Appendices

Appendix I. Topography survey protocols

BOEM Topographic Complexity Survey Protocol

Goal

Structural surveys are intended to provide information on topographic complexity at each site where fish and line point intercept (LPI) surveys are conducted. Structural surveys are concurrent with and along the same transect as fish surveys.

Likely task allocation scenario

1 LPI/TOPO diver + fish diver:

LPI diver completes identification of 100 points (1 every 50 cm) on outbound transect (see LPI methods for details). Maximum abiotic and biotic structural measures, 25 per transect (1 every 2 m), are collected on return transect.

1 LPI diver + ad hoc buddy (e.g. ship's crew) + fish diver

LPI diver completes identification of 100 points (1 every 50 cm) on outbound transect. Ad hoc buddy collects abiotic and biotic height measures, 25 per transect (1 every 2m), on outbound transect. If capable with a camera, ad hoc buddy may be tasked with photo quads or additional site video instead of abiotic measurements.

Topographic Complexity (TOPO) Transect Methods

TOPO transects will be surveyed at all fish survey sites along the same transect (50-m transect).

1. Site selection, navigation, and deployment

    a. As part of the dive preparation, the fish diver will obtain a bearing that maximizes contact with the habitat (based on side scan or multibeam data).

    b. **Headers on all datasheets are filled out prior to entering water** – site number, date, time, buddy. Fill in all categories legibly (see Figure1)

BOEM Topographic Datasheet		Topo Diver		Octo Diver	
LPI Diver		Fish Diver		Photo diver	
Site ID		Date		Time	

Figure 1 TOPO datasheet header – should be completed by diver prior to entering water.

    c. Small boats will navigate to the selected site using a handheld GPS unit. When the coordinate has been reached, confirm depth with coxswain then deploy a weighted float to mark the start of the transect.

    d. Divers will descend following the weighted line as rapidly and safely as possible, maintaining good buddy contact. If the site exceeds the maximum allowable depth

(either by diver table limits or cruise limit (130')) the dive is aborted and a new site is selected.

e. These dives are intended to quantify communities in hardbottom areas. Where no hardbottom is visible divers are instructed to take a 360 degree short video and two or three close up photos representative of sediment type, abort the dive and select a new site.

2. TOPO In water methods

a. The predetermined compass bearing is used for the transect bearing unless the habitat is clearly in a different direction. The transect orientation can be altered as necessary to maximize contact with hard substrate. Fish diver will record any adjustments to the bearing.

b. LPI surveys will be conducted on outbound transect. TOPO surveys will be conducted on the return, unless an extra diver is available then TOPO data are recorded on outbound transect.

c. At transect turn around, the fish surveyor gives the TOPO/LPI diver the transect tape. As fish surveyor conducts prey surveys on the return transect, the TOPO/LPI diver reels in the tape collecting the following height measurements in every 2m L x 1m wide block. Should an ad hoc buddy be recording heights on outbound transect, fish diver maintains control of the transect tape and all other divers follow the fish diver to end of transect (enjoy the swim!).

i. The priority of this survey is to collect maximum structural height. Within each 2m long x 1m wide block of the transect, record the maximum abiotic (hardbottom) and biotic relief in the appropriate cell of the datasheet (see Figure2) to the nearest 5 cm. (record actual measurements if taken)

1. Biota (e.g. Sponge) growing on the hard substrate should not be included in the hardbottom measurement. The height recorded here is of the hardbottom only.

2. If there is no hardbottom within the 2 x 1m area – record a 0 (zero) for that row on the datasheet.

ii. Record presence of undercut height (check mark). If there is no undercut at the site record a - for that row. See Figure3 for undercut example, undercuts can be considerably smaller than the one in Fig. 3.

iii. Within each 2 x 1m box also, record the height of the maximum biotic component (to the nearest 5cm) within that 2x2m block and record it in the

appropriate cell of the datasheet (Figure2), thus recording two heights and one check mark within each 2 x 1m block (biotic, hardbottom, & undercut). NOTE: you do not need to record the maximum height of each biotic component listed on the datasheet – unless this diver has an inordinate amount of bottom time and can collect such data without buddy separation or bottom time violation.

1. For biotic height measurements, height is measured by extending the organism vertically and recording max. Height. Do not record vertical height of organism bent in the current.

iv. **Minimum site depth and Maximum site depth** – record these to the nearest foot (using dive computer). The difference in these two measures provides the depth range of the site and substratum slope.

v. **Additional measures** Presence/absence (Fig. 2)–

1. Crevice/hole – record as present if either categories are found along the transect 50 x 2m. The minimum size to be considered a hole or crevice would be about the size of your hand (large enough for a mid-sized fish to find refuge).

2. Turtles – because these are a protected species, recording their presence anywhere at the site is important. If you see a turtle anywhere within the limits of visibility – record present.

3. TOPO out of water methods

a. Between dives or as soon as possible after your dive, exchange datasheets with another diver to ensure data consistency and continuity between divers. Any problems encountered should be documented thoroughly on the datasheet.

b. Data entry into database should be done as soon as possible (assuming I have completed this portion of the data entry system)

min depth (ft)	
max depth (ft)	

	check if present
crevice/hole	
turtles	

Max Height (CM) in 2 m L x 1m W box	hardbottom	under cut	sponge	Macroalgae	hydroid	coral	octocoral
50 - 48							
46 - 48							
44 - 46							
42 - 44							
40 - 42							
38 - 40							
36 - 38							
34 - 36							
32 - 34							
30 - 32							
28 - 30							
26 - 28							
24 - 26							

Figure 2. TOPO datasheet – record max. hardbottom height (cm) and undercut height (cm) every 2 x 2m and max. biota height (cm) as time permits.

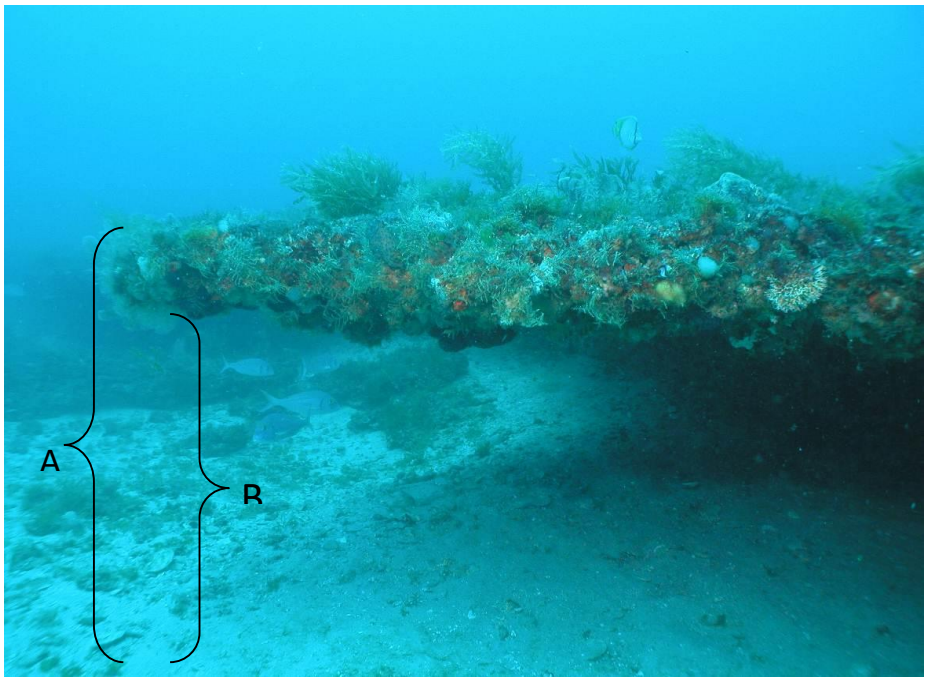


Figure 3. An example of a ledge undercut. Ledge height measurement (A) and undercut presence (B) are shown.

Appendix II. Line point intercept (LPI) survey protocols

BOEM Line Point Intercept (LPI) Survey Protocol

Goal

Data collected by LPI surveys are intended to provide a measure of percent cover of biotic and abiotic components of the benthos. Surveys are concurrent with and along the same transect as fish surveys

Likely task allocation scenario

1 LPI diver + fish diver:

LPI diver completes identification of 100 points (1 every 50 cm) on outbound transect. Maximum abiotic and biotic height measures; 25 per transect (1 every 2 m) are collected on return transect (see topographic protocols document)

1 LPI diver + ad hoc buddy (e.g. ship's crew) + fish diver

LPI diver completes identification of 100 points (1 every 50 cm) on outbound transect. Ad hoc buddy collects abiotic and biotic height measures; 25 per transect (1 every 2m) on outbound transect (see topographic protocols document). If capable with a camera, ad hoc buddy may be tasked with photo quads or additional site video instead of abiotic measurements.

LPI Transect Methods

LPI transects will be surveyed at all fish survey sites along the same transect (50m transect).

