (Ferry Landing)

Ferry Landing was initially analyzed as a potential landing site option as part of the RFI process. In a response to the RFI, one vendor suggested that landing the cable at Ferry Landing could provide significant cost savings and other advantages over the Windmill Beach site. One advantage was that a manhole with potential existing conduit infrastructure to the BCO was already in place at Ferry Landing. This manhole is approximately 500 meters from the shipping channel which would have allowed the cable laying vessel to efficiently and safely deploy the cable. In addition, this landing site is more protected than the Windmill Beach site which would provide more favorable conditions for landing the cable. Following the RFI process, the DISA issued a Draft RFP on June 28, 2013, the purpose of which was to seek industry comment and feedback to further refine a potential RFP for the GTMO SFOC system.

During the RFI and RFP processes, it was determined that Windmill Beach was not a viable landing point primarily due to the impacts from Hurricane Sandy and the risk future tropical storms would pose to the cable and associated onshore infrastructure. During the RFP process, the DISA offered vendors two bidding options - one that had the cable making landfall at Ferry Landing and the other with the cable landing at Glass Beach, which is approximately 1.4 km southwest of the Ferry Landing site.

2.5.3 Alternative 3 (Glass Beach – Preferred Alternative)

Following the analysis under the DTS and RFI/RFP process of Alternative 1 (Windmill Beach) and Alternative 2 (Ferry Landing), DISA decided upon Glass Beach as the preferred landing site alternative since existing subaqueous utility conduits made landfall at this location, in addition, connectivity to onshore communication infrastructure was already in place which would result in significant cost savings for the project and the greatest opportunity for environmental impact avoidance and minimization, both within the nearshore and onshore environments.

The Glass Beach landing site already has a concrete pad at the water line that supports two subaqueous utility lines that come ashore here. Laying the GTMO SFOC within this existing utility corridor provides the greatest degree of avoidance and minimization of impacts to nearshore marine resources and the shoreline environment. Furthermore, since existing communication infrastructure is already in place at this location, ground disturbance activities (e.g. trench excavation) are greatly minimized resulting in insignificant impacts to the terrestrial portion of the project area.

2.6 Deepwater Route Alternatives

Three alternative cable routes were evaluated for the deep ocean cable lay which accounts for greater than 99 percent of the project area. All deepwater route alternatives have the same point of divergence from the nearshore route alternatives discussed in Section 2.4 outside the US EEZ which is located approximately 50 km offshore of Florida at -79.604717º W, 26.098535º N. **Figure 17** provides an overview of the alternative routes end to end and **Table 4** below provides a breakdown of segment length for each alternative with respect to international maritime boundaries. Initial coordination has been made with the Bahamas Environment Science and Technology Commission for approvals to lay cable in Bahamian waters to coordinate requirements necessary for the issuance of the proper authorizations from the Ministry of Foreign Affairs.

These routes are examined in thorough detail within the *GTMO-SFOC Desktop Study Report* (IT International Telecom, Inc., 2014) that evaluate the geology and seismology of the seabed, climatology, oceanographic data, and commercial operations (e.g. shipping lanes, ocean lease blocks, regional submarine cable crossings). The deepwater route alternatives were developed within the larger context of existing submarine cable routes and are relatively coincident, maintaining 2-3 times water depth separation when possible according to industry standards.

Based on the burial assessment and estimated external aggression risk, the GTMO-SFOC system could technically be buried according to industry standards with maximum depth at 1,000 meters and maximum slope less than 12 degrees. However, burial is not recommended by the DTS for this system as it cannot protect against large vessel anchors and fishing activity is limited within the planned routes. Additionally, the activities off Guantanamo Bay are well controlled and limited in nature so as not to warrant any burial for protection.

Table 4 Alternative Routes within Maritime Boundaries

Maritime Limits	Southern Route (km)				Northern Route (km)				Short Northern Route (km)			
	USA	Bah.	Cuba	GTMO	USA	Bah.	Cuba	GTMO	USA	Bah.	Cuba	GTMO
State Waters	6	-	-	-	6	-	-	-	6	-	-	-
Territorial Waters	17	514	-	25	17	614	-	25	17	814	-	26
Contiguous Zone	62	-	208	27	24	-	185	27	24	-	196	9
Economic Zone	1	276	87	-	10	491	52	-	9	230	2	-
TOTAL	*86*	*790*	*295*	*52*	*57*	*1105*	*236*	*52*	*56*	*1044*	*198*	*35*
	1223				**1451**				**1333**			

2.6.1 Alternative 1 (Southern Route)

Heading east from Dania Beach, then south through the middle of the Florida Strait to go through Santaren and Old Bahama Channel as it traverses through four (4) Bahama Petroleum Corporation (BPC) lease blocks, merging together with the other alternative route before going through the Windward Passage, turning west following the southern coast of Cuba then north into Guantanamo Bay.

2.6.2 Alternative 2 (Northern Route)

From the divergence point of Dania Beach, the route goes northeast to avoid the BPC Miami Lease Block, then turns east through the Northwest Providence Channel into the Atlantic Ocean, then proceeds southeast to avoid submarine ridges before heading back into Bahamian territorial waters, continues on a southerly route through outer islands and cays, turns into the Windward Passage, and merges with the Southern Route up to the Guantanamo Bay landing.

2.6.3 Alternative 3 (Northern Short Route – Preferred Alternative)

From the divergence point of Dania Beach, the route extends more easterly through the BPC Miami Lease Block, east through the Northwest Passage (south of the Northern Route), and briefly merges with the Northern Route. Once out of the Northwest Channel, the route turns back into Bahamian territorial waters earlier than the Northern Route, continues southerly through the outer islands and cays, and makes a shortcut across a ridge west of Inagua before merging with the other route alternatives through the Windward Passage. This route takes another shortcut, staying closer to the Cuban shelf slope and turns towards Guantanamo Bay in a steeper, less perpendicular slope alignment.

All alternatives, including the preferred, have been determined to be a Major Federal Action are subject to EO 12114. However the action of a one time, direct-laid SFOC system on the seabed has been demonstrated in past project actions at SFOMF and worldwide to ordinarily have only a minor, localized, and transient effect on the environment; as such, the action lacks the potential to cause significant harm to the environment outside the United States and meets the exemption requirement (E2.3.3.1.1) to prepare environmental documentation under EO 12114.

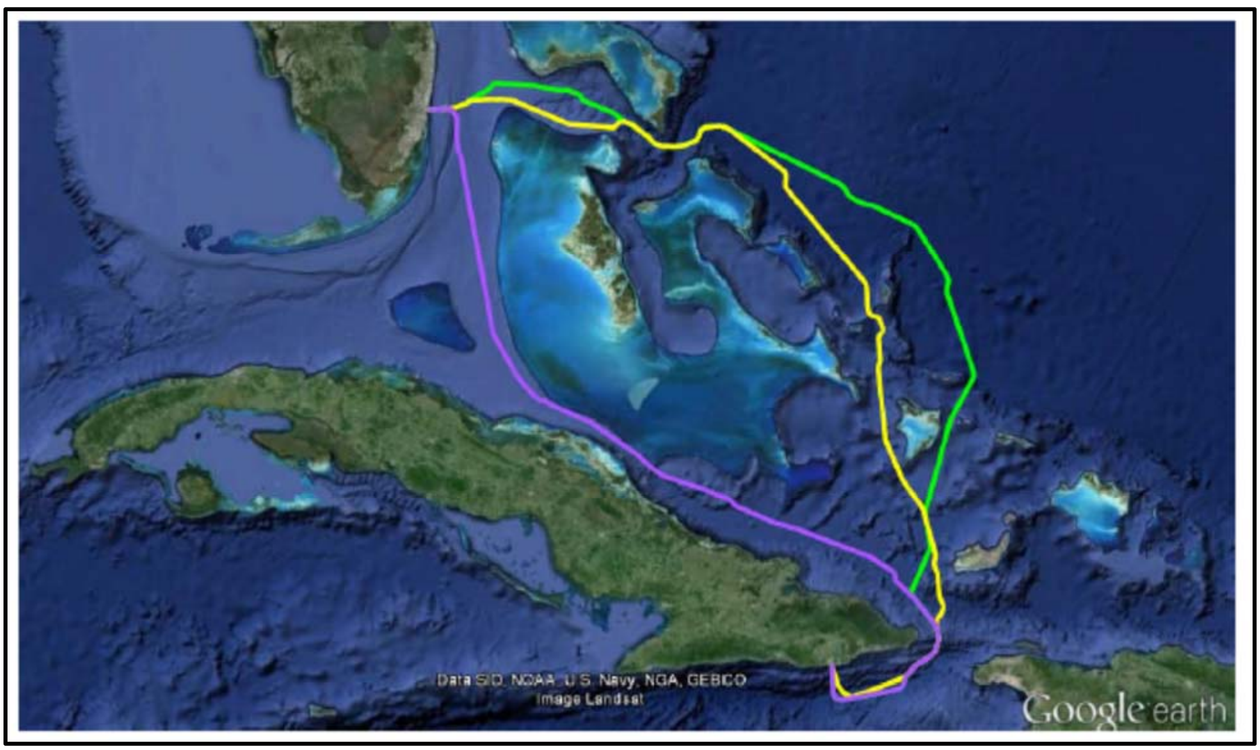

Figure 17 Deepwater Route Alternatives

Chapter 3

Affected Environment

3.1 Dania Beach, Florida: SFOC Onshore and Offshore (≤12NM)

3.1.1 Geology

Geology and soils include the landforms, soils/sediments, substrate, and topography of a given area.

The more recent geologic past for this region of Florida resulted in the Pleistocene-aged Anastasia Formation and Pamlico Sand with interfingering of the Fort Thompson and Miami Limestone formations, geologic units that form the backbone of the coastal ridge system in Broward County. Three shore-parallel reef ridges (inner, middle, and outer) are found on the narrow, shallow shelf off Broward County and extend from Palm Beach County south to Miami-Dade County. A ridge complex also exists between the shore and the innermost parallel reef ridge, which is composed of a mixture of Pleistocene coquina (Anastasia Formation) and Holocene deposits. These ridges were developed as paleo-beach and dune structures that provided a substrate for coral recruitment and are believed to have provided the original topography needed for reef initiation during rising Holocene sea levels, both off Broward County and farther south off the Florida Keys.

Soils (Terrestrial)

Three terrestrial soil types are mapped as occurring at the SFOMF site: beaches, Palm Beach sand, and Urban land (National Resources Conservation Service [NRCS] 2009). Beaches are nearly level to sloping narrow sandy strips adjacent to the ocean shoreline and consist of fine to coarse sand, mixed with shells and shell fragments. Due to wave action processes and tidal phases, beaches typically do not support vegetation. The Palm Beach soil series consists of shells and sandy marine deposits and are considered to be excessively drained soils. Urban land is characterized as areas that are more than 70 percent covered by impervious surfaces resulting in the natural soil not being readily observable (U.S. Department of Agriculture [USDA] 1984). The water table is typically 80 inches (200 centimeters [cm]) below land surface and side slopes of excavations in these soil associations are unstable and must be shored (USDA 1984).

Sediments (Marine)

Most marine sediments are derived from terrestrial sources or the sea itself, either from the erosion and transport of rocks on the land that are carried to the sea, or from the deposition of broken and disintegrated marine organisms. Whatever their origin, the physics of transport and deposition of these marine sediment grains are governed by wave energy and currents (Morelock et al. 2005). Sediments are generally classified by grain size or formation; however, for the purposes of this document, sediments would be discussed as being either unconsolidated (loose, marine-bottom detritus material) or consolidated hardbottom substrates (encrusted skeletal buildups). Burrowing in marine unconsolidated sediments by vertebrates and invertebrates actively mixes sediments, and in concert with tides, currents, wave action, and storms can increase physical transport (Deaton et al. 2010). Hardbottom substrates are exposed areas of consolidated sediments occupied by species that grow on the surface of other sessile organisms. These species are generally long-lived and offer habitat critical to a wealth of smaller invertebrates, juvenile fishes and mobile crustaceans.

3.1.2 Biological Resources

3.1.2.1 Coral and Hardbottom Habitat

Coral and hardbottom resources occur along the nearshore portion of the proposed cable installation route (**Figure 18**). The nearshore hardbottom habitat is located in a physically and environmentally stressed setting characterized by variable wave action, sediment transport, turbulence, and water clarity. Species present in the nearshore hardbottom habitat must be extremely tolerant of this fluctuating physical environment. Therefore, the nearshore hardbottom mainly provides habitat for low-profile, encrusting, and boring organisms capable of securely attaching themselves to the hard substrate (Coastal Eco-Group, Inc. 2008). These habitats include coral reefs and other live/hardbottom communities, including artificial reefs. Typical species assemblages found in these habitats include sea fans and sea whips (Order Gorgonacea), ascidians (Class Ascidiacea), bryozoans (Phylum Bryozoa), hard/soft corals (Orders Scleractinia and Alcyonacea), hydroids (Order Hydroidia), anemones (Order Actiniaria), encrusting algae, sponges (Phylum Porifera), and larger organisms such as sea turtles (Superfamily Cheloniodea), and fishes.

The Navy recently completed several benthic habitat characterization studies for SFOMF, including the most recent 2013 shallow–water Essential Fish Habitat (EFH) Report (DON 2013a, included in **Appendix C**) which provides detailed descriptions of the benthic communities found within a portion of SFOMF's four restricted offshore operation areas, including the primary corridor for existing cables, encompassing all waters in the vicinity of this proposed cable installation project.

Several coral reef tracts run parallel to the shoreline in the vicinity of the SFOMF, ranging from near the shoreline to the 60-m (197-ft.) bathymetry contour. A live reef occurs at the eastern edge of the facility (DON 2008b). These reef tracts typically include hardbottom areas, patch reefs, and worm reefs exhibiting abundant octocoral, macroalgae, stony coral, and sponge assemblages. Three primary types of coral reef habitats exist in Broward County: 1) coral reef and colonized hardbottom; 2) unconsolidated sediments; and 3) other delineations (Walker et al. 2008). Coral reef and colonized hardbottom are considered hardened substrate formed by the deposition of calcium carbonate by reef-building corals and other organisms, or existing as exposed bedrock or volcanic rock. This classification includes spur and groove, individual and aggregated patch reefs, and gorgonian-colonized pavement and bedrock.

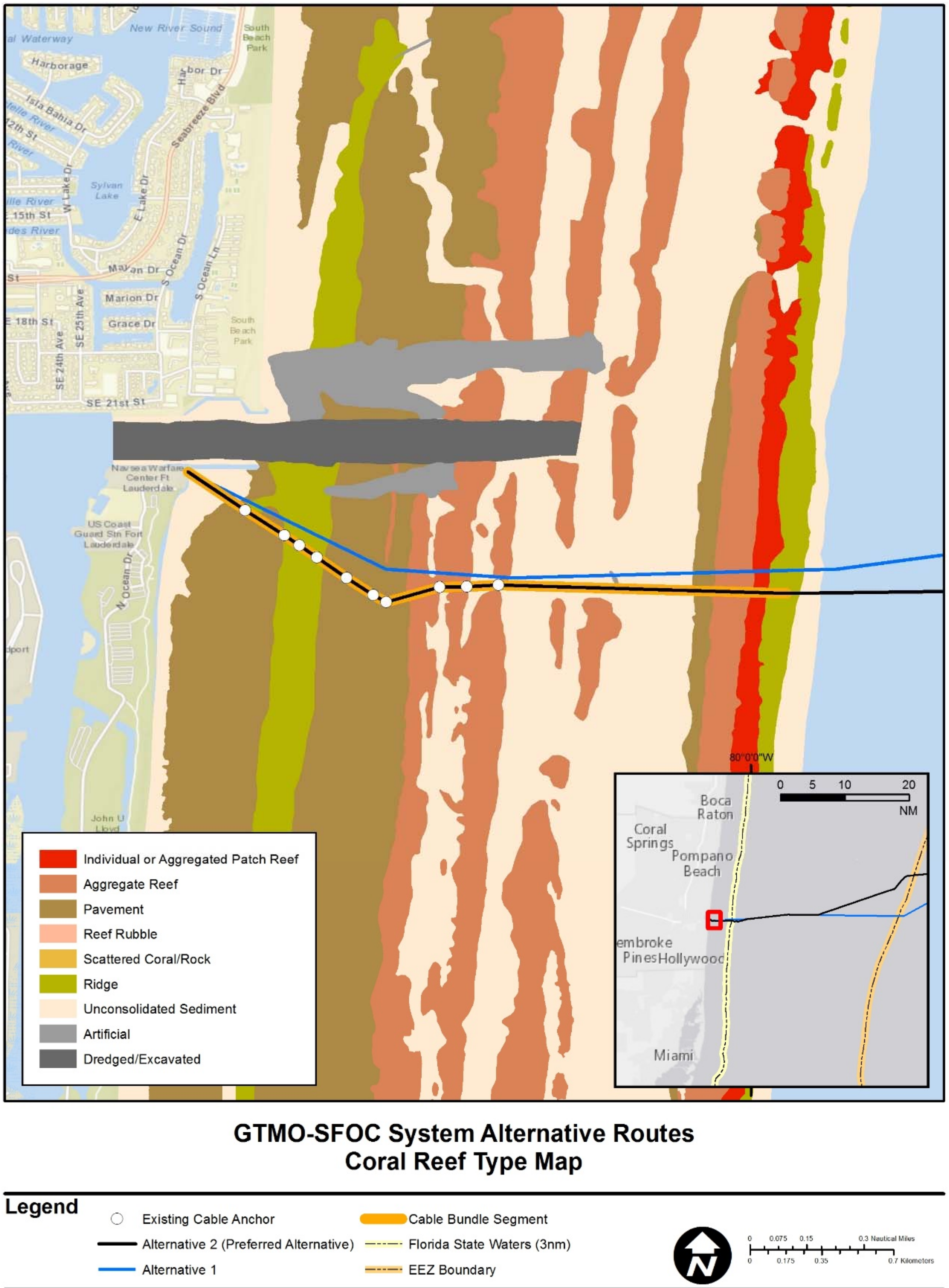

Figure 18 Coral Reef Types Map

Unconsolidated sediments include coarse and fine sediments such as reef rubble and uncolonized bedrock. Other delineations include man-made habitats (e.g., wrecks, piers, submerged portions of riprap jetties), terrestrial features above the spring high tide line, and other features not interpretable due to interference (e.g., turbidity, water depth) (NOAA 2008). **Figure 18** depicts the types of coral reefs present in the vicinity of the proposed cable installation corridor. It should be noted that coral reef mapping (types) is only available and provided for the nearshore waters at depths less than 50-m (150 ft.). Mapping of coral, coral reef, and hardbottom beyond the 50-m (150 ft.) bathymetry is not currently available.

Deep water corals are primarily found on rocky bottoms along continental shelves, slopes, canyons, ocean ridges, and seamounts at depths between 50 and 2,000 m (164 and 6,562 ft) (NOAA 2008). Some occurrence of deepwater corals such as *Lophelia* sp. lies between Broward County and the Bahamas over a depth range of 50 to 2,170 m (164 and 7,119 ft) (DON 2008a; Lumsden et al. 2007). In order to identify and map deep water coral habitats, specialized underwater technologies such as multi-beam sonar, laser-line scans, Remotely Operated Vehicles (ROVs), human occupied submersibles, autonomous underwater vehicles, and advanced technical diving are needed (NOAA 2008a). In December 2007, NOAA released a document entitled, *The State of Deepwater Coral Ecosystems of the United States*: 2007. The purpose of this document was to compile all available information on deep water sea corals occurring at depths greater than 50 m (164 ft). It was determined that basic data are lacking for the majority of coral habitats located at depths greater than 200 m (656 ft; Lumsden et al. 2007).

Information regarding deep water corals in the vicinity of the proposed cable installation corridor is sparse. Much of the deep water coral habitat is part of a 65-km long carbonate platform between Boca Raton and South Miami (Reed et al. 2006). Mounds of *Lophelia* sp. are known to be present at the base of the escarpment. In 2011-2012, the Navy completed a deep water benthic habitat characterization survey (DON 2012b) along the CS-96 fiber-optic cable corridor from a depth of approximately 30 m to the reported eastern seaward terminus on the Miami Terrace (approximated 500 m depth). The CS-96 cable is currently the only cable located in SFOMC's deep water offshore operation area. The *Deep-water Benthic Habitat Report* (DON 2012b; included in **Appendix D**) provides a description of deep water corals and benthic habitats specific to the CS-96 cable corridor, and is likely the only deep water survey relevant to deep water habitats in the vicinity of the proposed cable corridor.

Artificial reefs, which typically consist of sunken man-made structures, including ships, barges, limestone rock, concrete culverts, engineered concrete artificial reef modules, and other environmentally suitable artificial reef materials, support similar species assemblages as the coral reef and hardbottom habitats. Broward County has created over 112 artificial reef sites in waters off its shores. Several additional artificial reefs occur south of the inlet, in water depths ranging from near the shoreline to approximately 170 meters (557 feet) (**Figure 19**). The proposed cable route avoids the nearest known artificial reef (105' sailing vessel "*Te Amo*") by more than 100 meters (360 feet).

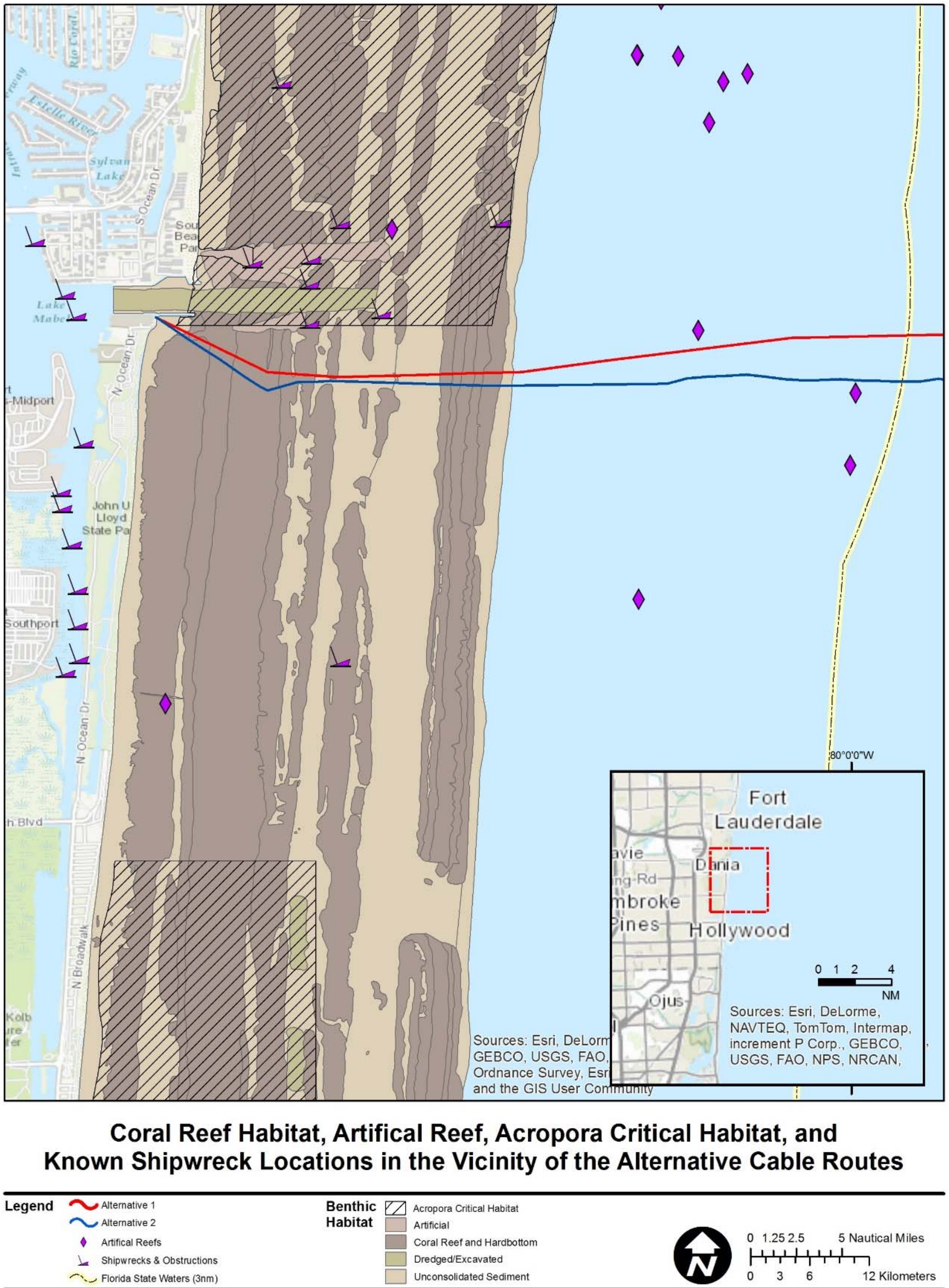

Figure 19 Coral Reef Habitat, Artificial Reef, Acropora Critical Habitat, and Known Shipwreck Locations

3.1.2.2 Seagrass Habitat

Within the project vicinity, seagrasses occur in the ICW and along the southern side of the Port Everglades inlet which borders the northwest portion of the SFOMF property. Documented species observed in this vicinity include paddle grass (*Halophila decipiens*), shoal grass (*Halodule wrightii*), and Johnson's seagrass (*Halophila johnsonii*). No seagrasses have been documented in the Atlantic Ocean within the Proposed Action area.

Johnson's seagrass is federally listed as threatened under the Endangered Species Act (ESA). Critical habitat for this species is designated nearby in Palm Beach and Miami-Dade Counties, but has not been designated in Broward County. The nearest designated critical habitat area is approximately 10 miles to the south of the proposed project corridor in Biscayne Bay.

3.1.2.3 Threatened and Endangered Species

3.1.2.3.1 Corals

Seven stony coral species within the Florida-Atlantic coast and Caribbean are currently listed as threatened under the ESA (50 CFR Part 223) as defined in the recent Final Rule delivered by the National Oceanic and Atmospheric Administration (NOAA) on August 27, 2014. These threatened coral species include:

- Staghorn coral (*Acropora cervicornis*);
- Elkhorn coral (*Acropora palmata*);
- Pillar coral (*Dendrogyra clylindrus*);
- Caribbean star coral (*Orbicella annularis*);
- Mountainous star coral (*Orbicella faveolata*);
- Boulder star coral (*Orbicella franksi*); and
- Rough cactus coral (*Mycetophyllia ferox*).

All these species have been observed within the vicinity of the proposed cable corridor. The proposed cable route is outside the Staghorn and Elkhorn corals' designated critical habitat areas (**Figure 17**). The restricted anchorage area (as defined in 33 CFR 334.580) used by SFOMF was excluded from the critical habitat designation areas due to national security impacts pursuant to ESA Section 4(b)(2) (73 CFR 72210). Details about the presence, distribution, and relative abundance of these listed coral species are provided in Section 4.2.2.3.2.

3.1.2.3.2 Marine Mammals

All marine mammals are protected under the Marine Mammal Protection Act (MMPA) (PL 92-522). The MMPA provides for the conservation and management of marine mammals and their habitats. The MMPA established, with limited exceptions, a complete cessation on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. This broad prohibition applies to all marine mammals, not just those deemed to be threatened or endangered. The term "take" is defined in the MMPA as to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. Although the MMPA establishes a moratorium on the taking of marine mammals by any person in U.S. waters and by U.S. citizens in international waters, certain activities are exempted from the moratorium as outlined in Sections 101 and 104. The category pertinent to the Navy is that of incidental "take" during non-fishery activities (Section 101[a][5][A][ii]).

Authorization from the National Marine Fisheries Service (NMFS) is required to participate in such a designated activity. Such authorization is known as a Letter of Authorization (LOA). If the "take" would be by harassment only, an Incidental Harassment Authorization (IHA) may be issued by NMFS.

The information on marine species distribution relies heavily on data gathered in the Navy's Marine Resource Assessment (MRA) program. The Navy MRA Program was implemented by the Commander, Fleet Forces Command, to initiate collection of data and information concerning protected and commercial marine resources found in the Navy's Operation Areas (OPAREAs). Specifically, the goal of the program is to describe and document the marine resources present in each of the Navy's OPAREAs. Marine mammal descriptions for the Proposed Action Area are supported largely from the data contained in the Navy's MRA for the Southeastern Florida and AUTEC-Andros Operating Area (DON 2013c). The updated marine mammal densities affecting SFOMF are contained in the node for the Southeast OPAREAs (DON 2013c). This report provides a compilation of the most recent data and information on the occurrence, distribution, and density of marine mammals in the southeastern U.S. Included in the discussion below is the subset of federally protected (ESA and MMPA) marine mammals that potentially occur along the coastal waters of Florida in the vicinity of the Proposed Action Area.

Mysticetes (Baleen Whales)

Three baleen whale species (North Atlantic right whale [*Eubalaena glacialis*], humpback whale [*Megaptera novaeangliae*], and fin whale [*Balaenoptera physalus*]) are found off the eastern U.S. coast and potentially occur off southeastern Florida. Mysticetes may occur in many water depths, including deep oceanic water, continental shelf water, and nearshore water. In addition, right whales can be found in particularly shallow water during calving season (mid-December through March), sometimes just outside the surf zone. All three baleen whales are protected under the MMPA, as well as the ESA.

Odontocetes (Toothed Whales and Dolphins)

A number of Odontocetes have been documented in nearshore and offshore waters of southeast Florida. The bottlenose dolphin (*Tursiops truncatus*) is the most commonly sighted species with inshore species sighted found within 4.0 nm (7.5 km) of shore and offshore species sighted further than 18.3 nm (34 km) from shore (DON 2007c). Other relatively abundant species include the Atlantic spotted dolphin (*Stenella frontalis*), dwarf and pygmy sperm whales (*Kogia* spp.), various beaked whale species (Genera *Ziphius* and *Mesoplodon*), Risso's dolphin (*Grampus griseus*), and short-finned pilot whale (*Globicephala macrorhynchus*). All Odontocetes are protected under the MMPA.

Threatened and Endangered Marine Mammals

Some species of marine mammals are afforded additional protection under the ESA. The ESA provides for conservation of wildlife and plants that have been listed as either threatened or endangered. The ESA also outlines the need to protect the designated "Critical Habitat" of listed species (16 USC 1531). The ESA applies to Federal actions in two separate respects. First, the ESA requires that Federal agencies, in consultation with the responsible wildlife agency (i.e., U.S. Fish and Wildlife Service [USFWS] or NMFS), ensure that proposed actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of a Critical Habitat (16 USC 1536 [a][2]). Regulations implementing the ESA expand the consultation requirement to include those actions that "may affect" a listed species or adversely modify Critical Habitat. Second, if an agency's proposed action would "take" a listed species, then the agency must obtain an Incidental "Take" Statement from the responsible regulatory agency.

Descriptions for the threatened and endangered marine mammals of the SFOMF Study Area are summarized below from the MRA for the Southeastern Florida and AUTEC-Andros OPAREA (DON 2013c).

North Atlantic Right Whale

The North Atlantic right whale is federally listed as endangered under the ESA (35 FR 18319). Right whales are large baleen whales, generally 13.7 m to 16.7 m in length and can weigh up to 70 tons. Female right whales are larger than males. Right whales feed from spring to fall and, in certain areas, also in winter. Right whales are skimmers; they feed by removing prey from the water using baleen while moving with their mouth open through a patch of zooplankton. The right whale occurs primarily in coastal or shelf waters, with a range strongly correlated to the distribution of its prey. Although the location of much of the population is unknown during winter, right whales do occur in lower latitudes during the winter and migrate to higher latitudes during the spring or summer.

Critical Habitat – The NFMS designated Critical Habitat for the North Atlantic right whale in 1994 (59 FR 28805). The whale's southeastern Critical Habitat unit is designated above the 28th parallel (NOAA Fisheries, Office of Protected Resources 2008). The Proposed Action Area is located approximately 161 km south of this designated Critical Habitat area.

Humpback Whale

Humpback whales are listed as endangered under the ESA (35 FR 18319). A distinguishing characteristic of humpback whales is their long pectoral fins, which can be up to 4.6 m in length (NOAA Fisheries, Office of Protected Resources 2010b). Similar to the North Atlantic right whale (and other baleens), adult females are larger than adult males. Whale watchers enjoy the humpback's aerial display and slapping of the surface. Humpback whales feed on tiny crustaceans, plankton, and small fish. Humpbacks are found in high latitude feeding grounds during the summer; in the winter they migrate to calving grounds. The seasonal migration of the humpback whale consists of long distances. During migration, humpbacks stay near the surface of the ocean, but while feeding and calving, humpback are found in shallow (warmer) waters

(NOAA Fisheries, Office of Protected Resources 2010a). Gestation lasts about 11 months and mothers are protective of their calves; males do not provide support for the calves.

Critical Habitat - There is no Critical Habitat designated for the humpback whale.

Fin Whale

Fin whales are also listed as endangered under the ESA (35 FR 18319). The second largest species of whale, female fin whales are slightly longer than males (NMFS 2010b). Fin whales are found in social groups in the North Atlantic, including with humpbacks, minkes, and Atlantic white-sided dolphins (Jefferson et al. 2008 as cited in NOAA Fisheries, Office of Protected Resources 2010c). Fin whales are found in offshore (deep) waters in the temperate to polar latitudes, and are rarely found in the tropics.

Critical Habitat - Critical Habitat has not been designated for the fin whale.

Sperm Whale

The sperm whale is listed as endangered under the ESA (35 FR 38385). The sperm whale is an odontocete; its head is so large it composes up to one-third of its total body length and more than one-third of its mass (DON 2013c), and males are considerably larger than females. A sperm whale's diet consists mainly of medium-sized deepwater squid, but it also feeds on species of fish, skate, octopus, smaller squid, and sharks (DON 2013c; NOAA Fisheries, Office of Protected Resources 2010d). Although males reach sexual maturity at approximately 10 years of age, they do not breed until their late 20s. Females reach sexual maturity at 7 to 13 years of age (DON 2013c), when they start producing a calf approximately once every 5 years (NOAA Fisheries, Office of Protected Resources 2010d). Sperm whales have a global distribution and are found in the North Atlantic, North Pacific, and southern oceans (NMFS, Office of Protected Resources 2009). Sperm whales inhabit areas with water depths of approximately 600 m or more, and are less likely to inhabit waters less than 300 m deep (NOAA Fisheries, Office of Protected Resources 2010d).

Critical Habitat - There is no Critical Habitat listed for the sperm whale.

West Indian (Florida) Manatee

The Florida subspecies of the West Indian manatee (*Trichechus manatus latirostris*) is federally listed as endangered under the ESA (32 FR 4061) and is further protected under the MMPA and is under the jurisdiction of the USFWS. The species' year-round range is generally restricted to the southeastern U.S., although individuals may range as far as Massachusetts and Texas during warm months. Manatees are common within 5 km of the southeastern coast and use a variety of aquatic habitats (marine, brackish, and fresh water; canal systems, mangroves, salt marsh complexes) where water depths are greater than 1 to 2 m (DON 2007c). Manatees are herbivores that feed on a variety of submerged, floating, and emergent vegetation. The current population is estimated to be at least 3,800 individuals (USFWS 2009). Both year-round and transient manatee populations occur off Broward County (Coastal Eco-Group Inc. 2008b). Manatee occurrences have been documented on the Atlantic shoreline, as well as the entire length of the

ICW, including waters bordering SFOMF. A manatee sanctuary (Whiskey Creek) is located south of the SFOMF site at the John U. Lloyd Beach State Park.

Critical Habitat - Critical habitat was designated (final) on September 22, 1977 (42 FR 47840-47845) for the West Indian manatee. On January 12, 2010, USFWS announced their 12-month finding stating that revisions to Critical Habitat for the West Indian manatee are warranted (75 FR 1574-1581). However, funding is not available at this time to complete the revisions.

Although there is no critical habitat located offshore of Broward County or within the Proposed Action area, the nearest critical habitat unit is located approximately 13 km south of the SFOMF.

Non-Listed Marine Mammals

There are 27 non-endangered or non-threatened marine mammal species with known or potential occurrence in the SFOMF Study Area: two baleen whale, 23 toothed whale, and two seal species. There are few records for most marine mammal species that occur in the southeastern Florida OPAREA (DON 2013c). This is primarily due to lack of survey effort, difficulty in species identification, or extralimital occurrences.

Detailed descriptions of the occurrence, life history, behavior, abundance, and hearing for the non-listed marine mammals of the SFOMF Study Area have been well documented in the Navy's MRA for the Southeastern Florida and AUTEC-Andros OPAREA (DON 2013c).

3.1.2.3.3 Sea Turtles

All sea turtle species are protected under the ESA. NMFS and the USFWS share jurisdiction for sea turtles, with NMFS having jurisdiction for the conservation and recovery of sea turtles in the marine environment and USFWS for sea turtles on nesting beaches. The ESA outlines the need to protect the designated Critical Habitat of listed species and since the NMFS and USFWS share jurisdiction of sea turtles, coordination with each respective agency would depend on the potentially impacted habitat.

There are five sea turtle species occurring along the Florida east coast (**Table 5**). Current information about sea turtles indicates that their distribution is both specific to the species and to their stage in the life cycle. Most sea turtles associate with specific habitats during the life-cycle stages of post-hatchling, juvenile and subadult, and adult. Nesting females and hatchling sea turtles make use of nesting beaches. Post-hatchling sea turtles prefer oceanic waters where *Sargassum* rafts are located. Generally, larger juveniles and some adults (hard-shelled sea turtles) tend to favor benthic habitats in shallow nearshore waters, while other adults (leatherback sea turtles) are associated with deeper pelagic waters. Water temperature, seasonal changes, and migration patterns are other factors that affect the distribution of sea turtles (DON 2007c).

Table 5 Sea Turtle Occurrences along the Florida East Coast

Common Name	Scientific Name	ESA Status
Green sea turtle	*Chelonia mydas*	Threatened
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermachelys coriacea*	Endangered

Loggerhead Sea Turtle

The loggerhead sea turtle occurs in temperate and tropical marine waters world-wide. Depending on the life stage, loggerheads may occur in terrestrial, oceanic, or nearshore habitats. The loggerhead favors warm temperate and subtropical waters relatively close to shorelines, and may occur year-round off southern Florida. The loggerhead was listed as threatened throughout its range on 28 July 1978 (43 FR 32808). NMFS designated Critical Habitat for the Northwest Atlantic Ocean loggerhead sea turtle Distinct Population Segment (DPS) within the Atlantic Ocean and the Gulf of Mexico (but not for Dania Beach, Florida) (79 FR 39855). Specific areas proposed for designation include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors.

Green Sea Turtle

The green sea turtle is globally distributed in tropical and subtropical waters along continental coasts and islands. Depending on life stage, green sea turtles may occur at oceanic beaches (nesting), open ocean convergence zones, and coastal benthic feeding areas. In the U.S. Atlantic, green sea turtles primarily inhabit inshore and nearshore waters. The green sea turtle was listed on 28 July 1978 as threatened throughout its range except for Florida and the Pacific Coast of Mexico, where it was listed as endangered (43 FR 32808). In the U.S., green sea turtles nest primarily along the coast of eastern Florida, predominantly Brevard through Broward counties. From 2001 to 2005, an average of 5,055 green sea turtles nested in Florida. This estimate suggests that Florida supports the second largest green sea turtle nesting population in the wider Caribbean (Moncada et al. 2006). In Broward County, 276 nests were documented in 2008 (FWC 2009c), and green sea turtles have frequently been sighted offshore during surveys (Coastal Eco-Group Inc. 2008a). Nesting season extends from March 1 to October 31. Green turtles have been known to nest in the relatively undeveloped portion of beach within the John U. Lloyd Beach State Park (FDEP 2010). In the 2010 season, there were 34 green turtle nests found along the John U. Lloyd Beach State Park (3.9 km) (Burney and Wright 2010).

Leatherback Sea Turtle

Leatherback sea turtles occur circumglobally in tropical, subtropical, and warm-temperate waters throughout the year and in cooler temperate waters during warmer months (DON 2008d). The species is primarily pelagic, but may enter coastal waters for foraging and reproduction. The leatherback sea turtle was listed as endangered throughout its range on June 2, 1970 (35 FR 8495). Leatherbacks nest primarily in tropical regions. Nesting activity in Florida is low, with the number of nests typically ranging from 30 to 60 annually (FWC 2009d). In 2008, 14 nests were documented in Broward County (FWC 2009e). Nesting season extends from March 1 to October 31. Nesting of leatherback turtles has occurred in the relatively undeveloped portion of beach within the John U. Lloyd Beach State Park (FDEP 2010). In the 2010 season there were two leatherback nests found along the John U. Lloyd Beach State Park (3.9 km) (Burney and Wright 2010).

Hawksbill Sea Turtle

The hawksbill sea turtle is circumtropical in distribution, generally occurring from 30°N to 30°S within the Atlantic, Pacific, and Indian oceans (Witzell 1983). Hawksbill post-hatchlings and juveniles inhabit oceanic waters, later moving to benthic foraging grounds. Adult habitat includes nearshore waters associated with coral reefs, mangroves, and seagrass beds (Musick and Limpus 1997; Bjorndal and Bolten 1988; DON 2008d). The hawksbill was federally listed as endangered on 2 June, 1970 (35 FR 8495). Hawksbills are common in the waters off southern Florida, although nesting is rare. Five hawksbill sea turtle nests have been documented in Broward County since 1986.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle is restricted to the North Atlantic Ocean, where a moderate number of individuals occur along the U.S. Atlantic Coast. Kemp's ridley sea turtles occur in open ocean habitats of the North Atlantic Ocean as post-hatchlings and small juveniles (Manzella et al. 1991), moving to benthic nearshore feeding grounds as adults (Morreale and Standora 2005). The Kemp's ridley sea turtle was listed as endangered throughout its range on December 2, 1970 (35 FR 18320). There is no documentation of nesting in Broward County, although the species occurs in nearshore waters.

Sea Turtle Nesting (All Species)

The Proposed Action is within the normal nesting areas of three species of sea turtles: the loggerhead sea turtle, the green sea turtle, and the leatherback sea turtle. John U. Lloyd State Park is one of the Broward County survey areas where annual sea turtle nesting data are collected and reported. Nesting data for the 2010 season (**Table 6**) provide the relative abundance and density of sea turtle nesting activity proximal to the Proposed Action Area (NSU 2010).

Table 6 Documented Sea Turtle Nests at the John U. Lloyd State Park Survey Area (2010)

Species	Total Nests (Number)	Density (Nests/km)	Mean Daily (Nests/km)
Loggerhead sea turtle	202	51.8	0.308
Green sea turtle	34	8.7	0.057
Leatherback sea turtle	2	0.5	0.004

Critical Habitat – The NMFS designated critical habitat (final) on July 10, 2014 (79 FR 39855) for the Northwest Atlantic Ocean Distinct Population Segment (DPS) of the loggerhead sea turtle that includes 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. The Proposed Action falls within the LOGG-N-19 critical habitat unit for offshore migratory habitat that extends from the Mean High Water (MHW) line to 1.6 km seaward.

Concurrent with this rulemaking, the USFWS designated critical habitat (final) on July 10, 2014 for terrestrial areas (nesting beaches) in a separate document (79 FR 39755) for the Northwest Atlantic Ocean DPS of the loggerhead sea turtle. In total, approximately 1,102 km of coastline fall within this critical habitat designation. The nearest designated critical habitat unit (LOGG-T-FL-14) extends along the coastline from the Boca Raton Inlet to the Hillsboro Inlet from which is approximately 18.5 km (10 nm) to the north of the Proposed Action.

3.1.2.3.4 Fish

One federally listed endangered fish species, the smalltooth sawfish (*Pristis pectinata*), occurs off Broward County and potentially within the Proposed Action Area. Part of a group of fishes called elasmobranchs that includes all rays and sharks, the smalltooth sawfish was listed as endangered in 2003 (68 FR 15674-15680). Sawfish are typically found in shallow waters close to shore over muddy and sandy bottoms, including bays, shallow banks, and estuaries or river mouths. Young sawfish in Florida are born about 0.7 m long. Make sawfish are thought to reach sexual maturity at approximately 3 to 3.3 m, while females reach sexual maturity at 3.3 to 3.6 m. The largest sawfish are 5.5 m in length.

Critical Habitat – Two areas have been designated as Critical Habitat for the smalltooth sawfish. These areas include the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/Everglades Unit. Neither of these units is located near the Proposed Action Area in Broward County, Florida. Because no Critical Habitat for the smalltooth sawfish is present near the Proposed Action Area, no further consideration of impacts on the Critical Habitat for smalltooth sawfish is included in this EA.

3.1.2.3.5 Birds

The Migratory Bird Treaty Act (MBTA) provides for the protection of migratory birds through various international treaties to ensure the protection of shared migratory bird species. Many common birds are protected under the act, and a complete list of MBTA-protected species is found at 50 CFR 10.13. Over 80 bird species protected by the MBTA occur along the southeast Florida coastline for at least part of the year and could utilize areas within or adjacent to the proposed cable corridor.

A list of state and federally threatened and endangered bird species for Broward County, Florida has been compiled from the USFWS and Florida Fish and Wildlife Conservation Commission (FFWCC) (**Table 7**).

A total of 15 state-listed bird species and eight (8) federally-listed bird species, including one candidate species have the potential to occur in or adjacent to the Proposed Action Area based on review of recent literature and sightings at the SFOMF and adjacent John U. Lloyd State Park.

Table 7 ESA and State Listed Bird Species Occurring in Broward County

Common Name	Scientific Name	Protection Status	Likelihood of Occurrence in the Proposed Action Area*
Florida scrub jay	*Aphelocoma coerulescens*	FT	Unliklely
Limpkin	*Aramus guarauna*	SSC	Unlikely
Burrowing owl	*Athene cunicularia*	SSC	Unlikely
Rufa Red knot	*Calidris canutus rufa*	FC	Unlikely
Ivory-billed woodpecker	*Campephilus principalis*	FE	Unlikely
Piping plover	*Charadrius melodus*	FT	Likely
Little blue heron	*Egretta caerulea*	SSC	Likely - Lloyd SP
Reddish egret	*Egretta rufescens*	SSC	Likely
Snowy egret	*Egretta thula*	SSC	Likely
Tri-colored heron	*Egretta tricolor*	SSC	Likely
White ibis	*Eudocimus albus*	SSC	Unlikely
SE American kestrel	*Falco sparverius paulus*	ST	Likely - Lloyd SP
Florida sandhill crane	*Grus canadensis pratensis*	ST	Unlikely
American oystercatcher	*Haematopus palliatus*	SSC	Unlikely
Wood stork	*Mycteria americana*	FE	Likely - Lloyd SP
Osprey**	*Pandion haliaetus*	SSC	Likely
Brown pelican	*Pelecanus occidentalis*	SSC	Likely
Red-cockaded woodpecker	*Picoides borealis*	FE	Unlikely
Roseate spoonbill	*Platalea ajaja*	SSC	Likely - Lloyd SP
Crested caracara	*Polyborus plancus audubonii*	FT	Unlikely
Snail kite	*Rostrhamus sociabilis plumbeus*	FE	Unlikely
Black skimmer	*Rynchops niger*	SSC	Likely
Least tern	*Sternula antillarum*	ST	Likely
Roseate Tern	*Sterna dougallii dougallii*	FT	Likely

SSC = State Species of Special Concern; ST = State Threatened; FC = Federal Candidate Species; FE = Federally Endangered; FT = Federally Threatened
* Refers to likelihood of occurring in the vicinity of SFOMF; unlikely or likely based on sighting records, habitat preferences, abundance, and interpretation of existing data. Sources: U.S. Navy 2013, USFWS 2014, FFWCC 2013, eBird 2014.
** SSC designated species in Monroe County only.

3.1.3 Essential Fish Habitat

Under the direction of the Magnuson Stevens Fishery Conservation and Management Act (50 CFR 600.10), EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. This includes the marine areas and their chemical and biological properties that are utilized by the organism. Substrate includes sediment, hard bottom, and other structural relief underlying the water column along with their associated biological communities. EFH is designated in Florida offshore waters by the South Atlantic Fishery Management Council (SAFMC). SAFMC designated EFH for seven groups of species under their respective Fishery Management Plans (FMPs): Coral, Coral Reef, and Live/Hard Bottoms, Snapper-Grouper Complex, Coastal Migratory Pelagics, Dolphin-Wahoo, Golden Crab, Shrimp, and Spiny Lobster. In addition to and as a subset of EFH, the SAFMC identified Habitat Areas of Particular Concern (HAPC) based on the following criteria: ecological function of the habitat is important; habitat is sensitive to anthropogenic degradation; development activities are or will stress the habitat; or the habitat type is rare. **Table 8** summarizes EFH and HAPC for the seven South Atlantic FMPs. Within and including the 12 nm limit (NEPA portion of the project area), EFH is present for each of these species groups.

Table 8 EFH and HAPC Designated within the Proposed Action Area

Fishery Management Plan Name	General Species Included	EFH-HAPC Description
Coral, Coral Reef, and Live/Hard Bottoms	Predominantly corals belonging to the Class Hydrozoa and Anthozoa	The Phragmatopoma (worm reefs) reefs off the central east coast of Florida; nearshore (0-4 meters; 0-12 feet) hard bottom off the east coast of Florida from Cape Canaveral to Broward County); offshore (5-30 meter; 15-90 feet) hard bottom off the east coast of Florida from Palm Beach County to Fowey Rocks; Biscayne Bay, Florida; Biscayne National Park, Florida; and the Florida Keys National Marine Sanctuary. Oculina Banks off the east coast of Florida from Ft. Pierce to Cape Canaveral.
Snapper-Grouper Complex	Sea Basses and Groupers, Snappers, Wreckfish, Snappers, Porgies, Grunts, Tilefishes, Jacks, Triggerfishes, Wrasses and Spadefishes	Medium to high profile offshore hard bottoms where spawning normally occurs; localities of known or likely periodic spawning aggregations; nearshore hard bottom areas; The Point, The Ten Fathom Ledge, and Big Rock, (NC); The Charleston Bump (SC); mangrove habitat, seagrass habitat, oyster/shell habitat; all coastal inlets, all state-designated nursery habitats of particular importance to snapper grouper; pelagic and benthic Sargassum; Hoyt Hills for wreckfish; the Oculina Bank Habitat Area of Particular Concern; all hermatypic coral habitats and reefs; manganese outcroppings on the Blake Plateau; and Council-designated Artificial Reef Special Management Zones (SMZ's).
Coastal Migratory Pelagics	Cero, Cobia, King Mackerel, Little Tunny, Spanish Mackerel	sandy shoals of Capes Lookout, Cape Fear, and Cape Hatteras from shore to the ends of the respective shoals, but shoreward of the Gulf stream; The Point, The Ten-Fathom Ledge, and Big Rock (North Carolina); The Charleston Bump and Hurl Rocks South Carolina); The Point off Jupiter Inlet (Florida); Phragmatopoma (worm reefs) reefs off the central east coast of Florida; nearshore hard bottom south of Cape Canaveral; The Hump off Islamorada, Florida; The Marathon Hump off Marathon, Florida; The “Wall” off of the Florida Keys; Pelagic Sargassum; and Atlantic coast estuaries with high numbers of Spanish mackerel (Bogue Sound and New River, NC) and Cobia (Broad River, SC).
Dolphin-Wahoo	Dolphinfish, Wahoo	The Point, The Ten-Fathom Ledge, and Big Rock (North Carolina); The Charleston Bump Complex and Georgetown Hole (South Carolina); The Point off Jupiter Inlet (Florida); The Hump off Islamorada, Florida; The Marathon Hump off Marathon, Florida; The “Wall” off of the Florida Keys.
Golden Crab	Golden Crab	Essential fish habitat for golden crab includes the U.S. Continental Shelf from Chesapeake Bay south through the Florida Straits (and into the Gulf of Mexico). In addition, the Gulf Stream is an essential fish habitat because it provides a mechanism to disperse golden crab larvae. Also, it should be noted that the Gulf Stream occurs within the EEZ.
Shrimp	White Shrimp, Pink Shrimp, Brown Shrimp, Rock Shrimp, Royal Red Shrimp	All coastal inlets, all state-designated habitats of particular importance to shrimp, state-identified overwintering areas.
Spiny Lobster	Spiny Lobster	Florida Bay, Biscayne Bay, Card Sound, and coral/hard bottom habitat from Jupiter Inlet, Florida through the Dry Tortugas, Florida.

3.1.4 Cultural Resources

There are no historic properties listed on the National Register of Historic Places (NRHP) within one mile of the SFOMF. The NOAA's Office of Coast Survey's Automated Wreck and Obstruction Information System (AWOIS) indicated one shipwreck in offshore waters located near the GTMO cable route. Additionally, one artificial reef site that consists of a 105-foot vessel named "*Te Amo*" was also identified within proximity of the cable route as well as in a previous assessment for SFOMF. **Figure 19** provides the locations of the known shipwrecks in relation to the proposed cable route. None of the listed shipwrecks are included in the NRHP; therefore, they are not protected by the National Historic Preservation Act. However, they are protected under the Abandoned Shipwreck Act.

3.1.5 Land and Water Use

The land portion of SFOMF is a federally owned and controlled Navy facility. This area has been the location of the cable termini and shore landings for numerous cable installations and repairs from 1952 to present day. Additionally, there is a posted "restricted area" where beach segments of existing cable are buried in approximately one meter deep trenches between the beach front and installation conduits.

The nearshore waters of the Proposed Action Area are located in the SFOMF's Restricted OPAREA that extends to the east for approximately 5.5 km (3 nm) and to the south for 7.4 km (4 nm). Three other SFOMF OPAREA's extend offshore approximately 37 km (20 nm) to the north and south of the SFOMF facility where military training exercises occur on a routine basis and are potentially hazardous to the public. Non-participating vessels are warned to avoid specified areas and activities through a Notice to Mariners and SFOMF ensures that hazard areas are cleared prior to each exercise.

3.2 Guantanamo Bay, Cuba: SFOC Onshore and Offshore

The project area on the NAVSTAGTMO portion of the SFOC installation includes both onshore and offshore components. For purposes of this document, the offshore area is defined as the portion of the cable route that lies within Guantanamo Bay and approximately 12 nm southward from the mouth of Guantanamo Bay into the Caribbean Sea (**Figure 20**). The onshore component occurs in an area known as Glass Beach located on the windward coast of Guantanamo Bay. This portion of the project area includes terrestrial areas landward of the shoreline within which activities related to this project will occur.

3.2.1 Geology

NAVSTAGTMO lies within a broad valley that is 40.2 km (25 miles) long and 24.1 km (15 miles) wide known as the Guantanamo Basin (Geo-Marine Inc., 2006). The most common geologic formations within NAVSTAGTMO include sedimentary rocks and volcanic conglomerates. Along the coast, coral platforms are extensive and characterized by broad areas exhibiting little topographic relief or low outcropping hills. Corals and uncharacterized open water are present within the offshore components of the project area. The underlying geology associated with the terrestrial component of the project area is characterized as Coral Reef Pleistocene Level 2 (DON 2014).

Soils (Terrestrial)

Soils within NAVSTAGTMO are diverse and their development is influenced by the underlying geology and landscape-level processes. Soils within the project area are characterized as Red gravelly terrace soils, 2 to 12 percent slopes. This soil type is described as a deep, well-drained, alkaline, moderately permeable soil found in terraces, foot slopes, and outwash fans (DON 2014).

Topography

The project area occurs within the windward side of the base, located on the east side of Guantanamo Bay. The windward side is generally described as rugged and hilly. Low coral plateaus, low rounded hills, and steep-sided hills that rise 91 to 152 m (299 - 499 ft.) above sea level comprise the primary topographic features on the windward side of the base (Geo-Marine Inc., 2006).

The onshore portion of the project area consists of a moderately steep rocky shoreline that transitions into a relatively flat area with little topographic relief.

Bathymetry

The bathymetry of the project area includes shallow waters along the coastline, the shelf break which occurs near the 130 m (427 ft.) isobath approximately 0.5 nm south of the mouth of Guantanamo Bay (**Figure 20**), and deep waters up to approximately 4,000 m (13,123 ft.) near the intersection of the SFOC route and southeastern end of the project area within the Caribbean Sea.

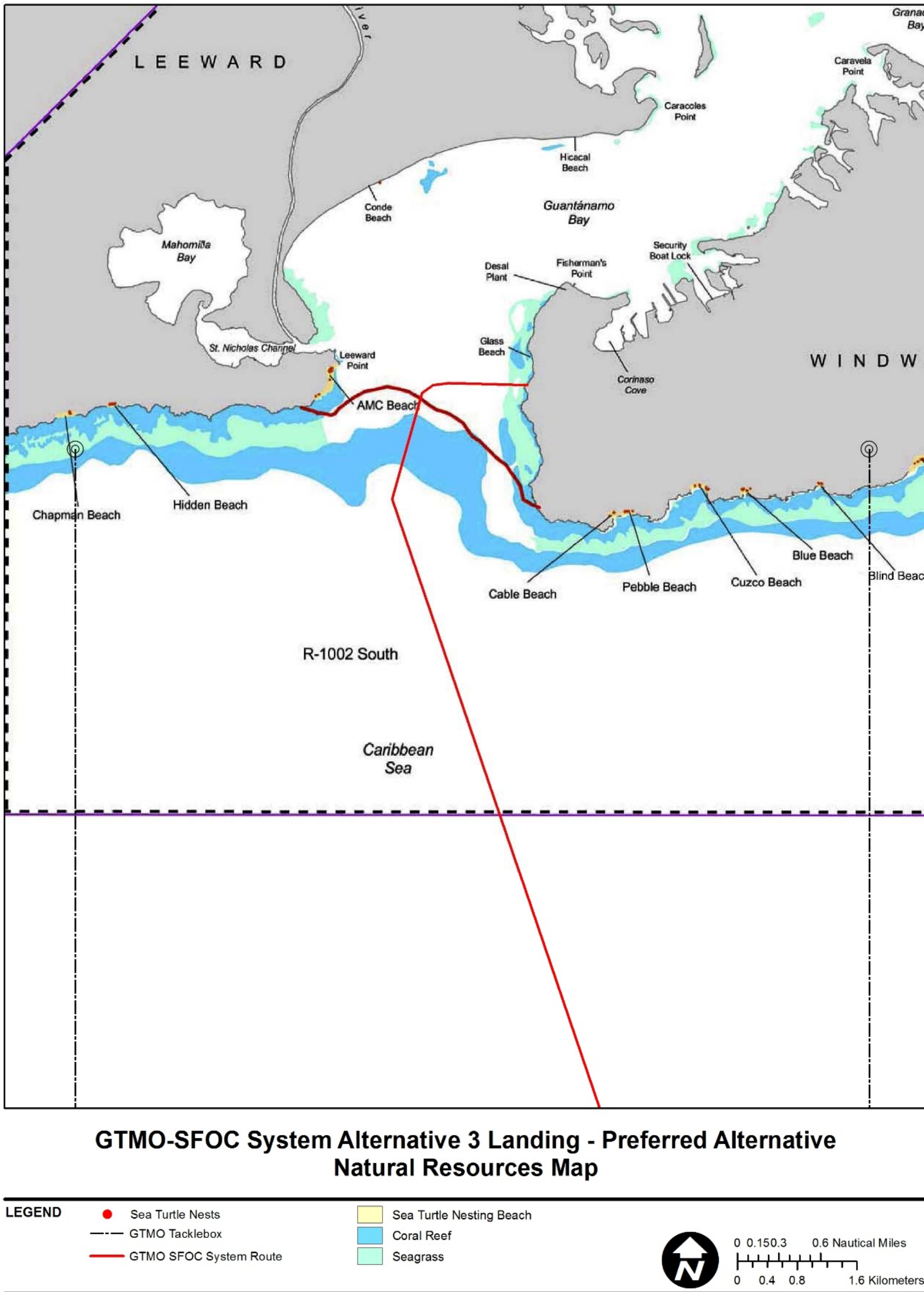

Figure 20 Guantanamo Bay Cable Route at Glass Beach, Cuba

3.2.2 Biological Resources

3.2.2.1 Coral and Hardbottom Habitat

Coral reefs are common along the coast of Cuba and occur within both shallow and deep portions of the cable route. A nearshore fringing reef system with well-developed spur-and-groove formations occur on the shallow and deeper fore-reef slope between approximately 4 m (13 ft.) and 20 m (66 ft.) in depth (DON 2014, Roca and Sedaghatkish 1998, Chiappone et al. 2001). Within the mouth of Guantanamo Bay, spurs are oriented east-to-west (Chiappone et al. 2001) along the coast of the bay. Shallow (< 7 m/23 ft.) spur-and-groove reefs are dominated by algae and stony corals including thin leaf lettuce coral (*Agaricia tenuifolia*) and elkhorn coral. Deeper spur-and-groove reefs extend from the shallow zone to approximately 20 m (66 ft.) deep. Deep spur-and-groove reefs are dominated by several algal functional groups and stony coral species including star coral (*Montastraea annularis*), finger coral (*Porites porites*), and staghorn coral (Roca and Sedaghatkish 1998).

The shelf margin adjacent to deeper water (> 100 m/328 ft.) is comprised of the fore reef slope and escarpment (Roca and Sedaghatkish 1998). A deep reef system is located near the mouth of Guantanamo Bay (**Figure 20**) at an approximate depth range of 30-130 m (98-492 ft.) (NOAA); this reef is contiguous with fringing reefs along the windward and leeward Caribbean coasts. It is presumed based on available information that this system represents the fore reef slope and escarpment. Specific information regarding species composition on this reef is not available.

3.2.2.2 Seagrass Habitat

Seagrass beds are generally located throughout NAVSTAGTMO's nearshore waters, with the largest contiguous areas occurring along the Caribbean coasts of the leeward and windward sides of the base (**Figure 20**). Seagrass beds at NAVSTAGTMO are composed of several species including turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass. Seagrass beds are important foraging areas for manatees and green sea turtles and also serve as nursery grounds for a wide variety of fish species. Collectively, coral reefs and seagrass beds provide suitable habitat for numerous marine species including marine mammals, sea turtles, fishes, crustaceans, mollusks, sponges, starfishes, sea cucumbers, and sea urchins (Geo-Marine, Inc. 2006).

3.2.2.3 Threatened and Endangered Species

The Final Governing Standards for Environmental Protection by U.S. Forces in Cuba (FGS-Cuba) establishes standards and guidance for natural resources management at NAVSTAGTMO. Included are biological species (plants and animals) existing on properties under DoD control and declared endangered or threatened by either the U.S. or host nation governments (DON 1994). For purposes of this document, the FGS-Cuba and the federal (U.S.) list of threatened and endangered species comprise the threatened and endangered species subject to analysis under this document. This combined listing is consistent with the threatened and endangered species list used in the development of NAVSTAGTMO's Integrated Natural Resources Management Plan (DON 2014). This list also maintains compliance with the Overseas Environmental Baseline Guidance Document (OEBGD) of 2000, also known as DoD Instruction 4715.5-G. **Table 9** provides a list of these species and applicable regulations as reported in DON 2014.

Table 9 Protected Species at NAVSTAGTMO

Species	OEBGD	Host Nation	The FGS (Cuba)	ESA
American crocodile (*Crocodylus rhombifer*)				
Bachman's warbler (*Vermivora bachmanii*)	X		X	X
Cuban hook-billed kite (*Chondrohierax uncinatus wilsonii*)	X		X	
Cuban parrot (*Amazona leucocephala*)	X		X	
Cuban rock iguana (*Cyclura nubila nubile*)	X		X	
Cuban sandhill crane (*Grus canadensis nesiotes*)	X		X	X
Desmarest's hutia (*Capromys pilorides*)		X		
Elkhorn coral (*Acropora palmata*)				X
Everglades snail kite (*Rostrhamus sociabilis plumbeus*)			X	X
Green sea turtle (*Chelonia mydas*)		X		X
Hawksbill sea turtle (*Eretmochelys imbricata*)		X		X
Ivory-billed woodpecker (*Campephilus principalis*)	X		X	X
Kemp's ridley sea turtle (*Lepidochelys kempii*)		X		X
Leatherback sea turtle (*Dermochelys coriacea*)		X		X
Loggerhead sea turtle (*Caretta caretta*)		X		X
Staghorn coral (*Acropora cervicornis*)				X
West Indian manatee (*Trichechus manatus*)		X		X
Seven ESA-listed corals				X
Dendrogyra cylindrus				
Orbicella annularis				
Orbicella faveolata				
Orbicella franksi				
Mycetophyllia ferox				

3.2.2.3.1 Corals

Staghorn and elkhorn corals have both been identified on NAVSTAGTMO's nearshore reefs (DON 2014). In a recent assessment of fringing coral reefs at Guantanamo Bay, staghorn coral was identified at both the Phillips and Glass Beach areas (Marx et al. 2012). Previous studies on Cuban reefs show that staghorn and elkhorn corals are among eight species that comprise the dominant structural elements (Chiappone et al. 2001).

Marx et al. (2012) found bolder star coral to be the second most prevalent coral species among NAVSTAGTMO's nearshore reefs. In a study by Chiappone et al. 2001 analyzing species richness and community structure among NAVSTAGTMO's coral reefs, Caribbean star coral, pillar coral, and rough cactus coral were identified. Included within the study area were shallow bay reefs at Phillip's Park and deeper bay reefs (Mike Boat Reef), both of which are approximately 1.5 km (0.93 mi.) south of the cable landing area at Glass Beach. In summary, six stony coral species listed as threatened under the ESA have been documented in NAVSTAGTMO's waters (Chiappone et al. 2001, Marx et al. 2012). Based on these studies and known geographic ranges (Humann and DeLoach 2002), it is possible that any of the federally listed coral species may be present within the cable route.

3.2.2.3.2 Marine Mammals

Thirty-two marine mammal species, including thirty-one (31) cetacean (whale and dolphin) and one sirenian (manatee) species, have been documented or have the potential to occur within the project area (Geo-Marine, Inc. 2006). **Table 10** shows both federally listed and non-listed marine mammals that may occur in and around the project area including seasonal and depth-related distribution patterns. Detailed information on life-history and spatio-temporal distribution patterns in and near the project area can be found in the U.S. Navy's Seasonality and Distribution of Marine Life at U.S. Naval Station Guantanamo Bay and in the Guantanamo OPAREA (Geo-Marine, Inc. 2006).

Table 10 Spatial and Temporal Distribution of Marine Mammals in and around the Project Area

Threatened and Endangered	Guantanamo Bay	Offshore (outside of Guantanamo Bay)
North Atlantic right whale (*Eubalaena glacialis*)	Not expected	Not expected
Humpback whale (*Megaptera novaeangliae*)	Not expected	Throughout: November - May
Sei whale (*Balaenoptera borealis*)	Not expected	Not expected
Fin whale (*Balaenoptera physalus*)	Not expected	Throughout: October - May
Blue whale (*Balaenoptera musculus*)	Not expected	Throughout: October - May
Sperm whale (*Physeter macrocephalus*)	Not expected	Throughout: Year-round
West Indian manatee (*Trichechus manatus*)	Throughout: Year-round	Inshore of the 100 m isobath; Potential movement seaward of the 100 m isobath: Year-round; Potential movement of individuals across deep waters between Haiti, Jamaica, and Cuba: Year-round
Non-Threatened and Non-Endangered	Guantanamo Bay	Offshore (outside of Guantanamo Bay)
Minke whale (*Balaenoptera acutorostrata*)	Not expected	Throughout: December - May (particularly January and February)
Bryde's whale (*Balaenoptera edeni/brydei*)	Not expected	Throughout: Year-round
Pygmy sperm whale (*Kogia breviceps*)	Not expected	Throughout (particularly seaward of the shelf break): Year-round
Dwarf sperm whale (*Kogia sima*)	Not expected	Throughout (particularly seaward of the shelf break): Year-round

Beaked whale (Family *Ziphiidae*)	Not expected	Throughout (particularly seaward of the shelf break): Year-round
Rough-toothed dolphin (*Steno bredanensis*)	Not expected	Throughout: Year-round
Bottlenose dolphin (*Tursiops truncatus*)	Throughout: Year-round; Occurrence may be concentrated throughout this area	Throughout: Year-round
Pantropical spotted dolphin (*Stenella attenuata*)	Not expected	Throughout (seaward of the shelf break): Year-round
Atlantic spotted dolphin (*Stenella frontalis*)	Not expected	Throughout: Year-round
Striped dolphin (*Stenella coeruleoalba*)	Not expected	Throughout (particularly seaward of the shelf break): Year-round
Spinner dolphin (*Stenella longirostris*)	Not expected	Throughout: Year-round
Clymene dolphin (*Stenella clymene*)	Not expected	Throughout (seaward of the shelf break): Year-round
Fraser's dolphin (*Lagenodelphis hosei*)	Not expected	Throughout (seaward of the shelf break): Year-round
Common dolphin (*Delphinus* spp.)	Not expected	Not expected
Risso's dolphin (*Grampus griseus*)	Not expected	Throughout (seaward of the shelf break): Year-round
Melon-headed whale (*Peponocephala electra*)	Not expected	Throughout: Year-round
Pygmy killer whale (*Feresa attenuata*)	Not expected	Just inshore to seaward of the shelf break: Year-round
False killer whale (*Pseudorca crassidens*)	Not expected	Throughout: Year-round
Killer whale (*Orcinus orca*)	Throughout: Year-round	Throughout: Year-round
Short-finned pilot whale (*Globicephala macrorhynchus*)	Not expected	Throughout: Year-round
Hooded seal (*Cystophora cristata*)	Not expected	Not expected

3.2.2.3.3 Reptiles

Six reptile species protected under FGS-Cuba and/or the ESA are known to occur at NAVSTAGTMO: the American crocodile, Cuban rock iguana, green sea turtle, hawksbill sea turtle, loggerhead sea turtle, and leatherback sea turtle.

American Crocodile

The American crocodile is protected under FGS-Cuba and the Cuban population is listed as threatened under the ESA. The American crocodile occurs from the Atlantic and Pacific coasts of Southern Mexico through Central America and in South America as far as Peru and Venezuela. It also breeds in Cuba, Jamaica, and Hispaniola, and there is a remnant population of approximately 2,000 in Florida. Freshwater or brackish water coastal habitats and mangrove swamps largely comprise the American crocodile's habitat. At NAVSTAGTMO, primary habitat is the Guantanamo River due to its freshwater (DON 2014). This species' habitat is not located within or near the project area.

Cuban Rock Iguana

The Cuban rock iguana is protected under the FGS-Cuba. Cuban rock iguanas are distributed throughout Cuba and are known to occur all over NAVSTAGTMO, where an estimated 6,300 individuals comprise the population. This species requires habitats with suitable forage, basking areas, retreats, and nesting sites (DON 2014). Tolson 2012 reported the highest density of iguanas occurred along undisturbed and disturbed coastal habitats within NAVSTAGTMO. This species has potential to occur within the onshore portion of the project area.

Sea Turtles

Six species of sea turtles are documented to occur in the Caribbean region and could potentially occur in the project area. These species include the green, hawksbill, loggerhead, Kemp's ridley, olive ridley (*Lepidochelys olivacea*), and leatherback turtles. All of these species are protected under the ESA. Those species regularly encountered at NAVSTAGTMO include the green, hawksbill, loggerhead, and leatherback turtles. Kemp's ridley and olive ridley turtles are not expected to occur within the project area and any occurrences would be considered extralimital (Geo-Marine, Inc. 2006).

The coastal waters and beaches of the Cuban archipelago, including nearby Jamaica, Haiti, the Bahamas, and the Cayman Islands, provide important foraging and nesting habitat for green, hawksbill, and loggerhead turtles, while offshore waters are often utilized by leatherback turtles (Fleming 2001). Although sea turtles are common residents throughout the Cuban shelf, there are few documented occurrence records available for the island's waters. The only data available providing evidence of sea turtle movement through NAVSTAGTMO's waters include tagging, satellite-tracking, and genetic studies carried out by various sea turtle research programs (Geo-Marine, Inc. 2006). Systematic survey efforts have not been performed in Cuban waters, however, nesting surveys have been conducted throughout the Cuban archipelago including several nesting beaches at NAVSTAGTMO.

The beaches at NAVSTAGTMO have been documented to provide suitable nesting habitat for green, hawksbill, loggerhead, and leatherback turtles (Geo-Marine, Inc. 2006). These beaches include AMC Beach, Hidden Beach, and Chapman Beach on the leeward side of the base. On the windward side of the base, all of the nesting beaches are located on the Caribbean-facing side of the island east of Windward Point. No nesting beaches have been documented on the windward side of Guantanamo Bay up to and including the mouth of the bay (Geo-Marine, Inc. 2006). The lack of nesting beaches on the windward side of the bay may be due to the physical nature of the coastline.

All species of sea turtles generally require sandy beaches for nesting, with varying preferences among different species in terms of the physical attributes associated with those beaches. Many physical attributes affect a beach's overall suitability for nesting sea turtles including: loose sand, a high percentage of debris, low light levels, vegetation, slope, and absence of obstructions (e.g. man-made structures). For instance, slopes that are very steep can prevent turtles from reaching suitable nesting sites. In contrast, extremely low gradient beaches can put nests at risk of inundation (Alberts et al. 2001). In addition, the presence of man-made structures can hinder or prevent utilization by nesting sea turtles (Geo-Marine, Inc. 2006).

The cable landing area at Glass Beach does not provide suitable nesting habitat for any species of sea turtle. This area lacks a sandy beach and is characterized by a relatively steep rocky escarpment with a concrete pad up to the water line as shown in **Figure 21**.

Figure 21 Cable Landing Area at Glass Beach

Although the cable landing area at Glass Beach does not provide suitable nesting habitat for any species of sea turtle, the nearshore coral reefs and seagrass communities may provide resting and foraging habitat for green, hawksbill, loggerhead, and leatherback turtles. Based on spatio-temporal distribution patterns in and around NAVSTAGTMO and life-stage habitat preference information presented in Geo-Marine, Inc. 2006, the species most likely to utilize the nearshore reefs and seagrass communities off Glass Beach are green and hawksbill turtles. Optimal habitats for green turtles include areas with abundant submerged aquatic vegetation (seagrass and/or algae) which are located in close proximity to nearshore coral reefs. These turtles forage on submerged aquatic vegetation and use coral reefs for resting. Both juvenile and adult hawksbill turtles are also associated with coral reefs and rocky outcrops, where they feed on sponges and other prey items. These areas also provide refuge and shelter for resting (Geo-Marine, Inc. 2006).

3.2.2.3.4 Birds

Cuba is inhabited by approximately 350 species of birds which include 106 permanent residents, 114 winter residents, 15 summer residents, and 115 transient or vagrant species. In addition, there are approximately 21 endemic species, eight of which are known to occur on NAVSTAGTMO (DON 2014). All non-permanent residents are protected by the MBTA and some of these may occur within the project area based on habitat associations.

Five species of birds protected under FGS-Cuba and/or the ESA are known or presumed to occur on NAVSTAGTMO: Bachman's warbler, Cuban hook-billed kite, Cuban parrot, Cuban sandhill crane, and the Everglades snail kite (DON 2014).

Bachman's Warbler

Bachman's warbler is listed as endangered under the ESA. This small warbler breeds in the southeastern U.S. and winters in western Cuba and the Isle of Pines (now known as Isla de Juventud or Island of Youth). Winter specimens have been collected from a variety of lowland and other habitats throughout Cuba (Hamel 1995). Specifics concerning habitat preference of this species in winter are not available (FWS 2014a). Based on available information regarding habitat preference and distribution, this species would not be expected in the project area.

Cuban Hook-Billed Kite

The Cuban hook-billed kite is protected under the FGS-Cuba. This species was formerly widespread on Cuba but now only occurs in a small area on the eastern side of the island between Moa and Baracoa and possibly other parts of the Holguin and Guantanamo provinces. Historically, it inhabited xerophytic vegetation and montane forest (Bird Life International 2014). This species is now confined to montane gallery forest, where it feeds chiefly on tree snails Polymita and slugs in the understory. Based on this species' limited distribution and lack of appropriate habitat within the project area, it would not be expected to occur within the project area.

Cuban Parrot

The Cuban parrot is protected under FGS-Cuba. The Cuban parrot occurs on Cuba, the Bahamas, and the Cayman Islands. It was once widespread in Cuba but its population has declined and it is now restricted to Guanahacabibes peninsula, Zapata peninsula (where it is still common), Macizo de Guamuhaya, Loma de Cunagua, Sierra de Najasa, and the forests of the western Sierra Maestra and Cuchillas del Toa. On Cuba, this species inhabits dense woodland (Bird Life International 2014). Based on this species distribution and habitat preference, it would not be expected to occur within or near the project area.

Cuban Sandhill Crane

The Cuban sandhill crane is listed as endangered under the ESA and is also protected under the FGS-Cuba. The Cuban sandhill crane is one of six subspecies of sandhill cranes. The sandhill crane complex includes both migratory and non-migratory species; the Cuban sandhill crane is non-migratory and, therefore, considered a resident population on Cuba (Meine and Archibald 1996).

Most cranes prefer relatively open spaces, require a wide range of visibility, and generally maintain a distance of at least several kilometers between themselves and human activity. Space and solitude are especially important requirements during the breeding season. Most species nest in shallow wetlands although the degree to which cranes use and require wetlands varies widely among, and within, species. The Cuban sandhill crane lives in pine-palmetto savannas and nests and rears its young on dry ground (Meine and Archibald 1996). Since the project area is generally in an area of human activity and neither wetlands nor pine-palmetto savannas are present (DON 2014), this species would not be expected to utilize the project area.

Everglades Snail Kite

The Everglades snail kite is listed as endangered under the ESA and is protected under the FGS-Cuba. This species primarily uses lowland freshwater marshes for feeding, breeding, and roosting (FWS 2014b). This habitat type is not located within or near the project area, therefore, this species would not be expected within the project area.

Ivory Billed Woodpecker

The ivory billed woodpecker (subspecies *bairdii*) formerly occurred at low densities in Cuba. Currently, no evidence exists that this species still occurs in Cuba although the possibility of its existence cannot be ruled out since suitable habitat still remains. This species' preferred habitat generally includes large forests (Bird Life International 2014), which are not present in or near the project area. Based on lack of habitat and the extremely low likelihood that this species still occurs on Cuba, it would not be expected within the project area.

3.2.2.3.5 Mammals (terrestrial)

Desmarest's Hutia

The Cuban hutia is a relatively large species of rodent endemic to Cuba. The Cuban hutia is one of 12 species of hutia endemic to the Caribbean and is the least threatened hutia species. Hutias generally forage on vegetation although they are known to feed on a variety of bark, leaves, and fruits and are known to occasionally eat lizards and other small mammals. Hutias generally inhabit forested or rocky areas where they are mainly arboreal using tree and rock crevices as dens (DON 2014).

On NAVSTAGTMO, hutia management has been a priority for nearly 20 years. Due to a lack of natural predators and an abundant food supply, the hutia population has increased dramatically (DON 2014). These animals present a significant management concern on NAVSTAGTMO due to their tendency to destroy natural vegetation through herbivory. Various management programs have been implemented throughout NAVSTAGTMO including onsite relocation and lethal culling. Due to their widespread presence and generalistic nature, it is possible that this species could utilize the project area at Glass Beach.

3.2.3 Cultural Resources

It is presumed that the beach landing site, including the terrestrial portion beyond the top of the slope, would not be considered a culturally significant site based on its present and historical use.

A search of NOAA's Electronic Navigational Charts (ENC) database and AWOIS indicated that there are no charted shipwrecks close to the route in the Guantanamo Bay area.

3.2.4 Land and Water Use

In order to achieve installation-wide goals, NAVSTAGTMO has been divided into functional areas. The onshore portion of the project occurs within the Commissions functional area. The Commissions functional area is located at the former McCalla Airfield, which is a vintage World War II airfield. The site is currently the location of the legal entry at NAVSTAGTMO and is highly urbanized. Natural resource management objectives within the Commissions functional area include hutia management, erosion and sediment control, and invasive species control (DON 2014).

Upland communities within the onshore portion of the project area have been classified as developed (DON 2014). The onshore component of the project area is disturbed due to historic and ongoing human activity associated with the airfield and its present use as a submarine utility landing area. The cable landing area below the top of the slope has been altered from its natural condition by construction of a stairway and concrete pad that supports both a fuel and water utility pipelines that come ashore here. Beyond the top of the slope, an interconnected system of near-surface (subterranean) utility conduits and two beach manholes are present. The SFOC will connect to these features via installation of additional conduit and a new beach manhole.

The nearshore (offshore) portion of the project area occurs within the Marine/Shoreline functional area. These areas offer numerous outdoor recreational pursuits such as picnicking, fishing, boating, snorkeling, and scuba diving. Selected portions of the beach and coastal terraces are also used for field training exercises. Management objectives within the Marine/Shoreline functional area include erosion and sediment control, hutia management, land management, recreational fishing, rare, threatened and endangered species habitat enhancement, and wildlife viewing areas (DON 2014).

All entries are controlled within the Guantanamo Bay Naval Base Boundary, which includes the Guantanamo Bay Naval Defensive Area and Naval Airspace Reservation. At no time shall any ship or other craft, other than public ships of the United States, be navigated into it unless authorized by the Secretary of the Navy. Recreational hook-and-line fishing would be expected in the waters outside the NAVSTAGTMO boundary.

Chapter 4

Environmental Consequences

Impacts (consequence or effect) can be either beneficial or adverse, and can be either directly or indirectly caused by the action. Direct impacts are those effects that are caused by the action and occur at the same time and place (40 CFR 1508.8[a]). Indirect impacts are those effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). As discussed in this section, the No Action Alternative, as well as the Action Alternatives, may create temporary (lasting up to 48 hours), short-term (up to one year), or long-term (greater than one year) impacts or effects.

Whether an impact is significant depends on the context in which the impact occurs and the intensity of the impact. Impacts can vary in degree or magnitude from a slightly noticeable change to a total change in the environment. Significant impacts are those effects that would result in substantial changes to the environment (40 CFR 1508.27) and should receive the greatest attention in the decision-making process.

For the purpose of this analysis, the intensity of impacts would be classified as negligible, minor, moderate, or major. The intensity thresholds are defined as follows:

- **Negligible**: A resource would not be affected or the effects would be at or below the level of detection and changes would not be of any measurable or perceptible consequences.
- **Minor**: Effects on a resource would be detectable, although the effects would be localized, small, and of little consequence to the sustainability of the resource. Mitigation measures, if needed to offset adverse effects, would be simple and achievable.
- **Moderate**: Effects on a resource would be readily detectable, long-term, localized, and measureable. Mitigation measures, if needed to offset adverse effects, could be extensive and likely achievable.
- **Significant**: Effects on a resource would be obvious, long-term, and would have substantial consequences on a regional scale. Mitigation measures to offset the adverse effects would be required, extensive, and success of the mitigation measures would not be guaranteed.

The analysis of impacts associated with the SFOC installation activities additionally considered and evaluated applicable protective measures in the form of BMP’s that would be implemented to avoid or minimize environmental effects on the natural resources relevant to the SFOC installation activities. The following section describes and, where possible, quantifies the potential impacts associated with each alternative on the resources within the project area.

4.1 No Action Alternative

If the No Action alternative is selected, no environmental consequences associated with the GTMO-SFOC installation are anticipated. This would effectively result in none of the GTMO-SFOC project proceeding, since the basic submarine cable segment from NAVSTAGTMO at Guantanamo Bay, Cuba to the SFOMF at Dania Beach, Florida would not be constructed. Forward connectivity from NAVSTAGTMO with the CONUS would continue to operate with existing SATCOM capabilities.

4.2 Dania Beach, Florida: SFOC Onshore and Offshore (≤12NM)

4.2.1 Geology

Less than 0.5 acres of soils would be impacted during onshore burial of the cable and trenching within the SFOMF facility between existing cable trenches, the OGB and CLS. A National Pollutant Discharge Elimination System (NPDES) permit would not be required due to the small area of disturbance. With the implementation of a Stormwater Pollution Prevention Plan (associated with final CLS design and permitting), and associated BMP's, there would be minor, temporary impacts on terrestrial soils from the onshore cable installation activity.

4.2.1.1 Alternative 1

Impacts to geological resources in the nearshore and offshore from the installation of a surface laid cable under this alternative would be limited to the temporary disruption of sediment as the cable settles on the seafloor. The total extent of temporary disturbance from the direct cable impact footprint from the beach to the 3 nm extent of State Waters is approximately (0.065 acre). This was calculated as follows:

Cable diameter = 39 mm = 1.54 inches = 0.128 ft

0.128 ft x 19,682 ft = 2,519 sq ft = 0.065 acres

The direct cable impact footprint from the SFOMF beach shoreline to the 12 NM boundary, which is located 16.8 km from the mean high water line and demarcates the federal limit of NEPA, is approximately (0.162 acre). This was calculated as follows:

16.8 km = 55,167 ft x 0.128 ft (diameter of cable) = 7,061 sq ft = 0.162 acres

As discussed in Sections 3.1.1 and 3.1.2.1, the affected areas between the second and third reef tract and beyond the 60-m depth contour are of unconsolidated sediment out to the EEZ. The placement of the SFOC would result in short-term negligible impacts to surface sediments in the immediate vicinity of the SFOC, and there would be no significant impacts to marine geological resources. The installation of structures on the seafloor within 12 nm would require a Section 10 Rivers and Harbor Act permit from the USACE, which would be acquired prior to installation activities.

4.2.1.2 Alternative 2 (Preferred Alternative)

Impacts to geological resources in the nearshore and offshore from the installation of a surface laid cable under this alternative would be limited to the temporary disruption of sediment as the cable settles on the seafloor. The total extent of temporary disturbance from the direct cable impact footprint from the beach to the 3 nm extent of State Waters is approximately (0.058 acre). This was calculated as follows:

Cable diameter = 39 mm = 1.54 inches = 0.128 ft

0.128 ft x 19,888 ft = 2,545 sq ft = 0.058 acres

The direct cable impact footprint from the SFOMF beach shoreline to the EEZ boundary, which is located 16.8 km from the mean high water line and demarcates the federal limit of NEPA, is approximately (0.162 acre). This was calculated as follows:

16.8 km = 55,167 ft x 0.128 ft (diameter of cable) = 7,061 sq ft = 0.162 acres

As discussed in Sections 3.1.1 and 3.1.2.1, the affected areas between the second and third reef tract and beyond the 60-m depth contour are of unconsolidated sediment out to the EEZ. The placement of the SFOC would result in short-term negligible impacts to surface sediments in the immediate vicinity of the SFOC, and there would be no significant impacts to marine geological resources. The installation of structures on the seafloor within 12 nm would require a Section 10 Rivers and Harbor Act permit from the USACE, which would be acquired prior to installation activities.

4.2.2 Biological Resources

4.2.2.1 Coral and Hardbottom Habitat

Executive Order 13089 (Coral Reef Protection) requires all federal agencies whose actions may affect U.S. coral reef ecosystems to identify the actions that may harm coral reefs; utilize their programs and authorities to protect and enhance the ecosystems; and, to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. Based on coral surveys conducted for SFOMF (DON 2013a, **Appendix C**) and as described in Section 3.1.2.1, the submerged bottom within the proposed cable route consists of a variety of habitats including barren bottom and hardbottom habitat with an assortment of hard and soft corals. The proposed alternatives incorporate methods and procedures to minimize potential impacts of the nearshore SFOC installation on live coral and benthic resources.

For both alternatives considered, additional precautionary measures concerning the method of cable placement rely on floating the cable in across the reef track and using diver-assisted positioning and systematic release of the buoys resulting in a controlled release through the water column to avoid any damage to corals and hardbottom relief.

The proposed cable route also avoids all artificial reef sites. The nearest known artificial reef site is located approximately 182 m (600 ft.) north of the proposed cable corridor. Therefore no significant impact to artificial reefs is anticipated.

4.2.2.1.1 Alternative 1

For this alternative, the route would transit a new path through the reef tracks with a total length of approximately 1,616 m in mapped reef and hardbottom that would equate to 678 ft^2 (0.01 acre) of direct impact from the cable. This was calculated as follows:

Cable diameter = 39 mm = 1.54 inches = 0.128 ft

0.128 ft x 5,301 ft = 678.5 sq ft = 0.01 acres

4.2.2.1.2 Alternative 2 (Preferred Alternative)

Decision criteria used in the planning of the GTMO SFOC route was based upon recent permitting guidance regarding future cable installations at SFOMF, which require future cables, such as the GTMO SFOC, to be laid as close to existing cables as possible to minimize environmental impacts to the greatest extent. In concert with this permit mandate, the GTMO SFOC is proposed to be bundled to an existing cable (CS-125) that has already been reviewed, permitted and laid on the seafloor through the nearshore reef tracks and would presumably have the least impact on coral and hardbottom resources.

The total length of bundled CS-125 and proposed GTMO SFOC traverses the entire reef track for a distance of 1.6 km (5,482 ft.), in which the GTMO SFOC system will continue to run parallel to the CS-125 cable to a point 7.8 km (25,590 ft.) from shore, then diverge north along the deep ocean route.

Once the cable is diver-assisted on the seafloor it is attached to the existing cables, thereby anchoring the GTMO SFOC system to the seafloor and adding additional stability to the bundled cable system to further abate any potential secondary impacts from lateral cable movement.

4.2.2.2 Seagrass Habitat

Seagrass resources are only known to occur in the ICW and along the southern side of the Port Everglades inlet. No seagrass resources have been identified or are known to occur in the Atlantic Ocean within the vicinity or within the direct impact footprint of either alternative, thus the preferred alternative would have no effect, and therefore no significant impact on seagrass resources.

4.2.2.3 Threatened and Endangered Species

Summarized briefly below is a discussion of the listed species that may occur in the vicinity of the proposed nearshore alternatives. Readily available data sources, as well as the Navy's Draft Environmental Assessment for the Infrastructure and Maintenance Activities at the SFOMF (2013), were reviewed to determine if any protected species or their habitats occur within or adjacent to the project corridor for both considered alternatives.

4.2.2.3.1 Johnson's Seagrass

Johnson's seagrass is federally listed as threatened under the ESA. Critical Habitat for this species is designated in Palm Beach and Miami-Dade Counties, but has not been designated in Broward County. The nearest designated Critical Habitat area is approximately 10 miles to the south of the proposed project corridor in Biscayne Bay. No Johnson's seagrass has been documented in the Atlantic Ocean within the project vicinity or within the direct impact footprint of the proposed alternatives, therefore no impacts are anticipated.

4.2.2.3.2 Corals

The distribution and relative abundance of the currently listed coral species (staghorn coral, elkhorn coral, pillar coral, Caribbean star coral, mountainous star coral, boulder star coral, and rough cactus coral) were recently documented during an extensive in-water survey and reported in the *Benthic Habitat Characterization for the South Florida Ocean Measurement Facility* (SFOMF) – Protected Stony Corals Species Assessment (DON 2011; included in Appendix D). This effort was conducted for the Navy in accordance with NMFS recommended survey protocols (Williams et al. 2006). The protocol utilizes a two-tiered survey approach. The protocol recommends data collection at one sampling site per every 10,000 m^2 within the survey area. The Tier 1 survey is a rapid assessment of the site to locate any occurrences of federally listed coral species. The Tier 2 survey is a more comprehensive effort designed to provide greater detail on colony abundance, size, and condition. The location descriptions for all protected coral species listed in the following paragraphs is based on this 2011 survey effort.

Staghorn Coral

Staghorn coral can be found in southeast Florida coral reef habitats (Gilliam et al. 2011, Gilliam 2011). Habitat for staghorn coral occurs in and adjacent to the proposed project corridor in reef habitats at water depths less than 30 m (90 ft). Staghorn coral was identified within 45 of the 376 Tier 1 sites. A majority of these sites were within the nearshore habitats (colonized pavement-shallow, ridge-shallow, and inner linear reef) in depths less than 10 m (30 ft). Staghorn coral was found in all of the habitats surveyed except for the aggregated patch reef, which was generally located in depths greater than 20 m (60 ft). **Figure 22 and 23** depicts the identified staghorn coral location that occurs at one survey location (Station ID 60 and ID 41) in each Alternative (1 and 2 respectively), within 50 m of the proposed cable route.

Elkhorn Coral

Elkhorn coral is found in the U.S. from the Dry Tortugas up into the Florida reef tract northeast to Broward County (Jaap 2000). This species is typically found in water depths ranging from 0.5 to 5 m (2 to 15 ft.), with a maximum depth of 17 m (50 ft.) (Goreau and Wells 1967). Surveys of elkhorn coral were conducted at the same locations surveyed for staghorn coral. No elkhorn coral colonies were identified at any of the 376 Tier 1 sites during the survey effort. Therefore, because no elkhorn corals were identified in or adjacent to the proposed cable corridor, it is not anticipated that the project will impact this species.

Pillar Coral

Pillar coral occurs in waters throughout the Caribbean, the southern Gulf of Mexico, Florida, and the Bahamas. This species is relatively uncommon. It is typically observed in low abundances in shallow, well-circulated areas (Aronson et al. 2008b). Pillar coral is most commonly found in depths ranging from 3 to 8 m (9 to 25 ft) and up to 20 m (60 ft) (Goreau and Wells 1967). During the survey efforts pillar coral colonies were only identified at four (4) of the 376 Tier 1 sites and were only identified within the inner linear reef habitat. Pillar coral was not documented at any of the survey locations within 50 m of the Proposed Alternatives.

Caribbean Star Coral

Caribbean star coral occurs in the Caribbean, Gulf of Mexico, Florida, the Bahamas, and Bermuda. It can be found in depths from 0.5 to 82 m (2 to 250 ft) (Reed 1985), and is often most in the one to ten meter (3 to 33 ft) depth range, especially in semi-protected reef environments. Caribbean star coral colonies were identified at 85 of the 376 Tier 1 sites during the survey effort. A total of 14 sites supported more than five colonies of Caribbean star coral, and three sites in the middle linear reef habitat had more than 10 colonies identified. Caribbean star coral was not documented at any of the survey locations within Alternative 2, however two survey locations within Alternative 1 (**Figure 23** - Station ID 83 and 84) were identified within 50 m of the proposed cable route.

Mountainous Star Coral

Mountainous star coral occurs in the Caribbean, the Gulf of Mexico, Florida, and the Bahamas. Mountainous star coral is found at depths of 1 to 30 m (3 to 90 ft) in back-reef and fore-reef habitats, and is typically most abundant between the 10 to 20 m (30 to 60 ft) depth ranges in fore-reef environments. Mountainous star coral colonies were identified from 291 of the 376 Tier 1 sites during the survey effort. The middle reef supported the highest abundance of mountainous star coral. More than five colonies of mountainous star coral were identified in 180 sites, and 11 sites had more than 50 colonies identified. **Figure 22 and 23** depicts the identified mountainous star coral locations in relation to each Alternative.

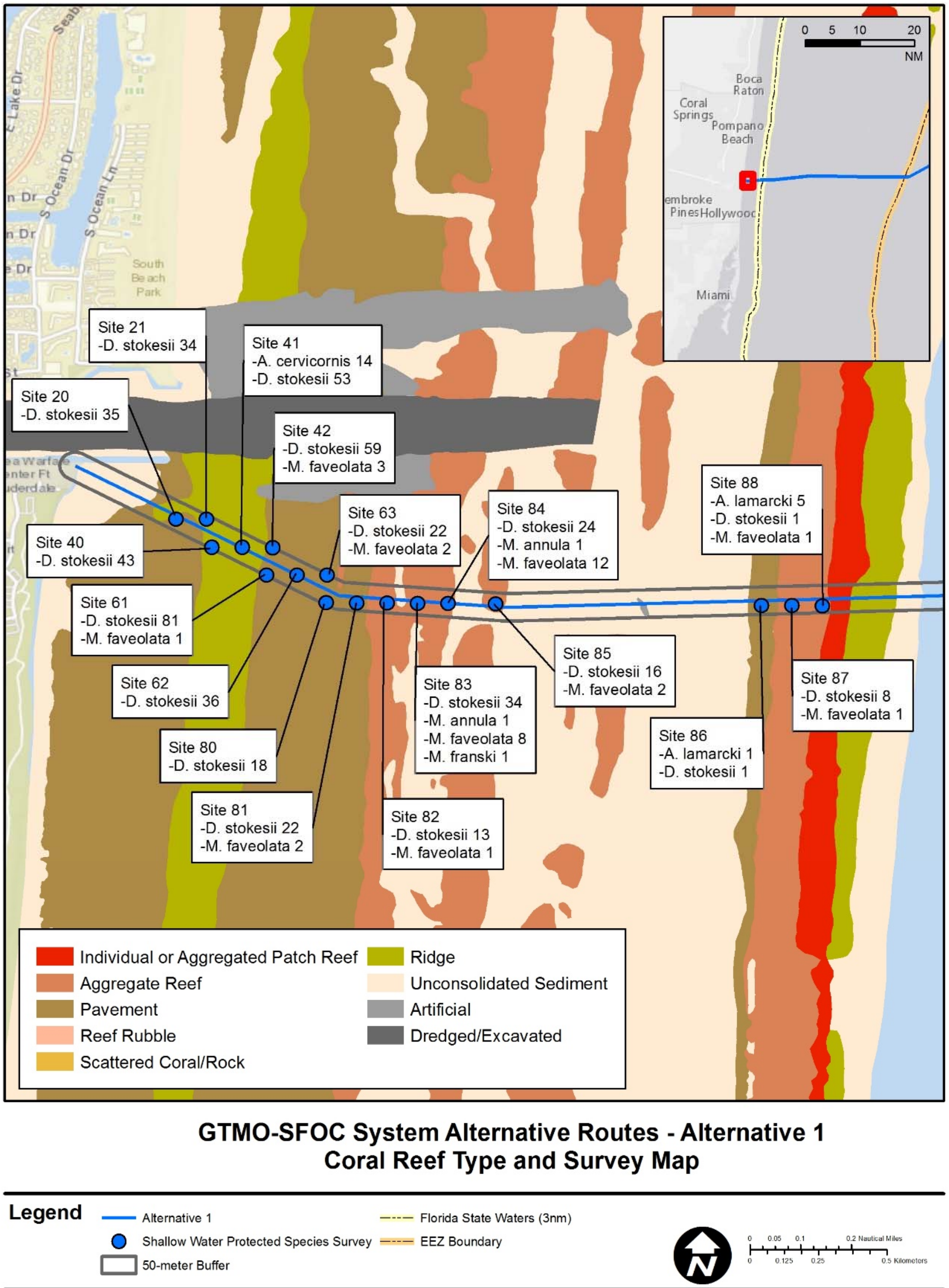

Figure 22 Alternative 1 Coral Reef Type and Survey Map

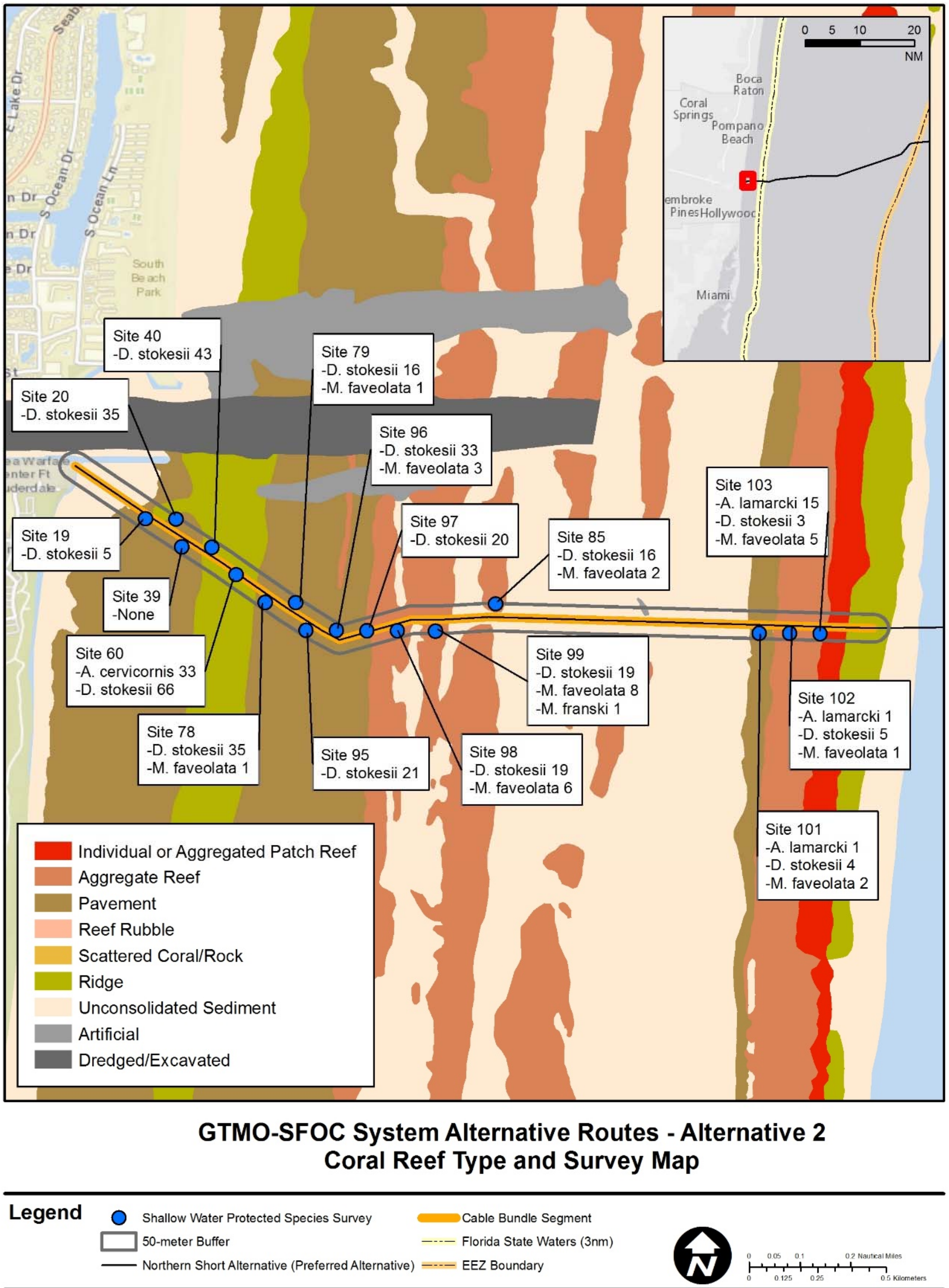

Figure 23 Alternative 2 Coral Reef Type and Survey Map

Boulder Star Coral

Boulder star coral occurs in the Caribbean, the Gulf of Mexico, Florida, the Bahamas, and Bermuda. It is infrequently found in very shallow water. Boulder star coral is typically found in water depths from 5 to 50 m (15 to 150 ft), and is typically most abundant between the 15 to 30 m (45 to 90 ft) depth range in fore-reef environments (Weil and Knowlton 1994, Szmant et al. 1997). Boulder star coral colonies were identified at only 74 of the 376 Tier 1 sites during the survey effort. Boulder star coral colonies were identified in all habitats except the ridge shallow habitat; more than five colonies of boulder star coral were identified in 15 sites, and the middle linear reef supported the highest abundance of colonies. **Figure 22 and 23** depicts the identified boulder star coral location that occurs at one survey location (Station ID 83 and ID 99) in each Alternative (1 and 2 respectively), within 50 m of the proposed cable route.