1. Site selection, navigation, and deployment

    a. As part of the dive preparation, the fish diver will obtain a bearing that maximizes contact with the habitat (based on side scan or multibeam data).

    b. **Headers on all datasheets are filled out prior to entering water** – site number, date, time, buddy. Fill in all categories legibly (except habitat type)

BOEM Line Point Intercept Datasheet		Topo Diver		Octo Diver	
LPI Diver		Fish Diver		Photo diver	
Site ID		Date		Time	

Figure 1 LPI datasheet header.

    c. **Test camera & strobes by taking a picture of the datasheet** – make sure site name is in picture.

    d. Small boats will navigate to the selected site using a handheld GPS unit. When the coordinate has been reached, confirm depth with coxswain then deploy a weighted float to mark the start of the transect.

    e. Divers will descend following the weighted line as rapidly and safely as possible, maintaining good buddy contact. If the site exceeds the maximum allowable depth

(either by diver table limits or cruise limit (130')) the dive is aborted and a new site is selected.

f. Fish and Benthic dives are intended to quantify communities in hardbottom areas. Where no hardbottom is visible divers are instructed to take a 360 degree short video and two or three close up photos representative of sediment type, abort the dive and select a new site.

2. LPI In water methods

a. The predetermined compass bearing is used for the transect bearing unless the habitat is clearly in a different direction. The transect orientation can be altered as necessary to maximize contact with hard substrate. Fish diver will record any adjustments to the bearing.

b. LPI diver will follow behind fish diver at a reasonable distance to minimize buddy separation yet avoid influencing swimming behavior of fishes.

c. Fish surveyor will anchor the transect tape at 0m and at a minimum of two additional places to secure the tape along the bottom; ensuring data are collected along the same path as the fish data collection and minimizing transect billowing in current. Transect tape will NOT be wrapped around abiotic or biotic objects, as this distorts sampling distances.

d. While waiting for fish diver – **take a brief video and/or a minimum of 4 photos capturing 360 landscape of the site**.

e. **LPI divers record the following at 100 points (every 50cm) along the transect. Starting at 0 m ending at 49.5m.**

i. Identify **top layer** of primary biota and substrate type below point record mark in appropriate biota row in the corresponding abiotic column (see Figure2). E.g. sponge upright on hardbottom.

1. Abiotic categories are: hard (rock, reef, hard bottom), soft/sand (sand or mud), and rubble (unconsolidated rocks fist size or smaller). Hardbottom (rock) is bare hardbottom that is uncolonized rock, without or with (<2.5 cm or 1") a dusting of sand. Soft sand/mud is selected when sand depth exceeds 2.5cm (1") depth. Rubble is defined as moveable rock (that is up to fist size that is moveable).

a. Hardbottom with a veneer of sand (< 2.5cm) is recorded as hard bottom. Where sand depth exceeds 2.5cm, record abiotic habitat as sand.

2. Biotic categories are: bare, macroalgae (red, green, brown), coral, and other inverts (see species identification guide for descriptions and examples)

ii. Exercise caution when identifying a particular point to evaluate. The most objective way to score a point along the transect is to use a straight edge (e.g., pencil) and vertically orientate it downward toward the substratum. Bias, subjectivity and "artificial selection" of favored substrates (e.g., non-bare) should be avoided. However, the point should be identified quickly.

iii. Sand patches are not skipped. If substrate is bare – without any small organism, even if unidentifiable, record a tick mark in the appropriate abiotic/bare area of the datasheet (see figure 2).

The initial biotic organism encountered is what is recorded.

1. Octocorals

    a. Some are highly branched and/or fan like. Octocoral is recorded when any part of the organism is the first item encountered below the point. You do NOT need to hit the holdfast to score octocoral.

2. Sponges:

    a. Occasionally sponges encrusted with other organisms (e.g. zoanthids, algae) are encountered. In this scenario, the primary organism attached to the benthos is scored – sponge. For branching sponges, if a branch is encountered by the point, sponge is recorded, you do NOT need to hit the holdfast to score sponge in this scenario.

3. Branching corals (e.g. *Oculina*)

    a. Most NC corals are small, solitary cups or small heads. Some habitats have larger heads of branching *Oculina*. If your point is on the branches of this coral colony, *Oculina* is scored.

4. Encrusting organisms (turf algae, sponge, tunicates, soft coral, bryozoan) - are valid points. Anytime this is the first organism encountered – score as appropriate.

5. CCA and Peyssonelia-like organisms (& maybe encrusting bryozoans) – record tickmark when encountered.

6. Algae are valid points.

    a. Depending on the season, many species can be tall and act as a canopy to other encrusting organisms. If this canopy is the first biota encountered at the target point – record the appropriate algae category. The target point does NOT have to be at the holdfast of the algae to be recorded.

iv. Double check that the proper number of points were collected. You should have 100 points every time. If you shortened the transect short due to time or other limitations – write down the distance where you stopped sampling.- you should have the appropriate # of points for the distance traveled.

v. At the end of the dive circle the appropriate habitat type category (see fig. 1) in the header section of the datasheet.

3. LPI out of water

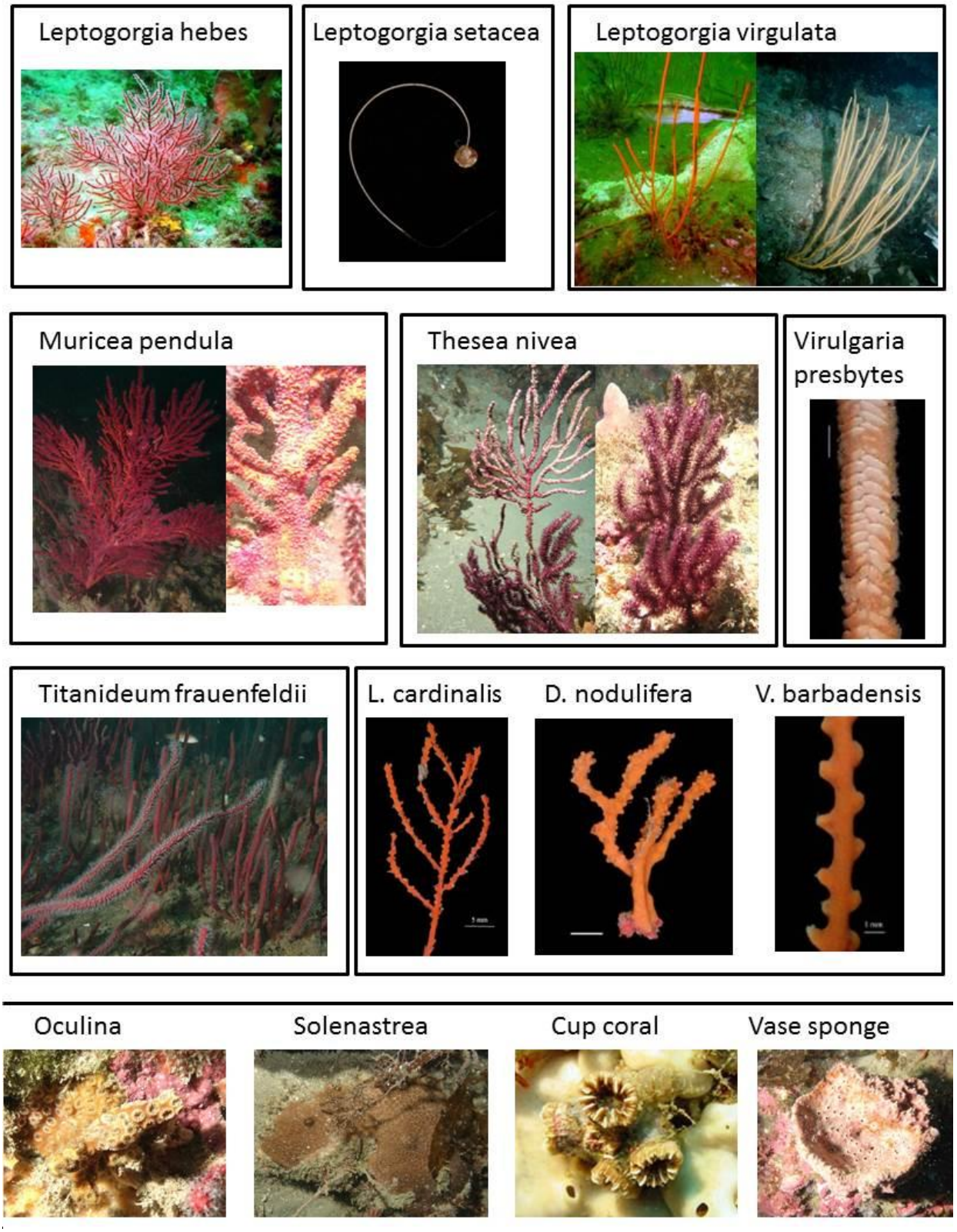
    a. Between dives or as soon as possible after your dive, exchange LPI datasheets with another diver to ensure data consistency and continuity between divers. Any problems encountered should be documented thoroughly on the datasheet.

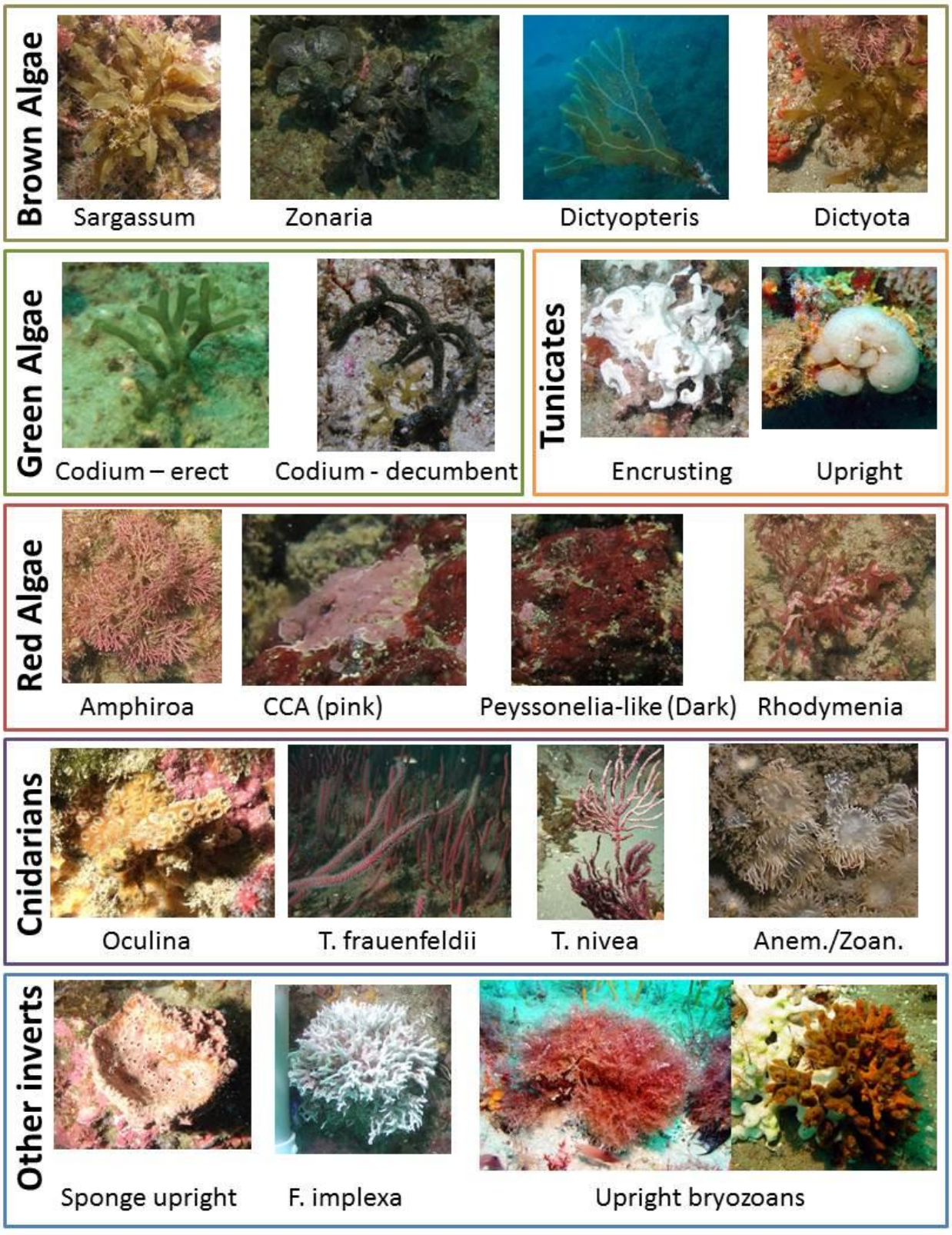
    b. Data entry into database should be done as soon as possible (assuming I have completed this portion of the data entry system)

	One point every 50cm	Hardbottom	Soft/Sand	Rubble
	Bare			
Brown	Sargassum			
	Zonaria			
	Dictyopteris (midrib)			
	Dictyota (y - blade)			
	Other brown			
Green	codium erect			
	codium decumbent			
	other green			
Red	Amphiroa			
	CCA			
	Peyssonelia-like			
	Rhodymenia (Y)			
	Other Red			
Cnidarians	Oculina spp.			
	Other hard coral			
	Titanideum frau.			
	Thesea nivea			
	Other Soft Coral			
	Anem./Zoanthid			
Other Inverts	Hydroids			
	Sponge - encrust			
	Sponge - upright			
	Tunicate - encrust			
	Tunicate - upright			
	Filograna implexa			
	Worms			
	molluscs			
	Bryozoan - encrust			
	Bryozoan - upright			
	Unknown Invert			
	NOTES			

Figure 2 LPI datasheet – record biota for 100 points (1 every 50 cm) in the appropriate abiotic category.

Appendix III. Quick reference species identification sheet for line point intercept and targeted benthic macro-invertebrate surveys




Brown Algae
Sargassum
Zonaria
Dictyopteris
Dictyota
Green Algae
Codium – erect
Codium - decumbent
Tunicates
Encrusting
Upright
Red Algae
Amphiroa
CCA (pink)
Peyssonelia-like (Dark)
Rhodymenia
Cnidarians
Oculina
T. frauenfeldii
T. nivea
Anem./Zoan.
Other inverts
Sponge upright
F. implexa
Upright bryozoans

Appendix IV. Targeted benthic macro-invertebrate survey protocol.

BOEM benthic macro-invertebrate (OCTO) Survey Protocol

Goal

Data collected by OCTO surveys are intended to provide a measure of octocoral (by species) and barrel/vase sponge abundance. Surveys are concurrent with photo quadrat surveys and along the same transect as fish surveys.

Likely task allocation scenario

1 OCTO diver + Photo Quad diver:

OCTO diver counts and estimates heights and identifies all octocorals and corals to species, and barrel/vase sponges in a 1m wide belt beginning at 0m. Ideally diver is able to cover a minimum of 25m length in 20 min.

--in depths > 100 ft. OCTO & Photo Quad divers enter the water after LPI & Fish divers have exited the water (transect will stay on bottom). They will retrieve the transect tape and send up the anchor prior to leaving the bottom.

--in depths < 100 ft. OCTO & Photo Quad divers will enter the water approximately 10 min after LPI & fish divers. They will retrieve the transect tape and send up the anchor prior to leaving the bottom.

OCTO Transect Methods

OCTO transects will be surveyed at a subset of fish survey sites along the same transect (50m transect).

1. Site selection, navigation, and deployment
    a. As part of the dive preparation, the fish diver will obtain a bearing that maximizes contact with the habitat (based on side scan or multibeam data).
    b. **Headers on all datasheets are filled out prior to entering water** – site number, date, time, buddy. Fill in all categories legibly

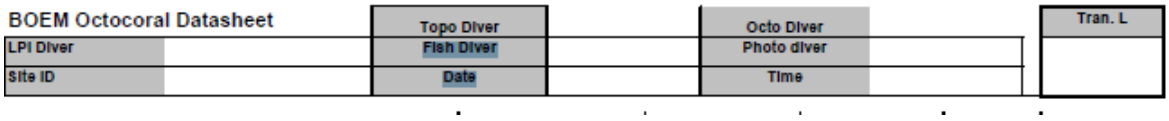


Figure 2 OCTO datasheet header.

    c. **Test camera & strobes by taking a picture of the datasheet** – make sure site name is in picture.
    d. Small boats will navigate to the selected site using a handheld GPS unit. When the coordinate has been reached, confirm depth with coxswain then deploy a weighted float to mark the start of the transect.
    e. Divers will descend following the weighted line as rapidly and safely as possible, maintaining good buddy contact. If the site exceeds the maximum allowable depth (either by diver table limits or cruise limit (130')) the dive is aborted and a new site is selected.
    f. Fish and Benthic dives are intended to quantify communities in hardbottom areas. Where no hardbottom is visible divers are instructed to abort the dive and select a new site.
2. OCTO In water methods

a. Fish diver will deploy the transect and anchor it periodically to minimize transect billowing in current.
b. Where OCTO diver is in the water at the same time as Fish/LPI divers, they should always stay behind the fish diver to avoid influencing swimming behavior of fishes.
c. OCTO divers record the following within a 1m wide belt for as long of an area as can be covered within limits of bottom time – Ideally you will have a minimum of 25m
    i. For each octocoral encountered – identify species, estimate height, and place tick mark on the datasheet in the appropriate height column (10cm bins). (Figure2)
        1. If species is not known, write a description, take a picture and place a tick mark in row w/description.
        2. Sites that are covered by a single species of octocoral (see figure3) and counting each individual would be too time consuming, write 100+ in the appropriate height column and forget about this species for the remainder of the transect. Where there may be fewer than 100 individuals, please estimate # and height.
    ii. For each barrel sponge (*iricinia* spp or *xestospongia* spp., likely) encountered – place a tick mark on the datasheet in appropriate height column.
    iii. For each hard coral (*oculina* spp., cup corals, or *solenastrea hyades*), estimate maximum colony height and place a tick mark on the datasheet in the appropriate height column.
    iv. Be sure to search the entire 1m wide belt, use 1m (or 50cm) pvc to ensure you've covered appropriate area.
        1. If any portion of a target organism is within your belt – it should be counted.
            a. For example, if a small portion of a barrel sponge is within the belt it should be counted.
            b. If the canopy of a soft coral is within the belt, but the basal area is outside the belt – it should still be counted.
    v. Continue searching belt and recording data for as long as bottom time permits. Record transect length surveyed (figure1) when the dive is turned.
    vi. Double check that all areas of datasheet are completed

3. Octo out of water
    a. Between dives or as soon as possible after your dive, exchange datasheets with another diver to ensure data consistency and continuity between divers. Any problems encountered should be documented thoroughly on the datasheet.
    b. Data entry into database should be done as soon as possible (assuming i have completed this portion of the data entry system).