Rough Cactus Coral

Rough cactus coral occurs in the Caribbean, southern Gulf of Mexico, Florida, and the Bahamas. It is relatively common in fore-reef environments from 5 to 30 m (15 to 90 ft) water depths, but also occurs in low abundances in select deeper back-reef habitats and deep lagoons. The species is most abundant in water depths ranging from 10 to 20 m (30 to 60 ft). Rough cactus coral colonies were identified at 24 of the 376 Tier 1 sites during the survey effort. Rough cactus coral was not documented at any of the survey locations within 50 m of the proposed Alternatives.

Alternative 1

Based on the known distribution of the four identified ESA-listed corals to occur within the reef tracks off of Dania Beach, it can be presumed that some of these species occur within or proximal to the proposed cable route alternatives. For Alternative 1, this route is a new path through the reef tracks and it would be reasonable to presume that some ESA-listed corals occur within or proximal to the proposed alternative. However, given the limited occurrence and scattered distribution of known coral colonies within the cable route, the ESA-listed coral species likely account for a much smaller subset of individual species that could be present. This potential could be further lessened with diver-assisted cable placement, down to a safe diver depth of 20 m. Therefore, it is considered discountable that any colonies of ESA-listed corals would be affected by physical impacts due to the proposed cable installation.

Alternative 2 (Preferred Alternative)

For Alternative 2, this alternative will be bundled to the existing CS-125 cable that has already been permitted and laid on the seafloor through the reef tracks. Pursuant to the SFOMF's protocol for installing cable and permitting requirements, this cable route was recently installed and presumably clear of existing hard corals, reducing the likelihood of any ESA-listed corals occurring within the existing cable route. Therefore, it is considered discountable that any colonies of ESA-listed corals would be affected by physical impacts due to the proposed cable installation.

4.2.2.3.3 Marine Mammals

Most of the ESA protected marine mammals of the SFOMF offshore area do not have life history or feeding behavior requirements, other than migration, that would cause them to occur in close proximity of the GTMO SFOC installation. Where the West Indian manatee may utilize the near coastal waters of the SFOMF facility for migration, the lack of freshwater sources and seagrass beds within the SFOMF nearshore environment would not typically provide resting or foraging opportunities. Potential pathways of injury that are applicable to marine mammals during SFOC installation include:

• Physical disturbance and strike (stress or injury); and

• Entanglement (stress or injury).

Based on the estimated low densities and frequency of occurrence for marine mammals potentially occurring within the SFOMF OPAREAs (DON 2013c), the probability of a direct strike or entanglement is extremely low. When combined with the implementation of the SFOMF Protective Measures (Section 5.0), the likelihood of a direct physical impact (from vessels) or entanglement (from mooring lines or cables) on ESA-protected marine mammals resulting from a one-time SFOC installation would be avoided.

Based on the extremely slow speeds at which all vessels will be operating and modern cable laying practices, significant impacts to whales and dolphins are not anticipated as a result of the Proposed Action.

West Indian Manatee

The West Indian manatee is listed as endangered under the ESA. Both year-round and transient manatee populations occur in waters off of Broward County. Manatee occurrences have been documented on the Atlantic shoreline, as well as the entire length of the ICW, including waters bordering the SFOMF. A manatee sanctuary known as Whiskey Creek is located adjacent to the SFOMF site at John U. Lloyd Beach State Park. The nearest designated critical habitat area is approximately 10 miles to the south of the proposed project corridor in/around Golden Beach, near the southern border of Broward County. Seagrass is the primary food source for the manatee. The lack of seagrass resources within or adjacent to the proposed cable corridor will likely limit manatee utilization of the area. However, manatees will likely migrate through the area and could be present during construction. Therefore to prevent potential project-related impacts, during all in-water work, the contractor will commit to comply with the standard manatee protection construction conditions listed in the attached 2-page "Standard Manatee Conditions for In-Water Work, 2011" (**Appendix E**). Based on these commitments, no significant impact to manatees or designated critical habitat are anticipated.

4.2.2.3.4 Sea Turtles

Five sea turtle species occur along the Broward County coast: green, hawksbill, leatherback, loggerhead, and Kemp's ridley. All five species are protected under the ESA; hawksbill, Kemp's ridley, and leatherback sea turtles are classified as endangered, while loggerheads and green sea turtles are classified as threatened. NMFS and the USFWS share jurisdiction for sea turtles, with NMFS having jurisdiction for the conservation and recovery of sea turtles in the marine environment and USFWS for sea turtles on nesting beaches. The NMFS has designated critical habitat for the loggerhead sea turtle in the marine environment as it relates to their migratory pathway, which extends from the MHW line of the Proposed Action Area to 1.6 km seaward.

John U. Lloyd Beach State Park, located directly adjacent to and south of the proposed cable corridor, contains approximately 2.5 miles of undeveloped sandy beach that provides ideal sea turtle nesting habitat. Loggerhead, leatherback, and green sea turtles all have documented nest sites in the park in recent years. John U. Lloyd State Park is one of Broward County's designated survey areas where annual sea turtle nesting data are collected and reported. Therefore, it is possible that some or all of these species may nest on or adjacent to the proposed cable landing site. It is also likely that sea turtles utilize the reef and hardbottom habitats located within and adjacent to the proposed cable corridor and could be present during project construction. Therefore to prevent potential project-related impacts, during all in-water work, the contractor shall comply with NOAA's sea turtle construction conditions listed in the attached one (1) page "Sea Turtle and Smalltooth Sawfish Construction Conditions, 2006" (**Appendix F**).

Sea turtle nesting season spans from March 1 to October 31. Direct lighting of the beach and nearshore waters shall be limited to the immediate construction area during early (March 1 through April 30) and late (November 1 through November 30) nesting season and shall comply with safety requirements. No direct lighting of the beach and nearshore waters will be implemented during the remaining portion of the nesting season. Based on these commitments, no significant impacts to sea turtles or designated critical habitat are anticipated.

4.2.2.3.5 Fish

One federally listed endangered fish species, the smalltooth sawfish, occurs within nearshore waters off of Broward County. Cable laying within the nearshore would involve using buoys to float the cable in to shore using diver-assisted positioning and systematic release of the buoys for a controlled release through the water column. It is theoretically possible that smalltooth sawfish could be present in the Proposed Action Area, therefore to prevent potential project related impacts, during all in-water work, the contractor shall comply with NOAA's smalltooth sawfish construction conditions listed in the attached "Sea Turtle and Smalltooth Sawfish Construction Conditions, 2006" (Appendix F) and implementation of Protective Measures (Chapter 6) would also provide added protections. As such, direct and indirect effects on the smalltooth sawfish are considered negligible and discountable due to the habitat preference and infrequent exposure to a one-time surface lay of cable on the seafloor. Based on these commitments, no significant impacts to smalltooth sawfish are anticipated.

No Critical Habitat for the smalltooth sawfish is present near the Proposed Action Area. No further consideration of impacts on the Critical Habitat for smalltooth sawfish are included in this EA.

4.2.2.3.6 Birds

The John U. Lloyd Beach State Park and the surrounding waters are important areas for feeding, lofting, and roosting of several species of listed and migratory birds. The southeastern American kestrel, protected under the MBTA, has been observed in the vicinity of the proposed cable landing site. Other birds protected under the MBTA that are anticipated to occur near the project corridor include wading birds such as herons and egrets, coastal birds such as gulls, terns, plovers, and sandpipers, and other shorebirds.

It is not anticipated that the proposed project will impact any of the above-referenced federal-, state-listed, or bird species protected under the MBTA because the nearshore construction area (CLS) is relatively small (anticipated to be less than 0.5 acres) and habitat within and immediately adjacent to the nearshore construction area contains little vegetative cover and foraging potential compared to other portions of John U. Lloyd State Park. The project will not impact more than five acres of suitable wood stork foraging habitat, therefore no compensatory mitigation will be required for potential impacts to wood stork foraging habitat. Therefore, no significant impact to any of the above-referenced federal-, state-listed, or bird species protected under the MBTA is anticipated.

4.2.3 Essential Fish Habitat (EFH)

In considering the potential impacts of a Proposed Action on EFH, all designated EFH must be considered. The designated EFH within the project area includes nearshore benthic habitat, pelagic habitat, and coral reef habitat. The Proposed Action is designed and configured to avoid sensitive nearshore habitat entirely by utilizing established BMP measures developed by the Navy for the SFOMF. As described above, underwater construction would not adversely affect the coral reef ecosystem off SFOMF. The installation would avoid impacting live coral by co-locating the GTMO SFOC to existing SFOC cable through the reef track. Temporary and minor turbidity and sedimentation during installation would not affect the ability of EFH to support healthy fish populations. The Proposed Action would not adversely impact coral reef habitat or other EFH components. In the offshore water column EFH, the Proposed Action would have no effect and would entail temporary activity on the surface and in the water column during the installation. The activity would have no more than temporary and minimal impacts, and therefore would not adversely affect EFH.

The offshore water column habitat where the Proposed Action would occur is EFH. Under the provisions of the MSFCMA, as reauthorized by the Sustainable Fisheries Act Amendments, federal agencies must consult with NMFS prior to undertaking any actions that may adversely affect EFH. Federal agencies retain the discretion to determine what actions fall within the definition of "adverse affect." Temporary or minimal impacts, as defined in NMFS (50 CFR Part 600) regulations are not considered to "adversely affect" EFH. "Temporary impacts" are those that are limited in duration and that allow the particular environment to recover without measurable impact. "Minimal impacts" are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions. Relevant to EFH in the offshore area of installation (see **Table 8**), the Proposed Action would have no effect on EFH benthic habitats, and would entail temporary activity on the surface and in the water column during the installation. The activity clearly would have no more than temporary and minimal impacts, and therefore would have no adverse effect on EFH. Therefore, no consultation is required. No significant harm to EFH would occur.

Summarizing the above subsections, the Proposed Action would not result in significant harm to biological resources in the open ocean environment.

4.2.4 Cultural Resources

There are no historic properties listed on the National Register of Historic Places (NRHP) within one mile of the Proposed Action Area. The proposed cable route avoids the nearest known shipwreck by more than 100 meters (360 feet). Therefore no cultural resource impacts are anticipated.

4.2.5 Land and Water Use

Onshore, the Proposed Action is limited to the SFOMF installation boundary which has housed an active, continuously operating Navy test site over the last 40 years. SFOMF continues to support various RDT&E program requirements and also supports a variety of communications equipment essential to the DISN.

The Proposed Action qualifies for a 'Consent by Rule' authorization to use state-owned submerged lands under Florida Department of Environmental Protection (FDEP) Rule 18-21.005(1)(b)1 through 5, F.A.C. The proposed project is a federally-funded project conducted for the purposes stated in 43 USC 1311(d) and 1314 that enhances national defense and international affairs. This project does not include the use of sovereignty submerged lands for other purposes, such as placement of spoil on state sovereignty submerged lands or non-water dependent activities.

The Navy began coordination with the FDEP Coastal Construction Control Line (CCCL) Program Administration Division in March 2014. Tony McNeal, FDEP's CCCL Program Administrator approved the location of the proposed building structure in June 2014. A copy of the correspondence authorizing this is provided in **Appendix G**.

DISA's Proposed Action of installing a one-time SFOC is a routine action that has been found over decades of time to not have significant effects on the natural or human environment, individually or cumulatively, under normal circumstances. The location of the Proposed Action is consistent with the historical work at SFOMF; therefore there will be no change in land use and no significant impact would occur.

4.3 Guantanamo Bay, Cuba: SFOC Onshore and Offshore (≤12NM)

4.3.1 Geology

Within the offshore portion of the project, the cable will laid upon the surface of the seafloor. Only minor disturbances to surface sediments would be expected. Within the onshore portion of the project, only minor disturbances to the near-surface geology will result from the construction of a new beach manhole, beach cable anchor, and two 152-mm (6-inch) conduits, including concrete casing, that will be installed approximately 0.61 m (2 ft.) below ground surface between the beach landing site and an existing manhole located beyond the top of the slope. Likewise, the construction of the CLS and the associated installation of conduits that will connect the CLS to the adjacent and existing beach manhole will only result in minor surface disturbances to approximately 0.61 m (2 ft.) below ground surface. Based on the limited disturbance to the surface geology from both the onshore and offshore portions of the project, no significant impacts to geological resources are anticipated as a result of the Proposed Action.

4.3.2 Biological Resources

4.3.2.1 Coral Habitat

A fringing reef is present within the cable route at the Glass Beach landing site. This reef is located in the immediate nearshore environment and does not appear to extend beyond 50 m from shore based on information presented in DON 2014. A much deeper (up to 130 m) fringing reef system is also present near the mouth of Guantanamo Bay and is contiguous with nearshore fringing reefs along the windward and leeward Caribbean coasts. Coral species comprising these reefs may include a variety of soft and stony corals including federally listed species.

The cable installation contractor has determined that the cable laying vessel (*IT Intrepid*) will be able to safely come within 0.5 km (0.54 nm) from the beach landing point. The *Intrepid's* deepest draft is approximately 7 m (23 ft.) and the charted water depth 0.5 km (0.54 nm) from the beach is 24 m (79 ft.). The deepest occurrence of coral reef off the beach landing point is in the immediate nearshore environment in approximately 3-5 m (10-16 ft.) water depth (DON 2014, NOAA, Roca and Sedaghatkish 1998). Therefore, no direct coral impacts from the *Intrepid* would occur.

The *Intrepid* would maintain its offshore position through DP. The WG II will be launched to conduct a trial run to shore and provide divers with small mooring anchors for the WG II to secure to during shore landing. These mooring anchor locations will have been identified during the shallow water survey, which, at the time of writing of this document, is currently being conducted to identify mooring locations and a cable path along the seafloor that is devoid of coral resources and other obstructions. Following the trial run and placement of mooring anchors, the WG II will be loaded with the necessary amount of cable which will be pulled to the beach mooring position where she will moor-up with the assistance of the *Intrepid's* RHIB. The WG II and RHIB have a 101.6 mm (4 in.) draft and 0.53 m (1.74 ft.) draft, respectively. Given the shallow draft of both of these vessels and normal precautionary measures that will be taken by the captains operating these vessels to avoid collisions with underwater obstructions, neither vessel would be expected to impact any coral.

The purpose of the currently ongoing shallow water survey is to select a refined cable route and mooring locations for the WG II that avoids coral reefs. Preliminary survey results identified two coral platforms within the nearshore approach from Glass Beach; the cable route will be located between these two platforms to avoid all potential impacts from the cable installation. Based on these avoidance measures, no significant impacts to these nearshore coral reefs are anticipated as a result of the Proposed Action. It should also be noted that this cable will be laid adjacent to existing fuel and water utility pipelines that already traverse the reef in this area.

The coral reef located in deeper water (up to 130 m) near the mouth of the bay is beyond the safe diver depth of 20 m (65 ft.); therefore, diver-assisted placement will not be possible here. Since only minor, localized impacts from the cable would be anticipated, these would not reach the threshold of significance. Therefore, no significant impacts to the deepwater coral reefs are anticipated as a result of the Proposed Action.

4.3.2.2 Seagrass Habitat

Within the cable footprint, seagrass beds extend seaward approximately 195 m from shore to a depth of approximately 5 m (16 ft.) (DON 2014, NOAA). Based on seagrass bed boundary information presented in DON 2014, it is estimated that the cable will traverse approximately 135 m (443 ft.) cumulatively of discontinuous seagrass bed habitat

According to Geo-Marine, Inc. 2006, 434 hectares (ha) (1,072 acres) of seagrass beds occur throughout NAVSTAGTMO. These areas are important nursery grounds for many species of fish and serve as primary food sources for both green sea turtles and manatees. Given the overall large area of seagrass coverage throughout NAVSTAGTMO relative to the area that will be preempted by the cable, no significant impacts to seagrass resources are anticipated as a result of the Proposed Action.

4.3.2.3 Threatened and Endangered Species

4.3.2.3.1 Corals

Based on a review of best available information for coral species occurrence in and around the waters of NAVSTAGTMO, it can be presumed that any of the federally listed coral species occur or have the potential to occur within the nearshore reef at Glass Beach. Given the shallow drafts of the vessels that will be involved in the shore ending of the cable and the measures that will be implemented to avoid placing either mooring anchors or the cable on nearshore coral reefs, no significant impacts to federally listed coral species in the nearshore reef are anticipated as a result of the Proposed Action.

All of the federally listed coral species, with the exception of elkhorn coral and pillar coral, have the potential to occur within the deeper escarpment/fore-reef slope based on documented depth ranges of these species (Humann and DeLoach 1992). However, these species are more likely to occur in shallower waters less than 30 m (98 ft.) deep (Humann and DeLoach 2002, Aronson et al. 2008). If any of these species were present within the deeper portion of the cable route, the effect of laying a 0.39 mm (1.5 in.) cable on or adjacent to the coral would be considered a minor and localized effect not reaching the threshold of a significant impact. Therefore, no significant impacts to federally listed coral species in the deeper escarpment/fore-reef slope would be anticipated as a result of the Proposed Action.

4.3.2.3.2 Marine Mammals

Whales and Dolphins

All whales and dolphins listed in **Table 10** have the potential to occur within the project area to varying degrees based on seasonality and depth-related habitat preferences. During a July 11, 2014 site visit to the NAVSTAGTMO cable landing site, NAVSTAGTMO personnel informed the installation contractor that dolphins and whales (and manatees) are frequent visitors to the area. Given their documented occurrence in the area, it will be especially important for personnel on all vessels involved in the cable lay operation to be aware of their presence both in deep offshore waters and shallower nearshore waters.

In general, whales and dolphins are highly motile species that are capable of avoiding slow-moving watercraft and are known to generally engage in avoidance behavior when surface vessels move towards them (Wursig et al. 1998; Nowacek 2004). During cable laying operations, the *Intrepid* operates at a maximum speed of 7.4 km/hr in deeper waters and will be moving extremely slow as it enters the mouth of Guantanamo Bay up to the point that it maintains its position 0.5 km (0.54 NM) offshore of the landing site. The WG II will be operating at a maximum speed of 2-3 km/hr and the support RHIB shall operate at similar speeds. At these speeds, it is reasonable to assume that both whales and dolphins would engage in avoidance behavior thereby reducing the possibility of a ship strike to negligible levels. Furthermore, the captains of all vessels would be expected to engage in routine forward-looking observation practices that are intended to prevent collisions with marine mammals or other obstructions.

The other direct impact pathway to consider is entanglement with the submarine cable as it is being laid. Entanglement of marine mammals with submarine cables came to the fore in papers by Bruce Heezen in 1957 and 1969 (Heezen 1957; Heezen and Johnson 1969). Using available cable company records, he documented 16 cable disruptions by sperm whales, between 1877-8 and 1960. Since that time, there have been no mammal entanglements recorded in either the mainstream scientific literature or available cable-fault databases. While reasons for this change remain uncertain, markedly lowered incidences of entanglement coincide with improved cable design and laying practices, which allow cables to be laid without loops and with minimal suspensions.

Based on the extremely slow speeds at which all vessels will be operating and modern cable laying practices, significant impacts to whales and dolphins are not anticipated as a result of the Proposed Action.

West Indian Manatee

Manatees have been sighted off of Glass Beach and are known to occur throughout NAVSTAGTMO year-round (Geo-Marine, Inc. 2006, DON 2014). Certain areas including the Windward channels off the main bay, the entire leeward shoreline extending 137 m (449 ft) from shore (this area is designated as the Manatee Conservation Zone), the St. Nicholas channel, Mahomilla Bay, and the Guantanamo River are noted areas of high manatee use. Manatees may also move across deep waters between Haiti, Jamaica, and Cuba; therefore, manatees may also be found in offshore waters (Geo-Marine, Inc. 2006).

The greatest risk that the Proposed Action poses to manatees is injury or death that could occur as a result of a collision with a vessel involved in the cable lay operation, including shore-ending. In Florida, approximately 25 to 35 percent of manatee deaths statewide are attributed to watercraft (FWC 2014). In 1999, a manatee stranding (fatality) near Conde Beach in Guantanamo Bay was attributed to a boat collision (Geo-Marine, Inc. 2006).

The vessels involved in the cable lay operation move at extremely low speeds. The Intrepid lays cable at a maximum speed of 7.4 km/hr and the WG II will be operating at a maximum speed of 2-3 km/hr. To avoid potential project-related impacts, the contractor will commit to comply with the standard manatee protection construction conditions listed in the attached “Standard Manatee Conditions for In-Water Work, 2011” (**Appendix E**) during all in-water work. Based on the slow speeds at which the cable laying vessels operate and the application of standard manatee construction conditions during all in-water work, no significant impacts to manatees are anticipated as a result of the Proposed Action.

Sea Turtles

Four species of sea turtles, the green, hawksbill, leatherback, and loggerhead, are regularly encountered in the waters around NAVSTAGTMO (DON 2014). As discussed previously, the cable landing site does not provide suitable nesting habitat for any species of sea turtle. In addition, no known sea turtle nesting beaches are located on the windward side of Guantanamo Bay (DON 2014). However, sea turtles, particularly hawksbill and green turtles, may utilize the seagrass beds and nearshore coral reefs located within the project area. The primary potential direct impact would be a strike from a vessel involved in the cable laying operation. However, this is unlikely for the following reasons: these species are highly motile, the *Intrepid* will be stationed well offshore of these resources, the WG II will be operating at a relatively slow speed of 2-3 km/hr. during cable laying operations, and the installation contractor shall commit to comply with NOAA’s sea turtle protection construction conditions listed in the attached “Sea Turtle and Smalltooth Sawfish Construction Conditions, 2006” (**Appendix F**). It is also reasonable to assume that sea turtles would leave or avoid the area during cable laying operations. Based on consideration of these factors and the implementation of sea turtle protection construction conditions, no significant impacts to sea turtles are anticipated as a result of the Proposed Action.

Birds

Based on known habitat requirements and available geographic distribution information, no threatened or endangered bird species are anticipated at the beach landing site or the terrestrial portion of the project beyond the top of the slope. It is possible, however, that common coastal birds such as gulls and terns protected under the MBTA may be present in the general area. If these birds are present in the area prior to commencement of construction activities, it is reasonable to assume they would avoid the area. Wading birds would not be anticipated given the large boulders and other obstructions (pipes) present at the beach landing site which would preclude utilization by wading birds. In general, the beach landing site and the areas located beyond the top of the slope are very disturbed relative to their historical natural condition. Based on the factors presented here, no significant impacts to threatened or endangered birds or those protected under the MBTA are anticipated as a result of the Proposed Action.

Mammals (terrestrial)

The only listed mammal with potential to occur within or near the project area is the Cuban hutia. This species population is currently managed in accordance with the management goals in NAVSTAGTMO's Integrated Natural Resource Management Plan (INRMP). It is unlikely that the Proposed Action would have any effect on this species as it would likely avoid the area during construction. Therefore, no significant impacts to this species are anticipated as a result of the Proposed Action.

4.3.3 Cultural Resources

Cultural resources are not known to occur within the project area. Therefore, no significant impacts will occur as a result of the Proposed Action.

4.3.4 Land and Water Use

Much of the offshore portion of the project is within Guantanamo Bay Naval Base Boundary, which includes the Guantanamo Bay Naval Defensive Area and Naval Airspace Reservation. Public vessels are generally not allowed in this area. Seaward of this zone and within the project area, limited hook and line fishing may occur. Nearshore, personnel on NAVSTAGTMO may use the area in the vicinity of Glass Beach for recreational purposes such as diving. Overall, the Proposed Action is consistent with ongoing uses at the beach landing site and within the NAVSTAGTMO boundary, therefore, no significant changes to land use or water use are anticipated.

Chapter 5

Cumulative Impacts

This section of the EA addresses the potential cumulative impacts associated with the alternatives and other past, present, or future projects planned for the area under study. The CEQ defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time by various agencies or individuals. Cumulative impact analyses inform decision making through consideration of cumulative impacts resulting from projects that are proposed, under construction, recently completed, or anticipated to be planned in the reasonably foreseeable future.

This cumulative impacts analysis summarizes expected environmental consequences from the combined impacts of past, current, and reasonably foreseeable future projects within or near the study area which have the potential to interact with the Proposed Action. The scope of the analysis is limited to those past, present, or reasonably foreseeable future projects, located in the same geographic area and which have the potential to affect the same ecological resources, with respect to both space and time, as the Proposed Action.

The SFOMF EA/ Draft Overseas Environmental Assessment (OEA) (DON 2013b) provides an up-to-date and comprehensive cumulative effects analysis for the Preferred Alternative (under the SFOMF EA/OEA) along with past, present, and reasonably foreseeable future projects located within or near the SFOMF EA/OEA Study Area (**Figure 2**), which encompasses the portions of the study area under this EA subject to NEPA. A summary of the SFOMF EA/OEA Preferred Alternative and associated cumulative impacts summary is discussed below in order to provide rationale for its use as the basis for the cumulative effects analysis provided in this EA.

The Preferred Alternative under the SFOMF EA/OEA provides an increase in the future infrastructure and maintenance systems capability of SFOMF to support the Navy's testing and training. Specifically, the Preferred Alternative provides for a 30 to 50 percent (estimated average) increase (over current baseline level) in the infrastructure and maintenance activities, along with the addition of new required infrastructure that will provide SFOMF with greater project diversity and capability. Permanent underwater assets currently in place within the SFOMF Study Area include, but are not limited to, over 130,000 m of cable, tracking sensors used to track submerged targets while conducting testing, sensors that measure the electromagnetic signature of a submarine, and a passive acoustic sensor array used to obtain detailed acoustic signature data. SFOMF additionally operates undersea ROV's and a variety of underwater sensors, instrumentation, and floating sensors in support of the RDT&E and training activities. The Preferred Alternative under the SFOMF EA/OEA supports the annual deployment and maintenance of approximately (estimated average) 520 sensors, 640 targets, 20 buoys, and their associated mooring structures across all OPAREAs within the SFOMF Study Area. In addition, approximately 0.15 km, 53 km, and 18 km of cable are estimated for installation or repair annually within the Shore Base, Restricted, and Shallow OPAREAs, respectively.

A summary of natural resource impact level of significance determinations associated with the Preferred Alternative (under the SFOMF EA/OEA) within territorial waters, as mitigated with the Protective Measures (as proposed under the SFOMF EA/OEA), and that are applicable to the natural resources analyzed under this EA, is provided below. Those Protective Measures proposed under the SFOMF EA/OEA to minimize environmental impacts associated with cable deployment activities have been adopted as Protective Measures under this EA (Section 6.0).

Terrestrial Soils – Minor and temporary (insignificant) impacts

Marine Sediments – Localized and temporary negligible impacts

Biological Resources – Short-term and long-term, negligible to minor impacts

Hardbottom Areas and Coral Communities – Short-term and long-term, negligible to minor impacts

Threatened, Endangered, and Candidate Corals – Potential negligible effects would not result in adverse impacts or jeopardize the continued existence of any species.

Seagrasses – No involvement (seagrasses do not exist within the Study Area)

Artificial Reefs – No significant impacts

Fishes – Negligible impacts

Threatened, Endangered, and Candidate Fishes – Would not jeopardize the continued existence of the federally listed smalltooth sawfish or any of the federal candidate fish species

Essential Fish Habitat – Negligible, minor, discountable, and temporary impacts

Birds – No significant impacts

Federally-Listed Birds – Would not jeopardize the continued existence of any species

Marine Mammals and Sea Turtles – Insignificant impacts that would not jeopardize the continued existence of any species

Cultural Resource – No significant impacts

The past, present, and reasonably foreseeable future projects analyzed under the SFOMF EA/OEA included the Atlantic Fleet Training and Testing (AFTT) Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) (DON 2013c), Florida Atlantic University's proposed energy generating technologies utilizing/transferring wave or current energy into usable power, Port Everglades inlet maintenance (widening and dredging), and Broward County beach renourishment activities. The SFOMF EA/OEA determined that cumulative impacts resulting from the activities proposed under the Preferred Alternative combined with the past, present, and reasonably foreseeable future projects would be less than significant as long as applicable Protective Measures implemented by SFOMF are employed by these projects to avoid and minimize natural resource impacts.

The Preferred Alternative analyzed under this EA, within territorial waters, includes bundling the GTMO SFOC to an existing cable (CS-125) within a previously-permitted cable corridor where coral impacts have already been mitigated through relocation. Using an established cable route is a significant avoidance and minimization measure that was made part of the Protective Measures for both the SFOMF EA/OEA and this project. Considering the much larger scale of activities, both in time and space, analyzed under the SFOMF EA/OEA, including 71.15 km of cable to be installed or repaired annually within the OPAREAs, and a cumulative impacts determination of less than significant with the implementation of Protective Measures by both SFOMF and other agency/organization projects, it is reasonable to determine that installation of the GTMO SFOC system, with implementation of Protective Measures (Chapter 6) would result in insignificant cumulative impacts.

Chapter 6

Protective Measures

The proposed GTMO SFOC system will be installed in existing nearshore corridors that already contain numerous submerged cables and connect to existing naval facilities at each shore-end segment. The GTMO SFOC is proposed to be bundled to an existing cable (CS-125) that has already been reviewed, permitted and laid on the seafloor through the nearshore reef tracks and would have the least impact on coral and hardbottom resources. Adherence to the 16-page "Laying Seafloor Cable Using Best Management Practices" document provided in **Appendix B** shall minimize the potential for unanticipated impacts to protected resources and water quality.

In addition, to further minimize potential impacts to corals, all corals located directly within the proposed cable route footprint and within the safe diving depth zone [maximum water depth of 65 ft. (20 m)] shall be relocated. Any potentially impacted corals, hard corals, octocorals, and sponges greater than 15 centimeters in diameter shall be re-attached to the surrounding reef a safe distance from the cable project.

The following Protective Measures have been developed from BMP's, Standard Operating Procedures (SOP's) and negotiated permit conditions originally derived from historic SFOMF cable installations. These Protective Measures focus on the in-water and shore-based activities to ensure that potential effects on terrestrial and marine resources, both biological and physical, are avoided and/or minimized to the maximum extent practicable. The SFOMF Protective Measures also references supplemental BMPs from the Best Management Practices (BMPs) for Construction, Dredge, and Fill and Other Activities Adjacent to Coral Reefs (Post, Buckley, Schuh and Jernigan [PBS&J] 2008), the NMFS Final EFH Assessment Letter for the USWTR EIS (DON 2009b), the Atlantic Fleet Training and Testing EIS/OEIS (DON 2012e), the NSWC-Panama City EIS/OEIS (DON 2009), and a series of current (2011 - 2013) Federal, state, and county permits currently supporting cable installations at SFOMF.

These Protective Measures have been adopted and incorporated into the environmental consequence analyses for the GTMO SFOC installation activities on biological and physical resources. Specific Protective Measure actions for corals, marine mammals, sea turtles, fishes, etc., have been further detailed in Chapter 4 to demonstrate the appropriateness of these actions to avoid and/or minimize to the maximum extent practicable adverse impacts and thus to provide greater species and habitat protection.

The DISA has identified in advance the proposed cable installation route that will minimize the required cable path and length of cable deployment. As necessary, the DISA's installation contractor will perform a pre-installation survey for submerged resources in order to determine a path of minimum impact. As appropriate, the following practices will be implemented to minimize impacts for specific situations (Italicized items indicate the measure will be implemented at both Dania Beach <u>and</u> Guantanamo Bay, otherwise these measure pertain to Dania Beach only.

Nearshore Cable Route Planning

- *Use of established cable and pipeline routes and corridors will be considered in order to reduce the potential for unnecessary contact with previously undisturbed coral, coral reef, and other living hardbottom EFH and HAPC communities.*

- Previous permit guidance FDEP Environmental Resource Permit (ERP); 06-0307167-001; 08-19-11) states that future cable installations in less than 27.5 m of water depth will be co-located with and affixed to existing cables when this would result in minimizing impacts. Beyond 27.5 m of water depth, cables will be laid as close to existing cables as possible when this would result in minimizing impacts. The proposed GTMO SFOC installation footprint was pre-selected based on several previous environmental planning assessments of the area and is designed to be bundled to existing cables to the greatest extent possible to meet this permit mandate.

- *Identify the location of important biological and physical features, such as biogenic reef formations and shipwrecks, prior to planning a cable installation. Knowledge of the presence of these features would allow for their avoidance to the maximum extent practicable.*

- *Cable path and overall deployment length has been minimized to reduce the potential for contact with coral, coral reef, and other living hardbottom EFH and HAPC communities.*

Marine Monitors/Look-outs

- Trained marine lookout surveyor(s) will be on site, and in constant communication with operations personnel.

- Lookout surveyor(s) would observe for the presence of protected marine species (marine mammals and sea turtles) and advise the *Intrepid*'s Captain of potential encounters in order to prevent entanglement or ship strike.

- Lookout surveyor(s) would observe for *Sargassum* mats, as well as inform the *Intrepid*'s Captain, to facilitate avoiding the mats to the maximum extent practicable.

- The *Intrepid*, as well as all support vessels, will operate at slow speed with minimum wake to further prevent potential strikes of protected marine species (sea turtles and marine mammals).

- Vessels will not activate any acoustic sources other than the required shipboard depth finders.

<u>Vessel Operation</u>

- *The primary cable deployment vessel will hold a relatively fixed position in the operating area using a dynamic positioning system.*

- *Vessel movement and drift will be minimized to ensure that the proposed cable installation plan is followed with limited deviation.*

- *Construction work vessels will be prohibited from anchoring or spudding over coral, coral reef, and hardbottom habitat (NMFS-EFH Conservation Recommendations and USACE-Special Conditions; SAJ-2011-01555; 07-05-11).*

- All watercraft associated with the construction and use of the permitted structures will only operate within waters of sufficient depth so as to preclude bottom scouring or prop dredging. Specifically, there will be a minimum of 1.5 m (5 ft.) of clearance between the deepest draft of the vessel (with the motor in the down position) and the bottom substrate at mean low water.

- *Operations will only be conducted when sea and wind conditions allow the vessels to maintain maximum position and speed control.*

<u>Nearshore Cable Installation</u>

- Cable installation would use a surface deployment procedure that attaches flotation buoys (also serving as markers) while paying out the cable shoreward using a small craft and divers as the cable remains tethered to the surface “lay” ship.

- During installation, cables will be guided into place (NMFS-EFH Conservation Recommendations; SAJ-2011-01555; 07-05-11). Divers will ensure that a precision cable installation is performed within safe diving limits [maximum water depth of 20 m (65 ft.)].

- Divers will release the buoys to control the lowering of the cable through the water column and ensure that the proposed cable installation plan is followed with limited deviation.

- *Diver-assisted cable placement with sufficient slack will be used to provide a precise placement and location of the cables in order to avoid individual coral and other living hardbottom items of significant relief (10 cm).*

- The GTMO SFOC will be bundled to an existing cable (CS-125) at the Dania Beach shore end landing through the nearshore reef tracks. Once attached to the existing cables, the GTMO SFOC will add additional stability to the bundled cable systems to further abate any potential secondary impacts from lateral cable movement.

- *The cable route selected will avoid and minimize new impacts on coral, coral reef, and hardbottom habitats to the maximum extent practicable (NMFS EFH Conservation Recommendations; SAJ-2011-01555; 07-05-11).*

- *Avoidance strategies, such as cable route realignment, will take precedence when any federally or state protected corals occur in a potential path of impact.*

- *Divers will perform a "post-lay" swim of the cable route with video to verify the position and security of the cable within safe diving limits [maximum water depth of 20 m (65 ft.)].*

- No structure or work will adversely affect or disturb properties listed in the NRHP or eligible for inclusion in the NRHP based on recent environmental planning studies for SFOMF.

- *If unexpected cultural resources are encountered at any time within the Study Area that were not subject of a previous cultural resources assessment survey, work should cease in the immediate vicinity of such discoveries (USACE-Special Conditions; SAJ-2011-01555; 07-15-11).*

- *If unmarked human remains are encountered, all work will stop immediately, and the proper authorities will be notified (USACE-Special Conditions; SAJ-2011-01555; 07-15-11).*

- *Activities will comply with the "Standard Manatee Conditions for In-Water Work – 2011" (USACE-Special Conditions; SAJ-2011-01555; 07-15-11).*

- *Activities will comply with NMFS' "Sea Turtle and Smalltooth Sawfish Construction Conditions" dated March 26, 2006 (USACE-Special Conditions; SAJ-2011-01555; 07-15-11).*

- *No explosive devices will be utilized during cable installation activities.*

- *No toxic substances will be introduced to the land, beach, or ocean environment during cable installation activities.*

<u>On-Shore Cable Installation during Sea Turtle Nesting Season</u>

- To the maximum extent practicable, cable installations would avoid the Broward County, Florida, sea turtle nesting season. Sea turtle nesting season typically begins in early March for leatherbacks, April for loggerheads, and May/June for greens. Nesting continues through September, with the peak season for loggerheads typically in June/July.

- Schedule modifications for on-shore cable installations will be considered to avoid impacts on sea turtle nesting and hatching activities.

- All installation activities will take place during daylight hours at Dania Beach (USACE-*Special Conditions*; SAJ-2011-01555; 08-23-11).

- There will be no lighting on the beach that could impact sea turtles at Dania Beach.

- A sea turtle permit holder from the John U. Lloyd Beach State Park will be present during all on-shore cable installation activities at Dania Beach (USACE-*Special Conditions*; SAJ-2011-01555; 08-23-11).

- Daily consultations and inspections by John U. Lloyd Beach State Park officials will be coordinated and conducted during cable installation activities requiring beach area activities at Dania Beach.

- Morning sea turtle nesting surveys must be completed and all nests must be marked within the project area prior to commencement of any work at Dania Beach (USACE-*Special Conditions*; SAJ-2011-01555; 08-23-11).

- A 10-foot buffer will be created around each marked and unmarked nest at Dania Beach (USACE-*Special Conditions*; SAJ-2011-01555; 08-23-11).

- If any nests deposited in the project area (Dania Beach) are close to their emergence date, monitors must be present to make sure no hatchlings are impacted during their migration to the ocean (USACE-*Special Conditions*; SAJ-2011-01555; 08-23-11).

- If a nest is identified within the direct impact area of the on-shore construction area at Dania Beach, standard procedures for sea turtle nest relocation will be considered if impacts to the nest are unavoidable.

- In the event a turtle or nest is found, activities will cease until the turtle is no longer observed in the area for at least 5 minutes or until the nest has been relocated.

Chapter 7

Listing of Agencies and Persons Consulted

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Chapter 8

Public Noticing

NEPA processes require that Federal agencies public involvement in their project planning, as stipulated in 40 CFR Part 1503. Additionally, Section 1507.3 CEQ regulations directs that Federal agencies shall, as necessary, adopt procedures to supplement the CEQ regulations. To that extent, 32 CFR Part 188 – Environmental Effects in the United States of DoD Actions, Enclosure 1.C(3) – Public participation stipulates that DoD components shall involve environmental agencies, applicants, and the public, to the extent practicable, in preparing environmental assessments. In determining “to the extent practicable,” factors that may be considered include: (a) magnitude of the proposal, (b) likelihood of public interest, (c) need to act quickly, and (d) national security classification issues.

In reference to 32 CFR Part 188 1.C(4) – Finding of No Significant Impact, if a DoD component determines on the basis of the environmental assessment not to prepare an environmental impact statement, the DoD component shall prepare a finding of no significant impact in accordance with CEQ 1501.4(e) and make the finding of no significant impact available to the affected public as specified in CEQ 1501.4(e) and CEQ 1506.6.

To that extent, publication of the Final EA and signed FONSI will be included in the Federal Register and available upon request by contacting the DISA PAO Office at DISA headquarters located at:

DISA Public Affairs Office
P.O Box 549
Fort Meade, Maryland 20755-0549

Additionally, notice and coordination will be made available through the State of Florida Clearinghouses as part of the state’s ERP process.

Chapter 9

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Chapter 10

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Appendix A

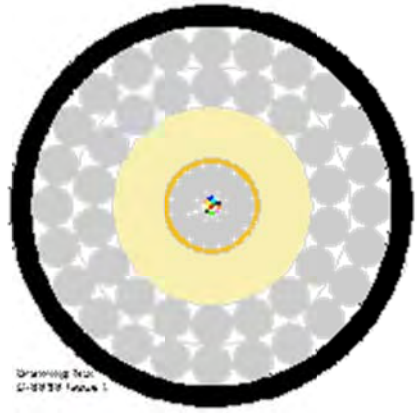
Cable Specifications

Submarine Optical-Fiber Cable
ROC-2 DA3.6_3.6

Document no.:	TF666-TD

Unit content:

Single-mode fibers	1-12 Off



Material description :	Gn-QYVA-ø2.45-R3.6/3.6	Material no.:	

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Nexans

Nexans Norway AS, P.O. Box 6450 Etterstad, N-0605 Oslo, Norway

1.1.1.3.1 Design details

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1.1.1.3.2 Physical Characteristics

Physical characteristics	Unit	Nominal value	±
Cable core diameter	mm	18	1
Cable outer diameter	mm	39	1.5
Weight in air, equivalent to a mass of	kg/m	4.4	0.2
Weight in seawater, equivalent to a mass of	kg/m	3.3	0.1
Maximum Deployment Ocean Depth	m	1500	-
Hydrostatic Pressure Resistance	Bar	800	-
Cable Breaking Load	kN	550	-
Nominal Transient Tensile Strength, NTTS	kN	350	-
Nominal Operating Tensile Strength, NOTS	kN	200	-
Nominal Permanent Tensile Strength, NPTS	kN	140	-
Minimum Bending Radius, tensioned	m	1.5	-
Minimum Bending Radius, handling	m	0.95	-

*Nexans granted permission for public release of this information on March 27, 2015.

Physical characteristics	**Unit**	**Nominal value**	**±**
Minimum recommended coiling radius	m	1.5	-
Operating Temperature Range	°C	-15 to +40	-
Installation Temperature Range	°C	-10 to +45	-
Handling Temperature Range, <NPTS	°C	-15 to +50	-
Storage Temperature Range	°C	-30 to +60	-
Crush Resistance, 0.1m	kN	40	-
Impact Resistance, 0.05m	J	400	-
Axial stiffness (Fixed ends)	MN	91	-

Electrical Characteristics	**Unit**	**Nominal value**	**±**
DC resistance @ 20°C	Ω/km	1	-
Insulation resistance for single cable Measured from conductor to water/armoring	GΩ·km	>10	-
Insulation resistance, system average Measured from conductor to water/armoring	GΩ·km	>100	-
Capacitance, conductor to water/armoring	nF/km	175	-
Operational Voltage	kV DC	10	-
Inductance, 0-25Hz	mH/km	1.5	1

1.1.1.3.3 Fiber marking

Refer to section 1.1.1.1.3.

1.1.1.3.4 Cable marking

For installation purpose, 6 yellow yarns are inserted in the yarn layer. Length marking is applied every 1000m using orange printed self-adhesive labels. Other marking is applied according to TR-001-12 when relevant.

1.1.1 Cable Product Set

The cable product set offered for this system is manufactured by Nexans of Norway. The product type is known as Repeatered Optical Cable (ROC-2). At the pre-desk study stage only 3 of the cable types in Nexans range of ROC02 cables are used in the provisional SLD:-

- Double Armored (DA) at the shore ends in shallow water, typically less that 20m
- Single Armored (SA) in shallow water, typically ranging from 20m to 1000m
- Lightweight Cable (LW) for deep water, typically greater than 1000m

As a result of the desk top study and marine route survey these cable types will be subject to change. A typical example of a shallow water cable change is where consistent cable burial to target depth is confirmed. In this case the SA cable could be replaced by a single armor light (SAL) employing smaller diameter armor wires. In deep water the high resolution survey may identify areas of rough seabed, in which case the LW cable would be upgraded to a lightweight protected (LWP) design.

It should be noted that all three cables offered share the same 18mm diameter LW core. This core is wrapped with a single layer of 3.6mm wires to form the SA design and a double layer of 3.6mm wires to form the DA design

The ROC-2 cable has been developed for deep water subsea applications which require both optical transmission and electric power transfer, mainly repeatered optical transmission systems. The integrated vault armoring ensures pressure resistance at deep waters and provides electrical conductivity as well as tensile strength for the LW cable. Both copper tube and steel tube are hydrogen barriers, and in addition the steel tube is filled with hydrogen absorbing compound.

Direct exposure to sunlight must be avoided for the ROC-2 cable core (LW) as this will degrade the long term electrical properties of the insulation.

We note the request for qualification reports; results of sea trials. Qualification reports are proprietary information; and can be viewed at the factory

> All the cable will be manufactured at the Nexans factory in Rognan, Norway. Customers are welcome to visit the plant. Nexans Rognan has capacity to produce LW of 6000 km per year, alternatively 4000 km of DA can be manufactured and can produce the cable for this project within the project timescale.

Outline specifications of the three ROC-2 cable types are included as follows:-

1.1.1.1 LW Cable Type

Appendix B

Laying Seafloor Cable BMPs

Laying Seafloor Cable Using Best Management Practices

Eric Dykes and William Venezia

PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the cable laying procedures used at the South Florida Ocean Measurement Facility (SFOMF), documentation requirements, permitting required, and actions necessary for the safe, economical, and environmentally compliant cable installation. This SOP refines the Best Management Practice (BMP) initially documented in May 2011. This refinement accounts for the lesions learned during two offshore to onshore cable lays know as the Gateway and Small Craft Measurement Site (SCMS). SFOMF understands that the installation of a subsea cable will affect the environment. This document seeks to refine and provide the least impactful seafloor cable laying installation and sustainment techniques for use at the SFOMF.

SCOPE

This document includes procedures for laying cable that extend from a point offshore through the surf zone and up onto the beach. It includes procedures for laying cable from pointtopoint at sea and laying cable point-to-point as a function of various water depths, bottom types, and environmental habitats extending from the surf zone to water depths in excess of 2000 feet. It provides SOP's for routine, emergency, and non-routine cable laying. It defines the materials and equipments necessary for cable laying and the types of cables used.

Two recent cable lays are referenced as examples. They are the Small Craft Measurement Site (SCMS) cable lay and the Gateway cable lay. The SCMS cable is NS24 SA trunk cable with an outer diameter of 1.88 inches and a weight in seawater of 1.7 pound per foot. The SCMS cable laid in May 2012 goes from shore to approximately 15-foot water depth (3000 ft in length). The second example is the Gateway cable. The Gateway cable is Tyco SL21 DA Cable with an outer diameter of 1.56 inches and a weight in seawater of 2.4 pounds/ foot. The gateway cable laid in September 2010 goes from shore to approximately 300-foot water depth (15000 ft in length).

SHORE ENDING A SEA FLOOR CABLE

Shore ending a submarine cable (sea floor cable) is the act of pulling a cable from an off shore supply ship onto the shore for connection to a shore station. This effort uses the same general procedures used at the SFOMF as those used since 1952 and in general as the earliest U.S. cable laying operations, see Figure 1.

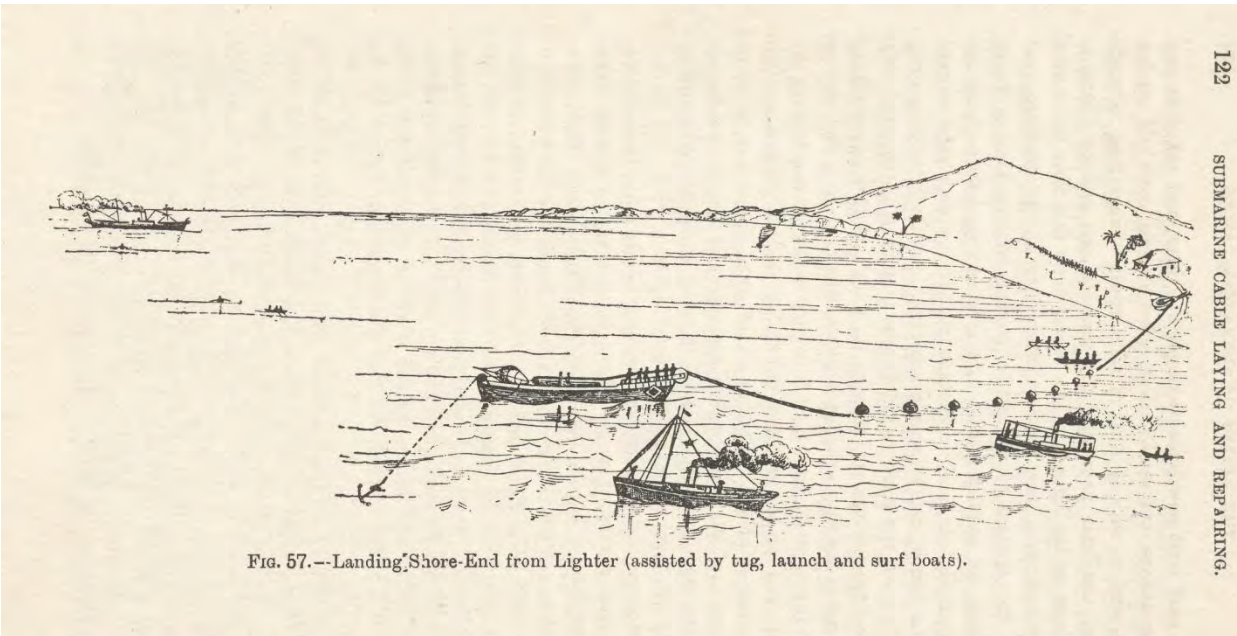

Figure 1: Shore ending a cable in 1896

With a few notable exceptions, the procedures have remained the same. Figure 1, from Wilkinson, "Submarine Cable Laying and Repairing" shows the refined process used in 1896. The best know process at that time is as follows:

1. The cable laying ship anchors off shore.
2. To reduce the friction of dragging the cable on the sea floor the cable is buoyed up by adding glass balls encased in nets.
3. As the ship lets out cable and attaches floats, the cable is pulled to shore with a smaller vessel.
4. The route to shore is that set by the wind and the tide.
5. When the cable end nears shore, a swimmer attaches a shore ending lead in line to the cable.
6. This shore lead in line runs through a fixed sheave on the shore that changes the direction of the cable from towards shore to along shore.

7. The cable is pulled to shore, up the beach escarpment by using a shore side pulling power.
8. The operation is assisted by smaller boats to fix entanglement problems as needed.
9. Once the glass balls are removed the cable laying ship pulls up anchor and follows a pre determined survey route to the cable end destination.

Figure 2 shows the most recent cable being shore ended at SFOMF this cable is the SCMS cable. It was shore ended on 4 April 2012.

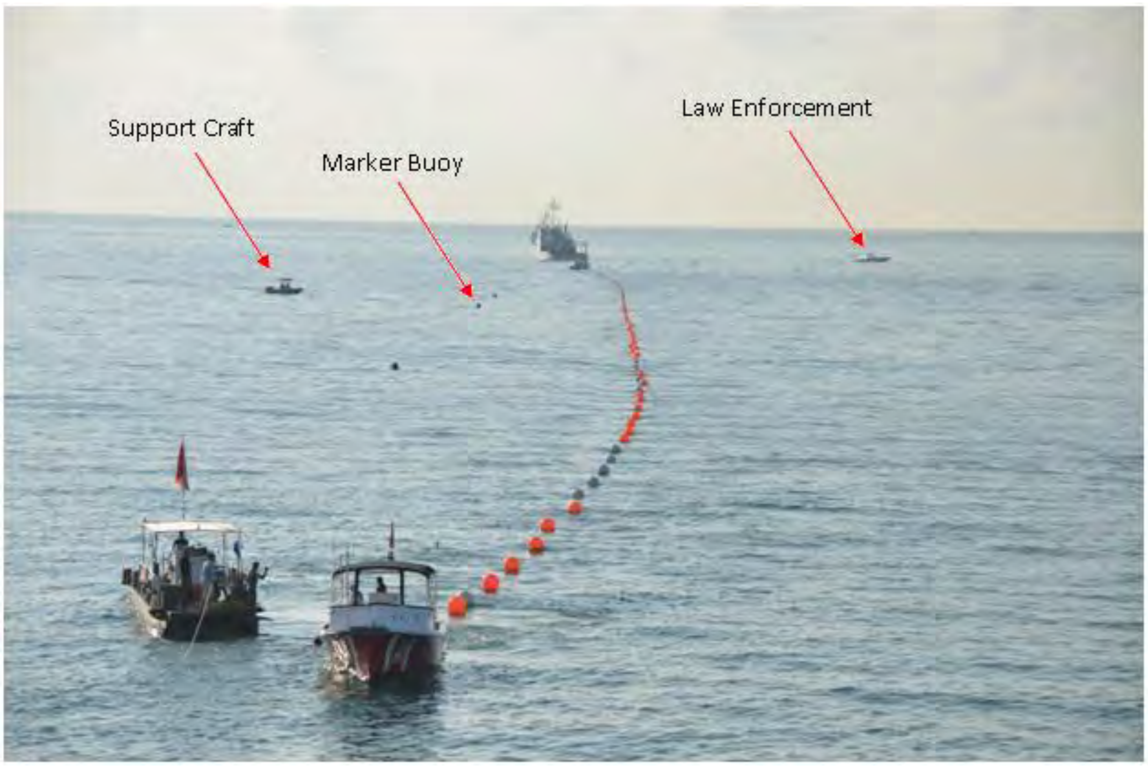

Figure 2: Preparing to attach SCMS cable to shore ending lead in line

The best know shore ending process used during the April 2012 SCMS is described below.

1. Divers place multiple marker buoys marking a route for every cable shore ending.
2. The cable laying ship holds station offshore using dynamic positioning (no anchors).
3. As the ship lets out cable and attaches floats, the cable is pulled to shore with a smaller vessel.
4. The route to shore is that set by the wind and the tide.
5. When the cable end nears shore, a swimmer attaches a shore ending lead in line to the cable.

6. This shore lead in line runs through a fixed sheave on the shore that changes the direction of the cable towards a dead man beach anchor.
7. The cable is pulled to shore, up the beach escarpment, into a pre-dug trench, by using shore side pulling power.
8. The operation is assisted by smaller boats to fix entanglement problems and assist as needed.
9. Once the floats are removed the cable laying ship moves from holding position and follows a pre determined survey route to the cable end destination.
10. On removal of the floats divers guide the cable to the sea floor divers and place it next to the last cable laid (Figure 3).
11. The cable is attached to the sea at pre determined hard points.
12. Where practical the cables are tied together to form a larger bundle that is less resistant to movement by a ship anchor.

The following figures are screen captures from video take immediately after the SCMS cable lay.

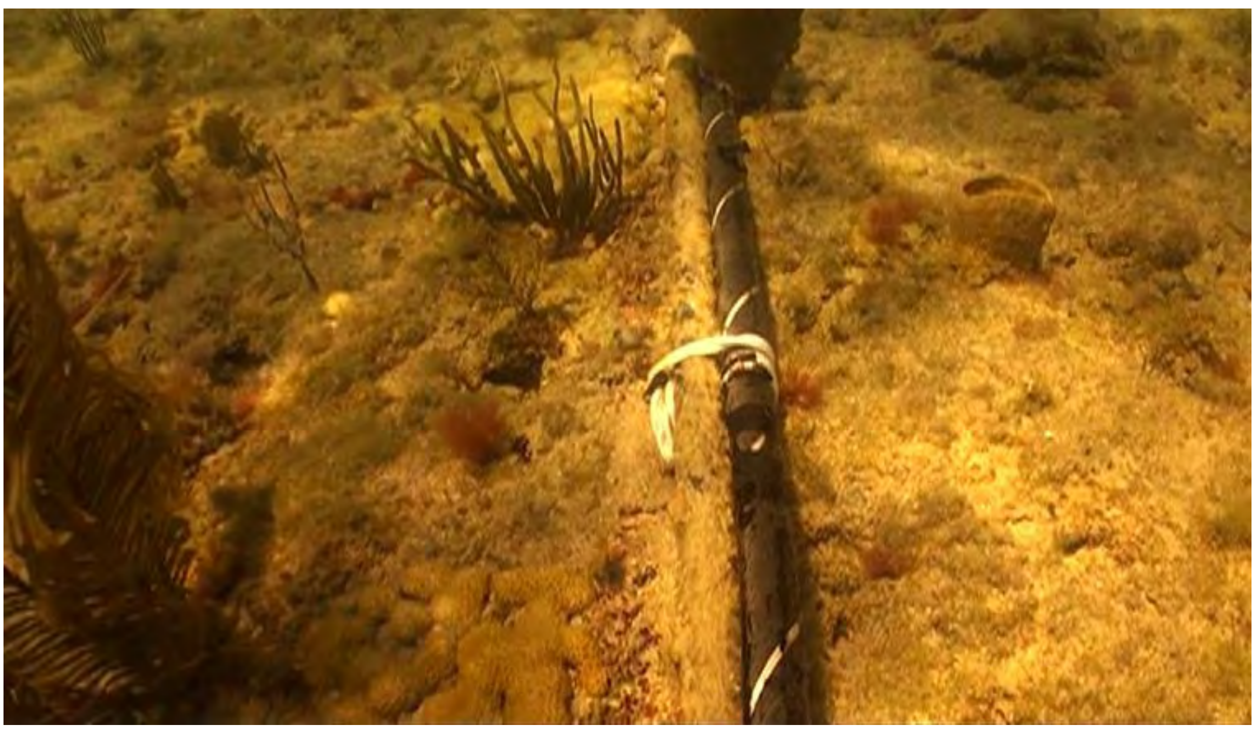

Figure 3: Gateway and SCMS cables on seafloor (bundled with previously laid cable)

Figure 4: Gateway and SCMS cables on seafloor joining other cables heading to the beach

Figure 5: Gateway, SCMS and other cables secured to seafloor at hard point

This SOP modifies the process to include procedural changes based on lesions learned from the past two cable lays. The Gateway cable, laid in September 2011, was the 121st cable laid to shore and it was the first cable permitted for installation since the facilities inception in 1952. The U.S. Army Corps of Engineers, Florida Department of Environmental Protection (DEP) granted permits, and Broward County issued a license. Prior to installation of a shore cable, it is now SOP to obtain the aforementioned permits and license. It is now SOP to trench by hand cables through the beachfront to a minimum depth of three feet.

Figure 6: SCMS cable trench (left), Gateway cable trench (right)

Cable Installation Procedures:

Cable installation procedures and routes will form an "installation template" that can be used in future shallow and deep cable laying operations. The actions to be taken will include:

- ***Preliminary route selection***
- ***Route survey (deep and shallow)***
- ***Scientific assessment***
- ***Impact minimization***
- ***Installation***
- ***Post inspection.***

Each of these topics is described in some detail below.

- ***Preliminary Route Selection:***

The first step for an installation is preliminary route selection. Generally SFOMF has a sea-cable end location requirement and will work landwards (towards shore) to determine the best route. SFOMF maintains and regularly updates a Geospatial Information Software (GIS) database that contains, but is not limited to, bathymetry, bottom type, and cultural and biological resources. This data base will include the data from the in progress SFOMF Environmental Assessment. Utilizing this data base, SFOMF will select a path of presumed least affects (avoiding major bottom relief and known major coral resources).

As an example, Figure 7 illustrates the preliminary Gateway cable route on the GIS system and SFOMF's attempt to determine the minimal impact route. The enlarged section of the figure (red box) shows efforts to avoid major bottom relief. Additional efforts will involve consultation with a reef biologist / mapper who may be able to identify a routing that further reduces the length and impact of the cable over hardbottom. This process may also involve taking advantage of grooves (lower relief areas) along the inner reef which qualitatively appear to have fewer stony corals and octocorals.

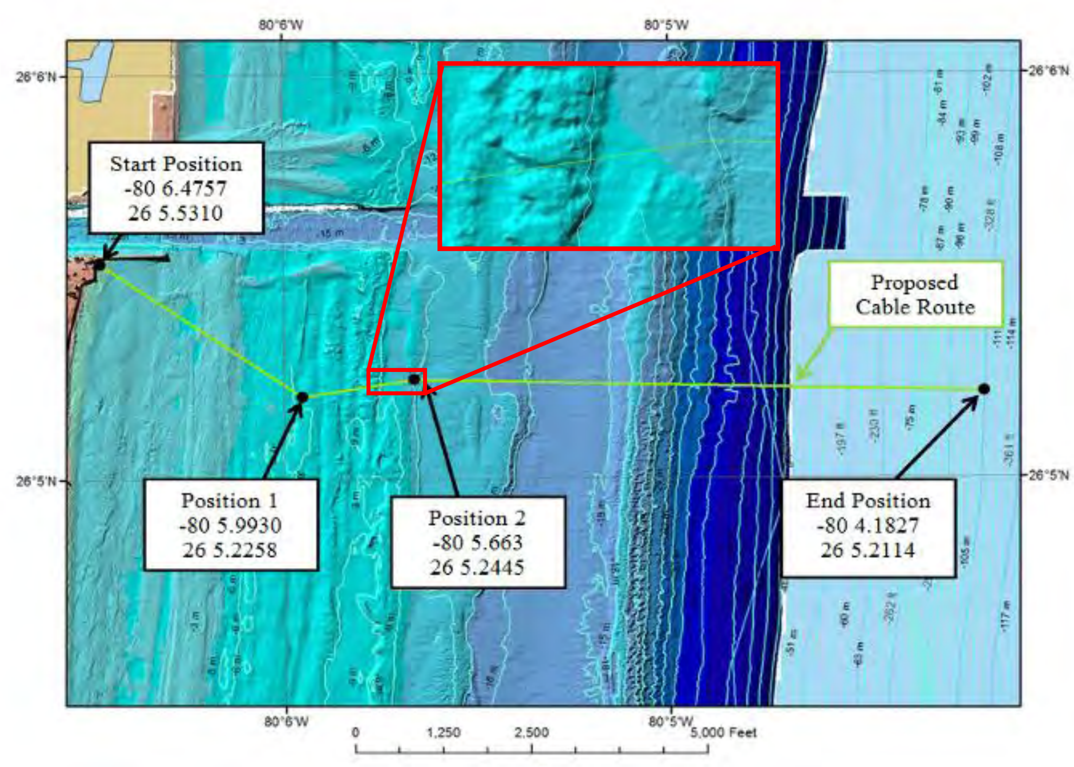

Figure 7: Gateway Cable Route

- ***Route survey:***

Deep

Once the initial preliminary route is determined, a visual underwater survey of the sea floor under the route will be conducted. For water depths greater than 100' the NSWCCD designed Television Observed Nautical Grappling System (TONGS) a Remote Operated Vehicle (ROV) will be used to capture High Definition (HD) quality video and still pictures along the route. The TONGS position data is recorded simultaneously with the video and still images for later geo-referencing. For example, Figure 8 shows the actual bottom position of the TONGS along the proposed Gateway cable route. The exact route a cable will take in deep water is at best an approximation of the proposed survey of the cable route. Consequently a best effort will be made to lay the cable along the survey route.

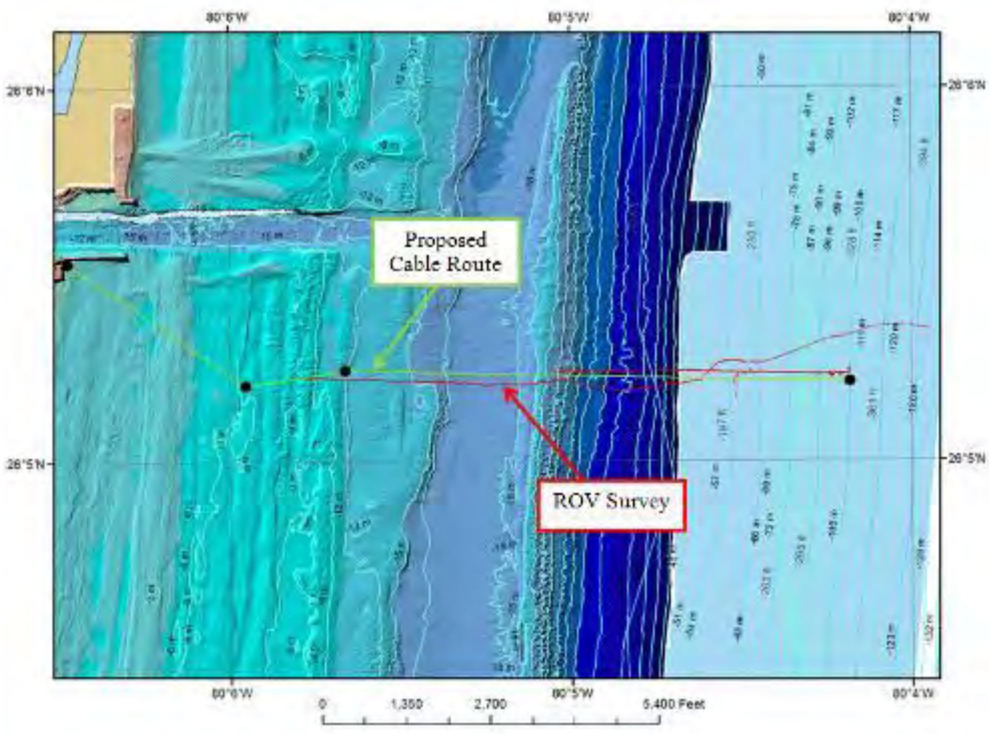

Figure 8: ROV Survey of Gateway

Shallow

For water depths less than 100’ the underwater visual survey will be conducted by scientific divers. The divers will follow the predetermined route taking still images and notes of significant features. For example, Figure 9 shows the shallow water Gateway route that was followed by scientific divers. The divers were given a distinct path for the route (following existing cables and marked subsurface buoys).

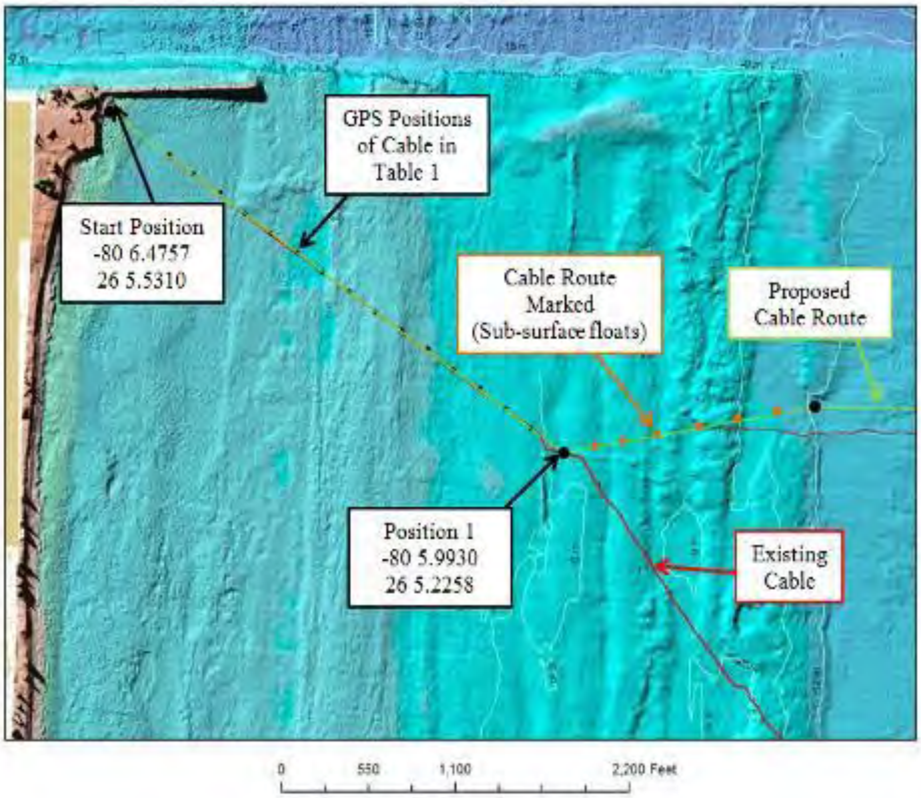

Figure 9: Diver Survey of Gateway Cable

- ***Scientific Qualitative Assessment***

Once the qualitative route survey is conducted, it will be reviewed by a qualified environmental scientist (or scientists) to determine the general degree to which impact will occur from the cable to coral resources including to endangered coral species. The scientist will make suggestions for route modification to avoid endangered coral species and to reduce the impact to other coral and biological resources.

- ***Impact minimization***

Route Modification and Securing Cable to the Sea Floor

The inputs from the environmental scientists and the information collected during the surveys will be taken into consideration to minimize impacts. Impact minimization could be a route modification to avoid benthic biological resources and to to secure the cable on the seafloor using hard points.

For example, for the installation of the Gateway and SCMS cables it was decided to use hard points to secure the cable to the seafloor. Hard points allow the cable to be secured and help to prevent the cable from moving laterally (sweeping). There is evidence of existing cable sweeping from instances of boat anchors caught in the cables. The SFOMF cable field resides within a "No Anchorage Zone", but enforcement is non-existent. Some hard points can also aid in the installation of the cable near shore by providing physical points of reference for the cable route. Because hard points will impact the bottom, the hardpoints will be distributed such to minimize the area of impact while providing resistance to movement when fouled by anchors. Hard points to which the cable will be affixed will be inserted at locations near to known coral colonies and at intervals determined by SFOMF engineers.

Figure 10: Example of boat anchor entangled in sea cable.

- ***<u>Cable Installation</u>***

The cable installation procedure can be broken into two portions: Shore Ending and Cable Laying. The Shore Ending is the installation of the cable from a stationary ship approximately 0.6 nm off shore to a designated point on the beach. During the cable laying operation, the ship is moving seaward and laying cable from the shore ending position to the cable route end position.

Shore Ending

The cable laying vessel will hold station at a predetermined position while a "pulling boat" pulls the cable off the ship towards the shore. During this procedure, buoys will be attached to the cable. The buoy spacing will be chosen based on water depth at the closest approach to the beach of a given buoy such that if two buoys come together, the cable loop will not touch the sea floor. The buoys allow the cable to be floated over sensitive areas while it is being pulled to shore. Once the cable is on shore, it will be secured to a pre-installed dead man anchor. When the cable is secured to the beach and at the boat, the cable is then pulled laterally into the predetermined position marked out on the surface with buoys that are to be attached to preinstalled "hard points". The predetermined hard points allow for the cable to be safely and efficiently settled to the bottom. Ultimately the cable will be secured all along its length at the hard point intervals previously defined. The cable will be initially secured to the hard point buoys. Divers then work from shore to sea cutting the cable buoys. When the dive team reaches a "hard point" buoy, they will cut the float and guide the cable into position as usual; the divers will secure the cable to the hard point on the seafloor. This progression will continue until the divers have cut all of the cable buoys off. The ship will then proceed with the cable laying operation. Attachment I illustrates this evolution in detail.

Cable Laying

The cable laying operations commences after the cable has been shore ended and secured to the seafloor at the hard-point anchors. During the cable laying operation the vessel will transit towards the end position of the installation along the predetermined surveyed route. During this movement the cable is lowered off the stern of the vessel in a controlled manner. The position of the ship is very precisely recorded and monitored using Real Time Kinematic (RTK) GPS.

- ***<u>Pre-Installation Work</u>***

For example, for the Gateway cable installation, a predetermined number of "hard points" were installed. An example of hard points is illustrated in Figure 11. There are two types of hard points that could be used for this application, grouted rod and “manta anchors”. The grouted rod is used on hard bottom seafloor and is the same type anchor used by the county for public use on the reef. The “Manta Anchor” is used on sand bottoms. The hard points will be used for two purposes:

1) To ensure that the cable is laid as accurately as practical on the selected route. The hard points will have surface markings that will allow the installation team to drag the floated cable into position before cutting the floats.

2) To secure the cable to the seafloor along hardground and reef areas to prevent cable sweeping from anchor entanglement or other events.

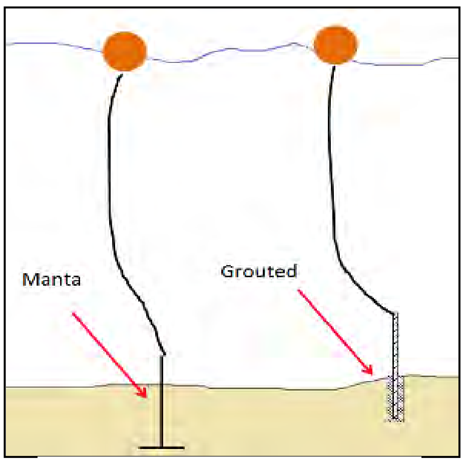

Figure 11: Anchor Types

- ***Post Inspection***

After the cable has been installed, a qualified environmental scientist will inspect the shallow water portion of the cable where it was laid, and quantitatively document impact. Mitigation efforts of physically moving the cable may be recommended if it is deemed appropriate and practical.

For deep water (> 100’) an ROV will be used to inspect the cable; any impact will be documented but no attempt will be made to move the cable with the ROV.

Attachment I

Cable shore ending procedure in detail (Gateway shore ending as example).

Step I

Cable laying vessel moves into position 1 (Figure 1) and will station keep.

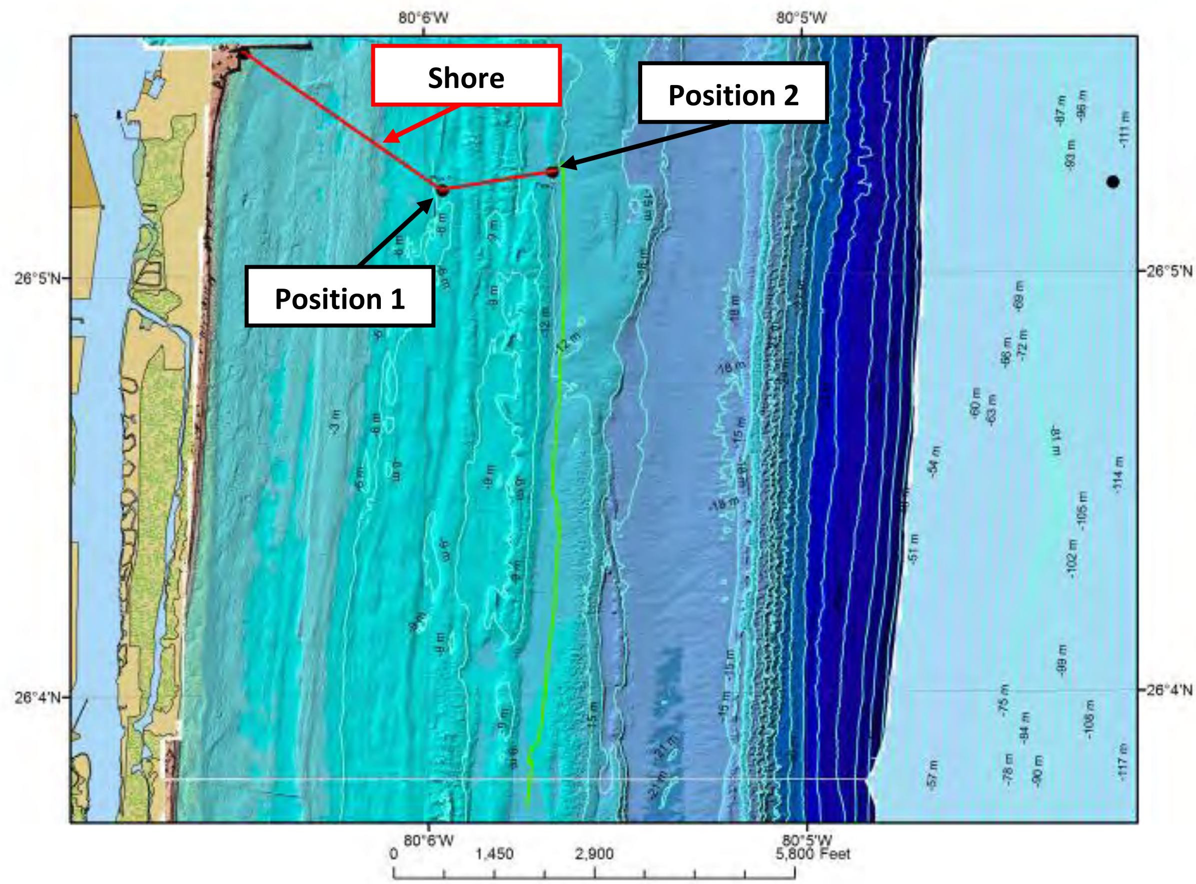

Figure 1: Ship Positions

Step II

The pulling boat will grab the end of the cable and begin to pull it towards shore. During this time cable floats are being attached to the cable as it is being pulled of the ship. This step is illustrated in Figure 2.

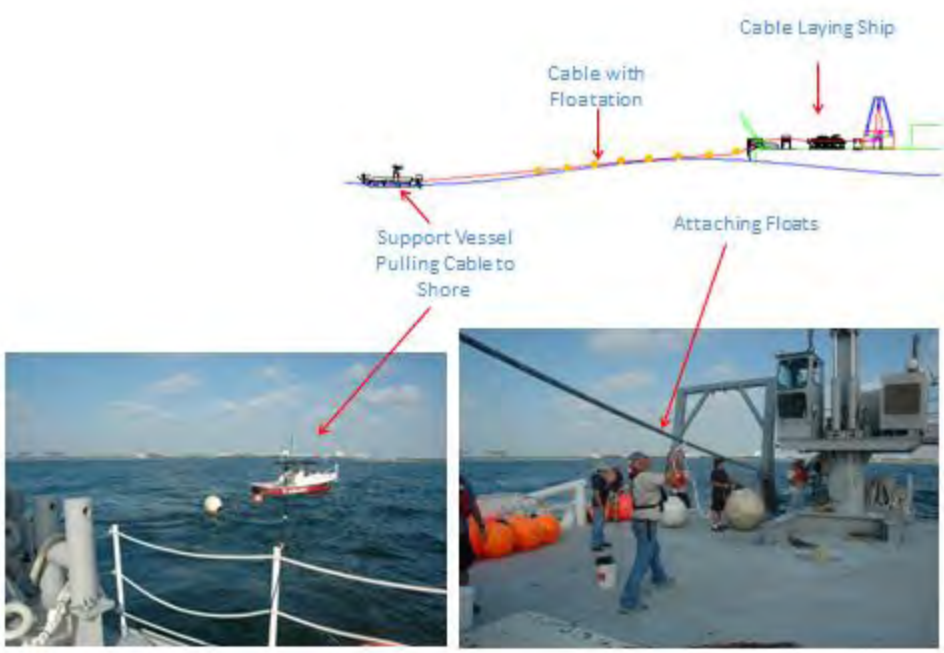

Figure 2: Shore Ending Procedure

Step III

The pulling boat pulls the cable all the way to shore and hands it off to the shore team. The Shore team secures the cable to the existing “dead man” and removes any cable floats that have been dragged onto the beach. (Figure 3).

Figure 3: Shore Team

Step IV

Once the cable has been secured on the beach, the support craft will pull the cable into the predetermined route marked out by the hard point buoys. The cable will then be secured to these buoys; this will help keep the cable in the position needed to install it along the selected route.

Step V

The dive team begins to cut the cable floats and places the cable on the seafloor, Figure 4. The team will work from shore to sea. The dive team will guide the cable onto the seafloor as it touches down and will move the cable as necessary to avoid direct contact with corals where practical. This process will continue until the dive team reaches Position 1 on Figure 1, at this point the cable will be secure to another hard point on the seafloor.

Figure 4: Dive Team cutting floats

Step VI

Once all of the cable floats are removed and the divers are clear, the cable laying ship will begin to move into Position 2 of Figure 1. This portion of the cable installation is also over a sensitive bottom type; while the ship is moving to Position 2 floats will be attached to the cable in the same fashion as before.

Step VII

When the cable laying ship reaches Position 2 it will hold station. The support craft will then pull the cable into position marked out by the surface floats if applicable. The dive team will then proceed with cutting floats and placing the cable on the seafloor in the same manner as before.

Step VIII

Once all of the floats have been removed, the ship will then begin to lay the cable to the south along the selected route. The cable will not be laid under great tension. The cable laying ship will be equipped with RTK GPS to ensure the most accurate positional information available.

Appendix C

Draft EFH Assessment (2013)

Shallow-Water Benthic Habitat Characterization and Cable/Benthic Activity Impact Assessment for the South Florida Ocean Measurement Facility (SFOMF)

June 2012

Prepared for:

Commander
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By:

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SUMMARY

This effort provided: 1) a characterization of three specific Essential Fish Habitat (EFH) areas-Coral, Coral Reefs and Live Hardbottom Habitat- within the South Florida Ocean Measurement Facility Restricted OPAREA cable corridor, and 2) an identification and estimation of impacts to these EFH resources from cable deployments in the same corridor. Surveys were completed in seven reef habitats occurring in water <30 m deep and included from nearshore to offshore: colonized pavement-shallow (CPS), ridge-shallow (RS), linear reef-inner (IR), linear reef-middle (MR), colonized pavement-deep (CPD), linear reef-outer (OR), and spur and groove (SG).

Sample sites were selected randomly and stratified by habitat and cable presence. Five sites were sampled within each habitat in areas which included the presence of cables (cable sites), and five sites were sampled within each habitat in areas which did not include the presence of cables (non-cable sites, at least 10 meters away from cable). A total of 70 sites were sampled. For habitat characterization, benthic biological communities within sites were evaluated in two ways. First, a percent cover estimate was calculated for substrate types and major benthic communities, including stony corals, gorgonians, sponges, zoanthids, and algae. These values were calculated from digital video transect images analyzed with Coral Point Count with Excel extensions (CPCe). Secondly, an *in situ* population dynamics approach using three taxonomic groups considered to be indicator organisms on southeast Florida reefs, stony corals, gorgonians and barrel sponges, was utilized along belt transects for the estimation of impacts to coral reef communities within the cable corridor.

Comparisons between non-cable and cable sites within each habitat were conducted to identify cable-associated impacts to the benthic community. Stony coral and gorgonian impacts included dislodged colonies adjacent to a cable, colonies abraded by contact with a cable, colonies growing on cable, or colonies shaded by but not in contact with cable. Barrel sponge impacts included shearing, which is the loss of the sponge barrel, abrasion, shading, and growth on cable. Data collection within cable sites was essentially identical to that collected in non-cable sites. For the video analysis, additional functional groups were added to capture data associated with the cable. Gorgonians, sponges, and algae growing on cable were distinguished from those colonies growing on reef pavement not in contact with cable. Cable was added to the substrate types as well as scour, which was recently disturbed substrate adjacent to a length of cable seen in the images. The treatment of ‘cable” as an artificial motile substrate is similar to “unconsolidated rubble” as a substrate type in reef environments when examining habitat damage and the effect of substrate type on stability and settlement and survivorship of reef biota (Gilliam and Moulding 2011). Within the belt transect in each cable site, stony corals, branching gorgonians, and barrel sponges impacted by cable were recorded.

Habitat Characterization

Macroalgae and turf algae dominated benthic cover within all habitats with greater than 80% combined cover in the nearshore CPS, RS, and IR habitats, greater than 70% cover in the offshore MR, CPD, and OR habitats, and 57% cover in the offshore SG habitat. Stony coral cover was less than 1% in all habitats except RS (2.0%) and SG (1.6%). Of the faunal groups, sponges had the greatest coverage in all habitats except RS. Branching gorgonians followed

sponges in coverage for all habitats except CPD and SG. The ‘other live’ benthic coverage group was prominent in the offshore habitats (MR, CPD, OR, and SG). In all these habitats, most of the ‘other live’ group was dominated by cyanobacteria.

A multivariate approach utilizing a matrix of substrate and biota functional group percent benthic cover was used to examine community similarities among the seven reef habitats. Four habitat groupings were identified. The three nearshore habitats, CPS, RS, and IR, each formed their own distinct habitat group based upon percent benthic cover of substrate and biota. The four offshore habitats, MR, CPD, OR, and SG, formed one distinct offshore habitat group, being statistically similar to each other, and dissimilar from each of the three shallow habitats. Substrate and biota were assigned to 23 functional groups. The coverage of branching gorgonian, sponge, barrel sponge, and ‘other live’ groups contributed to the within-group similarities and between-groups dissimilarities. The nearshore habitats (CPS, RS, and IR) generally had greater cover branching gorgonian and sponge versus the offshore habitats (MR, CPD, OR, and SG).

Stony coral cover was greatest in the RS (2.0%) and SG (1.6%) habitats and lowest in the CPS (0.3%) and CPD habitats (0.3%). Stony coral densities (colonies/m^2) were statistically similar in all habitats, ranging from 1.3/m^2 in the CPD to 2.1/m^2 in the SG. Twenty-five stony coral species were identified within the seven reef habitats. The highest number of species (17) was identified in the offshore MR and SG habitats and the fewest in the nearshore CPS habitat (9). Colonies in the 2-5 cm diameter size class dominated the stony coral assemblage in all habitats, and this size class was the only one with densities greater than 1.0 colonies/m^2. All habitats supported colonies larger than 50 cm diameter. Larger colony sizes were identified in the RS and SG habitats which were also the only habitats which had colonies larger than 100 cm diameter.

Branching gorgonian percent cover ranged from 1.5% to 8.1% and was greater in the offshore habitats (MR, CPD, OR, and SG) than in nearshore habitats (CPS and RS). Branching gorgonian density (colonies/m^2) also tended to be greater in the offshore habitats than in nearshore habitats. The SG habitat had the greatest density (8.9/m^2), and the CPS habitat had the lowest (1.8/m^2). All gorgonians were identified to genus, and those that could were identified to species. The most taxa (20) were identified in the SG habitat, located farthest offshore in the study area, and the fewest (14) were identified in the nearshore RS and IR habitats. In all habitats, the 11-25 cm size (height) class contributed most to overall gorgonian density. The offshore SG habitat had more gorgonians in the 26-50 cm and >50 cm size classes.

Barrel sponges were observed in all habitats except the nearshore RS. Barrel sponge density was greatest in the SG (0.61 sponges/m^2) and lowest in the IR (0.16 sponges/m^2) habitat. Although mean sponge volume (cm^3) was similar within the IR, MR, CPD, OR, and SG habitats, the largest sponges were seen in the offshore OR and SG habitats.

Cable Impact Assessment

Although cable-associated EFH impacts may occur during cable deployment and continuously over the time cable remains on reef habitat, this project was not designed to and could not distinguish deployment impacts from impacts that have occurred since deployment. The multivariate approach used to characterize the habitats at the community level was also used to evaluate within habitat non-cable and cable site similarity. The presence of cable is contributing to dissimilarities between cable and non-cable sites in each of the habitats. Within cable sites, cable presence was not determined to be directly reducing the benthic cover of groups such as stony corals, gorgonians, or sponges, but rather, appears to be taking the place of natural reef substrate, which may indirectly impact the reef community by limiting growth or directly impacting biota due to cable movement.

Impacts associated with cable movement were documented within 27 (77%) of the 35 cable sites. Substrate scour was identified in 22 cable sites, and mortality to stony corals, gorgonians or barrel sponges associated with cable movement specifically were identified in 12 sites. Additional examples of impacts from cable movement included broken, frayed, and tangled cables. These observations indicated that cable movement occurs, and that these movements create an impact area greater than the width of a cable.

No within-habitat differences were determined for stony coral density (colonies/m^2) and number of species based upon cable presence within each habitat. The shallow-water RS non-cable sites were determined to have significantly greater mean percent cover (t test: $p = 0.014$) and greater colony size (t test: $p = 0.044$) than the cable sites. No differences were determined for any gorgonian or barrel sponge parameters between cable and non-cable sites within habitats.

Impacts to stony coral and gorgonian colonies were identified in all habitats. Impacts to barrel sponges were identified in all six habitats that had barrel sponges (no barrel sponges were seen in the RS sites). Within the cable sites, the percentage of stony coral colonies impacted by cables ranged from 8.4% in the IR to 21.5% in the RS. For gorgonians, the percentage impacted ranged from 2.4% in the RS to 9.8% in the SG, and barrel sponge impacts ranged from 7.2% in the CPD to 23.3% in CPS (note that only seven barrel sponges were identified in the CPS cable sites).

Mean density (colony or sponge/m^2) of all impact types was also estimated within each habitat. These densities were used to estimate the total number of stony coral and gorgonian colonies and barrel sponges impacted within a 1.5 m belt adjacent to all cables within each habitat. Over 33,000 (14%) stony coral colonies, 19,000 (3%) gorgonian colonies, and 3,700 (12%) barrel sponges were estimated to be currently impacted within a 1.5 m belt adjacent to all cables in the project area. These large numbers are not driven by great densities of impacted colonies or sponges within individual sites, but by the numerous cables impacting large areas within each habitat and the total project area. These estimates also only include impacts to colonies and sponges that still had living tissue at the time of the survey. Impacts to colonies or sponges that have been dislodged and moved or colonies or sponges that have experienced complete mortality over the entire time cable has been deployed were not captured in this effort.

Cable movement appeared to be greater in the nearshore habitats, most likely due to shallower water depths relative to the offshore habitats. More scoured substrate was present in the shallow CPS and RS habitats, and growth on cable contributed more to the percent impacted coral colonies and sponges in the offshore, deeper habitats, indicating higher stability of cables in these habitats. However, cable movement in any of the habitats is of particular concern because it greatly increases the impact area and may limit reef community development in areas adjacent to cables.

This project was a one-time characterization of specific EFH and cable impacts within the SFOMF Restricted OPAREA cable corridor. Identifying and measuring long-term cable associated impacts to the reef communities will require continuous monitoring which will also facilitate differentiating cable from non-cable associated reef community changes over time.

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I. SCOPE OF WORK AND PROJECT AREA

The purpose of this effort was to 1) provide a characterization of the coral reef habitats within the South Florida Ocean Measurement Facility (SFOMF) Restricted OPAREA cable corridor, and 2) identify and estimate impacts to reef resources from cable infrastructure in the same corridor. These habitats represent valuable Essential Fish Habitat (EFH) resources under the Magnuson-Stevens Fishery Conservation and Management Act. Survey efforts were focused on the area of the primary corridor since this is where the majority of cables have been placed in the past and are anticipated to be placed in the future.

The project extent for this effort was entirely within the SFOMF Restricted OPAREA located just south of the Port Everglades entrance channel in Broward County, Florida. The estimated area of coral reef habitats sampled within the project extent is approximately three square kilometers and includes benthic habitats in water depths less than 30 m. Figure 1 depicts the project extent (yellow outline) and the benthic habitats included in the project. Table 1 lists the benthic habitats surveyed and the estimated area of each habitat type within the project extent.

Table 1. The area (m^2 and acres) of each benthic habitat surveyed within the project extent and number of sample sites within each habitat.

Habitat	Square meters	Acres	No. of Cable Sample Sites	No. of Non-Cable Sample Sites
Colonized Pavement-Shallow (CPS)	565,791	140	5	5
Ridge-Shallow (RS)	173,880	43	5	5
Inner Linear Reef (IR)	716,962	177	5	5
Middle Linear Reef (MR)	640,020	158	5	5
Colonized Pavement-Deep (CPD)	202,260	50	5	5
Outer Linear Reef (OR)	252,368	62	5	5
Spur and Groove (SG)	422,374	104	5	5
Total	2,973,655	735	35	35

This study focused on three taxonomic groups (stony corals, gorgonian corals (i.e. soft corals), and the giant barrel sponge, *Xestospongia muta*, for estimation of impacts to coral reef communities within the cable corridor. These three groups are often used as indicator taxa on the Florida reef tract (FWC/NSUOC 2007; Bertin and Callahan 2008). Reef indicator taxa are selected based on the ability to measure sensitivity to environmental stressors and known responses to disturbance events (Dale and Beyeler 2001). Stony corals are most often selected as primary indicator organisms for reef communities because they form complex, three-dimensional structures upon which many other species depend (EPA 2010). Due to the relatively low density of stony corals on Florida reef tract, especially in southeast Florida region, gorgonian corals are often used as ecological indicators of coral reef community condition and have been used in other areas of the Caribbean to assess coral reef condition and anthropogenic impacts (e.g. Gonzalez-Diaz et al. 2010).

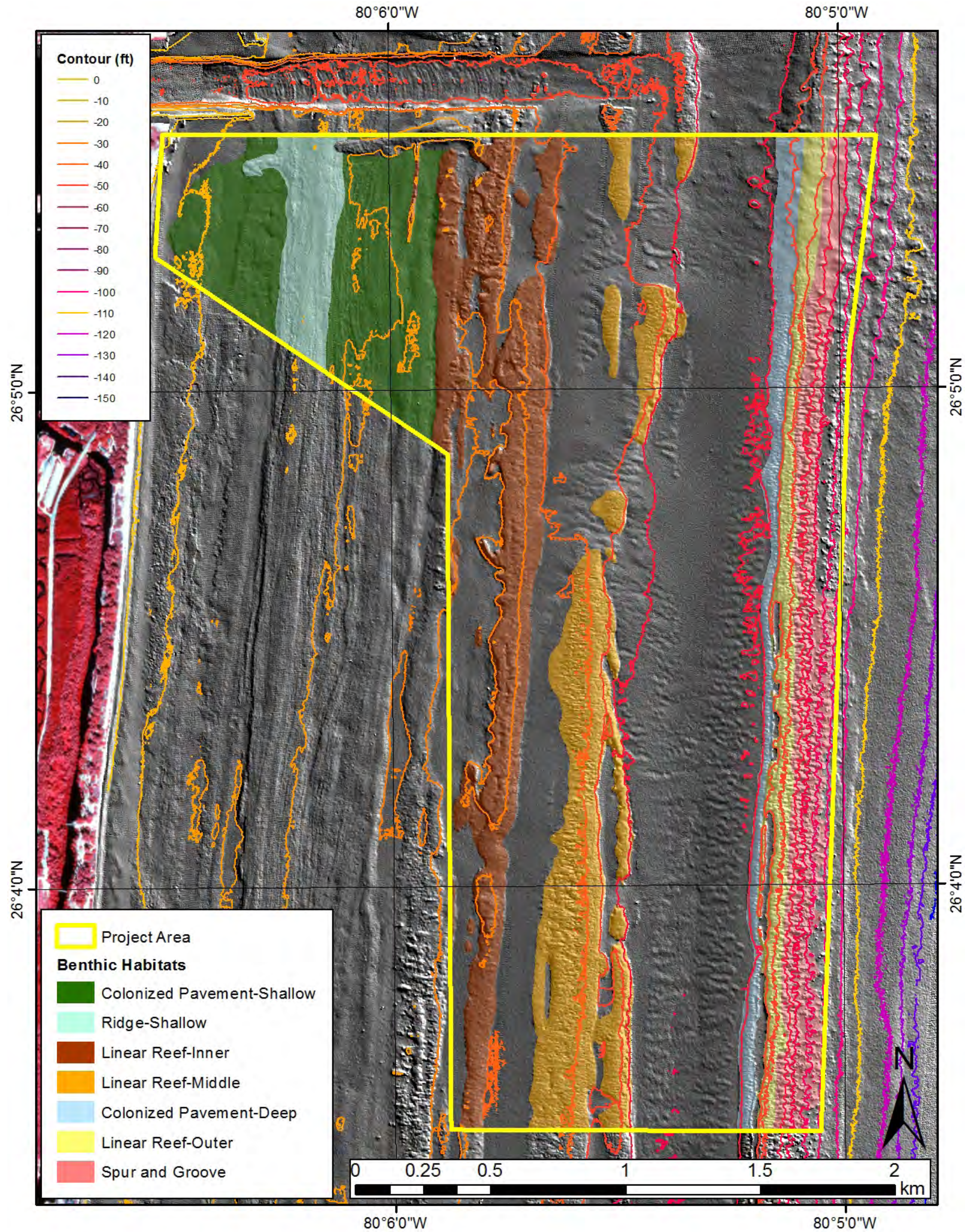

Figure 1. Map of the project extent (inside the yellow line) within the shallow-water (<30m deep) cable conduit area of the SFOMF Restricted OPAREA. The map displays the benthic habitats from Walker et al. 2008 over a hillshaded image of the 2008 Broward LIDAR survey.