	Height (cm)	0-10	10 - 20	20 - 30	30 - 40	40 - 50	>50 (write Ht)
Octocorals	Leptogorgia hebes						
	Leptogorgia setacea						
	Leptogorgia virgulata						
	Muricea pendula						
	Thesea nivea						
	Titanideum frauenfeldii						
	Virgularia presbytes						
	Diodogorgia nodulifera						
	Leptogorgia cardinalis						
	Viminella barbadensis						
	Nidalia occidentalis						
Other	**Cup corals**						
	Oculina						
	Solenastrea hyades						
	Barrel/Vase Sponge						

Figure 3. OCTO datasheet – record Barrel/vase sponge, coral, & Octocoral species height within a 1m wide belt.

Figure 3. An example of a site with abundant *Titanideum frauenfeldii*.

Appendix V. Photo-quadrat survey protocol

BOEM Photo Quad Survey Protocol

Goal

Photo quads collected during this survey will be analyzed at a later date and are intended to provide an estimate of percent cover of benthic species. Surveys are concurrent with octocoral surveys and along the same transect as fish surveys.

Likely task allocation scenario

1 Photo Quad diver + OCTO diver:

Photo diver collects a 30x30cm quadrat picture every 2 meters (starting at 0 ending at 50) along the fish transect. Hardbottom is targeted and the transect tape does not need to be in the frame.

--in depths > 100 ft. OCTO & Photo Quad divers enter the water after LPI & Fish divers have exited the water (transect will stay on bottom). OCTO & Photo divers will retrieve the transect tape and send up the anchor prior to leaving the bottom.

--in depths < 100 ft. OCTO & Photo Quad divers will enter the water approximately 10 min after LPI & fish divers. OCTO & Photo divers will retrieve the transect tape and send up the anchor prior to leaving the bottom.

Photo Transect Methods

Photo quad transects will be surveyed at a subset of fish survey sites along the same transect (50m transect).

1. Site selection, navigation, and deployment
    a. **Test camera & strobes by taking a picture of the datasheet** – make sure site name is in picture.
    b. Small boats will navigate to the selected site using a handheld GPS unit. When the coordinate has been reached, confirm depth with coxswain then deploy a weighted float to mark the start of the transect.
    c. Divers will descend following the weighted line as rapidly and safely as possible, maintaining good buddy contact. If the site exceeds the maximum allowable depth (either by diver table limits, MOD, or cruise limit (130')) the dive is aborted and a new site is selected.
    d. Fish and Benthic dives are intended to quantify communities in hardbottom areas. Where no hardbottom is visible divers are instructed to abort the dive and select a new site.
2. Photo Quad In water methods

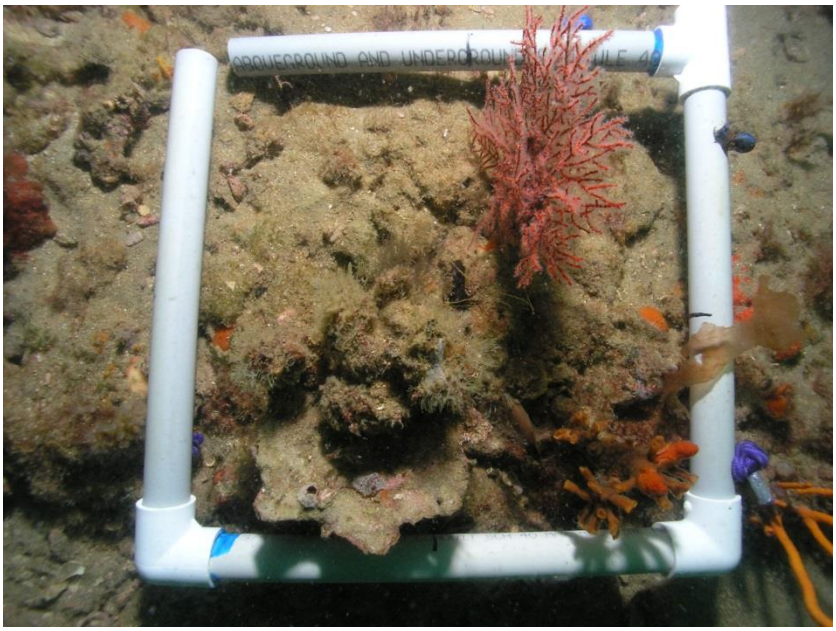
a. Fish diver will deploy the transect and anchor it periodically to minimize transect billowing in current.
b. Where Photo quad diver is in the water at the same time as Fish/LPI divers, they should always stay behind the fish diver to avoid influencing swimming behavior of fishes.
c. Test camera prior to taking photo quadrat pictures. make sure strobe is flashing, pictures are not blown out by too much flash, or too dark, and that benthos is in focus. Minimize backscatter of particulate – see camera tips at end of protocols.
d. Record 4 pictures (360 degrees) of area – collecting larger landscape of site. Make sure benthos is clearly in the view frame (e.g. not all water & fish).
e. Photo quad divers records a picture of the quadrat every 2m (thus 26 different quadrat placements from including 0 & 50m).
    i. The **transect tape does NOT have to be in the frame**. Please take pictures in order from 0 – 50. Any deviation of this should be noted on Octocoral's datasheet.
    ii. Please take multiple shots of the same quadrat – make sure you are happy with focus & lighting before moving on – the photo quad analyzer will thank you for extra in water efforts to take a good picture.
    iii. Lighting should be uniform within the quadrat – avoid hot spots of light & dark. Photo analyzer will not be happy with this type of picture.
    iv. The quadrat should occupy the majority of the camera frame. Minimize excess benthos around the perimeter of the quad.
    v. Make sure your camera is parallel to the angle of the quadrat. For most cases this will be directly over the substrate. Angle differences between substrate & camera introduce error and skew pictures making analysis difficult.
    vi. For each quadrat location – make sure quadrat is flush with the bottom (where possible). **Avoid quad at angles if possible.**
    vii. Should your quadrat encompass a tall octocoral or sponge that prevents it from being nearly flush – do the best you can. Do not place your quadrat elsewhere.
    viii. Where sand is encountered at a point where your photo quad should be you have a judgement call –
        1. If there is hardbottom within 1m (e.g., Likely the transect tape billowed & moved or ledge curved & tape didn't) **then swim to the hardbottom and take your picture.** ***this is often the case when swimming along a ledge.
        2. If you are in a sea of sand – place your quad at the targeted distance and take a picture of all sand. If you lose hardbottom on a transect (e.g. At 30 m). Continue to take pictures to 50m but **make a note at what distance hb ended.**
f. **Make a note of transect placement** on the octocoral datasheet (or carry your own – there are no official photoquad datasheets – just make your own from extra blank paper that is packed). Communities differ based on position from ledge habitats – this is a qualitative effort to describe transect placement. Please select

one & if you feel it is needed – add additional comments in site notes. Your choices on the data entry system are:

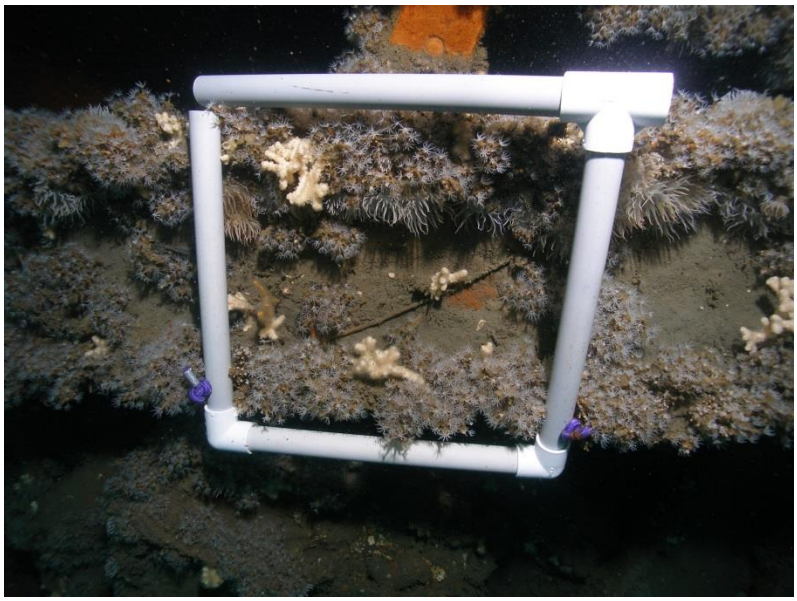
i. *Uniform hardbottom:* habitat is uniform hard bottom – transect did not follow any noteable interface
ii. *Interface:* typically ledge transition between HB & sand. Transect is placed approximately in the middle of the ledge – not in sand & not set back on top of ledge.
iii. *Top of ledge:* again this is on an interface habitat but transect is placed at the crest of the ledge
iv. *Bottom of ledge:* on an interface habitat transect is placed at the bottom of the ledge between HB & soft bottom. Likely missing some HB areas due to curvature of the transect tape.
v. *Inset from top of ledge 1m or more*: here survey was again along an interface but the transect placement was set back on the top of the ledge 1m or more.

3. Photo quad out of water
    a. Between dives or as soon as possible after your dive, exchange datasheets with another diver to ensure data consistency and continuity between divers. Any problems encountered should be documented thoroughly on the datasheet.
    b. Data entry into database should be done as soon as possible.
    c. **Download pictures to the network into the designated photo quadrat folder**.
        i. Name site folder as: sitename_date (e.g., 6402p_1_5.20.14). Each folder should contain photos from only one site/date. Make another folder if 2 sets of pictures were taken at a site on the same day.
        ii. Do not edit pictures – e.g. Adjust lighting or any other color adjustments
        iii. Rename pictures in the order in which they were encountered on the transect. For example: at 0m pictures would be called: 000a (for best picture at that distance), 000B, 000C, etc. Ending at 050A.
4. Camera tips & tricks
    a. Camera should be on shutter mode (S)
    b. Strobe should be on TTL mode with dial turned all the way up (full)
    c. Diffuser should be on strobe. If necessary you can remove it underwater depending on what conditions dictate. Diffuser helps reduce backscatter & hotspots.
    d. Camera settings are all pre-set. Should you feel like something changed & you want to change something – check the camera settings guide in the camera spares box & on google drive.
    e. If you need more light – switch strobe from TTL to first setting on left dial. On this setting you can manually adjust strobe intensity with dial on right. I suggest starting on ¾ power. Be careful you are not blowing out pictures with backscatter from particulate.
    f. If there is a lot of particulate in the water angle the strobe about 45 degrees to the angle of your lens. This reduces the reflection of strobe flash off particulates and back into the lens (as happens when strobe is parallel to lens).
    g. Charge strobe & camera batteries between morning & afternoon rounds of dives.

h. You may find you need to bring an extra set of strobe batteries if 3 dives are done with 1 camera.
i. WATER TEST CAMERA IN FRESH WATER AFTER EACH TIME THE CAMERA IS OPENED!
j. After it has been in salt water, soak camera in freshwater and push ALL buttons before opening camera. Make sure camera is dry before opening. There are plenty of lab towels packed for this purpose.
k. Test camera each morning & afternoon while still aboard Foster – troubleshoot before you're stranded on small boats.



Above is an example of good lighting, focus, and angle of photo quad.



Above is a beautiful picture but angle is bad. Lens should be parallel to the quad angle.

Appendix VI. Mean (standard error) percent cover of benthic community overall and by habitat type quantified by photo quadrat analysis

Phyla	Species / species group	Major Group	Overall Mean (SE)	Ledge (SE)	Mixed HB / Sand (SE)	Pavement (SE)
Macroalgae	Cladophora prolifera	CHLOROPHYTA	0.13 (0.05)	0.18 (0.08)	0.12 (0.06)	
	Cladophora sp.	CHLOROPHYTA	0.01	0.01 (0.01)	0.01 (0.01)	
	Codium carolineaum	CHLOROPHYTA	0.07 (0.05)	0.11 (0.11)	0.05 (0.05)	
	Codium fragile	CHLOROPHYTA	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	
	Unidentified Green Algae	CHLOROPHYTA	0.14 (0.04)	0.25 (0.09)	0.08 (0.05)	0.06 (0.06)
	Dictyota spp.	PHAEOPHYTA	0.13 (0.04)	0.17 (0.05)	0.13 (0.06)	
	Lobophora	PHAEOPHYTA	0.04 (0.03)	0.02 (0.01)	0.02 (0.01)	0.34 (0.34)
	Sargassum sp.	PHAEOPHYTA	2.60 (0.43)	4.18 (0.72)	1.91 (0.45)	0.17 (0.17)
	Unidentified Brown	PHAEOPHYTA	0.02 (0.01)	0.02 (0.01)	0.02 (0.01)	
	Zonaria tournefortii	PHAEOPHYTA	0.05 (0.04)	0.15 (0.09)		
	Amphiroa beauvoisii	RHODOPHYTA	0.16 (0.09)	0.43 (0.23)	0.01 (0.01)	
	Botrycladia occidentalis	RHODOPHYTA		0.01 (0.01)		
	CCA	RHODOPHYTA	1.41 (0.26)	1.82 (0.46)	1.19 (0.35)	1.05 (0.91)
	Champia/Lomentaria	RHODOPHYTA	0.27 (0.06)	0.38 (0.11)	0.23 (0.07)	0.06 (0.06)
	Eucheuma isiforme	RHODOPHYTA		0.01 (0.01)		
	Gracilaria/Rhodymenia	RHODOPHYTA	0.74 (0.27)	1.58 (0.68)	0.27 (0.10)	0.25 (0.25)
	Jointed Calcareous Algae	RHODOPHYTA		0.01 (0.01)		
	Peyssonnelia	RHODOPHYTA	0.04 (0.02)	0.04 (0.02)	0.04 (0.02)	0.06 (0.06)
	Solieria filiformis	RHODOPHYTA	0.09 (0.03)	0.18 (0.07)	0.05 (0.03)	
	Unidentified Red	RHODOPHYTA	1.39 (0.54)	2.55 (1.32)	0.84 (0.40)	

Phyla	Species / species group	Major Group	Overall Mean (SE)	Ledge (SE)	Mixed HB / Sand (SE)	Pavement (SE)
	Turf	MACROALGAE	0.18 (0.07)	0.38 (0.16)	0.08 (0.04)	
Invertebrate	Leptogorgia hebes	OCTOCORAL	0.21 (0.08)	0.21 (0.15)	0.24 (0.11)	
	Leptogorgia virgulata	OCTOCORAL	0.02 (0.01)	0.03 (0.03)	0.01 (0.01)	
	Octocorallia	OCTOCORAL	0.10 (0.02)	0.07 (0.03)	0.09 (0.03)	0.31 (0.03)
	Telesto sp.	OCTOCORAL	2.56 (0.55)	1.63 (1.11)	3.18 (0.65)	2.25 (0.38)
	Thesea nivea	OCTOCORAL	1.40 (0.26)	1.39 (0.46)	1.47 (0.36)	0.94 (0.94)
	Titanideum frauenfeldii	OCTOCORAL	0.80 (0.15)	0.78 (0.30)	0.72 (0.18)	1.50 (0.15)
	Occulina sp.	SCLERACTINIAN	0.01 (0.01)		0.02 (0.02)	
	Paracyathus pulchellus / Phyllangia americana	SCLERACTINIAN	0.01 (0.01)		0.01 (0.01)	0.06 (0.06)
	Unidentified Hard Coral	SCLERACTINIAN	0.03 (0.01)	0.02 (0.01)	0.03 (0.02)	
	Amathia sp.	OTHER INVERT	0.01	0.02 (0.01)		
	Anenome zoanthid	OTHER INVERT	0.14 (0.06)	0.12 (0.07)	0.08 (0.04)	0.73 (0.73)
	Barnacles	OTHER INVERT	1.05 (0.63)	0.70 (0.33)	1.39 (1.10)	
	Bryozoa: Soft	OTHER INVERT	0.09 (0.04)	0.16 (0.09)	0.06 (0.03)	0.03 (0.03)
	Clathria prolifera	OTHER INVERT		0.01 (0.01)		
	Cliona	OTHER INVERT	0.01		0.01 (0.01)	
	Encrusting sponge/ tunicate	OTHER INVERT	2.73 (0.32)	2.82 (0.37)	2.72 (0.49)	2.39 (1.99)
	Euherdmania gigantea	OTHER INVERT			0.01 (0.01)	
	Hydroid	OTHER INVERT	6.21 (1.29)	9.09 (2.97)	4.86 (1.14)	2.67 (2.20)
	Ircinia campana	OTHER INVERT	0.29 (0.12)	0.07 (0.07)	0.47 (0.20)	
	Other sessile invertebrates	OTHER INVERT	3.32 (0.43)	4.33 (0.64)	2.81 (0.58)	2.36 (1.96)
	Schizoporella cornuta	OTHER INVERT	0.16 (0.05)	0.17 (0.09)	0.14 (0.07)	0.34 (0.34)

Phyla	Species / species group	Major Group	Overall Mean (SE)	Ledge (SE)	Mixed HB / Sand (SE)	Pavement (SE)
	Schizoporella floridana	OTHER INVERT	0.37 (0.11)	0.54 (0.25)	0.27 (0.13)	0.25 (0.25)
	Spirastrella sp.	OTHER INVERT	0.06 (0.03)	0.11 (0.09)	0.03 (0.02)	0.11 (0.11)
	Sponges	OTHER INVERT	1.51 (0.34)	1.94 (0.70)	1.12 (0.33)	2.48 (2.42)
	Stylea plicata_Molgula occidentalis	OTHER INVERT	0.07 (0.02)	0.10 (0.05)	0.06 (0.02)	
	Unknown Tunicate	OTHER INVERT	0.60 (0.16)	0.96 (0.40)	0.42 (0.11)	0.29 (0.22)
	Worms: Polychaetes: Tube worms	OTHER INVERT	0.13 (0.03)	0.13 (0.05)	0.11 (0.03)	0.22 (0.22)
Substrate	Rock	BOTTOMTYPE	0.87 (0.17)	0.73 (0.24)	0.96 (0.26)	0.74 (0.46)
	Rock Rubble	BOTTOMTYPE	0.10 (0.04)	0.12 (0.08)	0.10 (0.06)	
	Sediment	BOTTOMTYPE	66.03 (2.26)	57.86 (2.41)	70.22 (2.93)	73.37 (10.13)
	Shell/ Shell Hash	BOTTOMTYPE	3.63 (0.50)	3.44 (0.72)	3.32 (0.64)	6.99 (2.91)

Appendix VII. Seasonal sampling dates of sixteen hardbottom study sites in Onslow Bay and Long Bay, NC. Dates indicate when individual transects were conducted on each site