The giant barrel sponge is one of the largest and most important components of the coral reef community on Caribbean and especially in southeast Florida reefs and is also one of the longest-lived animals (McMurray et al. 2008), making it an ideal reef indicator species. Individual sponges often achieve heights and diameters in excess of one meter on Florida reefs. Due to the large size and abundance on the Florida reef tract, barrel sponges provide important seawater-filtering functions and essential habitat for numerous fish and invertebrate species.

II. METHODS

Site Selection

Shallow benthic habitats have been previously characterized and mapped in GIS at a high level of accuracy (> 89.6%) utilizing the Broward County Benthic Habitat classification developed by the National Coral Reef Institute (Walker et al. 2008).

Within each habitat, five sites were surveyed in areas which included the presence of cables (cable sites), and five sites were surveyed in areas which did not include the presence of cables and were a minimum of 10 m from any cable (non-cable sites). A total of 70 sites were surveyed (7 habitats x 5 sites x 2 site types (cable and non-cable) = 70 total sites (Table 1). Surveys were completed where cables were present and absent in each of the following seven mapped benthic habitat types occurring in water <30 m deep: colonized pavement-shallow (CPS), ridge-shallow (RS), linear reef-inner (IR), linear reef-middle (MR), colonized pavement-deep (CPD), linear reef-outer (OR), and spur and groove (SG)(Figure 1 and Table 1).

Site locations were obtained using ArcGIS 10. A line shapefile of all known cable positions was supplied by the Naval Surface Warfare Center Carderock Division’s South Florida Ocean Measurement Facility (SFOMF) Dania, Florida. To generate random points on known cables, an intersect was performed between the cable shapefile and each previously mapped benthic habitat from Walker et al. 2008. Random points were plotted on the cable lines present in each habitat at a minimum distance of 40 m apart to avoid overlap. Positions for all locations were obtained (Figure 2 and Appendix 1 and 2) from the GIS.

The same cable shapefile was used to generate the random locations of non-cable sites. A 10 m buffer was created around the cable lines, which was then unioned to and subtracted from the benthic habitat polygons. A 10 m buffer was chosen with the intent to separate non-cable sites from potential cable impacts as much as possible. This resulted in habitat polygons without a 10 m area around all known cable positions. Then a 20 m buffer was applied to the habitats to eliminate all habitat polygons smaller than the survey length and create minimum survey distance between adjoining habitats. Random points were plotted at a minimum distance of 40 m apart for each habitat in the remaining area to ensure each point landed at least 20 m from the 10 m cable buffer and adjoining habitat edges. Thus, any compass heading could be chosen for the surveys. Positions for all locations were obtained in GIS and random headings were assigned (Figure 2 and Appendix 1).

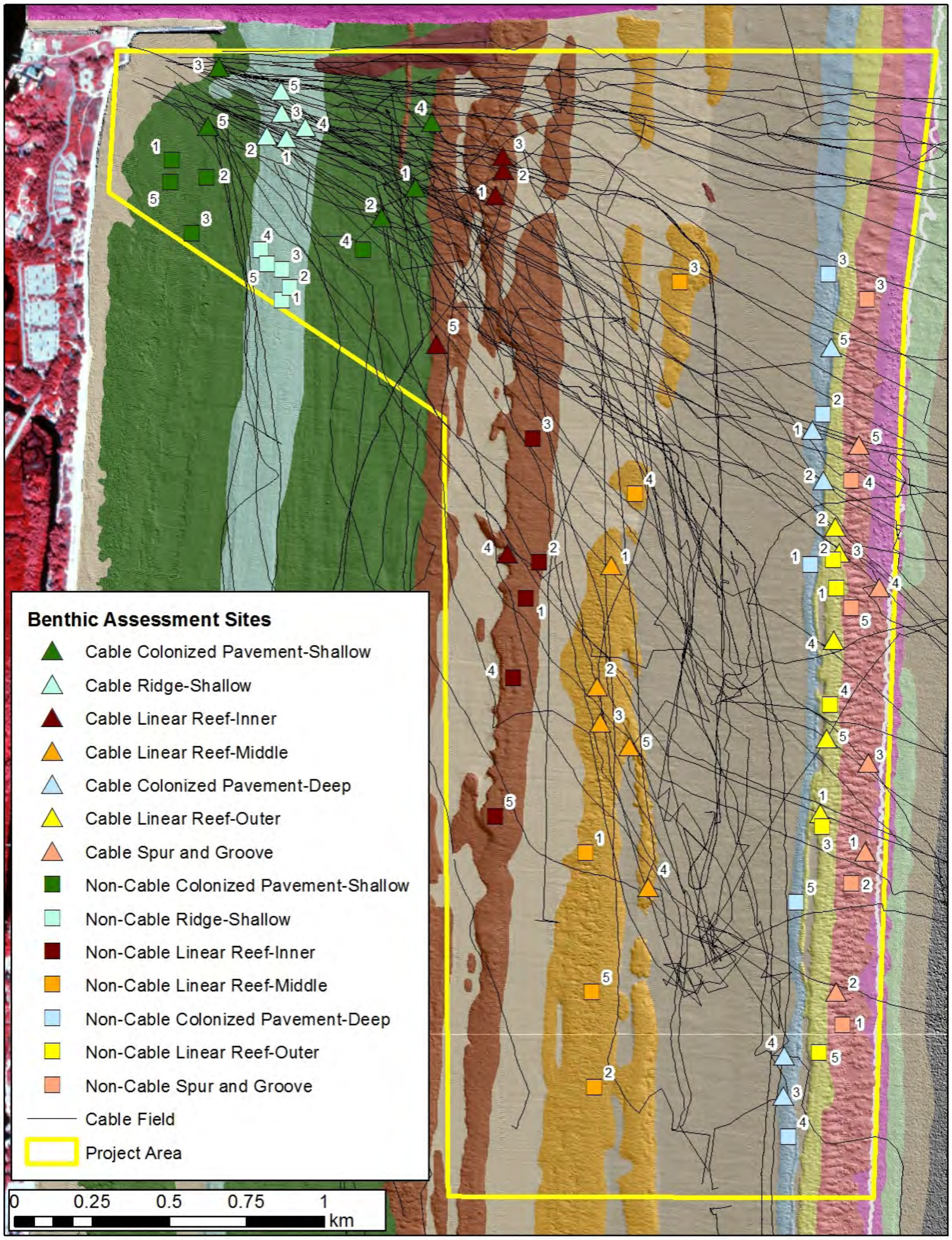

Figure 2. Map of the project extent (inside the yellow line) displaying the locations of the cable (triangles) and non-cable (squares) sites within each habitat. Cable positions were supplied by the Naval Surface Warfare Center Carderock Division's South Florida Ocean Measurement Facility (SFOMF) Fort Lauderdale, Florida and do not represent exact as-built survey locations.

Prior to data collection, reconnaissance dives were made at each site to ensure that the site locations were appropriate habitats. All sites had to be located on reef habitat not dominated by sand, and all cable sites had to include a minimum of one cable running through the survey area.

Data Collection

For habitat characterization, benthic biological communities within the non-cable sites were evaluated by two methods. First, percent cover was estimated for substrate types and major benthic communities, including stony corals, gorgonians, sponges, zoanthids, and algae. These values were calculated from digital video images analyzed with Coral Point Count with Excel extension (CPCe) software developed by the National Coral Reef Institute (NCRI) (Kohler and Gill 2006). Second, a population dynamics approach was utilized to evaluate stony and gorgonian corals and barrel sponges. Species (genus for gorgonians which are difficult to visually identify to species level in the field) distribution, abundance, density, and size class were measured. These parameters were evaluated *in situ* along belt transects.

All sites included three video transects and one belt-quadrat transect. Video transects were run over and approximately 2-3 m on either side parallel of the belt transect. Each video transect was 0.4 m x 20 m for a sample area of 8 m^2 per video transect and 24 m^2 per site. Image software (RAVEN View by Observa, Inc.) was used to grab individual video frames (images).

Each image was processed via NCRI CPCe, and 25 points were examined per image to determine percent cover of each functional group. Functional groups included biotic taxa (stony coral, gorgonian, sponge, coralline algae, macroalgae, zoanthid, and turf algae) and substrate type (pavement, rubble, and sand). Table 2 lists the groups included in the image analysis and their descriptions.

Each belt transect was 20 m long and 1.5 m wide. Surveying both sides of the transect provided a 30 m^2 total survey area per site (40 m x 0.75 m). In each transect, stony corals (≥ 2 cm diameter), branching gorgonians (≥ 2 cm in height), and barrel sponges (*Xestospongia muta*) were identified and measured. Stony corals were identified to species and colony diameter (cm) was measured. Colony diameter measurements were assigned into size classes (2-10 cm, 11-20 cm, 21-30 cm, 31-40 cm, 41-50 cm, and >50 cm) for analysis. Branching gorgonians were identified to genus (species when possible) and were assigned to height size classes (2-5 cm, 6-10 cm, 11-25 cm, 26-50 cm, >50 cm). Barrel sponge base length (cm diameter) and height were measured, and these measurements were used to calculate sponge volume (McMurray et al. 2008).

Non-cable and cable sites within each habitat were compared to identify potential cable-associated impacts to the benthic community. Data collection within cable sites was identical to that collected in the non-cable sites, except additional functional groups were added to the video analysis to capture data associated with the cable. Gorgonians and sponges in contact with cable were distinguished from those not in contact with cable, and cable was added to the substrate types, as well as scour, which was defined as recently disturbed substrate (bare or covered by turf algae) adjacent to a length of cable seen in the images.

Table 2. Descriptions of functional groups included in the image analysis for estimating percent coverage from video transects.

Group	Description
Stony Coral	all sites - stony coral species
Branching Gorgonian on Cable	cable sites only - most gorgonians with a vertical growth form growing on cable
Branching Gorgonian on Pavement	all sites - most gorgonians with a vertical growth form growing on reef substrate
Encrusting Gorgonian on Cable	cable sites only - gorgonians with a horizontal growth form - *Erythropodium caribaeorum* or *Briareum asbestinum* - growing on cable
Encrusting Gorgonian on Pavement	all sites - gorgonians with a horizontal growth form - *Erythropodium caribaeorum* or *Briareum asbestinum* - growing on reef substrate
Sponge on Cable	cable sites only - all sponges (except the barrel sponge) growing on cable
Sponge on Pavement	all sites - all sponges (except the barrel sponge) growing on reef substrate
Sponge on Rubble	all sites - all sponges (except the barrel sponge) growing on rubble
Barrel sponge	all sites - barrel sponge (*Xestospongia muta*)
Palythoa spp.	all sites - generally *P. carbaeorum*
Zoanthid	all sites - all non-*Palythoa* zoanthids
Coralline algae on Cable	cable sites only - coralline algae growing on cable
Coralline algae on Pavement	all sites - coralline algae growing on reef substrate
Coralline algae on Rubble	all sites - coralline algae growing on rubble
Macroalgae on Cable	cable sites only - macroalgae growing on cable
Macroalgae on Pavement	all sites - macroalgae growing on reef substrate
Macroalgae on Rubble	all sites - macroalgae growing on rubble
Turf Algae on Cable	cable sites only - turf algae growing on cable
Turf Algae on Pavement	all sites - turf algae growing on reef substrate
Turf Algae on Rubble	all sites - turf algae growing on rubble
Other Live	all sites - biota not included in any other group includes cyanobacteria, hydroids, and polychaete worms
Sand	all sites - bare sand
Scour	cable sites only – flat, bare or turf covered pavement adjacent to cable which had the appearance of being rubbed by cable

Within the belt transect in each cable site, stony corals, branching gorgonians, and barrel sponges impacted by cable were recorded. Stony coral and gorgonian impacts included dislodged colonies adjacent to a cable, colonies abraded by contact with a cable, colonies growing on cable, or colonies shaded by but not in contact with cable. Barrel sponge impacts included shearing, which is the loss of the sponge barrel, abrasion, shading and growth on cable.

Statistical Analysis

Univariate and multivariate analyses were used to characterize the reef habitats within the study area and examine cable associated impacts. To examine differences in benthic functional group coverage among and within habitats, Bray-Curtis similarity indices were derived from fourth-root transformed data of percent cover (Primer™ v6 multivariate statistical software package, Clarke and Warwick 2001). These indices were used to construct non-metric, multi-dimensional scaling (MDS) plots. MDS plots provided a visual representation (a “map”) of the similarity (or dissimilarity) between assessment sites such that the distance between sites in these plots reflected the relative similarity (or dissimilarity) in functional group cover. Functional groups that were principally responsible for the similarity and dissimilarity of sites were examined with the Primer™ SIMPER procedure (Primer™ v6 multivariate statistical software package, Clarke and Warwick 2001).

Univariate statistics were run on STATISTICA 10.0 (StatSoft 2010). Normality was first tested at the habitat level using the Shapiro-Wilk test. Due to the small sample size (5 sites/cable category/habitat), normality was further tested by examining the normality of residuals over the entire data set. Stony coral and barrel sponge densities and size data were log(n+1) transformed and gorgonian density and all percent cover data were square root transformed. For the habitat characterization comparison among non-cable sites one-way analysis of variance (ANOVA) tests were applied, and post-hoc comparisons were performed using the Tukey HSD test when significance was determined ($p < 0.05$). One-sample *t*-tests (significance $p < 0.05$) were used to compare stony coral, gorgonian, and barrel sponge data between cable and non-cable sites within each habitat.

III. RESULTS

Figure 2 presents the project extent map with locations of the 70 sample sites (35 non-cable and 35 cable). All sites were sampled between April and September 2011. Appendix Tables 1 and 2 lists the site sample dates, locations, habitats, and depths.

Habitat Characterization

Within the project area, five non-cable sites were surveyed in each of the seven habitats for a total of 35 sites. Data from the video transects was used to characterize functional group coverage within the habitats. Table 3 lists the mean (±1 standard error [SE]) coverage data for each habitat.

Table 3. Functional group mean (±1 SE) percent coverage at the non-cable sites

Group	CPS Mean	CPS SE	RS Mean	RS SE	IR Mean	IR SE	MR Mean	MR SE
Stony	0.276	0.097	1.965	0.513	0.468	0.092	0.844	0.298
BGP	1.539	1.366	3.299	1.046	3.691	0.814	5.365	1.011
EGP	0.262	0.195	0.274	0.080	1.501	0.468	4.024	1.308
SP	2.417	0.751	1.034	0.199	4.319	0.622	8.180	1.375
SR	0.004	0.000	0.000	0.000	0.004	0.000	0.000	0.000
BS	0.000	0.000	0.000	0.000	0.515	0.152	1.125	0.366
PALY	1.246	0.985	4.915	1.006	1.831	0.649	0.585	0.456
ZO	0.573	0.531	0.000	0.000	0.000	0.000	0.000	0.000
CAP	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.014
CAR	0.000	0.000	0.000	0.000	0.008	0.005	0.000	0.000
MAP	30.206	6.136	1.504	0.723	15.505	2.608	7.046	1.140
MAR	0.063	0.035	0.005	0.005	0.034	0.034	0.004	0.004
TAP	55.971	4.616	83.615	1.665	67.260	2.105	66.005	4.538
TAR	1.694	0.357	0.498	0.361	1.148	0.307	0.146	0.019
Other Live	0.012	0.008	0.000	0.000	0.717	0.241	3.024	1.369
Sand	5.737	2.010	2.892	0.884	2.999	0.976	3.630	0.870

Group	CPD Mean	CPD SE	OR Mean	OR SE	SG Mean	SG SE
Stony	0.321	0.062	0.732	0.155	1.606	0.383
BGP	4.962	0.510	4.866	1.010	8.108	1.891
EGP	2.893	1.090	2.722	0.607	9.458	2.252
SP	6.432	0.496	7.600	0.414	11.175	1.848
SR	0.000	0.000	0.000	0.000	0.000	0.000
BS	1.930	0.531	2.327	0.671	2.400	0.498
PALY	0.136	0.044	0.260	0.215	0.068	0.058
ZO	0.000	0.000	0.004	0.004	0.000	0.000
CAP	0.000	0.000	0.000	0.000	0.019	0.019
CAR	0.000	0.000	0.000	0.000	0.000	0.000
MAP	4.900	1.568	12.042	3.984	4.502	1.774
MAR	0.000	0.000	0.000	0.000	0.000	0.000
TAP	69.105	1.771	66.497	3.723	52.200	2.909
TAR	0.264	0.066	0.074	0.023	0.094	0.040
Other Live	5.928	1.682	1.846	1.051	8.425	1.208
Sand	3.131	1.002	1.032	0.331	1.946	0.850

Group legend: Stony = stony coral, BGP = branching gorgonian, EGP = encrusting gorgonian, SP = sponge, SR = sponge on rubble, BS = barrel sponge, PALY = Palythoa, ZO = zoanthid, CAP = coralline algae on pavement, CAR = coralline algae on rubble, MAP = macroalgae on pavement, MAR = macroalgae on rubble, TAP = turf algae on pavement, and TAR = turf algae on rubble. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Macroalgae and turf algae dominated benthic cover within all habitats with greater than 80% combined cover in the nearshore colonized pavement shallow (CPS), ridge shallow (RS), and inner reef (IR) habitats, greater than 70% cover in the offshore middle reef (MR), colonized pavement deep (CPD), and outer reef (OR) habitats, and 57% cover in the offshore spur and groove (SG) habitat. Stony coral cover (Figure 3) was less than 1% in all habitats except RS (2.0%) and SG (1.6%) which had significantly greater stony coral cover than the habitats with the lowest coverage (CPS and CPD) (ANOVA: $p < 0.0001$). Of the faunal groups, sponges (Figure 3) had the greatest coverage in all habitats except RS. The SG (11.2%) and MR (8.2%) habitats had significantly greater sponge coverage than the CPS (2.4%) and RS (1.0%) habitats (ANOVA: $p < 0.0001$). Branching gorgonians followed sponges in coverage for all habitats except CPD and SG (Figure 3), and ranged from 8.1% (SG) to 1.5% (CPS). Branching gorgonian coverage was significantly greater in the offshore habitats (SG, OR, and CPD) than the CPS habitat (ANOVA: $p = 0.0012$). The 'other live' benthic coverage group was prominent in the offshore habitats (MR, CPD, OR, and SG) especially CPD (5.9%) and SG (8.4%). In all these habitats most of the 'other live' group were dominated by cyanobacteria either as tufts on substrate or *Lyngbya* spp. growing epiphytically on branching gorgonians and sponges.

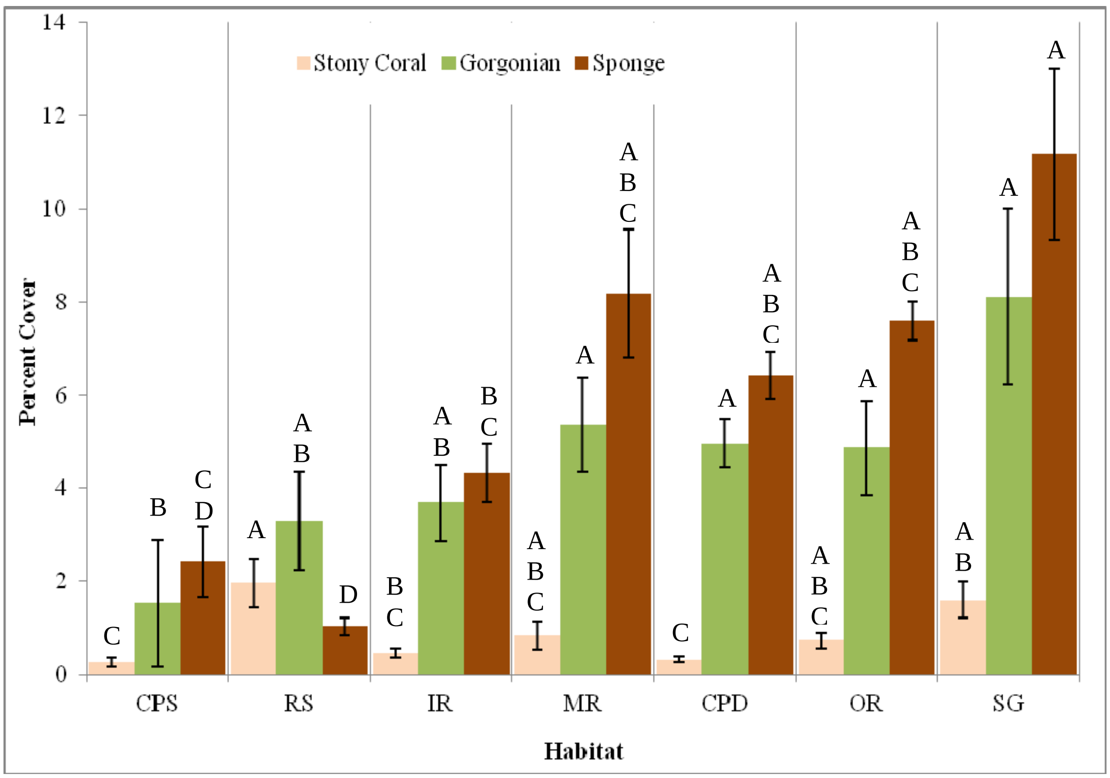

Figure 3. Stony coral, gorgonian, and sponge mean (±1 SE) percent coverage for each habitat. Means with different letters are significantly different. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

A multivariate approach was also used to characterize the benthic habitats at the community level. Figure 4 represents the MDS plot of functional group percent coverage data listed in Table 2. The outlines (clusters) indicate the Bray-Curtis similarities between sites at the 60% and 78% levels. The MDS plot illustrates that the sites break into four habitat clusters (78% level). The sites within each of the shallow nearshore habitats, CPS and RS, and IR, form within habitat clusters while the remaining sites in the deeper offshore habitats, MR, CPD, OR, and SG, all form a single cluster. Essentially this analysis illustrates that the sites within the CPS, RS, and IR habitats have greater within habitat similarity than the sites in the MR, CPD, OR and SG habitats. The MR, CPD, OR and SG habitats are more similar to each other than they are to CPS, RS, and IR.

The SIMPER procedure indicated that greater offshore percent cover of 'other live' (mostly cyanobacteria), barrel sponges, and branching gorgonians contributed to the separation (dissimilarity) of offshore habitat sites from nearshore habitat sites. The higher coverage of *Palythoa* nearshore also contributed to the separation of nearshore sites from offshore sites. The CPS and IR sites had greater coverage of macroalgae versus turf algae. Greater percent coverage of turf algae and stony corals also contributed to the separation of the RS sites.

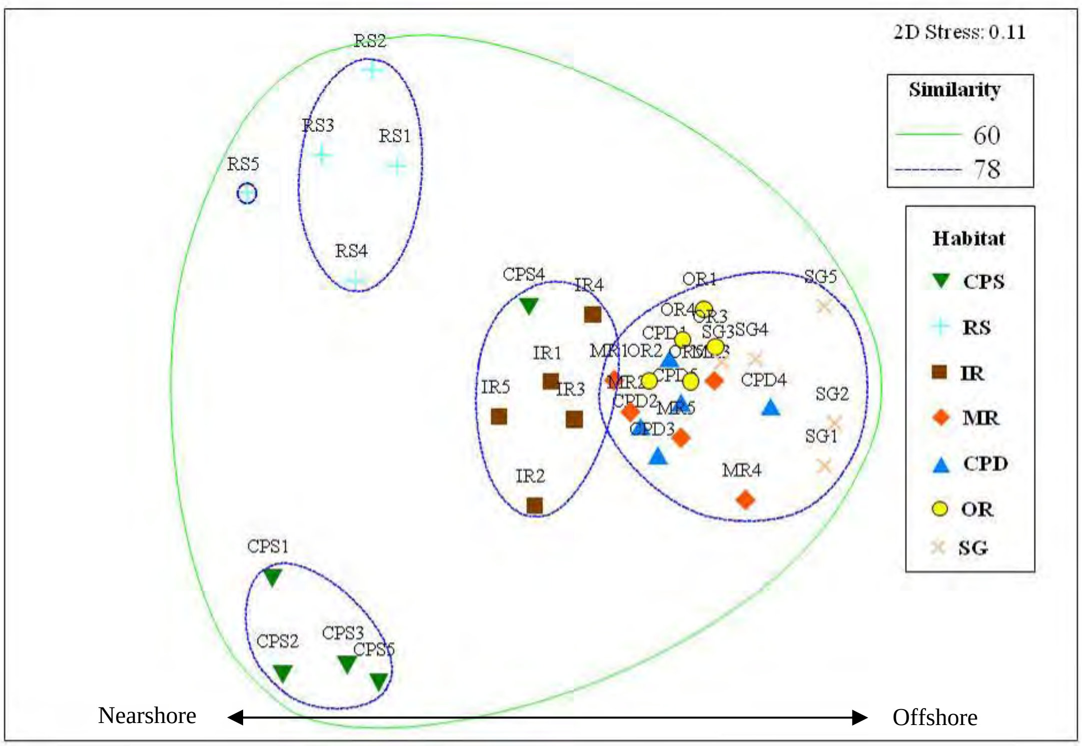

Figure 4. Benthic assessment functional group MDS plot with superimposed Bray Curtis clusters at 60% (green) and 78% (blue) similarity levels. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Stony Corals
A total of 1,850 colonies (≥2 cm diameter) comprised of 25 stony coral (scleractinian) species and the hydrocoral *Millepora alcicornis* were identified within the 35 non-cable sites (Table 4).

Table 4 lists the mean (±1 SE) density (colonies/m²) of each species identified within the habitats. Three species were identified in all seven habitats, *Siderastrea siderea*, *Porites astreoides*, and *Montastrea cavernosa*. *Dichocoenia stokesii*, *Meandrina meandrites*, *Porites porites*, *Solenastrea bournoni*, *Stephanocoenia intersepta,* were identified in six habitats. *Siderastrea siderea* was also the most abundant species with the highest or second highest density in all seven habitats. *Porites astreoides* was also one of the top five most abundant in all habitats. *Montastrea cavernosa* and *Stephanocoenia intersepta* contributed to top five density rankings in six of the habitats. The most species (n=17) were identified in the MR and SG habitats, and the fewest (n=9) were identified in the CPS habitat (Table 5); this difference was determined to be significant (ANOVA: $p = 0.0042$) (Figure 5).

Total stony coral density within the project area ranged from 2.2 ± 0.5 colonies/ m² (CPS) to 1.3 ± 0.1 colonies/m² (IR) (Table 5) with no significant difference in colony density determined among the seven habitats (Figure 5) (ANOVA: $p = 0.110$).

Significant differences in mean colony size (diameter [cm]) were determined among the seven habitats (ANOVA: $p < 0.0001$). Four size class groups were determined (Figure 6) and, in summary, the RS and SG habitats had larger mean colony sizes than the other five habitats, and the CPS habitat had smaller mean colony sizes than the other six habitats.

Stony coral size (diameter) class distribution was evaluated by assigning all stony corals to a size category (2-10 cm, 11-20 cm, 21-30 cm, 31-40 cm, 41-50 cm, >50 cm). Table 6 lists the mean (±1SE) density (colonies/m²) for each size class within each habitat. For all habitats, the smaller sizes classes (2-10 cm and 11-20 cm) dominated size class distribution (Figure 7) with density declining with larger colony sizes. Only the three smallest size classes had sufficient colonies in each of the habitats to permit meaningful statistical analyses.

The nearshore CPS habitat had significantly fewer colonies in the 11-20 cm and 21-30 cm size classes (ANOVA: $p < 0.0001$). Although not statistically tested, the RS and SG habitats had the greatest density in most of the larger size classes (Figure 7).

Gorgonians
A total of 5,203 colonies (≥2 cm height) comprised of 23 taxa were identified within the 35 non-cable sites. The most taxa (n=20) were identified in the SG habitat and the fewest number of taxa (n=14) were identified in the RS and IR habitats (Table 7). There was no significance difference in mean species (taxa) richness determined among habitats (Figure 8) (ANOVA: $p = 0.2730$).

Table 4. Stony coral species mean (±1 SE) density (colonies/m²) identified at non-cable sites within the CPS, RS, IR, and MR habitats. Species are listed in decreasing overall density within the project area.

	CPS		RS		IR		MR	
Species	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Siderastrea siderea	1.440	0.443	0.347	0.264	0.493	0.088	0.413	0.069
Porites astreoides	0.053	0.053	0.493	0.103	0.200	0.072	0.360	0.133
Stephanocoenia intersepta	0.033	0.015	0.000	0.000	0.233	0.062	0.447	0.089
Montastraea cavernosa	0.047	0.047	0.040	0.012	0.153	0.023	0.167	0.043
Porites porites	0.600	0.278	0.087	0.036	0.073	0.032	0.027	0.012
Meandrina meandrites	0.000	0.000	0.007	0.007	0.067	0.024	0.153	0.034
Madracis decactis	0.000	0.000	0.000	0.000	0.000	0.000	0.033	0.015
Acropora cervicornis	0.000	0.000	0.260	0.105	0.000	0.000	0.000	0.000
Dichocoenia stokesii	0.020	0.013	0.107	0.040	0.060	0.037	0.027	0.012
Diploria clivosa	0.007	0.007	0.207	0.074	0.000	0.000	0.000	0.000
Agaricia agaricites	0.000	0.000	0.000	0.000	0.020	0.013	0.027	0.012
Montastraea faveolata	0.000	0.000	0.000	0.000	0.007	0.007	0.027	0.012
Solenastrea bournoni	0.040	0.012	0.013	0.008	0.033	0.015	0.007	0.007
Agaricia fragilis	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.000
Diploria strigosa	0.000	0.000	0.000	0.000	0.007	0.007	0.027	0.012
Eusmilia fastigiata	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.008
Diploria labyrinthiformis	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.008
Agaricia lamarcki	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Colpophyllia natans	0.007	0.007	0.000	0.000	0.000	0.000	0.007	0.007
Mycetophyllia aliciae	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Montastraea franksi	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Madracis mirabilis	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Montastraea annularis	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oculina diffusa	0.000	0.000	0.007	0.007	0.000	0.000	0.000	0.000
Scolymia cubensis	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Scolymia spp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 4. Continued. Stony coral species mean (±1 SE) density (colonies/m²) identified within the offshore CPD, OR, and SG habitats. Species are listed in decreasing overall density within the project area.

	CPD		OR		SG	
Species	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Siderastrea siderea	0.353	0.066	0.493	0.046	0.460	0.083
Porites astreoides	0.080	0.025	0.333	0.064	0.267	0.069
Stephanocoenia intersepta	0.340	0.084	0.407	0.080	0.307	0.052
Montastraea cavernosa	0.240	0.043	0.480	0.070	0.553	0.037
Porites porites	0.007	0.007	0.013	0.013	0.000	0.000
Meandrina meandrites	0.053	0.013	0.093	0.031	0.107	0.032
Madracis decactis	0.120	0.023	0.053	0.017	0.193	0.049
Acropora cervicornis	0.000	0.000	0.000	0.000	0.000	0.000
Dichocoenia stokesii	0.013	0.013	0.027	0.012	0.000	0.000
Diploria clivosa	0.000	0.000	0.000	0.000	0.000	0.000
Agaricia agaricites	0.040	0.019	0.040	0.019	0.013	0.008
Montastraea faveolata	0.000	0.000	0.027	0.012	0.073	0.027
Solenastrea bournoni	0.020	0.013	0.007	0.007	0.000	0.000
Agaricia fragilis	0.033	0.021	0.000	0.000	0.007	0.007
Diploria strigosa	0.000	0.000	0.007	0.007	0.007	0.007
Eusmilia fastigiata	0.007	0.007	0.000	0.000	0.013	0.008
Diploria labyrinthiformis	0.000	0.000	0.007	0.007	0.000	0.000
Agaricia lamarcki	0.013	0.013	0.000	0.000	0.007	0.007
Colpophyllia natans	0.000	0.000	0.000	0.000	0.000	0.000
Mycetophyllia aliciae	0.000	0.000	0.000	0.000	0.007	0.007
Montastraea franksi	0.000	0.000	0.000	0.000	0.013	0.013
Madracis mirabilis	0.000	0.000	0.000	0.000	0.013	0.013
Montastraea annularis	0.000	0.000	0.000	0.000	0.007	0.007
Oculina diffusa	0.000	0.000	0.000	0.000	0.000	0.000
Scolymia cubensis	0.000	0.000	0.000	0.000	0.000	0.000
Scolymia spp.	0.013	0.008	0.000	0.000	0.020	0.008

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 5. Stony coral species count and mean (±1 SE) density (colonies/m^2) and diameter (cm) per habitat. The largest (diameter [cm]) colony size and species identified within each habitat is also listed.

Habitat	Species Total	Species Mean	SE	Density Mean	SE	Diameter Mean	SE	Largest Diameter	Species
CPS	9	4.200	0.800	2.247	0.527	4.718	0.385	75	*M. cavernosa*
RS	10	7.000	0.837	1.567	0.248	19.540	1.411	137	*D. clivosa*
IR	12	7.600	1.077	1.360	0.301	6.931	0.603	52	*S. bournoni*
MR	17	10.600	1.030	1.773	0.217	9.034	0.575	70	*D. labyrinthiformis*
CPD	14	8.600	0.927	1.333	0.132	7.900	0.557	52	*A. lamarcki*
OR	13	8.400	0.927	2.010	0.131	8.815	0.513	75	*M. meandrites*
SG	17	9.600	0.400	2.067	0.122	14.906	0.887	120	*A. lamarcki*

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

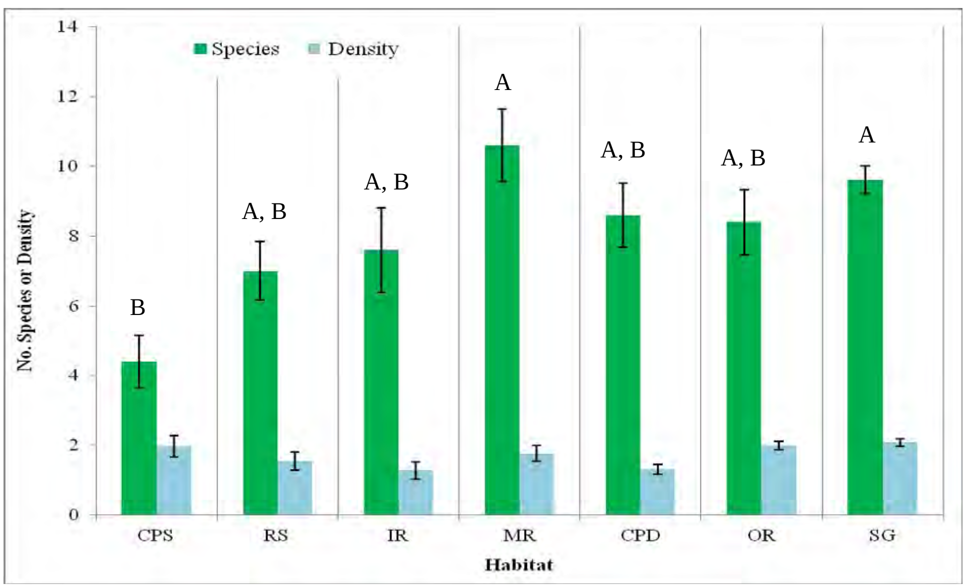

Figure 5. Stony coral mean (±1 SE) species richness and density (colonies/m²) for each habitat. Species richness means with different letters are significantly different. No significant difference was determined in density. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

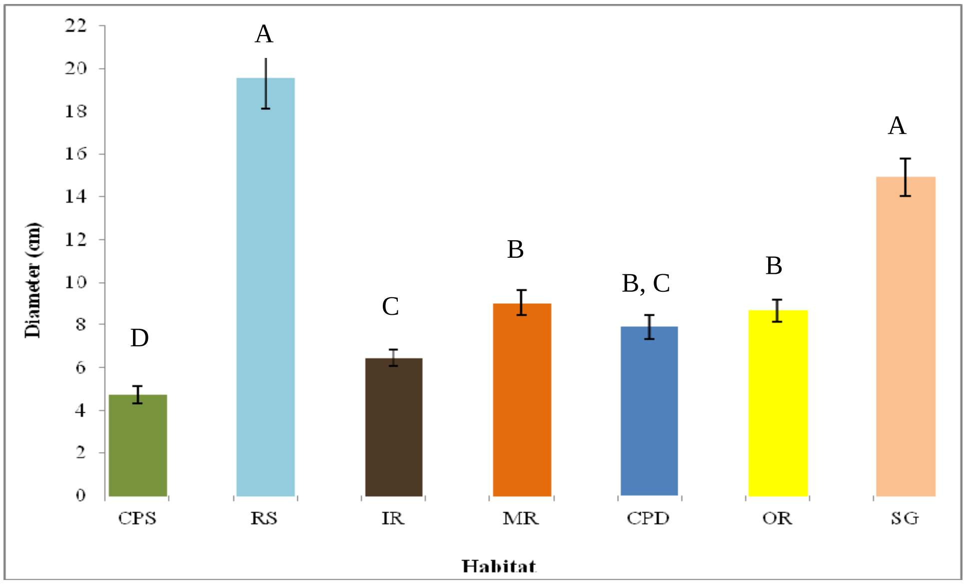

Figure 6. Stony coral mean (±1 SE) colony diameter (cm) for each habitat. Means with different letters are significantly different. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 6. Stony coral mean (±1 SE) size (diameter [cm]) class density (colonies/m²) per habitat.

	2-10 cm		11-20 cm		21-30 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS	2.147	0.543	0.053	0.013	0.013	0.013
RS	0.707	0.319	0.373	0.046	0.193	0.027
IR	1.153	0.231	0.180	0.074	0.013	0.008
MR	1.373	0.163	0.287	0.063	0.053	0.008
CPD	1.093	0.114	0.167	0.051	0.040	0.012
OR	1.493	0.101	0.387	0.068	0.027	0.019
SG	1.227	0.190	0.400	0.049	0.167	0.060

	31-40 cm		41-50 cm		>50 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS	0.013	0.008	0.000	0.000	0.020	0.020
RS	0.113	0.027	0.053	0.027	0.127	0.051
IR	0.000	0.000	0.000	0.000	0.013	0.013
MR	0.020	0.013	0.020	0.013	0.020	0.013
CPD	0.020	0.008	0.000	0.000	0.013	0.008
OR	0.060	0.007	0.000	0.000	0.020	0.008
SG	0.113	0.044	0.087	0.029	0.073	0.029

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

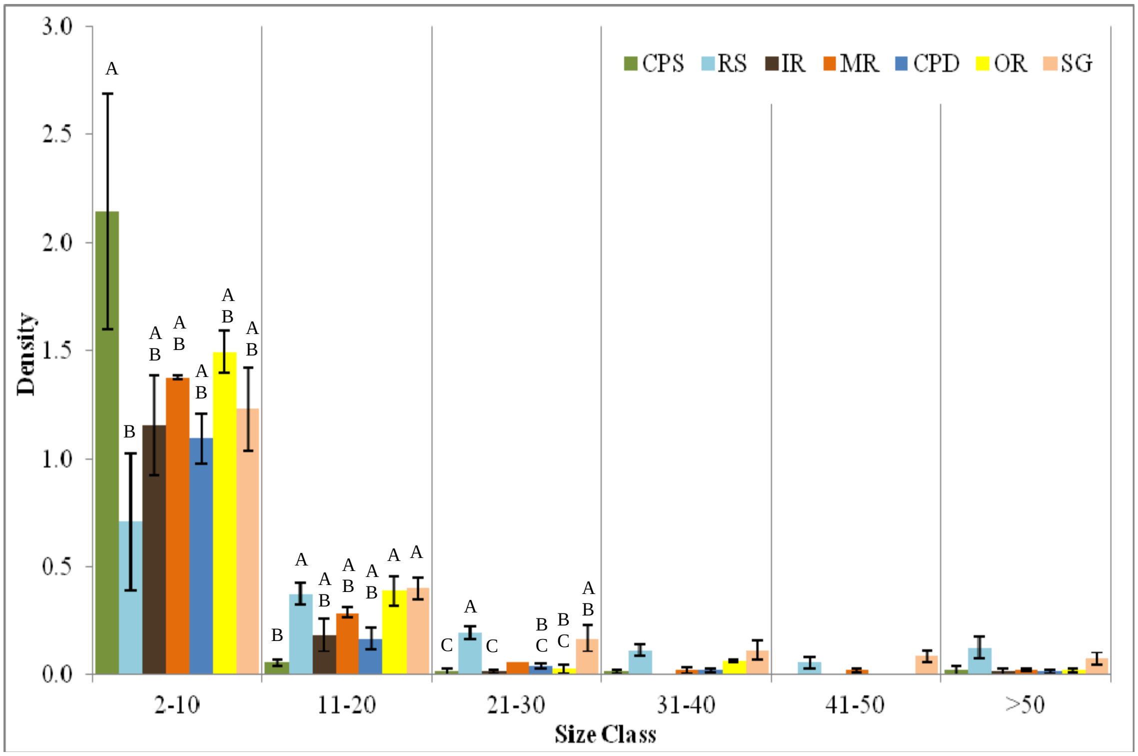

Figure 7. Stony coral mean (±1 SE) density (colonies/m²) per size (diameter [cm]) class for each habitat. Means with different letters are significantly different within each class. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 8 lists the mean (±1 SE) density (colonies/m²) of each gorgonian taxa identified within each habitat. Seven species of gorgonians were identified within all seven habitats: *Eunicea flexuosa, Eunicea laciniata, Eunicea mammosa, Gorgonia ventalina, Muricea muricata, Pseudopterogorgia americana,* and *Pseudoplexaura porosa.*

Two additional species, *Pseudopterogorgia acerosa* and *Pterogorgia citrina,* were identified in six habitats. *Pseudopterogorgia americana* was the most abundant species ranking first or second in density in six habitats and third in RS habitat. *Eunicea flexuosa* and *Pseudoplexaura porosa* were also very abundant with a top five ranking in all habitats. Total gorgonian density ranged from a high of 10.0 ± 2.9 colonies/ m² (SG) to a low of 1.7 ± 1.2 colonies/m² (CPS) (Table 7) with the CPS density determined to be significantly less than the other seven habitats (Figure 8) (ANOVA: p = 0.0388).

Gorgonian size class distribution was evaluated by assigning all colonies to a size (height) category (2-5 cm, 6-10 cm, 11-25 cm, 26-50 cm, >50 cm). Table 9 lists the mean (±1SE) density (colonies/m²) for each size class within each habitat. Size class distribution was similar in all habitats. The 11-25 cm size class had the greatest density with colony density declining towards the smaller and larger size classes. The SG habitat had the greatest colony density in most size classes while the CPS habitat had the lowest and the difference between these habitats was determined to be significant for the three larger size classes (Figure 9) (11-25 cm ANOVA: p = 0.0420) (26-50 cm ANOVA: p = 0.0180) (>50 cm ANOVA: p < 0.0001).

Table 7. Gorgonian mean total (±1 SE) taxa and mean density (colonies/m^2) per habitat.

Habitat	Taxa Total	Mean	SE	Density Mean	SE
CPS	15	8.000	1.450	1.827	1.187
RS	14	7.600	0.750	3.053	0.673
IR	14	9.600	1.210	5.587	1.268
MR	15	9.600	0.680	5.480	0.739
CPD	16	10.000	0.840	5.480	0.650
OR	16	7.000	0.950	4.367	0.875
SG	20	10.000	1.410	8.893	2.438

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove

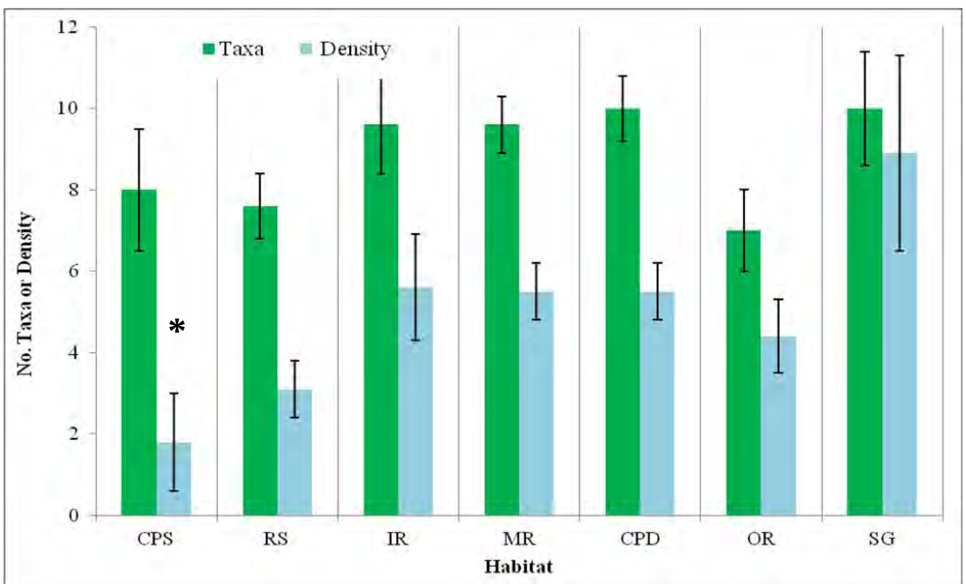

Figure 8. Gorgonian mean (±1 SE) taxa richness and density (colonies/m²) for each habitat. No significant difference was determined in taxa richness. * CPS density was determined to be significantly different. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Barrel Sponges (Xestospongia muta)

A total of 323 sponges were identified within the 35 non-cable sites. Total sponge density within the project area ranged from 0.61 ± 0.06 colonies/ m² (SG) to 0 sponges/m² (RS) (Table 10). The density in the offshore habitats (SG, OR, CPD, and MR) was determined to be significantly greater than in the nearshore habitats (IR, RS, and CPS) (ANOVA: $p < 0.0001$) (Figure 10). The maximum size of the sponges identified within the habitats increased with distance from shore and depth (Table 10) with the largest sponge (214,164 cm^3 or 80 cm base diameter x 60 cm

Table 8. Gorgonian (mean ±1 SE) taxa density (colonies/m²) identified within CPS, RS, IR, and MR habitats. Taxa are listed in decreasing overall density within the project area.

	CPS		RS		IR		MR	
Taxa	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Eunicea spp.	0.627	0.519	1.127	0.289	2.300	0.425	2.460	0.586
Pseudopterogorgia americana	0.307	0.282	0.327	0.141	2.227	0.634	1.860	0.191
Eunicea flexuosa	0.220	0.212	0.680	0.122	0.313	0.142	0.293	0.062
Pseudoplexaura porosa	0.047	0.039	0.153	0.051	0.160	0.152	0.293	0.142
Gorgonia ventalina	0.040	0.040	0.420	0.104	0.047	0.025	0.093	0.040
Pseudoplexaura spp.	0.047	0.031	0.020	0.008	0.033	0.011	0.067	0.052
Pseudopterogorgia acerosa	0.053	0.017	0.000	0.000	0.187	0.070	0.160	0.078
Muricea muricata	0.113	0.047	0.033	0.018	0.013	0.008	0.080	0.025
Eunicea laciniata	0.080	0.040	0.073	0.036	0.033	0.018	0.067	0.043
Pterogorgia citrina	0.047	0.029	0.000	0.000	0.107	0.039	0.027	0.027
Eunicea mammosa	0.007	0.007	0.087	0.036	0.027	0.012	0.040	0.024
Plexaurella nutans	0.133	0.095	0.047	0.033	0.000	0.000	0.007	0.007
Muricea spp.	0.000	0.000	0.007	0.007	0.047	0.047	0.000	0.000
Plexaurella spp.	0.060	0.019	0.007	0.007	0.020	0.013	0.013	0.008
Pseudopterogorgia spp.	0.000	0.000	0.000	0.000	0.060	0.037	0.007	0.007
Pseudopterogorgia rigida	0.000	0.000	0.040	0.019	0.000	0.000	0.007	0.007
Pterogorgia anceps	0.040	0.040	0.000	0.000	0.000	0.000	0.007	0.007
Plexaura homomalla	0.007	0.007	0.027	0.012	0.000	0.000	0.000	0.000
Plexaura spp.	0.000	0.000	0.007	0.007	0.000	0.000	0.000	0.000
Unknown spp.	0.000	0.000	0.000	0.000	0.013	0.013	0.000	0.000

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

height) measured in the SG habitat. There was no significant difference determined in mean sponge volume (cm^3) among the seven habitats (Figure 11) (ANOVA: p = 0.2229).

Barrel sponge size class distribution was evaluated by assigning all sponges to the following size (volume) categories: 0-5,500 cm^3, 5,500-40,300 cm^3, 40,300-126,200 cm^3, and >126,200 cm^3 which are equivalent to the following base widths x heights: 20 X 20 cm, 40 x 40 cm, 60 x 60 cm, and >60 x >60 cm. Table 11 lists the mean (±1SE) density (colonies/m²) for each size class within each habitat. Only the two smaller size classes had sufficient abundance of sponges in each of the habitats to permit meaningful statistical analyses. The SG habitat had significantly greater sponge density than the IR habitat in both size classes (0-5,500 cm^3ANOVA: p = 0.0005) (5,500-40,300 cm^3 ANOVA: p < 0.0001). Only the offshore habitats (SG, OR, CPD) had sponges in the largest size class (Figure 12). This result is not unexpected since *X. muta* is most commonly found at depths greater than 10 m (Bertin and Callahan 2008).

Table 8. Continued. Gorgonian (mean ±1 SE) taxa density (colonies/m²) identified within the offshore CPD, OR, and SG habitats. Taxa are listed in decreasing overall density within the project area.

	CPD		OR		SG	
Taxa	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Eunicea spp.	2.620	0.559	2.227	0.566	5.233	1.573
Pseudopterogorgia americana	1.627	0.119	1.013	0.272	0.887	0.429
Eunicea flexuosa	0.507	0.103	0.533	0.089	0.487	0.133
Pseudoplexaura porosa	0.067	0.024	0.127	0.045	0.320	0.093
Icilogorgia schrammi	0.040	0.012	0.060	0.060	0.940	0.433
Gorgonia ventalina	0.133	0.057	0.147	0.069	0.047	0.033
Pseudoplexaura spp.	0.093	0.034	0.053	0.031	0.567	0.421
Pseudopterogorgia acerosa	0.173	0.078	0.047	0.013	0.127	0.087
Muricea muricata	0.067	0.035	0.027	0.012	0.027	0.007
Eunicea laciniata	0.027	0.019	0.033	0.021	0.007	0.007
Pterogorgia citrina	0.027	0.027	0.047	0.033	0.067	0.032
Eunicea mammosa	0.053	0.031	0.027	0.019	0.040	0.016
Plexaurella nutans	0.007	0.007	0.007	0.007	0.000	0.000
Muricea spp.	0.020	0.008	0.000	0.000	0.067	0.021
Plexaurella spp.	0.020	0.013	0.000	0.000	0.013	0.013
Pseudopterogorgia rigida	0.000	0.000	0.007	0.007	0.007	0.007
Plexaura homomalla	0.000	0.000	0.007	0.007	0.007	0.007
Pterogorgia guadalupensis	0.000	0.000	0.000	0.000	0.027	0.027
Plexaura spp.	0.000	0.000	0.007	0.007	0.013	0.013
Ellisella barbadensis	0.000	0.000	0.000	0.000	0.007	0.007
Pseudopterogorgia bipinnata	0.000	0.000	0.000	0.000	0.007	0.007

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 9. Gorgonian mean (±1 SE) size (height [cm) class density (colonies/m²) per habitat.

	2-5 cm		6-10 cm		11-25 cm		26-50 cm		>50 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS	0.120	0.073	0.447	0.262	0.633	0.451	0.460	0.287	0.167	0.125
RS	0.560	0.167	0.653	0.168	1.020	0.260	0.547	0.132	0.273	0.069
IR	0.340	0.107	1.567	0.325	2.627	0.666	0.860	0.252	0.193	0.053
MR	0.367	0.114	1.067	0.183	2.667	0.453	1.127	0.127	0.253	0.042
CPD	0.467	0.193	1.280	0.165	2.273	0.416	1.040	0.140	0.420	0.092
OR	0.480	0.079	1.000	0.241	1.687	0.439	0.867	0.139	0.333	0.095
SG	0.480	0.207	1.293	0.266	4.807	1.670	1.627	0.287	0.687	0.138

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

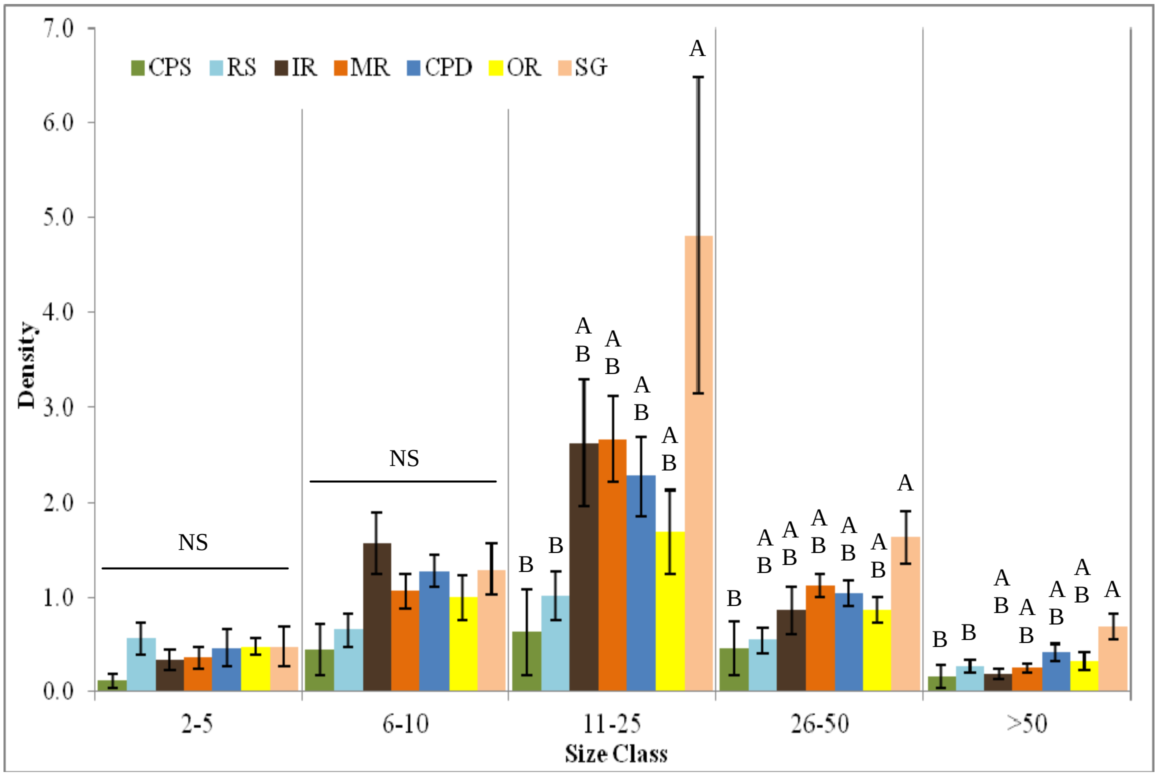

Figure 9. Gorgonian mean (±1 SE) density (colonies/m²) per size (height [cm]) class for each habitat. Means with differing letters (A or B) are significantly different within each class. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 10. Barrel sponge mean (±1 SE) density (sponges/m^2) and volume (cm^3) per habitat. Maximum sponge volume (cm^3) and size (base diameter and height [cm]) for each habitat also listed. Only one sponge was identified in the CPS habitat, and no sponges were identified in the RS habitat.

	Density		Volume		Maximum	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Volume**	**DxH**
CPS	0.01		7,630		7,630	25x18
RS	0.00					
IR	0.16	0.03	12,119	4,697	81,971	48x59
MR	0.41	0.03	12,578	2,782	98,988	55x55
CPD	0.58	0.08	16,424	3,254	130,718	67x50
OR	0.33	0.06	22,709	4,549	141,747	70x50
SG	0.61	0.06	12,052	2,788	214,164	80x60

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

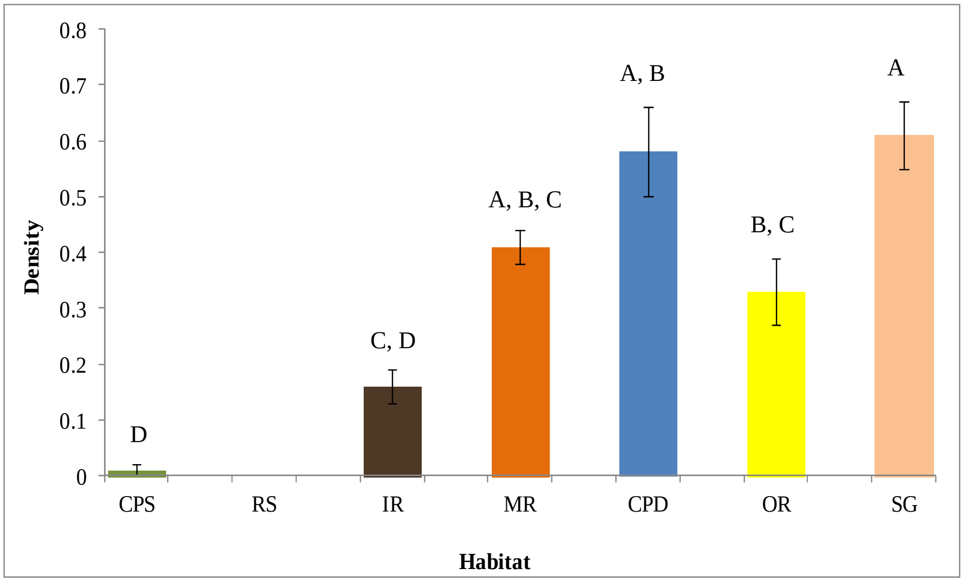

Figure 10. Barrel sponge mean (±1 SE) density (sponges/m²) for each habitat. Means with differing letters are significantly different. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

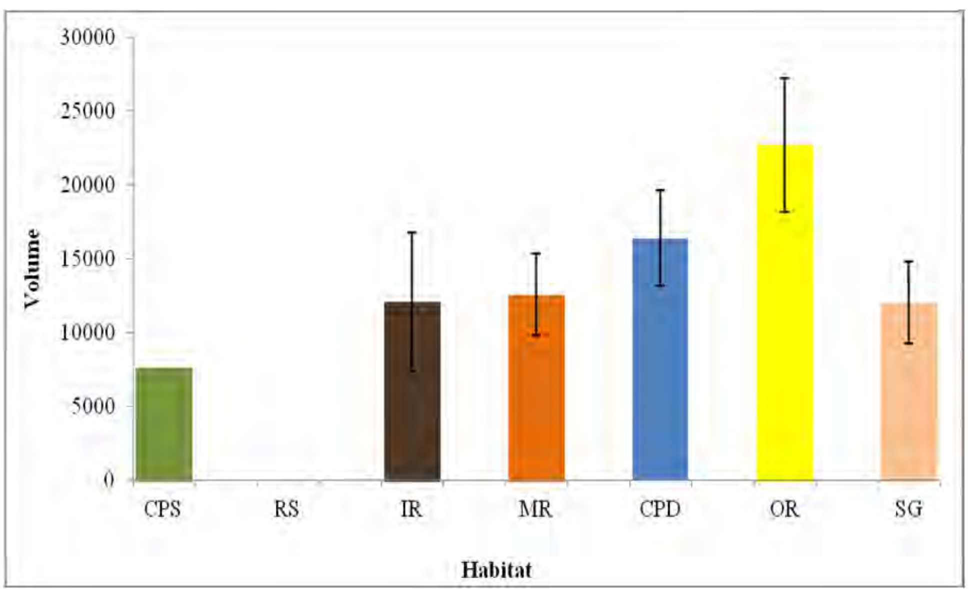

Figure 11. Barrel sponge mean (±1 SE) volume (cm^3) for each habitat. No significant difference was determined in volume. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 11. Barrel sponge mean (±1 SE) size (volume [cm^3]) class density (sponge/m²) per habitat.

Habitat	0-5,000 cm^3 Mean	SE	5,000-40,300 cm^3 Mean	SE	40,300-126,200 cm^3 Mean	SE	>126,200 cm^3 Mean	SE
CPS	0.000		0.033		0.000		0.000	
RS	0.000		0.000		0.000		0.000	
IR	0.113	0.017	0.027	0.019	0.020	0.013	0.000	0.000
MR	0.260	0.019	0.100	0.015	0.053	0.017	0.000	0.000
CPD	0.353	0.045	0.140	0.029	0.080	0.025	0.007	0.007
OR	0.147	0.013	0.120	0.037	0.053	0.025	0.013	0.008
SG	0.393	0.061	0.227	0.024	0.027	0.012	0.013	0.008

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove

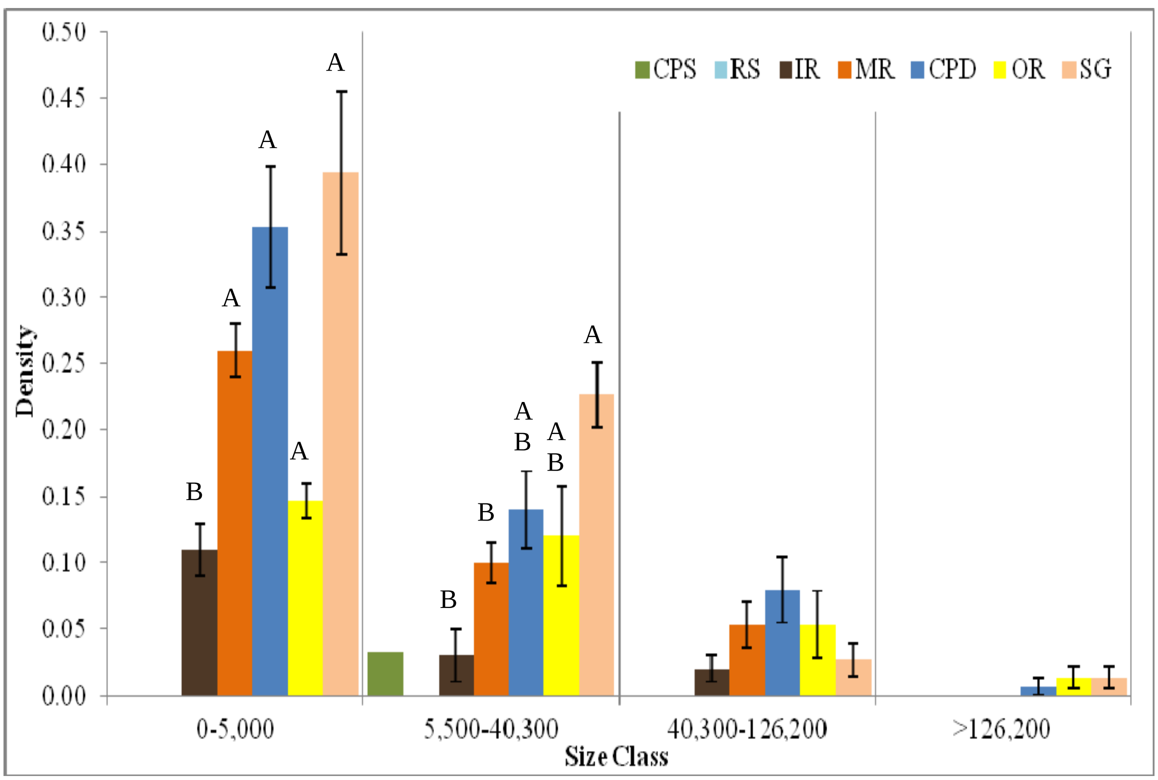

Figure 12. Barrel sponge mean (±1 SE) density (sponges/m²) per size (volume [cm^3]) class for each habitat. Means with differing letters (A or B) are significantly different within each class. Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Cable Impact Assessment

Within the project area, 35 cable sites were sampled with a distribution of five sites per each of the seven habitats. The assessment of cable associated impacts to Essential Fish Habitat (EFH) resources was analyzed in two ways. The first compared the benthic community between non-cable and cable sites within each habitat, and the second specifically evaluated evidence of cable movement, and cable associated impacts to key components of the benthic community, stony corals, gorgonian, and barrel sponges.

Cable sites were chosen based on the presence of cable. A minimum of one cable had to be present within each survey area, and a cable defined the location and stretched the length of the belt transects (which were also one of the three video transects). Table 12 lists the number of cables within each of the cable site survey areas. The number of cables within each site area was greatest in the nearshore sites (CPS and RS) due to the greater density of cables running through the nearshore CPS and RS habitats immediately offshore the Navy facility (see Figure 2).

Table 12. Number of cables within each of the cable site survey areas and the mean per habitat.

Site	No. Cables	Site	No. Cables
CPS1-C	3	CPD1-C	1
CPS2-C	6	CPD2-C	1
CPS3-C	10	CPD3-C	1
CPS4-C	2	CPD4-C	1
CPS5-C	1	CPD5-C	1
Mean	4	Mean	1
RS1-C	5	OR1-C	1
RS2-C	1	OR2-C	2
RS3-C	4	OR3-C	1
RS4-C	2	OR4-C	1
RS5-C	2	OR5-C	2
Mean	3	Mean	1
IR1-C	3	SG1-C	1
IR2-C	3	SG2-C	2
IR3-C	1	SG3-C	1
IR4-C	1	SG4-C	1
IR5-C	1	SG5-C	1
Mean	2	Mean	1
MR1-C	2		
MR2-C	1		
MR3-C	2		
MR4-C	2		
MR5-C	1		
Mean	2		

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Data from the video transects were used to estimate functional group coverage within the cable sites in each habitat. Table 13 lists the mean (±1 SE) coverage data for each habitat. The functional groups listed in Table 13 include the functional groups analyzed for habitat characterization using the non-cable sites (Table 3), and several additional groups which capture the coverage of cable (e.g. branching gorgonian on cable and sponge on cable) in each site. Additionally, scour was included to permit an estimate of recent or on-going cable movement impacting reef substrate.

Table 13. Functional group mean (±1 SE) percent coverage for the CPS, RS, and MR habitats from the cable sites.

	CPS-C		**RS-C**		**IR-C**		**MR-C**	
Group	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stony	0.843	0.270	0.589	0.122	0.957	0.120	0.648	0.106
BGC	0.101	0.056	0.257	0.170	0.392	0.127	0.902	0.298
BGP	2.024	0.651	2.684	0.701	2.515	0.662	4.993	0.801
EGC	0.022	0.014	0.079	0.053	0.092	0.062	0.619	0.329
EGP	0.441	0.231	0.457	0.057	1.592	0.273	3.120	0.569
SC	0.271	0.119	0.416	0.178	1.568	0.630	0.981	0.247
SP	1.539	0.546	1.512	0.186	3.796	0.555	5.215	0.774
SR	0.000	0.000	0.013	0.013	0.004	0.004	0.008	0.005
BS	0.012	0.012	0.005	0.005	0.252	0.125	0.825	0.382
PALY	0.799	0.470	5.493	1.304	2.577	0.566	0.054	0.031
ZO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CAC	0.004	0.004	0.042	0.038	0.038	0.024	0.011	0.011
CAP	0.004	0.004	0.021	0.012	0.012	0.008	0.009	0.009
CAR	0.020	0.015	0.004	0.004	0.021	0.016	0.000	0.000
MAC	3.949	2.326	0.597	0.329	0.517	0.225	0.607	0.288
MAP	22.385	3.598	17.384	6.221	12.051	2.603	7.141	2.005
MAR	0.057	0.024	0.004	0.004	0.028	0.028	0.000	0.000
TAC	3.628	1.064	5.021	0.329	3.384	0.519	2.469	0.183
TAP	53.650	5.874	61.608	4.972	66.808	4.197	68.587	2.270
TAR	2.309	1.056	1.050	0.298	0.804	0.201	0.132	0.037
Other Live	0.026	0.005	0.059	0.026	0.090	0.035	0.188	0.108
Sand	6.368	3.976	2.126	0.926	1.064	0.290	3.370	1.175
Scour	1.548	0.781	0.578	0.360	1.438	0.818	0.119	0.087

Group legend: Stony = stony coral, BGC = branching gorgonian on cable, BGP = branching gorgonian on pavement, EGC = encrusting gorgonian on cable, EGP = encrusting gorgonian on pavement, SC = sponge on cable, SP = sponge on pavement, SR = sponge on rubble, BS = barrel sponge, PALY = Palythoa, ZO = zoanthid, CAC = coralline algae on cable, CAP = coralline algae on pavement, CAR = coralline algae on rubble, MAC = macroalgae on cable, MAP = macroalgae on pavement, MAR = macroalgae on rubble, TAC = turf algae on cable, TAP = turf algae on pavement, and TAR = turf algae on pavement.
Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef.

Table 13. Continued. Functional group mean (±1 SE) percent coverage for the CPS, RS, and MR habitats from the cable sites.

	CPD-C		OR-C		SG-C	
Group	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Stony	0.892	0.311	1.049	0.226	1.622	0.268
BGC	0.451	0.211	0.094	0.047	0.182	0.071
BGP	4.481	0.794	3.631	1.223	4.507	1.310
EGC	0.396	0.167	0.377	0.149	0.864	0.429
EGP	2.442	0.339	2.393	0.639	3.873	0.807
SC	1.780	0.854	1.695	0.693	0.789	0.323
SP	7.605	0.522	5.757	0.412	6.859	0.838
SR	0.000	0.000	0.004	0.004	0.000	0.000
BS	1.216	0.280	1.265	0.080	1.942	0.416
PALY	0.109	0.057	0.143	0.118	0.105	0.090
ZO	0.000	0.000	0.000	0.000	0.000	0.000
CAC	0.038	0.024	0.095	0.051	0.004	0.004
COP	0.000	0.000	0.046	0.042	0.004	0.004
CAR	0.000	0.000	0.000	0.000	0.000	0.000
MAC	0.471	0.265	0.249	0.088	0.410	0.388
MOP	6.575	2.524	15.402	6.430	16.215	7.223
MAR	0.000	0.000	0.000	0.000	0.000	0.000
TAC	2.252	0.521	1.491	0.497	1.078	0.327
TAP	63.792	1.785	60.871	7.046	52.899	5.360
TAR	0.089	0.021	0.253	0.135	0.245	0.110
Other Live	6.045	2.796	3.736	1.478	5.060	1.385
Sand	1.179	0.290	1.283	0.849	3.326	1.617
Scour	0.181	0.181	0.161	0.130	0.013	0.009

Group legend: Stony = stony coral, BGC = branching gorgonian on cable, BGP = branching gorgonian on pavement, EGC = encrusting gorgonian on cable, EGP = encrusting gorgonian on pavement, SC = sponge on cable, SP = sponge on pavement, SR = sponge on rubble, BS = barrel sponge, PALY = Palythoa, ZO = zoanthid, CAC = coralline algae on cable, CAP = coralline algae on pavement, CAR = coralline algae on rubble, MAC = macroalgae on cable, MAP = macroalgae on pavement, MAR = macroalgae on rubble, TAC = turf algae on cable, TAP = turf algae on pavement, and TAR = turf algae on pavement.
Habitat legend: CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

The multivariate approach used to characterize habitats at the community level was also used to evaluate similarities among non-cable and cable sites. Figure 13 represents the MDS plot of percent coverage data of the functional groups listed in Table 3 for the non-cable sites and Table 13 for the cable sites. The outlines (clusters) indicate the Bray-Curtis derived site similarities at the 78% level. The MDS plot illustrates that the sites break into habitat clusters (78% level) with the cable site clusters separate from the non-cable site clusters. The presence of cable, essentially as a substrate type (branching gorgonians or sponge on cable instead of natural pavement), is driving this dissimilarity. The relationship among the cable sites is similar to that of the non-cable sites in that the sites within each of the shallow nearshore habitats, CPS, RS, and IR form within habitat clusters while the remaining sites in the deeper offshore habitats, MR, CPD, OR,

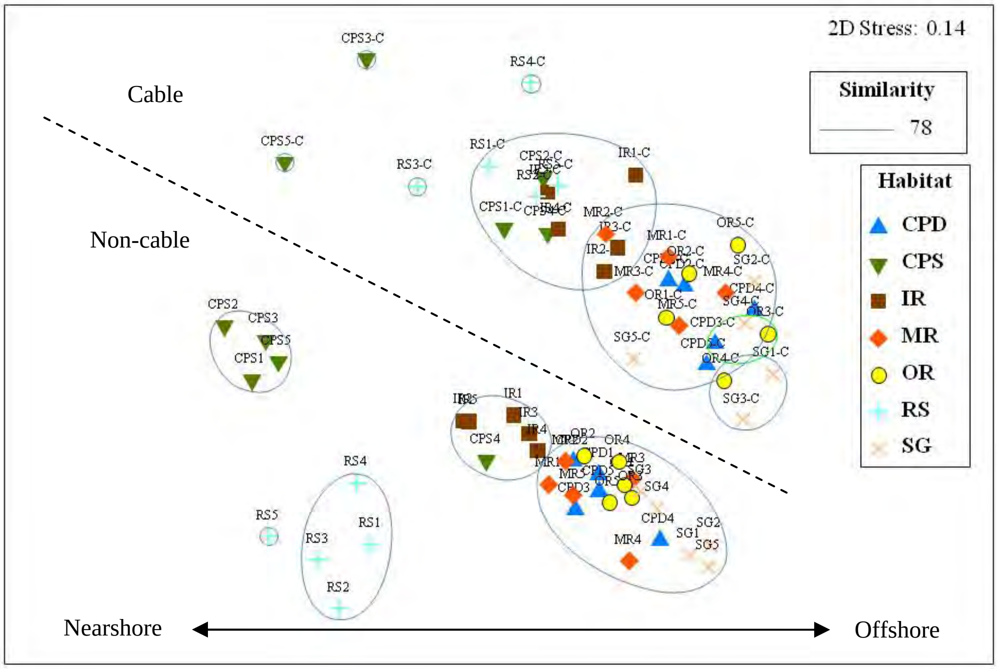

Figure 13. Cable and noncable benthic assessment functional group MDS plot with superimposed Bray Curtis clusters at 78% (blue) similarity levels. Habitat legend: C = cable; CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

and SG, form a single cluster. As identified in Figure 4, the sites within the CPS, RS, and IR habitats have greater within habitat similarity than the sites in the MR, CPD, OR and SG habitats which are more similar to each other than to CPS, RS, or IR.

Figure 14 represents the MDS plot when the cable groups are combined with the pavement groups (i.e. the branching gorgonian on cable percent cover was combined with the branching gorgonian on pavement). When cable is essentially removed as a substrate type, separation of the cable sites from non-cable sites is no longer present, except for non-cable RS sites. This indicates that when cable is removed as a substrate type from the analysis, the cable and non-cable sites within habitats are similar at the community level.

Scour was identified in 22 of the 35 cable sites (Table 13 and 14). The nearshore habitats (CPS, RS, and IR) were characterized by greater percent cover of scoured substrate, although this was not significant (ANOVA: $p = 0.0771$). Scour is an indication of cable movement against the substrate, creating a relatively flat space void of biota except for turf algae. Figure 15 provides an example image from a transect video with cable scour from site IR1-C.

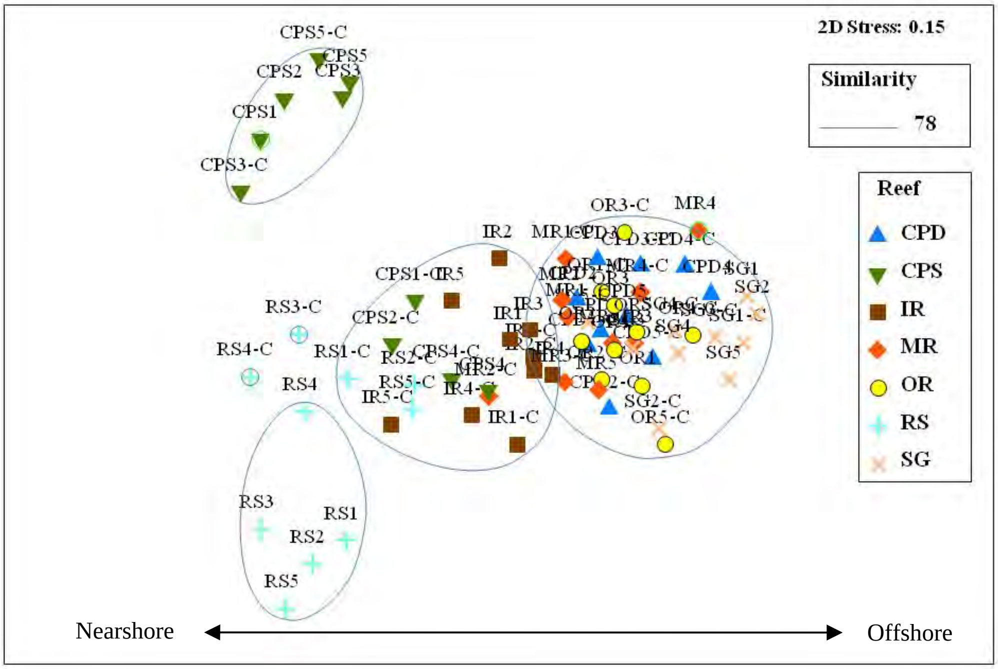

Figure 14. Cable and noncable benthic assessment functional group (cable removed as a substrate type) MDS plot with superimposed Bray Curtis clusters at 78% (blue) similarity levels. Habitat legend: C = cable; CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Cable movement was documented within 27 cable sites (Table 14). In addition to scour identified in the video transects, movement was also documented in the belt transects as scour areas or as impacts to stony corals, gorgonians, or barrel sponges adjacent to, but no longer in contact with, a cable during the survey. Figure 16 shows a representative scour area from the IR1-C belt transect. Figures 17 (stony coral, *M. meandrites*, in the CPS habitat), 18 (stony coral, *M. cavernosa*, in site CPS2-C), and 19 (barrel sponge, *X. muta*, in site MR1-C) provide examples of past impacts (abrasions) from cables that were not in contact with the colonies or sponges during the time of the survey, thus providing visual evidence of cable movement. Additional indications of cable movement included broken cables (Figure 20) seen within the CPS habitat, frayed cables (Figure 21) recorded in two sites (RS4-C and IR1-C), and tangled cables (Figure 22) recorded in five sites (CPS1-C, CPS2-C, CPS3-C, RS1-C, and IR5-C).

Table 14. Cable sites with documented evidence of cable movement.

Site	Notes on Movement
CPS1-C	scour, impacted stony corals, and tangled cables
CPS2-C	scour, impacted stony corals, and tangled cables
CPS3-C	scour, impacted stony corals, and tangled cables
CPS4-C	scour
CPS5-C	scour
RS1-C	scour, impacted stony corals, and tangled cables
RS2-C	scour
RS3-C	scour
RS4-C	frayed cable
RS5-C	scour
IR1-C	scour, frayed cable
IR2-C	impacted gorgonians
IR3-C	scour, impacted gorgonians
IR4-C	scour
IR5-C	scour, impacted stony corals, and tangled cables
MR1-C	scour, impacted barrel sponge and stony corals
MR2-C	scour
MR3-C	scour
MR5-C	impacted barrel sponge
CPD2-C	scour
OR2-C	scour
OR3-C	impacted barrel sponge
OR4-C	scour
OR5-C	scour
SG1-C	scour
SG2-C	scour, impacted stony corals
SG4-C	impacted barrel sponge

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

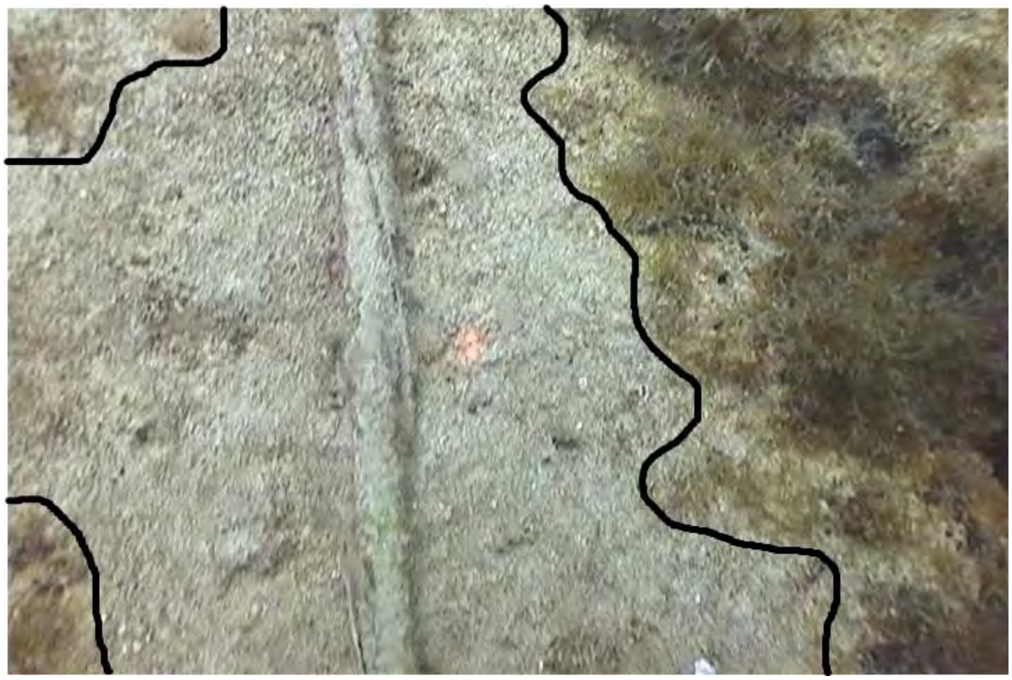

Figure 15. An example image grabbed from a transect video of cable scour from site IR1-C. The outlined scoured substrate and the worn cable provide evidence of cable movement.

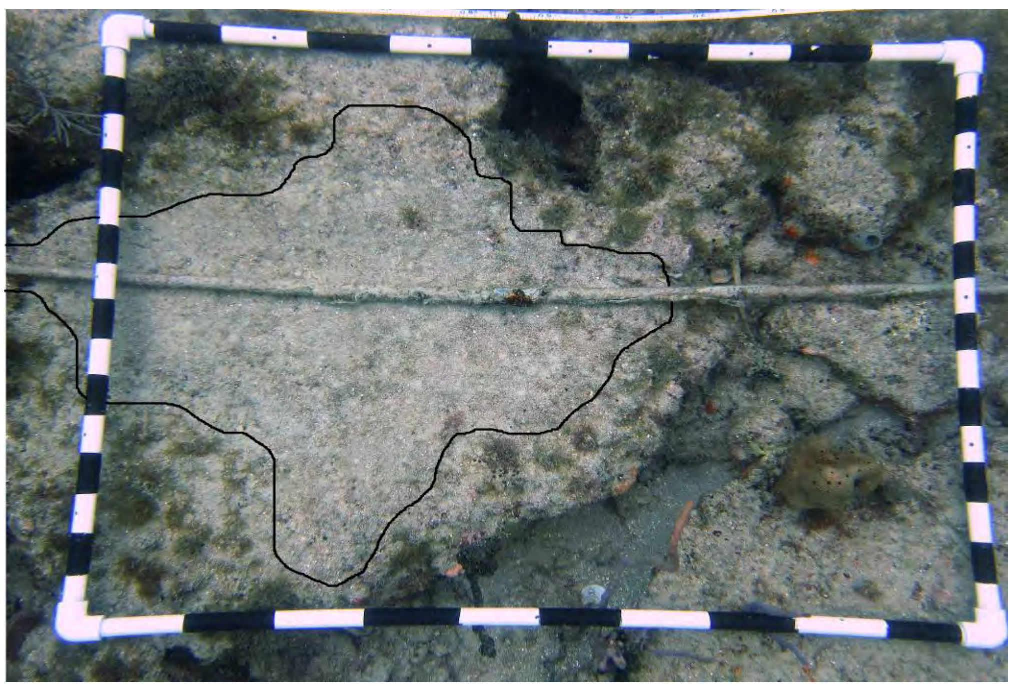

Figure 16. An example of a quadrat (75x100 cm) with scour from the site IR1-C belt transect. The outlined scoured substrate and the worn cable provide evidence of cable movement.

Figure 17. An example of a stony coral, *M. meandrites*, in the CPS habitat with an abrasion (partial mortality) from past contact with the adjacent cable providing evidence of cable movement.

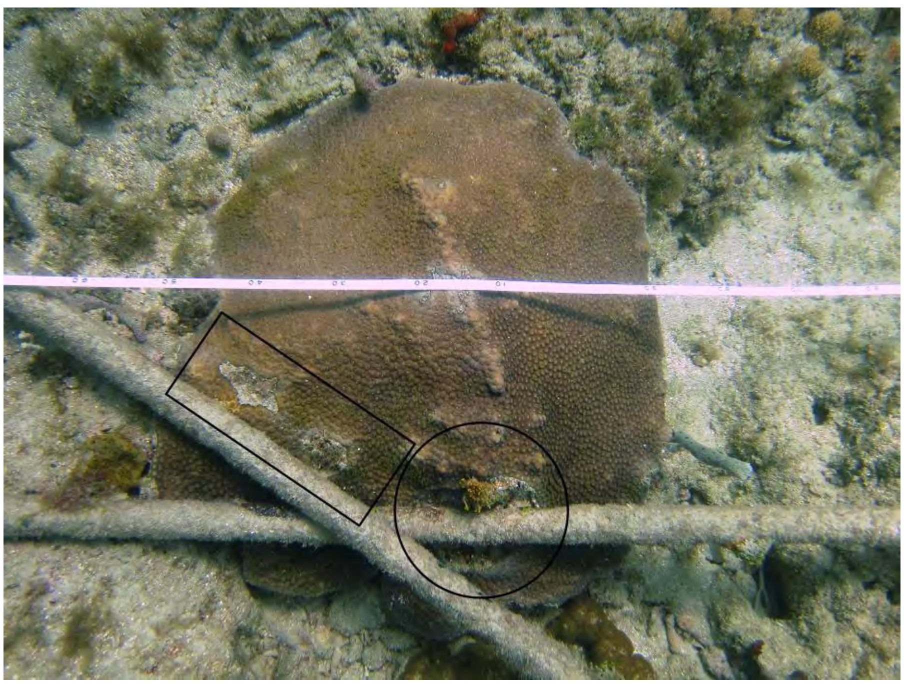

Figure 18. An example of a stony coral, *M. cavernosa*, in site CPS2-C with an abrasion (partial mortality), outlined with the box, from past cable contact, providing evidence of cable movement. This is also an example of a colony abraded by contact with cable, two in this case (circled area and below boxed area).

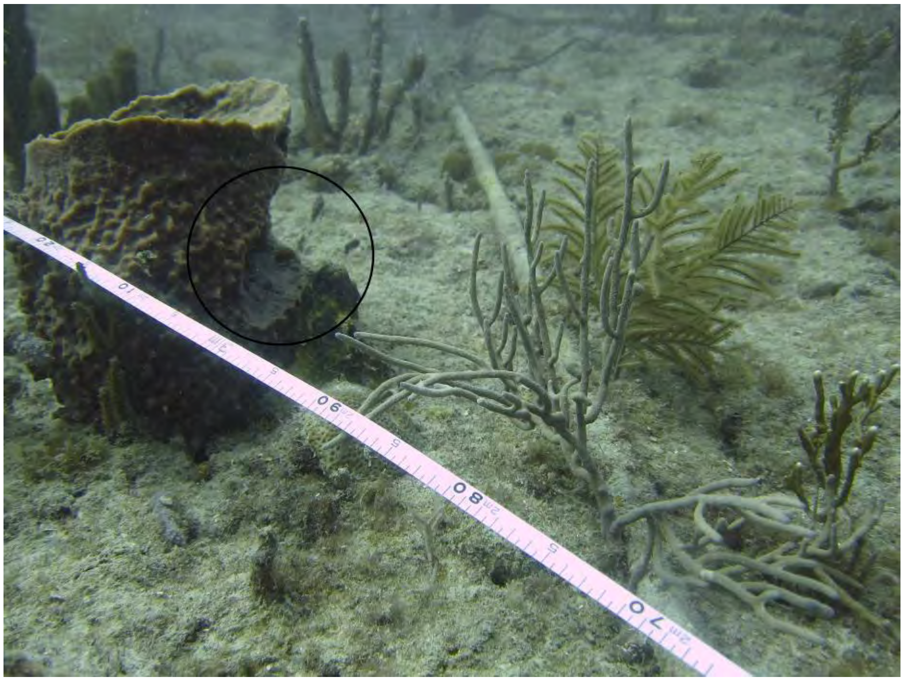

Figure 19. An example of a barrel sponge, *X. muta*, in site MR1-C with an abrasion (circled area), semi-circle notched area, from past contact with the adjacent cable, providing evidence of cable movement.

Figure 20. An example of a broken cable in the CPS habitat. The broken end and the non-linear position of the cable provide evidence of cable movement.

Figure 21. An example of a frayed cable in the CPS habitat. Movement of the smaller diameter cable along the larger cable is also evident.

Figure 22. An example of several tangled cables in the CPS habitat.

Stony Corals

The stony coral assemblage (colonies > 2cm diameter) was compared at the population level between the cable and non-cable sites within each habitat. There were few differences determined between the cable and non-cable sites within a habitat. Table 15 lists cable and non-cable mean (±1SE) stony coral percent cover and species richness for each habitat. The shallow-water RS non-cable habitat was determined to have significantly greater average percent cover (t test: $p = 0.014$) and greater colony size (t test: $p = 0.044$) than the cable sites. No significant differences were determined in total density (colonies/m²) between cable and non-cable sites among any of the habitats (Table 16) (t test: $p > 0.1$ for all habitat comparisons). A total of 25 stony coral (scleractinian) species and the hydrocoral *Millepora alcicornis* were identified within the 35 cable sites (Table 17). Table 17 also lists the mean (±1 SE) density (colonies/m²) of each species identified within the cable sites. Comparing size class densities, the RS non-cable sites had significantly greater densities of colonies in the 11-20 cm and 11-20 cm size classes than the RS cable sites (Table 18) (t test: $p = 0.025$).

Table 15. Stony coral mean (±1 SE) percent cover and mean species richness per habitat for cable and non-cable sites.

Habitat	Cover Mean	SE	Species Total	Mean	SE
CPS-C	0.843	0.270	12	6.800	0.970
CPS	0.276	0.097	9	4.400	0.748
RS-C	0.589	0.122	11	7.200	0.663
RS	1.965	0.513	10	7.000	0.837
IR-C	0.957	0.120	13	8.000	0.837
IR	0.468	0.092	12	7.600	1.208
MR-C	0.648	0.106	18	9.600	1.030
MR	0.844	0.298	17	10.600	1.030
CPD-C	0.892	0.311	15	9.000	1.049
CPD	0.321	0.062	14	8.600	0.927
OR-C	1.049	0.226	14	8.200	1.281
OR	0.732	0.155	13	8.400	0.927
SG-C	1.622	0.268	16	9.800	1.020
SG	1.606	0.383	17	9.600	0.400

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Cable impacts were recorded at the colony level (colonies > 2cm diameter). Within each belt transect, the abundance of colonies dislodged, abraded, or shaded by cables were recorded. For colonies or sponges to be recorded as being dislodged or abraded there had to be strong visual evidence that the impact was caused by cable. This included the colony or sponge either remaining in contact with a cable or having mortality consistent with past contact with a cable (see Figures 17-19 as examples). The abundance of colonies with growth on cable was also recorded. Table 19 lists overall mean (±1 SE) colony density (colonies/m²) and the mean density and mean percent of the total sampled colonies represented by each impact type. The density of each type of impacted colony within each site was determined by dividing the number of impacted colonies identified in the surveyed belt transect by the belt transect survey area (30 m^2) while the percent of each type of impacted colony was determined by dividing the number of colonies of each impact type by the total number of colonies. The Figure 23 shows the mean (±1 SE) percent contribution of each impact type and the total impact percent contribution for each habitat.

Table 16. Stony coral total mean (±1 SE) density (colonies/m^2) and colony diameter (cm) per habitat for cable and non-cable sites. The largest (diameter [cm]) colony size and species identified within each habitat is also listed.

Habitat	Density Mean	Density SE	Diameter Mean	Diameter SE	Largest Diameter	Colony Species
CPS-C	1.620	0.478	6.996	0.572	85	*M. cavernosa*
CPS	2.247	0.527	4.718	0.385	75	*M. cavernosa*
RS-C	1.040	0.192	8.179	0.770	60	*D. clivosa*
RS	1.567	0.301	19.540	1.411	137	*D. clivosa*
IR-C	1.647	0.137	9.445	0.921	80	*M. faveolata*
IR	1.360	0.301	6.931	0.603	52	*S. bournoni*
MR-C	2.100	0.198	8.130	0.526	75	*C. natans*
MR	1.773	0.217	9.034	0.575	70	*D. labyrinthiformis*
CPD-C	1.387	0.352	8.096	0.521	60	*M. faveolata*
CPD	1.333	0.132	7.900	0.557	52	*A. lamarcki*
OR-C	1.747	0.115	9.202	0.666	100	*M. cavernosa*
OR	2.010	0.131	8.715	0.513	75	*M. meandrites*
SG-C	2.547	0.383	13.052	0.596	70	*M. faveolata*
SG	2.067	0.122	14.906	0.887	120	*A. lamarcki*

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Dislodged colonies were colonies no longer attached to the substrate and in contact with a cable. Figure 24 provides an example of a dislodged *Diploria clivosa* colony in site RS3-C resting on two cables. Only three dislodged colonies were identified within the 35 cable sites with one colony found within each of the CPS, MR, and OR habitats.

Colonies recorded as abraded were those with areas of partial mortality caused by direct contact with a cable. Figure 25 provides an example of a *M. cavernosa* colony from site RS1-C with abrasions (partial mortality) from contact with multiple cables, and abrasion from cable movement. Abraded colonies were identified in all habitats except CPD. The nearshore, shallower habitats (CPS, RS, and IR) had a greater density and percent contribution of abraded colonies than the more offshore and deeper habitats (Table 19). The CPS habitat had the greatest mean (±1 SE) density (0.11 ± 0.06 colonies/m^2) and percent contribution (10.4 ± 5.2%) of abraded colonies.

Shaded colonies were those with a portion of the colony growing under, but not in contact with, a cable. These colonies are likely to make contact with the cable as they grow or be impacted (dislodged or abraded) by the cable if the cable moves. Figure 26 provides an example of a *M. cavernosa* colony in CPS habitat growing under a cable but, although very close, not in contact with the cable. Colony shading was observed in all seven habitats (Table 19). The RS (0.17 ± 0.06 colonies/m²) and SG (0.28 ± 0.08 colonies/m²) habitats had the greatest density and percent contribution (14.0 ± 3.2% and 19.3 ± 3.2%, respectively) of shaded colonies.

Table 17. Stony coral species mean (±1 SE) density (colonies/m²) identified at cable sites within the CPS, RS, IR, and MR habitats. Species are listed in decreasing overall density within the project area.

	CPS		**RS**		**IR**		**MR**	
Species	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Siderastrea siderea	0.607	0.190	0.520	0.187	0.627	0.168	0.540	0.088
Stephanocoenia intersepta	0.067	0.035	0.033	0.018	0.213	0.062	0.700	0.163
Montastraea cavernosa	0.127	0.064	0.073	0.016	0.240	0.043	0.260	0.032
Porites astreoides	0.253	0.163	0.040	0.019	0.220	0.054	0.200	0.028
Madracis decactis	0.000	0.000	0.000	0.000	0.013	0.013	0.040	0.032
Porites porites	0.387	0.271	0.093	0.037	0.047	0.020	0.060	0.037
Meandrina meandrites	0.007	0.007	0.000	0.000	0.060	0.031	0.153	0.043
Dichocoenia stokesii	0.053	0.027	0.160	0.040	0.140	0.039	0.007	0.007
Solenastrea bournoni	0.053	0.025	0.067	0.024	0.047	0.023	0.013	0.013
Montastraea faveolata	0.000	0.000	0.000	0.000	0.007	0.007	0.027	0.012
Agaricia agaricites	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.011
Diploria strigosa	0.033	0.018	0.000	0.000	0.000	0.000	0.027	0.012
Diploria clivosa	0.020	0.013	0.027	0.012	0.007	0.007	0.000	0.000
Agaricia fragilis	0.000	0.000	0.000	0.000	0.020	0.013	0.000	0.000
Agaricia lamarcki	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Scolymia spp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mycetophyllia aliciae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Eusmilia fastigiata	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Oculina diffusa	0.007	0.007	0.007	0.007	0.007	0.007	0.000	0.000
Acropora cervicornis	0.000	0.000	0.013	0.013	0.000	0.000	0.000	0.000
Colpophyllia natans	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Diploria labyrinthiformis	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Montastraea annularis	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Mycetophyllia lamarckiana	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.007
Scolymia cubensis	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Unid species	0.007	0.007	0.007	0.007	0.000	0.000	0.007	0.007

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, and MR = Middle Linear Reef.

Table 17. Continued**.** Stony coral species mean (±1 SE) density (colonies/m²) identified at cable sites within the CPD, OR, and SG habitats. Species are listed in decreasing overall density within the project area.

	CPD		**OR**		**SG**	
Species	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Siderastrea siderea	0.393	0.131	0.487	0.056	0.300	0.030
Stephanocoenia intersepta	0.220	0.057	0.260	0.032	0.587	0.139
Montastraea cavernosa	0.273	0.051	0.380	0.025	0.493	0.058
Porites astreoides	0.240	0.096	0.347	0.082	0.320	0.070
Madracis decactis	0.047	0.013	0.053	0.034	0.500	0.179
Porites porites	0.000	0.000	0.020	0.013	0.000	0.000
Meandrina meandrites	0.067	0.015	0.067	0.030	0.140	0.027
Dichocoenia stokesii	0.027	0.019	0.033	0.015	0.027	0.019
Solenastrea bournoni	0.020	0.008	0.007	0.007	0.007	0.007
Montastraea faveolata	0.007	0.007	0.013	0.013	0.080	0.034
Agaricia agaricites	0.020	0.013	0.053	0.023	0.013	0.008
Diploria strigosa	0.007	0.007	0.013	0.008	0.000	0.000
Diploria clivosa	0.000	0.000	0.000	0.000	0.000	0.000
Agaricia fragilis	0.007	0.007	0.000	0.000	0.013	0.013
Agaricia lamarcki	0.013	0.008	0.007	0.007	0.020	0.008
Scolymia spp.	0.020	0.013	0.000	0.000	0.013	0.008
Mycetophyllia aliciae	0.013	0.013	0.000	0.000	0.013	0.008
Eusmilia fastigiata	0.000	0.000	0.007	0.007	0.007	0.007
Oculina diffusa	0.000	0.000	0.000	0.000	0.000	0.000
Acropora cervicornis	0.000	0.000	0.000	0.000	0.000	0.000
Colpophyllia natans	0.000	0.000	0.000	0.000	0.000	0.000
Diploria labyrinthiformis	0.000	0.000	0.000	0.000	0.000	0.000
Montastraea annularis	0.000	0.000	0.000	0.000	0.000	0.000
Mycetophyllia lamarckiana	0.000	0.000	0.000	0.000	0.000	0.000
Scolymia cubensis	0.000	0.000	0.000	0.000	0.007	0.007
Unid species	0.013	0.013	0.000	0.000	0.007	0.007

Habitat legend: CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 18. Mean (±1 SE) stony coral size (diameter [cm]) class density (colonies/m²) per habitat for cable and non-cable sites.

	2-10 cm		11-20 cm		21-30 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS-C	1.407	0.517	0.120	0.031	0.033	0.018
CPS	2.147	0.543	0.053	0.013	0.013	0.013
RS-C	0.813	0.224	0.153	0.020	0.020	0.008
RS	0.707	0.319	0.373	0.046	0.193	0.027
IR-C	1.240	0.158	0.273	0.039	0.073	0.032
IR	1.153	0.231	0.180	0.074	0.013	0.008
MR-C	1.733	0.205	0.247	0.027	0.067	0.018
MR	1.373	0.163	0.287	0.063	0.053	0.008
CPD-C	1.107	0.277	0.207	0.051	0.060	0.029
CPD	1.093	0.114	0.167	0.051	0.040	0.012
OR-C	1.373	0.122	0.240	0.045	0.080	0.027
OR	1.493	0.101	0.387	0.068	0.027	0.019
SG-C	1.560	0.318	0.540	0.080	0.273	0.065
SG	1.227	0.190	0.400	0.049	0.167	0.060

	31-40 cm		41-50 cm		>50 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS-C	0.047	0.017	0.007	0.007	0.007	0.007
CPS	0.013	0.008	0.000	0.000	0.020	0.020
RS-C	0.033	0.021	0.013	0.008	0.007	0.007
RS	0.113	0.027	0.053	0.027	0.127	0.051
IR-C	0.013	0.013	0.033	0.011	0.013	0.008
IR	0.000	0.000	0.000	0.000	0.013	0.013
MR-C	0.020	0.013	0.020	0.013	0.013	0.008
MR	0.020	0.013	0.020	0.013	0.020	0.013
CPD-C	0.000	0.000	0.000	0.000	0.013	0.008
CPD	0.020	0.008	0.000	0.000	0.013	0.008
OR-C	0.027	0.019	0.013	0.008	0.013	0.013
OR	0.060	0.007	0.000	0.000	0.020	0.008
SG-C	0.080	0.020	0.073	0.024	0.020	0.013
SG	0.113	0.044	0.087	0.029	0.073	0.029

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Colonies growing on cable were those with live tissue observed growing on cable. Cable is not natural substrate, and if cable movement occurs, these colonies may be dislodged or experience complete or partial mortality from abrasion and loss of the tissue growing on the cable. Figure 27 is an example of a *M. cavernosa* colony in the RS habitat in contact (partial mortality) with and tissue growing on a cable. Colonies with growth on cable were observed in all seven habitats

(Table 19). The SG habitat had the greatest density (0.17 ± 0.08 colonies/m²) and the CPD (6.0 ± 2.4%) had the greatest percent contribution of colonies with growth on cable.

In total (all impact types combined), cable sites within the habitats had mean densities of impacted colonies greater than 0.1 colonies/m² with percent impacted colonies near (IR at 9%) or more than 10% (Table 19). Four habitats (CPS, RS, MR, and SG) had impacted colony mean densities greater than 0.3 colonies/m², and three habitats had mean percent contributions of near (SG at 19%) or greater (CPS and RS) than 20%.

Table 19. Mean (±1 SE) stony coral total density (colonies/m²) and impact type density per habitat for cable sites and the mean percent of sampled colonies represented by each impact type per habitat (see Appendix 3 for the site density and percent data).

	CPS-C		RS-C		IR-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	1.620	0.478	1.040	0.192	1.647	0.137
Density						
Dislodged	0.007	0.007	0.000	0.000	0.000	0.000
Abraded	0.100	0.059	0.033	0.021	0.053	0.017
Shaded	0.140	0.087	0.167	0.061	0.040	0.012
Growth on cable	0.040	0.019	0.033	0.011	0.040	0.012
Total	0.287	0.069	0.233	0.057	0.133	0.028
Percent						
Dislodged	0.645%	0.645%	0.000%	0.000%	0.000%	0.000%
Abraded	9.226%	5.204%	4.126%	2.556%	3.408%	1.186%
Shaded	6.156%	2.608%	14.006%	3.231%	2.715%	0.966%
Growth on cable	3.416%	1.791%	3.354%	1.000%	2.712%	0.955%
Total	19.443%	5.453%	21.486%	2.896%	8.835%	2.463%

	MR-C		CPD-C		OR-C		SG-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	2.100	0.198	1.387	0.352	1.747	0.115	2.547	0.383
Density								
Dislodged	0.007	0.007	0.000	0.000	0.007	0.007	0.000	0.000
Abraded	0.020	0.013	0.000	0.000	0.053	0.017	0.033	0.026
Shaded	0.073	0.034	0.107	0.043	0.073	0.032	0.280	0.083
Growth on cable	0.120	0.047	0.080	0.027	0.053	0.025	0.167	0.083
Total	0.220	0.070	0.187	0.062	0.187	0.023	0.480	0.118
Percent								
Dislodged	0.313%	0.308%	0.000%	0.000%	0.426%	0.426%	0.000%	0.000%
Abraded	1.203%	0.850%	0.000%	0.000%	3.227%	1.112%	1.623%	1.393%
Shaded	3.554%	1.588%	6.550%	2.349%	3.847%	1.577%	12.179%	3.687%
Growth on cable	5.765%	2.248%	6.051%	2.386%	3.211%	1.528%	5.520%	2.293%
Total	10.835%	3.272%	12.601%	4.424%	10.771%	1.249%	19.321%	3.222%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

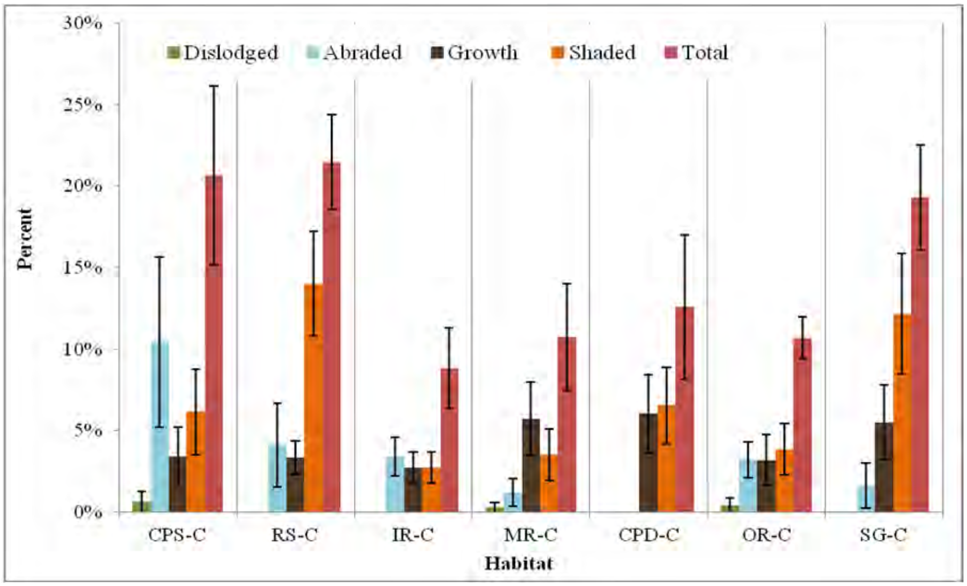

Figure 23. Mean (±1 SE) percent contribution for each impact type and total impact percent contribution for each habitat. Habitat legend: C = cable; CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Figure 24. A dislodged stony coral, *D. clivosa*, resting on two cables in site RS3-C.

Figure 25. An example of a *M. cavernosa* colony from site RS1-C with abrasions (partial mortality) from contact with four cables, and additional abrasion from movement of the top cable (circled area).

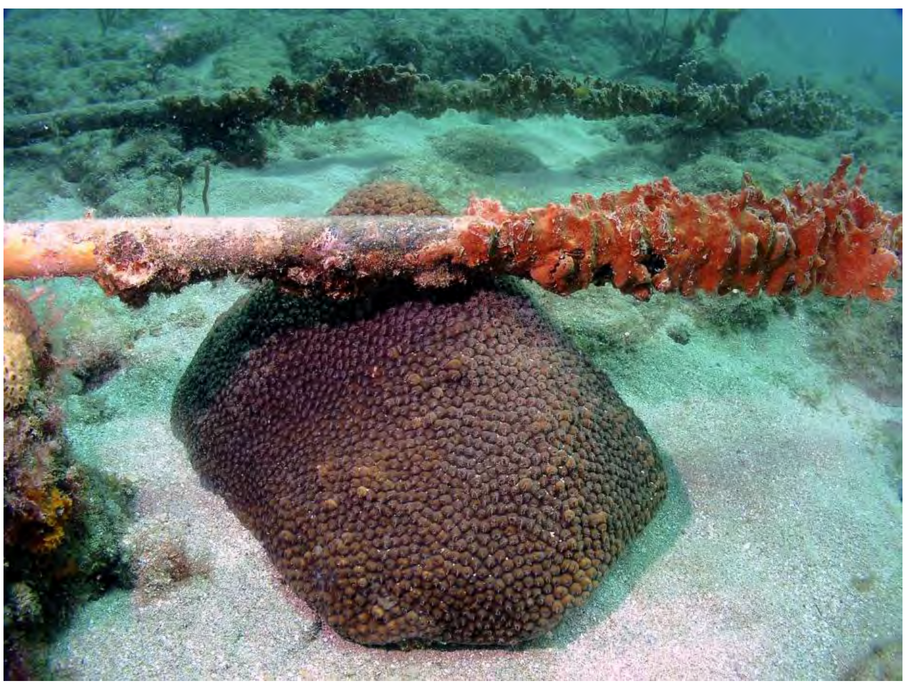

Figure 26. An example of a RS habitat *M. cavernosa* colony growing under, but not in contact with, a cable. This image also provides an example of two cables suspended above the substrate.

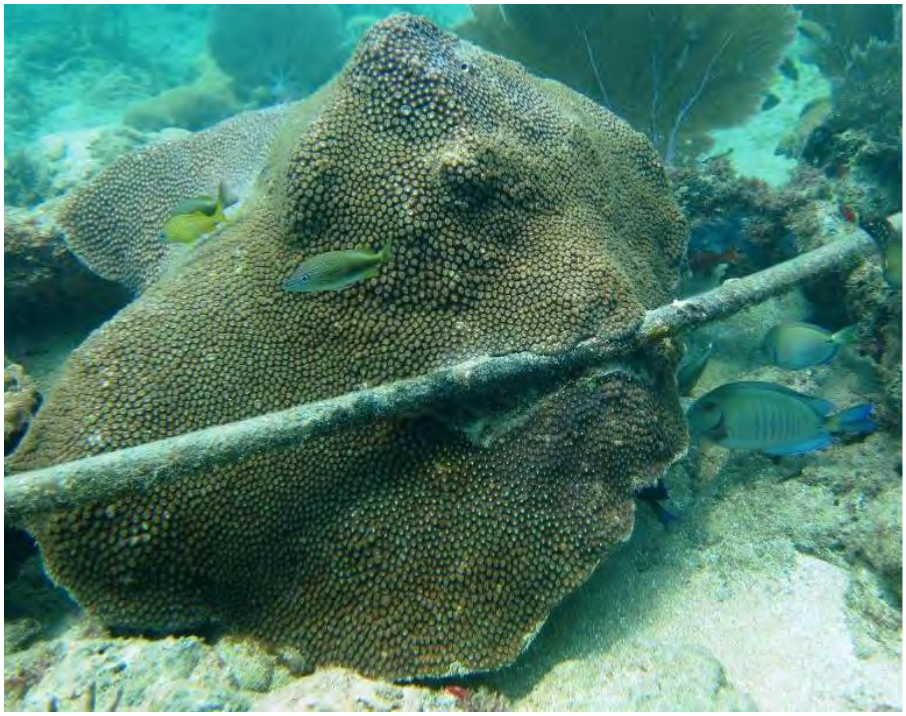

Figure 27. An example of a *M. cavernosa* colony from the RS habitat with growth over the cable and partial mortality from contact with the same cable.

Gorgonians

The gorgonian assemblage (colonies > 2 cm height) was compared at the population level between the cable and non-cable sites within each habitat. Table 20 lists cable and non-cable mean (±1SE) branching gorgonian percent cover, taxa richness, and density (colonies/m²) for each habitat. Total percent branching gorgonian cover was compared and included the percent cover estimates derived from the video transects for branching gorgonian on pavement for non-cable sites and branching gorgonian on pavement combined with branching gorgonian on cable for the cable sites. There were no significant differences determined between cable and non-cable sites within a habitat for percent cover, taxa richness, or density (t test: $p > 0.1$ for all comparisons). There were also no significant differences in any colony size (height) classes (Table 21) between cable and non-cable sites (t test: $p > 0.1$ for all comparisons).

Similar to stony corals, gorgonian cable impacts were recorded at the colony level (colonies > 2 cm height). Within each belt transect, the abundance of dislodged gorgonian colonies and colonies abraded and shaded by cables were recorded. The abundance of colonies with growth on cable was also recorded. Table 22 lists overall mean (±1 SE) colony density (colonies/m²) and the mean density and mean percent of the sampled colonies represented by each impact type. The density of each type of impacted colony within each site was determined by dividing the number of impacted colonies identified in the surveyed belt transect by the belt transect survey area (30 m^2) while the percent of each type of impacted colony was determined by dividing the number of colonies of each impact type by the total number of colonies. Figure 28 shows the mean (±1 SE) percent contribution of each impact type and the total impact percent contribution for each habitat.

Table 20. Gorgonian mean (±1 SE) percent cover, mean species (taxa) richness and density (colonies/m²) per habitat for cable and non-cable sites.

	Cover		Taxa			Density	
Habitat	**Mean**	**SE**	**Total**	**Mean**	**SE**	**Mean**	**SE**
CPS-C	2.024	0.651	15	10.000	1.140	4.220	1.599
CPS	1.539	1.366	15	8.000	1.450	1.827	1.187
RS-C	2.684	0.701	16	10.000	0.710	3.867	0.609
RS	3.299	1.046	14	7.600	0.750	3.053	0.673
IR-C	2.515	0.662	12	8.200	1.240	4.713	1.481
IR	3.691	0.814	14	9.600	1.210	5.587	1.268
MR-C	4.993	0.801	15	9.800	1.070	7.847	1.622
MR	5.365	1.011	15	9.600	0.680	5.480	0.739
CPD-C	4.481	0.794	15	8.800	0.970	6.100	1.516
CPD	4.962	0.510	16	10.000	0.840	5.480	0.650
OR-C	3.631	1.223	16	7.400	0.400	4.187	1.258
OR	4.866	1.010	16	7.000	0.950	4.367	0.875
SG-C	4.507	1.310	15	8.000	0.550	5.800	2.492
SG	8.108	1.891	20	10.000	1.410	8.893	2.438

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 21. Gorgonian mean (±1 SE) size (height [cm]) class density (colonies/m²) per habitat for cable and non-cable sites.

	2-5cm		6-10cm		11-25cm		26-50cm		>50 cm	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS-C	0.573	0.297	1.040	0.329	1.780	0.665	0.827	0.330	0.100	0.042
CPS	0.120	0.073	0.447	0.262	0.633	0.451	0.460	0.287	0.167	0.125
RS-C	0.333	0.067	0.920	0.162	1.687	0.283	0.720	0.178	0.207	0.049
RS	0.560	0.167	0.653	0.168	1.020	0.260	0.547	0.132	0.273	0.069
IR-C	0.707	0.402	1.220	0.307	1.913	0.609	0.740	0.195	0.133	0.100
IR	0.340	0.107	1.567	0.325	2.627	0.666	0.860	0.252	0.193	0.053
MR-C	0.500	0.057	1.780	0.411	3.687	1.102	1.627	0.255	0.253	0.083
MR	0.367	0.114	1.067	0.183	2.667	0.453	1.127	0.127	0.253	0.042
CPD-C	0.293	0.113	1.660	0.524	2.907	0.758	1.007	0.147	0.233	0.038
CPD	0.467	0.193	1.280	0.165	2.273	0.416	1.040	0.140	0.420	0.092
OR-C	0.493	0.181	1.053	0.426	1.733	0.447	0.760	0.216	0.147	0.056
OR	0.480	0.079	1.000	0.241	1.687	0.439	0.867	0.139	0.333	0.095
SG-C	0.213	0.181	1.413	0.923	2.313	1.059	1.107	0.355	0.753	0.194
SG	0.480	0.207	1.293	0.266	4.807	1.670	1.627	0.287	0.687	0.138

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 22. Mean (±1 SE) gorgonian total density (colonies/m²) and impact type density per habitat for cable sites and the mean percent of sampled colonies represented by each impact type per habitat (see Appendix 4 for the site density and percent data).

	CPS-C		RS-C		IR-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	4.220	1.606	3.867	0.609	4.713	1.481
Density						
Dislodged	0.000	0.000	0.027	0.019	0.020	0.020
Abraded	0.033	0.021	0.007	0.007	0.033	0.018
Shaded	0.027	0.019	0.013	0.008	0.020	0.008
Growth on cable	0.027	0.012	0.020	0.008	0.060	0.031
Total Impacted	0.087	0.037	0.067	0.035	0.133	0.047
Percent						
Dislodged	0.000%	0.000%	1.124%	0.880%	0.194%	0.194%
Abraded	0.431%	0.280%	0.303%	0.303%	0.766%	0.346%
Shaded	1.704%	1.386%	0.448%	0.301%	0.408%	0.202%
Growth on cable	1.360%	1.026%	0.564%	0.280%	1.410%	0.944%
Total	3.494%	1.244%	2.439%	1.681%	2.778%	0.598%

	MR-C		CPD-C		OR-C		SG-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	7.853	1.627	6.100	1.547	4.173	1.255	5.800	2.492
Density								
Dislodged	0.000	0.000	0.007	0.007	0.013	0.008	0.000	0.000
Abraded	0.000	0.000	0.000	0.000	0.007	0.007	0.000	0.000
Shaded	0.020	0.013	0.033	0.033	0.020	0.013	0.020	0.020
Growth on cable	0.213	0.114	0.193	0.046	0.113	0.058	0.347	0.185
Total Impacted	0.233	0.117	0.233	0.043	0.153	0.045	0.367	0.183
Percent								
Dislodged	0.000%	0.000%	0.080%	0.080%	0.535%	0.330%	0.000%	0.000%
Abraded	0.000%	0.000%	0.000%	0.000%	0.294%	0.294%	0.000%	0.000%
Shaded	0.234%	0.178%	0.398%	0.398%	0.559%	0.469%	0.811%	0.811%
Growth on cable	2.577%	1.287%	4.547%	1.849%	3.736%	1.909%	8.964%	3.120%
Total	2.812%	1.377%	5.025%	1.687%	5.125%	1.590%	9.775%	3.169%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

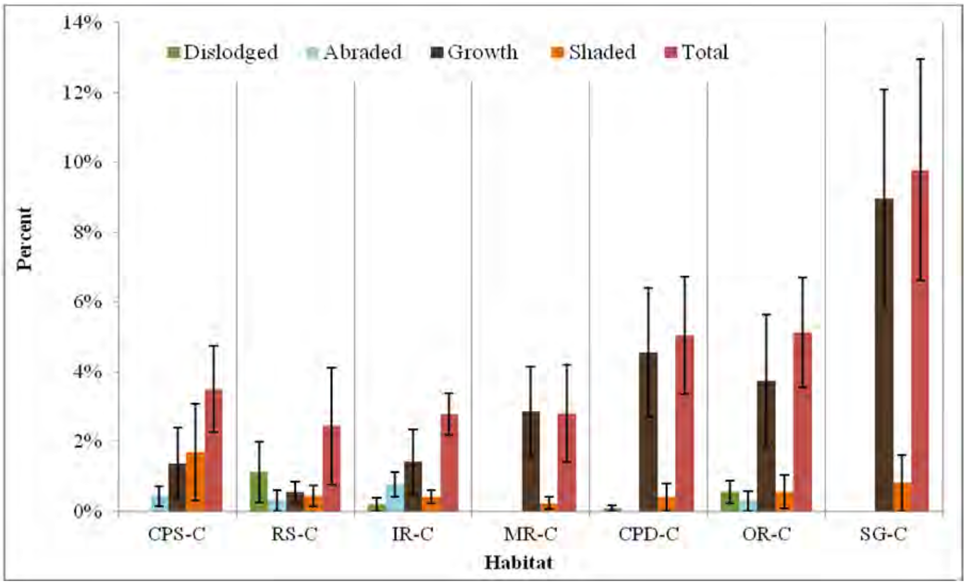

Figure 28. Gorgonian mean (±1SE) percent contribution for each impact type and total impact percent contribution for each habitat. Habitat legend: C = cable; CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Dislodged gorgonian colonies were colonies no longer attached to the substrate and in contact with or adjacent to a cable. Only ten dislodged colonies were identified within the 35 cable sites with colonies found within the RS, IR, CPD, and OR habitats (Table 22).

Colonies recorded as abraded were those with areas of partial mortality caused by direct contact with a cable. Figure 29 provides an example of a *Muricea* spp. colony in the CPS habitat with abrasions (partial mortality) from contact with cable. Abraded colonies were identified in four habitats, CPS, RS, IR, and OR (Table 19). The density of abraded colonies was less than 0.05 colonies/m² and percent contribution was less than 1% in all four habitats.

Shaded gorgonian colonies were those with a portion of the colony growing under, but not in contact with, a cable. These are colonies likely to make contact with the cable as they continue to grow or be impacted (dislodged or abraded) by the cable if the cable moves. Colony shading was observed in all seven habitats (Table 22). The density of shaded colonies was less than 0.05 colonies/m² in all habitats and percent contribution was greater than 1% in only the CPS (1.7%) habitat.

For gorgonians, colonies growing on cable were those growing with their holdfasts on a cable. Cable is not natural substrate, and if cable movement occurs, these colonies may be dislodged or experience complete or partial morality from abrasion. Figure 30 is an example of a *Gorgonia ventalina* colony in the OR habitat growing on a cable.

Figure 29. An example of a *Muricea* spp. colony in the CPS habitat with abrasions (partial mortality) from contact with cable.

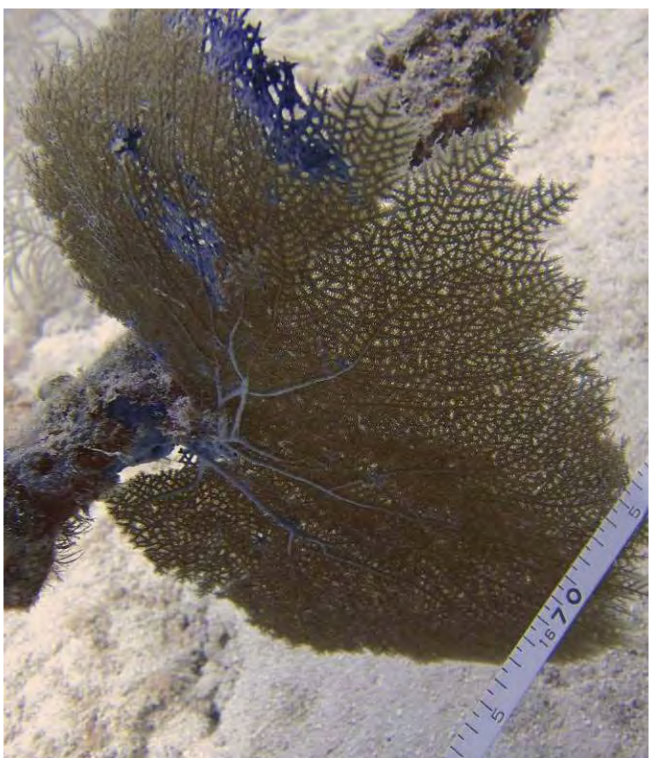

Figure 30. An example of a *Gorgonia ventalina* colony in the OR habitat growing on a cable.

Colonies with growth on cable were observed in all seven habitats (Table 22) with the highest density and percent contribution of colonies growing on cable at the offshore (MR, CPD, OR, and SG) habitats. Growth on cable also contributed most to the total cable impact in five of the seven habitats with the exceptions being the CPS and RS habitats. The SG habitat had the greatest density (0.35 ± 0.18 colonies/m²) and the greatest percent contribution (9.0 ± 3.1 colonies/m²) of colonies with growth on cable.

In total (all impact types combined), five habitats (IR, MR, CPD, OR, and SG) had mean densities of impacted colonies greater than 0.1 colonies/m² with percent impacted colonies more than 2.5% (Table 22). The three most offshore habitats (CPD, OR and SG) had mean percent contributions greater than 5%.

Barrel sponges

The barrel sponge, *Xestospongia muta*, population was compared between the cable and non-cable sites within each habitat. Table 23 lists cable and non-cable mean (±1 SE) barrel sponge density (colonies/m²) and volume (cm³) and maximum volume for each habitat. There were no significant differences determined between the cable and non-cable sites within a habitat for density (t test: $p > 0.1$ for all comparisons) or volume (t test: $p > 0.07$ for all comparisons). There was also no significant difference in any colony size (volume) classes (Table 24) between cable and non-cable sites (t test: $p > 0.1$ for all comparisons).

Table 23. Barrel sponge mean (±1 SE) density (sponges/m^2) and volume (cm^3) per habitat. Maximum sponge volume (cm^3) and size (base diameter and height [cm]) for each habitat also listed. Only one sponge was identified in the CPS sites, and no sponges were identified in the RS habitat.

	Density		Volume		Maximum	
Habitat	Mean	SE	Mean	SE	Volume	DxH
CPS-C	0.047	0.039	1034.878	663.699	4969.937	17x25
CPS	0.007	0.007	7630.054		7630.054	25x18
RS-C	0.000	0.000	0.000	0.000	0.000	
RS	0.000	0.000	0.000	0.000	0.000	
IR-C	0.260	0.072	4475.425	1830.743	64847.122	55x35
IR	0.160	0.032	12119.006	4696.544	81970.730	48x59
MR-C	0.393	0.041	7962.167	1823.676	81555.485	52x50
MR	0.413	0.027	12578.093	2782.410	98987.750	55x55
CPD-C	0.473	0.090	14977.843	5386.427	327755.293	83x85
CPD	0.580	0.078	16423.506	3253.947	130718.135	67x50
OR-C	0.407	0.092	15823.428	3295.056	134982.692	65x55
OR	0.333	0.064	22709.040	4548.768	141746.933	70x50
SG-C	0.760	0.048	15011.469	3212.662	305018.774	90x70
SG	0.613	0.062	12052.264	2787.905	214164.428	80x60

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Table 24. Mean barrel sponge (±1 SE) size (volume [cm³]) class density (sponge/m²) per habitat.

	0-5,500		5,500-40,300		40,300-126,200		126,200-278,200		>278,200	
Habitat	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
CPS-C	0.117	0.083	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CPS	0.000		0.033		0.000		0.000		0.000	
RS-C										
RS										
IR-C	0.207	0.046	0.047	0.023	0.007	0.007	0.000	0.000	0.000	0.000
IR	0.113	0.017	0.027	0.019	0.020	0.013	0.000	0.000	0.000	0.000
MR-C	0.260	0.045	0.127	0.024	0.007	0.007	0.000	0.000	0.000	0.000
MR	0.260	0.019	0.100	0.015	0.053	0.017	0.000	0.000	0.000	0.000
CPD-C	0.333	0.071	0.100	0.015	0.027	0.016	0.007	0.007	0.007	0.007
CPD	0.353	0.045	0.140	0.029	0.080	0.025	0.007	0.007	0.000	0.000
OR-C	0.220	0.081	0.133	0.024	0.047	0.013	0.007	0.007	0.000	0.000
OR	0.147	0.013	0.120	0.037	0.053	0.025	0.013	0.008	0.000	0.000
SG-C	0.420	0.068	0.267	0.024	0.067	0.024	0.000	0.000	0.007	0.007
SG	0.393	0.061	0.227	0.024	0.027	0.012	0.013	0.008	0.000	0.000

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Cable impacts were recorded for each individual barrel sponge. Within each belt transect, the abundance of barrel sponges sheared, abraded, and shaded by cables was recorded. The abundance of sponges with growth on cable was also recorded. Table 25 lists mean (±1 SE) total barrel sponge density (colonies/m²) and the mean density and mean percent of the sampled sponges represented by each impact type. The density of each type of impacted sponge within each site was determined by dividing the number of impacted sponges identified in the surveyed belt transect by the belt transect survey area (30 m^2) while the percent of each type of impacted sponge was determined by dividing the number of sponges of each impact type by the total number of sponges. Figure 31 shows the mean (±1 SE) percent contribution of each impact type and the total impact percent contribution for each habitat.

Sheared sponges were sponges which had entire portions of their barrels removed reducing the height of the sponge (Figure 32). Sheared barrel sponges were observed in all six habitats which had barrel sponges (no barrel sponges were recorded in the RS habitat), and mean density (0.01 sponges/m²) was similar in each (Table 25). Greater than 1% of the barrel sponges were sheared in all six habitats with two habitats (IR and OR) having greater than 4% sheared.

Abraded sponges were those with tissue loss either on their barrels or bases but the overall sponge height was not reduced (see Figure 19 which has a circular area of lost tissue from cable impact on the side of the barrel). All six habitats with barrel sponges had abraded sponges. The MR habitat had the greatest mean (±1 SE) density (0.04± 0.02 sponges/m²) and percent contribution (10.2± 4.5%) of sheared sponges.

Table 25. Mean (±1 SE) barrel sponge total density (colonies/m²) and impact type density per habitat for cable sites and the mean percent of sampled barrel sponges represented by each impact type per habitat (see Appendix 5 for the site density and percent data).

	CPS-C		RS-C		IR-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	0.047	0.039	0.000	0.000	0.260	0.072
Density						
Sheared	0.007	0.007	0.000	0.000	0.007	0.007
Abraded	0.000	0.000	0.000	0.000	0.007	0.007
Shaded	0.007	0.007	0.000	0.000	0.007	0.007
Growth on cable	0.000	0.000	0.000	0.000	0.000	0.000
Total Impacted	0.013	0.008	0.000	0.000	0.020	0.008
Percent						
Sheared	3.333%	3.333%	0.000%	0.000%	4.000%	4.000%
Abraded	0.000%	0.000%	0.000%	0.000%	4.000%	4.000%
Shaded	20.000%	20.000%	0.000%	0.000%	6.667%	6.667%
Growth on cable	0.000%	0.000%	0.000%	0.000%	0.000%	0.000%
Total	23.333%	19.437%	0.000%	0.000%	14.667%	6.464%

	MR-C		CPD-C		OR-C		SG-C	
Impact	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Total Density	0.393	0.041	0.473	0.090	0.407	0.092	0.760	0.048
Density								
Sheared	0.013	0.008	0.007	0.007	0.013	0.008	0.013	0.013
Abraded	0.040	0.019	0.020	0.013	0.007	0.007	0.007	0.007
Shaded	0.007	0.007	0.000	0.000	0.013	0.008	0.053	0.023
Growth on cable	0.000	0.000	0.007	0.007	0.000	0.000	0.033	0.011
Total Impacted	0.060	0.024	0.033	0.026	0.033	0.018	0.107	0.029
Percent								
Sheared	3.538%	2.197%	1.333%	1.333%	4.222%	2.592%	1.905%	1.905%
Abraded	10.192%	4.506%	4.485%	2.827%	2.000%	2.000%	0.952%	0.952%
Shaded	1.538%	1.538%	0.000%	0.000%	3.429%	2.148%	6.854%	2.874%
Growth on cable	0.000%	0.000%	1.333%	1.333%	0.000%	0.000%	4.767%	1.681%
Total	15.269%	5.338%	7.152%	5.187%	9.651%	5.517%	14.478%	4.178%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

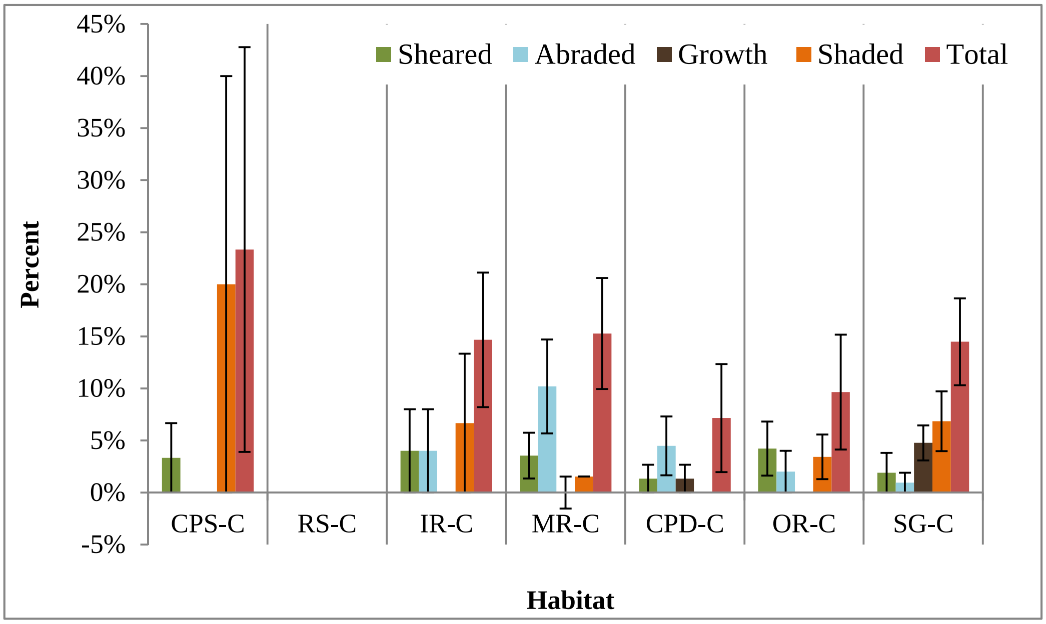

Figure 31. Barrel sponge percent contribution for each impact type and total impact percent contribution for each habitat (no sponges were observed in the RS habitat). Habitat legend: C = cable; CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.

Figure 32. An example of a barrel sponge in the OR habitat with a sheared barrel from contact with cable. The majority of the sponge barrel has been removed by movement of the adjacent cable.

Shaded barrel sponges were those with a portion of the sponge growing under, but not in contact with, a cable. These sponges are likely to make contact with the cable as they grow or be impacted (sheared or abraded) by the cable if the cable moves. Sponge shading was observed in all habitats (Table 25) with barrel sponges except for the CPD habitat. Shaded sponge density colonies was less than 0.01 sponges/m² in all habitats except OR (0.01±0.01 sponges/m²), and the percent contribution was greater than 3% in all habitats except MR (1.5±1.5 %).

Barrel sponges with growth on cable (Figure 33) were observed only in the offshore deep-water CPD and SG habitats (Table 25) with SG having greater density and percent contribution than CPD.

Figure 33. An example of a barrel sponge with growth on cable. The multiple barrels in the sponge indicate that the original barrel was sheared resulting in multiple barrels growing during recovery.

Impacted barrel sponges were observed in six habitats (no barrel sponges were observed in the RS habitat). All six habitats had mean impacted sponge densities greater than 0.01 sponges/m² and percent impacted sponges greater than 7% (Table 25). Two habitats (MR and SG) had impacted densities greater than 0.05 sponges/m² and percent impacted sponges greater than 14%.

Estimated total stony coral, gorgonian, and barrel sponge impacts in project area

Each of the 35 cable survey sites included one 1.5 m x 20 m belt transect. These transects were positioned such that a cable ran through the entire transect. This design permitted impacts to stony coral (colonies > 2 cm diameter) and gorgonian (colonies > 2 cm height) colonies and barrel sponges to be identified and counted. The density (colonies or sponges/m²) of impacted colonies or sponges within each transect was determined by dividing the number of impacted colonies or sponges by 30 m² (1.5 m x 20 m = 30m²). The mean impacted colony or sponge (all types) density within transects in each habitat is listed in Tables 19 (stony corals), 21 (gorgonians), and 25 (barrel sponges). These impact densities can be used to estimate the total number of impacted colonies or sponges within 1.5 m of all cables in the project area and, as requested, within the entire project area (Figure 2).

A shapefile of the defined project area and a line shapefile of all known cable positions was supplied by the Naval Surface Warfare Center Carderock Division's South Florida Ocean Measurement Facility (SFOMF) Dania, Florida (see Figure 2). Using ArcGIS, the cable line file was buffered by 0.75 m to obtain the area around each cable, and then the benthic habitat layer was clipped by this buffer file. This yielded a non-overlapping 1.5 m wide area around all of the cables in each habitat. Impacted colony or sponge densities were then multiplied by these areas to estimate the total number of impacted colonies or sponges within 1.5 m of all cables by habitat in the project area.

The number of impacted (all types) stony coral and gorgonian colonies and barrel sponges within the belt areas was estimated by multiplying the mean densities for each impact type within each habitat (Tables 19, 22, and 25) by the total belt area for each habitat in Table 26. These same impacts within the total project area was estimated by multiplying the mean densities for each impact type within each habitat (Tables 19, 22, and 25) by the total project area for each habitat in Table 1.Tables 27 (stony corals), 28 (gorgonians), and 29 (barrel sponges) list the estimated numbers of impacted colonies or sponges within each habitat by belt and project area. These tables also include an estimated total number of colonies or sponges within the belt and project areas by multiplying the mean total densities within each habitat (Table 19 [stony corals], Table 22 [gorgonians], and Table 25 [barrel sponges]) by the total belt area for each habitat in Table 26 or project area in Table1.

Table 26. Estimated cable length within each habitat and impact area within each habitat.

Habitat	Est. Total Cable Length (m)	Estimated Belt Area (m²)
Colonized Pavement-Shallow (CPS)	49,290	46,117
Ridge-Shallow (RS)	17,483	17,109
Inner Linear Reef (IR)	34,062	41,270
Middle Linear Reef (MR)	13,770	18,829
Colonized Pavement-Deep (CPD)	3,757	4,839
Outer Linear Reef (OR)	3,534	4,929
Spur and Groove (SG)	5,737	8,032
Total	127,634	141,125

The average total impacted density (stony corals, gorgonians, and barrel sponges combined) was less than 0.25 colonies or sponges/m² for all habitats (see Tables 19, 22, and 25). The number of estimated impacted stony corals (33,151), gorgonians (19,863), and barrel sponges (3,752) (Table 27, 28, and 29) was driven by the number of cables and resulting 1.5 m impact areas adjacent to these cables (Table 26).

Table 27. Estimated number of impacted stony coral colonies, total colonies and estimated percent colonies impacted within each habitat belt area and total defined project area.

Habitat	Impact Type D	A	S	G	Total Impacted	Total Belt Area Colonies	Percent Impact of Belt Area	Total Study Area Colonies	Percent Impact of Study Area
CPS	307	4,612	6,456	1,845	13,236	74,710	17.716%	916,581	1.444%
RS	0	570	2,852	570	3,992	17,793	22.436%	180,835	2.208%
IR	0	2,201	1,651	1,651	5,503	67,972	8.096%	1,180,836	0.466%
MR	126	377	1,381	2,259	4,142	39,541	10.476%	1,344,042	0.308%
CPD	0	0	516	387	903	6,712	13.458%	280,535	0.322%
OR	33	263	361	263	920	8,611	10.685%	440,887	0.209%
SG	0	268	2,249	1,339	3,855	20,458	18.846%	1,075,787	0.358%
Total	466	8,290	15,466	8,314	32,551	235,796	13.805%	5,419,503	0.601%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.
Impact type legend: D = dislodged, A = abraded, S = shaded, G = growth on cable.

Table 28. Estimated number of impacted gorgonian colonies, total colonies and estimated percent colonies impacted within each habitat belt area and total defined project area.

Habitat	Impact Type D	A	S	G	Total Impacted	Total Belt Area Colonies	Percent Impact of Belt Area	Total Study Area Colonies	Percent Impact of Study Area
CPS	0	1,537	1,230	1,230	3,997	194,614	2.054%	2,387,638	0.167%
RS	456	114	228	342	1,141	66,155	1.724%	672,336	0.170%
IR	825	1,376	825	2,476	5,503	194,519	2.829%	3,379,281	0.163%
MR	0	0	377	4,017	4,393	147,745	2.974%	5,022,024	0.087%
CPD	32	0	161	936	1,129	29,518	3.825%	1,233,786	0.092%
OR	66	33	99	559	756	20,636	3.662%	1,056,581	0.072%
SG	0	0	161	2,784	2,945	46,586	6.322%	2,449,769	0.120%
Total	1,380	3,060	3,080	12,344	19,863	699,772	2.839%	16,201,414	0.123%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.
Impact type legend: D = dislodged, A = abraded, S = shaded, G = growth on cable.

Table 29. Estimated number of impacted barrel sponges, total sponges and estimated percent sponges impacted within each habitat belt area.

Habitat	Impact Type SH	A	S	G	Total Impacted	Total Belt Area Sponges	Percent Impact of Belt Area	Total Study Area Sponges	Percent Impact of Study Area
CPS	307	0	307	0	615	2,152	28.571%	26,404	2.329%
RS	0	0	0	0	0	0	0.000%	0	0.000%
IR	275	275	275	0	825	10,730	7.692%	186,410	0.443%
MR	251	753	126	0	1130	7,406	15.254%	251,741	0.449%
CPD	32	97	0	32	161	2,290	7.042%	95,736	0.168%
OR	66	33	66	0	164	2,004	8.197%	102,630	0.160%
SG	107	54	428	268	857	6,104	14.035%	321,004	0.267%
Total	1,039	1,211	1,202	300	3,752	30,688	12.228%	983,925	0.381%

Habitat legend: CPS = Colonized Pavement-Shallow, RS = Ridge-shallow, IR = Inner Linear Reef, MR = Middle Linear Reef, CPD = Colonized Pavement-Deep, OR = Outer Linear Reef, and SG = Spur and Groove.
Impact type legend: SH = sheared, A = abraded, S = shaded, G = growth on cable.

IV. DISCUSSION

This effort provided a benthic habitat characterization of the hard bottom Essential Fish Habitat (EFH) areas (Coral, Coral Reefs and Live Hardbottom Habitat) within the SFOMF Restricted OPAREA cable corridor and identified and estimated impacts to EFH resources from cable deployments in the same corridor. Survey efforts were focused on the area of the primary corridor since this is where the majority of cables have been placed in the past and are anticipated to be placed in the future. Survey efforts were entirely within the SFOMF Restricted OPAREA located just south of the Port Everglades entrance channel in Broward County, Florida. The estimated three square kilometers of coral reef habitat within the project extent included seven habitats in water depths less than 30 m (Figure 1).

Habitat Characterization

A multivariate approach utilizing a matrix of substrate and biota functional group percent benthic cover was used to examine community similarities among the seven reef habitats. As illustrated by the MDS plot shown in Figure 4, all 35 non-cable sample sites clustered within a 60% similarity level. The Figure 4 MDS plot also illustrates the nearshore-offshore relationship among the habitats which likely contributed to the similarity within each habitat. The sites within each of the shallower nearshore habitats, CPS and RS, and IR, formed separate habitat groups (78% similarity) while the more offshore MR, CPD, OR, and SG sites formed a single habitat group. These habitat similarity groups and functional group percent benthic cover estimates are consistent with findings of southeast Florida reef monitoring efforts (Gilliam 2011, Gilliam et al. 2011).

Branching gorgonian, sponge, barrel sponge, and ‘other live’ groups contributed less to total benthic cover in the nearshore habitats (CPS, RS, and IR) than the offshore habitats (MR, CPD, OR, and SG) (Table 3). The IR habitat was more similar to the offshore habitats (MR, CPD, OR, and SG) than to the nearshore CPS and RS habitats. The ‘other live’ group was dominated by cyanobacteria either as tufts growing on the substrate or *Lyngbya* spp. growing epiphytically on branching gorgonians and sponges. Cyanobacteria has previously been identified as a measurable contributor to benthic cover in southeast Florida (Gilliam et al. 2011; Gilliam 2011), and dense blooms of epiphytic *Lyngbya* spp. have been observed episodically on reef habitats immediately south of Port Everglades within the study area since 2003.

Macroalgae and turf algae dominated benthic cover within all habitats with greater than 80% combined cover in the nearshore CPS, RS, and IR habitats, greater than 70% cover in the offshore MR, CPD, and OR habitats, and 57% cover in the offshore spur and groove (SG) habitat. The CPS habitat had the lowest branching gorgonian cover, but the greatest macroalgae cover, which was not unexpected given its location closest to shore. Previous studies have demonstrated dominance by fleshy macroalgae, turf algae, and cyanobacteria on nearshore hardbottom (i.e. CPS) immediately south of Port Everglades Inlet within John U. Lloyd Beach State Park (USACE 2003). Nearshore hardbottom habitats immediately north of Port Everglades Inlet were dominated by macroalgae and turf algae during a benthic habitat characterization study conducted in 2007 (NSUOC 2008).

The RS habitat had the lowest sponge cover, but the greatest *Palythoa* and stony coral cover. High cover of zoanthids (mostly *Palythoa caribaeorum*) has also been recorded in nearshore CPS habitat immediately north of Port Everglades Inlet (NSUOC 2008). The relatively higher abundances of *Siderastrea siderea*, *Porites astreoides*, and *Acropora cervicornis* were responsible for the majority of stony coral cover in the RS. The RS habitat was the only habitat in this study in which *A. cervicornis* was found (although *A. cervicornis* was identified in all seven habitats during the protected stony coral species assessment, Gilliam and Walker 2011), and it was the third most abundant coral in the RS (0.269±0.105). Mean (±1 SE) stony coral cover was greatest in the RS (2.0±0.5%) and SG (1.6±0.4%) habitats, and these cover estimates were significantly greater than the cover in the CPS habitat (ANOVA: $p < 0.0001$).

The stony coral assemblage data (cover and colony density) collected in this effort are consistent with data from southeast Florida reef monitoring projects which include sites in similar habitats (Gilliam et al. 2011; Gilliam 2011). Twenty five coral species were identified in the seven reef habitats in this study. Similarly, a total of 25 stony coral species (including the hydrocoral *Millepora alcicornis*) were recorded during the 2008 annual survey of 25 permanent reef monitoring sites in Broward County (Gilliam et al. 2009). Only one species recorded at the permanent Broward County stations was not recorded during the current study, the small cryptic coral *Phyllangia americana*. However, *P. americana* has been documented on the IR within a permanent monitoring station offshore of John U. Lloyd Beach State Park (Gilliam et al. 2009).

Stony coral mean species richness was significantly greater in the offshore MR and SG habitats in comparison to the nearshore CPS habitats (ANOVA: $p = 0.0042$). The offshore MR and SG habitats were the most speciose with 17 stony coral species, and the fewest species (9) were recorded in the nearshore CPS habitat. *Siderastrea siderea* was the most abundant species with the highest or second highest density in all seven habitats. *Porites astreoides* was also one of the top five most abundant in all habitats, and *Montastrea cavernosa* and *Stephanocoenia intersepta* contributed to top five density rankings in six of the habitats. These results are similar to the long-term monitoring dataset from the County's program; the most abundant species at the 25 County stations are *S. siderea*, *M. cavernosa*, *P. astreoides*, and *S. intersepta* (Gilliam et al. 2011).

All habitats supported stony colonies larger than 50 cm diameter, and only the nearshore RS and offshore SG habitats had colonies larger than 100 cm diameter. Small colonies in the 2-5 cm (diameter) size class dominated the stony coral assemblage in all habitats (Table 6 and Figure 7), and this size class was the only size class with densities greater than 1.0 colonies/m^2.

Branching gorgonian percent benthic cover and density were greater in the offshore habitats (MR, CPD, OR, and SG) than in the nearshore habitats (CPS and RS). Mean (±1 SE) branching gorgonian cover was significantly greater in the SG (8.1±1.9 %) habitat than in the CPS (1.5±1.4 %) and RS (3.3±1.0 %) habitats (ANOVA: $p = 0.0012$). The SG habitat had the greatest density (8.9±2.4 colonies/m^2) and diversity of gorgonians (20 taxa). The CPS habitat had the lowest density of branching gorgonians (1.8±1.2 colonies/m^2) while the least speciose habitats were the RS and IR habitats (14 taxa). The mean number of taxa identified within the habitats ranged from 7 (OR) to 10 (SG), and no significance difference in mean taxa richness was determined among habitats (Figure 8) (ANOVA: $p = 0.2730$). In all habitats, the 11-25 cm size (height) class contributed most to overall gorgonian density (Figure 9). No differences were determined among habitats for the smaller size classes, but the offshore SG habitat had significantly greater 26-50 cm and >50 cm size class densities than the nearshore CPS and RS habitats (26-50 cm ANOVA: $p = 0.0180$) (>50 cm ANOVA: $p < 0.0001$), perhaps indicating a more stable habitat in the offshore reef environments (Figure 9). As seen with the stony coral assemblage, the gorgonian assemblage data (cover and colony density) collected in this effort are consistent with that collected in southeast Florida reef monitoring projects which include sites in similar habitats (Gilliam et al. 2011 and Gilliam 2011)

Barrel sponges, *X. muta*, were observed in all habitats except the RS. This does not imply that barrel sponges are not present within the RS habitat, but none were identified within the five sample sites. Only one barrel sponge was identified within the five nearshore shallow-water CPS habitats. Within the remaining five habitats, barrel sponge mean (±1SE) density was greatest in the SG (0.61±0.06 sponges/m^2) and CPD habitats (0.58±0.08 sponges/m^2) and both were significantly greater than the mean density found in the IR (0.16±0.03 sponges/m^2) habitat (Table 10 and Figure 10) (ANOVA: $p < 0.0001$). No significant difference in mean sponge volume (cm^3) was determined within the five habitats (IR, MR, CPD, OR, and SG) (ANOVA: $p = 0.2229$). Consistent with the CRMP monitoring data from the Florida Keys National Sanctuary, where barrel sponges were most abundant at the deep sites (Bertin and Callahan 2008), the data from this study suggest that barrel sponges are more commonly found in the offshore, deeper-water habitats in comparison to the nearshore, shallow-water habitats in the study area. Although not significant, the largest sponges in the study area were seen in the offshore OR and SG habitats.

Cable Impact Assessment

This survey effort was not designed to and could not estimate EFH impacts associated with cable deployment activities or distinguish deployment impacts from impacts that have occurred since deployment. Impacts that occur during deployment include physical dislodgment of reef biota, which likely result in complete mortality and physical abrasion of reef biota, and at a minimum, cause partial mortality of impacted biota. Impacts continue during the life of the cable on or over reef habitat. Cables that remain in place over reef substrate impact EFH resources by covering and shading essential natural hardbottom substrate required for reef community settlement. Continuous direct contact with important reef biota such as stony and gorgonian corals and barrel sponges also could potentially result in mortality. Cable movement on the benthos increases impacts by scouring additional reef substrate, further limiting reef community development, increasing mortality of biota previously in contact with cable, and continued dislodgement and abrasion of reef biota.

Within the project area, five cable sites in each of the seven habitats were assessed for cable-associated impacts to EFH resources. These sites had at least one cable within each belt transect. The assessment was analyzed in two ways. The first compared the benthic community between non-cable and cable sites within each habitat, and the second specifically evaluated evidence of cable movement, and cable-associated impacts to key components of the benthic community, stony corals, gorgonian, and barrel sponges.

The average number of cables at each cable site was greatest in the nearshore sites (CPS and RS) due to the greater density of cables running through the nearshore habitats immediately offshore of the Navy facility. The CPS and RS habitats had a greater number of cables running through a smaller area (see Figure 2), and this cable density decreases offshore. This is also shown by the greater number of cables within each cable survey site nearshore (Table 12). Many of the offshore sites only had one cable within the sample area.

The multivariate approach used to characterize the habitats was also used to evaluate habitat similarities within non-cable and cable sites. The purpose of this analysis was to identify, through percent cover of benthic functional groups, differences at the community level between cable sites and non-cable sites within each habitat. The data from this study show that the presence of cable(s) is contributing to dissimilarities between cable and non-cable sites in each of the reef habitats (Figures 13 and 14). In Figure 13, the MDS plot includes ‘cable’, an artificial, potentially-motile substrate, as opposed to reef pavement, as a substrate type for branching gorgonians, encrusting gorgonians, sponges, and algae (Table 13). The cable and non-cable sites within each habitat form distinct clusters with clear separation of all cable sites from non-cable sites. This treatment of ‘cable” as an artificial motile substrate is similar to “unconsolidated rubble” as a substrate type in reef environments when examining habitat stability and settlement and reef biota survivorship (Gilliam and Moulding 2011).

Cable density likely contributed to the nearshore RS and CPS habitats having reef community and stony coral population differences between the cable and non-cable sites. This is illustrated by the separation of the RS non-cable sites from the RS cable sites in Figure 14, and with the non-cable RS sites having greater stony coral cover and colony size (Tables 15 and 16). Because of the greater density and shallower water depths, these nearshore hardbottom habitats are perhaps at the greatest risk from the continued presence of cable.

When ‘cable’ is removed as a substrate type, the between cable and non-cable site dissimilarity within each habitat is reduced at all habitats except the RS. The resultant MDS plot (Figure 14) is very similar to the non-cable site only MDS plot (Figure 4). Within the cable sites, cable was not determined to be directly reducing the benthic cover of groups such as stony corals, gorgonians, and sponges, but rather, the artificial, potentially-motile cable substrate appears to be taking the place of natural reef substrate, which may indirectly impact the reef community by limiting growth or directly impacting biota from cable movement.

Evidence of cable movement was observed at 27 of the 35 cable sites (Table 14). Substrate scour was a typical symptom of cable movement and was identified at 22 cable sites (Tables 13 and 14 and Figures 16 and 17). Mortality to stony corals, gorgonians, and barrel sponges associated with cable movement was identified in 12 sites (see Figures 17-19). Additional examples of cable movement included broken (Figure 20), frayed (Figure 21), and tangled cables (Figure 22). These observations indicate cable movement creates an impact area greater than the width of the cable.

Differences in population parameters of stony corals, gorgonians, and barrel sponges were evaluated between cable and non-cable sites within habitats, and few differences were identified. There were no significant differences in stony coral density (colonies/m²) (Table 16) or species richness (Table 15) (t test: $p > 0.1$ for all habitat comparisons) based upon cable presence. There was significantly greater percent cover (t test: $p = 0.014$) of stony corals (Table 15) and mean colony size (diameter) (t test: $p = 0.044$) (Table 16) at the non-cable sites than at the cable sites on the nearshore RS habitat. No significant differences were determined for any gorgonian or barrel sponge comparisons of population parameters (Tables 20, 21, and 23) (t test: $p > 0.1$ for all habitat comparisons).

Impacts to stony and gorgonian coral colonies were identified in all habitats (Tables 19 and 22). Impacts to barrels sponges were identified in all six habitats which had barrels sponges (no barrel sponges were seen in the RS sites) (Table 25). Within the belt transect in cable sites, the percentage of the stony coral population impacted ranged from 8.4% in the IR to 21.5% in the RS (Table 19 and Figure 24). For gorgonians, the percentage of the population impacted ranged from 2.4% in the RS to 9.8% in the SG (Table 22 and Figure 28), and barrel sponge impacts ranged from 7.2% in the CPD to 23.3% in the CPS (only 7 barrel sponges colonies identified in the CPS) (Table 25 and Figure 31).

Mean density (colony or sponge/m²) of all impact types was also estimated within each habitat. These densities were used to estimate by habitat the total number of stony coral colonies (Table 27), gorgonian colonies (Table 28), and barrel sponges (Table 29) impacted within a 1.5-m belt adjacent to all cables within the defined project area (Figure 2). Over 33,000 (14%) stony coral colonies, 19,000 (3%) gorgonian colonies, and 3,700 (12%) barrel sponges were estimated to be currently impacted by cable within the belt areas in the defined project area (Tables 27-29). These numbers are not driven by great densities of impacted colonies or sponges within individual sites, but by the numerous cables impacting areas within each habitat and the total project area. These estimates also only include impacts to colonies and sponges which still had living tissue at the time of the survey. Impacts to colonies or sponges that have been dislodged and moved or colonies or sponges that have experienced complete mortality over the entire time cable has been deployed were not captured in this effort.

An estimate of the percent impacted colonies and sponges within the entire defined project area was requested. These percentages were determined by dividing the estimated total numbers of impacted stony coral and gorgonian colonies and barrel sponges by the total estimated numbers of stony coral and gorgonian colonies and barrel sponges within the defined project area. Within the defined project area, 0.601% of the stony coral colonies (Table 27), 0.123% of the gorgonian colonies (Table 28), and 0.381% of the barrel sponges (Table 29) were estimated to be currently impacted by cables.

Although impacts were identified in this study, cable-associated impacts at the reef community and stony coral, gorgonian, and barrel sponge population levels were difficult to determine. This is not to say that impacts at these levels do not exist; however, quantifying impacts at these levels is challenging due to the small sample size (N of 5 cable sites/habitat), the related scale of each survey site versus each habitat, and the inherent variability in coral reef communities within each habitat. The variability in the number and density (cables within a certain area) of cables in each habitat (see Figure 2 and Table 26) also contributed to the difficulty in measuring impacts at these higher levels.

Numerous cable-associated impacts were identified at the individual coral colony and sponge level. These impacts were likely associated with cable deployment and post-deployment cable movement. Cable movement appeared to be greater in the nearshore, shallower habitats. More scoured substrate was present in the CPS and RS habitats (Tables 13 and 14), and growth on cable contributed more to the percent impacted colonies and sponges in the offshore, deeper habitats, indicating higher cable stability in relatively deeper water (Tables 19, 22, and 25). However, cable movement in any of the habitats is of particular concern because it greatly increases the impact area and may limit reef community development in areas adjacent to cables.

The presence of cables is impacting EFH resource areas (Coral, Coral Reefs and Live Hardbottom Habitat) within the South Florida Ocean Measurement Facility Restricted OPAREA cable corridor. The impact assessment was limited by the number of survey sites, but it provided evidence of cable movement and detailed information on types and densities of cable impacts to stony corals, gorgonians, and barrel sponges. Because of the greater density and shallower water depths, nearshore hardbottom habitats are perhaps at the greatest risk from the continued presence of cable. It is important to emphasize that both the habitat characterization and impact assessment were only synoptic surveys providing data for a single point in time. Identifying and measuring long-term cable-associated impacts to reef communities and quantification of differences in levels of impacts between shallow-water nearshore and deeper-water offshore habitats will require continuous monitoring which will also facilitate differentiating cable from non-cable associated reef community changes over time. This study has demonstrated that impacts to reef biota continue to occur during the life of the cable on or over reef habitat, and the presence of cables, an artificial, motile substrate, increases the risk of future impacts to reef biota due to the motility of these cables in reef environments.

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APPENDIX 1. Non-cable site locations, depths, and sample dates.

Site	Habitat	Depth (m)	Latitude	Longitude	Sample Date
CPS1	Colonized Pavement-Shallow	3	26.08875148	-80.10665321	8-May-11
CPS2	Colonized Pavement-Shallow	5	26.08823333	-80.10555000	8-May-11
CPS3	Colonized Pavement-Shallow	5	26.08661667	-80.10603333	8-May-11
CPS4	Colonized Pavement-Shallow	5	26.08608333	-80.10051667	8-May-11
CPS5	Colonized Pavement-Shallow	3	26.08811175	-80.10670979	4-Aug-11
RS1	Ridge-Shallow	3	26.08463280	-80.10314329	10-May-11
RS2	Ridge-Shallow	3	26.08501377	-80.10287374	10-May-11
RS3	Ridge-Shallow	4	26.08554509	-80.10313501	10-May-11
RS4	Ridge-Shallow	5	26.08611571	-80.10380199	10-May-11
RS5	Ridge-Shallow	4	26.08570704	-80.10360701	10-May-11
IR1	Inner Linear Reef	9	26.07591667	-80.09533333	16-May-11
IR2	Inner Linear Reef	10	26.07696667	-80.09488333	16-May-11
IR3	Inner Linear Reef	7	26.08055000	-80.09506667	16-May-11
IR4	Inner Linear Reef	4	26.07360000	-80.09576667	16-May-11
IR5	Inner Linear Reef	4	26.06956083	-80.09636238	20-May-11
MR1	Middle Linear Reef	10	26.06848393	-80.09347191	19-May-11
MR2	Middle Linear Reef	11	26.06166667	-80.09323333	10-Aug-11
MR3	Middle Linear Reef	14	26.08508722	-80.09027841	19-Aug-11
MR4	Middle Linear Reef	14	26.07893436	-80.09176925	29-Aug-11
MR5	Middle Linear Reef	11	26.06444144	-80.09328805	6-Sep-11
CPD1	Colonized Pavement-Deep	15	26.07683333	-80.08613333	20-May-11
CPD2	Colonized Pavement-Deep	16	26.08121240	-80.08570383	29-Aug-11
CPD3	Colonized Pavement-Deep	16	26.08528009	-80.08549269	8-Sep-11
CPD4	Colonized Pavement-Deep	18	26.06016720	-80.08698120	13-Sep-11
CPD5	Colonized Pavement-Deep	17	26.06700000	-80.08666667	19-Sep-11
OR1	Outer Linear Reef	15	26.07615061	-80.08529960	4-May-11
OR2	Outer Linear Reef	14	26.07697714	-80.08541014	11-May-11
OR3	Outer Linear Reef	14	26.06921118	-80.08582135	11-May-11
OR4	Outer Linear Reef	13	26.07275278	-80.08553866	19-May-11
OR5	Outer Linear Reef	15	26.06262189	-80.08596866	12-Sep-11
SG1	Spur and Groove	20	26.06341671	-80.08520383	9-Sep-11
SG2	Spur and Groove	20	26.06755051	-80.08490062	12-Sep-11
SG3	Spur and Groove	18	26.08454652	-80.08425950	13-Sep-11
SG4	Spur and Groove	18	26.07927971	-80.08480599	16-Sep-11
SG5	Spur and Groove	17	26.07556014	-80.08483212	19-Sep-11

APPENDIX 2. Cable site locations, depths, and sample dates.

Site	Habitat	Depth (m)	Latitude	Longitude	Sample Date
CPS1-C	Colonized Pavement-Shallow	6	26.08788333	-80.09878333	8-Apr-11
CPS2-C	Colonized Pavement-Shallow	6	26.08703333	-80.09990000	8-Apr-11
CPS3-C	Colonized Pavement-Shallow	3	26.09143333	-80.10511667	11-Apr-11
CPS4-C	Colonized Pavement-Shallow	6	26.08980000	-80.09825000	11-Apr-11
CPS5-C	Colonized Pavement-Shallow	5	26.08971674	-80.10547845	11-May-11
RS1-C	Ridge-Shallow	3	26.08936667	-80.10293333	13-Apr-11
RS2-C	Ridge-Shallow	5	26.08943333	-80.10358333	13-Apr-11
RS3-C	Ridge-Shallow	3	26.09010000	-80.10310000	13-Apr-11
RS4-C	Ridge-Shallow	3	26.08968333	-80.10233333	13-Apr-11
RS5-C	Ridge-Shallow	4	26.09073176	-80.10311708	11-May-11
IR1-C	Inner Linear Reef	7	26.08763835	-80.09621532	1-Apr-11
IR2-C	Inner Linear Reef	7	26.08837734	-80.09593696	1-Apr-11
IR3-C	Inner Linear Reef	7	26.08880000	-80.09596667	1-Apr-11
IR4-C	Inner Linear Reef	6	26.07721667	-80.09591667	8-Apr-11
IR5-C	Inner Linear Reef	6	26.08333333	-80.09813333	8-Apr-11
MR1-C	Middle Linear Reef	12	26.07685000	-80.09255000	6-Apr-11
MR2-C	Middle Linear Reef	12	26.07333333	-80.09303333	6-Apr-11
MR3-C	Middle Linear Reef	11	26.07226667	-80.09295000	6-Apr-11
MR4-C	Middle Linear Reef	18	26.06746667	-80.09145000	11-Apr-11
MR5-C	Middle Linear Reef	14	26.07158333	-80.09201667	17-Apr-11
CPD1-C	Colonized Pavement-Deep	16	26.08075000	-80.08603333	19-May-11
CPD2-C	Colonized Pavement-Deep	14	26.07929420	-80.08569397	20-May-11
CPD3-C	Colonized Pavement-Deep	15	26.06136602	-80.08712789	26-May-11
CPD4-C	Colonized Pavement-Deep	15	26.06253862	-80.08709839	16-Jun-11
CPD5-C	Colonized Pavement-Deep	17	26.08315000	-80.08540833	23-Sep-11
OR1-C	Outer Linear Reef	15	26.06959234	-80.08585700	17-Apr-11
OR2-C	Outer Linear Reef	14	26.07792313	-80.08532467	17-Apr-11
OR3-C	Outer Linear Reef	14	26.07716667	-80.08518333	4-May-11
OR4-C	Outer Linear Reef	14	26.07463333	-80.08538333	4-Aug-11
OR5-C	Outer Linear Reef	13	26.07176667	-80.08565000	4-Aug-11
SG1-C	Spur and Groove	22	26.06846667	-80.08441667	6-Sep-11
SG2-C	Spur and Groove	21	26.06438333	-80.08540000	10-Aug-11
SG3-C	Spur and Groove	23	26.07105000	-80.08431667	19-Aug-11
SG4-C	Spur and Groove	22	26.07615000	-80.08391667	7-Jun-11
SG5-C	Spur and Groove	18	26.08030000	-80.08453333	26-May-11

APPENDIX 3. The total density of stony coral colonies and the density and percent of all impacted colonies (T) and density of dislodged (D), abraded (A), shaded (S), and growth over cable (G) identified within each belt transect in each cable site.

	Total	Density					Percent				
Site	Density	T	D	A	S	G	T	D	A	S	G
CPS1-C	1.467	0.233	0.000	0.000	0.167	0.067	15.91%	0.00%	0.00%	11.36%	4.55%
CPS2-C	1.167	0.333	0.000	0.267	0.033	0.033	28.57%	0.00%	22.86%	2.86%	2.86%
CPS3-C	1.033	0.333	0.033	0.167	0.033	0.100	32.26%	3.23%	16.13%	3.23%	9.68%
CPS4-C	0.933	0.067	0.000	0.067	0.000	0.000	7.14%	0.00%	7.14%	0.00%	0.00%
CPS5-C	3.500	0.467	0.000	0.000	0.467	0.000	13.33%	0.00%	0.00%	13.33%	0.00%
RS1-C	0.867	0.233	0.000	0.100	0.133	0.000	26.92%	0.00%	11.54%	15.38%	0.00%
RS2-C	0.600	0.067	0.000	0.000	0.033	0.033	11.11%	0.00%	0.00%	5.56%	5.56%
RS3-C	1.500	0.300	0.000	0.000	0.233	0.067	20.00%	0.00%	0.00%	15.56%	4.44%
RS4-C	0.733	0.167	0.000	0.067	0.067	0.033	22.73%	0.00%	9.09%	9.09%	4.55%
RS5-C	1.500	0.400	0.000	0.000	0.367	0.033	26.67%	0.00%	0.00%	24.44%	2.22%
IR1-C	1.233	0.200	0.000	0.067	0.067	0.067	16.22%	0.00%	5.41%	5.41%	5.41%
IR2-C	1.567	0.100	0.000	0.000	0.033	0.067	6.38%	0.00%	0.00%	2.13%	4.26%
IR3-C	1.933	0.067	0.000	0.033	0.000	0.033	3.45%	0.00%	1.72%	0.00%	1.72%
IR4-C	1.533	0.200	0.000	0.100	0.067	0.033	13.04%	0.00%	6.52%	4.35%	2.17%
IR5-C	1.967	0.100	0.000	0.067	0.033	0.000	5.08%	0.00%	3.39%	1.69%	0.00%
MR1-C	2.000	0.267	0.000	0.033	0.000	0.233	13.33%	0.00%	1.67%	0.00%	11.67%
MR2-C	1.533	0.167	0.000	0.067	0.067	0.033	10.87%	0.00%	4.35%	4.35%	2.17%
MR3-C	2.033	0.067	0.000	0.000	0.033	0.033	3.28%	0.00%	0.00%	1.64%	1.64%
MR4-C	2.133	0.467	0.033	0.000	0.200	0.233	21.88%	1.56%	0.00%	9.38%	10.94%
MR5-C	2.767	0.133	0.000	0.000	0.067	0.067	4.82%	0.00%	0.00%	2.41%	2.41%
CPD1-C	1.200	0.333	0.000	0.000	0.167	0.167	27.78%	0.00%	0.00%	13.89%	13.89%
CPD2-C	2.567	0.300	0.000	0.000	0.233	0.067	11.69%	0.00%	0.00%	9.09%	2.60%
CPD3-C	0.600	0.000	0.000	0.000	0.000	0.000	0.00%	0.00%	0.00%	0.00%	0.00%
CPD4-C	0.833	0.100	0.000	0.000	0.033	0.067	12.00%	0.00%	0.00%	4.00%	8.00%
CPD5-C	1.733	0.200	0.000	0.000	0.100	0.100	11.54%	0.00%	0.00%	5.77%	5.77%
OR1-C	1.933	0.233	0.000	0.000	0.167	0.067	12.07%	0.00%	0.00%	8.62%	3.45%
OR2-C	1.633	0.200	0.000	0.033	0.033	0.133	12.24%	0.00%	2.04%	2.04%	8.16%
OR3-C	1.500	0.200	0.000	0.100	0.033	0.067	13.33%	0.00%	6.67%	2.22%	4.44%
OR4-C	1.567	0.100	0.033	0.067	0.000	0.000	6.38%	2.13%	4.26%	0.00%	0.00%
OR5-C	2.100	0.200	0.000	0.067	0.133	0.000	9.52%	0.00%	3.17%	6.35%	0.00%
SG1-C	3.433	0.267	0.000	0.033	0.033	0.200	7.77%	0.00%	0.97%	0.97%	5.83%
SG2-C	1.867	0.367	0.000	0.133	0.200	0.033	19.64%	0.00%	7.14%	10.71%	1.79%
SG3-C	1.933	0.467	0.000	0.000	0.467	0.000	24.14%	0.00%	0.00%	24.14%	0.00%
SG4-C	3.533	0.933	0.000	0.000	0.467	0.467	26.42%	0.00%	0.00%	13.21%	13.21%
SG5-C	1.967	0.367	0.000	0.000	0.233	0.133	18.64%	0.00%	0.00%	11.86%	6.78%

APPENDIX 4. The total density of gorgonian colonies and the density and percent of all impacted colonies (T) and density of dislodged (D), abraded (A), shaded (S), and growth over cable (G) identified within each belt transect in each cable site.

	Total	Density					Percent				
Site	**Density**	**T**	**D**	**A**	**S**	**G**	**T**	**D**	**A**	**S**	**G**
CPS2-C	8.567	0.067	0.000	0.067	0.000	0.000	0.78%	0.00%	0.78%	0.00%	0.00%
CPS3-C	1.233	0.067	0.000	0.000	0.000	0.067	5.41%	0.00%	0.00%	0.00%	5.41%
CPS4-C	3.567	0.033	0.000	0.000	0.000	0.033	0.93%	0.00%	0.00%	0.00%	0.93%
CPS5-C	0.467	0.033	0.000	0.000	0.033	0.000	7.14%	0.00%	0.00%	7.14%	0.00%
RS1-C	3.100	0.033	0.033	0.000	0.000	0.000	1.08%	1.08%	0.00%	0.00%	0.00%
RS2-C	3.700	0.000	0.000	0.000	0.000	0.000	0.00%	0.00%	0.00%	0.00%	0.00%
RS3-C	4.600	0.067	0.000	0.000	0.033	0.033	1.45%	0.00%	0.00%	0.72%	0.72%
RS4-C	5.733	0.033	0.000	0.000	0.000	0.033	0.58%	0.00%	0.00%	0.00%	0.58%
RS5-C	2.200	0.200	0.100	0.033	0.033	0.033	9.09%	4.55%	1.52%	1.52%	1.52%
IR1-C	1.833	0.033	0.000	0.033	0.000	0.000	1.82%	0.00%	1.82%	0.00%	0.00%
IR2-C	3.300	0.167	0.000	0.000	0.000	0.167	5.05%	0.00%	0.00%	0.00%	5.05%
IR3-C	4.933	0.100	0.000	0.000	0.033	0.067	2.03%	0.00%	0.00%	0.68%	1.35%
IR4-C	3.200	0.067	0.000	0.033	0.033	0.000	2.08%	0.00%	1.04%	1.04%	0.00%
IR5-C	10.300	0.300	0.100	0.100	0.033	0.067	2.91%	0.97%	0.97%	0.32%	0.65%
MR1-C	7.267	0.467	0.000	0.000	0.067	0.400	6.42%	0.00%	0.00%	0.92%	5.50%
MR2-C	3.967	0.000	0.000	0.000	0.000	0.000	0.00%	0.00%	0.00%	0.00%	0.00%
MR3-C	5.267	0.067	0.000	0.000	0.000	0.067	1.27%	0.00%	0.00%	0.00%	1.27%
MR4-C	9.667	0.567	0.000	0.000	0.000	0.567	5.86%	0.00%	0.00%	0.00%	5.86%
MR5-C	13.100	0.067	0.000	0.000	0.033	0.033	0.51%	0.00%	0.00%	0.25%	0.25%
CPD1-C	8.367	0.300	0.033	0.000	0.167	0.100	3.59%	0.40%	0.00%	1.99%	1.20%
CPD2-C	2.233	0.100	0.000	0.000	0.000	0.100	4.48%	0.00%	0.00%	0.00%	4.48%
CPD3-C	10.233	0.167	0.000	0.000	0.000	0.167	1.63%	0.00%	0.00%	0.00%	1.63%
CPD4-C	6.767	0.267	0.000	0.000	0.000	0.267	3.94%	0.00%	0.00%	0.00%	3.94%
CPD5-C	2.900	0.333	0.000	0.000	0.000	0.333	11.49%	0.00%	0.00%	0.00%	11.49%
OR1-C	2.267	0.100	0.033	0.033	0.000	0.033	4.41%	1.47%	1.47%	0.00%	1.47%
OR2-C	2.767	0.133	0.033	0.000	0.067	0.033	4.82%	1.20%	0.00%	2.41%	1.20%
OR3-C	8.600	0.033	0.000	0.000	0.033	0.000	0.39%	0.00%	0.00%	0.39%	0.00%
OR4-C	5.300	0.300	0.000	0.000	0.000	0.300	5.66%	0.00%	0.00%	0.00%	5.66%
OR5-C	1.933	0.200	0.000	0.000	0.000	0.200	10.34%	0.00%	0.00%	0.00%	10.34%
SG1-C	2.467	0.300	0.000	0.000	0.100	0.200	12.16%	0.00%	0.00%	4.05%	8.11%
SG2-C	3.033	0.200	0.000	0.000	0.000	0.200	6.59%	0.00%	0.00%	0.00%	6.59%
SG3-C	5.567	1.067	0.000	0.000	0.000	1.067	19.16%	0.00%	0.00%	0.00%	19.16%
SG4-C	2.433	0.267	0.000	0.000	0.000	0.267	10.96%	0.00%	0.00%	0.00%	10.96%
SG5-C	15.500	0.000	0.000	0.000	0.000	0.000	0.00%	0.00%	0.00%	0.00%	0.00%

APPENDIX 5. The total density of barrel sponges and the density and percent of all impacted barrel sponges (T) and density of sheared (SH), abraded (A), shaded (S), and growth over cable (G) identified within each belt transect in each cable site.

	Total	Density					Percent				
Site	Density	T	SH	A	S	G	T	SH	A	S	G
CPS2-C	0.03	0.03	0.00	0.00	0.03	0.00	100.00%	0.00%	0.00%	100.00%	0.00%
CPS3-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
CPS4-C	0.20	0.03	0.03	0.00	0.00	0.00	16.67%	16.67%	0.00%	0.00%	0.00%
CPS5-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
RS1-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
RS2-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
RS3-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
RS4-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
RS5-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
IR1-C	0.17	0.03	0.00	0.03	0.00	0.00	20.00%	0.00%	20.00%	0.00%	0.00%
IR2-C	0.43	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
IR3-C	0.43	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
IR4-C	0.17	0.03	0.03	0.00	0.00	0.00	20.00%	20.00%	0.00%	0.00%	0.00%
IR5-C	0.10	0.03	0.00	0.00	0.03	0.00	33.33%	0.00%	0.00%	33.33%	0.00%
MR1-C	0.27	0.03	0.00	0.03	0.00	0.00	12.50%	0.00%	12.50%	0.00%	0.00%
MR2-C	0.50	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
MR3-C	0.33	0.03	0.03	0.00	0.00	0.00	10.00%	10.00%	0.00%	0.00%	0.00%
MR4-C	0.43	0.10	0.00	0.10	0.00	0.00	23.08%	0.00%	23.08%	0.00%	0.00%
MR5-C	0.43	0.13	0.03	0.07	0.03	0.00	30.77%	7.69%	15.38%	7.69%	0.00%
CPD1-C	0.37	0.03	0.00	0.03	0.00	0.00	9.09%	0.00%	9.09%	0.00%	0.00%
CPD2-C	0.27	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
CPD3-C	0.50	0.13	0.03	0.07	0.00	0.03	26.67%	6.67%	13.33%	0.00%	6.67%
CPD4-C	0.80	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
CPD5-C	0.43	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
OR1-C	0.33	0.10	0.03	0.03	0.03	0.00	30.00%	10.00%	10.00%	10.00%	0.00%
OR2-C	0.20	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
OR3-C	0.30	0.03	0.03	0.00	0.00	0.00	11.11%	11.11%	0.00%	0.00%	0.00%
OR4-C	0.47	0.03	0.00	0.00	0.03	0.00	7.14%	0.00%	0.00%	7.14%	0.00%
OR5-C	0.73	0.00	0.00	0.00	0.00	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
SG1-C	0.83	0.03	0.00	0.00	0.00	0.03	4.00%	0.00%	0.00%	0.00%	4.00%
SG2-C	0.90	0.10	0.00	0.00	0.10	0.00	11.11%	0.00%	0.00%	11.11%	0.00%
SG3-C	0.73	0.13	0.00	0.00	0.10	0.03	18.18%	0.00%	0.00%	13.64%	4.55%
SG4-C	0.63	0.07	0.00	0.00	0.00	0.07	10.53%	0.00%	0.00%	0.00%	10.53%
SG5-C	0.70	0.20	0.07	0.03	0.07	0.03	28.57%	9.52%	4.76%	9.52%	4.76%

Appendix D

Deepwater Benthic Habitat Characterization (2012)

Deep-Water Benthic Habitat Characterization and Cable Impact Assessment for the South Florida Ocean Measurement Facility (SFOMF)

July 2012

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1 INTRODUCTION

The purpose of this effort was to (1) provide a characterization of benthic habitats within the South Florida Ocean Measurement Facility (SFOMF) OP AREA cable corridor along deep fiber-optic cable C/S 96 from a depth of ~30 m to the reported eastern seaward terminus on the Miami Terrace (~500 m depth), and (2) identify and estimate impacts to deep benthic habitat resources from cable infrastructure in the same corridor preparatory to an Essential Fish Habitat (EFH) Assessment.

The project was carried out in response to a request from the SFOMF (a detachment of Naval Surface Warfare Center Carderock Division [NSWCCD]). This effort was carried out within the SFOMF OP AREA located just south of the Port Everglades entrance channel in Broward County, Florida (Figure 1-1). The survey consisted of a videographic and still photographic survey executed using the NSWCCD's Television Observed Nautical Grappling System (TONGS) Remotely Operated Vehicle (ROV) to examine a cable route and comparable areas without cables. The survey included a 26.2-km-long transect along a cable route, 1-km-long parallel transects 150 m on each side of the cable route between 30 m and 90 m depth, a 20.2-km-long transect ~1.6 km north of the cable route between 250 and 500 m depth, a 13.4-km-long transect ~2.2 km south of the cable route between 285 and 565 m depth, plus three north-south oriented transects along the cable route. The total length of the survey was approximately 67 km (=~36 nm).

Tasks included (1) review of video and still photographic data for organism identification, (2) analyses of still images for substrate type, taxon abundances and density by habitat/substrate type and location, and percent cover by taxon, (3) characterization and mapping of benthic habitats/biological zones, and (4) comparison of Cable and Non-Cable habitats.

The data and analyses in this report are part of a larger study that also assessed cable impacts in seven selected shallower-water habitats (0-30 m) in the OP AREA. Major differences in methodologies between the shallow-water study and this one necessitated different approaches to data collection. Environments beyond scuba depth are inherently far more difficult of access, and data acquisition is more limited for a given time effort. In addition, resource management agencies (e.g., BOEM, NOAA, SAFMC) apply different regulatory criteria to shallow versus deeper-water habitats (e.g., Coral Habitat of Particular Concern for deep-water corals; Section 2.4, below). The survey reported here was carried out at depths greater than recreational scuba diving limits (30 m). As a result, all data were collected remotely; results and analyses were based entirely on video and photographs, and all data were analyzed and reported to conform with agency criteria for deep-water habitats.

Although cable-associated EFH impacts may occur during cable deployment and continuously over the time cable remains on reef habitat, this project was not designed to and could not distinguish among impacts associated with deployment and those that have occurred since deployment. Similarly, it cannot anticipate the nature and breadth of future deployment impacts.

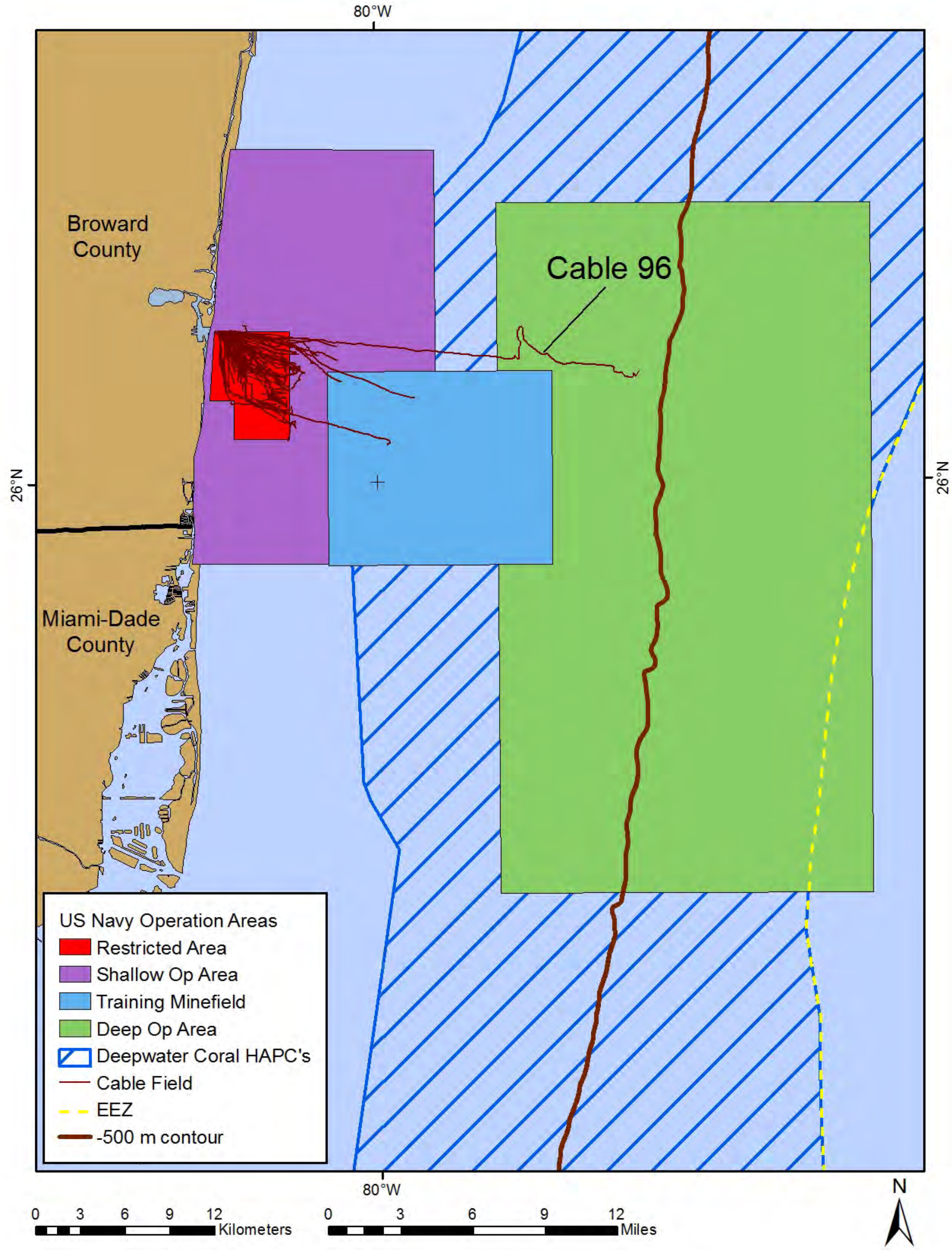

Figure 1-1. Map of US Navy Operation Areas (OP AREAs) in relation to the Deepwater Coral Habitat of Particular Concern (HAPC) and the Economic Exclusive Zone (EEZ) along the southeast Florida coast. This study aimed to provide a characterization of benthic habitats along submarine Cable 96 from a depth of ~30 m to the reported eastern seaward terminus on the Miami Terrace (~500 m depth).

2 BACKGROUND

2.1 Essential Fish Habitat (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; Public Law 104-208) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" [16 U.S.C. 1802 (10)]. The National Marine Fisheries Service (NMFS) and the South Atlantic Fisheries Management Council (SAFMC), one of eight regional fisheries management councils, are responsible for managing and protecting fisheries and habitat essential for the survival of managed species within the federal 200-nautical-mile limit off U.S. coasts extending from North Carolina to Key West, Florida. The provisions of the MSFCMA delegate this authority to the U.S. Secretary of Commerce, who acts through NMFS and the SAFMC. As amended by the Sustainable Fisheries Act of 1996, Section 303(a)(7), the MSFCMA includes several mandates for NMFS and SAFMC to identify and protect EFH for all managed species in each Fisheries Management Plan (FMP); minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH (FDOT, 2010).

EFH identified in the FMP Amendments for the SAFMC off southeastern Florida include live/hard bottoms, coral and coral reefs, artificial/manmade reefs, *Sargassum* and the water column (NOAA NMFS, 2000), which established the basis for quantitative photostation selection in this study. Note that BOEM (**Gulf of Mexico OCS Region,** NTL No. 99-G16) defines Live Bottom (in addition to shallow-water seagrass communities) as areas containing biological assemblages consisting of sessile invertebrates living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography, and areas where the lithotope (i.e., sedimentary environment) favors the accumulation of turtles, fishes, or other fauna. However, because extensive portions of the hard substrates in the study area support sparse to widely scattered sessile invertebrates, we use the term Hard Bottom exclusively.

This report provides a benthic habitat characterization along a designated cable route and additional transects in the SFOMC's OP AREA as described in Section 1.0, to examine the distribution of benthic habitats and evaluate existing and potential effects of cables on benthic communities. The report supports portions of two of the items required by the MSFCMA for an EFH Assessment for any proposed future cable deployment: 1) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage, and 2) results of an on- site inspection, the views of recognized experts on the habitat or species affects, a literature review, an analysis of alternatives to the proposed action, and any other relevant information (NOAA NMFS, 2000). Potential effects of future cables on EFH cannot be assessed without detailed information on techniques and procedures for cable deployment and are beyond the scope of this survey report.

2.2 Habitats of Particular Concern (HAPCs)

The MFSCMA describes HAPCs as subsets of EFH which are "rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area" (NOAA NMFS, 2000). Within the OP AREA treated here (Figure 1-1), NOAA NMFS (2000) indicates hermatypic coral habitat and reefs, and hard bottoms as HAPCs. In addition, one of the five deep-water Coral Habitat Areas of Particular Concern (CHAPCs), which includes coral, coral reefs, and live/hardbottom habitat, established by NOAA in 2010, also spans part of the OP AREA, in waters extending from the 250-m isobath, roughly along longitude 80.016 W, to the Exclusive Economic Zone boundary with the Bahamas. All deep-water hardbottom habitat encountered at depths >100 m fall within the CHAPC. Within the CHAPCs, it is prohibited to possess coral species or use all bottom-damaging gear, including bottom longline, trawl (bottom and mid-water), dredge, pot or trap, or anchor, anchor and chain, or grapple and chain by all fishing vessels. NOAA and the SAFMC have previously expressed concern regarding possible damage to Deep Sea Coral Ecosystem habitat from bottom-disturbing activities in this deep-water area. Although this is an extensive designated area, it spans a variety of habitats, some characterized by protected species such as deep-water mound-building corals, and some not. As a result, on 22 July 2010, NOAA Fisheries Service put into effect a final rule to its Comprehensive Ecosystem-Based Amendment 1 (CE-BA 1), which established allowable gear areas for golden crab and deepwater shrimp fisheries within the CHAPC, permitting continued access to historical fishing grounds that have little or no negative impacts on protected deepwater coral habitat.

2.3 Physical Setting

The southeastern Florida continental shelf is part of an extensive subsiding carbonate platform that includes the Florida peninsula and west Florida shelf. Shallow-water coral reefs along the inner southeastern margin of this platform off Broward County chiefly form three linear terrace-like features parallel to the coastline and separated by sand channels (Walker et al. 2008). The crest of the most seaward lies at a depth of ~16-18 m. An unpublished U.S. Navy multibeam bathymetric survey indicates an additional linear feature parallel to the coastline in 85-90 m that might represent a relict reef or erosional feature (Walker et al., 2004). Below ~300 m, submersible observations have revealed phosphorite nodules and slabs that begin to crop out of prograding sediments at the inshore margin of the northern end of the Miami Terrace, an elongated, 120-km-long, portion of a drowned carbonate platform that parallels the coast from Broward County to northern Key Largo. Since Siegler (1959) first reported the Terrace as “an old coral reef,” its geology has been investigated in substantial detail via high-resolution seismic reflection profiling, rock dredge sampling and submersible observations. It covers ~740 km^2, is widest off Miami (22.2 km), and tapers to the north and south where it disappears under prograding sediments (Kofoed & Malloy 1965, Rona & Clay 1966, Malloy & Hurley 1970, Neumann & Ball 1970, Ballard & Uchupi 1971, Mullins & Neumann 1979, Reed et al. 2006).

A distinct upper terrace, in ~200 to 375 m, exhibits highly irregular karstic topography with massive phosphoritic limestone outcrops and pavements most likely produced by subaerial exposure during the Middle to Late Miocene (Neumann & Ball 1970, Ballard & Uchupi 1971, Mullins & Neumann 1979). Ballard & Uchupi (1971) described the outer Terrace edge near the proposed pipeline track as continuous phosphoritic limestone with steep ridges 50 to >80 m in relief with some near-vertical slopes, undercuts and slump blocks, as well as shallower steps. South of the pipeline route off Miami, the outer Terrace margin consists of a pair of north-south ridges cresting in as little as 310 (west ridge) and 412 m (east ridge), with steep phosphoritic limestone escarpments and vertical relief reaching ~90 m (Neumann & Ball 1970, Reed et al. 2005, 2006). A narrower, discontinuous lower terrace in ~600-700 m apparently formed as a result of middle Miocene submarine erosion perhaps brought about by intensification of the Gulf Stream/Florida Current system associated with closure of the Isthmus of Panamá (Mullins &

Neumann 1979, Bartoli et al. 2005). Below the Terrace, extensive sediment deposits of the Pourtalès Drift, which extends from about 24°N to almost 26°30'N (Bergmann & Eberli 2003), are topped by mounds of azooxanthellate corals (Neumann & Ball 1970).

The survey area lies under the Florida Current, which flows northerly at 150 cm sec^{-1} or greater and transports a mean of 31.5 Sv to the North Atlantic with a seasonal range of up to ~10 Sv (Larsen and Sanford, 1985, Lee et al. 1985, Molinari et al. 1985, Leaman et al. 1987, Schott et al. 1988). Over 40% derives from the South Atlantic, restoring to the North Atlantic the water volume lost to the Southern Hemisphere via the deep thermohaline conveyor (Schmitz and Richardson 1991, Schmitz et al. 1993). The current has been subject to extensive modeling and observational studies (e.g., Düing 1973 1975, Kielmann & Düing 1974, Düing et al. 1977, Johns and Schott, 1987, Lee et al. 1995, Wang & Mooers 1998) and is influenced by inflows through channels in the Bahama banks (Atkinson et al. 1995, Leaman et al. 1995), local synoptic atmospheric (Lee & Williams 1988) and tidal forcing (Mayer et al. 1984), Gulf of Mexico Loop Current variability, and occasional large migrating mesoscale eddies (Lee et al. 1996). The current also sheds smaller mesoscale eddies inshore along the Florida Coast (Lee and Mayer 1977, Lee et al. 1992, Shay et al. 2000 2003). However, detailed physical characteristics of its complex benthic boundary layer remain largely unexplored, although both the face and foot of the Miami Terrace, the western slope of Little Bahama Bank, and the northern Strait floor to at least 845 m experience transient southward undercurrents and benthic countercurrents reaching 50 cm sec^{-1} (Hurley & Fink 1963, Neumann & Ball 1970, Düing & Johnson 1971, Düing 1975, Brooks & Niiler 1975, Lee et al. 1985, Messing, unpublished *in situ* observations).

2.4 Biological Environment

The Strait of Florida serves as both a biological conduit and barrier, and, although just a small marginal arm of the Atlantic Ocean, forms an important hotspot of biodiversity. The chiefly unidirectional flow of the Florida Current creates a continuous enough environment so that many bottom-associated organisms have ranges extending from northern South America to southern Florida. By contrast, the combination of water mass properties within the Strait and the physiographic features of its margins create important physical and biological barriers. The geostrophic flow characteristic of western boundary currents such as the Florida Current tilts isotherms across the channel so steeply that similar depths on opposite sides experience substantially different conditions, e.g., a mean temperature of 10°C occurs in 200 m on the Florida side of the northern Strait but almost 600 m on the Bahama side (Leaman et al. 1987). Similarly, although the Florida and Bahama platforms share a common origin, the relict phosphoritic terraces and thick sediment drapes of the Florida margin of the Strait contrast strongly with the steep bank-edge escarpments and lithified mounds of the Bahama side (Malloy & Hurley 1970, Ballard & Uchupi 1971, Neumann et al. 1977, Mullins & Neumann 1979, Anselmetti et al. 2000). As a result, the Strait represents an important biogeographic boundary where different faunas, especially those at ≥200-600-m depths, meet to contribute to what might be the greatest species richness in the western central Atlantic. The Strait also exhibits the greatest number of endemic marine fishes in the region (Carpenter 2002). As examples, northern taxa such as *Cancer borealis* (Brachyura) and *Coronaster briareus* (Asteroidea) reach their southern limits along the Florida side of the Strait, while many Caribbean taxa, e.g., *Iliacantha subglobosa* (Brachyura), *Endoxocrinus parrae* (Crinoidea) and *Triakis barbouri* (Chondrichthyes) occur only along the insular margin.

Although a substantial number of papers document composition and distribution of specific taxa collected in deep water off southeastern Florida, e.g., goniasterid sea stars (Halpern 1970), benthic fishes (Staiger 1970), nephropid lobsters (Holthuis 1974), crinoids (Meyer et al. 1978), scleractinian and stylasterid corals (Cairns 1979 1986), and brachyuran crabs (Soto 1985), focused investigations of the composition and distribution of benthic habitats in the survey areas have only begun recently. Ballard and Uchupi (1971) published two photographs of apparently barren phosphorite and sediment substrates on the Miami Terrace, though one showed a wreckfish, *Polyprion americanus*. At the foot of the Terrace south of the pipeline route off Miami in 700-825 m, Neumann and Ball (1970) observed thickets of unidentified deep-water branching azooxanthellate corals (most likely *Enallopsammia profunda* based on observations herein) capping mounds of muddy sand up to 0.5 m high and 3-4 m long, separated by patches of winnowed foram-thecosome sand, and Brooke *et al.* (2006) briefly noted the low *E. profunda*-capped mud mounds near the EEZ boundary. Reed et al. (2006) reported that the attached macrofauna on the terrace rim included the mound-forming scleractinian coral *Lophelia pertusa*, stylasterid lace corals (Hydrozoa), bamboo corals (Octocorallia, Isididae) and a variety of sponges (both Demospongiae and Hexactinellida) and other octocorals, as well as schools of jacks (Carangidae) and *P. americanus*. More recently, Shirur et al. (2008) quantified benthic habitat characteristics and sessile macrofaunal composition and abundances along nine submersible transects at three local sites from West Palm Beach to Miami (as well as along 12 transects at four sites further north from Cape Canaveral to St. Augustine, FL). Transects on the Miami Terrace in 321-383 m were dominated by *L. pertusa* accompanied by abundant primnoid octocorals, stylasterids and demosponges.

3 METHODS

3.1 Geophysical data and benthic habitat maps

The high-resolution multibeam bathymetry and benthic habitat maps spanning much of the Miami Terrace (~255-550 m) used in this study for site selection and depth profiles originated from a recent study by the authors for the Department of Energy. In 2010, a geophysical survey using multibeam sonar was carried out in an area overlapping the proposed cable survey area as part of the project “Siting Study for a Hydrokinetic Energy Project Located Offshore Southeast Florida” with funds provided by the US Department of Energy (DOE) to Dehlsen Associates LLC (Vinick et al., 2012). The multibeam survey covered almost all of Bureau of Ocean Energy Management (BOEM) Interim Policy block numbers 7053, 7054, and 7055 plus limited additional swaths to the west, east, northeast and southeast. This survey was conducted during November 2010 under the direction of David F. Naar, Associate Professor, University of South Florida, under contract with Dehlsen as part of the siting study mentioned above. The survey used a Kongsberg EM 710 FM sweep multibeam backscatter and bathymetry system that operated in the 70 to 100 kHz range.