Site Name	Location	Reef Type	Sample Period 1 (Fall)	Sample Period 2 (Winter)	Sample Period 3 (Spring)	Sample Period 4 (Summer)	Sample Period 5 (Fall)
Liberty Ship *Alexander Ramsey*	Onslow	Artificial	2013-09-19; 2013-09-19	2014-04-24; 2014-04-24	2014-07-01; 2014-07-01	2014-09-05, 2014-09-05	2014-11-13, 2014-11-13
Dredge *Hyde*	Onslow	Artificial	2013-09-24; 2013-09-24	2014-02-10; 2014-02-10	2014-06-24; 2014-06-24	2014-08-07; 2014-08-07	2014-11-13, 2014-11-13
Tanker *John Gill*	Onslow	Artificial	2013-09-24; 2013-09-24	2014-02-25; 2014-02-25	2014-06-24; 2014-06-24	2014-08-07; 2014-08-07	2014-11-13, 2014-11-13
Tanker *Cassimir*	Onslow	Artificial	Not sampled (sea conditions)	2014-04-10; 2014-04-10	Not sampled (sea conditions)	2014-09-04, 2014-09-04	2014-11-05, 2014-11-05
Dallas Rocks	Onslow	Natural	2013-09-20; 2013-09-20	2014-04-10; 2014-04-24	2014-07-01; 2014-07-01	2014-09-04, 2014-09-04	2014-11-05, 2014-11-05
200 / 200 Ledge	Onslow	Natural	2013-09-20; 2013-09-20	2014-04-10; 2014-04-10	2014-07-01; 2014-07-01	2014-09-04, 2014-09-04	2014-11-05, 2014-11-05
23 Mile Ledge	Onslow	Natural	2013-09-20; 2013-09-20	2014-02-25; 2014-02-25	2014-06-24; 2014-06-24	2014-09-05, 2014-09-05	Not sampled (sea conditions)
5 Mile Ledge	Onslow	Natural	2013-09-19; 2013-09-19	2014-04-24; 2014-04-24	2014-07-01; 2014-07-01	2014-09-05, 2014-09-05	2014-11-13, 2014-11-13
Tanker *Raritan*	Wilmington-East	Artificial	2013-09-25; 2013-09-25	Not sampled (sea conditions)	2014-06-25; 2014-06-30	2014-09-11, 2014-09-11	2014-12-18, 2014-12-18
Passenger Freighter *City of Houston*	Wilmington-East	Artificial	2013-09-25; 2013-09-25	Not sampled (sea conditions)	2014-06-25; 2014-06-25	2014-09-11, 2014-09-11	2014-11-15, 2014-11-15
Unknown Wreck 1	Wilmington-East	Artificial	2013-12-04; 2013-12-04	Not sampled (sea conditions)	2014-06-25; 2014-06-25	2014-09-11, 2014-09-11	2014-11-13, 2014-11-13

Site Name	Location	Reef Type	Sample Period 1 (Fall)	Sample Period 2 (Winter)	Sample Period 3 (Spring)	Sample Period 4 (Summer)	Sample Period 5 (Fall)
Unknown Wreck 2	Wilmington-East	Artificial	Not sampled (sea conditions)	Not sampled (sea conditions)	Not sampled (sea conditions)	Not sampled (sea conditions)	2014-12-19, not sampled 2x
Thumb Ledge	Wilmington-East	Natural	2013-09-25; 2013-09-25	Not sampled (sea conditions)	2014-06-25; 2014-06-30	2014-09-11, 2014-09-11	2014-12-19, 2014-12-19
Hammerhead Ledge	Wilmington-East	Natural	2013-12-13; 2013-12-13	Not sampled (sea conditions)	2014-06-30; 2014-06-30	2014-09-11, 2014-09-11	2014-12-19, 2014-12-19
Lightning Bolt Ledge	Wilmington-East	Natural	2013-12-13; 2013-12-13	Not sampled (sea conditions)	2014-06-25; 2014-06-25	2014-09-11, 2014-09-11	2014-12-19, 2014-12, 19
Bumpy Ledge	Wilmington-East	Natural	2013-12-13; 2013-12-13	Not sampled (sea conditions)	2014-06-25; 2014-06-25	2014-09-11, 2014-09-11	2014-12-15, 2014-12-15

Appendix VIII. Conspicuous community species, common name and trophic guild

Species Name	Common	Density
Acanthostracion quadricornis	Scrawled Cowfish	Invertivore
Acanthurus chirurgus	Doctorfish	Herbivore
Aluterus scriptus	Scrawled Filefish	Omnivore
Archosargus probatocephalus	Sheepshead	Invertivore
Atherinomorus species	Silversides	Planktivore
Balistes capriscus	Gray Triggerfish	Invertivore
Bodianus pulchellus	Spotfin Hogfish	Invertivore
Calamus bajonado	Jolthead Porgy	Invertivore
Calamus calamus	Saucereye Porgy	Invertivore
Calamus leucosteus	Whitebone Porgy	Invertivore
Calamus penna	Sheepshead Porgy	Invertivore
Calamus species	Calamus Sp.	Invertivore
Cantherhines macrocerus	American Whitespotted Filefish	Invertivore
Canthigaster rostrata	Sharpnose Puffer	Omnivore
Caranx crysos	Blue Runner	Benthic Carnivore
Carcharhinus plumbeus	Sandbar Shark	Piscivore
Carcharhinus species	Carcharhinus Species	Piscivore
Carcharias taurus	Sand Tiger	Piscivore
Carcharodon carcharias	Great White Shark	Piscivore
Centropristis ocyurus	Bank Sea Bass	Benthic Carnivore
Centropristis striata	Black Sea Bass	Benthic Carnivore
Chaetodipterus faber	Atlantic Spadefish	Invertivore
Chaetodon ocellatus	Spotfin Butterflyfish	Omnivore
Chaetodon sedentarius	Reef Butterflyfish	Omnivore
Chilomycterus schoepfi	Striped Burrfish	Invertivore
Chromis enchrysura	Yellowtail Reeffish	Planktivore
Chromis scotti	Purple Reeffish	Planktivore
Dasyatis americana	Southern Stingray	Benthic Carnivore
Decapterus macarellus	Mackerel Scad	Planktivore
Decapterus punctatus	Round Scad	Planktivore
Decapterus species	Scads	Planktivore
Diplectrum formosum	Sand Perch	Benthic Carnivore

Species Name	Common	Density
Diplodus holbrookii	Spottail Pinfish	Omnivore
Equetus lanceolatus	Jackknife Fish	Invertivore
Gymnothorax funebris	Green Moray	Piscivore
Gymnothorax miliaris	Goldentail Moray	Invertivore
Gymnothorax moringa	Spotted Moray	Piscivore
Gymnothorax species	Moray	Piscivore
Gymnura altavela	Spiny Butterfly Ray	Benthic Carnivore
Haemulon album	Margate (White)	Invertivore
Haemulon aurolineatum	Tomtate	Invertivore
Haemulon plumierii	White Grunt	Invertivore
Halichoeres bivittatus	Slippery Dick	Invertivore
Halichoeres caudalis	Painted Wrasse	Invertivore
Halichoeres garnoti	Yellowhead Wrasse	Invertivore
Holacanthus bermudensis	Blue Angelfish	Invertivore
Holacanthus ciliaris	Queen Angelfish	Invertivore
Holacanthus species	Angelfish Holacanthus Species	Invertivore
Holacanthus tricolor	Rock Beauty	Invertivore
Lachnolaimus maximus	Hogfish	Invertivore
Lactophrys triqueter	Smooth Trunkfish	Invertivore
Lagodon rhomboides	Pinfish	Omnivore
Lutjanus campechanus	Red Snapper	Benthic Carnivore
Lutjanus synagris	Lane Snapper	Piscivore
Muraena retifera	Reticulate Moray	Benthic Carnivore
Mycteroperca interstitialis	Yellowmouth Grouper	Piscivore
Mycteroperca microlepis	Gag	Benthic Carnivore
Mycteroperca phenax	Scamp	Piscivore
Myrichthys breviceps	Sharptail Eel	Benthic Carnivore
Opsanus tau	Oyster Toadfish	Benthic Carnivore
Orthopristis chrysoptera	Pigfish	Invertivore
Pagrus pagrus	Red Porgy	Benthic Carnivore
Parablennius marmoreus	Seaweed Blenny	Planktivore
Paralichthys albigutta	Gulf Flounder	Benthic Carnivore
Paralichthys lethostigma	Southern Flounder	Benthic Carnivore
Paralichthys species	Flounder Species	Benthic Carnivore

Species Name	**Common**	**Density**
Pareques umbrosus	Cubbyu	Benthic Carnivore
Pristigenys alta	Short Bigeye	Benthic Carnivore
Ptereleotris calliura	Blue Dartfish	Planktivore
Pterois volitans	Lionfish	Benthic Carnivore
Rachycentron canadum	Cobia	Benthic Carnivore
Raja eglanteria	Clearnose Skate	Benthic Carnivore
Rhizoprionodon terraenovae	Atlantic Sharpnose Shark	Piscivore
Rhomboplites aurorubens	Vermilion Snapper	Benthic Carnivore
Rypticus maculatus	Whitespotted Soapfish	Benthic Carnivore
Rypticus species	Soapfish Species	Benthic Carnivore
Scomberomorus	Mackeral Species	Piscivore
Scorpaena plumieri	Spotted Scorpionfish	Benthic Carnivore
Scorpaenidae	Scorpionfish Species	Benthic Carnivore
Seriola dumerili	Greater Amberjack	Piscivore
Seriola rivoliana	Almaco Jack	Piscivore
Seriola zonata	Banded Rudderfish	Piscivore
Serranus subligarius	Belted Sandfish	Invertivore
Sphoeroides spengleri	Bandtail Puffer	Benthic Carnivore
Sphyraena barracuda	Great Barracuda	Piscivore
Stegastes variabilis	Cocoa Damselfish	Herbivore
Stenotomus caprinus	Longspine Porgy	Benthic Carnivore
Stenotomus chrysops	Scup	Benthic Carnivore
Stephanolepis hispidus	Planehead Filefish	Benthic Carnivore
Tautoga onitis	Tautog	Benthic Carnivore
Triglidae species	Sea Robins	Planktivore
Upeneus parvus	Dwarf Goatfish	Benthic Carnivore
Urophycis earllii	Carolina Hake	Benthic Carnivore
Urophycis species	Hake Species	Benthic Carnivore