Other seafloor topography data were derived from multiple sources. The NOAA National Geophysical Data Center's U.S. Coastal Relief Model Volume 3 provided a comprehensive regional view, integrating various offshore bathymetry datasets into one seamless representation of the seafloor. Bathymetric data sources included the U.S. National Ocean Service Hydrographic Database, the U.S. Geological Survey, the Monterey Bay Aquarium Research Institute, the U.S. Army Corps of Engineers, the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico project, and various other academic institutions. A custom-sized DEM was downloaded from the NGDC DEM portal, imported into ArcGIS, and hill-shaded to provide a 3-D modeled surface illuminated at 45° sun angle and azimuth. 2001 Naval Oceanographic multibeam survey provided by NSWCCD was used to image the seafloor from 30 to ~230 m depth. NSWCCD also provided high-resolution sidescan sonar for an area from 30 to 200 m depth. Detailed metadata were not available for either dataset; thus we cannot report on how they were collected and processed. The only depth data available for the ~230-260-m depth range were low-resolution NOAA bathymetry, which did not offer enough resolution to generate an appropriate depth profile.

The benthic habitat map of the northern Miami Terrace (OP AREA) used in this study was modified from the results of the DOE siting study (Vinick et al., 2012). The benthic habitat map classification was organized by three main components: geomorphologic zone, substrate type, and slope. The geomorphologic zones were identified by previous research on the Miami Terrace (Mullins and Neumann, 1979). Mullins and Neumann (1979) divided the Miami Terrace into several cross-shelf zones according to their geomorphology as: Upper Terrace, Outer Terrace ridge, and Lower Terrace. This terminology was based on a cross-section across the southern portion of the Miami Terrace; however, it applied to the northern portion with some modifications. Differences in the benthic biological communities were evident between these zones; thus they were utilized as a habitat classifier. Differences in biological communities were also evident between two separate platforms of differing depths along the Upper Terrace, which was therefore divided into Inner and Outer Terrace Platforms to distinguish them as separate biological communities. Differences in biological communities between low and high slope areas within geomorphologic zones were also recognized; therefore a slope layer was calculated from the DOE multibeam geophysical data to distinguish low and high slope areas. Based on the results, areas with >5° were considered High-Slope and those with ≤5° were Low-Slope. The final benthic classification was supported by statistical analysis of species' density between quantitative photostations. Areas outside of the detailed multibeam bathymetry were extrapolated based on the geomorphology present in the DOE multibeam and the NOAA NGDC DEM and the field notes. Straight lines were drawn due north or west and the area was designated as a "probable" habitat type. Probable habitat types were used to characterize the photostations in areas outside of the DOE benthic habitat map.

3.2 Benthic video and photographic ROV survey

Benthic surveys were conducted using a ship-tethered remote operated vehicle (ROV). The ROV was lowered to the bottom and towed by the ship. Steering was accomplished by the ROV motors and radio communications to the ship captain. The surveys were conducted along several cross-shelf (east-west transects) and shorter north-south segments. One transect followed cables in all habitats across the shelf between 30 m - ~550 m depth. Then cross-shelf transects were conducted north and south of that route in areas thought to be free of cables. Three relatively short north-south segments bisecting the cable route were conducted as well.

The ROV used for the surveys was the Television Observed Nautical Grappling System (TONGS) (Figure 3-1), a deep-water heavy-lift underwater vehicle owned and operated by NSWCCD-Ft. Lauderdale. TONGS has a 3,000-m operating depth, 4,500-kg lift capability, and can operate in currents in excess of 5 kt within a 1-m radius on the seafloor for prolonged periods. Underwater position is determined using an ultra-short baseline acoustic tracking system integrated into a differential global positioning system (DGPS), which provides georeferenced bottom positions of ±15 m in deep water. Occasional greater scatter (to 20 m or more) may have been due to multipath or bottom bounce in the acoustic signal of the Track Point. TONGS is equipped with 3 Standard Definition color cameras, one High-Definition color camera, one digital stills camera, multiple underwater lights, dual-frequency imaging and search sonar, altimeter and depth sensor. Two cameras are mounted to a pan-and-tilt unit to provide variable camera orientation. TONGS also has two thrusters for orientation and minor positional changes (±10 m). All Non-Cable, data, and video are multiplexed thru a fiber-optic telemetry system to the surface, providing wide bandwidth and high-quality video (Eric S. Dykes, CIV NSWCCD, personal communication). For this survey, TONGS was equipped with a Kongsberg OE14-502 high-definition video camera, OE11-242 Flashgun and OE14-208 Digital stills camera, the latter provided with a pair of parallel scaling lasers spaced 8.3 cm apart. The survey was carried out aboard the NASA vessel *Freedom Star* (length 53.6 m; beam 11.2 m; draft 3.7 m; displacement 1,052 tons). TONGS carried out 13 dives to complete the survey.

Oblique frontal and side-looking video was run continuously throughout surveys while the ROV was on the bottom (i.e., within 1-2 m of the seafloor). Nadir still images (1-2 MB each) were taken at ~5-min intervals over sediment substrates. Over areas of biological interest on hard substrates, nadir still images were taken repeatedly as soon as the strobe recycled (which ranged from ~5 to over 20 sec) and the ROV moved far enough to avoid overlapping exposures. Images were also taken of specific organisms on all substrates for identification purposes.

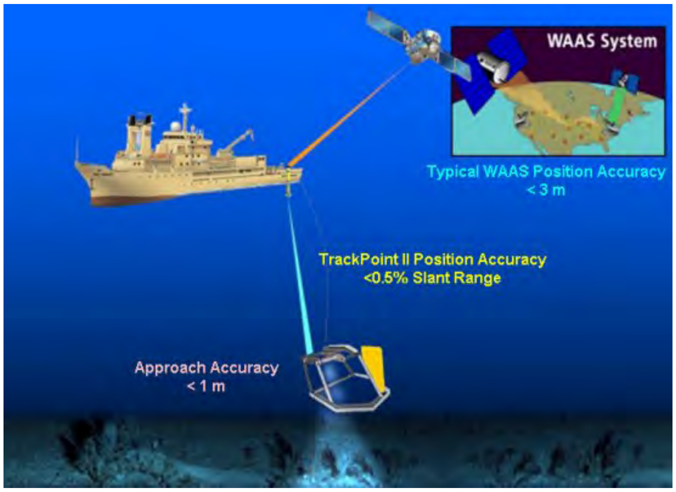

Figure 3-1. Television Observed Nautical Grappling System (TONGS).

3.3 Photographic station selection

Quantitative nadir digital photography stations (i.e., photo stations) were selected along sections of transects that traversed exposed hard substrates and thus represented Essential Fish Habitat as defined by the MSFCMA. Stations were selected in hard substrate areas on the basis of benthic habitats as defined by Vinick et al. (2012). The data from the field notes were also plotted onto the geophysical data in GIS to help guide photostation selection in probable habitats outside the DOE habitat map footprint. The field data indicated the presence of hard-bottom substrate along the ROV track in 200 – 500 m depth along the cable route. Stations were chosen along the cable route and the Non-Cable transects in areas that spanned single habitats that were identified as mostly hardbottom in the field notes. The size of the station depended on the density of photos taken in a given area. Quantitative images were analyzed from a total of 49 stations: 30 Low-Slope, 17 High-Slope, and 2 Sinkhole.

3.4 Data Analyses

Following the field surveys, video data were reviewed in the laboratory to confirm organism identifications to the lowest possible taxonomic level and to define biological zones and benthic habitats. Original field transcripts were summarized to produce habitat descriptions and identify transitions between habitats. Quantitative digital photographs were processed in the laboratory to improve image contrast when possible and to eliminate poor images due to excessive shadowing (due to strobe placement), darkness (due to excessive elevation above bottom), turbidity (when the ROV stirred up sediment following contact with the sea floor) and blurring (due to excessive speed over bottom). Images varied in brightness and area of cover dependent upon the height of the ROV off the bottom. Significant darkening and shadowing occurred when the ROV was >1 m off bottom, either due to distance above the sea floor or because a part of the ROV obscured the strobe. The strobe was re-oriented several times between dives to reduce this problem, but it was never completely solved. To provide the best image possible, each image was examined in Photoshop. Some were lightened using the Levels/midtone adjustment. Images were then cropped to remove unusable remaining shadowed portions. Images unusable because of dimness, lack of contrast, excessive elevation above bottom, or without visible paired lasers were deleted. Table 3-1 lists all quantitative photostations with numbers and percentages of used and removed images.

Table 3-1. Photostations showing numbers and percentages of images used and removed, and total area used in m^2 of each. Abbreviations: C - Cable stations (left columns); NC - Non-Cable stations (right columns); ITP – Inner Terrace Platform; OTP – Outer Terrace Platform; OTR – Outer Terrace Ridge; LT – Lower Terrace; SH – Sinkhole; HS – High Slope; LS – Low Slope. Horizontal lines separate sets of stations by habitat and slope. Station sets are listed in order of habitat from west to east (ITP, OTP, OTR, LS, SH) with low-slope stations listed first for each habitat.

PhotoStation	Images			Percent		Area	PhotoStation	Images			Percent		Area
	Removed	Used	Total	Removed	Used	m^2		Removed	Used	Total	Removed	Used	m^2
C ITP-LS 1	26	50	76	34.2	65.8	44.26	NC ITP-LS 1	11	50	61	18.0	82.0	43.77
C ITP-LS 2	14	49	63	22.2	77.8	74.46	NC ITP-LS 2	1	50	51	2.0	98.0	87.56
C ITP-LS 3	17	50	67	25.4	74.6	52	NC ITP-LS 3	7	50	57	12.3	87.7	56.69
C ITP-LS 4	15	50	65	23.1	76.9	55.12	NC ITP-LS 4	15	51	66	22.7	77.3	55.08
C ITP-LS 5	21	50	71	29.6	70.4	47.81	NC ITP-LS 5	17	50	67	25.4	74.6	68.94
C ITP-LS 6	22	50	72	30.6	69.4	44.06	NC ITP-LS 6	1	56	57	1.8	98.2	86.71
C ITP-LS 7	18	50	68	26.5	73.5	50.35	NC ITP-LS 7	0	54	54	0.0	100.0	87.24
C ITP-LS 8	18	48	66	27.3	72.7	28.53	NC ITP-HS 1	9	38	47	19.1	80.9	141.3
C ITP-LS 9	27	50	77	35.1	64.9	59.38	NC OTP-LS 1	21	51	72	29.2	70.8	52.66
C ITP-LS 10	34	41	75	45.3	54.7	40.4	NC OTP-LS 2	2	55	57	3.5	96.5	120.6
C OTP-LS 1	18	50	68	26.5	73.5	50.86	NC OTP-LS 3	4	50	54	7.4	92.6	57.8
C OTP-LS 2	22	50	72	30.6	69.4	44.81	NC OTP-LS 4	19	50	69	27.5	72.5	99.4
C OTP-LS 3	27	50	77	35.1	64.9	37.59	NC OTP-LS 5	4	51	55	7.3	92.7	132.7
C OTP-LS 4	22	50	72	30.6	69.4	47.9	NC OTP-HS 1	12	18	30	40.0	60.0	66.1
C OTP-LS 5	23	50	73	31.5	68.5	34.22	NC OTP-HS 2	0	29	29	0.0	100.0	73.91
C OTP-HS 1	2	34	36	5.6	94.4	30.57	NC OTR-LS 1	22	50	72	30.6	69.4	84.08
C OTP-HS 2	17	46	63	27.0	73.0	49.51	NC OTR-LS 2	1	62	63	1.6	98.4	127.3
C OTP-HS 3	21	50	71	29.6	70.4	59.3	NC OTR-HS 1	0	54	54	0.0	100.0	120.7
C OTP-HS 4	6	33	39	15.4	84.6	72.3	NC OTR-HS 2	0	65	65	0.0	100.0	110.9
C OTR-HS 1	0	56	56	0.0	100.0	100.5	NC OTR-HS 3	1	37	38	2.6	97.4	63.61
C OTR-HS 2	1	48	49	2.0	98.0	56.26	NC LT-HS 1	0	29	29	0.0	100.0	44.62
C OTR-HS 3	0	26	26	0.0	100.0	31.67	NC LT-SH 1	5	41	46	10.9	89.1	78.29
C OTR-HS 4	13	16	29	44.8	55.2	44.24							
C OTR-HS 5	37	40	77	48.1	51.9	55.3							
C OTR-LS 1	26	48	74	35.1	64.9	64.4							
C LT-HS 1	2	20	22	9.1	90.9	19.8							
C LT-SH 1	11	50	61	18.0	82.0	68.3							

All usable photostation images were analyzed in Coral Point Count with Excel extensions (CPCe)© (Kohler & Gill 2006), a Windows-based software tool for determining benthic habitat and organism cover, area analysis and for image calibration using transect photographs. The relatively low densities of benthic hard-bottom macrofauna anticipated in this study required a high number of random points to accurately capture the diversity of organisms and reflect their densities and percent cover. As a result, following successful previous analyses (Messing et al. 2006a, b), images were subjected to a two-stage analysis. Each image was initially analyzed using CPCe software for percent substrate cover (e.g., hard bottom, sediment-veneered hard bottom, sediment) with organisms identified to a general taxonomic level (e.g., sponge, cnidarian, echinoderm) at a density of 50 points per image (Table 3-2). Each image was then re-examined and all organisms larger than ~4 cm enumerated and identified as specifically as possible (e.g., *Pseudodrifa nigra*, *Phakellia* sp., Isididae, anemone sp. 1, unidentified hexactinellid). A question mark preceding a scientific name in text or tables indicates uncertain identification. Borderline small organisms were measured by magnifying the image (usually to ~50%), spanning the laser dots with a pair of 10-point dividers, and using 0.4 of that length (~3 cm) to decide which animals should be included or omitted.

Numbers of encrusting and smaller colonial organisms (e.g., zoanthids) were estimated. Several groups of organisms could not be accurately quantified for several reasons. Although some hydroids (Hydroidolina) were resolvable as individual colonies, many occurred in clusters of overlapping, filmy colonies. The great majority of ophiuroids (Ophiurida; which does not include euryalid snakestars and basketstars) were visible only as arms protruding from crevices, burrows or sediment (often overlapping and impossible to quantify accurately); in many cases, substantial numbers were out of focus in a given image (e.g., due to various combinations of small size, slenderness and ROV velocity). Solitary corals (Scleractinia) were chiefly <3 cm across. These three groups (hydroids, Ophiurida and solitary corals) were ranked by relative abundance classes [i.e., few (1), common (5), abundant (10)] and were not included in summary density tables and pie diagrams. Image area was calculated by converting image length and width in pixels to centimeters based on the number of pixels equivalent to the 8-cm laser scale. Organism densities per square meter (m^{-2}) were calculated by extrapolating from the number of organisms in the image area. Table 3-3 lists taxa used for density calculations. Both tables 3-2 and 3-3 include a few taxonomic updates relative to the original designations used in the analyses (e.g., Hydroidolina for Hydroida, *Gracilechinus* for *Echinus* and Octocorallia unidentified for Octocorallia, gorgonacea); none alter the analyses. After analysis of each image, the data were saved into an Excel database for analyses of (1) raw percent composition and (2) percent composition per area for each quantitative photostation. Calculations excluded all points categorized as photo effects (i.e., shadow, laser).

Organism densities are illustrated graphically with pie diagrams that show the percentages that major groups contribute to total density at the photostations for a given habitat. Taxa contributing small percentages (generally <1-2%) have been consolidated into larger groups for graphic clarity. As a result, groups named in the pie diagrams of Cable and Non-Cable photostations at a given habitat may differ, e.g., for sponges, the pie diagram for NC ITP L-S (Figure 4-25) shows Other Porifera [all identified taxa occurring at very low densities] and Unidentified Hexactinellida, whereas the equivalent for the Cable photostations (C ITP L-S, Figure 4-36A) shows Unidentified Demospongiae, Desmacellidae, Other Porifera [identified] and Unidentified Porifera. Such variations are a function of the taxa present and their densities. To permit straightforward comparison between Non-Cable and Cable photostations by habitat, section 4.3.2 (Cable Impact Assessment) includes tables that list density data for Cable photostations alongside the previously listed density data for Non-Cable photostations, and bar graphs that illustrate Cable and Non-Cable densities side by side for each taxonomic group with less consolidation than the pie diagrams, i.e., all groups that contribute at least 1% of the mean densities for that photostation (e.g., Figure 4-36B).

The percent cover and density data from the CPCe image analyses were analyzed using a multivariate approach. Benthic data at the subcategory level (Table 2A) (excluding fish, human debris, Detritus, Cable, Shadow, and unidentified organism) were analyzed using Bray-Curtis similarity indices (PRIMER v6) for similarity between quantitative still photographic stations. A cluster analysis and corresponding non-metric multi-dimensional scaling (MDS) plot was constructed of the data (square-root transformed) to understand the statistical relationships between stations. Stations were displayed by the map habitat classifications. MDS and cluster analyses were performed on all Non-Cable station data for the benthic characterization and on Cable and Non-Cable stations within each defined habitat type to elucidate potential cable impacts. In some cases, similarity percentages (SIMPER) were obtained for the geomorphologic zones and slope classifications to gauge what cover categories contributed most to the differences between Cable and Non-Cable stations. An analysis of similarity (ANOSIM) was performed in each test to determine the significance of the Cable and Non-Cable categories. ANOSIM is a permutation-based hypothesis test analogous to univariate analyses of variance (ANOVAs) that tests for differences between groups of (multivariate) samples from different experimental treatments. The closer the R statistic is to 1, the stronger the categorical groups. Its strength is dependent on the number of samples per category which defines the number of possible permutations. A low number of stations in a category limits the reliability of the results.

Table 3-2. Percent cover categories (BOLDFACE CAPS) and subcategories used in the photostation image analyses.

CORAL (COR)	**ECHIURA (ECR)**
Colonial Dead Coral (DC)	Forked Tongued Echiura (ECR)
Coral Rubble (CR)	**MOLLUSCA (MOL)**
Lophelia (LOP)	Gastropoda (GAS)
Madrepora (MAD)	Polyplacophora (CHI)
Solitary Coral (SC)	**BRYZOA (BRY)**
ARTHROPODA (ART)	Bryzoa (BRY)
Galatheidae (GAL)	**PORIFERA (POR)**
Lobster- *Acanthacaris,* Astacidea, *Nephropsis* (LOB)	Demospongiae (DEM)
Shrimp (SHR)	Hexactinellida (HEX)
CHORDATA (CHO)	Unidentified Porifera (UPO)
Fish (FIS)	**UNIDENTIFIED ORGANISM (UND)**
CNIDARIA NON SCLERACTINIA (CNI)	Unidentified Organism (UND)
Actinaria Non-Ceriantharia (ACT)	**SOFT BOTTOM SUBSTRATE (SB)**
Alcyonacea (ALC)	Sand-Shell Hash (HAS)
Antipatharia (ANT)	Soft Bottom Substrate (SB)
Ceriantharia (CER)	**HARD BOTTOM SUBSTRATE (HB)**
Gorgonacea (GOR)	Rock Outcrops, Rock Pavement, Sediment Veneer on Hard Bottom, Ledges, Boulders (ROC)
Hydroida (HYD)	Rubble, Cobble, Gravel (RUB)
Pennatulacea (PEN)	**CABLE (CB)**
Stylasteridae (STY)	Cable (CB)
Unidentified Cnidarian (UCN)	**HUMAN DEBRIS (HUM)**
Zoanthidea (ZOO)	Fishing Line/Long Line (FSL)
ECHINODERMATA (ECH)	Other Human Debris (HUM)
Asteroidea (AST)	**NATURAL DETRITUS (DET)**
Crinoidea (CRI)	Plant/Animal Detritus (DET)
Echinoidea (ECI)	**TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)**
Ophiuroidea (OPH)	Tape, Wand, Shadow , Photo Effect (TWS)

Table 3-3. Taxonomic categories used in density calculations.

Annelida	*Anthomastus* sp.	Psolidae
Sabellida	Antipatharia unid.	*Sclerasterias* sp.
Arthropoda	*Bathypathes alternata*	*Tremaster mirabilis*
Bathynectes longispina	Ceriantharia	**Echiura**
Brachyura	Corallimorpharia	Echiura
Cirripedia	*Eunicella* sp.	**Mollusca**
Crustacea unid.	Hydroidolina	*Calliostoma* sp.
Eumunida sp.	Isididae	Cephalopoda
Galatheidae	*Liponema* sp.	Gastropoda
Paguroidea	*Lophelia pertusa*	Pleurotomariidae
Paguroidea 1	*Madrepora* sp.	Polyplacophora
Penaeidae	Octocorallia, gorgonacea	*Scaphella junonia*
Pycnogonida	Pennatulacea	**Porifera**
Rochinia sp.	Plexauridae (Paramuriceidae)	*Aphrocallistes beatrix*
Brachiopoda	Primnoidae	Astrophorida
Brachiopoda	*Pseudodrifa nigra*	Axinellidae
Bryozoa	Sagartiidae	Demospongiae unid.
Bryozoa	Scleractinia (solitary)	Desmacellidae
Chordata	Stylasteridae	Euritidae/Farreidae
Actinopterygii	Zoanthidae	Geodiidae
Anguilliformes	**Echinodermata**	*Hertwigia falcifera*
Ascidiacea	*Araeosoma* sp.	Hexactinellida
Chlorophthalmus agassizi	Asteroidea	*Hyalonema* sp.
Elasmobranchii unid.	Cidaridae	*Hyatella* sp.
Helicolenus dactylopterus	*Coelopleurus floridianus*	*Leiodermatium* sp.
Laemonema sp.	Comatulida	Lithistida 1
Macrouridae	*Coronaster briareus*	Lithistida 2
Phycidae	Crinoidea (stalked)	Pachastrellidae
Pleuronectiformes	Echinoidea	*Phakellia* sp.
Rajidae	Euryalidae	Porifera unid.
Scorpaenidae	Goniasteridae	Raspailiidae
Cnidaria	Gorgonocephalidae	*Spongosorites* sp.
Actiniaria 1 (Actinauge?)	*Gracilechinus* sp.	*Vazella* sp.
Actiniaria 2	*Linckia* sp.	**Unknown**
Actiniaria unid.	Novodinia sp.	Unknown animal
Actinoscyphia sp.	Ophiuroidea	

4 RESULTS

As noted in Section 2.1 above, the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; Public Law 104-208) defines Essential Fish Habitat (EFH) as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” [16 U.S.C. 1802 (10)]. EFH identified in the Fisheries Management Plan Amendments for the SAFMC includes live/hard bottoms, and coral and coral reefs (NOAA NMFS, 2000). Therefore, all hard substrates described below represent EFH.

This section is divided into three parts: a description of the survey transects (4.1), the benthic characterization (4.2), and the impact assessment (4.3). The benthic characterization section first describes in detail the habitats and biota encountered along each transect. Then a statistical analysis was performed on the Non-Cable stations data to help determine habitat delineations. The impact assessment section analyzes the similarities between Cable and Non-Cable photostations grouped by habitat to determine any community-level cable impacts.

4.1 Description of the Survey Transects

On 26-31 January 2011 and 29-31 March 2011, the benthic video and photographic survey was conducted under the direction of Professor Charles Messing, PhD (Nova Southeastern University Oceanographic Center [NSU OC]), in cooperation with Brian Walker, PhD (NSU OC), and John Reed, MS (Harbor Branch Oceanographic Institute at Florida Atlantic University). Figure 4-1 illustrates the ROV transects in relation to the benthic habitats and existing cable routes supplied by the Naval Surface Warfare Center Carderock Division’s SFOMF Dania Beach, Florida, in the study area. Table 4-1 lists the beginning and ending coordinates for all transect lines in both decimal degrees and decimal minutes. The transect along the cable route (transect A in Figure 4-1) was executed in multiple ROV dives and, as a result, surveyed two different cables; it is uncertain which cables were surveyed. In addition to the primary transect along the cable, the Statement of Work called for two additional transects “parallel to Cable 96, 50 m on each side of it where hard-bottom habitats occur [in order to represent] areas unimpacted by the cable, as a control for comparison purposes to the area where the cable is present,” as well as “two 610 m long transects…in a north-south direction along areas of high biological interest to determine if areas exist that might represent alternative cable routes: one along the crest of the Miami Terrace escarpment [=Outer Terrace Ridge] and one near the EEZ along the deep-water coral thickets habitat.” The SOW left the precise locations of these two north-south transects unspecified. The second of these was abandoned as being far eastward of any current Navy cables and was replaced by another transect [here termed West N-S Transect] along the border of the Inner and Outer Terrace Platforms along apparent high slope based on multibeam topography (transect D in Figure 4-1). The transect along the Outer Terrace Ridge is here termed East N-S Transect (transect E in Figure 4-1).

In the shallowest hard-bottom portion, two transects were spaced ~50 m on each side of the cable as planned, from ~30 m through the disappearance of hard substrates in ~90-93 m (transects An and As in Figure 4-1). Transect lengths over this depth range were 1.1 km for the cable route (transect A), 1.1 km along An, and 1.2 km along As. The two flanking lines were planned as North and South Non-Cable Transects. However, cables were observed along both of these transects in this depth range. Limited ship time prevented execution of additional alternative shallow transects. Subsequently, cable data provided by Kameron Corregan

(NSWCCD) indicated that the large number of additional cables in the area (Figure 4-1) eliminated the possibility of selecting any nearby Non-Cable transects in similar habitat. Most of the hard bottom habitat along these transects was derived from the dumping of spoil during the creation of Port Everglades (Walker et al., In press). The GIS data show that cables have been deployed throughout the Port Everglades spoil habitat. The nearest similar spoil habitat potentially free of cables is at Government Cut, Miami; ~50 km south. Due to the recognized changes in biological communities with latitude along southeast FL (Walker, 2012), this habitat is too far away to be considered comparable and serve as a control. As a result, no valid Non-Cable transects could be examined in this depth range.

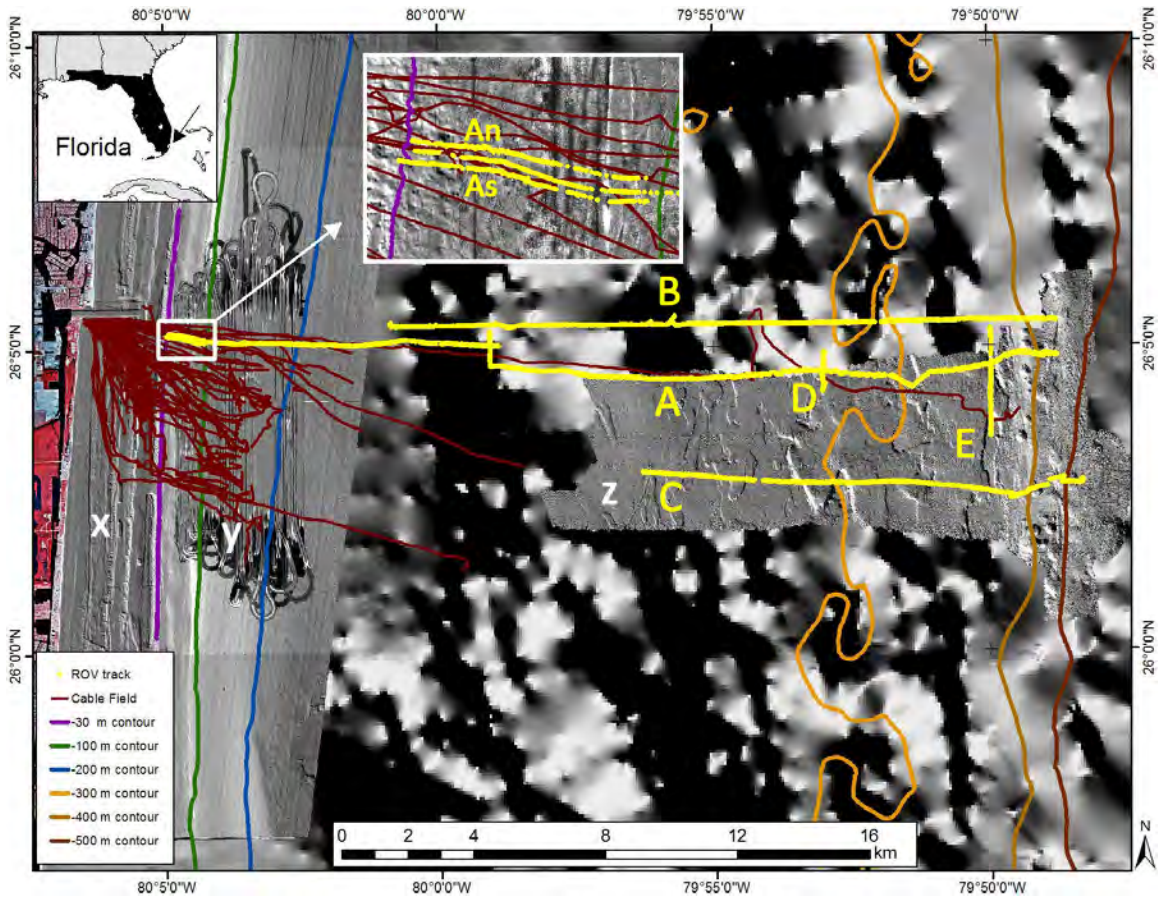

Figure 4-1. Study area showing cables (dark red) and ROV transects (yellow). A. Main cross-shelf cable transect (An and As in the insert indicate the flanking transects within the spoil habitat). The short vertical line below the insert indicates the Cable jog traversed to verify cable location and connect eastern and western portions of transect A. B. North Non-Cable Transect. C. South Non-Cable Transect. D. West N-S Transect. E. East N-S Transect. Upper center inset magnifies the three transects from ~30 to ~90-93 m. Cable field data provided by Kameron Corregan, NSWCCD. Bathymetric databases are x: inshore LIDAR (National Coral Reef Institute, NSU); y: sidescan and multibeam (NSWCCD), and z: multibeam (Dehlsen LLC). Background is low-resolution NOAA NGDC hydrographic data.

From ~90 m, the Cable Transect traversed 6.6 km of unconsolidated sediment substrates to a depth of 245 m, where the hard substrates of the Miami Terrace were first exposed, and was completed to a maximum depth of 457 m, east of the recorded terminus of the cable. Surface conditions, currents and intermittent sediment cover prevented the ROV from maintaining the cable in continuous view. As a result, a westward leg of the cable transect terminated in a north-south segment (on line A below the upper center insert in Figure 4-1; termed Cable jog in Table 4-1) to verify a cable's location and connect to the western shallower end of the transect. The eastern and western portions of cable transect A were separated at the jog by ~600 m suggesting they were not the same cable. Although the project plan called for a survey of Cable 96, it is not clear how much of the transect followed this cable. Cable was repeatedly lost from ROV view due to current and surface wind. At 26°04.568'N, 79°51.028'W (334 m), the ROV crew reported that the cable in sight might be number 58. At 26°04.565'N, 79°50.883'W (334 m) cable was in view, but the ROV position was ~1000 m north of the plotted line for cable 96. Finally, two cables were visible at the same time at 26°04.557'N, 79°52.6108'W (268 m) and 26°04.509'N, 79°51.778'W (279 m).

At least 11 cables appear to reach depths greater than 183 m (600 ft), of which nine were deployed between 1952 and 1979. Records are sparse as they were kept on paper and in log books. These nine were type 201 Harbor Defense Cables, with six attached to CAPTOR developmental mines (no ordnance) and three attached to underwater submarine tracking arrays. Two others are the well documented deep fiber optic cable (C/S 96) and the Acoustic Observatory cable (C/S 120) (William Venezia, SFOMC, personal communication, 15 May 2012).

The North Transect, located ~1.0-1.5 km north of the Cable route in an attempt to avoid other cables, spanned across the shelf from 235 m to 451 m water depth. The shallow terminus was selected to intercept the initial western appearance of hard substrate. However, cables were encountered between 243 and 262 m. Segments with observed cables were not considered during photo station selection. The South Transect, located ~3.0-3.5 km south of the cable route, spanned across the shelf from 272 m to 510 m water depth. Its shallow western end was terminated by time constraints.

Table 4-1. Beginning and ending coordinates for transects in decimal degrees (LatDD, LonDD) and decimal minutes (LatDM, LonDM). The N-S Cable jog transect connected the Shallow and Deep Cable Transects.

Transect End	LatDD	LonDD	LatDM	LonDM
Shallow North - East	26.086264	-80.071258	26 05.17584	-80 04.27548
Shallow North - West	26.087834	-80.081998	26 05.27004	-80 04.91988
Shallow Cable - East	26.08391	-79.981874	26 05.0346	-79 58.91244
Shallow Cable - West	26.087437	-80.081981	26 05.24622	-80 04.91886
Shallow South - East	26.08529	-80.071242	26 05.1174	-80 04.27452
Shallow South - West	26.087066	-80.082676	26 05.22396	-80 04.96056
Deep North - East	26.090363	-79.812938	26 05.42178	-79 48.77628
Deep North - West	26.089516	-80.014775	26 05.37096	-80 00.8865
Deep Cable - East	26.080679	-79.812652	26 04.84074	-79 48.75912
Deep Cable - West	26.078516	-79.984482	26 04.71096	-79 59.06892
Deep South - East	26.046727	-79.805155	26 02.80362	-79 48.3093
Deep South - West	26.049264	-79.938297	26 02.95584	-79 56.29782
Cable jog N-S - North	26.087977	-79.984509	26 05.27862	-79 59.07054
Cable jog N-S - South	26.078516	-79.984482	26 04.71096	-79 59.06892
West N-S - North	26.081745	-79.883315	26 04.9047	-79 52.9989
West N-S - South	26.071103	-79.88382	26 04.26618	-79 53.0292
East N-S - North	26.088163	-79.832844	26 05.28978	-79 49.97064
East N-S - South	26.058615	-79.832814	26 03.5169	-79 49.96884

4.2 Benthic Habitat Characterization

4.2.1 Geomorphologic Zone and Benthic Habitat Classification

The benthic habitat map classification was adopted from the US Department of Energy (DOE) project "Siting Study for a Hydrokinetic Energy Project Located Offshore Southeast Florida." Since the methodology for habitat polygon development used a subset of the data reported herein, the mapping results are presented here as well.

Benthic habitat classification was organized by three main components: geomorphologic zone, substrate type, and slope (see Section 3.1, paragraph 3). The geomorphologic zones of the topographically complex Miami Terrace were identified by previous research (Mullins and Neumann 1979). Mullins and Neumann (1979) divided the Miami Terrace into several cross-shelf zones according to their geomorphology as: Upper Terrace, Outer Terrace ridge, and Lower Terrace (Figures 4-2, 4-3). This terminology was based on a cross-section across the southern portion of the Miami Terrace; however, it applies to the northern portion as well with some modifications. Differences in the benthic biological communities were evident across these zones; thus they were utilized as an overall habitat classifier. Differences in biological communities were also evident between two separate platforms of differing depths along the Upper Terrace, which was therefore divided into Inner and Outer Terrace Platforms to distinguish them as separate biological communities. Although not easily recognizable in either plan-view or 3-dimensional images of multibeam topography (Figures 4-1, 4-2, 4-3), the bathymetry of the Outer Terrace Platform generally shoals from south to north across the surveyed area, while the Inner Terrace Platform gently deepens from south to north. It is possible that the two Terrace Platform subdivisions merge north of the survey area and contain similar biological communities.

The area surveyed by multibeam began in ~550 m and ran up the ~40º Lower Terrace and Outer Terrace Ridge across a swath of numerous sinkholes in ~475-360 m before reaching the narrow N-S-oriented crest of the Outer Terrace Ridge in 337 m with up to 20 m local vertical relief. West of this ridge, across the Outer Terrace Platform, the seafloor sloped very gradually upward from 348 m, shoaling only ~20 m overall across a distance of 4.0 nm, although with several broad platforms, depressions and narrow ridges of up to 20-m vertical relief. This gradual slope terminated along the transect line at what appeared to be a spur of Inner Terrace Platform with a vertical relief of ~70 m (~330-260 m). The western margin of this spur dropped to an almost flat stretch of the Outer Terrace Platform about 0.75 nm across in ~310 m before climbing another escarpment of ~60 m vertical relief. Above this feature, the Inner Terrace Platform consisted of chiefly low-relief substrates in 275-250 m with local depressions of 10-m vertical relief that suggested the irregular karstic topography most likely produced by subaerial exposure during the Middle to Late Miocene as reported by Neumann & Ball (1970), Ballard & Uchupi (1971), and Mullins & Neumann (1979).

Depth profiles were drawn from multibeam data along the South Non-Cable and East N-S Transects and along the deeper portion of the Cable Transect. Because available NOAA bathymetry outside the area surveyed by multibeam was low resolution, depth profiles could not be drawn for the North Non-Cable and West N-S Transects, and western portion of the Cable Transect (Figure 4-2). However, a depth profile was also drawn along the Cable Transect in 30-90 m using 2001 US Navy bathymetric multibeam data (Figure 4-4).

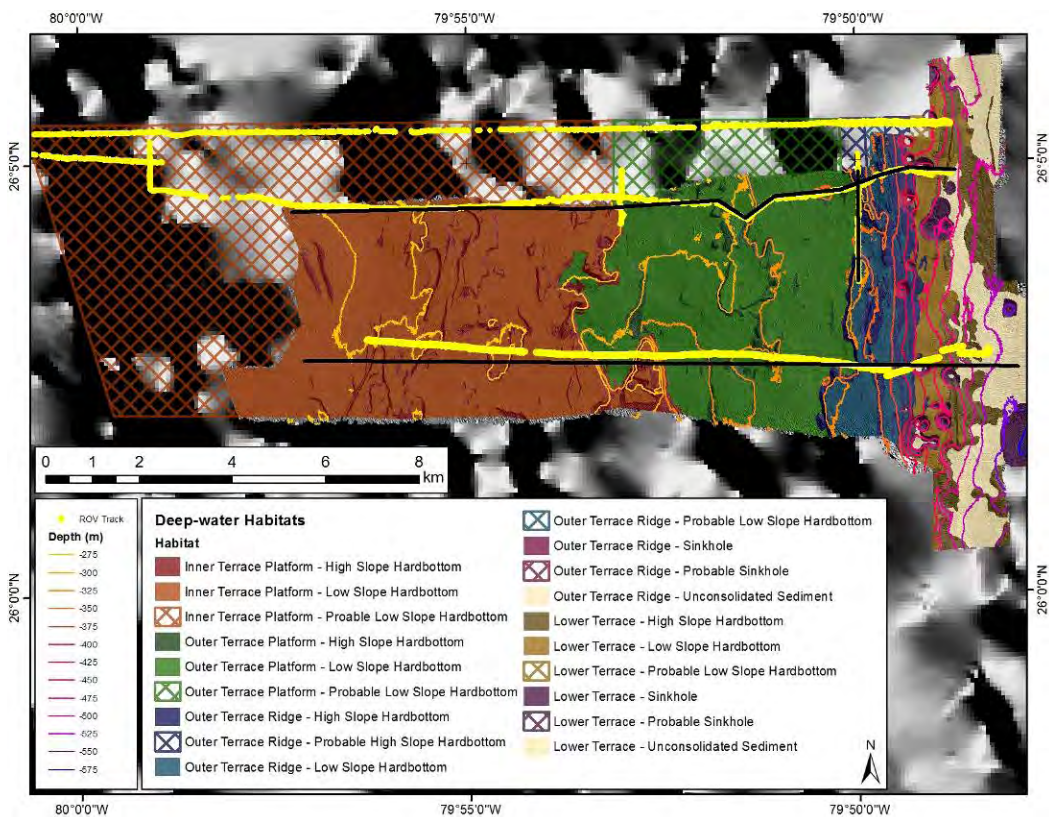

Figure 4-2. Plan view of multibeam topography overlain by benthic habitats illustrating the four major geomorphologic zones. Habitats in areas beyond the multibeam survey are suggested by cross hatching. Yellow lines are ROV transects; black lines are depth profiles derived from multibeam data.

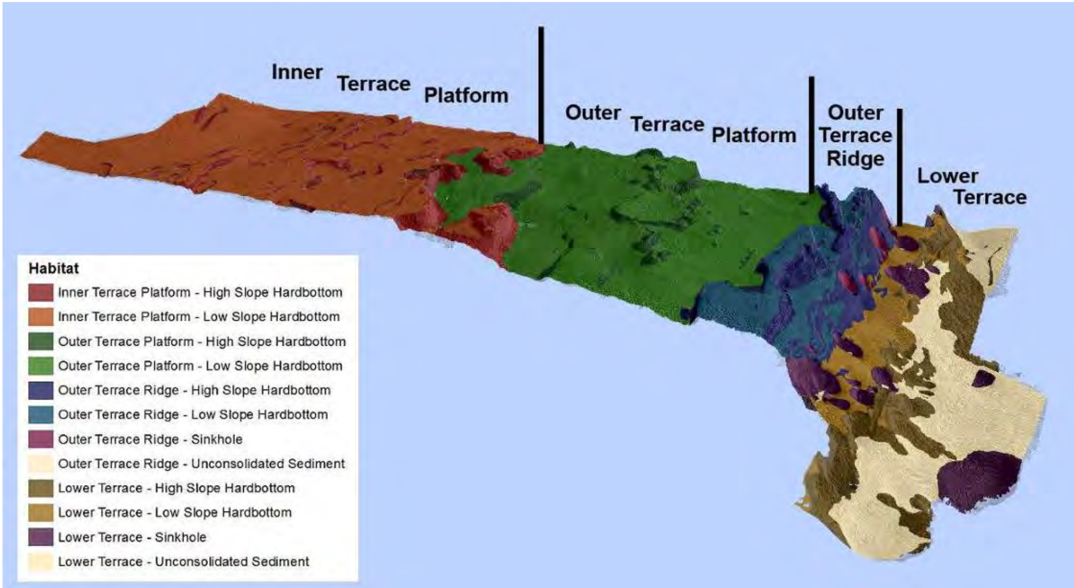

Figure 4-3. Three-dimensional rendering of multibeam topography overlain by benthic habitats illustrating the four major geomorphologic zones.

4.2.2 Qualitative Benthic ROV Transects and Habitat Mapping Results

This section describes the substrates and fauna encountered along the Cable and parallel Non-Cable ROV transects from shallow to deep, as well as the two shorter north-south transects along the Upper Terrace Platform and Outer Terrace Ridge.

4.2.2.1 ROV Transect A - Shallow Portion (30 m to 245 m)

This subsection refers to primary cable transect A and parallel transects An and As from 30 to 255 m depth (Figure 4-4). As all three included cables and crossed similar habitats at similar depths, they are treated here in a single descriptive narrative beginning with the bottom profile and then describing substrates and fauna.

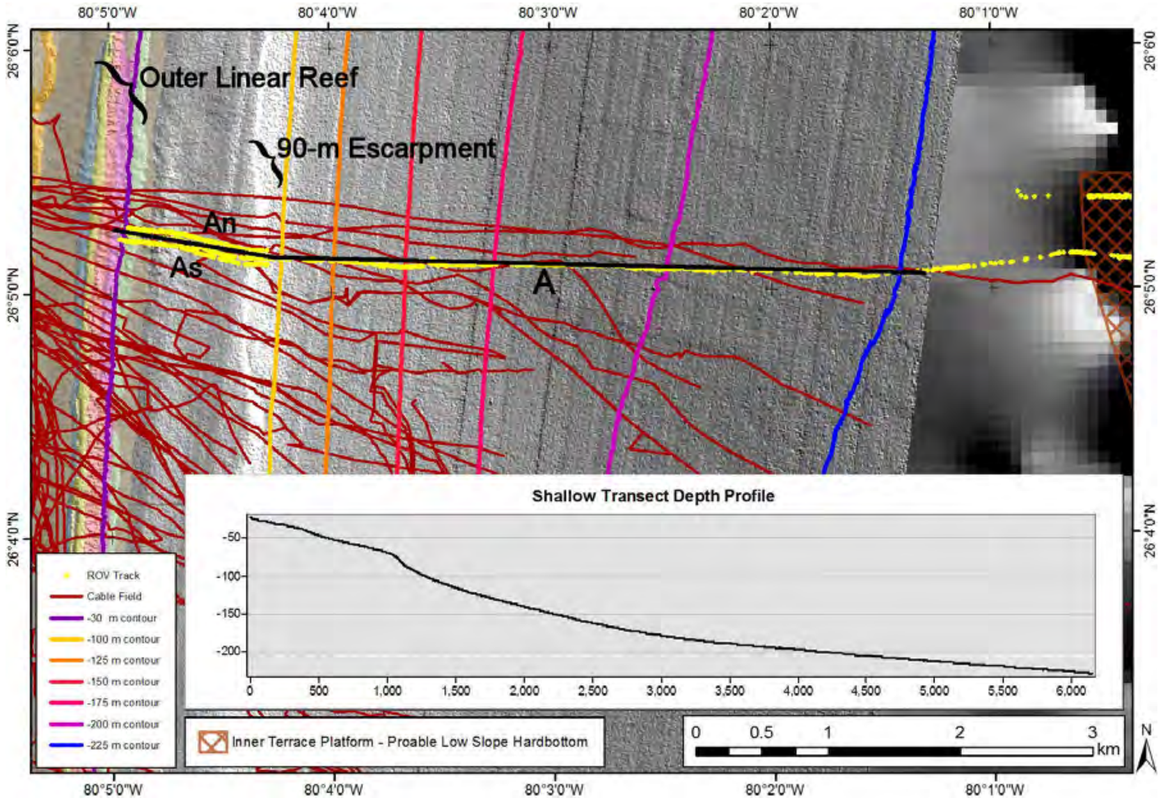

Figure 4-4. ROV Cable transect (transect A as in Figure 4-1) from western terminus in ~30 m to ~230 m (yellow line) with corresponding depth profile (black line) to just over 225 m shown in insert. The shallow (~30-90 m) North and South parallel Non-Cable transects (As and An) are visible at left. Background bathymetry: 2001 US Navy multibeam bathymetry.

From 30 to 36 m, the substrate consisted of combinations of rubble- to boulder-sized clasts and low-relief pavements with occasional outcroppings of underlying limestone. The clasts were likely deposited during the dredging of Port Everglades during the 1920s, and are distributed southeastward from the eastern end of the Port Everglades channel, covering 295 hectares, including the entire Outer Linear Reef of the Florida Reef Tract (Figure 4-4) along the cable route (Walker et al., 2006; Walker et al., in press). It is uncertain if any natural limestone substrate was visible. Algal turf covered most hard substrates as well as extending onto sediment in places. From ~36 to 44 m, the sea floor was 50-90% hard substrate, including boulders reaching ~1.5 m high. Small pockmark burrows and a microalgal film characterized sediment. Organisms on hardbottoms included a wide variety of sponges (e.g., *Amphimedon* sp., *Callyspongia vaginalis*, *Agelas* spp., *Geodia neptuni* and large *Xestospongia muta*), octocorals (e.g., *Ctenocella barbadensis*, *Ellisella* sp., *Iciligorgia schrammi*, *Swiftia exserta* and plexaurids), a few small stony corals (chiefly *Montastraea cavernosa* and fewer *Stephanocoenia intersepta* and *Siderastrea siderea*), antipatharians (several unidentified species, ?*Stichopathes luetkeni* and ?*Parantipathes tetrasticha*) and (in <38 m) the basketstar *Astrophyton muricatum* (Figure 4-5, Table 4-2).

Hard substrates became more scattered with increasing depth, diminishing to 20-50% of cover by 51-56 m, but still including cobbles up to ~30 cm across. Sponges (e.g., *Amphimedon* sp., *G. neptuni*), octocorals (*Swiftia exserta*, *I. schrammi*) and antipatharians decreased in numbers and richness with increasing depth. A few reticulated brittlestars (*Ophionereis reticulata*) were observed on sediment. By 63 m, *S. exserta*, pockmark burrows and the microalgal film had disappeared. Table 4-2 lists all animal taxa recorded from 30 m to the disappearance of *S. exserta* in ~63 m.

Although no comparative quantitative analysis was carried out in this depth range as all three transects traversed cables, an examination of 845 still photographs taken from the shallow end of the transects to the disappearance of *S. exserta* revealed that sponges (Porifera) appeared in 75-84% of images, octocorals in 33-69%, antipatharians in 14-22% and stony corals (Scleractinia) in 7-14% (possibly 16%) of images (Table 4-3). In addition to the (tentatively identified) main survey cable, the survey crossed other cables, particularly along transect An, where many lay perpendicular to the east-west route. Cables were covered with sediment, a pale turf similar to that covering adjacent hard substrates, sometimes abundant small hydroids, encrusting sponges, occasional larger sponges (e.g., *Aplysina cauliformis*), a few small octocorals, and cyanobacterial mat.

Hard substrates below 63 m were scattered small rubble clasts. In 67-73 m, the substrate was almost entirely rippled sediment with a few widely scattered bits of rubble. An artificial reef at 73 m (Transect An) supported encrusting sponges, hydroids, arrow crabs (*Stenorhynchus seticornis*), an unidentified scyllarid lobster, greater amberjack (*Seriola dumerili*) and lionfish (*Pterois volitans*). An amberjack was also seen at this depth on the Cable Transect A.

Small rock clasts covered with a low turf appeared in ~73 m, increased in abundance and included scattered larger cobbles to ~84 m and then disappeared by ~90 to 93 m (Figure 4-5F). The identity of the low turf is unknown; it may be algal, or possibly agglutinated foraminiferans, bryozoans, hydroids, or a combination. Moving winnowed sediment, octocoral whips bent against the seafloor, and pressure on the ROV and tether all indicated a strong bottom current. Organisms included small, chiefly encrusting sponges, the orange octocoral whip *Ctenocella barbadensis*, arrow crabs *S. seticornis*, box crab *Calappa* sp., and (on Transect As) a single corallimorph anemone *Pseudocorynactis caribbeorum*. Octocorals protruding from sediment suggested that the sediment is a veneer over buried hard substrate. These hard substrates may represent the more steeply sloping shore-parallel linear feature previously recorded in bathymetric maps extending north and south along southeastern Florida and referred to as the 90-m Escarpment (Walker et al., 2004).

Table 4-2. Animal taxa recorded in the video data log and in photographs from ~30 m to the disappearance of the octocoral *Swiftia exserta* in ~63 m. *indicates likely multiple species within genera.

PORIFERA	SCLERACTINIA	CRUSTACEA
**Agelas* spp.	*Agaricia* sp.	*Panulirus argus*
Aiolocroia crassa	*Diploria* sp.	ANNELIDA
Amphimedon compressa	?*Madracis* sp.	*Filograna implexa*
Amphimedon sp.	*Meandrina meandrites*	*Hermodice carunculata*
Aplysina cauliformis	*Montastraea annularis*	MOLLUSCA
Aplysina sp.	*Montastraea cavernosa*	*Hypselodoris edenticulata*
Callyspongia plicifera	*Montastraea faveolata*	*Prunum carneum*
Callyspongia vaginalis	*Mycetophyllia* sp.	*Spondylus americanus*
Cliona delitrix	*Scolymia* sp.	Unidentified squid
?*Cribrochalina vasculum*	*Siderastrea siderea*	ECHINODERMATA
Geodia neptuni	*Stephanocoenia intersepta*	*Astrophyton muricatum*
Iotrochota birotulata	ANTIPATHARIA	*Ophionereis reticulata*
?*Ircinia campana*	**Antipathes* spp.	OSTEICHTHYES
Ircinia strobilina	?*Parantipathes tetrasticha*	*Acanthostracion quadricornis*
Monanchora arbuscula	?*Stichopathes luetkeni*	Acanthuridae
Neofibularia nolitangere	OCTOCORALLIA	*Anisotremus virginicus*
Niphates digitalis	*Ctenocella barbadensis*	*Canthidermis sufflamen*
Niphates erecta	*Ellisella* sp.	Chaetodontidae
?*Smenospongia* sp.	*Eunicea* sp.	Diodontidae
?*Spirastrella coccinea*	*Iciligorgia schrammi*	Haemulidae
Xestospongia muta	?*Leptogorgia* sp.	Holocentridae
Unidentified black encrusting	*Plexaurella* sp.	*Lachnolaimus maximus*
Unidentified red encrusting	*Pseudoplexaura* sp.	*Malacanthus plumieri*
Unidentified tan encrusting	*Pseudopterogorgia* sp.	Ostraciidae
ZOANTHIDEA	*Swiftia exserta*	Pomacanthidae
Parazoanthus parasiticus	HYDROZOA	*Pterois volitans*
Parazoanthus swiftii	Unidentified hydroidiolina	Scaridae
	CHELICERATA	Synodontidae
	Unidentified pycnogonid	?Tetraodontidae
		Unidentified fish

Table 4-3. Numbers and percentages of major reef taxonomic components in images along the three shallow transects, from the shallow end (~30 m) to the disappearance of the octocoral *Swiftia exserta*. Numbers in parentheses include possible stony coral records that could not be confirmed. Because all three transects traversed cables, there were no control transects, and no quantitative photostations were occupied.

Taxon	**Transect**					
	Cable (A)		**North (An)**		**South (As)**	
	No.	%	No.	%	No.	%
Porifera	186	75.0	228	80.0	261	83.7
Octocorallia	172	69.4	94	33.0	133	42.6
Antipatharia	35	14.1	63	22.1	66	21.2
Scleractinia	18 (21?)	7.3(8.5)	21(23?)	7.4(8.1)	44(50?)	14.1(16.0)
Total images	248		285		312	

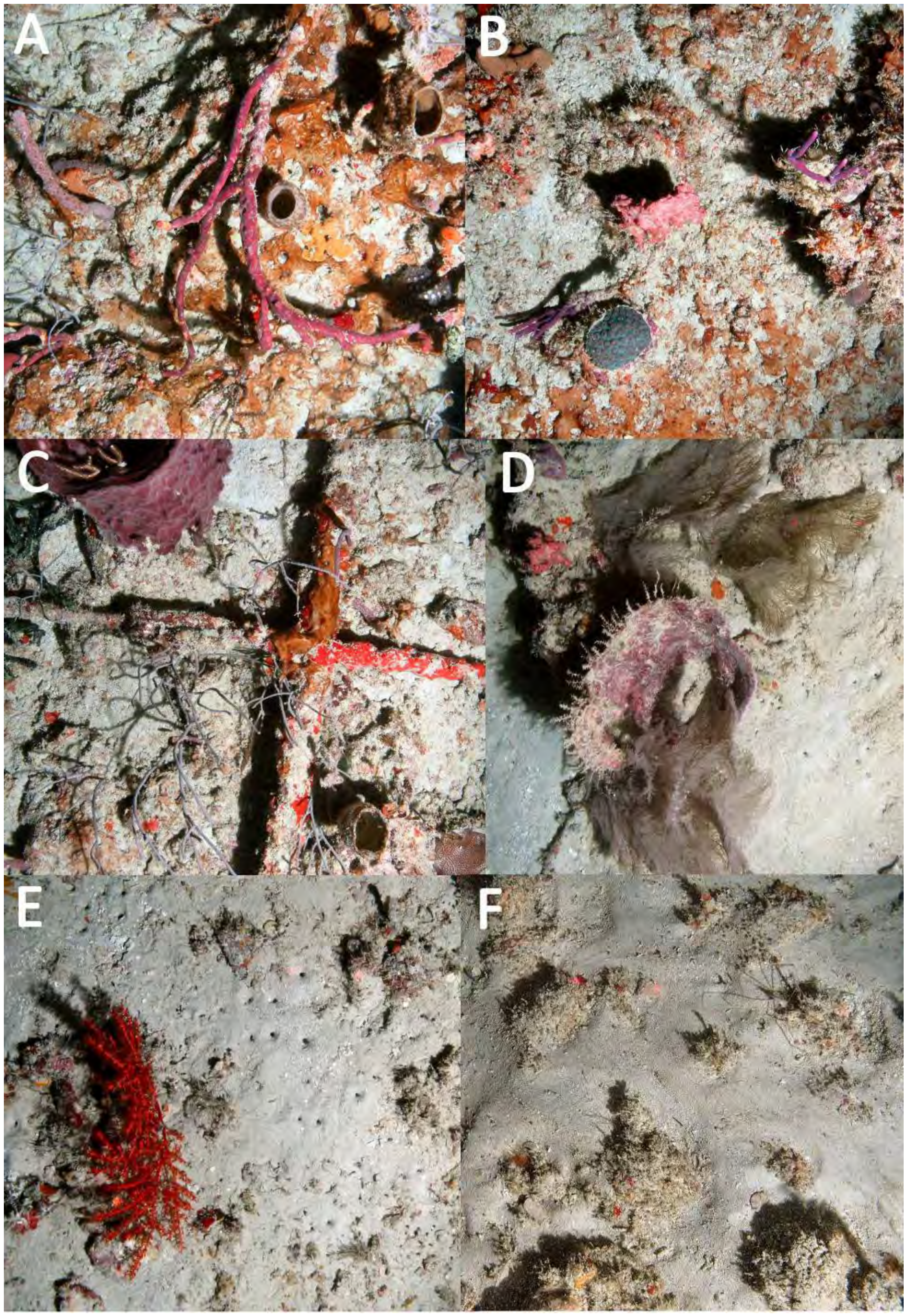

Figure 4-5. Characteristic substrates and fauna along the cable survey route, ~30-90 m. A. Brown cyanobacterial mat, sponges (*Niphates erecta*—purple branch, left; *Aplysina cauliformis*—long branches, center; *N. digitalis*—tubes, center, right) and plexaurid octocorals (left and bottom); ~33 m. B. Coral (*Montastraea cavernosa* lower center left); sponges (*Monanchora arbuscula* red, center; ?*Aplysina* sp.—branches, right, lower left; *Amphimedon* sp.---brown, upper left); ~38 m. C. Crossing cables with encrusting red sponge, cyanobacterial mat, plexaurid octocorals and barrel sponge (*Xestospongia muta*); ~30 m. D. Barrel sponge (*X. muta*) and unidentified antipatharians; ~50 m. E. Red octocoral (*Swiftia exserta*) on rubble; with pockmark burrows in sediment; ~53 m. F. Rubble with fine unidentified turf and arrow crab (*Stenorhynchus seticornis*); ~82 m.

The deepest observed stony coral (*M. cavernosa*) was between 38 and 43 m; reef sponges disappeared below ~49 m; antipatharians occurred between 38 and 51 m in association with the apparent spoil ridge and just overlapping the deepest occurrence of stony corals; *S. exserta* was characteristic of low-relief hard substrates chiefly in ~48-63 m, and octocorals disappeared below ~82 m.

From ~93 to 245 m, the seafloor was smooth or weakly bioturbated sediment with scattered small (5-10-cm) mounds, burrows, and trails, and (from ~215 m) with sparse to numerous small (~ 1 cm) tubes or tufts (possibly produced by polychaetes). A limited area of chiefly small, scattered rubble (to ~10 cm across) appeared in 220-223 m, and another patch with at least one larger clast in 230 m, both sparsely colonized by small anemones and plumulariid hydroids. An isolated dead head of a shallow-water reef coral and a patch of what appeared to be shallow-water staghorn coral (*Acropora cervicornis*) fragments were observed in 221 m and 245 m, respectively. Messing et al. (2006b) also found a cluster of dead shallow coral heads at a similar depth just north of the Port Everglades entrance channel. None appeared to have grown *in situ.* In 185-187 m and again in 242-245 m, two more or less parallel cables were visible at the same time, and, in 197-199 m (26°05.088'N, 80°02.545'W and 26°05.084'N, 80°02.481'W), the cable lay in a series of loops.

From 93 to ~125 m, benthic macrofauna included a few burrowing anemones (Ceriantharia), box crab (Calappidae), purse crab (Leucosiidae), spider crab (Majoidea), snake eels (Ophichthidae), batfish (Ogcocephalidae), unidentified flatfish (possibly *Citharichthys arctifrons*, Paralichthyidae), and blueline tilefish (*Caulolatilus microps*). Blueline tilefish crater-burrows were most common in 105-120 m and disappeared by ~190 m. Video records referenced three observations of these fishes in 102-132 m along the cable transect. Note that, although blueline tilefish is included under the SAFMC Snapper-Grouper Fishery Management Plan (FMP), the habitat requirements of this species differ substantially from those of other fishes under this FMP. As a result, SAFMC (2011a, b) has proposed a separate EFH-HAPC for this species (see discussion below).

Macroorganisms associated chiefly with sediment substrates that formed an assemblage characteristic of the outer shelf to at least 300 m and previously recorded at similar depths just north of the Port Everglades Entrance Channel (Messing et al. 2006a, b) gradually appeared between ~128 and 220 m. Table 4-4 lists their initial depths of appearance. Some, such as the fishes *Laemonema* sp. (Moridae) and *Helicolenus dactylopterus* (Sebastidae), and the pancake urchin *Araeosoma* sp. (all also associated with hard substrates), extended beyond the Outer Terrace Ridge into substantially deeper water.

In 230-231 m, organisms characteristic of the limestone substrates of the Miami Terrace to the east began to appear on or in association with the cable: the soft coral *Pseudodrifa nigra*, a colonial zoanthid anemone, the echiuran worm ?*Ochetostoma* sp, and the chirostylid squat lobster *Eumunida picta.* Table 4-5 in section 4.2.2.2 lists macrofaunal taxa associated with hard substrates on the Upper Miami Terrace, from 230 to 350 m.

Table 4-4. Initial depths of appearance in meters (m) of common outer-shelf, bottom-associated macrofauna on sediment substrates. Asterisks indicate taxa also often found on hard substrates on the Upper Terrace.

TAXON	m	TAXON	m	TAXON	m
CNIDARIA		BRACHYURA		ASTEROIDEA	
ACTINIARIA		*Bathynectes longispina*	146	*Coronaster briareus**	152
?*Actinauge* sp.*	152	*Cancer borealis*	~128	*Sclerasterias* sp.	~208
CERIANTHARIA		*Rochinia crassa**	154	CHONDRICHTHYES	
Unident. white ceriantharid	141	ECHINODERMATA		*Benthobatis marcida*	196
CRUSTACEA		ECHINOIDEA		Unidentified Rajidae	170
ANOMURA		*Araeosoma* sp.*	235	OSTEICHTHYES	
?*Munida iris*	162	*Cidaris* sp.*	230	*Helicolenus dactylopterus**	220
?*Pylopagurus* sp.	177	*Gracilechinus* sp.*	~227	*Laemonema* sp.*	218
Unidentified hermit crab*	206			*Peristedion* sp.	175
				Unidentified Scorpaenidae*	199

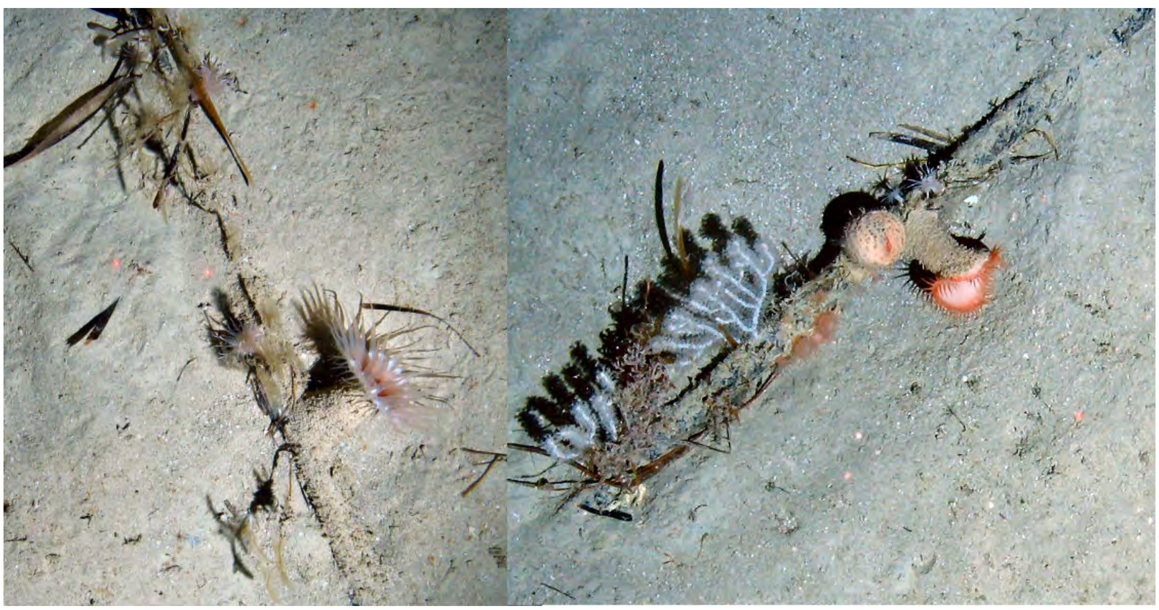

Figure 4-6. Organisms associated with cable on sediment in <250 m. Left: Anemones (including one large ?*Actinauge* sp.) and plumulariid hydroids, 208 m. Right: Two unidentified octocorals, small anemones and two Venus flytrap anemones (*Actinoscyphia* sp.) with scattered tufts visible on sediment, 230 m. Blades of turtle grass (*Thalassia testudinum*) and gulfweed (*Sargassum* sp.) have been swept against the cable.

4.2.2.2 ROV Transect A - Deep Portion (245 m to 457 m)

The remainder of the cable route transect described here begins at a depth of 245 m and continues to the eastern end in 457 m (Figures 4-7). Substrates and fauna are described in order of increasing depth. Note that the depth profile in Figure 4-7 begins at the western boundary of the 2010 DOE multibeam survey area in ~260 m, because the only depth data available between 225 m and 260 m was low-resolution NOAA bathymetry, which does not offer enough resolution to generate an appropriate depth profile.

Inner Terrace Platform.—Beginning in 245 m, black phosphoritic hard substrates of the western reaches of the Miami Terrace began to appear as scattered gravel and rubble, and small, low-relief exposed outcrops interspersed with expanses of either smooth weakly bioturbated sediment or raised rippled sediment. Depth shoaled gradually and irregularly to <240 m as more extensive hard substrates appeared in the form of patches of low aggregated hardbottom, low- to moderate-relief outcrops, fields of gravel and cobbles, sediment-veneered and exposed pavements, and occasional ledges and areas with larger cobbles, slabs or boulders with relief up to ~1 m. Qualitative estimates from video of percent cover of hardbottom substrates ranged from 20 to 80%. As depth shoaled to 236 m, the transect encountered more extensive hard substrates reaching 100% cover, including rubble-cobble fields, ledges, pavements and boulders with relief up to 1 m, but still with some patches of sediment.

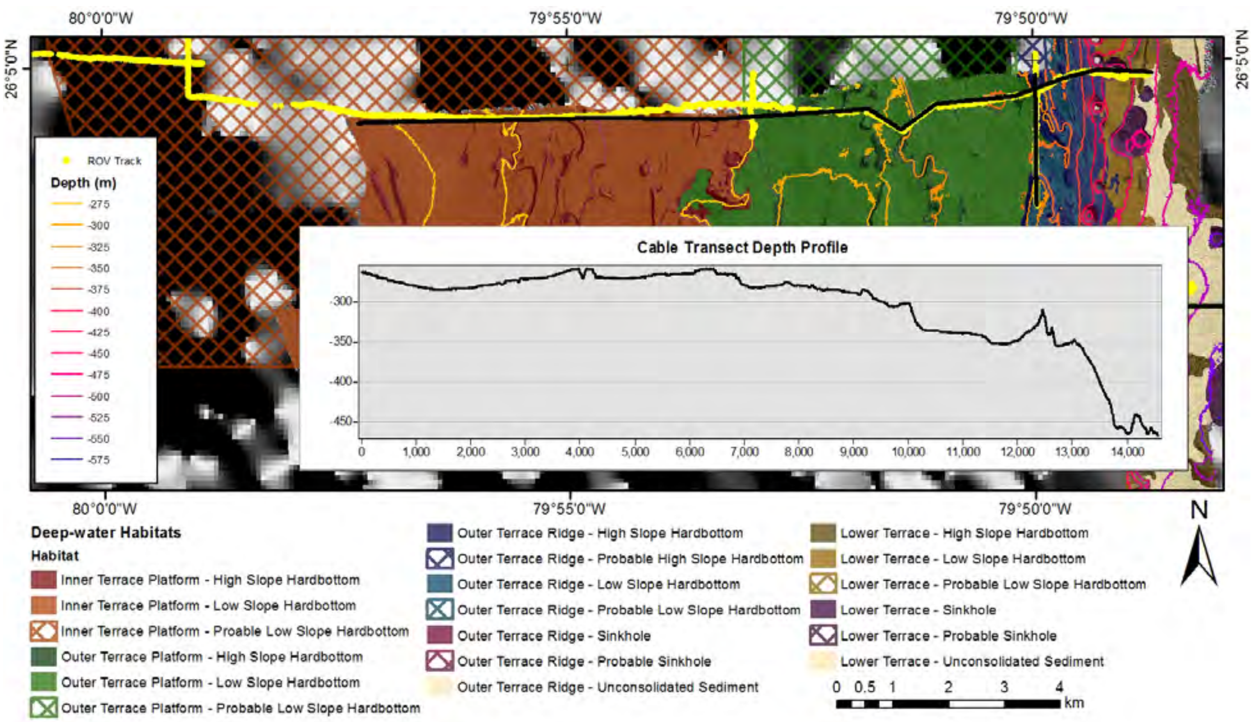

Figure 4-7. Cable Transect (A) habitat map continued from Figure 4-4 with depth profile from the western boundary of the multibeam survey area to the eastern transect terminus.

Organisms remained sparse, with gravel-rubble fields and some low-relief hardbottoms completely or almost devoid of benthic macrofauna. Numerous additional macrofaunal taxa characteristic of the Upper Terrace and Outer Terrace Ridge appeared for the first time (Table 4-5). The echiuran spoonworm, ?*Ochetostoma* sp., which buries its sausage-shaped body in crevices in hard substrates and extends its slender Y-shaped proboscis along the sediment surface, was often the most common macrofaunal taxon on low-relief, mixed hardbottom and sediment substrates (Figure 4-8).

As depth increased to the east from ~238 through ~265 m, percent cover of hard substrates—low-relief irregular pavements, rubble and mixed rubble-pavement—decreased somewhat, accounting for 30-80% of seafloor separated by broader areas of sediment. From ~267 through 280 m, low-relief exposed rubble (<15 cm) and hardbottom often formed north-south-oriented fingers populated by the same sparse fauna described above, with the addition of patches of sometimes numerous tiny white sponges, and separated by expanses of sediment. The short-nose greeneye, *Chlorophthalmus agassizi*, common on low-relief and sediment bottoms, first appeared in 280 m. At the same depth, a single *Phakellia* sp. fan sponge was found lying detached on the seafloor ~3 m away from the cable, with no indication of scour or scraping.

Between 79º 56.266'W and 79º54.361'W, the seafloor shoaled from 281 m to 264 m before reaching steeper irregular slopes and walls with vertical relief of ~5 m leading to a rocky plateau in 260 m at 26º04.489'N, 79º54.915'W. Substrates approaching the plateau remained chiefly the same with some limited areas of 100% low- to moderate-relief rock pavement, outcrops or boulders, but also with raised expanses of rippled sediment. Adjacent to the plateau, the cable was suspended up to ~ 5 m above the seafloor and supported *Actinoscyphia* sp. anemones, zoanthids and colonies of the stony branching coral *Lophelia pertusa* up to 2 m long. East of the plateau, the seafloor descended to 267 m with substrates including low-relief pavements, mixed rubble-cobble and sediment, rippled sediment with or without sparse rubble, and limited areas of larger clasts with up to 0.3 m relief before rising briefly up a rocky slope to 254 m with pavements, boulders up to 0.5 m vertical relief, and rubble and cobble clasts of both black phosphoritic and white limestone. The seafloor then sloped to 264 m and again rose to 254 m across a ridge before descending again to the Outer Terrace Platform.

Table 4-5. Benthic macrofauna associated with hard substrates on the Upper Terrace Platform; 230-350 m. Asterisks indicate taxa that likely include more than one species.

PORIFERA	ZOANTHIDEA	ECHINODERMATA
DEMOSPONGIAE	Unident. Zoanthidea*	ASTEROIDEA
Corallistes sp.	CORALLIMORPHARIA	?*Ceramaster* sp.
?*Discodermia* sp.	*Corallimorphus* sp.	Goniasteridae
Geodia sp.	ANTIPATHARIA	*Novodinia antillensis*
?*Leiodermatium* sp.	*Antipathes bipinnata*	*Porania* sp.
Phakellia sp.	*Leiopathes* sp.	*Tosia parva*
Spongosorites sp.	Unident. Antipatharia*	*Tremaster mirabilis*
Desmacellidae	SCLERACTINIA	Unident. Asteroidea*
Lithistida	*Lophelia pertusa*	CRINOIDEA
Pachastrellidae	Unident. solitary corals*	*Comatonia cristata*
Petrosiidae	OCTOCORALLIA	ECHINOIDEA
Raspailiidae	*Anthomastus* sp.	*Araeosoma* sp.
Spirophorida	*Eunicella* sp.	*Cidaris* ?*rugosa*
Unident. brown encrusting	*Isidella* sp.	*Gracilechinus* sp.
Unident. green mound	*Plumarella* sp.	Unident. Echinoidea
Unident. white fingers	*Pseudodrifa nigra*	OPHIUROIDEA
Unident. Demospongiae*	*Pennatula* or *Ptilosarcus* sp.	*Astroporpa annulata*
HEXACTINELLIDA	CRUSTACEA	*Gorgonocephalus arcticus*
Aphrocallistes beatrix	PENAEIDEA	?*Ophiomusium lymani*
Farrea sp.	?*Pleoticus robustus*	Unidentified Ophiuroidea
Vazella sp.	CARIDEA	HOLOTHUROIDEA
Unident. Hexactinellida*	Unident. rock shrimp	*Psolus* sp.
CNIDARIA	ANOMURA	CHONDRICHTHYES
HYDROIDLIOLINA	*Eumunida picta*	*Galeus arae*
Plumulariidae*	Unident. Paguroidea*	Unident. Rajidae
Stylasteridae*	BRACHYURA	OSTEICHTHYES
Unidentified hydroids*	*Chaceon fenneri*	*Chaunax suttkusi*
ACTINIARIA	ANNELIDA	*Chlorophthalmus agassizi*
Actinauge sp.	?*Ochetostoma* sp.	*Helicolenus dactylopterus*
Actinoscyphia sp.	MOLLUSCA	*Laemonema* sp.
Liponema sp.	GASTROPODA	Anthiinae
Sagartiidae	*Calliostoma* sp.	Callionymidae
		Scorpaenidae
		Unident. fish

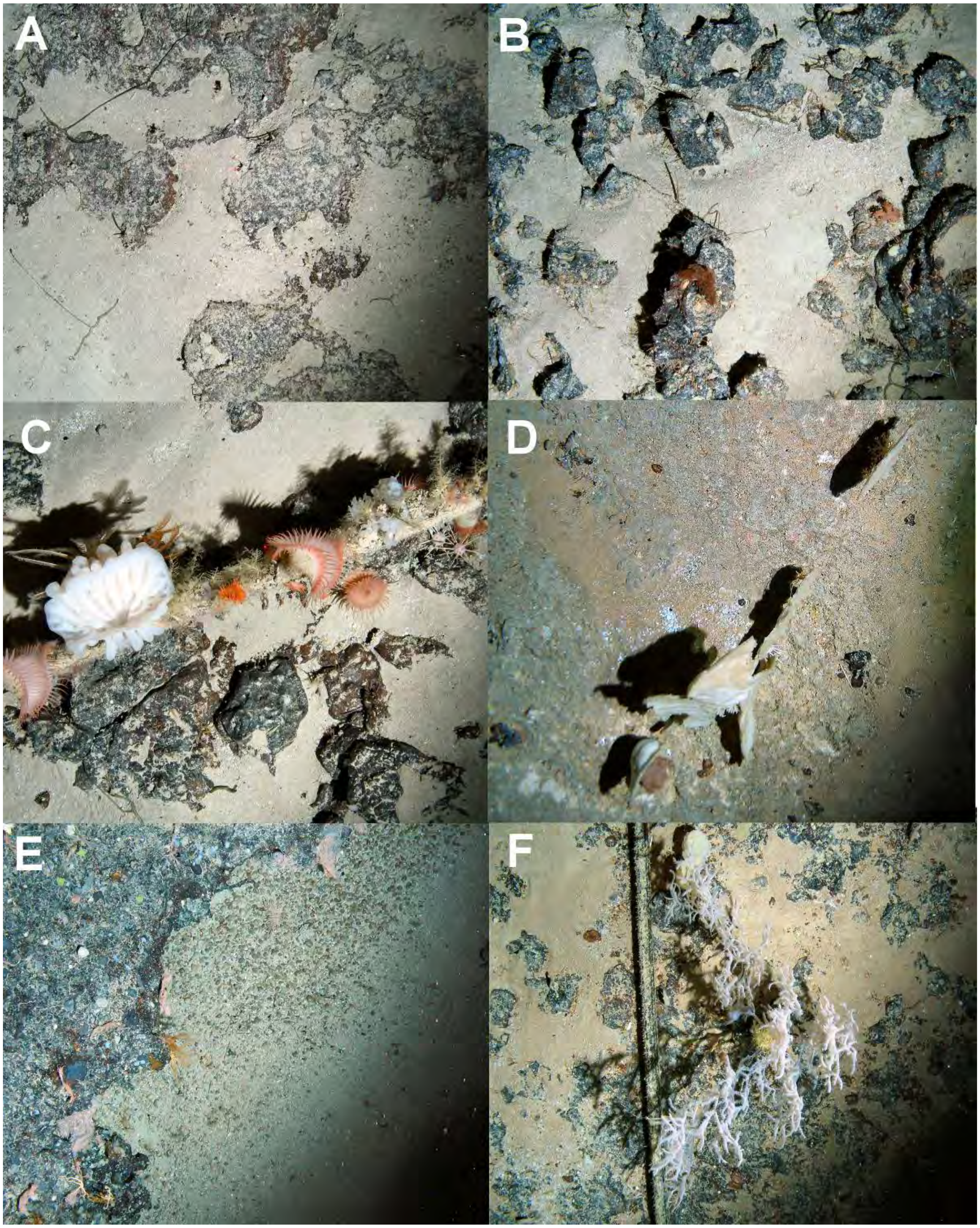

Figure 4-8. A-C. Inner Terrace Platform. A. Low-relief pavement and sediment with echiuran worms (?*Ochetostoma* sp.); 242 m. B. Cobbles on sediment with small soft coral, *Pseudodrifa nigra*; 236 m. C. Cable over cobbles; fouling organisms include Venus flytrap anemones (*Actinoscyphia* sp.), glass sponge (*Aphrocallistes beatrix*), crinoids (*Comatonia cristata*)(behind sponge), *Corallimorphus* sp. (pink anemone, right center) and hydroids; 273 m. D-F. Outer Terrace Platform. D. Sediment-veneered pavement with fan sponges (*Phakellia* sp.); 281 m. E. Sediment with brachiopod-shell lag at edge of pavement with crinoids and octocorals (*Plumarella* sp.); 282 m. F. Black coral (*Leiopathes* sp.) adjacent to cable on low-relief substrate near western base of Outer Terrace Ridge; 349 m.

Outer Terrace Platform.—The descent to the Outer Terrace Platform was a series of 1-2-m ledges widely separated by low- to moderate-relief gently sloping pavements, slabs and outcrops, boulders up to ~0.6 m tall, expanses of rubble and cobbles (both white and black phosphoritic limestone), and rubbly aggregated pavements, ranging chiefly between 50 and 100% cover, with occasional expanses of rippled sediment with or without scattered rubble. Occasional localized concentrations of brachiopod valves on sediment adjacent to higher relief irregular hard substrates and ledges reflect a cryptic fauna under overhanging surfaces not visible in downward-looking images (Figure 4-8E).

The fauna remained essentially the same but added a few more characteristic Terrace taxa: *Astroporpa annulata* and *Gorgonocephalus arcticus* (Ophiuroidea) and *Comatonia cristata* (Crinoidea), all suspension feeders associated with at least moderate benthic boundary flow, and, on sediment, a sea pen (*Pennatula* sp. or *Ptilosarcus* sp) up to 50 cm tall. Locally abundant organisms included the fan sponge *Phakellia* sp. and stylasterid fans on hard substrates, and unidentified ophiuroids (possibly *Ophiomusium lymani*) on sediment. Several colonies of *L. pertusa* were observed on higher-relief (up to 2 m) irregular outcrops and boulders in 298 m. Sections of cable suspended between elevated seafloor again supported anemones and *L. pertusa*.

From ~300 m, the bottom descended rapidly in steep irregular slopes with rugged slabs, boulders and ledges to sediment with up to 10-cm ripples in 321 m, and continued downward in a mixture of sediment and rubble, cobbles, boulders and possibly sediment-veneered hardbottom to 333 m. In 331 m (26°04.479’N, 79°51.179’W), the cable exhibited a 45º bend. Below this to 350 m, the slope became more gradual, chiefly inactively rippled sediment or sediment-veneered hardbottom, with patches or expanses of 5-10-cm rubble or larger (to 20-cm) cobbles usually accounting for no more than ~30% of cover, and with occasional outcrops and narrow, linear phosphoritic rock outcrops 10-15 cm high. Hardbottom fauna was dominated by the small white octocoral *Eunicella* sp., and fan sponges *Phakellia* sp. Other taxa included the glass sponges *A. beatrix*, *Farrea* sp. and *Hertwigia falcifera*, demosponges *Geodia* sp., Pachastrellidae, Lithistida and Raspailiidae, bamboo octocoral *Isidella* sp., anemones *Corallimorphus* sp. and *Liponema* sp., soft coral *P. nigra*, cidarid urchins, goniasterid seastars, and sometimes abundant ophiuroids. The sea pen *Pennatula* or *Ptilosarcus* sp. was sometimes common on sediment, although it was also appeared to anchor on or among gravel and rubble. Fishes included an unidentified rajid, the catshark *Galeus arae*, the gaper *Chaunax suttkusi*, *H. dactylopterus*, and *Laemonema* sp.

Outer Terrace Ridge.—From ~350 m, the seafloor gradually sloped upward to the crest of the Outer Terrace Ridge in 306 m. Hard substrates accounted for a greater proportion of the bottom, beginning with low-relief exposed and sediment-veneered pavements and ledges, and becoming higher-relief pavements and irregular ridges by 330 m, but still with many areas of rubble or cobble. Organisms remained similar but increased in abundance on higher-relief substrates. Additional fishes included a phycid hake (?*Urophycis* sp.) and Zeidae (?*Zenopsis* sp.). From 314 m to the crest, the substrate was chiefly high-relief rugged pavement with scattered sediment. The ridge crest was a flat, low-relief pavement with pockets of sediment. Organisms included numerous sponges (e.g., Pachastrellidae, Desmacellidae, Lithistida, *Farrea* sp. *Geodia* sp.), Stylasteridae, octocorals (*Eunicella* sp., *Plumarella* sp., *P. nigra*), *Lophelia pertusa*, *Comatonia cristata* and cidarid urchins (Figure 4-9).

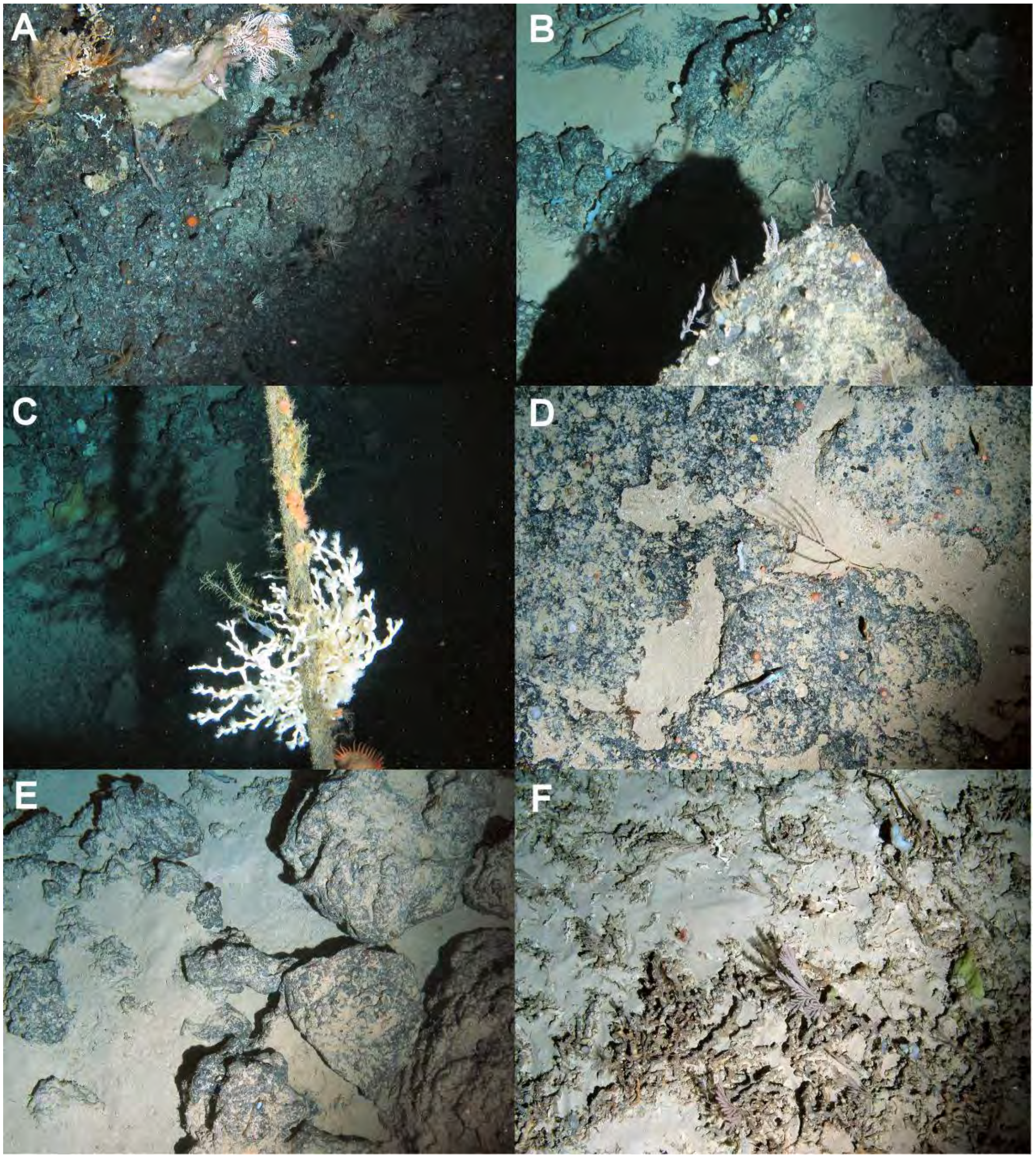

Figure 4-9. A-D. Outer Terrace Ridge. A. Sponges, crinoids (*Comatonia cristata*), Stylasteridae (white lace coral fan), and orange solitary corals on steep rugged drop-off near ridge crest; 307 m. B. Overhanging ledge with octocorals (*Plumarella* sp.); 400 m. C. *Lophelia pertusa*, anemones and hydroids on cable suspended between rugged elevations; 345 m. D. Low-relief, sediment veneered pavement on outer ridge slope, with bamboo octocoral (Isididae), solitary corals, and rattail fish (*Nezumia* sp.); 404 m. E. Barren cobbles and boulders on upper western slope of sinkhole; 440 m. F.Coral rubble with octocorals (*Plumarella* sp.) and sponge on Lower Terrace; 452 m.

The eastern slope of the Outer Terrace Ridge descended in a series of ledges, narrow ridges and high-relief rugged pavements with relatively little sediment cover and with the cable suspended up to 7 m above bottom in places. The slope was steep but irregular, dropping to 355 m and rising again to 342 m before continuing downward. Substrates varied among low-relief sediment-veneered pavements with or without loose gravel or cobbles, and moderate- to high-relief slabs, outcrops, and boulders. By 360 m, the substrate was chiefly low-relief, sediment-veneered, fractured pavement with some cobbly irregular low- to moderate-relief outcrops and patches of gravel or sediment. The fauna was similar to that on the western slope and crest but decreased in abundance with depth. The deep-water rattail fish *Nezumia* sp. first appeared in 385 m. Between 399 and 417 m, the substrate was largely barren, low-relief pavement with some sediment channels.

Sinkhole.—In 419 m, the transect descended into a sinkhole characterized by numerous boulders and rubble (Figure 4-9E) mixed with sediment and with almost no visible organisms except for *Actinoscyphia* sp. and *Comatonia cristata* on the suspended cable, and a single roughy or alfonsino, *Beryx decadactylus*. Rippled sediment floored the sinkhole in 440-443 m. Hard substrates appeared again on the eastern slope, first as patches of boulders and slabs on sediment with small coral rubble fragments, then becoming low- to moderate-relief pavement, slabs, and outcrops with gravel and cobbles upslope. Fauna was similar to that on the eastern slope of the Outer Terrace Ridge, with *Lophelia pertusa*, *Plumarella* sp., Stylasteridae, Isididae, demosponges and hexactinellids on boulders at and near the eastern rim in 432-435 m.

Lower Terrace.—East of the sinkhole rim, the seafloor continued to descend, varying among sediment-veneered pavements, rippled sediment, and low-relief hardbottom, with areas of sparse to dense *L. pertusa* coral rubble (Figure 4-9F). Organisms included hexactinellid sponges, Stylasteridae, *Plumarella* sp. and the first deep-water bamboo octocoral, *Keratoisis flexibilis* (436 m). The transect was terminated in 457 m, well east of the recorded terminus of cable 96.

4.2.2.3 South Non-Cable ROV Transect (C)

Figure 4-10 shows the South Non-Cable Transect and depth profile derived from multibeam data superimposed on the benthic habitats. Substrates and fauna are described in order of increasing depth.

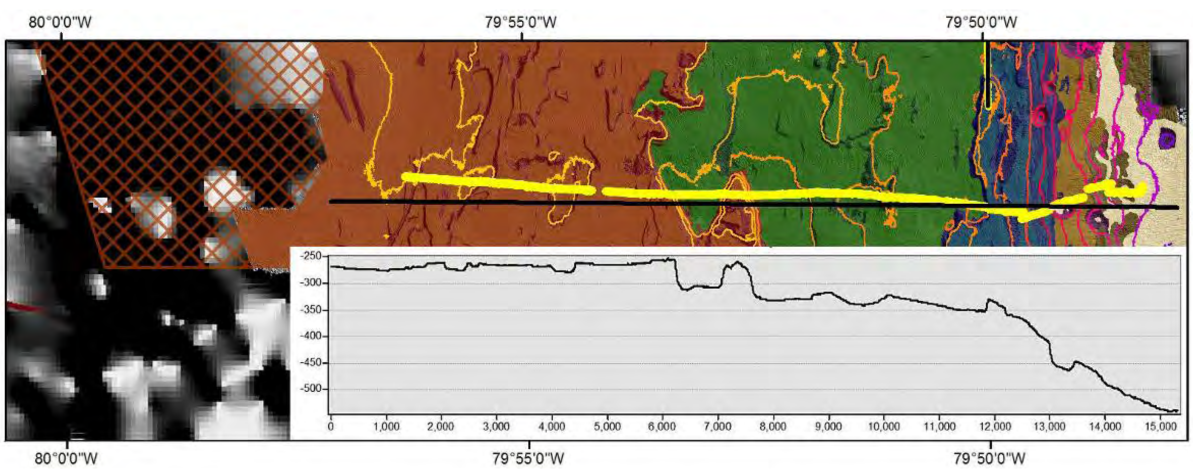

Figure 4-10. South Non-Cable Transect habitat map with depth profile derived from multibeam survey data. Isobath and habitat key as in Figure 4-7.

Inner Terrace Platform.—The westernmost portion of the transect beginning in 272 m was dominated by sediment substrates alternating between smooth, with unidentified tufts (possibly polychaete tubes), and rippled, interspersed with fields of sparse to dense gravel to cobbles, and low-relief pavements and irregular outcrops infrequently reaching ~0.6 m vertical relief with sediment pooling in depressions. Much of the western Inner Terrace Platform was vast fields of phosphoritic gravel, rubble and cobbles on sediment, with hard substrates accounting generally for 10-50% of cover, but interspersed with areas of more extensive low-relief pavement, outcrops, slabs and narrow low ridges. The transect crossed two depressions with vertical relief of up to 10 m (floor in 273 m) bordered by ledges and irregular high-relief outcrops and boulders, and floored by expanses of rippled sediment and fields of gravel and rubble on sediment. Eastward, the Inner Terrace Platform was characterized by low-relief, highly irregular phosphoritic outcrops, pavement and aggregated cobble substrate accounting for ~40-90% of cover, with sediment pooling in depressions (Figure 4-10). A phosphoritic ledge in 255 m dropped ~0.6 m to a distinctly different pale limestone pavement, which rapidly transitioned again to low-relief phosphoritic irregular outcrops.

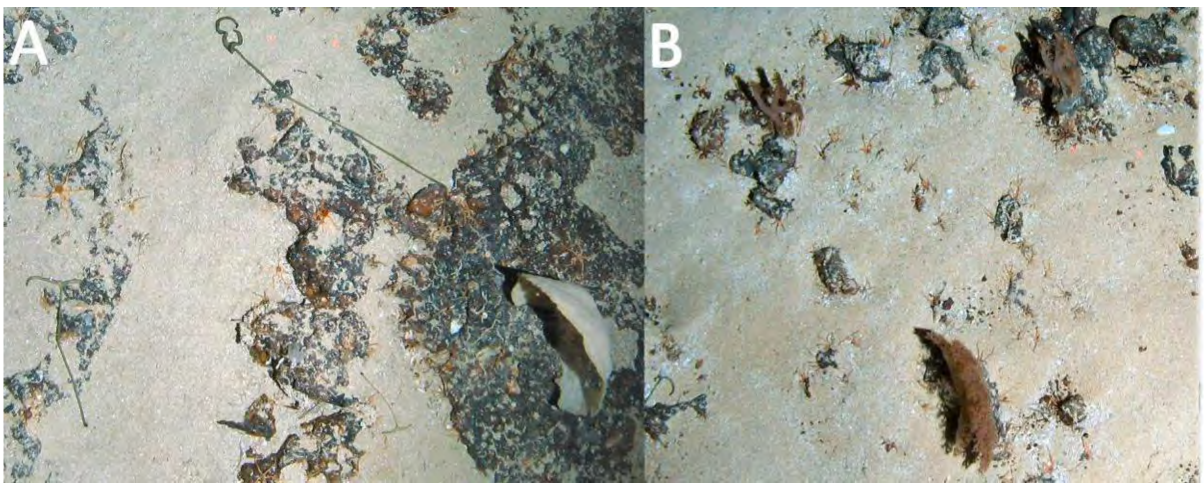

Figure 4-11. Inner Terrace Platform. A. Several echiuran worms ?*Ochetostoma* sp., fan sponge *Phakellia* sp. and numerous ophiuroids on low-relief, sediment-veneered pavement. B. Several soft corals *Pseudodrifa nigra* on phosphoritic rubble.

Most hard substrates supported sparse benthic macrofauna except for occasional local increases on low-relief substrates and typical often denser concentrations on local high-relief substrates (boulders and edges of ledges and raised slabs). Dominant organisms included fan sponges (*Phakellia* sp.), the spoonworm ?*Ochetostoma* sp. (Figure 4-11A), and the anemone *Liponema* sp., with local increases in pink-lipped sagartiid anemones, soft corals (*Pseudodrifa nigra*) (Figure 4-11B) and sea pens (*Pennatula* sp. or *Ptilosarcus* sp.), and enormous concentrations of ophiuroids. The shallowest, westernmost colony of *Lophelia pertusa* was observed on the rugged western lip of one of the sediment-floored depressions in 261 m, accompanied by sponges, antipatharians, hydroids and octocorals. Species richness clearly declined toward the western end of the transect; several taxa not previously seen and some characteristic of the Outer Terrace Platform were observed only once or rarely. Table 4-6 lists fauna observed on the Inner Terrace Platform, including the top of a triangular spur that extended northward from the southern edge of the geophysical survey area eastward of the Inner Terrace Platform escarpment.

Table 4-6. Benthic macrofauna observed on the Inner Terrace Platform. Asterisks indicate taxa observed once or rarely.

TAXON	TAXON	TAXON
PORIFERA	Unidentified Sagartiidae	ECHINODERMATA
DEMOSPONGIAE	Unidentified stripe-disk anemone*	CRINOIDEA
Geodia sp.	CORALLIMORPHARIA	_Comatonia cristata_
Phakellia sp.	_Corallimorphus_ sp.	Unidentified comatulid*
Unidentified Desmacellidae	CERIANTHARIA	ASTEROIDEA
Unidentified lithistid*	Unidentified cerianthid	Goniasteridae*
Unidentified Pachastrellidae*	SCLERACTINIA	_Tremaster mirabilis_
Unidentified Petrosiidae*	_Lophelia pertusa_*	Unidentified asteroids
Unidentified Raspailliidae	Unidentified solitary corals	OPHIUROIDEA
Slender branching sponge*	ANTIPATHARIA	_Astroporpa annulata_*
Spherical white sponge	_Leiopathes_ sp.	?_Ophiomusium lymani_
White encrusting sponge*	Unidentified black coral*	Unidentified ophiuroids
Yellow encrusting sponge	HYDROZOA	ECHINOIDEA
Unidentified demosponges	Unidentified Stylasteridae	_Cidaris_ sp.
HEXACTINELLIDA	Unidentified hydroids	_Echinus_ sp.*
_Aphrocallistes beatrix_*	ANNELIDA	HOLOTHUROIDEA
Farrea sp.	? _Ochetostoma_ sp.	_Psolus_ sp.*
Vazella sp.*	MOLLUSCA	VERTEBRATA
CNIDARIA	GASTROPODA	CHONDRICHTHYES
OCTOCORALLIA	_Calliostoma_ sp.	Unidentified Rajidae
?_Anthomastus_ sp.*	CRUSTACEA	OSTEICHTHYES
Eunicella sp.	ANOMURA	_Chlorophthalmus agassizi_
Isidella sp.*	Unidentified galatheoid*	_Helicolenus dactylopterus_ *
Pennatula or _Ptilosarcus_ sp.	Unidentified paguroid	_Laemonema_ sp.
Plumarella sp.*	BRACHYURA	_Polyprion americanum_ *
Pseudodrifa nigra	_Bathynectes longispina_*	Unidentified Scorpaenidae*
ACTINIARIA	_Cancer borealis_*	Unidentified fish*
Actinoscyphia sp.	?_Rochinia_ sp.*	
Liponema sp.		

Outer Terrace Platform.—The slopes of the spur and the escarpment at the western margin of the Outer Terrace Platform reached 60º with locally vertical ledges, and consisted chiefly of low-relief, mostly barren pavement with areas of phosphoritic rubble, boulders and irregular phosphoritic outcrops up to ~0.6 m tall on slopes and up to 2.0 m tall on the crest. Much of the pavement was pale limestone, in places overlain with contrasting phosphoritic gravel, rubble or cobbles (Figure 4-12E). Abrupt changes in slope and major local zones of high-relief conformed well with the 2010 DOE multibeam topography. The eastern escarpment of the Inner Terrace Platform dropped from 252 m to 300 m at its base. The triangular spur rose to 264 m and dropped on its eastern side back to the Outer Terrace Platform in 328 m.