Appendix IX. Conspicuous fish community mean site density (#/100 m^2) ± SE, and mean site biomass (kg/100 m^2) ± SE

Species Name	Common	Density	SE	Biomass	SE
Acanthostracion quadricornis	Scrawled Cowfish	0.02	0.01	<0.01	<0.01
Acanthurus chirurgus	Doctorfish	0.02	0.02	<0.01	<0.01
Aluterus scriptus	Scrawled Filefish	0.00	0.00	<0.01	<0.01
Archosargus probatocephalus	Sheepshead	0.19	0.08	0.04	0.02
Atherinomorus species	Silversides	0.72	0.72	<0.01	<0.01
Balistes capriscus	Gray Triggerfish	0.17	0.04	0.01	<0.01
Bodianus pulchellus	Spotfin Hogfish	0.03	0.02	<0.01	<0.01
Calamus bajonado	Jolthead Porgy	0.01	0.01	0.01	<0.01
Calamus calamus	Saucereye Porgy	0.11	0.04	0.02	<0.01
Calamus leucosteus	Whitebone Porgy	0.06	0.04	<0.01	<0.01
Calamus penna	Sheepshead Porgy	0.23	0.12	0.02	0.01
Calamus species	Calamus Sp.	0.79	0.25	0.22	0.08
Cantherhines macrocerus	American Whitespotted Filefish	0.07	0.06	0.01	0.01
Canthigaster rostrata	Sharpnose Puffer	0.01	0.01	<0.01	<0.01
Caranx crysos	Blue Runner	0.15	0.10	0.02	0.01
Carcharhinus plumbeus	Sandbar Shark	0.01	0.01	0.27	0.20
Carcharhinus species	Carcharhinus Species	0.01	0.01	0.29	0.21
Carcharias taurus	Sand Tiger	0.02	0.01	2.29	1.63
Carcharodon carcharias	Great White Shark	0.00	0.00	0.58	0.58
Centropristis ocyurus	Bank Sea Bass	0.39	0.09	0.03	<0.01
Centropristis striata	*C. striata*	5.55	0.99	0.77	0.12
Chaetodipterus faber	Atlantic Spadefish	2.10	1.92	0.25	0.23
Chaetodon ocellatus	Spotfin Butterflyfish	0.08	0.03	<0.01	<0.01
Chaetodon sedentarius	Reef Butterflyfish	0.03	0.02	<0.01	<0.01
Chilomycterus schoepfi	Striped Burrfish	0.00	0.00	<0.01	<0.01
Chromis enchrysura	Yellowtail Reeffish	0.02	0.01	<0.01	<0.01
Chromis scotti	Purple Reeffish	0.05	0.04	<0.01	<0.01
Dasyatis americana	Southern Stingray	0.00	0.00	0.07	0.07
Decapterus macarellus	Mackerel Scad	1.92	1.92	0.04	0.04
Decapterus punctatus	Round Scad	3.08	2.34	0.10	0.08
Decapterus species	Scads	1.92	1.37	0.06	0.05
Diplectrum formosum	Sand Perch	0.03	0.02	<0.01	<0.01
Diplodus holbrookii	Spottail Pinfish	16.86	9.70	1.07	0.64
Equetus lanceolatus	Jackknife Fish	0.03	0.02	<0.01	<0.01
Gymnothorax funebris	Green Moray	0.00	0.00	<0.01	<0.01
Gymnothorax miliaris	Goldentail Moray	0.01	0.01	<0.01	<0.01
Gymnothorax moringa	Spotted Moray	0.02	0.01	<0.01	<0.01
Gymnothorax species	Moray	0.01	0.01	<0.01	<0.01
Gymnura altavela	Spiny Butterfly Ray	0.00	0.00	0.23	0.23
Haemulon album	Margate (White)	0.00	0.00	<0.01	<0.01
Haemulon aurolineatum	Tomtate	79.24	20.71	1.75	0.45
Haemulon plumierii	White Grunt	2.45	1.13	0.34	0.09

Species Name	Common	Density	SE	Biomass	SE
Halichoeres bivittatus	Slippery Dick	0.69	0.21	0.01	<0.01
Halichoeres caudalis	Painted Wrasse	0.19	0.07	<0.01	<0.01
Halichoeres garnoti	Yellowhead Wrasse	0.00	0.00	<0.01	<0.01
Holacanthus bermudensis	Blue Angelfish	0.43	0.06	0.11	0.02
Holacanthus ciliaris	Queen Angelfish	0.02	0.01	<0.01	<0.01
Holacanthus species	Angelfish Holacanthus Species	0.01	0.01	<0.01	<0.01
Holacanthus tricolor	Rock Beauty	0.00	0.00	<0.01	<0.01
Lachnolaimus maximus	Hogfish	0.04	0.02	0.05	0.04
Lactophrys triqueter	Smooth Trunkfish	0.01	0.01	<0.01	<0.01
Lagodon rhomboides	Pinfish	2.34	1.61	0.31	0.30
Lutjanus campechanus	Red Snapper	0.22	0.07	0.21	0.11
Lutjanus synagris	Lane Snapper	0.00	0.00	<0.01	<0.01
Muraena retifera	Reticulate Moray	0.01	0.01	<0.01	<0.01
Mycteroperca interstitialis	Yellowmouth Grouper	0.00	0.00	<0.01	<0.01
Mycteroperca microlepis	Gag	1.44	0.22	1.92	0.50
Mycteroperca phenax	Scamp	0.36	0.11	0.39	0.21
Myrichthys breviceps	Sharptail Eel	0.00	0.00	<0.01	<0.01
Opsanus tau	Oyster Toadfish	0.03	0.02	<0.01	<0.01
Orthopristis chrysoptera	Pigfish	0.06	0.04	<0.01	<0.01
Pagrus pagrus	Red Porgy	0.10	0.06	0.01	<0.01
Parablennius marmoreus	Seaweed Blenny	0.02	0.01	<0.01	<0.01
Paralichthys albigutta	Gulf Flounder	0.01	0.01	<0.01	<0.01
Paralichthys lethostigma	Southern Flounder	0.01	0.01	0.02	0.02
Paralichthys species	Flounder Species	0.01	0.01	<0.01	<0.01
Pareques umbrosus	Cubbyu	2.05	0.72	0.20	0.10
Pristigenys alta	Short Bigeye	0.00	0.00	<0.01	<0.01
Ptereleotris calliura	Blue Dartfish	0.11	0.07	<0.01	<0.01
Pterois volitans	Lionfish	0.26	0.07	0.07	0.02
Rachycentron canadum	Cobia	0.03	0.02	0.30	0.26
Raja eglanteria	Clearnose Skate	0.00	0.00	<0.01	<0.01
Rhizoprionodon terraenovae	Atlantic Sharpnose Shark	0.00	0.00	<0.01	<0.01
Rhomboplites aurorubens	Vermilion Snapper	17.72	7.45	0.89	0.39
Rypticus maculatus	Whitespotted Soapfish	0.17	0.04	<0.01	<0.01
Rypticus species	Soapfish Species	0.01	0.01	<0.01	<0.01
Scomberomorus	Mackeral Species	0.00	0.00	<0.01	<0.01
Scorpaena plumieri	Spotted Scorpionfish	0.01	0.01	<0.01	<0.01
Scorpaenidae	Scorpionfish Species	0.02	0.01	<0.01	<0.01
Seriola dumerili	Greater Amberjack	0.93	0.37	4.71	1.81
Seriola rivoliana	Almaco Jack	0.16	0.11	0.16	0.09
Seriola zonata	Banded Rudderfish	1.28	0.72	0.68	0.37
Serranus subligarius	Belted Sandfish	0.03	0.02	<0.01	<0.01
Sphoeroides spengleri	Bandtail Puffer	0.05	0.03	<0.01	<0.01
Sphyraena barracuda	Great Barracuda	0.01	0.01	<0.01	<0.01
Stegastes variabilis	Cocoa Damselfish	0.03	0.02	<0.01	<0.01
Stenotomus caprinus	Longspine Porgy	13.22	4.01	0.42	0.14
Stenotomus chrysops	Scup	12.34	3.48	1.15	0.36

Species Name	Common	Density	SE	Biomass	SE
Stephanolepis hispidus	Planehead Filefish	0.10	0.03	<0.01	<0.01
Tautoga onitis	Tautog	0.07	0.02	0.05	0.02
Triglidae species	Sea Robins	0.01	0.01	<0.01	<0.01
Upeneus parvus	Dwarf Goatfish	0.00	0.00	<0.01	<0.01
Urophycis earllii	Carolina Hake	0.11	0.04	0.02	<0.01
Urophycis species	Hake Species	0.00	0.00	<0.01	<0.01