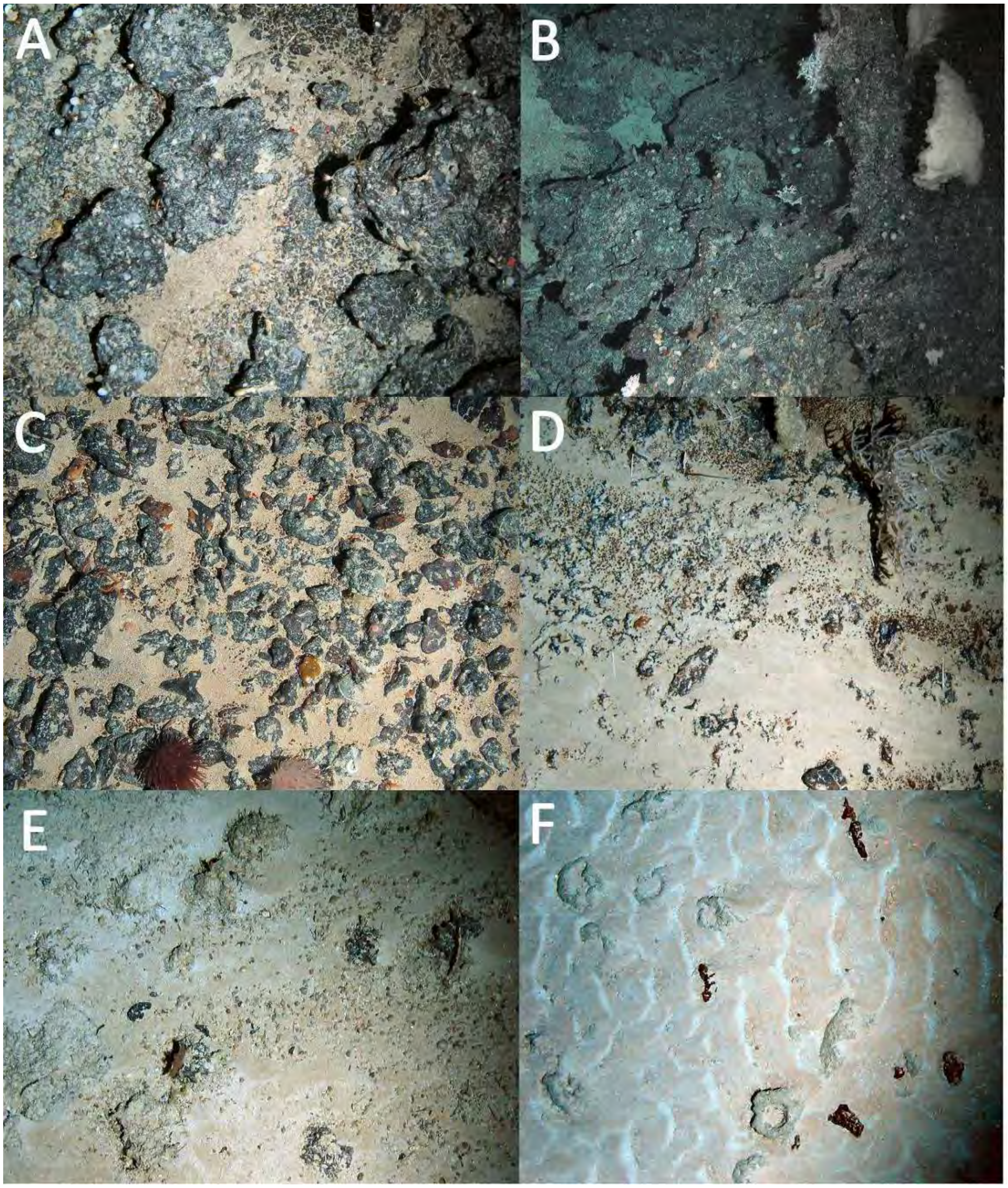

Figure 4-12. South Transect, Outer Terrace Platform. A. Sediment-veneered pavement with slab-like low-relief outcrops and patchy gravel and small cobbles. B. A series of ledges with Lophelia pertusa (small white colony at upper center), the octocoral Plumarella sp. and large white Phakellia sp. sponges. C. Low-relief field of rubble intermixed with gravel and the anemone Liponema sp. (bottom). D. Sediment-veneered pavement with gravel; a pachastrellid sponge and the black coral Leiopathes sp. are visible at top right. E. Pale sediment-veneered limestone pavement with a few small black phosphoritic clasts, gravel, and scattered brachiopod valves. F. Unusual bowl-like outcrops of pale limestone on rippled sediment-veneered hard bottom.

Beyond the triangular spur of the Upper Terrace the seafloor passed from sediment-veneered pale carbonate pavement overlain with phosphoritic rubble (Figure 4-12E) through decreasing density of gravel and rubble to an extensive rippled sediment field with broad sand waves up to 1 m high. A unique hard bottom appeared as local low-relief fields of pale bowl-like features 10-20 cm across (Figure 4-12F). Several images, particularly near steep substrates, revealed numerous brachiopod valves, sometimes accompanied by echinoid spines (Figure 4-12E).

The Outer Terrace Platform between the crest of the escarpment at the eastern boundary of the Inner Terrace Platform and the western escarpment of the Outer Terrace Ridge included a wide diversity of chiefly hard substrates including: a) low-relief, continuous, jointed or broken pavements with occasional abruptly delimited patches of gravel or small cobbles (Figure 4-12A); b) irregular low- to moderate-relief outcrops with sediment pooling in depressions; and c) occasional moderate- to high-relief ledges, jumbled boulders and tilted slabs, with higher relief associated with slopes below ledges (Figure 4-12B). However, much of the area consisted of extensive fields of gravel, rubble or cobbles (Figure 4-12C) with occasional patches of exposed hard substrates. Smooth or rippled sediment ranged from extensive areas with no exposed hard substrate through deeply or thinly-veneered pavement, or scattered small to large cobbles, to mixtures of aggregated gravelly hard bottom and more open sediment (Figure 4-12D) with broader hardbottom patches. The multibeam backscatter data did not appear to resolve differences between the sediment substrates and flatter hard bottoms, suggesting that the sediment was not particularly deep.

Hard substrates ranged from largely barren with only widely scattered organisms (although close-up images sometimes revealed large numbers of small ophiuroids) (Figure 4-13A), to supporting locally dense assemblages, particularly in areas of higher relief, although no consistency appeared between qualitative densities or composition relative to substrate complexity or topographic relief. For example, one slender white branching sponge was seen toward the western end of the Outer Terrace Platform but nowhere else on apparently similar substrates; isolated colonies of *Lophelia pertusa* were observed chiefly on higher-relief ledge edges but not on a pinnacle that rose 15 m above surrounding seafloor; and stylasterid hydrocorals or cidarid echinoids appeared in numbers in a few areas and were absent elsewhere on similar substrates. Nevertheless, the primnoid octocoral, *Plumarella* sp. generally appeared in numbers only near or on apparently elevated exposed substrates, and ledge edges typically supported diverse and often dense assemblages of sponges, stylasterids, and crinoids. Table 4-7 lists organisms observed on the Outer Terrace Platform, including the steep slopes rising to the Inner Terrace Platform.

The low-relief rubble-cobble fields between escarpments supported a sparse fauna dominated by the anemone *Liponema* sp. with some sponges, abundant ophiuroids, and a few widely scattered large black coral colonies (*Leiopathes* sp.). *Pennatula* or *Ptilosarcus* sp. was found both on sediment and among gravel and rubble (Figure 4-13B).

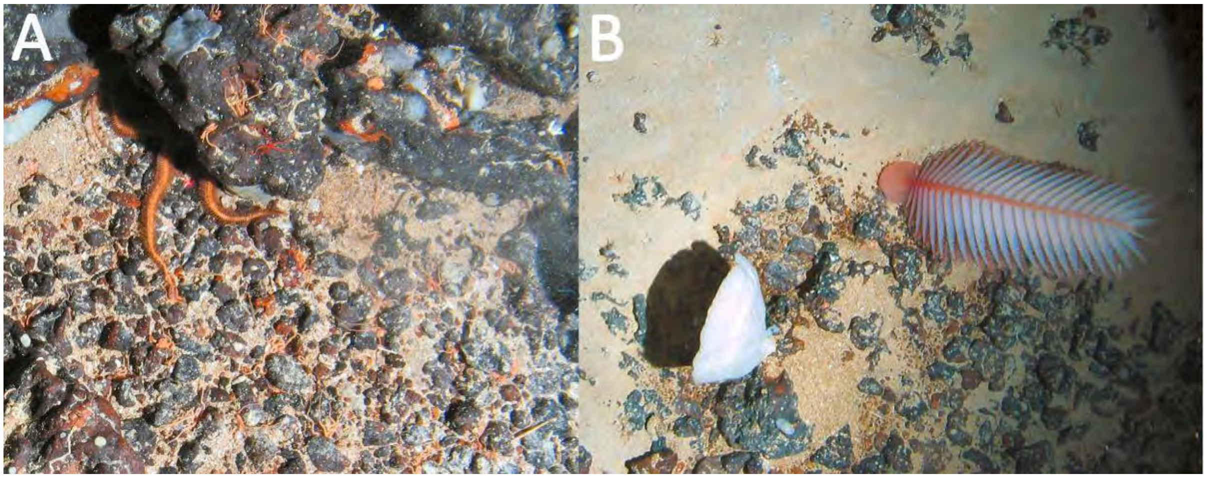

Figure 4-13. South Transect, Outer Terrace Platform. A. Abundant ophiuroids belonging to three species. B. Sea pen (*Pennatula* or *Ptilosarcus* sp.) apparently on sediment-veneered hard bottom, accompanied by the fan sponge *Phakellia* sp.

Table 4-7. Outer Terrace Platform, South Transect: Benthic macrofauna.

TAXON	TAXON	TAXON
PORIFERA	ACTINIARIA	ASTEROIDEA
DEMOSPONGIAE	*Actinoscyphia* sp.	Goniasteridae
Geodia sp.	*Liponema* sp.	Unidentified asteroids (~1)
Unidentified lithistid	Unidentified Sagartiidae	OPHIUROIDEA
Phakellia sp.	Unidentified anemone	*Asteroporpa annulata*
Spongosorites sp.	CORALLIMORPHARIA	Unidentified Asteroschematidae
Unidentified Desmacellidae	*Corallimorphus* sp.	Unidentified ophiuroids
Unidentified Pachastrellidae	SCLERACTINIA	ECHINOIDEA
Unidentified Raspailliidae	*Lophelia pertusa*	*Araeosoma* sp.
Unidentified spherical astrophorid	Solitary corals	*Cidaris* sp.
Brown encrusting sponge	ANTIPATHARIA	*Echinus* sp.
White wall sponge	*Leiopathes* sp.	*Stylocidaris* sp.
Unidentified demosponges	HYDROZOA	Unidentified echinoid
HEXACTINELLIDA	Unidentified Stylasteridae	VERTEBRATA
Aphrocallistes beatrix	Unidentified hydroids	CHONDRICHTHYES
Farrea sp.	ANNELIDA	*Benthobatis marcida*
Vazella sp.	*Ochetostoma* sp.	*Galeus arae*
Unidentified hexactinellid	CRUSTACEA	Unidentified Rajidae
CNIDARIA	ANOMURA	OSTEICHTHYES
OCTOCORALLIA	*Eumunida picta*	*Chaunax* sp.
Eunicella sp.	Unidentified paguroid	*Chlorophthalmus agassizi*
Isidella sp.	BRACHYURA	*Helicolenus dactylopterus*
Pseudodrifa nigra	*Cancer borealis*	*Laemonema* sp.
Plumarella sp.	ISOPODA	*Nezumia* sp.
Unidentified octocoral	*Bathynomus giganteus*	*Polymixia* sp.
Pennatula sp. (or *Ptilosarcus* sp.)	ECHINODERMATA	Unidentified Scorpaenidae
	CRINOIDEA	Unidentified fish
	Comatonia cristata	

Outer Terrace Ridge.—The slope below the Outer Terrace Ridge crest in ~337 m consisted of chiefly low-relief, clean and sediment-veneered, often jointed pavements with a flat top of aggregated rubble, slabs and sediment-veneered pavement. The eastern side of the Outer Terrace

Ridge began with a steep ledge with large blocks and slabs in 356 m that dropped to abundant cobbles (10-30 cm), larger blocks and slabs. The slope continued downward as low- to high-relief jointed and irregular pavements with slabs, outcrops, occasional low ledges, cobbles, a few isolated gravel patches, and pools and small expanses of sediment. Attached organisms were more diverse and abundant higher on the slope (the unidentified taxa in Table 4-8 likely conceal multiple species), but their distributions remained extremely patchy. Sponges dominated, with patches of stylasterid hydrocorals and, near the top of the slope, numerous small *Plumarella* sp. Several Outer Platform taxa reached their maximum depth limit here, e.g., demosponges *Geodia* sp. and Pachastrellidae, and the anemone *Liponema* sp.

Table 4-8. Outer Terrace Ridge, South Transect. Benthic macrofauna.

TAXON	TAXON	TAXON
PORIFERA	Unidentified octocoral	ECHINODERMATA
DEMOSPONGIAE	ACTINIARIA	CRINOIDEA
Corallistes sp.	*Actinoscyphia* sp.	*Comatonia cristata*
Geodia sp.	*Liponema* sp.	ASTEROIDEA
Unidentified lithistid	Unidentified orange anemone	Goniasteridae
Phakellia sp.	Unidentified red anemone	*Tosia parva*
Spongosorites sp.	Unidentified anemone	Unidentified asteroids (~4-5 species)
Unidentified Choristidae	CORALLIMORPHARIA	OPHIUROIDEA
Unidentified Desmacellidae	*Corallimorphus* sp.	*Asteroporpa annulata*
Unidentified Pachastrellidae	SCLERACTINIA	Unidentified ophiuroids
Unidentified Petrosiidae	*Lophelia pertusa*	ECHINOIDEA
Unidentified Raspailiidae	Solitary corals	*Araeosoma* sp.
Unidentified spherical astrophorid	ANTIPATHARIA	*Cidaris* sp.
Unidentified white branching sponge	*Leiopathes* sp.	Unidentified echinoid
Yellow encrusting sponge	HYDROZOA	HOLOTHUROIDEA
White wall sponge	Unidentified Stylasteridae	*Psolus* sp.
Unidentified demosponges	Unidentified hydroids	VERTEBRATA
HEXACTINELLIDA	BRYOZOA	CHONDRICHTHYES
Vazella sp.	Unidentfied bryozoan	*Galeus arae*
Unidentified hexactinellid	CRUSTACEA	Unidentified Rajidae
CNIDARIA	ANOMURA	OSTEICHTHYES
OCTOCORALLIA	Unidentified paguroid	*Helicolenus dactylopterus*
Eunicella sp.	BRACHYURA	*Laemonema* sp.
Isidella sp.	*Chaceon fenneri*	Unidentified fish
Pseudodrifa nigra		
Plumarella sp.		

Sinkhole.—The base of the Outer Terrace Ridge was a steep irregular escarpment of blocks, slabs and boulders to 418 m, the western edge of a sinkhole that sloped down as a smooth pavement thinly veneered with sediment, with small clumps of dead *L. pertusa* rubble on the western slope (Figure 4-14B). The sinkhole floor in 450 m was rippled and smooth sediment with small patches of pavement that alternated with fine coral rubble and sediment up the eastern slope to higher relief slabs, boulders and outcrops and coral rubble inside the edge at 436 m. An unidentified rajid skate and greeneye, *C. agassizi*, were the most common mobile organisms on the sinkhole floor.

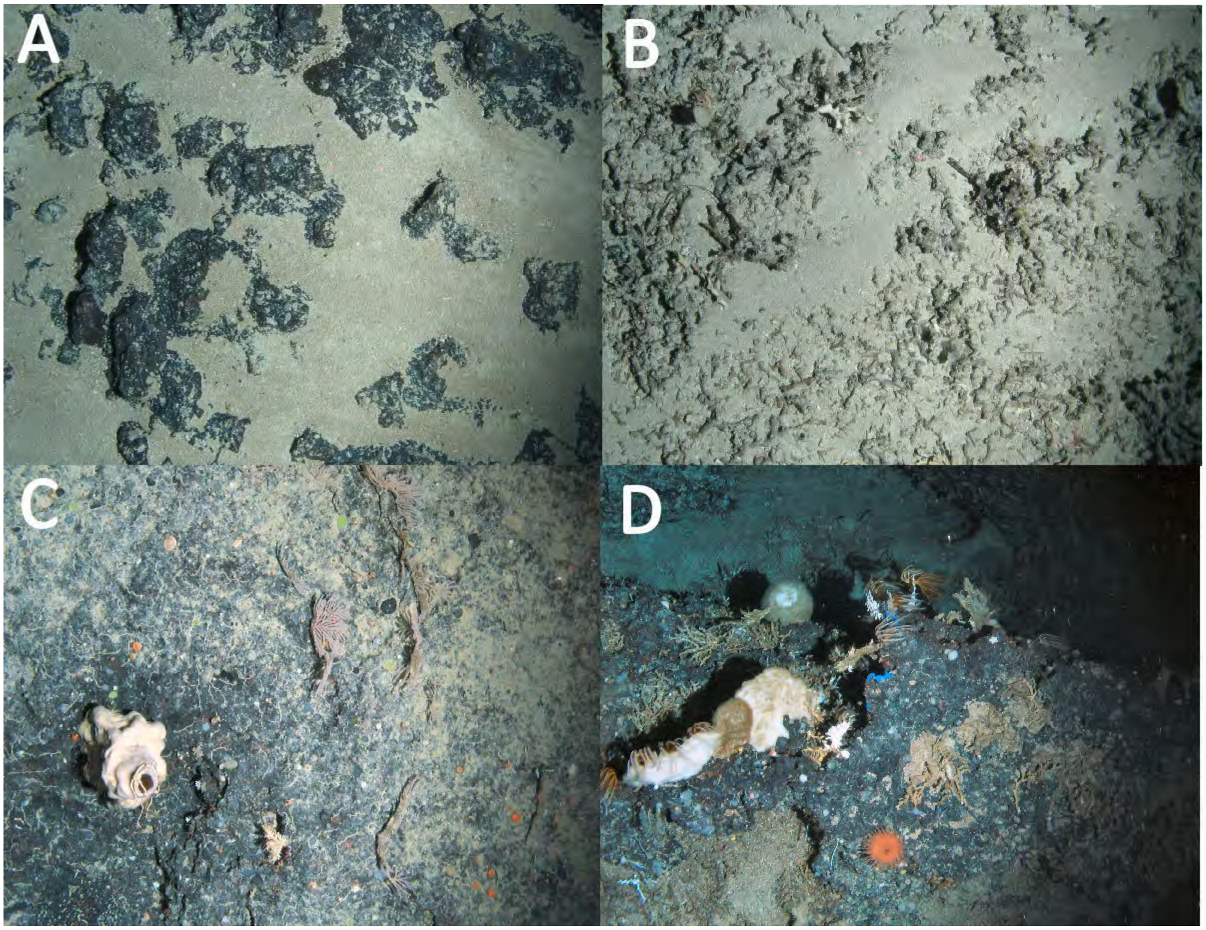

Figure 4-14. A. Low-relief aggregated phosphoritic cobble-rubble field on the deeper Lower Terrace slope in 507-510 m. B. *Lophelia pertusa* rubble on the Lower Terrace slope. C. Low-relief pavement near the top of the Outer Terrace Ridge with octocorals (*Plumarella* sp.), orange solitary corals, and white petrosiid sponge. D. Ledge near the top of the Outer Terrace Ridge with sponges, crinoids, *Corallimorphus* sp.(orange) and *Lophelia pertusa* fragments.

Lower Terrace.—Beyond the sinkhole, substrates ranged from low-relief cobble and rubble (10-30 cm across) fields to moderate- to high-relief phosphoritic boulders, low ledges, overhanging slabs and pavements up to 80-90% cover in 443-461 m, with ponds and expanses of chiefly rippled sediment. Benthic macrofauna was extremely sparse on low-relief substrates, and more common but still generally widely scattered and patchy on higher relief substrates. The most frequently seen organisms included the anemone *Corallimorphus* sp., isidid octocorals, golden crab *C. fenneri*, codling *Laemonema* sp., and small mottled rajids. In 467 m, the seafloor transitioned abruptly from the hard substrates of the Lower Terrace to largely barren sediment with ripples indicating southbound bottom flow, alternating with weakly bioturbated smooth sediment with scattered craters.

The deeper Lower Terrace slope from 507 to 510 m consisted of a series of intermixed substrates: low-relief aggregated phosphoritic cobble-rubble fields (20-40% hard bottom) (Figure 4-14A) alternating with areas that included low outcrops (to ~60% cover), a few areas of low- to moderate-relief outcrops, tilted slabs and boulders (to ~70% cover), patches of *L. pertusa* coral rubble in low mounds to ~1 m across (possibly isolated dead thickets), and fields of coral debris that in some places appeared as a continuous sediment-veneered pavement. All were separated by frequently oval patches of rippled or smooth, weakly-bioturbated sediment up to several meters across. Again, benthic attached organisms, such as stylasterid hydrocorals, octocorals and sponges, were somewhat more common on higher relief substrates. Table 4-9 lists organisms found on the western edge of the sinkhole in 418 m to the Lower Terrace slope in 510 m.

Table 4-9. Lower Terrace, South Transect. Benthic macrofauna from the western edge of the sinkhole to the east end of the transect.

TAXON	TAXON	TAXON
PORIFERA	CERIANTHARIA	ECHINODERMATA
DEMOSPONGIAE	Unidentified cerianthid	CRINOIDEA
Phakellia sp.	SCLERACTINIA	?*Comatonia cristata*
Spongosorites sp.	*Lophelia pertusa*	ASTEROIDEA
HEXACTINELLIDA	Solitary corals	Goniasteridae
Aphrocallistes beatrix	ANTIPATHARIA	OPHIUROIDEA
Hyalonema sp.	Unidentified black coral	?*Ophiomusium* sp.
Vazella sp.	HYDROZOA	VERTEBRATA
Unidentified sponge	Unidentified Stylasteridae	CHONDRICHTHYES
CNIDARIA	Unidentified hydroids	*Benthobatis marcida*
OCTOCORALLIA	CRUSTACEA	*Galeus arae*
Anthomastus sp.	PENAEOIDEA	Unidentified Rajidae
Isidella sp.	*Pleoticus robustus*	OSTEICHTHYES
Keratoisis sp.	CARIDEA	*Chaunax pictus*
Plexauridae (yellow fan)	*Glyphocrangon* sp.	*Chlorophthalmus agassizi*
Plumarella sp.	ANOMURA	*Helicolenus dactylopterus*
CORALLIMORPHARIA	Unidentified paguroid	*Laemonema* sp.
Corallimorphus sp.	BRACHYURA	*Nezumia* sp.
	Cancer borealis	*Peristedion* sp.
	Chaceon fenneri	

4.2.2.4 North Non-Cable ROV Transect (B)

The North non-cable ROV transect was run to the north of the multibeam survey area (Figure 4-1). Because the NOAA low-resolution data was the only bathymetry available, no depth profile was drawn. Similarly, precise transitions between successive habitats could not be confirmed.

The transect began in 235 m on weakly bioturbated sediment with a few mounds and depressions and probable polychaete tubes that continued to 245 m, where a combination of white and black rubble appeared and quickly transitioned to a mixture of rippled sediment, rubble, low relief outcrops, ledges, and sediment-veneered hardbottom. Organisms were the same as along both Cable and South Non-Cable Transects, e.g., the cnidarians ?*Actinauge* sp., *Liponema* sp., *Pseudodrifa nigra*, *Eunicella* sp., and solitary corals; the echinoderms *Coronaster briareus*, *Gracilechinus* sp., *Araeosoma* sp., Goniasteridae, and *Cidaris* ?*rugosa*; the crustaceans ?*Pylopagurus* sp., *Cancer borealis* and galatheids; the spoonworm ?*Ochetostoma* sp., and the fishes *Laemonema* sp., *Benthobatis marcida*, *Helicolenus dactylopterus*, *Chlorophthalmus agassizi*, and unidentified Scorpaenidae. A single possible colony of *Lophelia pertusa* was seen in 244 m.

Substrates subsequently became more variable, ranging from expanses of weakly bioturbated sediment with abundant worm tubes through fields of gravel- or rubble- to cobble-sized clasts, to low-relief smooth or fractured pavements (Figure 4-15), low- to moderate-relief outcrops, scattered slabs on sediment, and some areas with abrupt ledges, boulders and higher-relief outcrops. Depth varied irregularly between 242 and 235 m. Areas of sediment often alternated with north-south-oriented strips of hard substrate. Fauna increased in diversity and again included the same taxa as observed on the other transects, now including, e.g., sponges *Phakellia* sp., *Farrea* sp., *Aphrocallistes beatrix*, *Geodia* sp., *Spongosorites* sp., *Vazella* sp., unidentified branching sponge, unidentified Astrophorida, Pachastrellidae, Petrosiidae and Lithistida; cnidarians *Actinoscyphia* sp., *Corallimorphus* sp., Sagartiidae, zoanthids, *Isidella* sp., *Plumarella* sp., *Leiopathes* sp., and Stylasteridae; crustaceans *Eumunida picta*, *Bathynectes longispina*, and paguroid hermit crabs; echinoderms *Astropecten* sp., *Tosia parva* and ophiuroids; the gastropod *Calliostoma* sp., and the fishes *Chaunax* sp., unidentified anthiine and an unidentified Rajidae.

North-south-oriented strips of low-relief irregular pavements with rubble and cobbles alternated with areas of either rippled or weakly bioturbated sediment to 280 m. The only attached benthic organism observed along this transect but not along either the cable route or southern transect on the Terrace Platform was the primnoid octocoral *Callogorgia* cf. *americana*: ten colonies between 245 and 299 m. Scattered colonies were also seen along the LNG pipeline survey transects just north of the Port Everglades entrance channel (Messing et al. 2006a, b).

From 280 m, the seafloor sloped gently upward to 257 m as low-relief, chiefly sediment-veneered, irregular pavements sometimes broken into slabs, and rare low (<1 m) ledges; areas of gravel- through rubble- to cobble-sized clasts (often obviously over sediment-veneered pavement); rare larger boulders and irregular outcrops, and expanses of rippled sediment with or without scattered rubble. From this depth, the bottom descended gradually again over similar substrates to 264 m, where continuous irregular pavement was followed by drop-offs to 280 and then 292 m to irregular, moderate-relief slabs, outcrops and pavement followed by fields of gravel to cobbles, continuous rubbly pavement, and expanses of rippled sediment in 297 m.

The seafloor again rose gradually to 265 m at a possible transition to the Outer Terrace Platform, based on topography and habitats extrapolated beyond the 2010 DOE multibeam survey area, before sloping eastward to 308 m and ascending again up the western slope of the Outer Terrace Ridge in a series of rugged shelves and undercut overhanging ledges. The crest of the Outer Terrace Ridge in 280 m was chiefly low- to moderate-relief irregular pavement with sediment pooling in depressions. Characteristic organisms included demosponges (e.g., Astrophorida, Desmacellidae, *Geodia* sp., Lithistida, Pachastrellidae, *Phakellia* sp., Raspailiidae), hexactinellids (e.g., *Farrea* sp., *Vazella* sp.), Stylasteridae, anemones (e.g., *Actinoscyphia* sp., *Corallimorphus* sp., *Liponema* sp., Sagartiidae), octocorals (e.g,. *Pseudodrifa nigra*, *Plumarella* sp., *Callogorgia* sp.), the basketstar *Gorgonocephalus arcticus*, the crinoid *Comatonia cristata*, echinoids (*Araeosoma* sp., *Cidaris* ?*rugosa*, *Gracilechinus* sp.), numerous ophiuroids, and fishes (e.g., *Helicolenus dactylopterus* and *Laemonema* sp.).

From the eastern edge of the ridge crest in 289 m, the seafloor dropped in a series of irregular ledges and outcrops including an escarpment of ~25 m, interspersed with interspersed with low- to moderate-relief, sediment-veneered, often broken pavements and slabs, with or without overlying rubble; some irregular isolated table-like ledges; deeply eroded “ironshore”-like hard bottom, and short patches of barren rippled or smooth sediment, sometimes with gravel, to

Figure 4-15. North transect. A. Coarse shelly hash including echinoid spines on low-relief pavement with gastropod (?*Sconsia* sp.), solitary corals and ophiuroids. B. High-relief tilted phosphoritic slabs with a variety of sponges including lithistids (fluted plates) and a spherical astrophorid.

Table 4-10. North Transect benthic macrofauna.

TAXON	TAXON	TAXON
PORIFERA	*Keratoisis* sp.	BRACHYURA
DEMOSPONGIAE	*Pseudodrifa nigra*	*Bathynectes longispina*
Corallistes sp.	*Plumarella* sp.	*Chaceon fenneri*
Phakellia sp.	Unidentified octocoral	ECHINODERMATA
Spongosorites sp.	ACTINIARIA	CRINOIDEA
Unidentified Desmacellidae	*Liponema* sp.	*Comatonia cristata*
Unidentified Lithistida	Unidentified red anemone	Unidentified comatulid
Unidentified Lithistida (vase)	Unidentified Sagartiidae	ASTEROIDEA
Unidentified Pachastrellidae	CORALLIMORPHARIA	Goniasteridae
Unidentified Petrosiidae	*Corallimorphus* sp.	*Tosia parva*
Unidentified Raspailiidae	SCLERACTINIA	*Tremaster mirabilis*
Unidentified brown encrusting sponge	*Lophelia pertusa*	Unidentified asteroids (~4-5 species)
Unidentified spherical astrophorid	Solitary corals	OPHIUROIDEA
Unidentified white amphitheater sponge	ANTIPATHARIA	?*Ophiomusium lymani*
Unidentified white branching sponge	?*Leiopathes* sp.	Unidentified ophiuroids
Unidentified white conulose sponge	Unidentified black coral	ECHINOIDEA
Brown encrusting sponge	HYDROZOA	*Cidaris* sp.
White wall sponge	Unidentified Stylasteridae	*Echinus* sp.
Unidentified demosponges	Unidentified hydroids	VERTEBRATA
HEXACTINELLIDA	BRYOZOA	CHONDRICHTHYES
Aphrocallistes beatrix	Unidentfied bryozoan	*Benthobatis marcida*
Farrea sp.	MOLLUSCA	OSTEICHTHYES
Hertwigia falcifera	GASTROPODA	?*Aulopus* sp.
Heterotella sp.	?*Sconsia* sp.	?*Aldrovandia* sp.
Vazella sp.	CRUSTACEA	*Beryx decadactylus*
Unidentified hexactinellid	CARIDEA	*Chaunax pictus*
CNIDARIA	Unidentified caridean shrimp	*Chlorophthalmus agassizi*
OCTOCORALLIA	ANOMURA	*Helicolenus dactylopterus*
Anthomastus sp.	*Eumunida picta*	*Laemonema* sp.
Eunicella sp.	Unidentified galatheoid	*Nezumia* sp.
?*Eunicella* sp. (branched)	Unidentified paguroid	Unidentified Scorpaenidae
Isidella sp.		

continuous rippled sediment with isolated patches of hardbottom in 327 m. Much of the initial portion of this descent was continuous pale pavement overlain in many places with either a coarse shelly hash or phosphoritic rubble, or both,

Below this depth, perhaps corresponding to the transition between the Outer Terrace Ridge and the Lower Terrace (unconfirmed; the transect was outside the 2010 DOE multibeam survey), high-relief substrates were fewer and further apart, and were separated by a) low- to moderate-relief broken or jointed, sediment-veneered, pavements with sediment pooling in depressions; b) slabs; c) patches of gravel and rubble on sediment, and d) more frequent entirely sediment substrates. *Lophelia pertusa* coral rubble first appeared in 409 m and continued intermittently to at least 474 m in a sinkhole. The sinkhole slopes included broken and tilted slabs and cobbles, largely barren pavement, some ledges and boulders, with sediment, rubble, cobbles and coral rubble in the deeper portions. The easternmost end of the transect in 451 m was a combination of rippled and smooth gravelly sediment, small areas of scattered cobbles, largely barren hard bottom, deeply eroded cobbly hard bottom, and broken slabs.

Some areas of sea floor along this transect were largely or completely barren of macrofauna, with contrasting and often dense aggregations along and near the edges of ledges, overhanging pavement and other locally high-relief substrates (Figure 4-15B). Demosponges were the most diverse and abundant organisms (e.g., *Phakellia* sp., Raspailiidae, Pachastrellidae, Lithistida), accompanied by hexactinellid sponges, stylasterids, the anemone *Liponema* sp., local concentrations of the octocorals *Isidella* sp. or *Plumarella* sp., and locally dense populations of ophiuroids (Table 4-10).

4.2.2.5 West North-South ROV Transect (D)

The West North-South ROV transect ran from north to south, beginning in 275 m and ending in 262 m (Figure 4-1). Because most of its length lay outside the multibeam survey area, no depth profile was mapped.

The initial portion of the transect remained within a depth range of 274-278 m over chiefly sediment-veneered hardbottom with areas of gravel and rubble, dominated by *Liponema* sp., *P. nigra*, *Cidaris* ?*rugosa* and abundant ophiuroids. This low density and diversity segment ran from the beginning of the transect at 26°04.902'N, 79°53.003'W to 26°04.72'N, 79°53.013'W. The transect passed over several low-moderate relief irregular outcrops beginning at 26º04.6629'N, 79º53.004'W, an area of moderate-relief outcrops, boulders and cobbles at 26º04.439'N, 79º53.039'W, and ended on a combination of irregular pavements, ledges, large boulders and slabs mixed with cobbles in 258-278 m. The areas of greater hard-substrate exposure and relief were separated by sediment-veneered pavements and areas of gravel and rubble (e.g., 26°04.508'N, 79°53.04'W to 26°04.442'N, 79°53.045'W), the latter sometimes with numerous sea pens (*Pennatula* sp. or *Ptilosarcus* sp.) (14 in a sequence of 20 successive images, including 3 in one image) (26°04.07'N, 79°53.014'W to 26°04.364'N, 79°52.989'W). Table 4-11 lists organisms observed. Cable was crossed at 26°4.797'N, 79°53.01'W, 26°04.61'N, 79°52.996'W, and 26°04.313'N, 79°53.017'W.

Table 4-11. Organisms observed along the western North-South Transect (D).

PORIFERA	CORALLIMORPHARIA	ECHINODERMATA
DEMOSPONGIAE	*Corallimorphus* sp.	ASTEROIDEA
Geodia sp.	ANTIPATHARIA	*Astropecten* sp.
Phakellia sp.	Unident. Antipatharia	*Coronaster briareus*
Spongosorites sp.	SCLERACTINIA	*Tremaster mirabilis*
Desmacellidae	Unident. solitary corals	Unident. Asteroidea
Pachastrellidae	OCTOCORALLIA	CRINOIDEA
Unident. brown encrusting	*Eunicella* sp.	*Comatonia cristata*
Unident. Demospongiae	*Plumarella* sp.	ECHINOIDEA
HEXACTINELLIDA	*Pseudodrifa nigra*	*Cidaris* ?*rugosa*
Aphrocallistes beatrix	*Pennatula* or *Ptilosarcus* sp.	*Gracilechinus* sp.
Farrea sp.	CRUSTACEA	OPHIUROIDEA
CNIDARIA	ANOMURA	*Astroporpa annulata*
HYDROIDLIOLINA	?*Pylopagurus* sp.	?*Ophiomusium lymani*
Stylasteridae	Unident. Paguroidea	Unidentified Ophiuroidea
ACTINIARIA	ANNELIDA	CHONDRICHTHYES
Actinoscyphia sp.	?*Ochetostoma* sp.	*Galeus arae*
Liponema sp.	MOLLUSCA	Unident. Rajidae
Sagartiidae	GASTROPODA	OSTEICHTHYES
	Scaphella sp.	*Chlorophthalmus agassizi*
		Laemonema sp.
		Urophycis sp.

4.2.2.6 East North-South ROV Transect (E)

The East North-South ROV transect began north of the Cable Transect and traversed south along the western edge of the Outer Terrace Ridge beginning in 331 m, based on multibeam data (Figure 4-16).

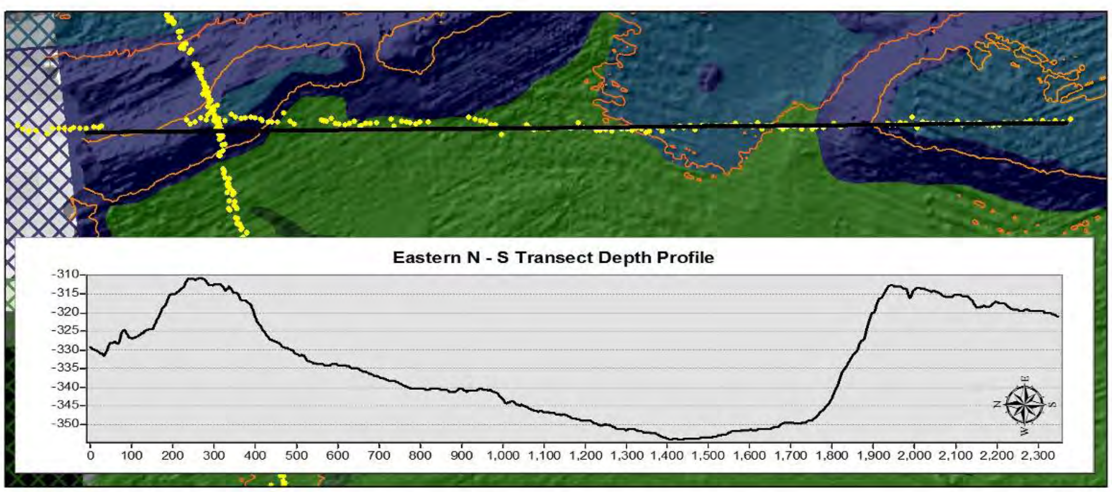

Figure 4-16. East N-S Transect (E) depth profile. North is on left. The almost vertical line of yellow dots at left represents the primary E-W Cable transect line (A), although additional cables were crossed.

The substrate at the beginning of the transect consisted of low-relief ridges and sediment-veneered pavement that ascended via a series of rugged ledges with vertical relief up to 2 m, and boulders up to 1 m tall interspersed with pavement, rubble patches and areas of coral rubble to a peak in 308 m. Characteristic Outer Ridge organisms included demosponges (e.g., *Corallistes* sp., *Geodia* sp., Pachastrellidae, *Phakellia* sp., Raspailiidae), hexactinellids (e.g., *Aphrocallistes beatrix*), Stylasteridae, abundant solitary scleractinian corals, and large antipatharians (*Leiopathes* sp.) (Figure 4-17). Live colonies of *Lophelia pertusa* to 20 cm across first appeared in ~314 m; larger thickets with colonies up to 1 m across were observed on the crest in 308 m (Figure 4-17A).

The transect then descended along an initially steep rugged slope over sediment-veneered pavement, boulders, and high-relief phosphoritic outcrops to a more gradual slope that still included up to 1-m ledges, narrow rock ridges, and boulders, before becoming chiefly pavement and rubble. The maximum depth recorded in the ROV datalog was 348 m, whereas the multibeam depth profile reached ~354 m. Metal wreckage was observed in 314 m between 26º04.339'N, 79º49.953'W and 26º04.264'N, 79º49.955'W (Figure 4-17B). Demosponges were the dominant organisms noted (e.g., *Corallistes* sp., *Discodermia* sp., *Geodia* sp., Pachastrellidae, *Phakellia* sp., *Spongosorites* sp. and *Stylocordyla* sp.). The lowest relief segment with the lowest qualitative organism richness ran from 26°04.269'N, 79°50.005'W to about 26°04.088'N, 79°49.973'W, but still included occasional ridges with up to ~0.5 m relief, a 1-m ledge, and scattered sponges (e.g., Pachastrellidae, *Vazella*).

The transect then ascended a steep slope of rugged rocky ledges with boulders to the top of a plateau in 307 m. The top consisted of low-relief, sediment-veneered pavement with cobbles, and gradually descended to the transect end in 317 m. Organisms on the upward slope and crest were similar to those noted on the higher elevations earlier in the transect, including a thicket of *L. pertusa* ~1 m across in 318 m.

Several cables were crossed during this transect, as follows: between 26º05.297'N, 79º50.011'W and 26º05.169'N, 79º50.004'W (~331 m); at 26º05.148'N, 79º049.972'W (331 m); between 26º04.418'N, 79º049.954'W and 26º04.698'W, 79º49.953'W (~308 m); between 26º04.17'N, 79º49.993'W and 26º04.414'N, 79º49.952'W (between 330-336 m), and between 26º04.00'N, 79º49.966'W and 26º03.893'N, 79º49.966'W (335 m).

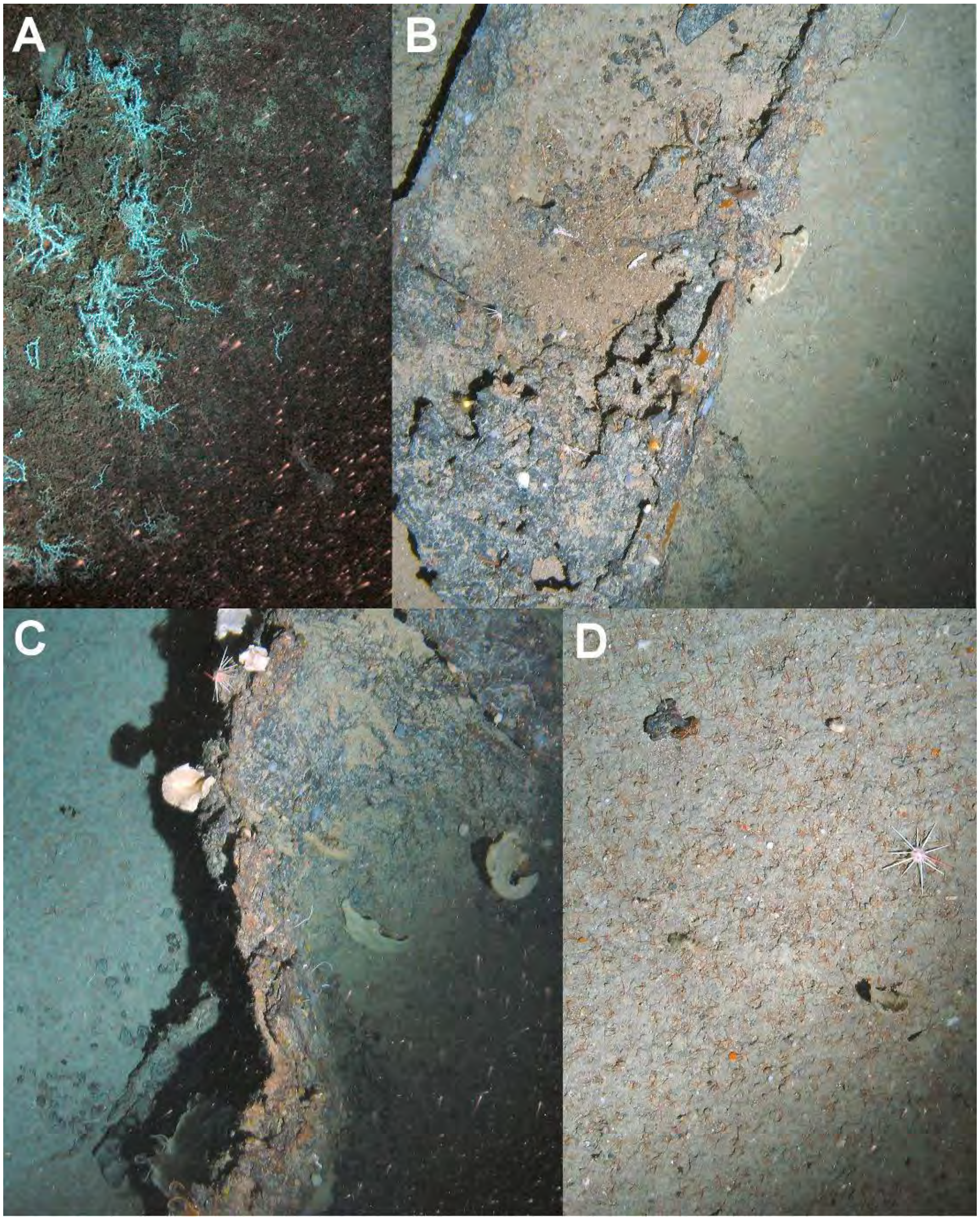

Figure 4-17. East N-S Transect (E) benthic habitats. A. *Lophelia pertusa* thicket on coral rubble; 308 m. B. Metal wreckage; 314 m. C. Narrow phosphoritic limestone ridge with lithistid sponges and *Cidaris* ?*rugosa*; ~348 m. D. Limestone pavement with *Cidaris* ?*rugosa* and abundant ophiuroids; ~347 m.

4.2.2.7 Summary of Qualitative Benthic ROV Transects Results

The preceding subsections 4.2.2.1 through 4.2.2.6 provide a detailed description of substrates and fauna along all transects.

- Seven transects were run:
  - Main Cable Transect (A; including Cable jog): ~30-457 m.
  - North Shallow Transect (An): ~30-90 m.
  - South Shallow Transect (As): ~30-90 m.
  - North Non-Cable Transect (B): 235-451 m.
  - South Non-Cable Transect (C): 272-510 m.
  - West N-S Transect (D): 262-275 m.
  - East N-S Transect (E): 308-348 m.
- Each description of east-west-oriented transects ran from shallow to deep.
- Descriptions were derived from both video observations and all still photographs (not just those in the quantitative stations treated below).
- Substrate features corresponded well with multibeam bathymetry, where available.
- The survey encountered four EFH (a fifth, coral reef, is questionable, because it is uncertain if any natural substrate identifiable as this habitat was visible):
  - artificial reef (the apparent spoil habitat encountered along the shallow transects in <93 m. Although not originally designed or deposited as such, the substrate currently functions as artificial reef),
  - hard bottom: chiefly phosphoritic limestone substrates including gravel and cobble fields, exposed and sediment-veneered pavements, irregular outcrops, boulders, slabs and escarpments, often in various combinations, with associated benthic macrofauna (e.g., sponges, anemones, zoanthids, octocorals, black corals, echinoderms, and a low richness bottom-associated fish fauna, e.g., *Laemonema* sp., *Helicolenus dactylopterus*, *Beryx decadactylus*),
  - tilefish habitat (*Caulolatilus microps* and burrows), and
  - deep-sea coral (*Lophelia pertusa* and associated organisms).
- The survey encountered two additional non-EFH:
  - rippled sediment, and
  - bioturbated sediment.
- On hard substrates below the coral reef and spoil deposit habitats (>200 m), benthic macrofaunal richness generally increased with a combination of increasing depth and higher substrate relief.
- Observed Effects of Cable on EFH
  - Splitting of a large sponge that continued to survive (43 m).
  - Fouling of cable by cyanobacterial mat and chiefly encrusting sponges in <90 m
  - Fouling by a variety of attached invertebrates, including *Lophelia pertusa*, in >90 m
  - Exposure of hard substrate via current scour around cable with apparent sheltering by a variety of taxa.

4.2.3 Quantitative Benthic ROV Transects & Habitat Mapping Results

This section provides a multivariate statistical analysis and summary of both percent cover and organism densities for hardbottom habitats on the Northern Miami Terrace (>245 m). All Non-Cable stations were analyzed to validate the habitat delineations of Vinick et al. 2012. Photostations along the Cable Transects (A, An, As) were considered separately in section 4.3.

4.2.3.1 Distribution of Photostations

Figures 4-18, 4-19, and 4-20 show the distribution of quantitative still photographic stations distributed along the Cable Transect (A) and the North and South Non-Cable transects. There was a total of 30 Low-Slope photostations: 10 Cable and 7 Non-Cable on the Inner Terrace Platform (ITP); 5 Cable and 5 Non-Cable on the Outer Terrace Platform (OTP), and one Cable and 2 Non-Cable on the Outer Terrace Ridge (OTR); the latter was limited by the small span of habitat crossed. There were also 17 High-Slope photostations, again limited by the span of habitats crossed: 1 Non-Cable on the ITP; 4 Cable and 2 Non-Cable on the OTP, 5 Cable and 3 Non-Cable on the OTR, and 1 Cable and Non-Cable on the Lower Terrace. We selected 1 Cable and 1 Non-Cable photostation in the Sinkhole habitat.

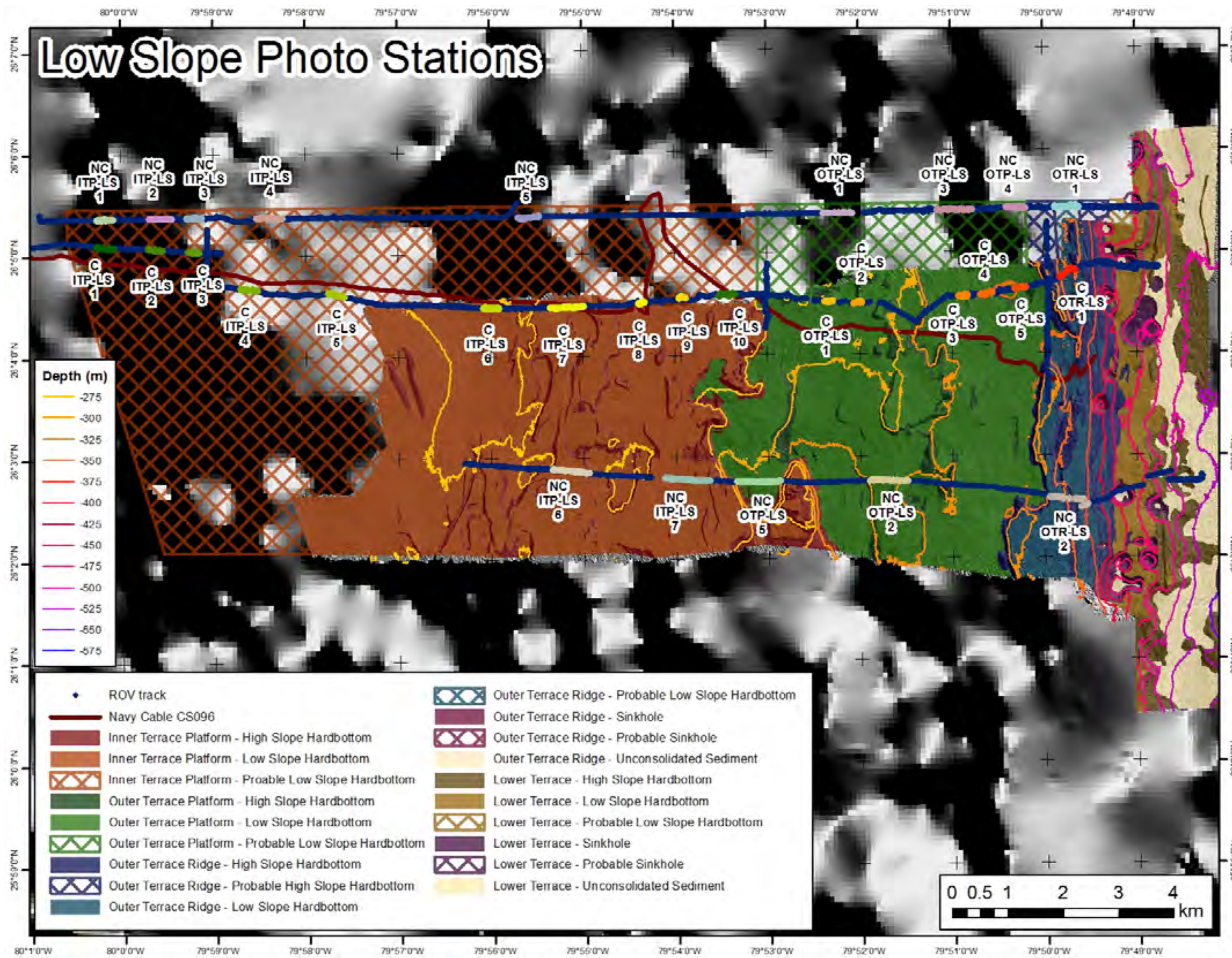

Figure 4-18. Low-Slope (LS) quantitative still photographic stations. C=Cable; NC=Non-Cable. Colors distinguish benthic habitats from Vinick et al. (2012) based on geomorphological zones and high- and low-slope substrates. ITP=Inner Terrace Platform; OTP=Outer Terrace Platform; OTR=Outer Terrace Ridge. Hatched areas are habitats identified as probable based on extrapolations beyond the geophysical survey area.

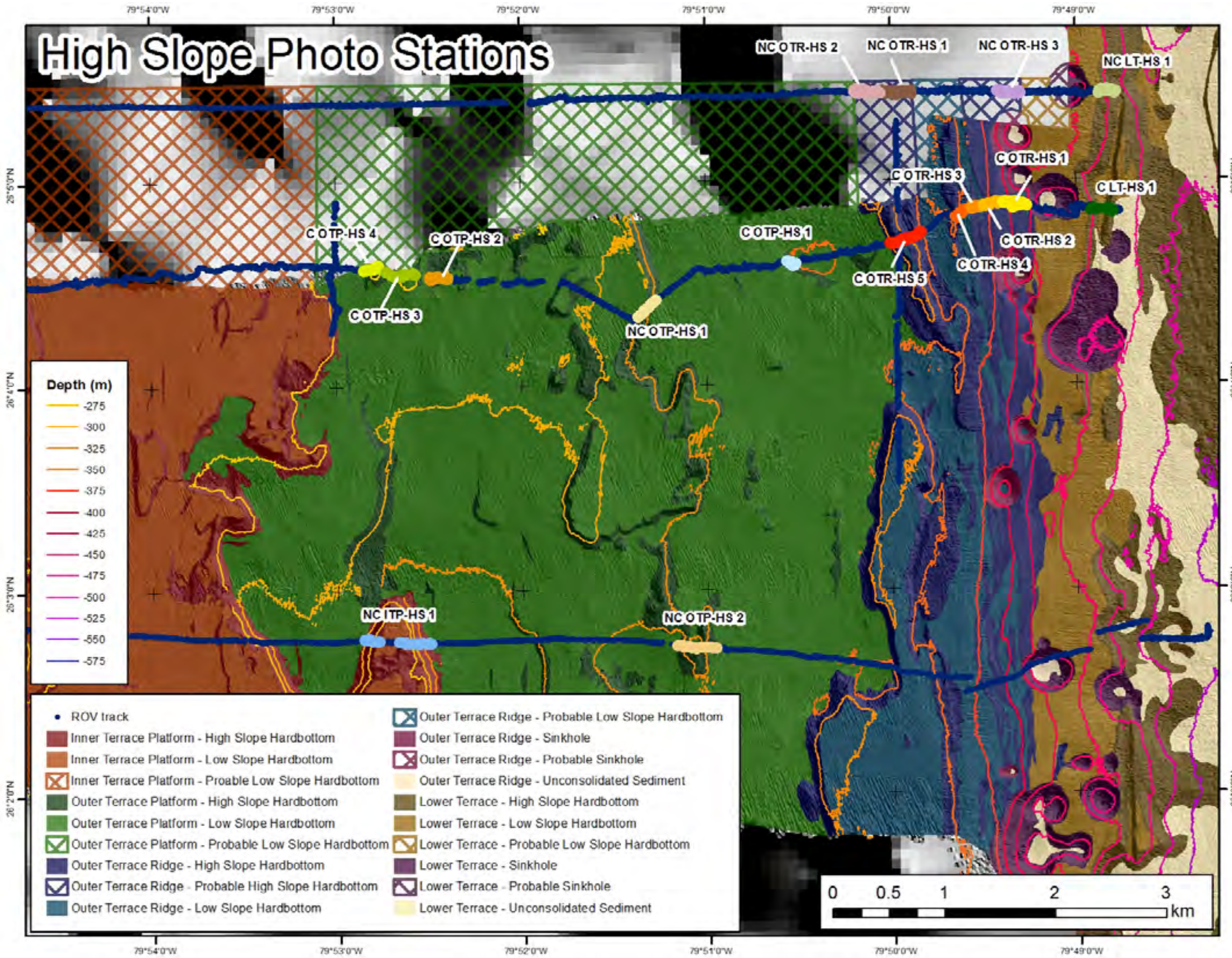

Figure 4-19. High-Slope (HS) quantitative still photographic stations. C=Cable; NC=Non-Cable. Non-Cable Outer Terrace Platform High-Slope station 1 (NC OTP-HS 1) was located on the ROV Cable Transect, but along a significant southerly departure that placed it at least ~0.25 km from the cable route; it was therefore treated as a Non-Cable station. Colors distinguish benthic habitats from Vinick et al. (2012) based on geomorphological zones and high- and low-slope substrates. . ITP=Inner Terrace Platform; OTP=Outer Terrace Platform; OTR=Outer Terrace Ridge; LT=Lower Terrace. Hatched areas are habitats identified as probable based on extrapolations beyond the geophysical survey area.

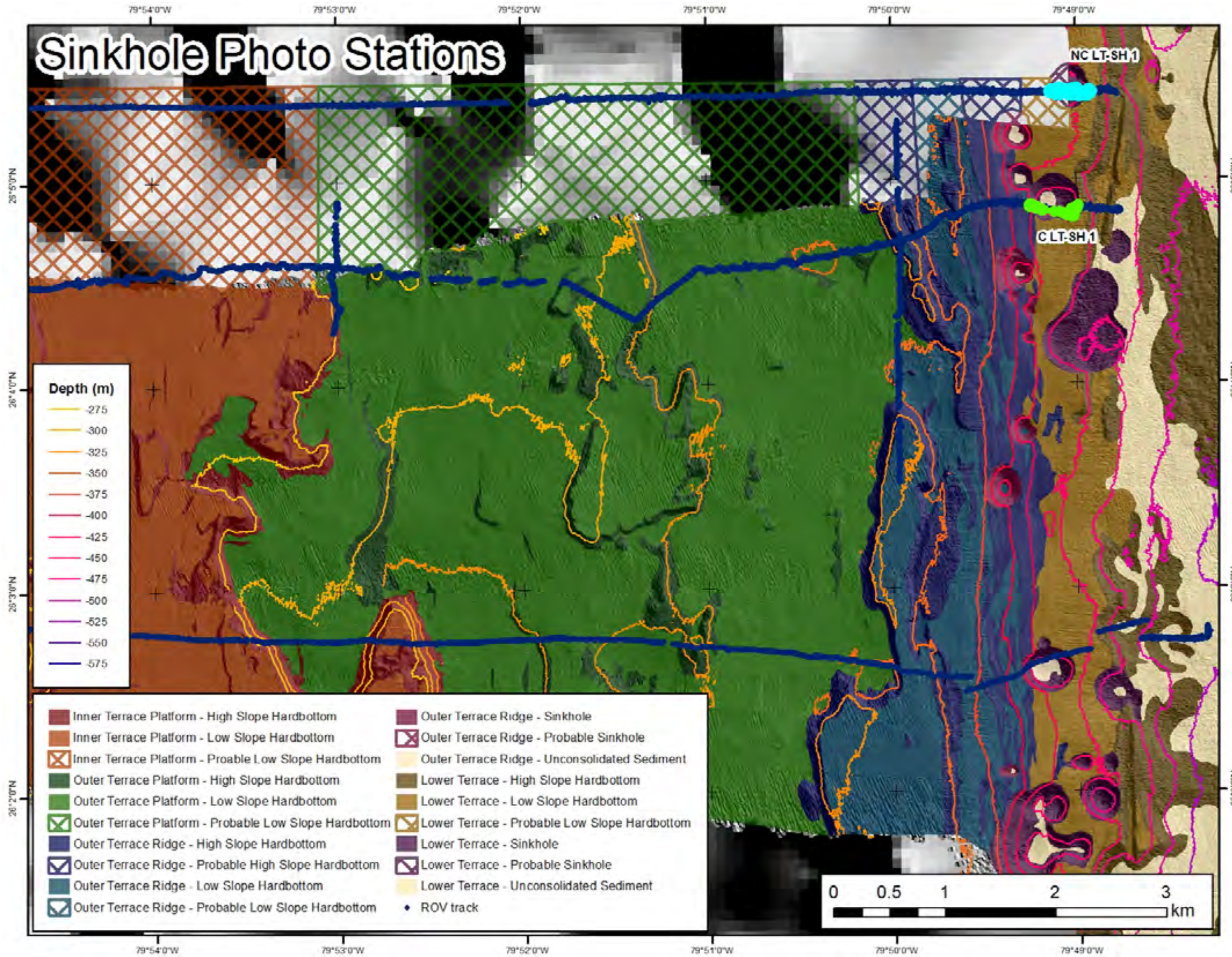

Figure 4-20. Sinkhole (SH) quantitative still photographic stations. C=Cable; NC=Non-Cable. Colors distinguish benthic habitats from Vinick et al. (2012) based on geomorphological zones and high- and low-slope substrates. Hatched areas are habitats identified as probable based on extrapolations beyond the geophysical survey area.

4.2.3.2 Multivariate Results of Non-Cable Photostations

The multivariate analyses of percent cover data of Non-Cable photostations showed no discernible patterns with regard to benthic habitats. There was no distinct clustering of stations by habitats in the dendrogram (Figure 4-21) or the Multidimensional Scaling (MDS) plot (Figure 4-22). This was due to a combination of the extremely low cover of organisms in these habitats and wide range of variation in proportions of hard substrate versus sediment within and across habitats. Percent cover analyses are most useful in areas that have large amounts of different organisms not discernible as individuals (e.g. algae, seagrass). In areas where organism densities are extremely low, percent cover analyses require a very large number of points to discern differences among sites and may still be masked by differences in substrates. In this study, the CPC data were almost completely driven by the relative cover of hard and soft substrates at each station and not by biological components. The maximum percent cover contributed by all living organisms to any individual photostation was 3.47% (NC OTR-LS 1; Table 4-20 below). Therefore the percent cover data was most useful at examining the variations of substrate between photostations and density was used to examine the biological communities.

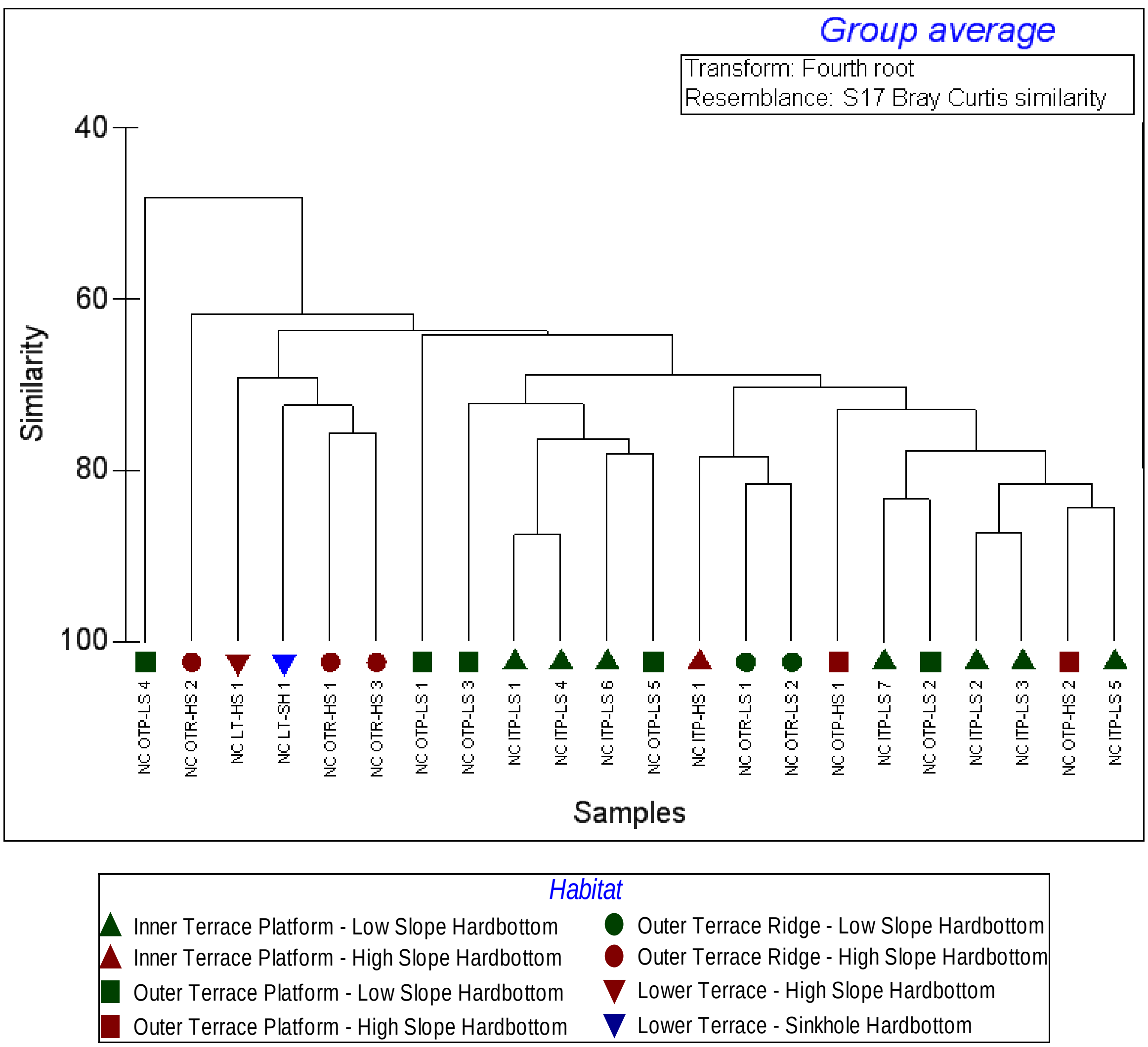

Figure 4-21. Dendrogram of percent cover data at all Non-Cable photostations categorized by habitat.

MDS plots illustrate the relationship of organism type and amounts among stations in a graphical form, in which sites nearest to each other are most similar (contain similar proportions of the same species or substrate types) and vice versa. As examples of some of the wider variations among photostations shown in the MDS plot in Figure 4-22, the outlying placement of Low-Slope Outer Terrace Platform station 4 (NC OTP-LS 4) is likely due to its high percentage of hard substrate (86%) and coral rubble (9%) relative to the other stations in this habitat (0% coral rubble and no more than 37.4% hard substrate). The outermost green circle separating this station from the others represents a similarity percentage of 60%. The relatively close placement of the outlying High-Slope and Sinkhole Lower Terrace stations (NC LT-HS 1 and NC LT-SH 1) is likely due to the combination of their similar values for percent cover by soft substrate (24.3 and 19.1%, respectively) and coral rubble (13.8 and 8.3%, respectively).

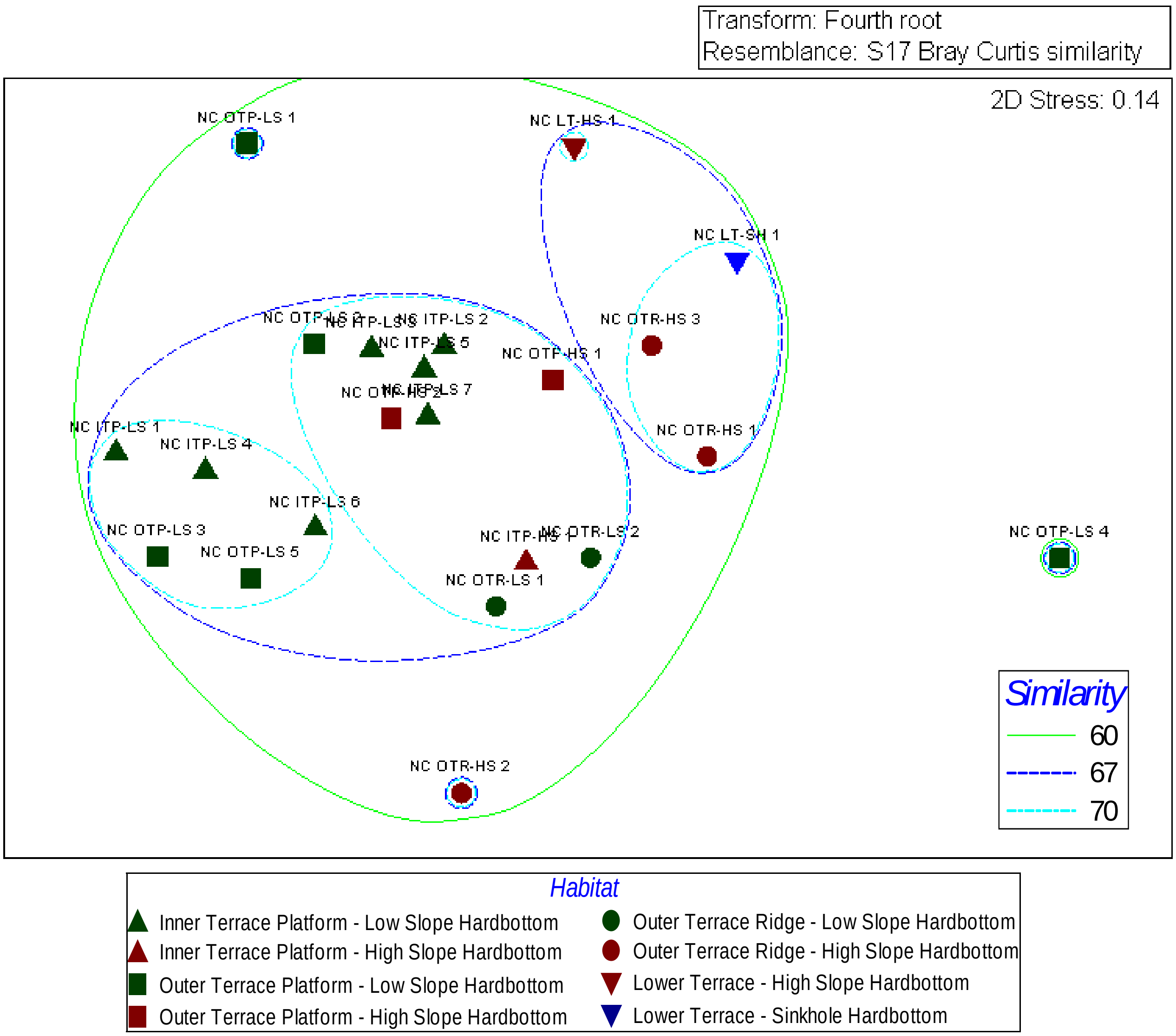

Figure 4-22. MDS plot of percent cover data at all photostations categorized by habitat. Circles indicate percent similarity from the cluster analysis.

Multivariate analyses of organism densities at all Non-Cable sites substantiated the habitat designations of Vinick et al. 2012. A cluster analysis of a Bray-Curtis similarity index analysis showed the relationship between stations based on organism type density at each site (Figure 4-23). The Sinkhole (SH), Lower Terrace (LT), and one High Slope Outer Terrace Ridge (OTR-HS) stations were the most distinct and split into a separate group at the lowest level. This means all other stations were more similar to each other than to these three and vice versa. Within the larger group, all of the shallowest Low Slope Inner Terrace Platform (ITP-LS) stations formed a separate cluster indicating they were distinctly different as well.

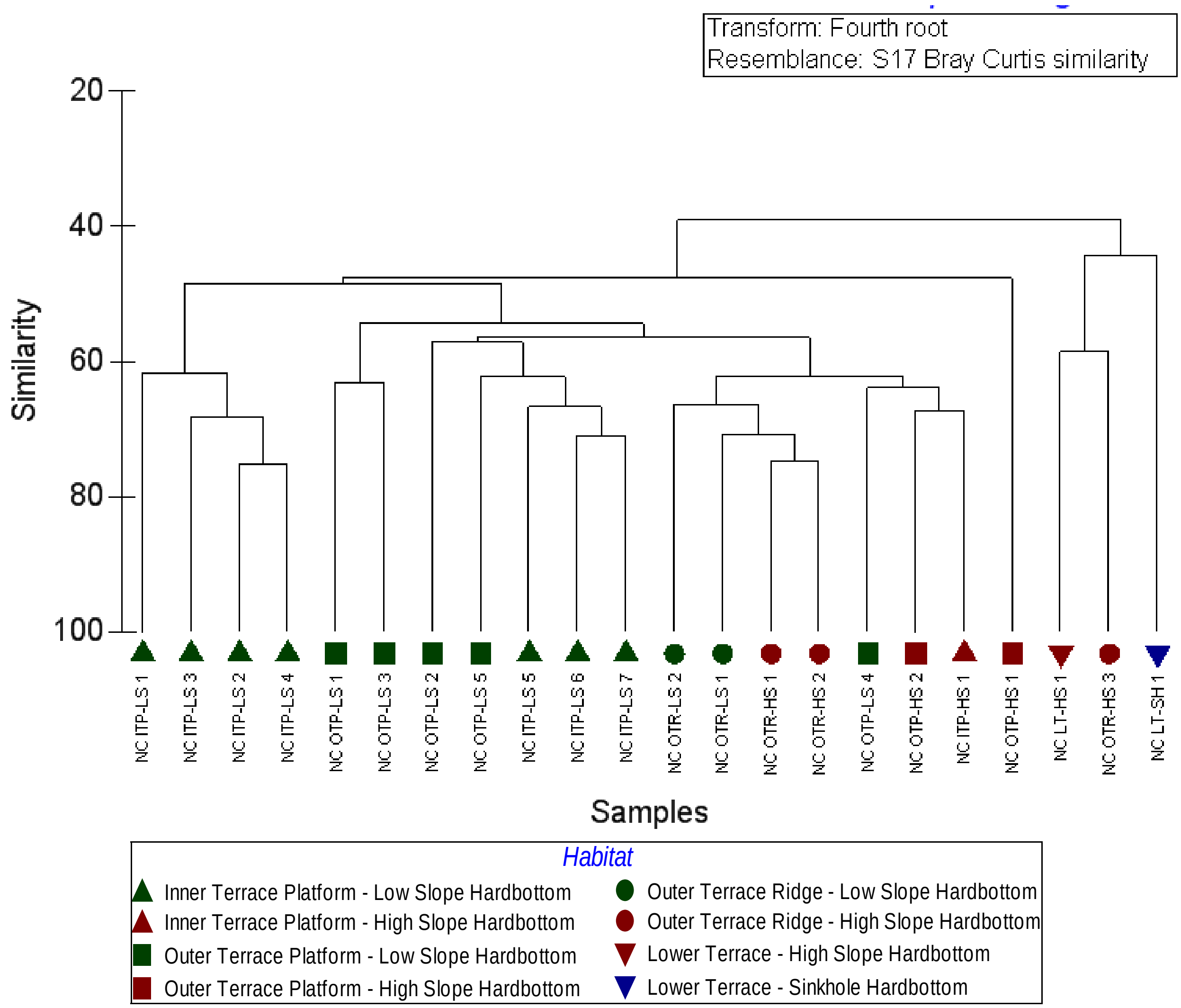

Figure 4-23. Dendrogram of density data at all Non-Cable photostations categorized by habitat.

These distinctions were best illustrated in an MDS plot (Figure 4-24). Two of the similarities in the cluster analysis are displayed as circles around the groups at different similarity percentages: 55% and 62%. Four stations (LT SH-1, LT HS-1, OTR HS-3, and OTP HS-1) were very distinct from the main group of stations and from each other. This was evident by the distance from other sites in the MDS and the single-station clusters formed at 62%. The remaining stations formed two distinct clusters at 55% and were relatively close to one another. The 4 shallow ITP-LS sites

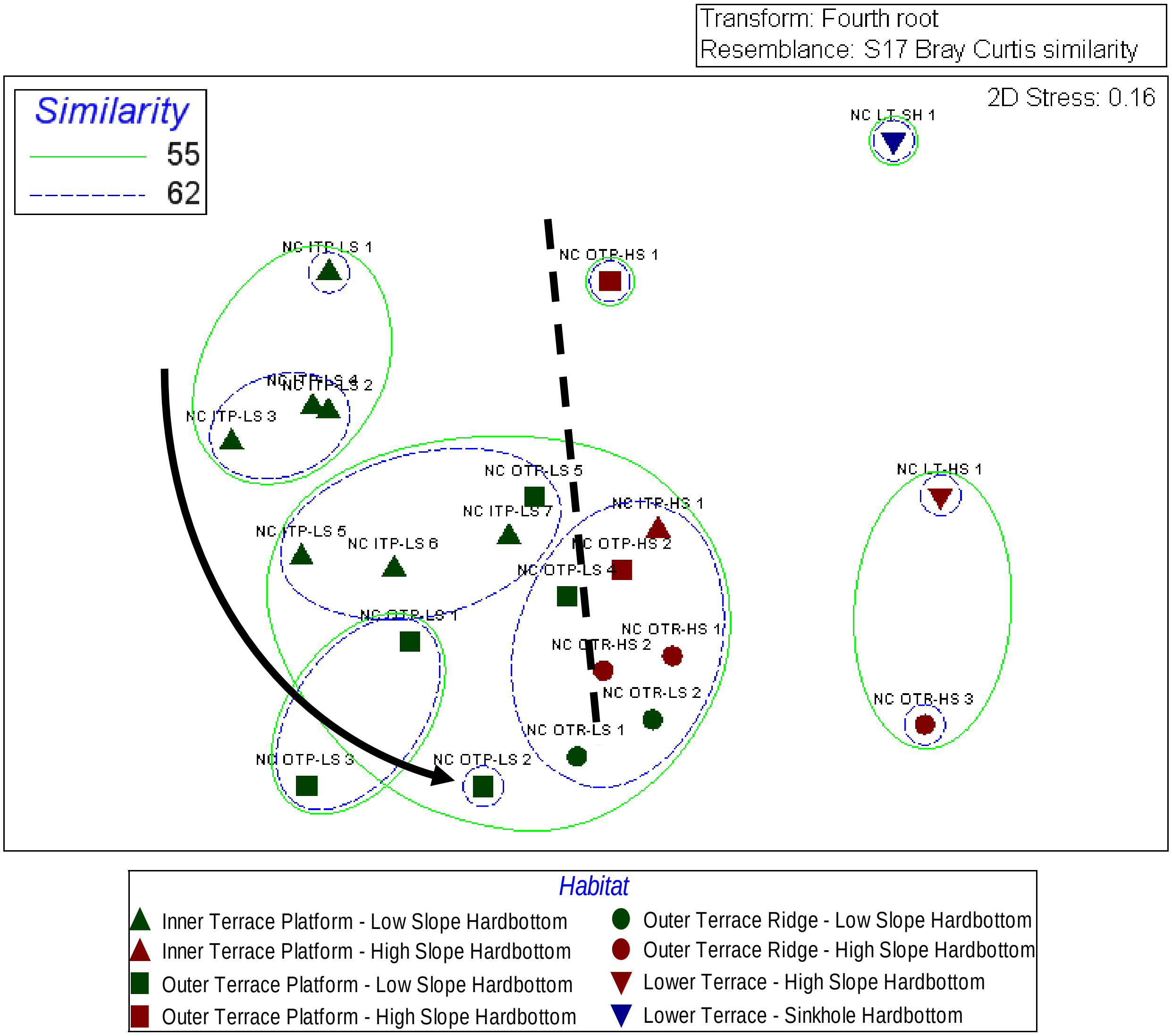

Figure 4-24. MDS plot of density data at all Non-Cable photostations categorized by habitat. The arrow illustrates the cross-shelf geomorphologic zone and depth trends from shallow to deep. The dashed line separates High-Slope (red) and Low-Slope (green) stations. Circles indicate percent similarity from the cluster analysis.

composed one of those groups, indicating they are more similar to each other than to stations in other habitats.

The MDS plot showed subtler distinctions than evident in the cluster analyses. The relationships among Non-Cable stations were arranged by geomorphology and depth. The plot progressed from shallow to deep habitats from the upper left to lower right. This progression also included cross-shelf changes in geomorphology. For example, the separate group of shallowest ITP-LS stations plotted in the upper left, whereas the three deeper Inner Terrace Platform stations were nearest to them towards the lower right. Next were the Outer Terrace Platform stations and finally the Outer Terrace Ridge stations. The MDS plot also indicated slope as a role in the relationship between stations. All of the High-Slope stations (red) were located on the right side of the plot and, with the exception of NC OTR-LS 2, the Low-Slope stations on the left. Since geomorphology, slope, and depth appear to be contributing to the similarity of organism types and densities between stations, the benthic habitat classification (which was based on these criteria as well) was used to categorize the photostations and statistically test for cable impacts.

4.2.3.3 Non-Cable Percent Cover and Density Data Summaries by Habitat

Tables 4-12 to 4-27 list percent cover and densities (in m^{-2}) of organisms, and Figures 4-25 to 4-31 illustrate important taxa as percentages of total benthic density, at Non-Cable photostations in order of geomorphological habitats containing EFH from west to east, with Low-Slope photostations treated first for each habitat. In tables listing percent cover, Colonial Dead Coral refers to intact, standing, dead colonies; Coral Rubble refers to broken dead coral fragments, and *Lophelia* refers to living colonies of the stony coral *Lophelia pertusa*. Because Hydroidolina, solitary scleractinian corals, and ophiurid ophiuroids often could not be counted accurately, they have been excluded from density summary tables and pie diagrams. Bottom-associated fishes have not been included in density tables because of their extremely low frequency of occurrence in quantitative still images. Of the 49 density records of fish taxa at all Non-Cable photostations, 45 were <0.05 fishes m^{-2}; the greatest density recorded was 0.14 Scorpaenidae m^{-2} at NC ITP-HS 1. The most frequently recorded recognizable taxon was the codling *Laemonema* sp. (at 19 of 22 stations), followed by the greeneye, *Chlorophthalmus agassizi* (at 8), unidentified Scorpaenidae (at 5), and blackbelly rosefish, *Helicolenus dactylopterus* (at 3). Other infrequently encountered groups for which component taxa have been combined in density tables are Arthropoda (most commonly paguroid hermit crabs and the chyrostylid squat lobster *Eumunida picta*), Mollusca (most commonly unidentified gastropods) and Annelida (chiefly sabellid featherduster worms). Other minor groups, e.g., Bryozoa, Brachiopoda, Urochordata (Ascidiacea), have not been divided into component taxa.

Inner Terrace Platform – Low-Slope Hardbottom (Tables 4-12, 4-13; Figure 4-25)

Hard substrates never accounted for more than 50% of cover at any of the 7 ITP-LS stations, with most stations ranging between 32 and 46%, and with station 1, the furthest inshore, exhibiting the lowest percent hard substrate cover (17.4%). Negligible contributions of unidentified coral rubble (≤0.075%) were recorded at two stations.

Table 4-12. Percent cover data for all Non-Cable Inner Terrace Platform Low Slope Hardbottom habitat photostations.

Non-cable Inner Terrace Platform - Low Slope	NC ITP-LS 1	NC ITP-LS 2	NC ITP-LS 3	NC ITP-LS 4	NC ITP-LS 5	NC ITP-LS 6	NC ITP-LS 7	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0	0.039	0	0	0	0	0.075	0.016	0.030	0.011
Coral Rubble (CR)	0	0.039	0	0	0	0	0.075	0.016	0.030	0.011
CHORDATA (CHO)	0	0	0.038	0	0.030	0	0	0.010	0.017	0.006
CNIDARIA NON SCLERACTINIA (CNI)	0.164	0.039	0.038	0.280	0.150	0.750	0.600	0.289	0.280	0.106
ECHINODERMATA (ECH)	0.164	0.039	0.077	0.031	0.210	0.143	0.375	0.148	0.120	0.045
ECHIURA (ECR)	0.263	0.118	0.077	0.062	0	0	0	0.074	0.095	0.036
PORIFERA (POR)	0.033	0.039	0.077	0.093	0.090	0.286	0.187	0.115	0.091	0.034
UNIDENTIFIED ORGANISM (UND)	0	0	0	0	0	0	0.037	0.005	0.014	0.005
SOFT BOTTOM SUBSTRATE (SB)	81.976	53.725	56.979	57.947	61.848	49.000	66.979	61.208	10.790	4.078
HARD BOTTOM SUBSTRATE (HB)	17.400	45.960	42.715	41.586	37.672	49.821	31.747	38.129	10.814	4.087
HUMAN DEBRIS (HUM)	0	0.039	0	0	0	0	0	0.006	0.015	0.006
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	0.131	0.510	1.585	2.576	0.478	0	1.185	0.923	0.921	0.348
Sum (excluding tape+shadow+wand)	100	100	100	100	100	100	100			

Overall, echiuran spoonworms (?*Ochetostoma* sp.) accounted for 26% of organism density at all ITP-LS stations taken together, followed by the soft coral *Pseudodrifa nigra* (15%) and unidentified sea anemones (Actiniaria) (14%). The spoonworm and *P. nigra* exhibited an inverse density relationship at these stations; the worms were the most abundant organisms at stations 1 through 4 and were far less common at stations 5-7, whereas the soft coral recorded the highest density of any organism at 5-7 and were less common at 1-4. Among other more common taxa, both the pompom anemone *Liponema* sp. and the octocoral *Eunicella* sp. generally increased in density from inshore to offshore.

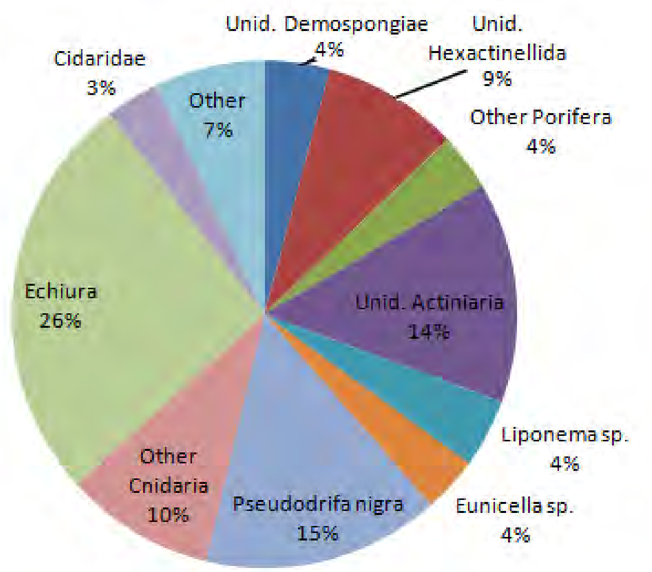

Figure 4-25. Macrofaunal organism densities (in m^{-2}) at Non-Cable Inner Terrace Platform Low-Slope photostations 1-7 expressed as percentages of mean organism densities summarized from Table 4-13. Other Porifera includes identified hexactinellid and both identified and unidentified demosponge taxa, each of which contributed less than ~3% of mean density.

Table 4-13. Density data (in m^{-2}): Non-Cable Inner Terrace Platform Low-Slope Hardbottom habitat photostations.

NC ITP-LS	1	2	3	4	5	6	7	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA											
DEMOSPONGIAE											
Astrophorida			0.018					0.018	0.003		
Axinellidae						0.012		0.012	0.002		
Demospongiae unident.	0.046	0.069	0.071	0.454	0.044	0.254	0.195	1.131	0.162	0.152	0.108
Desmacellidae						0.046	0.092	0.138	0.020	0.036	0.026
Geodiidae		0.011		0.018		0.012	0.023	0.064	0.009	0.009	0.007
Lithistida 1			0.018	0.018				0.036	0.005	0.009	
Pachastrellidae							0.011	0.011	0.002		
Phakellia sp.			0.018		0.116	0.023	0.011	0.168	0.024	0.042	0.029
HEXACTINELLIDA											
Euritidae/Farreidae			0.018		0.015	0.058	0.011	0.101	0.014	0.020	0.014
Hexactinellida unident.	0.183	0.023				1.407	0.756	2.369	0.338	0.545	0.386
Porifera unident.	0.023	0.011	0.053	0.254	0.087			0.428	0.061	0.091	0.064
CNIDARIA											
HEXACORALLIA											
?Actinauge sp.							0.069	0.069	0.010		
Actiniaria 2	0.183	0.023	0.018				0.160	0.384	0.055	0.081	0.057
Actiniaria unident.	1.348	0.525	0.635	0.563	0.203	0.231	0.309	3.814	0.545	0.393	0.278
Actinoscyphia sp.	0.023	0.023	0.018	0.018		0.023	0.080	0.185	0.026	0.025	0.018
Corallimorphidae						0.012	0.023	0.034	0.005	0.009	0.006
Liponema sp.		0.034	0.018	0.127	0.102	0.231	0.676	1.187	0.170	0.237	0.168
Sagartiidae				0.018	0.189	0.046	0.115	0.367	0.052	0.073	0.052
Zoanthidea	0.525			0.109	0.087	0.023	0.080	0.825	0.118	0.185	0.131
OCTOCORALLIA											
Eunicella sp.	0.023				0.102	0.138	0.699	0.962	0.137	0.254	0.180
Isididae				0.018				0.018	0.003		
Octocorallia unident.		0.011		0.018				0.030	0.004	0.007	0.005
Primnoidae	0.091	0.011					0.011	0.114	0.016	0.034	0.024
Pseudodrifa nigra	0.525	0.263	0.159	0.236	0.638	1.418	0.871	4.111	0.587	0.445	0.315
STYLASTERIDAE		0.023		0.036	0.044	0.069	0.413	0.584	0.083	0.147	0.104
ANNELIDA	0.069	0.023						0.091	0.013	0.026	0.018
ECHIURA	2.102	1.108	1.640	1.362	0.261	0.357	0.252	7.082	1.012	0.740	0.523
MOLLUSCA	0.023	0.069	0.123	0.091	0.029	0.127	0.011	0.473	0.068	0.048	0.034
ARTHROPODA	0.274	0.034		0.054	0.029	0.012	0.011	0.415	0.059	0.096	0.068
ECHINODERMATA											
ASTEROIDEA											
Asteroidea unident.	0.091	0.023	0.071	0.036	0.029	0.012	0.023	0.285	0.041	0.029	0.021
Coronaster briareus				0.018				0.018	0.003		
Goniasteridae		0.011				0.012	0.023	0.046	0.007	0.009	0.006
Sclerasterias sp.							0.011	0.011	0.002		
Tremaster mirabilis						0.012		0.012	0.002		
ECHINOIDEA											
Cidaridae	0.091	0.126	0.053	0.109	0.160	0.173	0.218	0.929	0.133	0.055	0.039
Echinoidea unident.						0.012		0.012	0.002		
Gracilechinus sp.	0.023		0.035		0.015	0.023		0.096	0.014	0.014	0.010
CRINOIDEA											
Comatulida			0.035				0.046	0.081	0.012	0.020	0.014
Crinoidea (stalked)						0.012		0.012	0.002		
OPHIUROIDEA											
Euryalidae							0.034	0.034	0.005		
HOLOTHUROIDEA											
Psolidae	0.023	0.034	0.018	0.036	0.015	0.023		0.149	0.021	0.012	0.009
UNKNOWN ANIMAL	0.023		0.071	0.054		0.035		0.182	0.026	0.029	0.020
TOTAL	5.689	2.456	3.087	3.649	2.161	4.809	5.238	27.088	3.870	1.393	0.985

Inner Terrace Platform - High Slope Hardbottom (Tables 4-14, 4-15; Figure 4-25)

The single station in this habitat was chiefly hard substrate (70.2%); non-scleractinian cnidarians accounted for 1.8% of cover, the highest for this category at any Non-Cable photostation. Coral rubble accounted for 0.43% of cover. The most abundant taxa were octocorals, *Eunicella* sp. (1.23 m^{-2}), which accounted for 34% of mean density, and *P. nigra* (0.83 m^{-2} and 23%) , followed by stylasterid lace corals (0.45 m^{-2} and 12%) and comatulid crinoids (likely all *Comatonia cristata*) (0.38 m^{-2} and 10%).

Table 4-14. Percent cover data for the Non-Cable Inner Terrace Platform High Slope Hardbottom habitat photostation 1.

Non-cable - Inner Terrace Platform - High Slope	**NC ITP-HS 1**
CORAL (COR)	0.434
Coral Rubble (CR)	0.434
CNIDARIA NON SCLERACTINIA (CNI)	1.845
ECHINODERMATA (ECH)	0.217
PORIFERA (POR)	0.271
SOFT BOTTOM SUBSTRATE (SB)	27.021
HARD BOTTOM SUBSTRATE (HB)	70.212
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	0.378
Sum (excluding tape+shadow+wand)	100

Table 4-15. Density data (in m^{-2}): Non-Cable Inner Terrace Platform High-Slope Hardbottom habitat photostation.

NC ITP HS	**1**		**1**
PORIFERA		Primnoidae	0.050
DEMOSPONGIAE		*Pseudodrifa nigra*	0.828
Demospongiae unident.	0.021	STYLASTERIDAE	0.446
Desmacellidae	0.141	ARTHROPODA	0.021
Pachastrellidae	0.021	BRYOZOA	0.007
Phakellia sp.	0.007	ECHINODERMATA	
Raspailiidae	0.014	ASTEROIDEA	
HEXACTINELLIDA		Asteroidea unident.	0.007
Euritidae/Farreidae	0.014	Goniasteridae	0.014
CNIDARIA		*Sclerasterias* sp.	0.014
HEXACORALLIA		ECHINOIDEA	
Actiniaria unident.	0.035	Cidaridae	0.156
Actinoscyphia sp.	0.035	CRINOIDEA	
Antipatharia unident.	0.007	Comatulida	0.375
Liponema sp.	0.120	OPHIUROIDEA	
Sagartiidae	0.085	Euryalidae	0.007
OCTOCORALLIA		UNKNOWN ANIMAL	0.014
Eunicella sp.	1.231	TOTAL	3.672

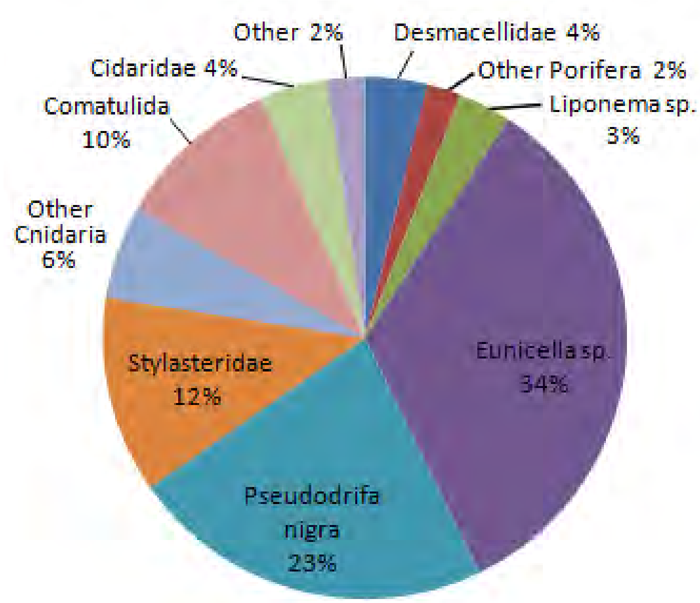

Figure 4-26. Macrofaunal organism densities at Non-Cable Inner Terrace Platform High-Slope photostation 1 expressed as percentages, summarized from Table 4-15.

Outer Terrace Platform – Low-Slope Hardbottom (Tables 4-16, 4-17; Figure 4-27)

Percent cover of hard substrates varied widely across this habitat, reflecting the diversity of local seafloor features within the major geomorphological habitats of the Miami Terrace. Station 4, located furthest offshore and closest to the Outer Terrace Ridge along the North Non-Cable Transect (B), differed substantially from the other four. Because it was located outside the area mapped in detail by multibeam, its assignment to habitat is uncertain (Figure 4-18). However, it did not cluster closely with any of the Outer Terrace Ridge photostations (Figure 4-22). Station 4 recorded the greatest percent cover of hard substrate (86.1%) despite being immediately adjacent to station 3, which recorded only 5.86% hard substrate. Station 4 also differed from the others in exhibiting a substantial percentage of coral cover. Although most was coral rubble (7.4%), living *Lophelia pertusa* contributed 0.24% of cover. Stations 1 through 3 recorded 2.54, 18.20 and 5.86% hard substrate cover, whereas station 5 recorded 37.37%. The greatest contribution to cover by a living group was 1.06% by non-scleractinian cnidarians.

Table 4-16. Percent cover data for all Non-Cable Outer Terrace Platform Low-Slope Hardbottom habitat photostations.

Non-cable - Outer Terrace Platform - Low Slope	NC OTP-LS 1	NC OTP-LS 2	NC OTP-LS 3	NC OTP-LS 4	NC OTP-LS 5	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0	0	0	9.469	0	1.894	4.235	1.894
Colonial Dead Coral (DC)	0	0	0	1.829	0	0.366	0.818	0.366
Coral Rubble (CR)	0	0	0	7.404	0	1.481	3.311	1.481
Lophelia (LOP)	0	0	0	0.236	0	0.047	0.106	0.047
CHORDATA (CHO)	0.028	0	0	0	0	0.006	0.012	0.006
CNIDARIA NON SCLERACTINIA (CNI)	0.363	0.395	0.297	1.062	0.623	0.548	0.313	0.140
ECHINODERMATA (ECH)	0.084	0.431	0.037	0.472	0.089	0.222	0.210	0.094
PORIFERA (POR)	0.223	0.179	0.297	0.619	0.044	0.273	0.215	0.096
UNIDENTIFIED ORGANISM (UND)	0.028	0	0	0	0	0.006	0.012	0.006
SOFT BOTTOM SUBSTRATE (SB)	96.737	80.797	93.511	2.242	61.877	67.033	38.721	17.317
HARD BOTTOM SUBSTRATE (HB)	2.538	18.198	5.858	86.106	37.367	30.013	34.200	15.295
HUMAN DEBRIS (HUM)	0	0	0	0.029	0	0.006	0.013	0.006
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	0.306	2.246	0.111	0.294	0.089	0.609	0.920	0.412
Sum (excluding tape+shadow+wand)	100	100	100	100	100			

All sponges together contributed 21% of organism density, a contirbution greater than that found in the Inner Terrace Platform Low-Slope habitat (17%). The most abundant individual taxa were *Eunicella* sp. (mean 0.73 m^{-2} and 20%) and *P. nigra* (mean 0.56 m^{-2} and 15%), somewhat lower percentages than in the Inner Terrace Platform High-Slope stations. The greatest abundances of both taxa occurred at station 4.

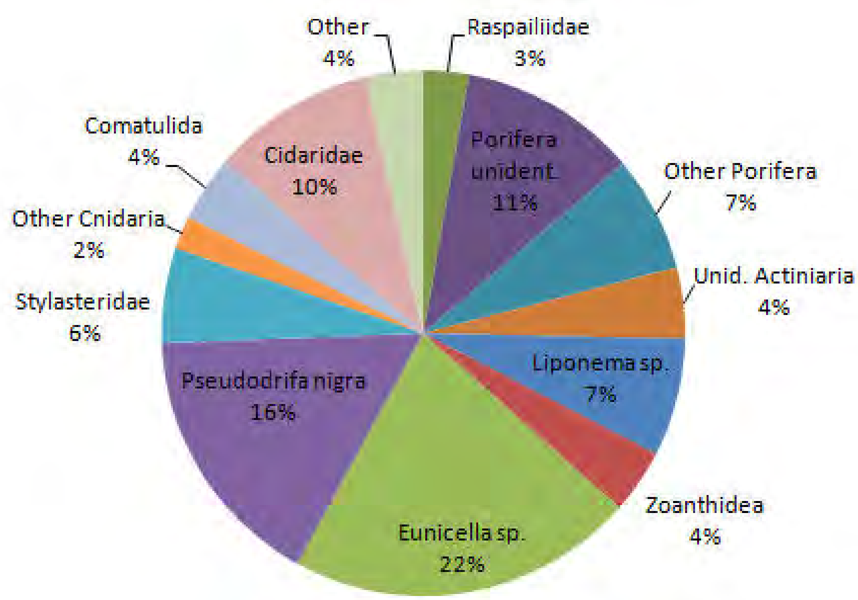

Figure 4-27. Macrofaunal organism densities (in m^{-2}) at the five Non-Cable Outer Terrace Platform Low-Slope photostations expressed as percentages of mean benthic organism densities, summarized from Table 4-17. Other Porifera includes both identified and unidentified demosponge and hexactinellid taxa, each of which contributed less than ~3% of mean density

Table 4-17. Density data (in m^{-2}): Non-Cable Outer Terrace Platform Low-Slope Hardbottom habitat photostations.

NC OTP LS	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA									
DEMOSPONGIAE									
Astrophorida					0.008	0.008	0.002		
Demospongiae unident.		0.124	0.017		0.053	0.194	0.039	0.052	0.028
Desmacellidae	0.076		0.035	0.241	0.038	0.390	0.078	0.095	0.055
Geodiidae		0.017		0.010		0.027	0.005	0.008	0.004
Lithistida 1		0.008				0.008	0.002		
Pachastrellidae	0.019	0.008	0.069	0.060		0.157	0.031	0.031	0.022
Phakellia sp.	0.019	0.166	0.225	0.020	0.015	0.445	0.089	0.099	0.063
Raspailiidae				0.473		0.473	0.095		
HEXACTINELLIDA							0.000		
Aphrocallistes beatrix	0.171		0.017			0.188	0.038	0.075	0.027
Euritidae/Farreidae	0.076	0.017	0.121	0.020	0.008	0.241	0.048	0.049	0.034
Hexactinellida unident.	0.076	0.050	0.035	0.010	0.181	0.351	0.070	0.066	0.050
Porifera unident.	0.114		1.159	0.594		1.867	0.373	0.503	0.264
CNIDARIA							0.000		
HEXACORALLIA							0.000		
?*Actinauge* sp.					0.030	0.030	0.006		
Actiniaria unident.	0.437	0.008		0.181	0.113	0.739	0.148	0.178	0.105
Actinoscyphia sp.				0.080	0.008	0.088	0.018	0.035	0.012
Antipatharia unident.				0.010		0.010	0.002		
Corallimorphidae		0.008		0.010		0.018	0.004	0.005	0.003
Liponema sp.	0.209	0.332	0.052	0.161	0.475	1.228	0.246	0.163	0.174
Lophelia pertusa				0.141		0.141	0.028		
Madrepora sp.			0.017			0.017	0.003		
Sagartiidae				0.050	0.030	0.080	0.016	0.023	0.011
Zoanthidea	0.646	0.017			0.008	0.670	0.134	0.286	0.095
OCTOCORALLIA							0.000		
Anthomastus sp.		0.017				0.017	0.003		
Eunicella sp.	0.114	0.041	0.294	2.827	0.354	3.631	0.726	1.181	0.513
Isididae			0.017	0.010	0.008	0.035	0.007	0.007	0.005
Octocorallia unident.		0.008				0.008	0.002		
Pennatulacea	0.057	0.041			0.023	0.121	0.024	0.025	0.017
Pseudodrifa nigra	0.057	0.232		2.103	0.384	2.776	0.555	0.878	0.393
STYLASTERIDAE	0.152	0.373	0.035	0.151	0.279	0.990	0.198	0.131	0.140
ECHIURA			0.069		0.023	0.092	0.018	0.030	0.013
MOLLUSCA		0.025	0.017	0.020		0.062	0.012	0.012	0.009
ARTHROPODA	0.019	0.025	0.069	0.141	0.128	0.382	0.076	0.057	0.054
BRACHIOPODA				0.010		0.010	0.002		
ECHINODERMATA							0.000		
ASTEROIDEA							0.000		
Asteroidea unident.	0.038		0.035	0.101	0.015	0.188	0.038	0.038	0.027
Goniasteridae		0.025				0.025	0.005		
Sclerasterias sp.		0.008				0.008	0.002		
ECHINOIDEA							0.000		
Cidaridae	0.114	0.066	0.121	1.368	0.030	1.700	0.340	0.576	0.240
Gracilechinus sp.	0.019	0.008		0.020	0.008	0.055	0.011	0.008	0.008
CRINOIDEA							0.000		
Comatulida	0.019	0.017		0.513	0.143	0.692	0.138	0.217	0.098
OPHIUROIDEA							0.000		
Euryalidae		0.008		0.070		0.079	0.016	0.031	0.011
HOLOTHUROIDEA							0.000		
Psolidae				0.010		0.010	0.002		
UNKNOWN ANIMAL	0.019	0.017	0.035	0.030		0.100	0.020	0.014	0.014
TOTAL	2.450	1.667	2.439	9.437	2.359	18.352	3.670	3.240	2.595

Outer Terrace Platform - High Slope Hardbottom (Tables 4-18, 4-19; Figure 4-28)
Both stations had similarly mixed contributions from hard and soft substrates with living organisms totaling less than 1% cover, but station 2, with a lower percent cover of hard substrate, recorded twice the overall organism density. The most abundant taxa were Stylasteridae (mean 0.52 m^{-2} and 21%), and *P. nigra* (0.37 m^{-2} and 15%), although both occurred in far greater abundance at station 2. Several other important taxa occurred exclusively at station 2, e.g., *Liponema* sp., Primnoidae and unidentified Hexactinellida. Comatulids and unidentified Actiniaria were more abundant at station 1.

Table 4-18. Percent cover data for all Non-Cable Outer Terrace Platform High Slope Hardbottom habitat photostations.

Non-cable - Outer Terrace Platform - High Slope	NC OTP-HS 1	NC OTP-HS 2	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0.358	0.150	0.254	0.147	0.104
Coral Rubble (CR)	0.358	0	0.179	0.253	0.179
Lophelia (LOP)	0	0.150	0.075	0.106	0.075
CNIDARIA NON SCLERACTINIA (CNI)	0.179	0.451	0.315	0.193	0.136
ECHINODERMATA (ECH)	0.537	0	0.268	0.379	0.268
PORIFERA (POR)	0.089	0.075	0.082	0.010	0.007
SOFT BOTTOM SUBSTRATE (SB)	46.154	54.511	50.333	5.910	4.179
HARD BOTTOM SUBSTRATE (HB)	52.683	44.812	48.748	5.566	3.936
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	6.833	1.481	4.157	3.784	2.676
Sum (excluding tape+shadow+wand)	100	100			

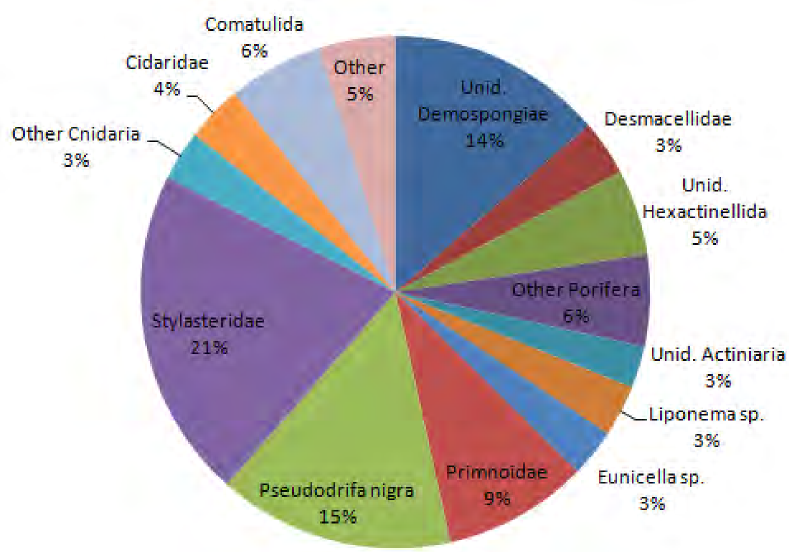

Figure 4-28. Total macrofaunal organism densities (in m^{-2}) at the two Non-Cable Outer Terrace Platform High-Slope photostations expressed as percentages of mean benthic organism abundance summarized from Table 4-19. Other Porifera includes identified demosponge and hexactinellid taxa and unidentified Porifera, each of which contributed less than ~3% of mean density.

Table 4-19. Density data (in m^{-2}): Non-Cable Outer Terrace Platform High-Slope Hardbottom habitat photostations.

NC OTP HS	1	2	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA						
DEMOSPONGIAE						
Demospongiae unident.	0.333	0.352	0.685	0.343	0.013	0.242
Desmacellidae	0.121	0.054	0.175	0.088	0.047	0.062
Geodiidae	0.015	0.014	0.029	0.015	0.001	0.010
Pachastrellidae	0.015	0.054	0.069	0.035	0.028	0.024
Phakellia sp.		0.041	0.041	0.021		
Raspailiidae		0.095	0.095	0.048		
HEXACTINELLIDA						
Euritidae/Farreidae		0.041	0.041	0.021		
Hexactinellida unident.		0.271	0.271	0.136		
Porifera Unident.	0.015		0.015	0.008		
CNIDARIA						
HEXACORALLIA						
Actiniaria unident.	0.106	0.027	0.133	0.067	0.056	0.047
Actinoscyphia sp.	0.015	0.014	0.029	0.015	0.001	0.010
Antipatharia	0.030		0.030	0.015		
Corallimorphidae		0.027	0.027	0.014		
Liponema sp.		0.162	0.162	0.081		
Lophelia pertusa		0.014	0.014	0.007		
Sagartiidae		0.014	0.014	0.007		
OCTOCORALLIA						
Eunicella sp.	0.015	0.135	0.150	0.075	0.085	0.053
Octocorallia unident.	0.045		0.045	0.023		
Primnoidae		0.460	0.460	0.230		
Pseudodrifa nigra	0.030	0.717	0.747	0.374	0.486	0.264
STYLASTERIDAE	0.151	0.893	1.044	0.522	0.525	0.369
MOLLUSCA	0.015	0.041	0.056	0.028	0.018	0.020
ARTHROPODA	0.015	0.014	0.029	0.015	0.001	0.010
ECHINODERMATA						
ASTEROIDEA						
Asteroidea unident.	0.045	0.027	0.072	0.036	0.013	0.025
Novodinia sp.	0.015		0.015	0.008		
ECHINOIDEA						
Cidaridae	0.030	0.149	0.179	0.090	0.084	0.063
Coelopleurus floridanus		0.014	0.014	0.007		
CRINOIDEA						
Comatulida	0.272	0.027	0.299	0.150	0.173	0.106
HOLOTHUROIDEA						
Psolidae	0.015		0.015	0.008		
UNKNOWN ANIMAL	0.015	0.027	0.042	0.021	0.008	0.015
TOTAL	1.316	3.680	4.996	2.498	1.672	1.766

Outer Terrace Ridge - Low Slope Hardbottom (Tables 4-20, 4-21; Figure 4-29)

Hard substrates accounted for more than 50% of cover at both stations, although accounting for much more at station 2. Interestingly, cover attributed to living organisms was about 3.5 times as great at station 1, which had substantially less hard substrate cover. Unidentified sponges (including those only identified to either Demospongiae or Hexactinellida) accounted for the greatest proportion of density (24%). *Eunicella* sp. (mean 01.49 m^{-2} and 20%), Stylasteridae (mean 1.40 m^{-2} and 19%) and unidentified sponges accounted for the greatest percentages of total density, but each was far more abundant at one of the two stations, *Eunicella* sp. and unidentified sponges at station 1 and Stylasteridae at station 2. Similarly, comatulid density was much greater at station 1, whereas cidarid urchin density was similar at both.

Table 4-20. Percent cover data for both Non-Cable Outer Terrace Ridge Low-Slope Hardbottom habitat photostations.

Non-cable - Outer Terrrace Ridge - Low Slope	NC OTR-LS 1	NC OTR-LS 2	TOTAL	MEAN	Std.Dev.	Std.Err.
CNIDARIA NON SCLERACTINIA (CNI)	0.587	0.254	0.842	0.421	0.235	0.167
ECHINODERMATA (ECH)	0.280	0.095	0.375	0.188	0.130	0.092
PORIFERA (POR)	2.601	0.636	3.237	1.619	1.390	0.983
SOFT BOTTOM SUBSTRATE (SB)	40.420	11.097	51.517	25.758	20.734	14.661
HARD BOTTOM SUBSTRATE (HB)	56.056	87.886	143.941	71.971	22.507	15.915
HUMAN DEBRIS (HUM)	0.056	0.032	0.088	0.044	0.017	0.012
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	0.694	0.159	0.853	0.427	0.379	0.268
Sum (excluding tape+shadow+wand)	100	100				

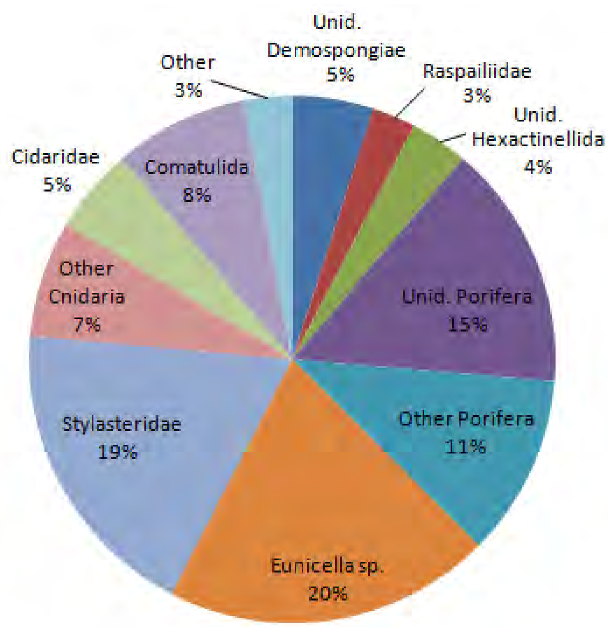

Figure 4-29. Macrofaunal organism densities (mean values of both stations in m^{-2}) at the two Non-Cable Outer Terrace Ridge Low-Slope photostations expressed as percentages of total benthic organism abundance summarized from Table 4-21. Other Porifera includes identified demosponge and hexactinellid taxa, each of which contributed less than ~3% of mean density.

Table 4-21. Density data (in m^{-2}): Non-Cable Outer Terrace Ridge Low-Slope Hardbottom habitat photostations.

NC OTR LS	1	2	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA						
DEMOSPONGIAE						
Astrophorida	0.012	0.126	0.138	0.069	0.080	0.057
Demospongiae unident.	0.143	0.597	0.740	0.370	0.321	0.227
Desmacellidae	0.059	0.024	0.083	0.042	0.025	0.018
Geodiidae		0.016	0.016	0.008		
Lithistida 1	0.309	0.063	0.372	0.186	0.174	0.123
Lithistida 2	0.024	0.094	0.118	0.059	0.050	0.035
Pachastrellidae	0.143	0.047	0.190	0.095	0.068	0.048
Phakellia sp.	0.036	0.346	0.381	0.191	0.219	0.155
Raspailiidae	0.238	0.157	0.395	0.197	0.057	0.040
Spongosorites sp.	0.095	0.016	0.111	0.055	0.056	0.040
HEXACTINELLIDA						
Aphrocallistes beatrix	0.012		0.012	0.006		
Euritidae/Farreidae	0.202	0.024	0.226	0.113	0.126	0.089
Hexactinellida unident.	0.059	0.471	0.531	0.265	0.291	0.206
Hyalonema sp.		0.008	0.008	0.004		
Vazella sp.		0.008	0.008	0.004		
Porifera unident.	2.248		2.248	1.124		
CNIDARIA						
HEXACORALLIA						
Actiniaria unident.	0.048	0.228	0.275	0.138	0.127	0.090
Corallimorphidae	0.012		0.012	0.006		
Liponema sp.	0.095	0.079	0.174	0.087	0.012	0.008
Zoanthidea		0.024	0.024	0.012		
OCTOCORALLIA						
Eunicella sp.	2.866	0.118	2.984	1.492	1.944	1.374
Isididae		0.094	0.094	0.047		
Plexauridae		0.039	0.039	0.020		
Primnoidae	0.095	0.267	0.362	0.181	0.122	0.086
Pseudodrifa nigra	0.071	0.016	0.087	0.044	0.039	0.028
STYLASTERIDAE	0.856	1.948	2.804	1.402	0.772	0.546
ANNELIDA	0.012		0.012	0.006		
ECHIURA	0.012		0.012	0.006		
MOLLUSCA	0.012	0.016	0.028	0.014	0.003	0.002
ARTHROPODA	0.071	0.024	0.095	0.047	0.034	0.024
BRACHIOPODA	0.012		0.012	0.006		
BRYOZOA	0.036	0.024	0.059	0.030	0.009	0.006
ECHINODERMATA						
ASTEROIDEA						
Asteroidea unident.	0.059	0.008	0.067	0.034	0.036	0.026
Goniasteridae	0.012	0.008	0.020	0.010	0.003	0.002
Linckia sp.		0.008	0.008	0.004		
ECHINOIDEA						
Cidaridae	0.393	0.385	0.777	0.389	0.005	0.004
Coelopleurus floridanus		0.016	0.016	0.008		
CRINOIDEA						
Comatulida	1.070	0.149	1.220	0.610	0.651	0.461
OPHIUROIDEA						
Euryalidae		0.008	0.008	0.004		
HOLOTHUROIDEA						
Psolidae	0.024		0.024	0.012		
UNKNOWN ANIMAL	0.059	0.024	0.083	0.042	0.025	0.018
TOTAL	9.396	5.474	14.870	7.435	2.774	1.961

Outer Terrace Ridge - High Slope Hardbottom (Table 4-22, 4-23; Figure 4-30)
All three stations in this habitat exhibited high percentages of hard substrate (83.0-95.0%), with stations 1 and 2 recording between 1 and 2% non-coral living cover, and stations 1 and 3 recording some coral habitat: chiefly rubble but with 0.05-0.08% living coral of two species. The greatest contributor to overall density was *Eunicella* sp. (mean 2.27 m^{-2} and 40%), although it contributed significantly only at stations 1 and 2. No other identified taxon accounted for >10% of overall density (unidentified demosponges accounted for 11%).

Table 4-22. Percent cover data for Non-Cable Outer Terrace Ridge High Slope Hardbottom habitat photostations.

Non-cable - Outer Terrace Ridge - High Slope	NC OTR-HS 1	NC OTR-HS 2	NC OTR-HS 3	TOTAL	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0.724	0	0.654	1.378	0.459	0.399	0.231
Colonial Dead Coral (DC)	0	0	0.05	0.055	0.018	0.031	0.018
Coral Rubble (CR)	0.65	0	0.55	1.193	0.398	0.348	0.201
Lophelia (LOP)	0.08	0	0	0.076	0.025	0.044	0.025
Madrepora (MAD)	0	0	0.05	0.055	0.018	0.031	0.018
CHORDATA (CHO)	0	0	0.055	0.055	0.018	0.031	0.018
CNIDARIA NON SCLERACTINIA (CNI)	0.267	0.185	0.164	0.615	0.205	0.054	0.031
ECHINODERMATA (ECH)	0.305	0.556	0	0.860	0.287	0.278	0.161
PORIFERA (POR)	0.610	1.111	0.164	1.885	0.628	0.474	0.274
UNIDENTIFIED ORGANISM (UND)	0	0	0	0.000	0.000	0.000	0.000
SOFT BOTTOM SUBSTRATE (SB)	14.248	2.995	15.921	33.164	11.055	7.030	4.059
HARD BOTTOM SUBSTRATE (HB)	83.848	95.029	83.043	261.919	87.306	6.700	3.868
NATURAL DETRITUS (DET)	0	0.123	0	0.123	0.041	0.071	0.041
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	2.778	0.338	3.474	6.590	2.197	1.646	0.951
Sum (excluding tape+shadow+wand)	100	100	100				

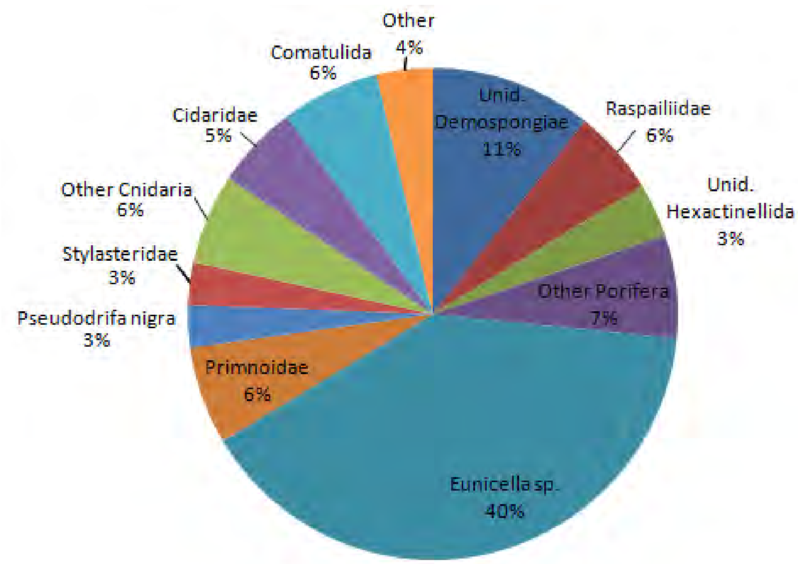

Figure 4-30. Macrofaunal organism densities (in m^{-2}) at the three Non-Cable Outer Terrace Ridge High-Slope photostations expressed as percentages of mean benthic organism densities summarized from Table 4-23. Other Porifera includes identified demosponge and hexactinellid taxa, each of which contributes less than~3% of mean density.

Table 4-23. Density data (in m^{-2}): Non-Cable Outer Terrace Ridge High-Slope Hardbottom habitat photostations.

NC OTR HS	1	2	3	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA							
DEMOSPONGIAE							
Demospongiae unident.	0.754	0.532	0.534	1.820	0.607	0.127	0.090
Desmacellidae	0.017	0.099		0.116	0.039	0.053	0.038
Geodiidae	0.008			0.008	0.003		
Leiodermatium sp.			0.031	0.031	0.010		
Lithistida 1	0.215	0.054	0.016	0.285	0.095	0.106	0.075
Pachastrellidae	0.025	0.036	0.016	0.077	0.026	0.010	0.007
Phakellia sp.	0.099	0.180	0.110	0.390	0.130	0.044	0.031
Raspailiidae	0.240	0.694	0.031	0.966	0.322	0.339	0.240
Spongosorites sp.	0.008			0.008	0.003		
HEXACTINELLIDA							
Aphrocallistes beatrix		0.009		0.009	0.003		
Euritidae/Farreidae	0.099	0.099		0.199	0.066	0.057	0.041
Hexactinellida unident.	0.215	0.135	0.252	0.602	0.201	0.060	0.042
Vazella sp.	0.008		0.031	0.040	0.013	0.016	0.012
CNIDARIA							
HEXACORALLIA							
Actiniaria 2	0.008		0.031	0.040	0.013	0.016	0.012
Actiniaria unident.	0.025	0.108		0.133	0.044	0.057	0.040
Bathypathes alternata	0.008		0.031	0.040	0.013	0.016	0.012
Corallimorphidae	0.025	0.036	0.016	0.077	0.026	0.010	0.007
Liponema sp.	0.083	0.207	0.016	0.306	0.102	0.097	0.069
Lophelia pertusa	0.008			0.008	0.003		
Madrepora sp.			0.016	0.016	0.005		
Sagartiidae	0.008	0.009		0.017	0.006	0.005	0.004
OCTOCORALLIA							
Eunicella sp.	2.153	4.606	0.047	6.806	2.269	2.282	1.613
Isididae		0.009	0.063	0.072	0.024	0.034	0.024
Octocorallia unident.	0.008	0.009	0.283	0.300	0.100	0.158	0.112
Pennatulacea	0.008			0.008	0.003		
Primnoidae	0.066		1.037	1.104	0.368	0.581	0.411
Pseudodrifa nigra	0.091	0.388		0.479	0.160	0.203	0.143
STYLASTERIDAE	0.091	0.388		0.479	0.160	0.203	0.143
MOLLUSCA	0.017	0.009		0.026	0.009	0.008	0.006
ARTHROPODA	0.033	0.018	0.031	0.083	0.028	0.008	0.006
BRYOZOA	0.017	0.018	0.016	0.050	0.017	0.001	0.001
ECHINODERMATA							
ASTEROIDEA							
Asteroidea unident.	0.116	0.153		0.269	0.090	0.080	0.057
Goniasteridae	0.025		0.016	0.041	0.014	0.013	0.009
Linckia sp.		0.009		0.009	0.003		
Sclerasterias sp.	0.008			0.008	0.003		
Tremaster mirabilis	0.017			0.017	0.006		
ECHINOIDEA							
Cidaridae	0.373	0.568		0.941	0.314		
Echinoidea unident.	0.008			0.008	0.003		
Gracilechinus sp.	0.033			0.033	0.011		
CRINOIDEA							
Comatulida	0.613	0.370	0.126	1.108	0.369	0.244	0.172
UROCHORDATA		0.072	0.016	0.088	0.029	0.038	0.027
TOTAL	5.532	8.815	2.767	17.114	5.705	3.028	2.141

Lower Terrace - High Slope Hardbottom (Tables 4-24, 4-25; Figure 4-31)

This station exhibited the greatest percent cover by deep-sea coral habitat (14.4%), although almost all was coral rubble. Living *Lophelia pertusa* was not reported in the CPCe analysis but did appear (0.022 m^{-2}) in the density analysis. Taxon richness appeared to be substantially lower than on either the Outer Terrace Ridge or Terrace Platforms. Primnoid octocorals (chiefly, if not all, *Plumarella* sp.) accounted for the greatest proportion of density (1.21 m^{-2} and 32%); however, the second most important group, unidentified octocorals (0.87 m^{-2} and 23%), was likely also Primnoidae. Hexactinellid sponge density was far greater than that of demosponges for the first time (although unidentified hexactinellids were recorded at higher densities than demosponges at NC ITP LS 6 and 7.

Table 4-24. Percent cover data for all Non-Cable Lower Terrace High-Slope Hardbottom habitat photostations.

Non-cable Lower Terrace - High Slope	NC LT-HS 1
CORAL (COR)	14.385
Colonial Dead Coral (DC)	0.559
Coral Rubble (CR)	13.827
CNIDARIA NON SCLERACTINIA (CNI)	0.489
PORIFERA (POR)	0.349
SOFT BOTTOM SUBSTRATE (SB)	60.475
HARD BOTTOM SUBSTRATE (HB)	24.302
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	1.241
Sum (excluding tape+shadow+wand)	100

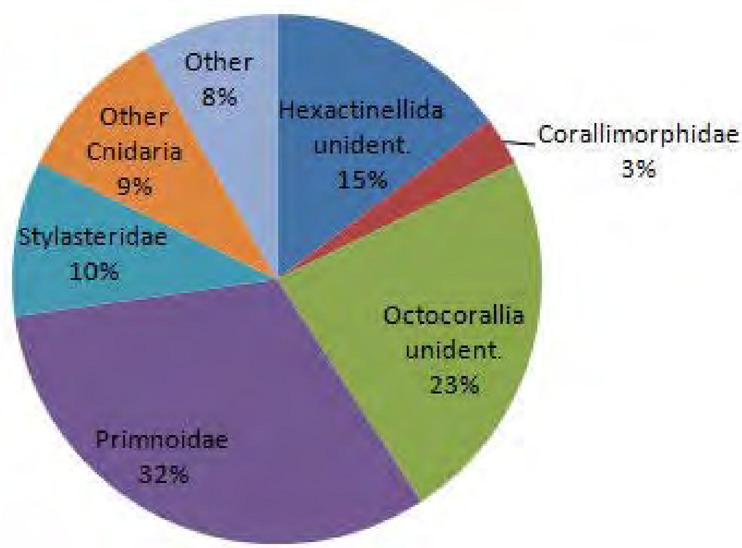

Figure 4-31. Macrofaunal organism densities (in m^{-2}) at the Non-Cable Lower Terrace High-Slope photostation expressed as percentages of total benthic organism density summarized from Table 4-25.

Table 4-25. Density data (in m^{-2}): Non-Cable Lower Terrace High Slope Hardbottom habitat photostation.

NC LT HS	1	NC LT HS	1
PORIFERA		OCTOCORALLIA	
DEMOSPONGIAE		*Eunicella* sp.	0.022
Demospongiae unident.	0.090	Isididae	0.022
Phakellia sp.	0.045	Octocorallia unident.	0.874
HEXACTINELLIDA		Primnoidae	1.210
Hexactinellida unident.	0.560	*Pseudodrifa nigra*	0.022
CNIDARIA		STYLASTERIDAE	0.359
HEXACORALLIA		MOLLUSCA	0.090
Actiniaria unident.	0.067	ARTHROPODA	0.045
Corallimorphidae	0.112	ECHINODERMATA	
Lophelia pertusa	0.022	CRINOIDEA	
Madrepora sp.	0.090	Comatulida	0.045
Sagartiidae	0.090	TOTAL	3.787
Zoanthidea	0.022		

Lower Terrace - Sinkhole Hardbottom (Tables 4-26, 4-27; Figure 4-32)

Percent cover was chiefly hard substrate (72.2%) with a substantial contribution from deep-sea coral rubble (8.3%). Living organisms accounted for <0.5% of cover. Living *Lophelia pertusa* was again not reported in the CPCe analysis but did appear (0.051 m^{-2}) in the density analysis. Primnoidae accounted for an even greater proportion of density (1.28 m^{-2} and 39%) than at the preceding station, and unidentified octocorals (1.29 m^{-2} and 39%) were again also likely Primnoidae. Again, hexactinellid sponge density was much greater than that of demosponges. Overall organism density (3.37 m^{-2}) was similar to that at the Lower Terrace High-Slope photostation (3.79 m^{-2}).

Table 4-26. Percent cover data: Non-Cable Lower Terrace Sinkhole Hardbottom habitat photostation.

Non-cable - Lower Terrace - Sinkhole	NC LT-SH 1
CORAL (COR)	8.264
Coral Rubble (CR)	8.264
CNIDARIA NON SCLERACTINIA (CNI)	0.220
PORIFERA (POR)	0.264
SOFT BOTTOM SUBSTRATE (SB)	19.077
HARD BOTTOM SUBSTRATE (HB)	72.176
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	1.087
Sum (excluding tape+shadow+wand)	100

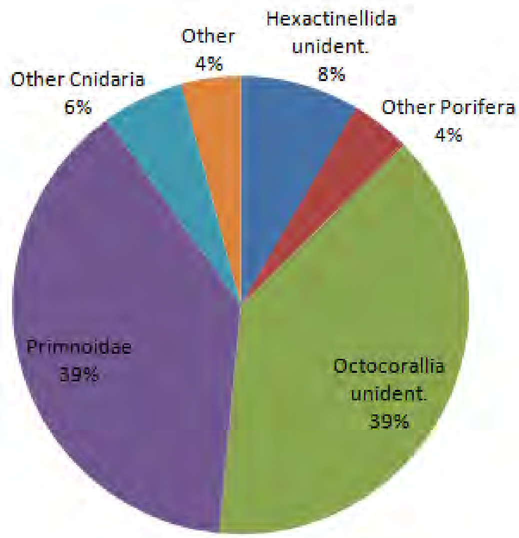

Figure 4-32. Macrofaunal organism densities (in m^{-2}) at the Non-Cable Lower Terrace Sinkhole Hardbottom photostation expressed as percentages of total benthic organism abundance summarized from Table 4-27.

Table 4-27. Density data for the Non-Cable Lower Terrace Sinkhole Hardbottom habitat photostation.

NC LT SH	1	NC LT SH	1
PORIFERA		OCTOCORALLIA	
HEXACTINELLIDA		Octocorallia unident.	1.290
Aphrocallistes beatrix	0.013	Primnoidae	1.277
Hexactinellida unident.	0.281	STYLASTERIDAE	0.089
Porifera Unident.	0.128	MOLLUSCA	0.013
CNIDARIA		ARTHROPODA	0.026
HEXACORALLIA		ECHINODERMATA	
Actiniaria unident.	0.026	Asteroidea unident.	0.013
Actinoscyphia sp.	0.013	Echinoidea unident.	0.013
Antipatharia unident.	0.013	UNKNOWN ANIMAL	0.077
Cerianthidae	0.038	TOTAL	3.372
Corallimorphidae	0.013		
Lophelia pertusa	0.051		

4.3 Cable Impact Assessment

This section provides a multivariate statistical analysis and summary of both percent cover and organism densities for hardbottom habitats on the Northern Miami Terrace to evaluate community-level impacts from cables. All photostations were categorized by benthic habitat types defined in Section 4.2. Percent cover and organism density at both Cable and Non-Cable stations were evaluated in each habitat to determine if the effects from cable presence on the benthic communities or substrate are significant at the community level.

Benthic habitats containing EFH are treated in order from west to east, with Low-Slope photostations treated first for each habitat. Section 4.3.1 summarizes percent cover and density analyses along the shallow Cable Transect and describes observed impacts from cable. Comparison of Cable versus Non-Cable was not possible in this habitat due to a lack of similar habitat without cables. Section 4.3.2 treats the deeper portion (>245 m) of Cable Transect A.

As noted in Sections 3.4 and 4.2.3.3, estimated organisms (Hydroidolina, solitary scleractinian corals, and ophiurid ophiuroids) have been excluded from density summary tables and pie diagrams. Bottom-associated fishes have not been included in density tables because of their extremely low frequency of occurrence in quantitative still images. Of the 30 density records of fish taxa at all Cable photostations, all were <0.05 m^{-2}. The most frequently recorded recognizable taxon was again the codling *Laemonema* sp. (at 12 of 27 stations), followed by the greeneye, *Chlorophthalmus agassizi* and blackbelly rosefish, *Helicolenus dactylopterus* (at 2 each). Other infrequently encountered groups for which component taxa have been combined in density tables are Arthropoda (again most commonly paguroid hermit crabs and *Eumunida picta*), Mollusca (again most commonly unidentified gastropods) and Annelida (chiefly sabellid featherduster worms). Other minor groups, e.g., Bryozoa, Brachiopoda, Urochordata (Ascidiacea), have not been divided into component taxa.

4.3.1 Shallow Transect

As noted in Section 4.1, because all three shallow transects (A, An, As) from ~30 to 90 m traversed cables, none could be used as Non-Cable transects, thus no detailed statistical comparison was carried out. The large number of additional cables in the area (Figure 4-1) and the limited amount of habitat precluded selection of any nearby Non-Cable transects in similar habitat using the ROV.

Section 4.2.2.1 described the shallow Cable Transects, but quantitative observations on stony corals (Scleractinia) are given here. A total of 83 (possibly 94) of 845 images taken between 30 m and the disappearance of the octocoral *Swiftia exserta* in 63 m included stony corals (the deepest observed in 38-43 m) (Table 4-2). Eight images included more than one colony for a total of 109 colonies (excluding unconfirmed, unidentified colonies). The great majority were <10 cm in maximum diameter; the largest recorded in still images were two *Montastraea cavernosa* (26 and 29 cm across) and two *Agaricia lamarcki* (26 and >26 cm [partly visible] across). None exhibited any recognizable impacts (dislodged, abraded or shaded).

The only direct effect on macrobenthos observed in the video and photographic record in this depth range and attributable to cable appeared at 26°05.249'N, 80°04.713'W, in 43 m along

Transect An, where a cable appeared to have split a large sponge, which continued to survive. Other effects included fouling of cables by cyanobacterial mat and chiefly encrusting sponges. At 26°05.219’N, 80°04.817’W, at a depth of 34 m, cable was also reported as “totally encrusted and embedded.”

From the disappearance of hard substrate in 90-93 m to the seaward end of the shallow portion of Cable Transect A, exposed cable supported often numerous hydroids and anemones, including ?*Actinauge* sp., a small white anemone (beginning in 194 m), and Venus flytrap anemone *Actinoscyphia* sp. (199 m), as well as a rare or occasional antipatharian (from 213 m), an unidentified white octocoral (215 m) and unidentified sponge (219 m). Anemones often grew at regular intervals of ~15 cm along the cable (Figure 4-6). Organisms such as the swimming crab *Bathynectes longispina* either created or took advantage of shallow scour under the cable for shelter. Anemones were also observed attached to anthropogenic debris such as aluminum cans and plastic trash bags.

4.3.2 Deep Cable Transect

Multivariate Analyses of all sites combined

The following analyses examine whether any statistical evidence existed for differences in either percent cover or density at all photostations based on the presence versus absence of cable. An MDS plot of percent cover data for all hardbottom habitat photostations (Figure 4-33) showed no overall pattern distinguishing Cable versus Non-Cable stations. The percent cover analysis mostly showed distinctions between percent substrate cover. Cables did not appear to be a factor in determining substrate differences, i.e., cables did not cause a hardbottom station to become softbottom.

An MDS plot of density data for all hardbottom habitat photostations (Figure 4-34) indicates that the presence of cable does not appear to be driving densities of biological organisms at a regional level. If regional-level cable impacts existed, Cable stations would be expected to group separately from Non-Cable stations. Analysis of all sites did not show any overarching patterning for Cable and Non-Cable sites. The same MDS plot coded for habitats illustrates that habitat is contributing more to the similarity of stations than cable effects (Figure 4-35). Similar to the Non-Cable density analysis, benthic habitats based on geomorphology (e.g., Inner Terrace Platform, Lower Terrace Sinkhole) and slope derived from geophysical multibeam data (Low versus High) are driving the regional differences among all stations rather than the presence of cable. The arrow in Figure 4-35 illustrates the cross-shelf geomorphologic habitat and depth trends from west (shallow) to east (deep). High slope stations (red) occupy the center and right part of the graph. Low slope stations (green) occupy center to left side. This means that habitat had more of an effect on all station similarity than Cable; therefore cable impacts were investigated further in the following sections by analyzing the stations within each habitat separately.

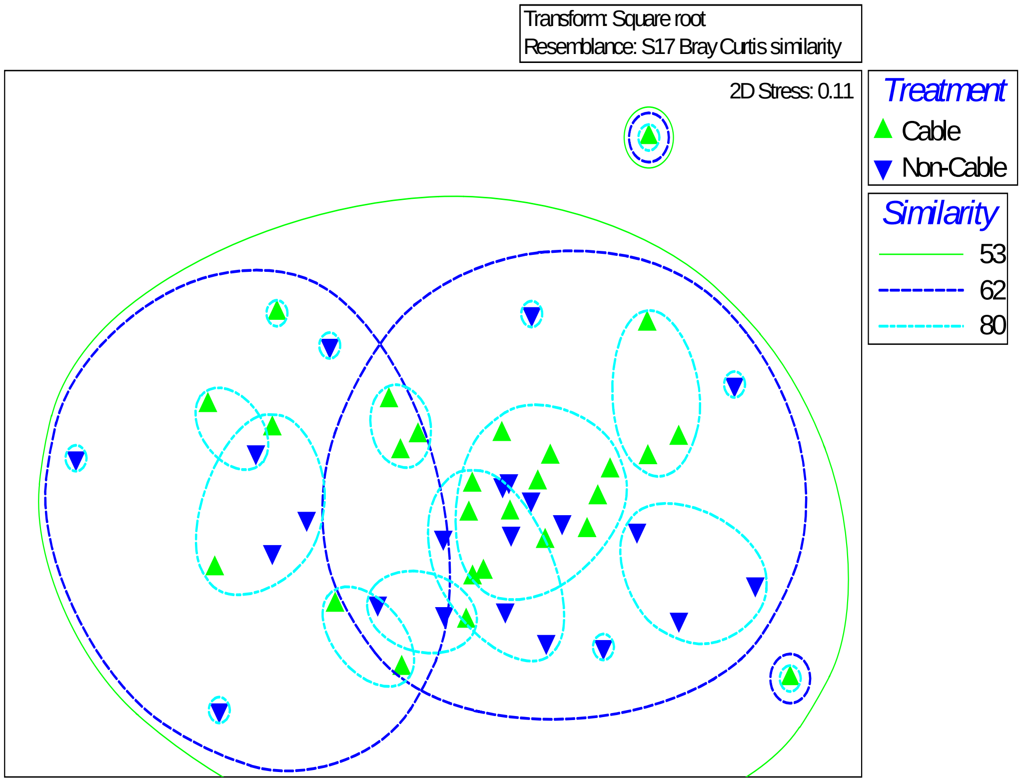

Figure 4-33. MDS plot of percent cover data for all hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Groupings indicate percent similarity from a cluster analysis.

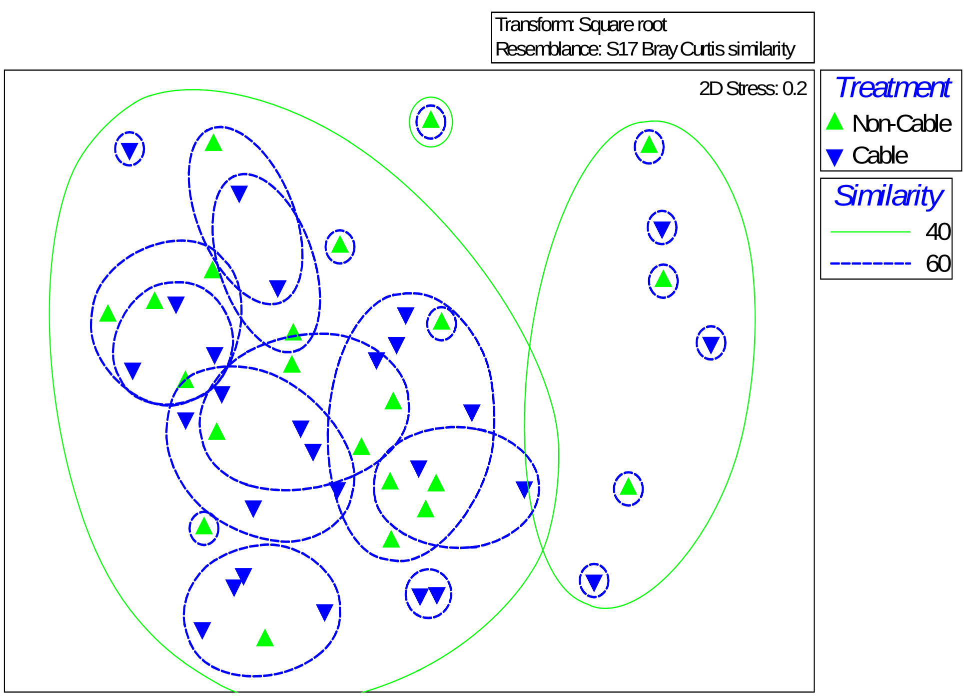

Figure 4-34. MDS plot of density data for all hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Groupings indicate percent similarity from a cluster analysis.

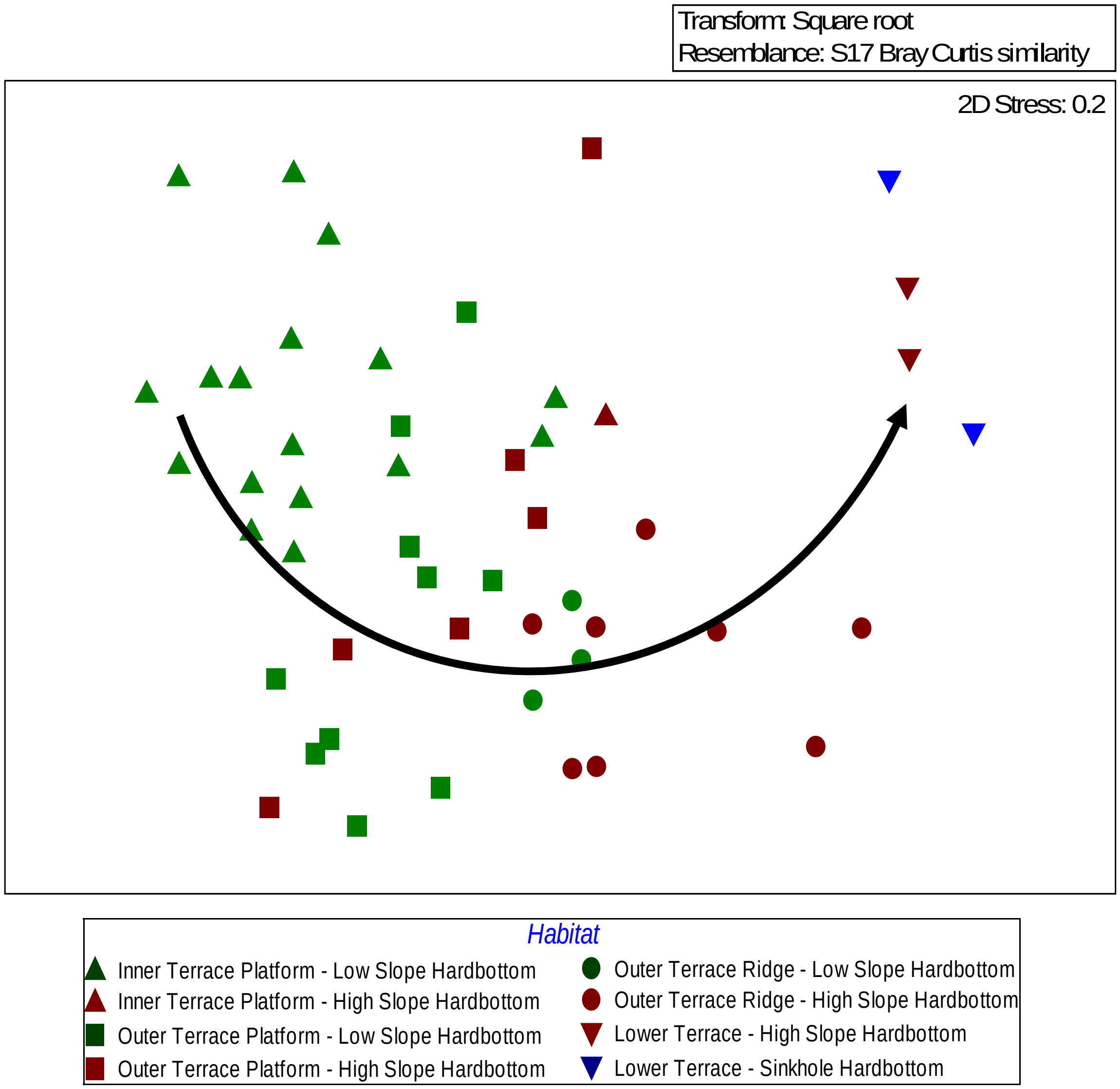

Figure 4-35. MDS plot of density data for all hardbottom habitat photostations. Stations are coded by Habitat. The arrow illustrates the cross-shelf geomorphologic zone and depth trends from shallow to deep. High slope stations (red) occupy the center and right part of the graph. Low slope stations (green) occupy center to left side.

Inner Terrace Platform Low-Slope Hardbottom (Tables 4-28 – 4-29; Figures 4-36 – 4-40)
Percent cover of hard substrates ranged from 9.3 to 54.4% cover, although six of the ten stations spanned a relatively narrow range of 37.9-54.4% (Table 4-28). Cover by all living organisms was chiefly <1% with a maximum of 2.0% at C ITP-LS 10. Although five stations recorded at least some deep-sea coral habitat, only two (2 and 10) included any living coral (maximum cover 0.069 m^{-2}). The greatest contribution was 6.06% cover of coral rubble at station 8.

An MDS plot of a cluster analysis of all ITP-LS hard substrate photostations (Figure 4-36) showed that percent cover of living organisms was too small to contribute any significant difference between Cable and Non-Cable stations. The complete overlap in the distribution of

Cable and Non-Cable stations indicates that the presence of cable did not significantly affect percent cover by substrate type.

Table 4-28. Percent cover data for all Cable Inner Terrace Platform Low-Slope Hardbottom habitat photostations.

Cable - Inner Terrace Platform - Low Slope	C ITP-LS 1	C ITP-LS 2	C ITP-LS 3	C ITP-LS 4	C ITP-LS 5	C ITP-LS 6	C ITP-LS 7	C ITP-LS 8	C ITP-LS 9	C ITP-LS 10	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0	0.138	0	0	0.060	0	0	6.126	0.535	0.032	0.689	1.917	0.606
Colonial Dead Coral (DC)	0	0	0	0	0.030	0	0	0.032	0	0	0.006	0.013	0.004
Coral Rubble (CR)	0	0	0	0	0.030	0	0	6.062	0.535	0	0.663	1.904	0.602
Lophelia (LOP)	0	0.069	0	0	0	0	0	0	0	0.032	0.010	0.023	0.007
Solitary Coral (SC)	0	0.069	0	0	0	0	0	0.032	0	0	0.010	0.023	0.007
ARTHROPODA (ART)	0	0	0	0	0	0	0	0	0	0.064	0.006	0.020	0.006
CHORDATA (CHO)	0	0	0	0	0	0.056	0	0	0	0	0.006	0.018	0.006
CNIDARIA NON SCLERACTINIA (CNI)	0.336	0.276	0.216	0.347	0.417	0.670	0.330	0.706	1.069	1.257	0.562	0.357	0.113
ECHINODERMATA (ECH)	0.084	0.034	0	0	0.060	0.168	0.300	0	0.134	0.355	0.113	0.127	0.040
ECHIURA (ECR)	0.112	0.241	0.124	0	0	0.056	0	0	0.027	0	0.056	0.081	0.026
PORIFERA (POR)	0.028	0.034	0.340	0.032	0.179	0.419	0.359	0.032	0.428	0.290	0.214	0.172	0.054
UNIDENTIFIED ORGANISM (UND)	0	0.034	0.031	0.063	0	0.056	0	0	0	0	0.018	0.025	0.008
SOFT BOTTOM SUBSTRATE (SB)	77.881	61.297	44.929	45.243	59.404	68.956	62.702	83.740	48.810	41.908	59.487	14.405	4.555
HARD BOTTOM SUBSTRATE (HB)	21.306	37.875	54.360	53.434	39.493	27.778	35.710	9.301	48.623	55.835	38.372	15.455	4.887
CABLE (CB)	0.196	0.069	0	0.851	0.238	1.787	0.539	0.032	0.374	0.226	0.431	0.542	0.171
HUMAN DEBRIS (HUM)	0	0	0	0.032	0.030	0.056	0.030	0.064	0	0.032	0.024	0.024	0.008
NATURAL DETRITUS (DET)	0.056	0	0	0	0.119	0	0.030	0	0	0	0.021	0.040	0.012
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	2.247	4.951	0.431	2.338	4.143	0.417	1.824	2.563	0.240	1.524	2.068	1.566	0.495
Sum (excluding tape+shadow+wand)	100	100	100	100	100	100	100	100	100	100			

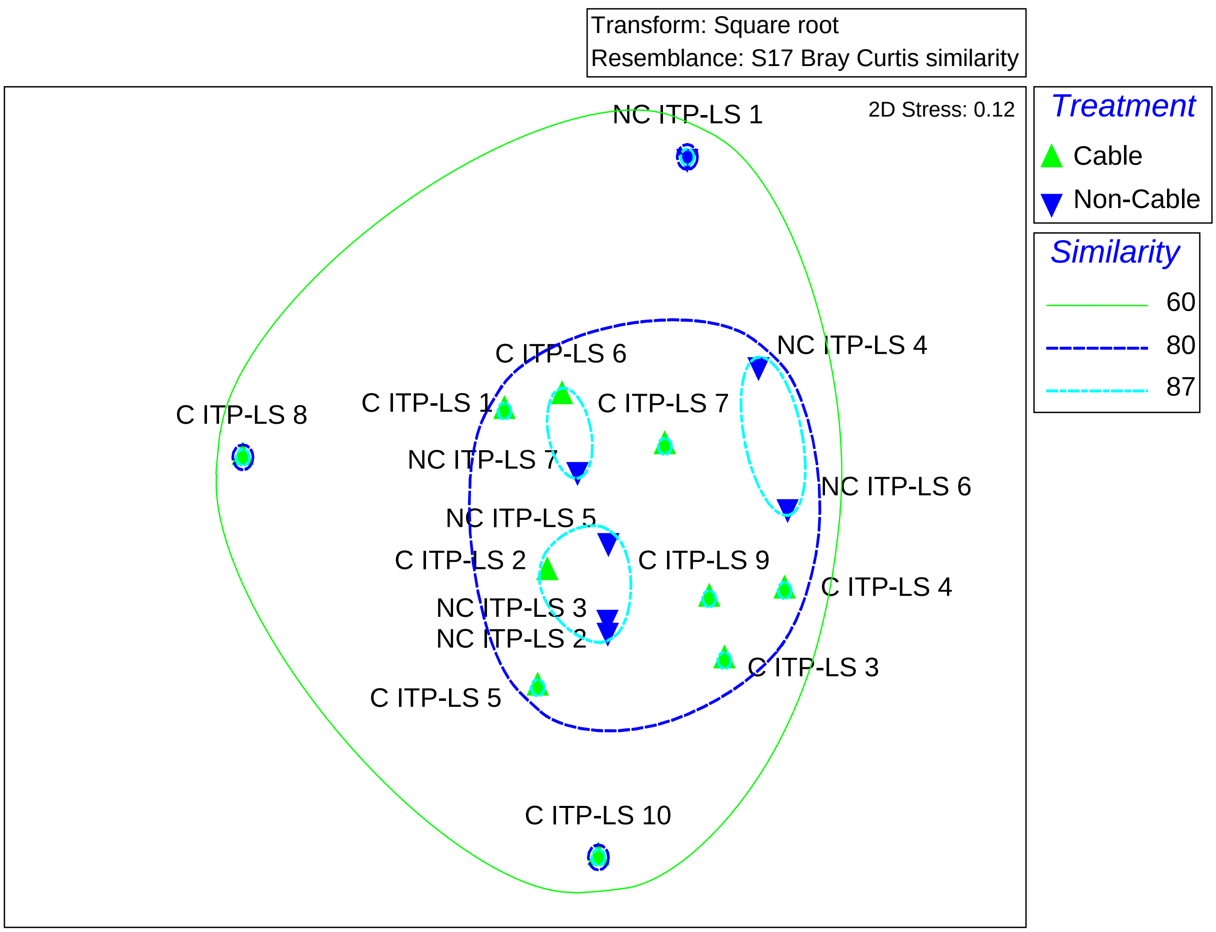

Figure 4-36. MDS plot of percent cover data for all Inner Terrace Platform Low Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Total organism density at eight of the ten stations ranged from 3.03 to 5.78 m^{-2} with higher densities recorded at stations 8 (8.89 m^{-2}) and 10 (17.15 m^{-2}). Table 4-29 lists organism densities at both Cable and Non-Cable ITP-LS photostations for comparison. Mean density was somewhat greater at the Non-Cable (7.9 m^{-2}) than the Cable photostations (5.9 m^{-2}), but station-by-station densities varied widely: from 4.46 to 12.24 m^{-2} at NC photostations, and 3.53 to 17.15 m^{-2} at Cable photostations (with Cable station 10 exhibiting the highest density of any station in this habitat). Major faunal components were similar to those at the equivalent NC ITP-LS stations, e.g., *Eunicella* sp. and *P. nigra*, although they did not all contribute the same proportion of density, e.g., Echiura contributed 21% of density at the Non-Cable stations and 11% at the Cable stations (Figures 4-25, 4-37). The substantial contribution of Primnoidae at the Cable stations was due to its abundance at station 10 alone. *Eunicella* sp. and comatulids were also far more abundant at this station than at any other. Qualitative observations of these taxa indicate that they typically occur in greater abundances in areas exposed to stronger near-benthic current, often but not always in association with elevated topography. By contrast, echiurans are common on low-relief substrates with extensive areas of sediment. All sponges together contributed a similar percentage to overall density at both Non-Cable (21%) and Cable (25%) stations in this habitat, although most were recorded as unidentified Hexactinellida at the Non-Cable photostations, but as Unidentified Porifera at the Cable photostations (Figure 4-37B).

Table 4-29. Density data for all Non-Cable and Cable Inner Terrace Platform Low-Slope Hardbottom habitat photostations.

	Non-Cable Inner Terrace Platform Low-Slope											Cable Inner Terrace Platform Low-Slope													
	1	2	3	4	5	6	7	TOT	MEAN	STD.DEV.	STD.ERR.	1	2	3	4	5	6	7	8	9	10	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA																									
DEMOSPONGIAE																									
Astrophorida			0.018					0.018	0.003																
Axinellidae						0.012		0.012	0.002																
Demospongiae unident.	0.046	0.069	0.071	0.454	0.044	0.254	0.195	1.131	0.162	0.152	0.108		0.081	0.385	0.599	0.146						1.210	0.121	0.215	0.152
Desmacellidae						0.046	0.092	0.138	0.020	0.036	0.026						0.023			0.556	0.446	1.024	0.102	0.221	0.156
Geodiidae		0.011		0.018		0.012	0.023	0.064	0.009	0.009	0.007					0.021				0.017		0.038	0.004	0.008	0.006
Lithistida 1			0.018	0.018				0.036	0.005	0.009					0.018	0.021						0.039	0.004	0.009	0.006
Pachastrellidae							0.011	0.011	0.002								0.023			0.034	0.074	0.131	0.013	0.026	0.018
Phakellia sp.			0.018		0.116	0.023	0.011	0.168	0.024	0.042	0.029	0.023	0.013		0.127	0.314	0.250	0.218		0.017		0.962	0.096	0.126	0.089
Raspailiidae																	0.023					0.023	0.002		
Spongosorites sp.														0.038				0.020				0.058	0.006	0.014	0.010
HEXACTINELLIDA																									
Aphrocallistes beatrix																		0.040				0.040	0.004		
Euritidae/Farreidae			0.018		0.015	0.058	0.011	0.101	0.014	0.020	0.014					0.021		0.040		0.067	0.099	0.227	0.023	0.036	0.026
Hexactinellida unident.	0.183	0.023				1.407	0.756	2.369	0.338	0.545	0.386		0.013	0.038	0.036	0.126		0.020	0.140	0.101		0.475	0.047	0.055	0.039
Vazella sp.														0.019		0.021						0.040	0.004	0.009	0.006
Porifera unident.	0.023	0.011	0.053	0.254	0.087			0.428	0.061	0.091	0.064					0.042	0.068	0.179		1.852	3.564	5.705	0.571	1.253	0.886
CNIDARIA																									
HEXACORALLIA																									
?Actinauge sp.							0.069	0.069	0.010			0.203				0.021						0.224	0.022		
Actiniaria 2	0.183	0.023	0.018				0.160	0.384	0.055	0.081	0.057	0.023		0.481	0.018	0.167						0.689	0.069	0.162	0.115
Actiniaria unident.	1.348	0.525	0.635	0.563	0.203	0.231	0.309	3.814	0.545	0.393	0.278	0.113	0.027	0.212	0.399	0.774	1.044	0.795	0.140	0.034	0.099	3.636	0.364	0.383	0.271
Actinoscyphia sp.	0.023	0.023	0.018	0.018		0.023	0.080	0.185	0.026	0.025	0.018	0.271	0.067	0.058	0.236	0.063	0.386	0.238	0.070	0.034	0.099	1.522	0.152	0.120	0.085
Cerianthidae															0.018			0.060		0.101	0.025	0.204	0.020	0.036	0.025
Corallimorphidae						0.012	0.023	0.034	0.005	0.009	0.006	0.023	0.040		0.018	0.105		0.099	0.035		0.050	0.369	0.037	0.040	0.029
Liponema sp.		0.034	0.018	0.127	0.102	0.231	0.676	1.187	0.170	0.237	0.168		0.027	0.019	0.018	0.586	0.091	0.278	0.596	0.051	0.173	1.838	0.184	0.235	0.166
Lophelia pertusa													0.013									0.013	0.001		
Sagartiidae				0.018	0.189	0.046	0.115	0.367	0.052	0.073	0.052		0.040	0.038		0.146		0.040		0.067	0.248	0.580	0.058	0.083	0.058
Zoanthidea	0.525			0.109	0.087	0.023	0.080	0.825	0.118	0.185	0.131	0.136	0.027	0.058	0.018	0.084		0.258	1.402		0.099	2.081	0.208	0.452	0.319
OCTOCORALLIA																									
Eunicella sp.	0.023				0.102	0.138	0.699	0.962	0.137	0.254	0.180				0.018	0.126	0.023	0.278	0.175	1.566	6.411	8.596	0.860	2.105	1.489
Isididae				0.018				0.018	0.003																
Pennatulacea																			0.035			0.035	0.004		
Primnoidae	0.091	0.011					0.011	0.114	0.016	0.034	0.024		0.175				0.023			1.044	2.822	4.063	0.406	0.952	0.673
Pseudodrifa nigra	0.525	0.263	0.159	0.236	0.638	1.418	0.871	4.111	0.587	0.445	0.315	0.746	0.470	0.635	0.671	1.025	0.635	1.271	0.806	1.987	0.941	9.187	0.919	0.462	0.327
Octocorallia unident.		0.011		0.018				0.030	0.004	0.007	0.005														
STYLASTERIDAE		0.023		0.036	0.044	0.069	0.413	0.584	0.083	0.147	0.104		0.013	0.019	0.018	0.021	0.068	0.139	0.035	0.236	0.421	0.970	0.097	0.139	0.098

Table 4-29, continued. Density data for all Non-Cable and Cable Inner Terrace Platform Low-Slope Hardbottom habitat photostations.

	Non-Cable Inner Terrace Platform Low-Slope											Cable Inner Terrace Platform Low-Slope													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**TOT**	**MEAN**	**STD.DEV.**	**STD.ERR.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TOT**	**MEAN**	**STD.DEV.**	**STD.ERR.**
ANNELIDA	0.069	0.023						0.091	0.013	0.026	0.018	0.023	0.013	0.038	0.036	0.021				0.017		0.149	0.015	0.016	0.011
ECHIURA	2.102	1.108	1.640	1.362	0.261	0.357	0.252	7.082	1.012	0.740	0.523	1.672	2.646	1.673	0.435	0.146	1.294	1.112	0.035	0.135	0.099	9.247	0.925	0.906	0.641
MOLLUSCA	0.023	0.069	0.123	0.091	0.029	0.127	0.011	0.473	0.068	0.048	0.034	0.045	0.013	0.096	0.036		0.023			0.017	0.025	0.255	0.026	0.030	0.021
BRYOZOA																0.021	0.023					0.044	0.004	0.010	0.007
ARTHROPODA	0.274	0.034		0.054	0.029	0.012	0.011	0.415	0.059	0.096	0.068		0.013	0.038	0.036	0.042	0.023			0.034	0.124	0.310	0.031	0.037	0.026
ECHINODERMATA																									
ASTEROIDEA																									
Asteroidea unident.	0.091	0.023	0.071	0.036	0.029	0.012	0.023	0.285	0.041	0.029	0.021	0.045	0.013	0.019		0.042	0.023			0.051	0.050	0.242	0.024	0.021	0.015
Coronaster briareus				0.018				0.018	0.003			0.023										0.023	0.002		
Goniasteridae		0.011				0.012	0.023	0.046	0.007	0.009	0.006					0.021						0.021	0.002		
Sclerasterias sp.							0.011	0.011	0.002																
Tremaster mirabilis						0.012		0.012	0.002				0.013				0.023	0.020				0.056	0.006	0.010	0.007
ECHINOIDEA																									
Cidaridae	0.091	0.126	0.053	0.109	0.160	0.173	0.218	0.929	0.133	0.055	0.039	0.045	0.107	0.038	0.109	0.084	0.295	0.298	0.070	0.404	0.470	1.921	0.192	0.161	0.113
Echinoidea unident.						0.012		0.012	0.002			0.023										0.023	0.002		
Gracilechinus sp.	0.023		0.035		0.015	0.023		0.096	0.014	0.014	0.010	0.023	0.013	0.019	0.054		0.023	0.020		0.051		0.203	0.020	0.021	0.015
CRINOIDEA																									
Comatulida			0.035				0.046	0.081	0.012	0.020	0.014	0.023		0.038	0.018		0.045	0.040	0.035	0.152	0.495	0.846	0.085	0.158	0.112
Crinoidea (stalked)						0.012		0.012	0.002																
OPHIUROIDEA																									
Euryalidae							0.034	0.034	0.005								0.023	0.119		0.051	0.124	0.316	0.032	0.052	0.037
HOLOTHUROIDEA																									
Psolidae	0.023	0.034	0.018	0.036	0.015	0.023		0.149	0.021	0.012	0.009	0.068	0.013	0.115	0.054	0.063	0.023	0.139		0.168	0.149	0.792	0.079	0.064	0.045
UNKNOWN ANIMAL	0.023		0.071	0.054		0.035		0.182	0.026	0.029	0.020				0.036	0.084	0.091	0.060	0.035	0.051	0.050	0.405	0.041	0.032	0.022
TOTAL	5.689	2.456	3.087	3.649	2.161	4.809	5.238	27.088	3.870	1.393	0.985	3.525	3.854	4.077	3.030	4.351	4.562	5.780	3.610	8.891	17.153	58.832	5.883	4.475	3.165

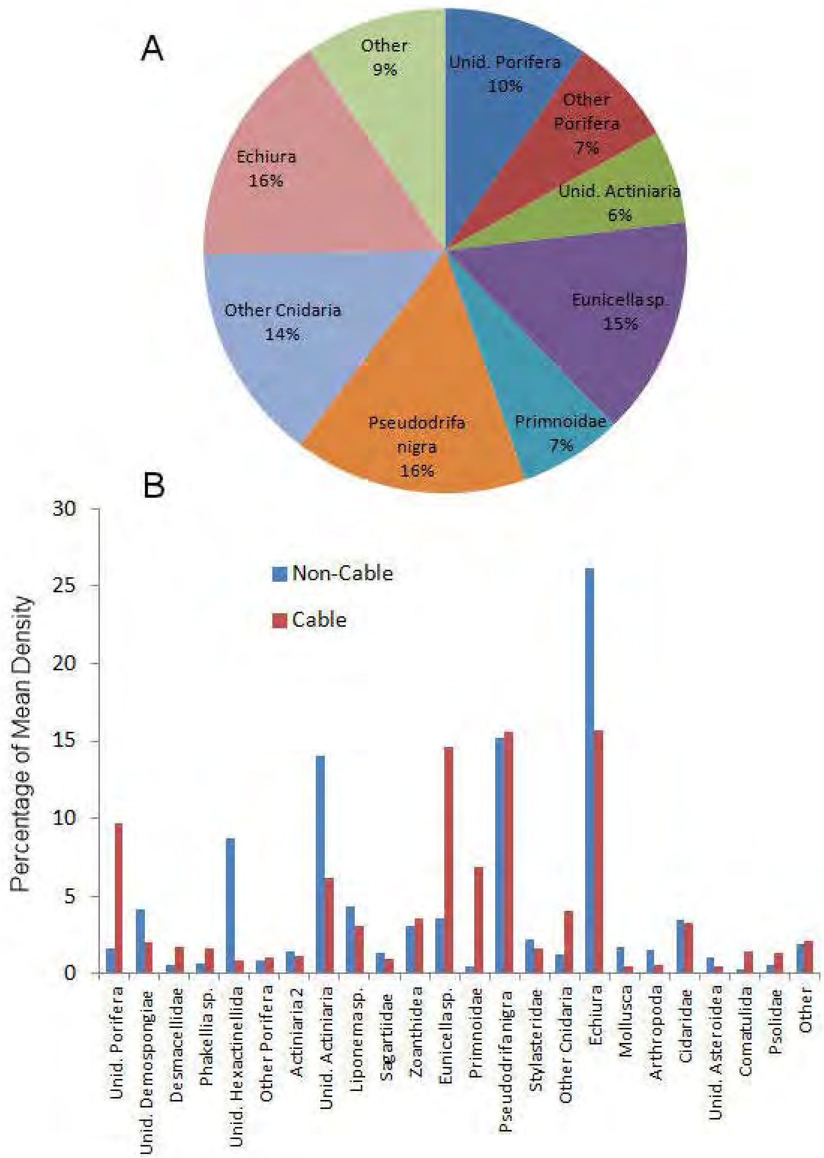

Figure 4-37. A. Macrofaunal organism densities (in m^{-2}) at the ten Cable Inner Terrace Platform Low-Slope photostations expressed as percentages of the total of mean organism densities. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable ITP L-S photostations. Data summarized from Table 4-29.

No cable effects on organism density were detected among ITP LS stations, but there was an obvious separation by depth. All stations at depths <275 m appear on the right side of the MDS plot and all deeper stations on the left side (Figure 4-38). Stations C ITP LS 9 and 10 are outliers likely due to their substantially higher overall densities and associated higher densities of several taxa, e.g., *Eunicella* sp., Primnoidae, unidentified Porifera and *P. nigra* (Table 4-29). A MDS plot of the shallower stations showed a spatial separation between Cable and Non-Cable groups (Figure 4-39) but this was not supported by cluster analyses. Cable and Non-Cable sites were over 60% similar. An Analysis of Similarity (ANOSIM) was performed to test the significance of the Cable and Non-Cable groups and did not find Cable/Non-Cable as significant contributors to the station similarities (Table 4-42, below). A MDS plot of these deeper stations showed a spatial separation between Cable and Non-Cable groups (Figure 4-40) but this also was not supported by cluster analyses. Cable and Non-Cable sites were over 50% similar. The Non-Cable sites plotted very near one another while the Cable sites were farther apart. This indicates that the Non-Cable sites were more similar to one another and the Cable sites were more heterogeneous. An Analysis of Similarity (ANOSIM) was performed to test the significance of the Cable and Non-Cable groups and did not find Cable/Non-Cable as significant contributors to the station similarities (Table 4-42, below).

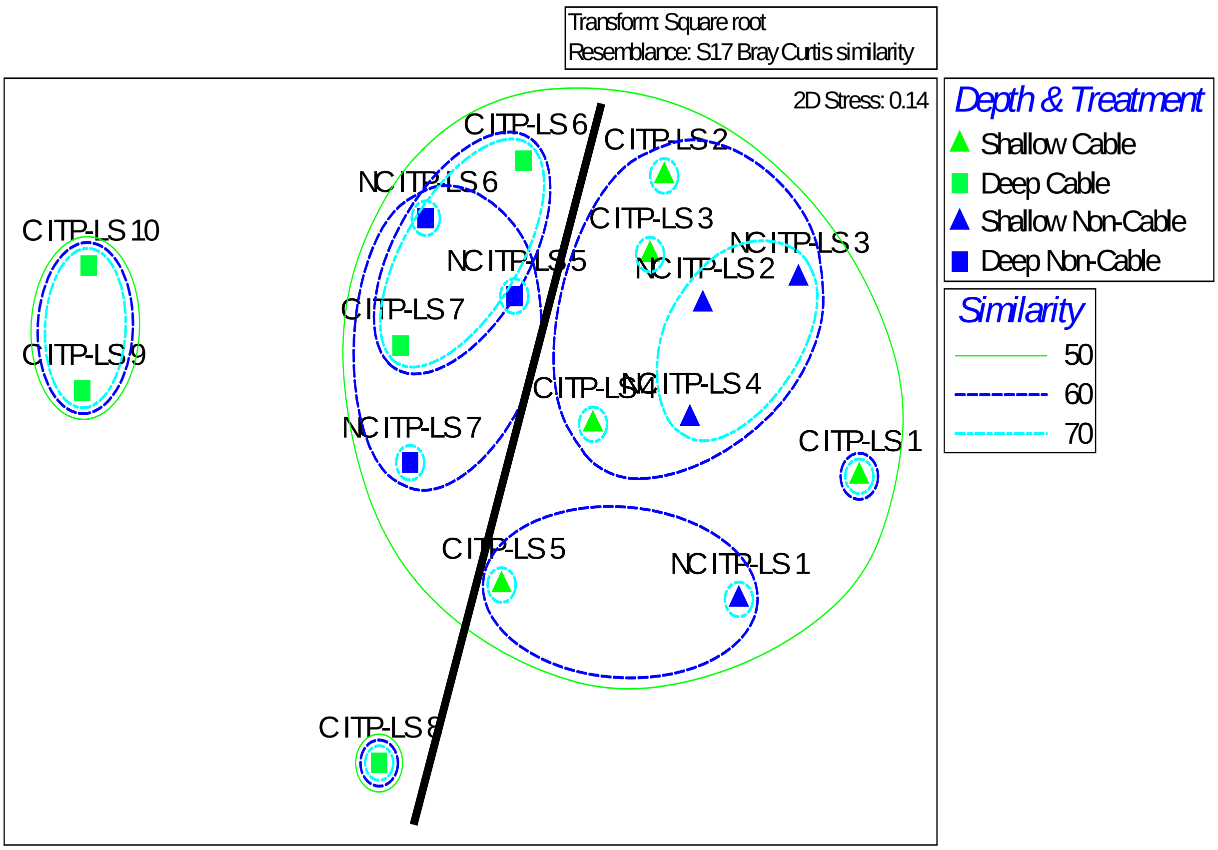

Figure 4-38. MDS plot of density data for all Inner Terrace Platform Low Slope Hardbottom habitat photostations. Stations are color coded by Cable and Non-Cable. Triangles indicate shallower (<275 m) photostations and squares indicate deeper (>275 m) ones. Circles indicate percent similarity from the cluster analysis.

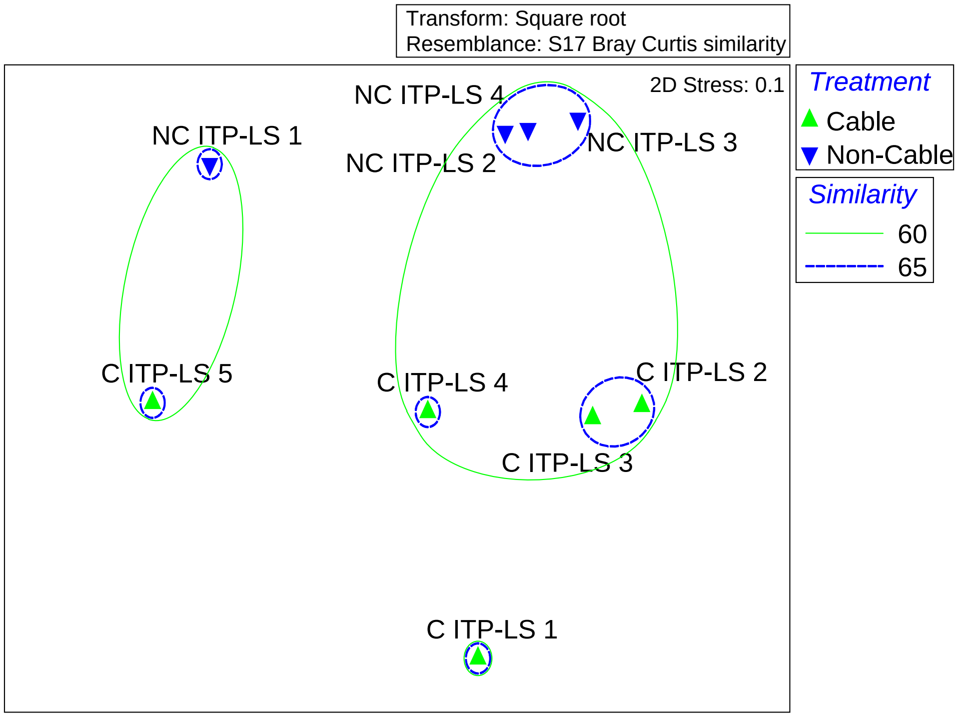

Figure 4-39. MDS plot of density data for all Inner Terrace Platform Low Slope Hardbottom habitat photostations in <275 m depth. Stations are color coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

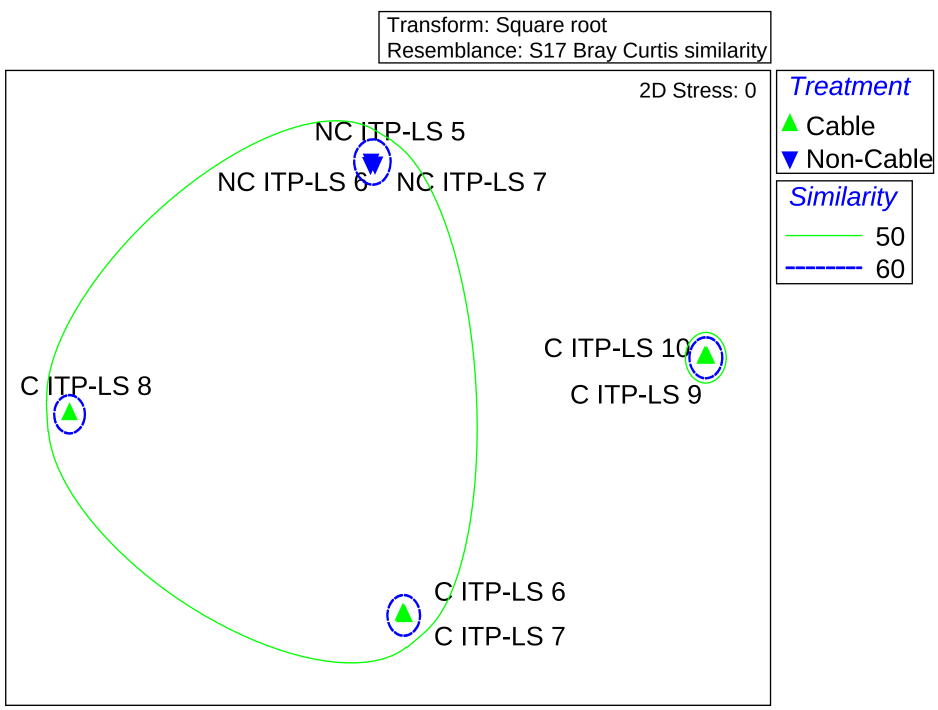

Figure 4-40. MDS plot of density data for all Inner Terrace Platform Low Slope Hardbottom habitat photostations in >275 m depth. Stations are color coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Outer Terrace Platform - Low Slope Hardbottom (Tables 4-30 – 4-31; Figures 4-41 – 4-43)
Sediment substrates dominated at all five stations, ranging from 52.1 to 88.7% of cover. Maximum cover by living organisms was 2.14% (station 5). Deep-sea coral habitat, chiefly as coral rubble, accounted for a small percentage of cover at stations C OTP LS 1 and 4.

Table 4-30. Percent cover data for all Cable Outer Terrace Platform Low Slope Hardbottom habitat photostations.

Cable - Outer Terrace Platform - Low Slope	C OTP-LS 1	C OTP-LS 2	C OTP-LS 3	C OTP-LS 4	C OTP-LS 5	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0.032	0	0	0.059	0	0.018	0.027	0.012
Coral Rubble (CR)	0.03	0.00	0.00	0.03	0.00	0.012	0.017	0.008
Solitary Coral (SC)	0.00	0.00	0.00	0.03	0.00	0.006	0.013	0.006
ARTHROPODA (ART)	0.127	0	0	0	0	0.025	0.057	0.025
CHORDATA (CHO)	0	0	0.027	0.030	0	0.011	0.016	0.007
CNIDARIA NON SCLERACTINIA (CNI)	0.668	0.447	0.327	0.207	0.536	0.437	0.179	0.080
ECHINODERMATA (ECH)	0.159	0.112	1.391	0.474	0.875	0.602	0.536	0.240
ECHIURA (ECR)	0	0.028	0.055	0	0.028	0.022	0.023	0.010
PORIFERA (POR)	0.796	0.279	0.218	0.444	0.649	0.477	0.244	0.109
UNIDENTIFIED ORGANISM (UND)	0.032	0	0	0	0.056	0.018	0.026	0.011
SOFT BOTTOM SUBSTRATE (SB)	67.187	52.108	88.707	86.264	72.340	73.321	14.940	6.681
HARD BOTTOM SUBSTRATE (HB)	30.968	46.858	9.056	12.256	24.922	24.812	15.247	6.819
CABLE (CB)	0.032	0.168	0.164	0.266	0.480	0.222	0.167	0.074
HUMAN DEBRIS (HUM)	0	0	0.055	0	0.113	0.033	0.050	0.022
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	1.782	0.500	3.526	3.486	2.905	2.440	1.293	0.578
Sum (excluding tape+shadow+wand)	100	100	100	100	100			

Variations among living organism densities and composition were too small to contribute to differences between Cable and Non-Cable station groups. The MDS plot revealed no significant effect of cable on percent substrate cover (Figure 4-41).

Organism densities ranged from 2.13 m^{-2} at station 4 to 6.96 m^{-2} at station 1. The identified taxa that contributed the most to faunal density were *Eunicella* sp. (mean 0.73 m^{-2} and 14%) and *P. nigra* (mean 0.56 m^{-2} and 12%) (Table 4-31, Figure 4-42), the same two as at the Non-Cable Outer Terrace Platform Low-Slope photostations. Both were substantially more common at stations 1 and 2 than at the remaining stations. By contrast, unidentified Porifera accounted for almost half of organism density at station 5 (Figure 4-42A). Mean density was lower at Non-Cable (3.67 m^{-2}) than Cable photostations (4.67 m^{-2}), although individual photostation densities overlapped widely: 1.67-9.44 m^{-2} at Non-Cable stations and 2.13-6.96 m^{-2} at Cable stations (Table 4-31). The primary overall faunal density difference between Non-Cable and Cable photostations was the substantially greater density of sponges (recorded as Unidentified Demospongiae and Unidentified Hexactinellida) at Cable photostations and the somewhat greater contribution to mean densities by *Eunicella* sp. and *Pseudodrifa nigra* at Non-Cable photostations (Figure 4-42B).

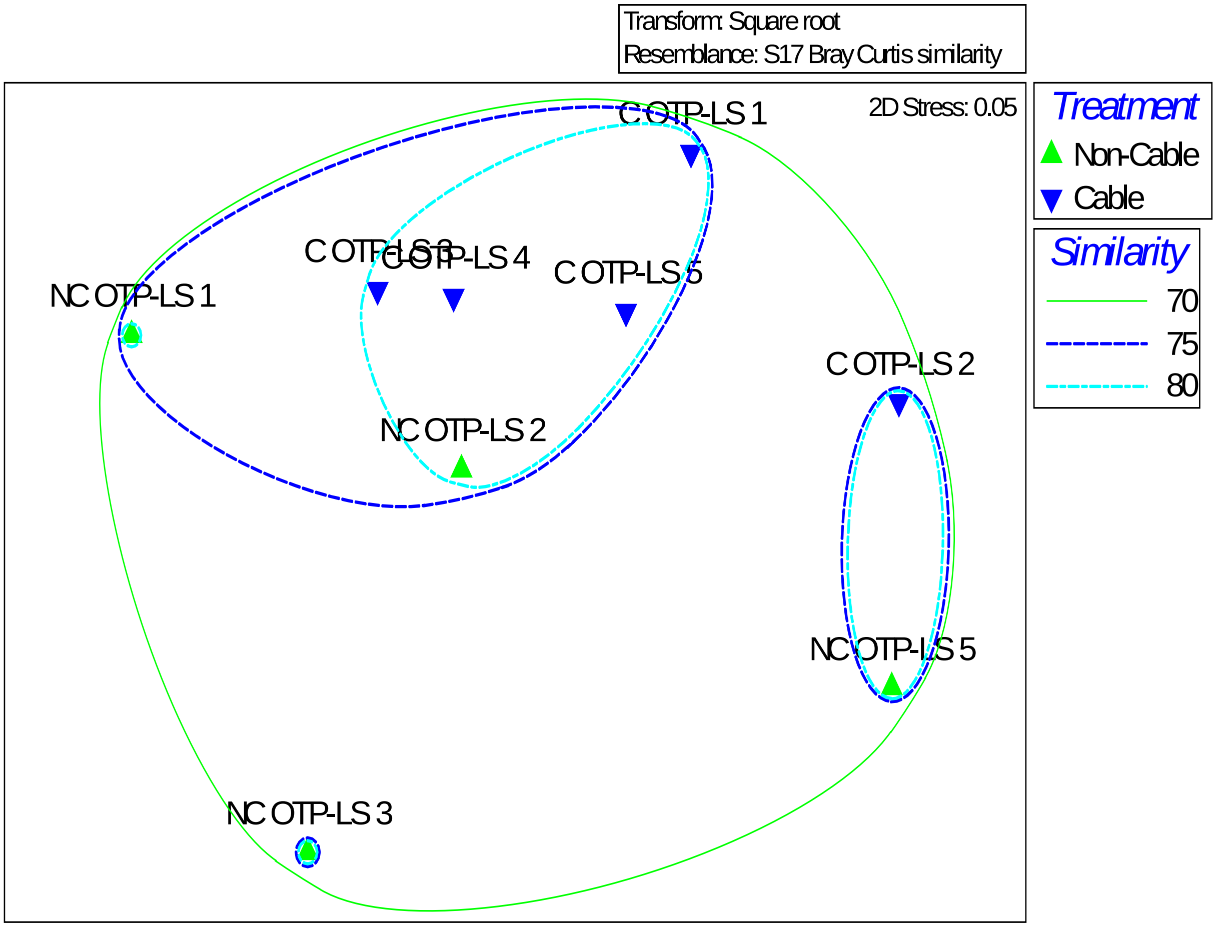

Figure 4-41. MDS plot of percent cover data for all Outer Terrace Platform Low-Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Station NC OTP-LS 4 was removed from analysis as an outlier [as noted above, likely due to its high percentage of hard substrate (86%) and coral rubble (9%) relative to the other stations in this habitat (0% coral rubble and no more than 37.4% hard substrate]. Circles indicate percent similarity from the cluster analysis.

An ANOSIM showed no significant differences between Cable and Non-Cable station groups. Their distribution appears to be mostly geographic: NC OTP LS stations 1, 2 and 5 all lie on the western side, whereas C OTP LS stations 3, 4 and 5, and NC OTP LS 3 are all in close proximity along a similar longitude. NC OTP LS 4 is again an outlier, grouping at a distance with C OTP LS stations 1 and 2 (Figure 4-43).

Table 4-31. Density data for all Non-Cable and Cable Outer Terrace Platform Low-Slope Hardbottom habitat photostations.

	Non-Cable Outer Terrace Platform Low-Slope									Cable Outer Terrace Platform Low-Slope								
	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA																		
DEMOSPONGIAE																		
Astrophorida					0.008	0.008	0.002											
Demospongiae unident.		0.124	0.017		0.053	0.194	0.039	0.052	0.028	0.944	0.848	0.559	0.397	0.088	2.835	0.567	0.346	0.245
Desmacellidae	0.076		0.035	0.241	0.038	0.390	0.078	0.095	0.055	0.256	0.245			0.058	0.560	0.112	0.129	0.091
Geodiidae		0.017		0.010		0.027	0.005	0.008	0.004									
Lithistida 1		0.008				0.008	0.002											
Pachastrellidae	0.019	0.008	0.069	0.060		0.157	0.031	0.031	0.022	0.020		0.027	0.125	0.175	0.347	0.069	0.077	0.054
Phakellia sp.	0.019	0.166	0.225	0.020	0.015	0.445	0.089	0.099	0.063	0.236	0.089	0.080	0.146	0.146	0.697	0.139	0.062	0.044
Raspailiidae				0.473		0.473	0.095				0.022	0.027	0.042	0.029	0.120	0.024	0.015	0.011
HEXACTINELLIDA																		
Aphrocallistes beatrix	0.171		0.017			0.188	0.038	0.075	0.027									
Euritidae/Farreidae	0.076	0.017	0.121	0.020	0.008	0.241	0.048	0.049	0.034	0.315	0.089	0.080	0.042	0.058	0.584	0.117	0.112	0.079
Hexactinellida unident.	0.076	0.050	0.035	0.010	0.181	0.351	0.070	0.066	0.050	0.629	0.312	0.692	0.376	0.643	2.652	0.530	0.173	0.122
Porifera unident.	0.114		1.159	0.594		1.867	0.373	0.503	0.264	0.020				2.104	2.124	0.425	0.939	0.664
CNIDARIA																		
HEXACORALLIA																		
?Actinauge sp.					0.030	0.030	0.006											
Actiniaria 2											0.022				0.022	0.004		
Actiniaria unident.	0.437	0.008		0.181	0.113	0.739	0.148	0.178	0.105	0.413	0.134	0.027	0.042		0.615	0.123	0.170	0.120
Actinoscyphia sp.				0.080	0.008	0.088	0.018	0.035	0.012	0.216	0.022				0.239	0.048	0.095	0.067
Antipatharia unident.				0.010		0.010	0.002			0.039				0.029	0.069	0.014	0.019	0.014
Corallimorphidae		0.008		0.010		0.018	0.004	0.005	0.003	0.059					0.059	0.012		
Liponema sp.	0.209	0.332	0.052	0.161	0.475	1.228	0.246	0.163	0.174	0.059	0.089	0.399	0.146		0.693	0.139	0.155	0.109
Lophelia pertusa				0.141		0.141	0.028											
Madrepora sp.			0.017			0.017	0.003											
Sagartiidae				0.050	0.030	0.080	0.016	0.023	0.011	0.020	0.045				0.064	0.013	0.020	0.014
Zoanthidea	0.646	0.017			0.008	0.670	0.134	0.286	0.095	0.079					0.079	0.016		
OCTOCORALLIA																		
Anthomastus sp.		0.017				0.017	0.003					0.027			0.027	0.005		
Eunicella sp.	0.114	0.041	0.294	2.827	0.354	3.631	0.726	1.181	0.513	1.317	0.848	0.266	0.251	0.351	3.032	0.606	0.467	0.330
Isididae			0.017	0.010	0.008	0.035	0.007	0.007	0.005		0.045			0.117	0.162	0.032	0.051	0.036
Octocorallia unident.		0.008				0.008	0.002											
Pennatulacea	0.057	0.041			0.023	0.121	0.024	0.025	0.017									
Primnoidae											0.179				0.179	0.036		
Pseudodrifa nigra	0.057	0.232		2.103	0.384	2.776	0.555	0.878	0.393	1.081	1.004	0.213	0.251	0.175	2.724	0.545	0.456	0.323
STYLASTERIDAE	0.152	0.373	0.035	0.151	0.279	0.990	0.198	0.131	0.140	0.511	1.272	0.027	0.063	0.292	2.165	0.433	0.508	0.359

Table 4-31, continued. Density data for all Non-Cable and Cable Outer Terrace Platform Low-Slope Hardbottom habitat photostations.

	Non-Cable Outer Terrace Platform Low-Slope									Cable Outer Terrace Platform Low-Slope								
	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.
ANNELIDA														0.029	0.029	0.006		
ECHIURA			0.069		0.023	0.092	0.018	0.030	0.013	0.098	0.112	0.053	0.042		0.305	0.061	0.045	0.032
MOLLUSCA		0.025	0.017	0.020		0.062	0.012	0.012	0.009	0.020			0.021		0.041	0.008	0.011	0.008
BRACHIOPODA				0.010		0.010	0.002			0.039		0.027		0.029	0.095	0.019	0.018	0.013
BRYOZOA													0.042		0.042	0.008		
ARTHROPODA	0.019	0.025	0.069	0.141	0.128	0.382	0.076	0.057	0.054	0.020	0.045		0.021	0.029	0.114	0.023	0.016	0.011
ECHINODERMATA																		
ASTEROIDEA																		
Asteroidea unident.	0.038		0.035	0.101	0.015	0.188	0.038	0.038	0.027	0.059	0.022		0.042		0.123	0.025	0.026	0.018
Goniasteridae		0.025				0.025	0.005							0.029	0.029	0.006		
Sclerasterias sp.		0.008				0.008	0.002											
ECHINOIDEA																		
Cidaridae	0.114	0.066	0.121	1.368	0.030	1.700	0.340	0.576	0.240	0.138	0.223	0.053	0.021	0.321	0.756	0.151	0.123	0.087
Gracilechinus sp.	0.019	0.008		0.020	0.008	0.055	0.011	0.008	0.008	0.059	0.045				0.104	0.021	0.029	0.020
CRINOIDEA																		
Comatulida	0.019	0.017		0.513	0.143	0.692	0.138	0.217	0.098	0.177	0.022		0.021	0.058	0.279	0.056	0.071	0.050
OPHIUROIDEA																		
Euryalidae		0.008		0.070		0.079	0.016	0.031	0.011		0.022				0.022	0.004		
HOLOTHUROIDEA																		
Psolidae				0.010		0.010	0.002			0.039	0.067		0.021		0.127	0.025	0.028	0.020
UNKNOWN ANIMAL	0.019	0.017	0.035	0.030		0.100	0.020	0.014	0.014	0.098	0.022	0.027	0.021	0.058	0.227	0.045	0.033	0.024
TOTAL	2.450	1.667	2.439	9.437	2.359	18.352	3.670	3.240	2.595	6.960	5.847	2.580	2.129	4.822	22.338	4.468	2.078	1.469

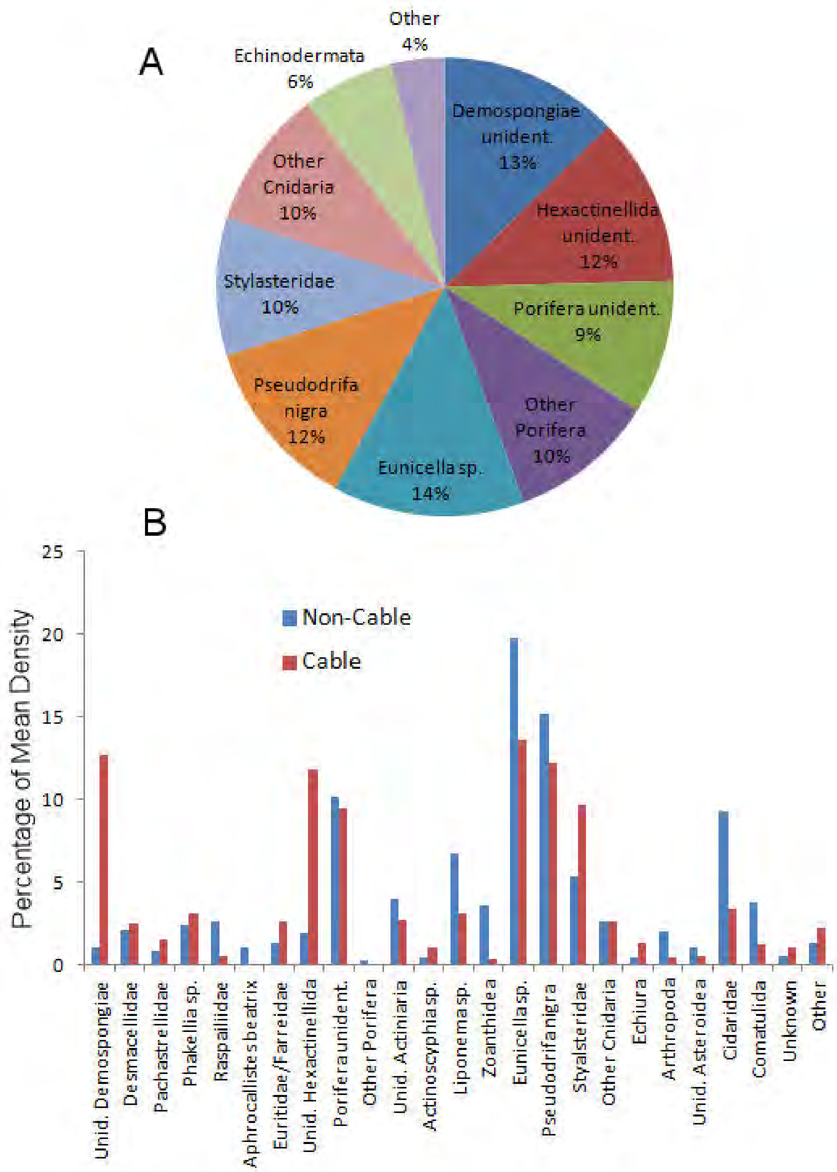

Figure 4-42. A. Macrofaunal organism densities (in m^{-2}) at the five Cable Outer Terrace Platform Low-Slope photostations expressed as percentages of the total of mean organism densities. Other Porifera includes identified demosponge and hexactinellid taxa, each of which occurs at <1 m^{-2}. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable OTP L-S photostations. Data summarized from Table 4-31.

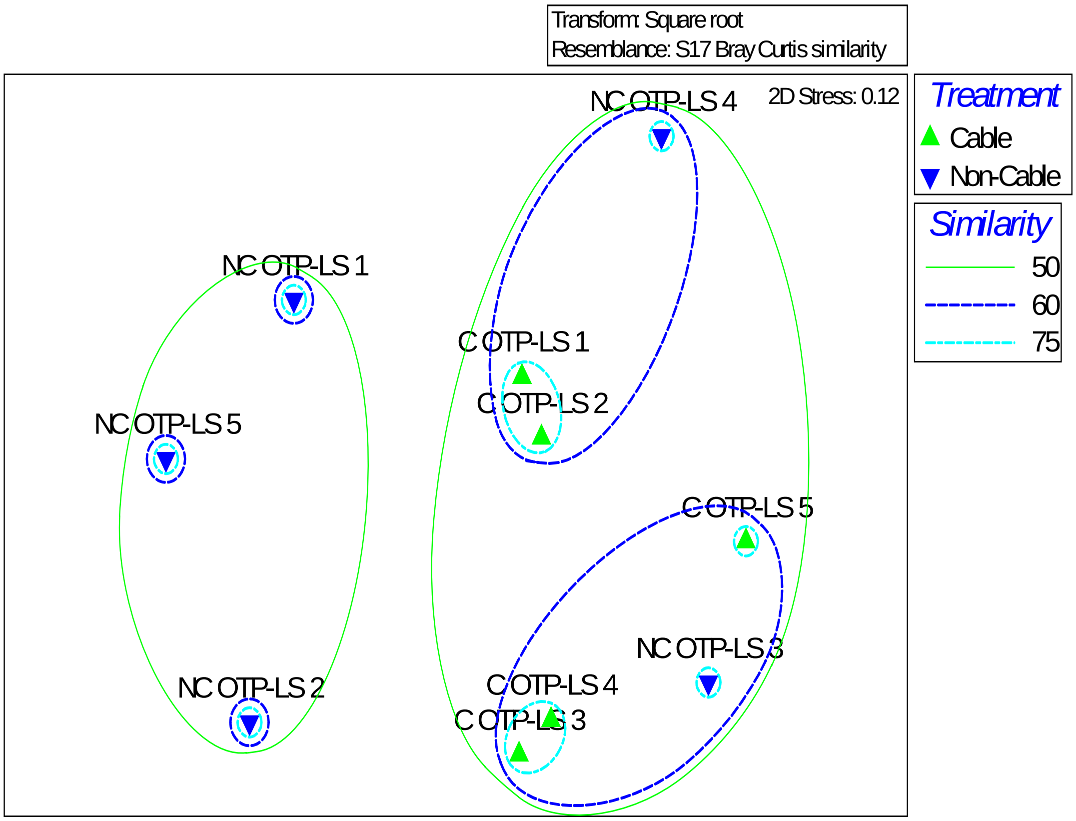

Figure 4-43. MDS plot of density data for all Outer Terrace Platform Low Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Station NC OTP-LS 4 was not removed from analysis as an outlier. Circles indicate percent similarity from the cluster analysis.

Outer Terrace Platform - High Slope Hardbottom (Tables 4-32 – 4-33; Figures 4-44 – 4-46)
Percent cover of hard substrates varied widely, ranging from 3.1% at C OTP HS 1 to 76.5% at C OTP HS 2. Cover by living organisms ranged from 0.843 (station 4) to 3.567% (station 3). Sponges accounted for most of living cover at stations 2 and 3, whereas echinoderms accounted for most at station 1. C OTP LS 3 also recorded a total deep-sea coral habitat cover of 0.43% including 0.028% living coral (*Lophelia pertusa*).

Again, the MDS plot of relative cover reflected percentages of hard versus soft substrates; living organism cover was too low to contribute significantly to any distinctions, and there were no significant differences based on Cable versus Non-Cable stations. The 95.3% sediment cover at station C OTP HS 1 generated its outlying position in the MDS plot in Figure 4-44.

Table 4-32. Percent cover data for all Cable Outer Terrace Platform High Slope Hardbottom habitat photostations.

Cable - Outer Terrace Platform - High Slope	C OTP-HS 1	C OTP-HS 2	C OTP-HS 3	C OTP-HS 4	MEAN	Std. Dev.	Std. Err.
CORAL (COR)	0.000	0.000	0.425	0.000	0.106	0.212	0.106
Colonial Dead Coral (DC)	0.000	0.000	0.227	0.000	0.057	0.113	0.057
Coral Rubble (CR)	0.000	0.000	0.170	0.000	0.042	0.085	0.042
Lophelia (LOP)	0.000	0.000	0.028	0.000	0.007	0.014	0.007
ARTHROPODA (ART)	0.000	0.000	0.057	0.158	0.054	0.074	0.037
CHORDATA (CHO)	0.000	0.032	0.000	0.000	0.008	0.016	0.008
CNIDARIA NON SCLERACTINIA (CNI)	0.169	0.223	0.821	0.316	0.382	0.299	0.149
ECHINODERMATA (ECH)	1.124	0.128	0.396	0.000	0.412	0.503	0.251
ECHIURA (ECR)	0.000	0.000	0.028	0.000	0.007	0.014	0.007
MOLLUSCA (MOL)	0.000	0.000	0.142	0.000	0.035	0.071	0.035
PORIFERA (POR)	0.000	1.563	2.067	0.316	0.987	0.987	0.494
UNIDENTIFIED ORGANISM (UND)	0.000	0.032	0.028	0.053	0.028	0.022	0.011
SOFT BOTTOM SUBSTRATE (SB)	95.278	20.772	48.343	32.859	49.313	32.655	16.327
HARD BOTTOM SUBSTRATE (HB)	3.092	76.452	47.352	66.140	48.259	32.432	16.216
CABLE (CB)	0.112	0.734	0.113	0.158	0.279	0.304	0.152
HUMAN DEBRIS (HUM)	0.056	0.064	0.028	0.000	0.037	0.029	0.015
NATURAL DETRITUS (DET)	0.169	0.000	0.198	0.000	0.092	0.107	0.053
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	1.167	0.508	0.535	0.053	0.566	0.458	0.229
Sum (excluding tape+shadow+wand)	100	100	100	100			

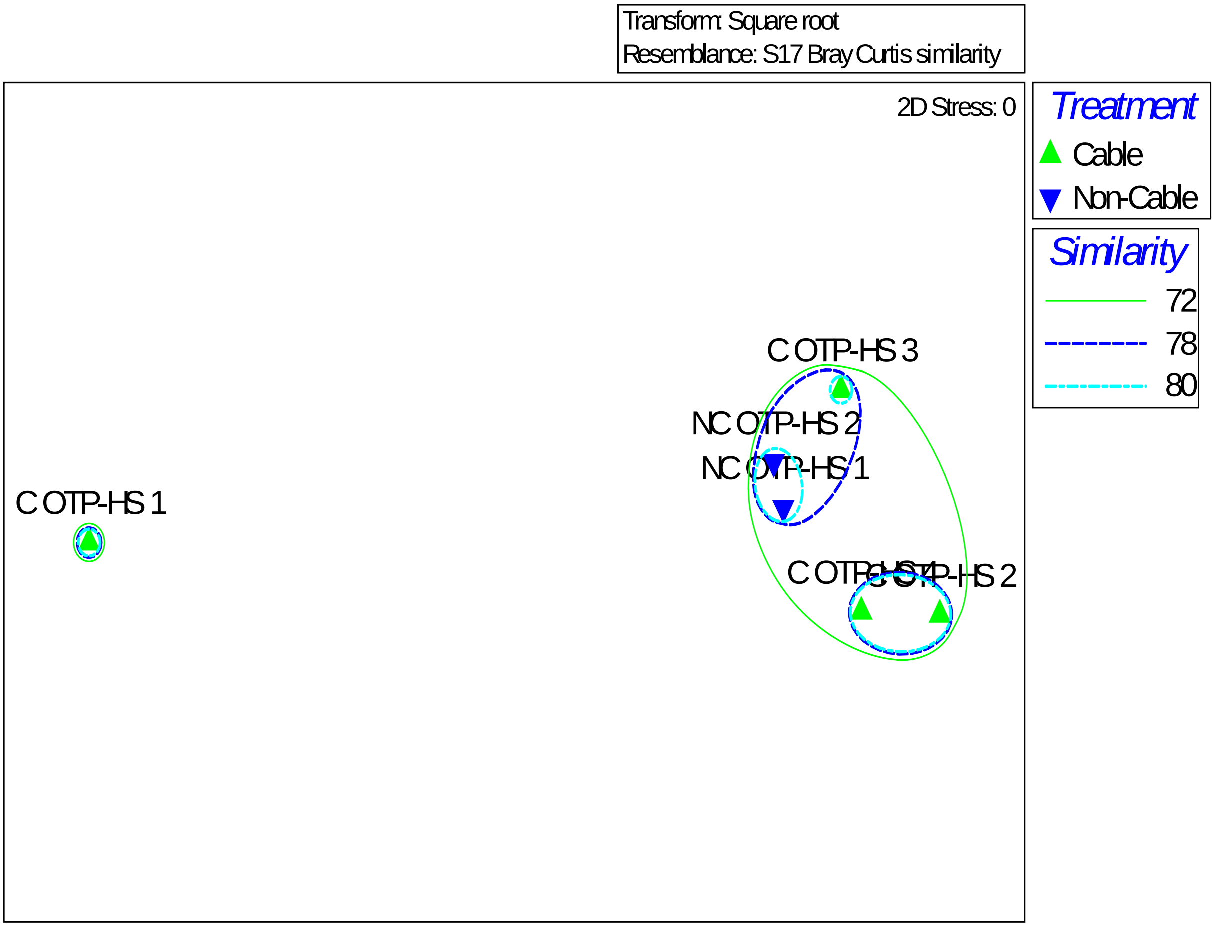

Figure 4-44. MDS plot of percent cover data for all Outer Terrace Platform High Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Organism densities ranged widely across the four stations, from 1.87 to 9.51 organisms m^{-2} (Table 4-33). Mean and maximum densities were substantially greater at the Cable photostations, perhaps at least in part because there were twice as many; both Non-Cable and Cable recorded one station each with similarly low densities (1.32 m^{-2} at NC OTP H-S 1 and 1.87 m^{-2} at C OTP H-S 1). The blue encrusting sponge in the family Desmacellidae was the most abundant taxon at the Cable photostations, accounting for 21% of organism density (mean 1.42 m^{-2}), much more than at the Non-Cable photostations (Figure 4-45). All other sponges together accounted for 27% of organism density, similar to the 30% accounted for by all sponges at the Non-Cable photostations. Again, sponge groups varied between Non-Cable and Cable stations as a result of the difficulty in identifying taxa from photographs (or video) in this group, i.e., chiefly unidentified demosponges and hexactinellids at Non-Cable versus *Phakellia* sp. and unidentified Porifera at Cable photostations (Figure 4-45B) *Pseudodrifa nigra* (mean 0.87 m^{-2} and 13%) accounted for the next greatest contribution to mean density, similar to that at the Non-Cable OTP High-Slope stations. The greater density of primnoid octocorals at NC OTP H-S 2 (0.46 m^{-2}) may have resulted from local exposure to stronger or more consistent near benthic flow.

Table 4-33. Density data for all Cable Outer Terrace Platform High-Slope Hardbottom habitat photostations.

	Non-Cable Outer Terrace Platform High-Slope						Cable Outer Terrace Platform High-Slope							
	1	2	TOT	MEAN	STD.DEV.	STD.ERR.	1	2	3	4	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA														
DEMOSPONGIAE														
Demospongiae unident.	0.333	0.352	0.685	0.342	0.013	0.009	0.818	0.101	0.675	0.014	1.607	0.402	0.403	0.285
Desmacellidae	0.121	0.054	0.175	0.088	0.047	0.033		2.242	2.513	0.941	5.695	1.424	1.171	0.828
Geodiidae	0.015	0.014	0.029	0.014	0.001	0.001		0.020		0.014	0.034	0.009	0.010	0.007
Lithistida 1									0.017	0.014	0.031	0.008	0.009	0.006
Pachastrellidae	0.015	0.054	0.069	0.035	0.028	0.019		0.040	0.202	0.041	0.284	0.071	0.090	0.063
Phakellia sp.		0.041	0.041	0.020			0.196	1.333	0.253	0.028	1.810	0.452	0.595	0.421
Raspailiidae		0.095	0.095	0.047				0.384	0.219	0.055	0.658	0.165	0.173	0.123
HEXACTINELLIDA														
Euritidae/Farreidae		0.041	0.041	0.020				0.020	0.067	0.083	0.171	0.043	0.039	0.028
Hexactinellida unident.		0.271	0.271	0.135			0.098				0.098	0.025		
Porifera Unident.	0.015		0.015	0.008			0.164	0.646	0.354	1.328	2.492	0.623	0.510	0.361
CNIDARIA														
HEXACORALLIA														
Actiniaria 2								0.020			0.020	0.005		
Actiniaria unident.	0.106	0.027	0.133	0.066	0.056	0.039		0.061	0.202	0.097	0.360	0.090	0.085	0.060
Actinoscyphia sp.	0.015	0.014	0.029	0.014	0.001	0.001		0.202	0.556	0.221	0.980	0.245	0.231	0.163
Antipatharia	0.030		0.030	0.015				0.020		0.014	0.034	0.009	0.010	0.007
Cerianthidae										0.028	0.028	0.007		
Corallimorphidae		0.027	0.027	0.014						0.055	0.055	0.014		
Liponema sp.		0.162	0.162	0.081				0.081	0.034	0.055	0.170	0.042	0.034	0.024
Lophelia pertusa		0.014	0.014	0.007										
Sagartiidae		0.014	0.014	0.007					0.067	0.249	0.316	0.079	0.118	0.083
Zoanthidea								0.040	0.084		0.125	0.031	0.040	0.028
OCTOCORALLIA														
Eunicella sp.	0.015	0.135	0.150	0.075	0.085	0.060	0.229		0.455	0.775	1.459	0.365	0.330	0.234
Octocorallia unident.	0.045		0.045	0.023										
Pennatulacea									0.017		0.017	0.004		
Primnoidae		0.460	0.460	0.230						0.055	0.055	0.014		
Pseudodrifa nigra	0.030	0.717	0.747	0.374	0.486	0.343	0.065	1.030	0.658	1.729	3.482	0.871	0.697	0.493
STYLASTERIDAE	0.151	0.893	1.044	0.522	0.524	0.371		0.040	1.450	0.705	2.196	0.549	0.682	0.482
ANNELIDA										0.290	0.290	0.073		
ECHIURA							0.033	0.020		0.014	0.067	0.017	0.014	0.010
MOLLUSCA	0.015	0.041	0.056	0.028	0.018	0.013		0.020			0.020	0.005		
BRACHIOPODA										0.014	0.014	0.003		
ARTHROPODA	0.015	0.014	0.029	0.014	0.001	0.001	0.033		0.185	0.124	0.343	0.086	0.085	0.060
ECHINODERMATA														
ASTEROIDEA														
Asteroidea unident.	0.045	0.027	0.072	0.036	0.013	0.009	0.033	0.121	0.017	0.041	0.212	0.053	0.047	0.033
Coronaster briareus										0.014	0.014	0.003		
Goniasteridae										0.014	0.014	0.003		
Novodinia sp.	0.015		0.015	0.008										
ECHINOIDEA														
Araeosoma sp.									0.017		0.017	0.004		
Cidaridae	0.030	0.149	0.179	0.090	0.084	0.059	0.033	1.111	0.438	0.249	1.831	0.458	0.466	0.329
Coelopleurus floridanus		0.014	0.014	0.007										
Gracilechinus sp.								0.020			0.020	0.005		
CRINOIDEA														
Comatulida	0.272	0.027	0.299	0.150	0.173	0.123		0.020	0.860	0.235	1.115	0.279	0.402	0.284
OPHIUROIDEA														
Euryalidae								0.020	0.067	0.014	0.101	0.025	0.029	0.021
Gorgonocephalidae										0.014	0.014	0.003		
HOLOTHUROIDEA														
Psolidae	0.015		0.015	0.008			0.033		0.051	0.028	0.111	0.028	0.021	0.015
UNKNOWN ANIMAL	0.015	0.027	0.042	0.021	0.008	0.006	0.131	0.202	0.051	0.083	0.466	0.117	0.066	0.047
TOTAL	1.316	3.680	4.996	2.498	1.672	1.182	1.865	7.816	9.511	7.635	26.826	6.707	3.337	2.359

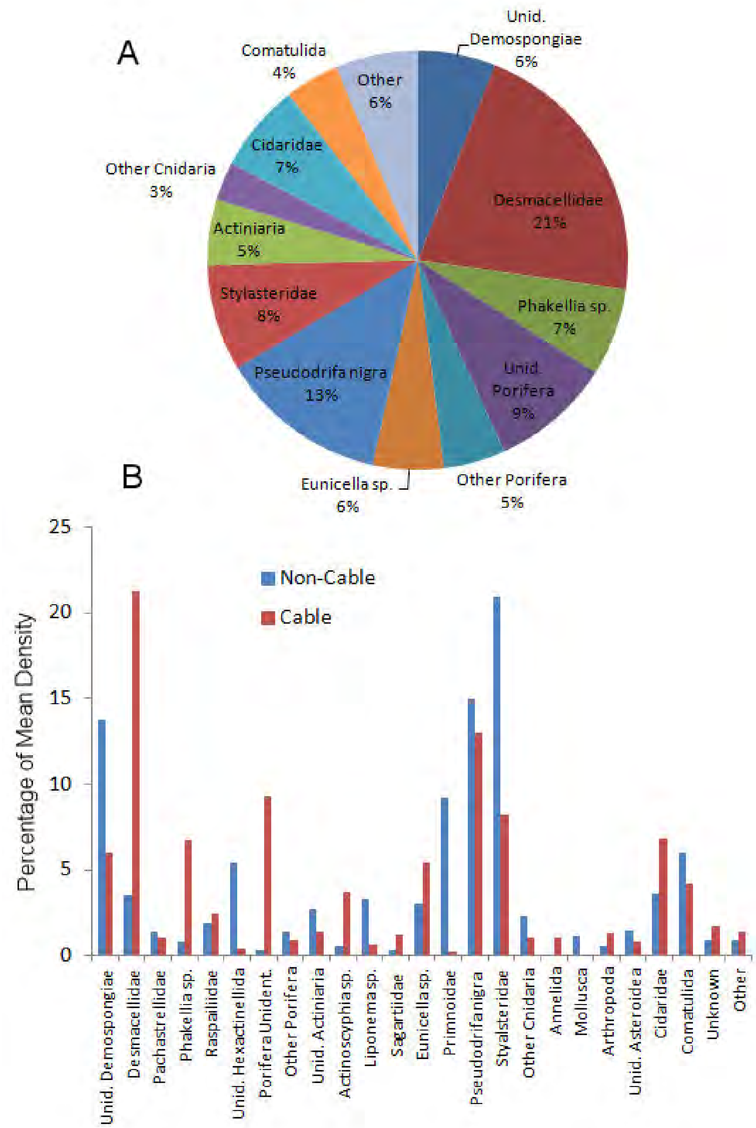

Figure 4-45. A. Macrofaunal organism densities (in m^{-2}) at the four Cable Outer Terrace Platform High-Slope photostations expressed as percentages of mean benthic organism abundance. Other Porifera includes identified demosponges and hexactinellids, each of which occurs at <1 m^{-2}. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable OTP H-S photostations. Data summarized from Table 4-33.

The MDS plot of density data showed no significant difference attributable to the presence versus absence of cable (Figure 4-46). Station distributions appeared to be chiefly geographic; the three cable stations C OTP HS 2, 3 and 4 all grouped closely together but also with NC OTP HS 2 at >50% similarity. The two outlying stations in the plot, C OTP HS 1 and NC OTP HS 1, both recorded far lower organism densities than at any of the other stations in this habitat, both Cable and Non-Cable.

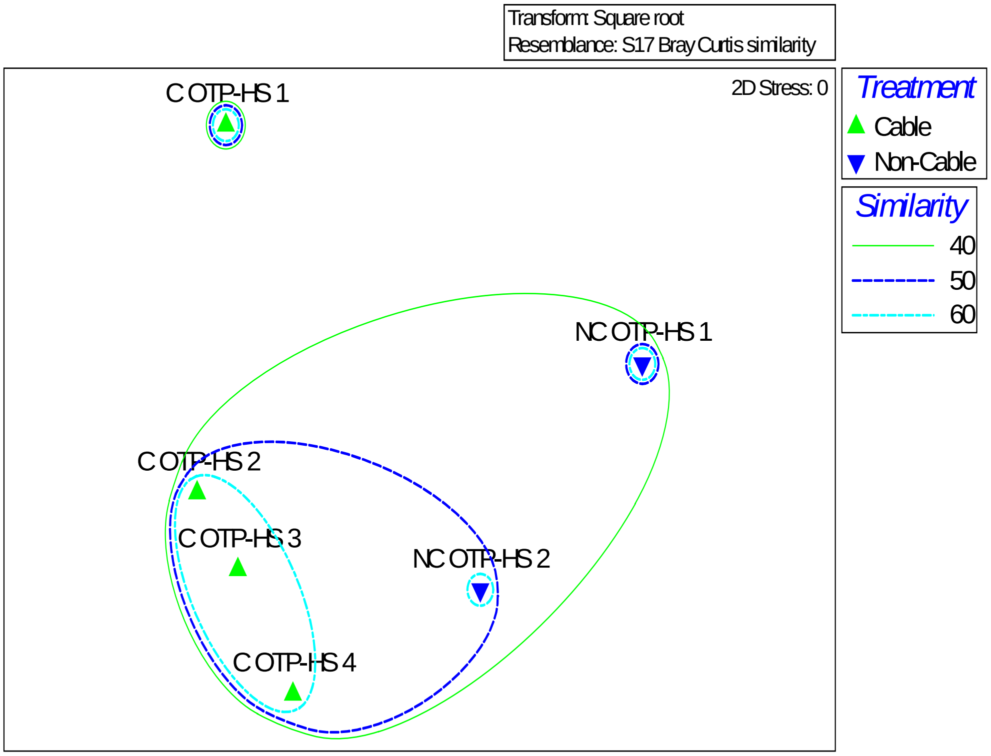

Figure 4-46. MDS plot of density data for all Outer Terrace Platform High Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Outer Terrace Ridge - Low Slope Hardbottom (Table 4-34 – 4-35; Figure 4-47)

Percent cover at the single cable station in this habitat was roughly split between hard and soft substrates, with 1.6% deep-sea coral habitat (chiefly coral rubble) and living organisms contributing 1.39% (Table 4-34).

Table 4-34. Percent cover data for all Cable Outer Terrace Ridge Low Slope Hardbottom habitat photostations.

Cable - Outer Terrace Ridge - Low Slope	C OTR-LS 1
CORAL (COR)	1.602
Colonial Dead Coral (DC)	0.092
Coral Rubble (CR)	1.510
CNIDARIA NON SCLERACTINIA (CNI)	0.370
ECHINODERMATA (ECH)	0.247
PORIFERA (POR)	0.770
SOFT BOTTOM SUBSTRATE (SB)	41.726
HARD BOTTOM SUBSTRATE (HB)	55.193
CABLE (CB)	0.062
HUMAN DEBRIS (HUM)	0.031
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	4.531
Sum (excluding tape+shadow+wand)	100

Both densities and major faunal components were similar at Non-Cable (mean 7.44 m^{-2}) and Cable (5.11 m^{-2}) photostations (Table 4-35). Sponges dominated at both, but with most recorded as Unidentified Porifera at NC stations and as Unidentified Demospongiae at the Cable photostation. The next most abundant taxa, *Eunicella* sp. and Stylasteridae, accounted for similar proportions of density at both sets of stations (Figure 4-47B).

Table 4-35. Density data for all Outer Terrace Ridge Low Slope Hardbottom habitat photostation. C OTR L-S refers to the single Cable Outer Terrace Ridge Low-Slope photostation.

	Non-Cable Outer Terrace Ridge Low-Slope						C OTR L-S
NC OTR LS	1	2	TOT	MEAN	STD.DEV.	STD.ERR.	1
PORIFERA							
DEMOSPONGIAE							
Astrophorida	0.012	0.126	0.138	0.069	0.080	0.057	
Demospongiae unident.	0.143	0.597	0.740	0.370	0.321	0.227	0.901
Desmacellidae	0.059	0.024	0.083	0.042	0.025	0.018	0.171
Geodiidae		0.016	0.016	0.008			
Lithistida 1	0.309	0.063	0.372	0.186	0.174	0.123	0.140
Lithistida 2	0.024	0.094	0.118	0.059	0.050	0.035	
Pachastrellidae	0.143	0.047	0.190	0.095	0.068	0.048	0.047
Phakellia sp.	0.036	0.346	0.381	0.191	0.219	0.155	0.047
Raspailiidae	0.238	0.157	0.395	0.197	0.057	0.040	0.016
Spongosorites sp.	0.095	0.016	0.111	0.055	0.056	0.040	0.062
HEXACTINELLIDA							
Aphrocallistes beatrix	0.012		0.012	0.006			
Euritidae/Farreidae	0.202	0.024	0.226	0.113	0.126	0.089	
Hexactinellida unident.	0.059	0.471	0.531	0.265	0.291	0.206	0.264
Hyalonema sp.		0.008	0.008	0.004			
Vazella sp.		0.008	0.008	0.004			
Porifera unident.	2.248		2.248	1.124			0.171
CNIDARIA							
HEXACORALLIA							
Actiniaria unident.	0.048	0.228	0.275	0.138	0.127	0.090	0.140
Actinoscyphia sp.							0.078
Corallimorphidae	0.012		0.012	0.006			0.016
Liponema sp.	0.095	0.079	0.174	0.087	0.012	0.008	0.016
Lophelia pertusa							0.016
Zoanthidea		0.024	0.024	0.012			
OCTOCORALLIA							
Eunicella sp.	2.866	0.118	2.984	1.492	1.944	1.374	1.040
Isididae		0.094	0.094	0.047			
Plexauridae		0.039	0.039	0.020			0.124
Primnoidae	0.095	0.267	0.362	0.181	0.122	0.086	0.202
Pseudodrifa nigra	0.071	0.016	0.087	0.044	0.039	0.028	0.031
STYLASTERIDAE	0.856	1.948	2.804	1.402	0.772	0.546	0.885
ANNELIDA	0.012		0.012	0.006			
ECHIURA	0.012		0.012	0.006			0.016
MOLLUSCA	0.012	0.016	0.028	0.014	0.003	0.002	
BRYOZOA	0.036	0.024	0.059	0.030	0.009	0.006	0.031
BRACHIOPODA	0.012		0.012	0.006			
ARTHROPODA	0.071	0.024	0.095	0.047	0.034	0.024	0.031
ECHINODERMATA							
ASTEROIDEA							
Asteroidea unident.	0.059	0.008	0.067	0.034	0.036	0.026	
Goniasteridae	0.012	0.008	0.020	0.010	0.003	0.002	
Linckia sp.		0.008	0.008	0.004			
ECHINOIDEA							
Cidaridae	0.393	0.385	0.777	0.389	0.005	0.004	0.311
Coelopleurus floridanus		0.016	0.016	0.008			
Echinoidea unident.							
Gracilechinus sp.							
CRINOIDEA							
Comatulida	1.070	0.149	1.220	0.610	0.651	0.461	0.311
OPHIUROIDEA							
Euryalidae		0.008	0.008	0.004			
Gorgonocephalidae							
HOLOTHUROIDEA							
Psolidae	0.024		0.024	0.012			
UROCHORDATA							0.047
UNKNOWN ANIMAL	0.059	0.024	0.083	0.042	0.025	0.018	
TOTAL	9.396	5.474	14.870	7.435	2.774	1.961	5.109

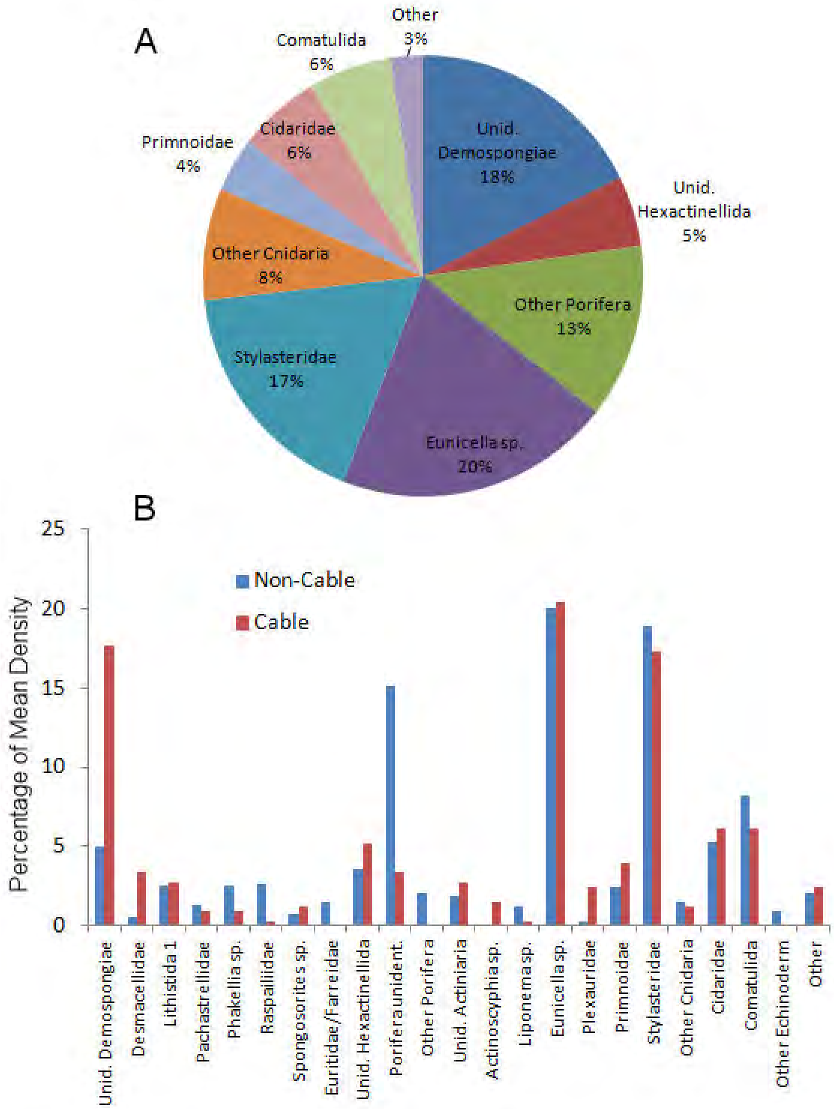

Figure 4-47. A. Macrofaunal organism densities (in m^{-2}) at the Cable Outer Terrace Ridge Low-Slope photostation expressed as percentages of benthic organism abundance. Other Porifera includes identified demosponges and unidentified Porifera, each of which occurs at <1 m^{-2}. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable OTR L-S photostations. Percentage values for Non-Cable stations are based on mean densities of the two stations; there was only one Cable station. Data summarized from Table 4-37.

Outer Terrace Ridge - High Slope Hardbottom (Tables 4-36 – 4-37 ; Figures 4-48 – 4-50)

Percent cover of hard substrates varied considerably but remained greater than 50% at all five photostations: 58.7-91.8% (Table 4-36). Deep-sea coral habitat contributed 0.18 to 0.54% at four stations, but accounted for 9.87% at C OTR HS 5. Living *L. pertusa* accounted for all of the deep-sea coral at C OTR HS 4. Non-coral living organisms contributed at most 2.93% (at C OTR HS 4).

Table 4-36. Percent cover data for all Cable Outer Terrace Ridge High Slope Hardbottom habitat photostations.

Cable - Outer Terrace Ridge - High Slope	C OTR-HS 1	C OTR-HS 2	C OTR-HS 3	C OTR-HS 4	C OTR-HS 5	MEAN	Std.Dev.	Std.Err.
CORAL (COR)	0.184	0.041	0.236	0.544	9.874	2.176	4.307	1.926
Colonial Dead Coral (DC)	0.074	0	0.157	0	3.678	0.782	1.620	0.725
Coral Rubble (CR)	0	0	0	0	6.045	1.209	2.704	1.209
Lophelia (LOP)	0	0	0	0.544	0	0.109	0.243	0.109
Solitary Coral (SC)	0.110	0.041	0.079	0	0.151	0.076	0.059	0.026
CHORDATA (CHO)	0	0.041	0	0	0	0.008	0.019	0.008
CNIDARIA NON SCLERACTINIA (CNI)	0.037	0.083	0.394	1.306	0.453	0.454	0.510	0.228
ECHINODERMATA (ECH)	0.037	0.207	0.787	0.326	0.756	0.423	0.335	0.150
BRYZOA (BRY)	0	0	0.079	0	0	0.016	0.035	0.016
PORIFERA (POR)	0.258	0.703	1.181	1.306	0.605	0.810	0.431	0.193
UNIDENTIFIED ORGANISM (UND)	0	0	0	0	0.252	0.050	0.113	0.050
SOFT BOTTOM SUBSTRATE (SB)	7.548	17.377	19.606	37.758	22.015	20.861	10.929	4.888
HARD BOTTOM SUBSTRATE (HB)	91.826	81.547	77.638	58.651	66.045	75.141	13.042	5.832
CABLE (CB)	0.110	0	0.079	0.109	0	0.060	0.056	0.025
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	3.000	1.307	2.308	8.100	3.171	3.577	2.633	1.177
Sum (excluding tape+shadow+wand)	100	100	100	100	100			

An MDS plot (Figure 4-48) of percent cover data for all OTR HS habitat photostations showed overlap of Cable and Non-Cable stations at the 70% similarity level, except outlying NC OTR HS 2. Living components again represented too small a contribution of percent cover to generate any significant difference between Cable and Non-Cable groups of stations. The presence versus absence of cable did not significantly affect substrate type.

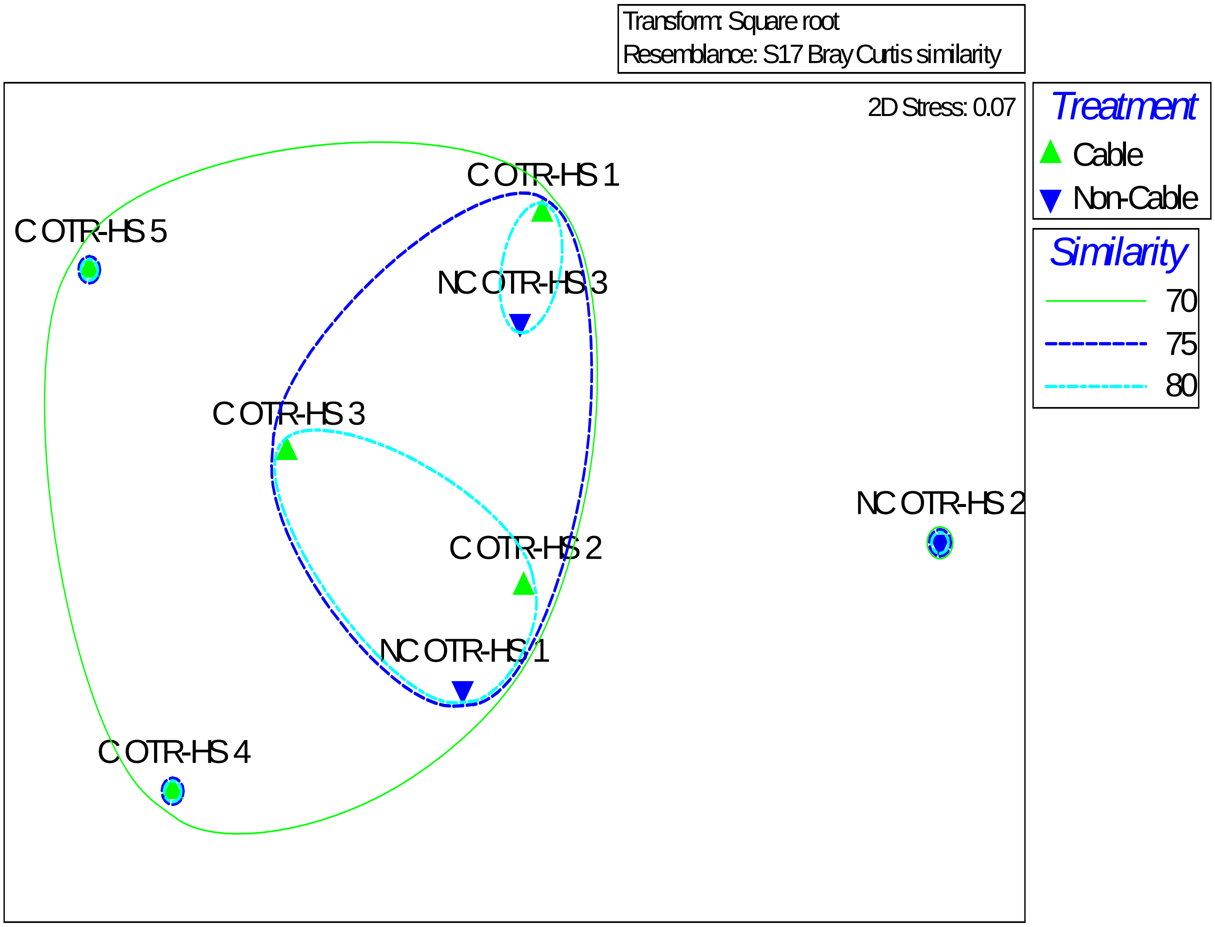

Figure 4-48. MDS plot of percent cover data for all Outer Terrace Ridge High Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Organism densities varied substantially, increasing progressively westward upslope toward the ridge crest, from 1.40 m^{-2} at C OTR HS 1 to 9.26 m^{-2} at C OTR HS 5, a possible reflection of increasing exposure to near-bottom current (Table 4-37). All sponges combined accounted for 44% of total density (Figure 4-49A), substantially greater than the 27% at the Non-Cable OTR High-Slope stations, and chiefly recorded as Unidentified Porifera. *Eunicella* sp., Primnoidae and *P. nigra* were again important identified components as at the NC OTR HS stations. *Eunicella* sp. was again the greatest contributor to mean density (mean 2.27 m^{-2} and 13%), but not nearly as great a percentage as at the Non-Cable photostations (40%) (Figure 4-49B). As at the Non-Cable photostations, high densities of major identified contributors did not occur at all stations, e.g., *P. nigra* was only observed at C OTR HS 5.

Table 4-37. Density data for all Cable Outer Terrace Ridge High Slope Hardbottom habitat photostations.

	Non-Cable Outer Terrace Ridge High-Slope							Cable Outer Terrace Ridge High-Slope								
	1	2	3	TOT	MEAN	STD.DEV.	STD.ERR.	1	2	3	4	5	TOT	MEAN	STD.DEV.	STD.ERR.
PORIFERA																
DEMOSPONGIAE																
Astrophorida										0.063	0.068		0.131	0.026	0.036	0.025
Demospongiae unident.	0.754	0.532	0.534	1.820	0.607	0.127	0.090	0.548	1.635	1.200	1.627	0.271	5.281	1.056	0.624	0.441
Desmacellidae	0.017	0.099		0.116	0.039	0.053	0.038	0.010	0.036	0.032	0.316	0.109	0.502	0.100	0.126	0.089
Geodiidae	0.008			0.008	0.003							0.018	0.018	0.004		
Leiodermatium sp.			0.031	0.031	0.010											
Lithistida 1	0.215	0.054	0.016	0.285	0.095	0.106	0.075	0.020			0.226		0.246	0.049	0.099	0.070
Pachastrellidae	0.025	0.036	0.016	0.077	0.026	0.010	0.007	0.040	0.018	0.032	0.068	0.181	0.338	0.068	0.066	0.047
Phakellia sp.	0.099	0.180	0.110	0.390	0.130	0.044	0.031	0.259	0.320	0.379	0.023		0.980	0.196	0.174	0.123
Raspailiidae	0.240	0.694	0.031	0.966	0.322	0.339	0.240	0.040	0.551	0.442	0.090	0.090	1.214	0.243	0.236	0.167
Spongosorites sp.	0.008			0.008	0.003					0.032	0.045	0.036	0.113	0.023	0.021	0.015
HEXACTINELLIDA																
Aphrocallistes beatrix		0.009		0.009	0.003											
Euritidae/Farreidae	0.099	0.099		0.199	0.066	0.057	0.041					0.109	0.109	0.022		
Hexactinellida unident.	0.215	0.135	0.252	0.602	0.201	0.060	0.042		0.053	0.411	0.158		0.622	0.124	0.172	0.122
Vazella sp.	0.008		0.031	0.040	0.013	0.016	0.012	0.010	0.071		0.023		0.104	0.021	0.030	0.021
Porifera unident.									0.071	1.074	0.520	1.302	2.967	0.593	0.584	0.413
CNIDARIA																
HEXACORALLIA																
Actiniaria 2	0.008		0.031	0.040	0.013	0.016	0.012									
Actiniaria unident.	0.025	0.108		0.133	0.044	0.057	0.040	0.050	0.018		0.023	0.054	0.144	0.029	0.023	0.016
Bathypathes alternata	0.008		0.031	0.040	0.013	0.016	0.012									
Corallimorphidae	0.025	0.036	0.016	0.077	0.026	0.010	0.007					0.036	0.036	0.007		
Liponema sp.	0.083	0.207	0.016	0.306	0.102	0.097	0.069	0.010	0.142	0.063		0.018	0.233	0.047	0.059	0.041
Lophelia pertusa	0.008			0.008	0.003			0.010				0.018	0.028	0.006	0.008	0.006
Madrepora sp.			0.016	0.016	0.005											
Sagartiidae	0.008	0.009		0.017	0.006	0.005	0.004					0.072	0.072	0.014		
Zoanthidea										0.032			0.032	0.006		
OCTOCORALLIA																
Anthomastus sp.											0.023		0.023	0.005		
Eunicella sp.	2.153	4.606	0.047	6.806	2.269	2.282	1.613	0.010	0.160	0.884	1.356	2.188	4.598	0.920	0.895	0.633
Isididae		0.009	0.063	0.072	0.024	0.034	0.024	0.080	0.124	0.063	0.023		0.290	0.058	0.049	0.035
Octocorallia unident.	0.008	0.009	0.283	0.300	0.100	0.158	0.112		0.018		0.023		0.040	0.008	0.011	0.008
Pennatulacea	0.008			0.008	0.003											
Primnoidae	0.066		1.037	1.104	0.368	0.581	0.411	0.189	0.018	0.095	0.768	0.904	1.974	0.395	0.410	0.290
Pseudodrifa nigra	0.091	0.388		0.479	0.160	0.203	0.143					1.157	1.157	0.231		
STYLASTERIDAE	0.091	0.388		0.479	0.160	0.203	0.143	0.050	0.089	0.632	1.379	0.543	2.691	0.538	0.538	0.380
MOLLUSCA	0.017	0.009		0.026	0.009	0.008	0.006	0.010					0.010	0.002		
BRYOZOA	0.017	0.018	0.016	0.050	0.017	0.001	0.001		0.071	0.158	0.023	0.018	0.270	0.054	0.064	0.045
ARTHROPODA	0.033	0.018	0.031	0.083	0.028	0.008	0.006		0.107	0.063		0.054	0.224	0.045	0.045	0.032
ECHINODERMATA																
ASTEROIDEA																
Asteroidea unident.	0.116	0.153		0.269	0.090	0.080	0.057			0.032	0.023	0.036	0.090	0.018	0.017	0.012
Goniasteridae	0.025		0.016	0.041	0.014	0.013	0.009									
Linckia sp.		0.009		0.009	0.003											
Sclerasterias sp.	0.008			0.008	0.003											
Tremaster mirabilis	0.017			0.017	0.006											
ECHINOIDEA																
Cidaridae	0.373	0.568		0.941	0.314	0.289	0.204				0.633	0.416	1.049	0.210	0.297	0.210
Echinoidea unident.	0.008			0.008	0.003				0.018				0.018	0.004		
Gracilechinus sp.	0.033			0.033	0.011			0.010					0.010	0.002		
CRINOIDEA																
Comatulida	0.613	0.370	0.126	1.108	0.369	0.244	0.172		0.373	0.726	0.181	1.447	2.727	0.545	0.571	0.404
OPHIUROIDEA																
Euryalidae												0.036	0.036	0.007		
Gorgonocephalidae											0.023		0.023	0.005		
HOLOTHUROIDEA																
Psolidae									0.018			0.018	0.036	0.007	0.010	0.007
UROCHORDATA		0.072	0.016	0.088	0.029	0.038	0.027			0.063			0.063	0.013		
UNKNOWN ANIMAL								0.060	0.089	0.189	0.226	0.127	0.691	0.138	0.069	0.049
TOTAL	5.532	8.815	2.767	17.114	5.705	3.028	2.141	1.404	3.999	6.663	7.866	9.259	29.191	5.838	3.144	2.223

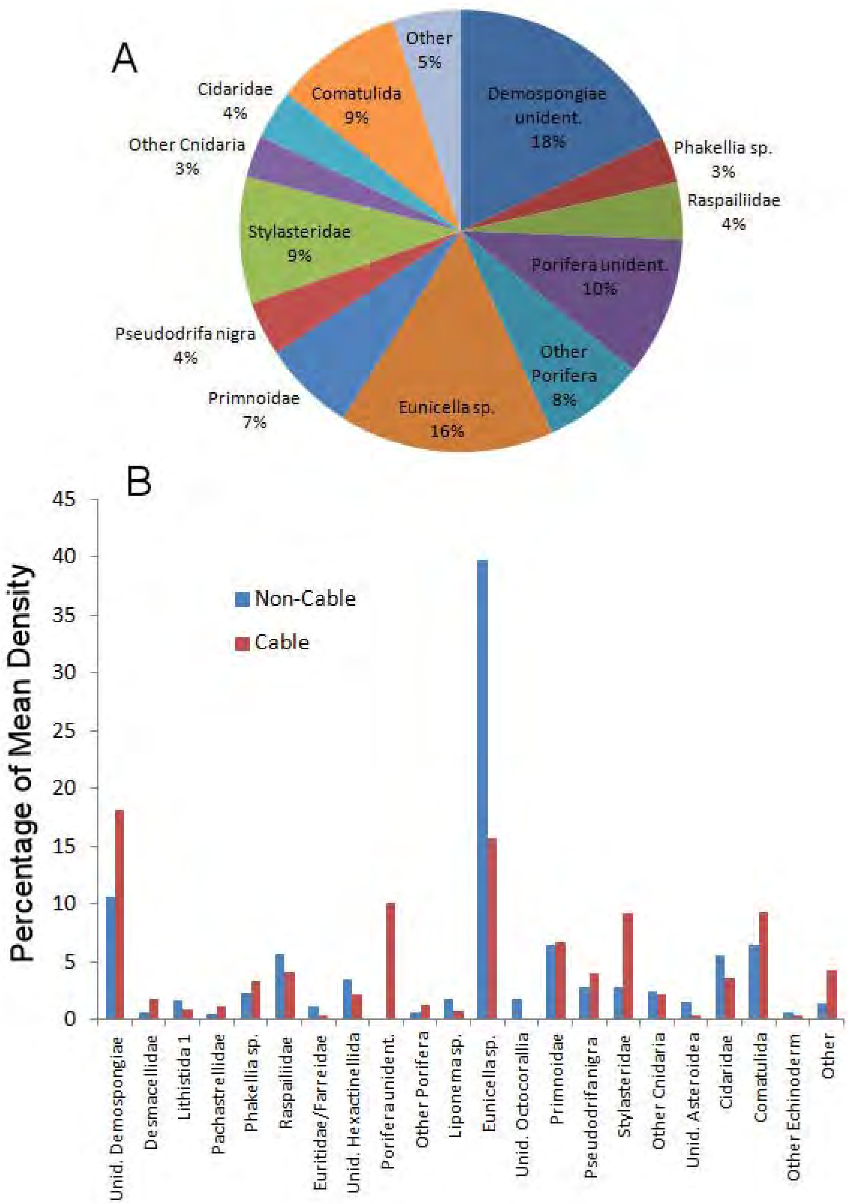

Figure 4-49. A. Macrofaunal organism densities (in m^{-2}) at the five Cable Outer Terrace Ridge High-Slope photostations expressed as percentages of mean benthic organism abundance. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable OTR H-S photostations. Data summarized from Table 4-37.

No cable impacts were evident in a cluster analysis of density data from Cable versus Non-Cable OTR HS stations. Relationships among stations make sense in terms of location. Geographically close stations were more similar as were stations on similar longitudes. C OTR HS 1 and NC OTR HS 3 both lay along the same longitude on the deeper edge of the Outer Terrace Ridge; three pairs of stations were adjacent to each other physically and in the MDS plot: NC OTR HS 1 and 2, C OTR HS 2 and 3 and COTR HS 4 and 5 (Figure 4-50).

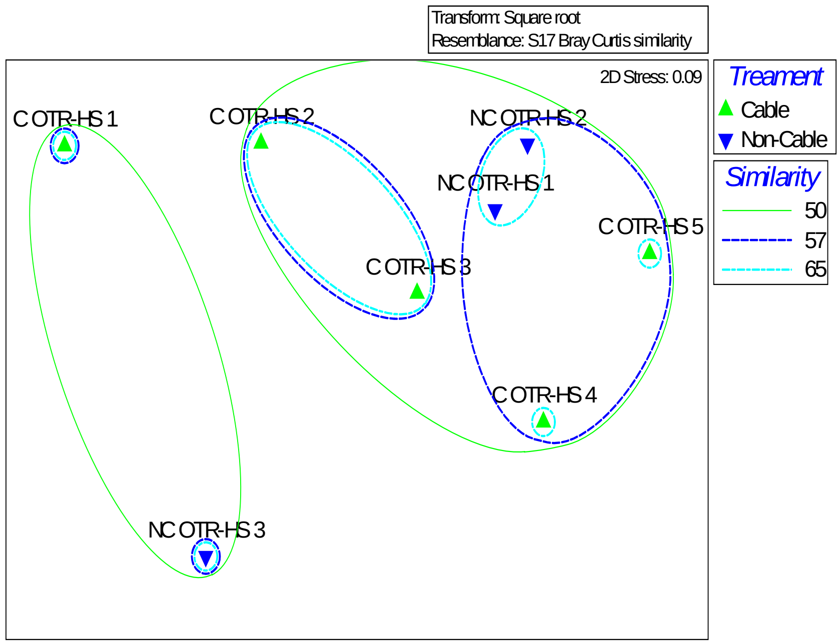

Figure 4-50. MDS plot of density data for all Outer Terrace Ridge High Slope Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. Circles indicate percent similarity from the cluster analysis.

Lower Terrace - High Slope Hardbottom (Tables 4-38 – 4-39; Figure 4-51)
The single station in this habitat was chiefly soft bottom (80.3%) but with a substantial percentage of deep-sea coral habitat as Colonial Dead Coral (9.25%). Living organisms contributed only 1.05% of cover (Table 4-38).

Total organism density was twice as great at the single Cable photostation (7.61 m^{-2}) relative to that at the Non-Cable photostation (3.79 m^{-2}). Octocorals accounted for 74.8% of density (5.69 m^{-2}) at the Cable photostation, greater than the 56.8% (2.15 m^{-2}) at the Non-Cable photostation in this habitat (Table 4-39). Primnoid octocorals contributed the greatest percentage of any individual taxon to density at both Non-Cable (1.21 m^{-2} and 31%) and Cable photostations (2.67 m^{-2} and 35%); *Eunicella* sp. and Unidentified Octocorals accounted for most of the remainder of octocoral density at the Cable (2.22 m^{-2} and 29%) and Non-Cable photostations (0.45 m^{-2} and 23%), respectively (Table 4-39, Figure 4-51). *Eunicella* sp. is a small octocoral not always easily identified.

Table 4-38. Percent cover data for the Cable Lower Terrace High Slope Hardbottom habitat photostation.

Cable - Lower Terrace - High Slope	C LT-HS 1
CORAL (COR)	9.25
Colonial Dead Coral (DC)	9.25
CNIDARIA NON SCLERACTINIA (CNI)	0.95
UNIDENTIFIED ORGANISM (UND)	0.10
SOFT BOTTOM SUBSTRATE (SB)	80.27
HARD BOTTOM SUBSTRATE (HB)	9.44
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	0.10
Sum (excluding tape+shadow+wand)	100

Table 4-39. Density data for the Non-Cable and Cable Lower Terrace High-Slope habitat photostations.

	NC-1	**C-1**
PORIFERA		
DEMOSPONGIAE		
Demospongiae unident.	0.090	0.050
Phakellia sp.	0.045	
Spongosorites sp.		0.101
HEXACTINELLIDA		
Hexactinellida unident.	0.560	0.101
Porifera unident.		0.202
CNIDARIA		
HEXACORALLIA		
Actiniaria unident.	0.067	0.202
Actinoscyphia sp.		0.050
Antipatharia unident.		0.151
Corallimorphidae	0.112	0.050
Lophelia pertusa	0.022	
Madrepora sp.	0.090	
Sagartiidae	0.090	
Zoanthidea	0.022	0.101
OCTOCORALLIA		
Anthomastus sp.		0.050
Eunicella sp.	0.022	2.217
Isididae	0.022	0.151
Octocorallia unident.	0.874	0.453
Primnoidae	1.210	2.671
Pseudodrifa nigra	0.022	0.151
STYLASTERIDAE	0.359	
BRYOZOA		0.101
MOLLUSCA	0.090	
ARTHROPODA	0.045	0.050
ECHINODERMATA		
CRINOIDEA		
Comatulida	0.045	
Crinoidea (stalked)		0.050
UNKNOWN ANIMAL		0.705
TOTAL	3.787	7.608

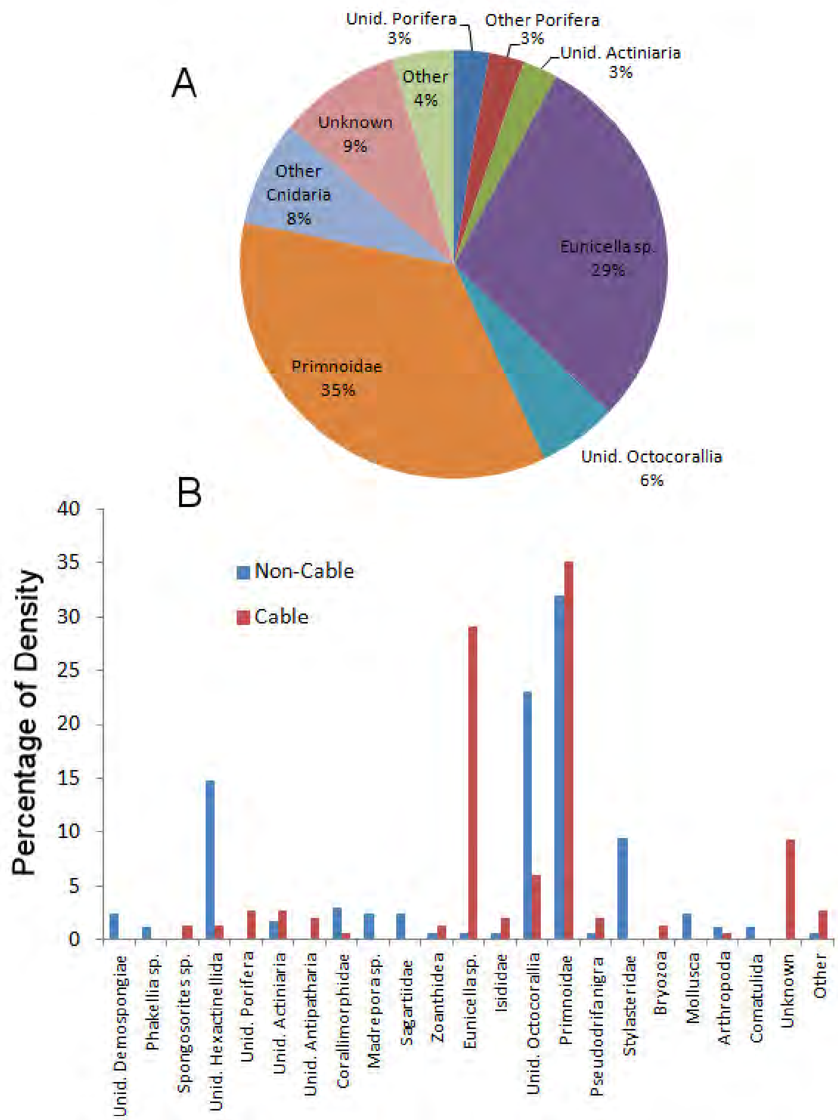

Figure 4-51. A. Macrofaunal organism densities (in m^{-2}) at the Cable Lower Terrace High-Slope photostation expressed as percentages of benthic organism abundance. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable LT H-S photostations. Data summarized from Table 4-39.

Lower Terrace - Sinkhole Hardbottom (Tables 4-40 – 4-41; Figures 4-52 – 4-53)

Percent cover at this station was almost evenly divided between hard and soft substrates, with a 2.56% contribution from deep-sea coral (rubble and colonial dead coral) (Table 4-40). As at the Non-Cable Lower Terrace Sinkhole station, Primnoidae accounted for the greatest percentage of organism density (69%) (Figure 4-52). Here, the great majority of octocorals were identified as Primnoidae; at the Non-Cable Sinkhole station, half of octocoral density was unidentified, but much of it was likely Primnoidae, which would make the percent contributions to density by Primnoidae at the two stations much more similar. Most of the sponges at the Cable photostation were recorded as Unidentified Porifera (13%), whereas at the Non-Cable photostation, most were recorded as Hexactinellida (8.7%).

Table 4-40. Percent cover data for all Cable Lower Terrace Sinkhole Hardbottom habitat photostations.

Cable - Lower Terrace - Sinkhole	C LT-SH 1
CORAL (COR)	2.56
Colonial Dead Coral (DC)	0.18
Coral Rubble (CR)	2.38
ARTHROPODA (ART)	0.04
CNIDARIA NON SCLERACTINIA (CNI)	0.65
MOLLUSCA (MOL)	0.04
PORIFERA (POR)	0.04
UNIDENTIFIED ORGANISM (UND)	0.04
SOFT BOTTOM SUBSTRATE (SB)	49.69
HARD BOTTOM SUBSTRATE (HB)	46.95
TAPE, WAND, SHADOW, PHOTO EFFECT (TWS)	2.70
Sum (excluding tape+shadow+wand)	100

Table 4-41. [Left] Density data for the Cable Lower Terrace Sinkhole Hardbottom habitat photostation.

	NC-1	C-1
PORIFERA		
DEMOSPONGIAE		
Demospongiae unident.		0.015
Phakellia sp.		0.029
HEXACTINELLIDA		
Aphrocallistes beatrix	0.013	
Hexactinellida unident.	0.281	
Porifera Unident.	0.128	0.483
CNIDARIA		
HEXACORALLIA		
Actiniaria unident.	0.026	0.015
Actinoscyphia sp.	0.013	
Antipatharia unident.	0.013	0.015
Ceriantthidae	0.038	
Corallimorphidae	0.013	0.015
Lophelia pertusa	0.051	0.029
OCTOCORALLIA		
Isididae		0.073
Octocorallia unident.	1.290	0.132
Primnoidae	1.277	2.520
STYLASTERIDAE	0.089	0.015
MOLLUSCA	0.013	
ARTHROPODA	0.026	0.073
ECHINODERMATA		
ASTEROIDEA		
Asteroidea unident.	0.013	0.015
ECHINOIDEA		
Echinoidea unident.	0.013	
OPHIUROIDEA		
Euryalidae		0.015
UNKNOWN ANIMAL	0.077	0.234
TOTAL	3.372	3.677

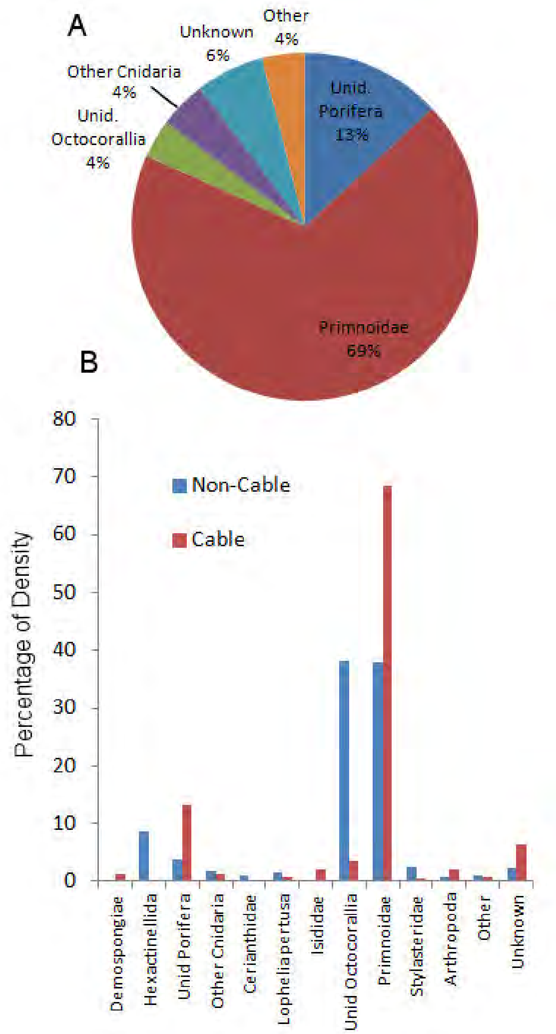

Figure 4-52. [Right above] A. Macrofaunal organism densities (in m^{-2}) at the Cable Lower Terrace Sinkhole photostation expressed as percentages of benthic organism density. B. Comparison of percentage contributions to organism densities at Cable vs. Non-Cable LT SH photostations. Data summarized from Table 4-41.

An MDS plot of a cluster analysis comparing Non-Cable and Cable Lower Terrace High-Slope and Sinkhole photostations (Figure 4-53) showed that the habitat distinctions were stronger than any Cable versus Non-Cable differences. However, the sample size (one of each habitat and treatment) was too low to determine any impact.

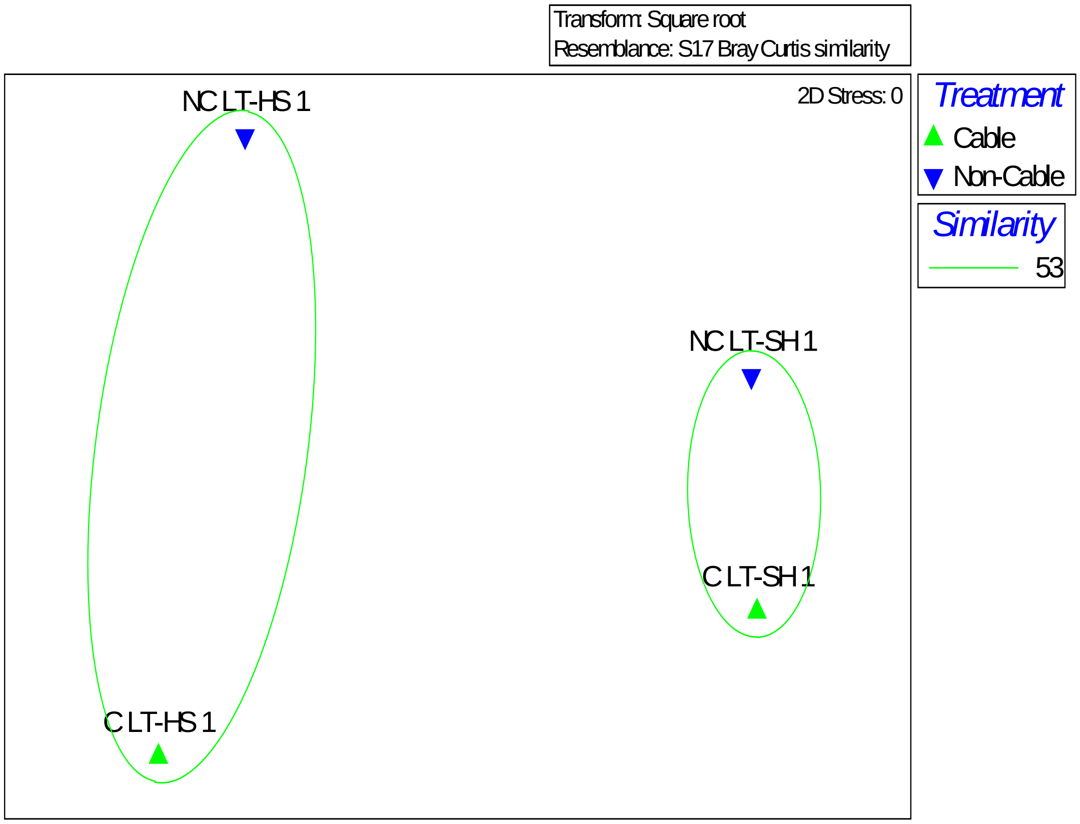

Figure 4-53. MDS plot of density data for all Lower Terrace Hardbottom habitat photostations. Stations are coded by Cable and Non-Cable. SH = Sinkhole, HS = High Slope. Circles indicate percent similarity from the cluster analysis.

Analysis of similarity

An analysis of similarity (ANOSIM) was performed for each habitat analysis with more than two Cable and Non-Cable stations to determine the significance of the Cable and Non-Cable categories within habitats. The ANOSIM is a permutation-based hypothesis test analogous to univariate ANOVAs that tests for differences between groups of (multivariate) samples from different experimental treatments. The closer the R statistic is to 1, the stronger the categorical groups. Its strength is dependent on the number of samples per category which defines the number of possible permutations. A low number of stations in a category limits the strength of the results. None of the Analyses of Similarity (ANOSIM) tests showed any significant groupings between Cable and Non-Cable stations. Global R must be close to 1 and significance level must be high to reflect any significant relationship. The cases with the highest R values here were with the result of low statistical power as indicated by the limited number of possible permutations.

Table 4-42. ANOSIM results of density data testing between cable and Non-Cable photostations.

ANOSIM Results - Density Subcategories - Cable v. Non-Cable	OTR-HS	OTP-LS	OTP-HS	ITP-LS_All	ITP-LS <275 m	ITP-LS >275 m	All Stations
Sample statistic (Global R)	0.046	0.188	0.464	0.059	0.306	0.159	0.062
Significance level of sample statistic	37.50%	12.70%	13.30%	23.40%	6.30%	25.00%	3.40%
Number of permutations	56 (All possible)	126 (All possible)	15 (All possible)	999	126 (All possible)	56 (All possible)	999
Number of permuted statistics greater than or equal to Global R	21	16	2	233	8	14	33

4.3.3 Cable Impact Assessment Summary

1) All three shallow transects (A, An, As) from ~30 to 90 m traversed cables. No similar habitat without cables was available, thus no statistical comparisons were performed.
2) A total of 109 identified colonies of stony corals (Scleractinia) was observed in 83 of 845 images taken between 30 m and 63 m, the deepest in 38-43 m. Most were <10 cm in maximum diameter. None exhibited any recognizable impacts (dislodged, abraded or shaded).
3) The only direct cable impact on macrobenthos observed in the video and photographic record in this depth range appeared at 26°05.249'N, 80°04.713'W, in 43 m along Transect An, where a cable appeared to have split a large sponge, which continued to survive.
4) Other effects associated with cable in 30-63 m included fouling of cables by cyanobacterial mat and chiefly encrusting sponges.
5) Organisms growing on cable at depths >90 m were initially dominated by hydroids and anemones (Actiniaria), accompanied at greater depths by zoanthids, demosponges, hexactinellid sponges, octocorals (e.g., *Pseudodrifa nigra*), antipatharians, stony coral (*Lophelia pertusa*), and the crinoid *Comatonia cristata*.
6) Although observations were made of cable coiled on the seafloor, the lack of catenary in cable suspended up to ~7 m above bottom between seafloor elevations, the growth of delicate colonies of *L. pertusa* on suspended cable, and the presence of large, old antipatharian colonies, as well as a wide diversity of other attached invertebrate macrofauna immediately adjacent to cable, suggest that substantial lengths of cable have not been subject to any appreciable post-deployment lateral movement.
7) On sediment-veneered pavement, exposure of hard substrate via current scour around cable generated space under the cable utilized by the crab *Bathynectes longispina*, the urchin *Cidaris* ?*rugosa*, and the codling *Laemonema* sp.
8) Percent cover, overall organism density and densities of individual taxa often varied widely within habitats along both Cable and Non-Cable transects, although both Cable and Non-Cable stations exhibited similar major faunal trends associated with habitat, e.g., the high contributions to density by the octocorals *Pseudodrifa nigra* and *Eunicella* sp. at Terrace Platform stations and Primnoidae at Lower Terrace stations.
9) Benthic habitats based on geomorphology (e.g., Inner Terrace Platform, Lower Terrace Sinkhole) and slope derived from geophysical multibeam data (Low versus High) are driving the regional (between-habitat) differences among groups of stations rather than the presence of cable. If any cable impacts exist, they are less than the differences among habitats.
10) Statistical analyses revealed no patterns in percent substrate cover or organism density within habitats that might be attributed to the presence of cable. Living organisms contributed too little to percent cover to drive any distinction, and the presence of cable had no effect on percent cover by non-living (hard versus soft) substrates. Organism density was not significantly affected by the presence of cable.

5 DISCUSSION

5.1 Introduction

This effort provided a benthic habitat characterization of the Essential Fish Habitat (EFH) areas within the SFOMF OP AREA south and southeast of the Port Everglades Entrance Channel, Broward County, Florida, along a series of cable and non-cable transects using remote technology at depths from 30 to ~550 m, and described impacts to EFH resources from cable deployments along the same transects. EFH in the study area consisted of Artificial Reef (spoil), Tilefish Habitat, Hardbottom and Deep-sea Coral. It is not clear whether any natural shallow Coral Reef EFH was exposed in the shallow survey where spoil overlaid the natural substrate.

Tilefish habitat was the only non-hard-substrate EFH recorded during this project, in the form of burrows in sediment. Although blueline tilefish (*Caulolatilus microps)* is included under the SAFMC Snapper-Grouper Fishery Management Plan (FMP), the habitat requirements of this species differ substantially from other fishes under this FMP. As a result, the SAFMC through the Comprehensive Ecosystem-Based Amendment 2 for the South Atlantic Region (CE-BA 2; SAFMC 2011a) has proposed an EFH-HAPC for blueline tilefish under the Snapper Grouper FMP "to include irregular bottom habitats along the shelf edge in 45-65 meters depth; shelf break; or upper slope along the 100-fathom contour (150-225 meters); hardbottom habitats characterized as rock overhangs, rock outcrops, manganese-phosphorite rock slab formations, or rocky reefs in the South Atlantic Bight; and the Georgetown Hole (Charleston Lumps) off Georgetown, SC" (SAFMC 2011b). With the exception of the apparent spoil habitat in <90-93 m, hard bottom EFH encountered in this survey was restricted to depths >245 m and thus fell outside the tilefish EFH-HAPC.

Surveys that necessarily rely on remote technology, in this case an ROV, are inherently difficult tasks. Water depths >30 m and current pose significant challenges to the study of such environments. As a result, our view of the seafloor is only a snapshot of the larger seascape, both temporally and spatially. For these reasons, mapping deep-water biological communities to the level of detail and accuracy as shallow-water systems is not currently feasible. Deep-water benthic habitat mapping is limited to broad categories of geological, topographical, and biological zonation.

The following discussion first outlines the major limitations of the study in terms of biological and habitat information, and design and instrumentation constraints, followed by alternative cable routes, quantitative analyses, and assessment of cable impacts to EFH.

5.2 Study Limitations - Biological and Habitat Data

Limited understanding of the population dynamics, growth rates, longevities and reproductive patterns of the living components of these biological communities presents obstacles to recognizing the effects of specific environmental factors such as cables. The organisms of interest are those associated chiefly with hard substrates. The local hard-substrate habitats are combinations of exposed hard-bottoms and variable-sized unconsolidated materials from slabs and boulders through cobbles to gravel. These hardbottoms span a continuum from completely exposed to fully buried. Partially exposed substrates range from pavements with small pools of sediment in depressions to scattered rubble or gravel clasts on otherwise buried hardbottoms.

Broad expanses of rippled sediment, many typically raised 10-30 cm above surrounding smooth, weakly bioturbated sediment areas, attest to the mobility of unconsolidated substrates under the influence of near-bottom flow. Hard substrates may be thus exposed or buried by moving bodies of sediments for undetermined lengths of time, depending on short- or long-term variations in bottom currents. Such natural environmental perturbations may potentially obscure or mask effects of cables or other anthropogenic installations on benthic fauna. However, the frequency (or rarity) and extent of burial and exposure of hard substrates and associated organisms in the deep habitats in this study remain unknown. At least limited adaptation to mobile sediments may exist as evidenced by growth of some attached fauna (i.e., some sponges and octocorals) on sediment-veneered hard substrates, although conditions permitting larval settlement and survival also remain unknown.

No information currently exists about the longevities of local benthic macrofauna, particularly relative to periods of exposure or burial of their substrates. However, radiocarbon measurements of a specimen of *Leiopathes glaberrima*—a Hawaiian black coral congeneric with local *Leiopathes* sp.—with a basal radius of 11.6 mm returned a growth rate of <10 μm yr^{-1} and an age of 2,377±15 y (Roark et al. 2006). *Leiopathes* sp. was widespread but widely scattered and infrequent in the current study, commonly occurring on low-relief, sediment-veneered pavements. Local colonies with basal diameters similar to that of the Hawaiian specimen are likely also centuries old (Figure 4-8). Although the (rare) observation of *Leiopathes* sp., as well as *Phakellia* sp. fan sponges adjacent to cables imply that at least some of these deep cables have not moved appreciably if at all since deployment, we cannot determine what if any adverse effects deployment generated.

The great majority of benthic macrofauna observed in our survey consisted of sessile or semi-sessile, suspension-feeding organisms (e.g., sponges, octocorals, antipatharians, stony and lace corals, and crinoids) that depend on ambient water movement for a sustained source of suspended food particles. Variations in organism assemblages attest to general broad-scale variations in near-bottom flow, e.g., broad, almost barren low-relief pavements and rubble fields on the Terrace Platform and barren high-relief boulders below the lips of sinkholes reflect little water movement, whereas dense assemblages of sponges, crinoids, octocorals and stylasterids on projecting high-relief ledges reflect exposure to consistently stronger flow. However, although the Florida Current has been subject to extensive modeling and observational studies, the detailed physical characteristics of its complex benthic boundary layer remain largely unknown (see Introduction- Background - Physical Setting section) as do the hydrodynamic requirements of resident organisms.

An additional layer contributing to variations in assemblage composition and organism densities among, and particularly within, habitats is the wide range of reproductive and developmental patterns found within the taxonomic groups represented in the survey area. Sponges, anemones and octocorals all exhibit both sexual and asexual reproduction that may generate wide variations in population sizes, genetic composition and dispersal. Asexual reproduction via pedal laceration in sea anemones serves a wide range of possible advantages including competitive ability and differential growth of locally successful genotypes (Clayton 1985). Brooded octocoral larvae likely have more limited dispersal abilities than broadcast larvae, and members of the family Nephthyidae, to which *Pseudodrifa nigra* belongs, commonly reproduce asexually (Simpson

2009). Adaptive strategies that include asexual reproduction and brooding, both of which may restrict dispersal of offspring, may contribute to observed organism patchiness within habitats in the absence of obvious environmental cues, e.g., why a cluster of bamboo corals or sagartiid anemones grows in one place that appears identical in substrate composition, relief, percent cover and slope to another that lacks the organism. Still, the current state of knowledge, with its lack of any substantial temporal or broad spatial data, or information on the biological processes associated with resident fauna, makes it extremely difficult to identify Non-Cable environmental factors. Even the most obvious associations are imperfectly understood. It is clear, for example, that numerous primnoid octocorals *Plumarella* sp. growing uniform orientation along the edges of projecting ledges are taking advantage of mean current flow; but it remains unclear why only on some ledges and not others nearby, and why they occasionally appear in large numbers on low-relief pavements. Such variations may derive from either local topography that modifies near-bottom flow, or patterns of reproduction, or some combination of both.

Small-scale benthic faunal and substrate variability notwithstanding, large-scale patterns emerged in the data that supported the benthic habitat map categorizations. Multivariate analyses of organism density showed clustering of photostation similarities by benthic habitats (Figure 4-24) and depth (e.g., Figure 4-37). Subtler patterns were also evident with organism densities in the MDS plots where the arrangement of the plot appeared to be driven by the cross-shelf organization of benthic habitats. These same plots did not show any clustering of Cable and Non-Cable photostations (e.g., Figures 4-33, 4-38); therefore, the data indicate that the presence of cable does not appreciably affect the regional-scale differences among the stations. In other words, the differences between stations is mostly determined by the geomorphology and slope along the shelf and any cable impacts, if present, are weaker than the influence of habitat. This is not surprising as previous studies have qualitatively described the change in communities across the terrace's geologic formations from the platform to the outer ridge (Mullins and Neumann, 1979; Reed et al. 2004). Furthermore seafloor slope has been recognized as an important factor in deep-water benthic community structure (Messing et al., 2008).

5.3 Study Limitations – Design and Instrumentation

As noted in the Introduction, this project was carried out at depths greater than recreational scuba diving limits (30 m) using a Remotely Operated Vehicle (ROV) under narrow time constraints based on available shiptime and funds. An ROV offers a much narrower observational field relative to scuba and thus limits the data that can be collected.

The limits of identification from ROV photographs may affect results. Whereas organisms such as the anemone *Liponema* sp. and the soft coral *Pseudodrifa nigra* represent single taxa and were easily identified wherever visible in images, sponges and some other anemones (and fewer examples of other organisms) often defied identification because of poor image resolution (due to distance, lighting, or size), angle of observation, or partial view, which almost certainly placed known taxa in one of several "unidentified" categories (e.g., Unidentified Porifera, Unidentified Demospongiae and Unidentified Actiniaria) that almost certainly included multiple taxa. As examples, the sponges recorded as Unidentified Porifera at a station may actually have included some Raspailiidae, Pachastrellidae, or Lithistida, which were identified and enumerated in other images from the same station. At another station, all sponges may have been identified, so the category Unidentified Porifera was absent from the analysis. Two red and white jointed legs protruding from under a rock might belong to either the squat lobster *Eumunida picta* or the crab *Bathynectes longispina*, requiring that the observation be recorded as Unidentified Crustacea, even though both species were recorded in other images from the station. Many, if not all, of the unidentified octocorals at the Sinkhole Non-Cable station, which accounted for 38% of density, were likely the primnoid octocoral *Plumarella* sp. Adding these unidentified colonies to those identified as primnoids at the station gave a total of 78%, close to the 69% contribution by primnoids at the Cable Sinkhole station (Figures 4-30, 4-50). Categories such as Unidentified Porifera were used out of necessity. We avoided combining all sponges, for example, in a single higher-level category, which would have obscured the great diversity of such organisms in these habitats. The more taxonomically refined the classification, the more accurate our appraisal of variations among stations. Finally, current understanding of local deep-water benthic macrofaunal taxonomy is imperfect at best, and some taxa require microscopic examination for identification.

As mentioned above, many species exhibited patchiness throughout the study area as exemplified by their variations in numbers and resulting densities among replicate stations within given habitats. The sources of such spatial variability may be rooted in a variety of biological and ecological processes such as response to local hydrodynamic conditions, reproductive strategy, and substrate preferences, rather than to the presence or absence of cable.

This study was designed before the habitat map was created and therefore utilized equal numbers of photostations within pre-defined depth zones whenever possible. Although not perfect, these depth zones corresponded closely with the habitat designations. Having the habitat map, beforehand would likely have affected data collection, e.g., by allowing us to target more of certain smaller habitats (particularly high slope) to more evenly distribute photostations per habitat. Also the northern Non-Cable transect was outside of the area mapped in detail, making it more difficult to discern habitat type. Because slope can be a determinant of organism density, and slope cannot be determined along this transect, it is difficult to know if high-slope habitats were included in some of the low-slope Non-Cable photostations.

5.4 Alternate Routes

Two north-south transects, each ~610 m long, were run to investigate potential alternate routes for future cables. The original plan called for one along the crest of the Miami Terrace escarpment (East N-S Transect E) and one near the EEZ along the deep-water coral thickets habitat. The second was abandoned as being far eastward of any current Navy cables and was replaced by another, termed West N-S Transect (D), along the border of the Inner and Outer Terrace Platforms along apparent high slope based on multibeam topography. Both north-south transects traversed several cables each.

Because most of the length of West N-S Transect (D) lay outside the multibeam survey area, where the only available seafloor data was NOAA’s low-resolution bathymetry, no depth profile was mapped. The initial portion of the transect, in 274-278 m, ran from the beginning of the transect at 26°04.902’N, 79°53.003’W, to 26°04.72’N, 79°53.013’W, a distance of ~350 m, over chiefly sediment-veneered hardbottom with areas of gravel and rubble. The dominant organisms were the anemone *Liponema* sp., the small soft coral *Pseudodrifa nigra*, pencil urchins (*Cidaris* ?*rugosa*) and abundant ophiuroids. This segment is the longest portion of the transect characterized by relatively low biological complexity. Beyond this, organism diversity and qualitative abundance, and substrate relief increased and included a variety of sponges, stylasterids, and black corals. Short stretches of gravel and rubble sometimes supported numerous sea pens.

The East North-South Transect (E) reflects the great variation in topography along the Outer Terrace Ridge of the Miami Terrace within the OP AREA. Much of this transect traversed relatively steep slopes characterized by series of rugged ledges with vertical relief up to 2 m, and boulders up to 1 m tall interspersed with pavement, rubble patches and areas of coral rubble, and with biologically diverse assemblages that included numerous sponges, Stylasteridae, large antipatharians (*Leiopathes* sp.) and living colonies of the deep-water reef-building coral *Lophelia pertusa* to 1 m across. The gently sloping to flat seafloor between peaks at the northern and southern ends of the transect still included up to 1-m ledges, narrow rock ridges, and boulders with a variety of sponges.

We found no alternative routes along which cables could be deployed without impacting hardbottom habitat. Many habitats were composed of varying proportions of sediment; however, this sediment overlays existing hardbottom and can shift due to prevailing bottom currents (as evidenced by ripple marks and sediment shadows). We observed no expansive cross-shelf areas of sediment devoid of hardbottom. However, Vinick et al. (2012), in a study designed to site hydrokinetic turbine arrays to utilize the energy of the Florida Current, identified cross-shelf areas north of the Miami Terrace suitable for avoiding impacts to hardbottom communities.

5.5 Cable Impact Assessment

Because cluster analysis is affected by all stations in the dataset and site similarity was affected by benthic habitats, analyses of organism density were performed on stations within each habitat (with two or more photostations per group) to determine if Cable stations clustered apart from Non-Cable stations without such inter-habitat influences. In all cases, Cable and Non-Cable stations did not significantly cluster separately. None of the Analyses of Similarity (ANOSIM) tests showed any significant distinctions between Cable and Non-Cable stations. In other words, there was no statistical difference in the biological communities (organism types and densities) between Cable and Non-Cable photostations.

Table 5-1 summarizes percent cover by hard and soft bottoms to illustrate the wide variations in proportional coverage by these substrates within given habitats, as well as the frequently similar mean values between Non-Cable and Cable photostations for given habitats. Thus, as examples, minimum and maximum values for percent hard and soft bottoms varied widely among individual stations at ITP LS, OTP LS, OTP HS and OTR HS habitats, but the mean values were similar for both Non-Cable and Cable photostations in each of these habitats. In fact, excepting those habitats represented by single stations, mean values for hard and soft bottoms differed substantially between Non-Cable and Cable photostations only in the OTR LS habitat (Table 5-1).

Table 5-1. Summary of minimum, maximum and mean values for percent cover by hard and soft bottoms at Non-Cable versus Cable photostations. Asterisks indicate single values rather than means for habitats represented by single stations. There were no stations in the Cable ITP HS habitat.

	Non-Cable							Cable						
		% Hard Bottom			% Soft Bottom				% Hard Bottom			% Soft Bottom		
	No. sta.	Min	Max.	Mean	Min	Max.	Mean	No. sta.	Min	Max.	Mean	Min	Max.	Mean
ITP LS	7	17.4	49.82	38.13	49	81.98	61.21	10	9.3	55.84	38.37	41.91	83.74	59.49
ITP HS	1			70.21*			27.02*							
OTP LS	5	2.54	86.11	30.01	2.24	96.74	67.03	5	9.06	46.86	24.81	52.11	88.71	73.32
OTP HS	2	44.81	52.68	48.75	46.15	54.51	50.33	4	3.09	76.45	48.26	20.77	95.28	49.31
OTR LS	2	56.06	87.89	71.97	11.10	40.42	25.76	1			55.19*			41.73*
OTR HS	3	83.04	95.03	87.31	3.00	15.92	11.06	5	58.65	91.83	75.14	7.55	37.76	20.86
LT HS	1			24.30*			60.48*	1			9.44*			80.27*
LT SH	1			72.18*			19.08*	1			46.95*			46.69*

Similarly, minimum and maximum total organism densities usually varied widely among stations within a habitat and treatment (Table 5-2). Mean organism density (and total density for habitats with single stations) was at least slightly greater at Cable photostations than Non-Cable photostations in all habitats except OTR LS. However, this habitat only included two Non-Cable and one Cable photostation, and the lowest density at the former (5.474 m^{-2}) and the one value at the latter (5.109 m^{-2}) were similar. Nevertheless, mean densities did not differ substantially between most Non-Cable and Cable photostations with multiple stations due to the wide range of densities at individual photostations, with the exception of OTP HS where mean Cable station organism densities were much higher.

Table 5-2. Summary of minimum, maximum and mean values plus standard deviations and standard errors for organism density (in m^{-2}) at Non-Cable versus Cable photostations. Asterisks indicate single values rather than means for habitats represented by single stations. Abbreviations as in Table 5-1. There were no stations in the Cable ITP HS habitat.

	Non-Cable						Cable					
	No. sta.	Min	Max.	Mean	StDev	StErr	No. sta.	Min	Max.	Mean	StDev	StErr
ITP LS	7	2.161	5.689	3.870	1.393	0.985	10	3.030	17.153	5.883	3.106	2.196
ITP HS	1			*3.672								
OTP LS	5	1.667	9.437	3.670	3.240	2.595	5	2.129	6.960	4.468	2.078	1.469
OTP HS	2	1.316	3.680	2.498	1.672	1.182	4	1.865	9.511	6.707	3.337	2.359
OTR LS	2	5.474	9.396	7.435	2.774	1.961	1			*5.109		
OTR HS	3	2.767	8.815	5.705	3.028	2.141	5	1.404	9.259	5.838	3.144	2.223
LT HS	1			*3.787						*7.608		
LT SH	1			*3.372						*3.677		

This does not mean that cables have not and are not affecting the benthos. As noted in the Introduction, cable-associated EFH impacts may occur during cable deployment and continuously over the time cable remains on the seafloor. However, this project was not designed to and could not distinguish among impacts associated with deployment and those that have occurred since deployment, e.g., lateral movement. Given the length of time since deployment, adverse effects associated with deployment, e.g., mortality resulting from burial by resuspended sediment, were highly unlikely to be observed. Similarly, as a one-time set of observations, this study could neither observe nor measure several of the impacts considered adverse effects by EFH rules, such as indirect impacts to fecundity and predator/prey interactions, and cumulative and synergistic consequences of actions.

Our assessment of impacts via video and still photographic examination of substrates between and adjacent to cables was limited to potential direct adverse effects on attached benthic macrofauna, i.e., sponges, octocorals, lace corals (Stylasteridae), black corals (Antipatharia) and stony corals (Scleractinia) associated with the post-deployment presence of the cable on the seafloor:

- Physical dislodgment resulting from lateral movement, likely resulting in complete mortality.
- Abrasion caused by direct contact, which may cause mortality, partial mortality or increased susceptibility to predation/grazing.
- Shading fauna or hard substrates suitable for settlement by attached macrofauna. This adverse effect is restricted in the study area to a depth of ~90 m. Below this depth, EFH essentially disappears and only reappears in ~245 m, a depth at which light and shading are no longer significant factors in community development and function.
- Covering hard substrates suitable for settlement by attached macrofauna.
- Scouring adjacent substrate via lateral movement, which may limit organism settlement, growth, and assemblage stability; increase mortality of organisms previously in contact with cable, and continue dislodgement and abrasion.

Apart from enumerating observed examples of dislodgement, abrasion, shading or scouring, the remote method used in this survey precluded quantification of habitat-wide impacts. Because cable was only intermittently visible in quantitative images, effects such as areal coverage of EFH by cable could not be extrapolated to entire photostations. Similarly, because cable was not in view along the entire cable transect, and was intermittently buried along patchy EFH, extrapolating cable area projected on the seafloor over the length of the transect on EFH would not provide an accurate measure of areal coverage of EFH by cable.

As noted in the shallow-water component of this project (Gilliam and Walker 2012), this survey effort was not designed to and could not estimate EFH impacts associated with cable deployment activities or distinguish deployment impacts from those that have occurred since deployment. Impacts to attached organisms in the deep-water component that occur during deployment include physical dislodgment or burial by resuspended sediment, which will likely result in complete mortality, and physical abrasion, which may cause mortality, partial mortality (in the case of sponges and colonial invertebrates), or increased susceptibility to predation/grazing. Some impacts may continue for the life of the cable on or over all EFH considered here. Shading of attached fauna by suspended cable is a potential adverse effect only from the shallow end of the deep-water component to a depth of ~90 m. Below this depth, hard-bottom EFH only reappears in ~245 m, a depth at which light and shading are no longer significant factors in community development and function. All other potential effects remain in force regardless of depth. Continuous direct contact with attached organisms could also potentially cause mortality. Cable movement on the seafloor can augment impacts by scouring additional substrate, which further limits organism settlement, growth, and assemblage stability; increasing mortality of organisms previously in contact with cable, and continuing dislodgement and abrasion.

Apart from hardbottom EFH, note that, although blueline tilefish is included under the SAFMC Snapper-Grouper Fishery Management Plan (FMP), the habitat requirements of this species differ substantially from other fishes under this FMP. As a result, SAFMC through the Comprehensive Ecosystem-Based Amendment 2 for the South Atlantic Region (CE-BA 2; SAFMC 2011a) has proposed an EFH-HAPC for blueline tilefish under the Snapper Grouper FMP "to include irregular bottom habitats along the shelf edge in 45-65 meters depth; shelf break; or upper slope along the 100-fathom contour (150-225 meters); hardbottom habitats characterized as rock overhangs, rock outcrops, manganese-phosphorite rock slab formations, or rocky reefs in the South Atlantic Bight; and the Georgetown Hole (Charleston Lumps) off Georgetown, SC" (SAFMC 2011b).

Cables may also affect local communities via fouling and attraction of organisms to cable as localized complex physical habitat. Although we did not specifically distinguish or quantify organisms attached to cables relative to those on surrounding substrates, a few species, e.g., the Venus flytrap anemone *Actinscyphia* sp., appeared to occur in substantially greater numbers on cable, often where it was suspended well above the seafloor between adjacent elevations. Also, in traversing extensive areas of sediment-veneered hard substrates, particularly pavements characterized by qualitatively low macrofaunal abundances (areas not included in quantitative photostations), bottom flow often scoured sediment from below cable, exposing underlying hard substrate and depositing a narrow sediment shadow parallel to the cable on the downcurrent side. Such scour appeared to result from water movement around the cable rather than any cable movement. Organisms such as the crab *Bathynectes longispina*, the urchin *Cidaris* ?*rugosa*, and the codling *Laemonema* sp., were observed apparently sheltering in the resulting space exposed beneath the cable. It is unknown whether potential shelter offered by the cable in otherwise open areas significantly increases numbers of predators such as crabs and fish that may have an impact on surrounding habitats.

Similarly, exposed cables may represent a corridor for the expansion of taxa into otherwise unavailable habitats. Organisms characteristic of Miami Terrace hard substrates, such as *Pseudodrifa nigra*, *Eumunida picta* and zoanthids began to appear on or in association with the cable in as little as 230 m, west of the initial exposure of natural hard substrates (Figure 4-6). It is unknown, however, whether fouling populations make any significant contribution to recruitment onto natural substrates. Colonies of the stony coral *Lophelia pertusa* often took advantage of suspended portions of the cable (Figure 4-9C), growing above otherwise undesirable substrates. However, this species is widely established elsewhere on the Terrace as well as in many locations all along the southeastern U.S. continental margin (e.g., Reed 2004, Partyka et al. 2007, Messing et al. 2008, Reed et al. 2006, and in press).

Apart from the communities growing on cable, which varied with benthic habitat, qualitative observations of potential interactions between benthic macrofauna and cable were extremely limited. As noted above, the only direct effect on macrobenthos observed in the video and photographic record and attributable to cable appeared in 43 m along the North Parallel Transect (An), where a cable appeared to have split a large sponge, which, however, continued to survive. In deeper water, several detached fan sponges (*Phakellia* sp.) and several dead stumps of bamboo octocoral (*Isidella* sp.) were seen chiefly where no cable was observed. Although not tested here, the deep-water cable exhibited no indication of lateral movement. The great majority of cable was apparently deployed under great tension, as evidenced by the long stretches of cable suspended without apparent catenary between elevations. The two instances where cable lay in multiple loops, which might permit lateral movement following deployment, were both on sediment substrates outside EFH. A 45° bend in the cable on a sediment and rubble substrate in 331 m was not accompanied by any evidence of lateral movement. We observed no indication of substrate scoured by cable or repeatedly impacted organisms. In fact the presence of *Lophelia pertusa* on the suspended cable and long-lived black coral immediately adjacent to cable on the seafloor leads us to conclude that they are moving little if at all. *L. pertusa* is a delicate hard coral that would likely break free of its attachment on the cable without much force.

Movement, retrieval, or removal of deep-water cables is not recommended. It is clear that any attempt to remove any of the existing cables, whether in shallow or deep water, will have important repercussions. Apart from the destruction of the communities growing on the cable (which include some protected coral species), removal will produce lateral cable movement, which will have the opportunity to damage or destroy benthic organisms, some of which are long-lived components of their communities and important contributors to habitat complexity (e.g., Figures 4-5B,C, 4-8F, 4-17A).

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Appendix E

Standard Manatee Construction Conditions

STANDARD MANATEE CONDITIONS FOR IN-WATER WORK

2011

The permittee shall comply with the following conditions intended to protect manatees from direct project effects:

a. All personnel associated with the project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.

b. All vessels associated with the construction project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

c. Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

d. All on-site project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shutdown if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.

e. Any collision with or injury to a manatee shall be reported immediately to the Florida Fish and Wildlife Conservation Commission (FWC) Hotline at 1-888-404-3922. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-731-3336) for north Florida or in Vero Beach (1-772-562-3909) for south Florida, and emailed to FWC at ImperiledSpecies@myFWC.com.

f. Temporary signs concerning manatees shall be posted prior to and during all in-water project activities. All signs are to be removed by the permittee upon completion of the project. Temporary signs that have already been approved for this use by the FWC must be used. One sign which reads *Caution: Boaters* must be posted. A second sign measuring at least 8½ " by 11" explaining the requirements for “Idle Speed/No Wake” and the shut down of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. These signs can be viewed at http://www.myfwc.com/WILDLIFEHABITATS/manatee_sign_vendors.htm. Questions concerning these signs can be forwarded to the email address listed above.

CAUTION: MANATEE HABITAT

All project vessels

IDLE SPEED / NO WAKE

When a manatee is within 50 feet of work
all in-water activities must

SHUT DOWN

Report any collision with or injury to a manatee:

Wildlife Alert:

1-888-404-FWCC(3922)

cell *FWC or #FWC

Appendix F

Sea Turtle and Smalltooth Sawfish Construction Conditions

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006
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Appendix G

FDEP CCCL Approval Letter

From:	Wettstein, John
To:	Stringfield, Edwin CIV NAVFAC SE, PWD Key West
Subject:	RE: Cable Landing Station
Date:	Friday, June 06, 2014 14:51:41

Edwin,

The location of the proposed building has been accepted by Tony McNeal, CCCL Program Administrator, with respect to the line of construction discussed earlier. Because of the uniqueness of the area, there is no "reasonably uniform and continuous line of construction" as described in state law.

Also note that the building must be located so that it does not interfere with maintenance of the bulkhead. That offset distance should be about 30 feet or beyond any tie-downs or deadmen used to anchor the wall and that may require maintenance. I think you should be able to meet that requirement but was unable to put a scale to dimension the building and the wall as it wraps around the property.

Fritz Wettstein, Environmental Consultant
Coastal Construction Control Line Program
850/245-7672

-----Original Message-----
From: Stringfield, Edwin CIV NAVFAC SE, PWD Key West [mailto:edwin.stringfield@navy.mil]
Sent: Thursday, June 05, 2014 3:42 PM
To: Wettstein, John
Subject: RE: Cable Landing Station

Thanks, I will be out of the office traveling to Dania Beach for a meeting tomorrow. If you have questions please feel free to contact me on my mobile (757) 839-2666.

V/R,

Edwin Stringfield
Planner, PWD Key West
Phone: 305-293-2292
DSN: 483-2292
EMAIL: edwin.stringfield@navy.mil

-----Original Message-----
From: Wettstein, John [mailto:John.Wettstein@dep.state.fl.us]
Sent: Thursday, June 05, 2014 3:36 PM
To: Stringfield, Edwin CIV NAVFAC SE, PWD Key West
Subject: RE: Cable Landing Station

Thanks. I'll need to discuss the line of construction with my boss, Tony. Maybe tomorrow.

Fritz Wettstein, Environmental Consultant Coastal Construction Control Line Program
850/245-7672

-----Original Message-----
From: Stringfield, Edwin CIV NAVFAC SE, PWD Key West [mailto:edwin.stringfield@navy.mil]
Sent: Thursday, June 05, 2014 3:22 PM
To: Wettstein, John
Subject: RE: Cable Landing Station

Good afternoon,

Per our conversation yesterday, I've used our GIS data to prepare a sketch showing the approximate location of the cable landing station and its proximity to a line between the existing buildings onsite and the nearest building in John U. Lloyd (JUL) State Park. I also drew a line to show that the utility structure will not be beyond existing buildings within our site. It will also be set behind the existing walkway used by JUL State Park patrons.

V/R,

Edwin Stringfield
Planner, PWD Key West
Phone: 305-293-2292
DSN: 483-2292
EMAIL: edwin.stringfield@navy.mil

-----Original Message-----
From: Wettstein, John [mailto:John.Wettstein@dep.state.fl.us]
Sent: Monday, March 24, 2014 11:00 AM
To: Stringfield, Edwin CIV NAVFAC SE, PWD Key West
Subject: RE: Cable Landing Station

Mr. Stringfield,

Preliminary Comments:
- yes the project is jurisdictional and requires a permit. The department issued two permits for similar activities, one in 1992 and another in 2000.
- the project appears to constitute a major non-habitable structure ($1,000) with additional fees if any other minor structures (not including cable).
- the project will be processed as a standard CCCL permit, with the DEP 73-100 application form.
- The CLS location needs to be adjusted a little landward. I recommend the new structure be located no farther than approximately 330 feet seaward of the control line, or no farther than approximately 20 feet in the east direction from the Power Vault. This ensures the project meets the "line of construction" rule policy [s. 161.053(4)(b), Florida Statutes].
- I cannot evaluate if the proposed structure is landward of the "thirty-year erosion projection" [s. 161.053(5)(b), Florida Statutes]. Although no erosion projection has been recommended at this location, it would be negated by the presence of a seawall seaward of the structure. The top of wall elevation should meet or exceed the thirty year storm elevation.
- There appears to be a seawall at the location. The application should include a CCCL special purpose topographic and boundary survey prepared per s. 62B-33.0081, Florida Administrative Code, identifying the location of a seawall, if present.
- Any exterior or construction lights will have to be consistent with the Florida Fish and Wildlife Conservation Commission sea turtle lighting guidelines [http://myfwc.com/wildlifehabitats/managed/sea-turtles/turtles-lights/].
- All excavated material must be maintained within the vicinity of the excavation site (eg. trench and slab backfill).

Fritz Wettstein, Environmental Consultant Coastal Construction Control Line Program
850/245-7672

-----Original Message-----
From: Stringfield, Edwin CIV NAVFAC SE, PWD Key West [mailto:edwin.stringfield@navy.mil]
Sent: Friday, March 21, 2014 10:42 AM
To: Wettstein, John
Subject: Cable Landing Station

Good Morning,

Please find attached the sketch we discussed on March 18th. This defines trenching work and building location within the limits of the property. The dot noted at CLS Center??? is where we are proposing to locate the building. The building compound will also include an emergency generator. The building dimensions will be approximately 8' high, 10' wide and 24' long. It will be a prefabricated concrete structure designed to meet hurricane standards for the area. The building is still being designed; thus exact dimensions and specifications are not available at this time.

Thank you in advance for taking the time to help us in getting this permitting process started and please feel free to contact me if you have any additional questions.

V/R,

Edwin Stringfield
Planner, PWD Key West
Lexington & Langley, Bldg A-629
Key West, Fl 33040
Phone: 305-293-2292
DSN: 483-2292
EMAIL: edwin.stringfield@navy.mil

[Dep Customer Survey]<http://survey.dep.state.fl.us/?refemail=John.Wettstein@dep.state.fl.us>
[Dep Customer Survey]<http://survey.dep.state.fl.us/?refemail=John.Wettstein@dep.state.fl.us>

NAVFAC GeoReadiness

Map of:

Prepared For:

edwin.stringfield@navy.mil

06/05/2014

Document Generated from GeoReadiness Explorer

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