Appendix X. Top five families by percent contribution to overall density and biomass for conspicuous communities by bottom type

Ledge				Pavement			
Family	**Density**	**Family**	**Biomass**	**Family**	**Density**	**Family**	**Biomass**
Haemulidae	55.14%	Carangidae	30.23%	Sparidae	68.62%	Sparidae	74.87%
Sparidae	18.59%	Odontaspididae	20.01%	Haemulidae	19.68%	Carcharhinidae	11.34%
Lutjanidae	14.82%	Serranidae	15.65%	Serranidae	5.35%	Haemulidae	8.47%
Serranidae	5.13%	Lutjanidae	7.30%	Carangidae	5.05%	Serranidae	3.41%
Carangidae	2.68%	Haemulidae	7.10%	Sciaenidae	0.61%	Carangidae	0.79%
Mixed Hardbottom/Sand				**Artificial**			
Family	**Density**	**Family**	**Biomass**	**Family**	**Density**	**Family**	**Biomass**
Haemulidae	44.97%	Carangidae	29.13%	Haemulidae	42.95%	Sparidae	41.45%
Sparidae	27.28%	Sparidae	20.42%	Sparidae	40.38%	Carangidae	26.24%
Carangidae	8.97%	Serranidae	16.78%	Lutjanidae	6.82%	Serranidae	13.74%
Lutjanidae	8.81%	Haemulidae	16.28%	Serranidae	4.91%	Haemulidae	10.34%
Serranidae	4.21%	Gymnuridae	3.61%	Atherinidae	2.84%	Lutjanidae	5.70%

Appendix XI. Cryptic community species, common name and trophic guild

Species Name	Common Name	Trophic Guild
Apogon townsendi	Belted Cardinalfish	Invertivore
Balistes capriscus	Gray Triggerfish	Invertivore
Bodianus pulchellus	Spotfin Hogfish	Invertivore
Calamus species	Calamus Sp.	Invertivore
Canthigaster rostrata	Sharpnose Puffer	Omnivore
Centropristis ocyurus	Bank Sea Bass	Benthic Carnivore
Centropristis striata	Black Sea Bass	Benthic Carnivore
Chaetodon ocellatus	Spotfin Butterflyfish	Omnivore
Chromis enchrysura	Yellowtail Reeffish	Planktivore
Chromis scotti	Purple Reeffish	Planktivore
Coryphopterus glaucofraenum	Bridled Goby	Omnivore
Coryphopterus personatus	Masked Goby	Omnivore
Diplectrum formosum	Sand Perch	Benthic Carnivore
Diplodus holbrookii	Spottail Pinfish	Omnivore
Equetus lanceolatus	Jackknife Fish	Invertivore
Gymnothorax miliaris	Goldentail Moray	Invertivore
Gymnothorax moringa	Spotted Moray	Piscivore
Gymnothorax species	Moray	Piscivore
Haemulon aurolineatum	Tomtate	Invertivore
Haemulon plumierii	White Grunt	Invertivore
Halichoeres bivittatus	Slippery Dick	Invertivore
Halichoeres caudalis	Painted Wrasse	Invertivore
Halichoeres garnoti	Yellowhead Wrasse	Invertivore
Holacanthus bermudensis	Blue Angelfish	Invertivore
Hypleurochilus geminatus	Crested Blenny	Omnivore
Lagodon rhomboides	Pinfish	Omnivore
Muraena retifera	Reticulate Moray	Benthic Carnivore
Mycteroperca microlepis	Gag	Benthic Carnivore
Opistognathus species	Jawfishes	Planktivore
Opsanus tau	Oyster Toadfish	Benthic Carnivore
Parablennius marmoreus	Seaweed Blenny	Planktivore
Pareques umbrosus	Cubbyu	Benthic Carnivore
Ptereleotris calliura	Blue Dartfish	Planktivore
Pterois volitans	Lionfish	Benthic Carnivore
Rypticus maculatus	Whitespotted Soapfish	Benthic Carnivore
Scorpaena plumieri	Spotted Scorpionfish	Benthic Carnivore
Serranus phoebe	Tattler Bass	Invertivore
Serranus subligarius	Belted Sandfish	Invertivore
Serranus tigrinus	Harlequin Bass	Invertivore
Sphoeroides spengleri	Bandtail Puffer	Benthic Carnivore
Stegastes partitus	Bicolor Damselfish	Herbivore
Stegastes variabilis	Cocoa Damselfish	Herbivore
Stenotomus caprinus	Longspine Porgy	Benthic Carnivore
Stenotomus chrysops	Scup	Benthic Carnivore

Species Name	Common Name	Trophic Guild
Stephanolepis hispidus	Planehead Filefish	Benthic Carnivore
Tetraodontidae species	Puffer Species	Invertivore
Upeneus parvus	Dwarf Goatfish	Benthic Carnivore
Urophycis earllii	Carolina Hake	Benthic Carnivore

Appendix XII. Cryptic fish community mean site density (#/100 m^2) ± SE, and mean site biomass (kg/100 m^2) ± SE

Species Name	Common Name	Density	SE	Biomass	SE
Apogon townsendi	Belted Cardinalfish	0.91	0.91	<0.01	<0.01
Balistes capriscus	Gray Triggerfish	0.08	0.08	<0.01	<0.01
Bodianus pulchellus	Spotfin Hogfish	0.04	0.04	<0.01	<0.01
Calamus species	Calamus Sp.	0.17	0.17	<0.01	<0.01
Canthigaster rostrata	Sharpnose Puffer	1.73	0.71	<0.01	<0.01
Centropristis ocyurus	Bank Sea Bass	3.60	0.86	0.10	0.03
Centropristis striata	Black Sea Bass	6.45	1.38	0.12	0.03
Chaetodon ocellatus	Spotfin Butterflyfish	0.60	0.37	0.02	0.02
Chromis enchrysura	Yellowtail Reeffish	0.87	0.75	<0.01	<0.01
Chromis scotti	Purple Reeffish	1.32	0.84	<0.01	<0.01
Coryphopterus glaucofraenum	Bridled Goby	1.32	0.43	<0.01	<0.01
Coryphopterus personatus	Masked Goby	0.55	0.40	<0.01	<0.01
Diplectrum formosum	Sand Perch	0.13	0.07	<0.01	<0.01
Diplodus holbrookii	Spottail Pinfish	2.38	1.80	0.11	0.08
Equetus lanceolatus	Jackknife Fish	0.17	0.17	<0.01	<0.01
Gymnothorax miliaris	Goldentail Moray	0.13	0.07	<0.01	<0.01
Gymnothorax moringa	Spotted Moray	0.04	0.04	<0.01	<0.01
Gymnothorax species	Moray	0.09	0.09	<0.01	<0.01
Haemulon aurolineatum	Tomtate	26.61	21.85	0.26	0.24
Haemulon plumierii	White Grunt	0.45	0.35	<0.01	<0.01
Halichoeres bivittatus	Slippery Dick	21.00	3.04	0.12	0.04
Halichoeres caudalis	Painted Wrasse	3.38	0.74	0.07	0.03
Halichoeres garnoti	Yellowhead Wrasse	0.04	0.04	<0.01	<0.01
Holacanthus bermudensis	Blue Angelfish	0.65	0.26	0.02	0.01
Hypleurochilus geminatus	Crested Blenny	0.13	0.09	<0.01	<0.01
Lagodon rhomboides	Pinfish	0.04	0.04	<0.01	<0.01
Muraena retifera	Reticulate Moray	0.04	0.04	<0.01	<0.01
Mycteroperca microlepis	Gag	0.09	0.06	<0.01	<0.01
Opistognathus species	Jawfishes	0.30	0.23	<0.01	<0.01
Opsanus tau	Oyster Toadfish	0.09	0.06	<0.01	<0.01
Parablennius marmoreus	Seaweed Blenny	3.92	0.94	<0.01	<0.01
Pareques umbrosus	Cubbyu	14.98	4.13	0.67	0.29
Ptereleotris calliura	Blue Dartfish	0.38	0.16	<0.01	<0.01
Pterois volitans	Lionfish	0.36	0.16	0.02	0.01
Rypticus maculatus	Whitespotted Soapfish	1.53	0.39	0.02	<0.01
Scorpaena plumieri	Spotted Scorpionfish	0.04	0.04	<0.01	<0.01
Serranus phoebe	Tattler Bass	0.04	0.04	<0.01	<0.01
Serranus subligarius	Belted Sandfish	8.98	2.01	0.03	<0.01
Serranus tigrinus	Harlequin Bass	0.04	0.04	<0.01	<0.01
Sphoeroides spengleri	Bandtail Puffer	0.66	0.34	0.01	<0.01
Stegastes partitus	Bicolor Damselfish	0.09	0.06	<0.01	<0.01
Stegastes variabilis	Cocoa Damselfish	0.47	0.22	<0.01	<0.01
Stenotomus caprinus	Longspine Porgy	13.19	10.80	0.30	0.24
Stenotomus chrysops	Scup	11.87	10.63	0.47	0.42
Stephanolepis hispidus	Planehead Filefish	0.04	0.04	<0.01	<0.01

Species Name	Common Name	Density	SE	Biomass	SE
Tetraodontidae species	Puffer Species	0.26	0.19	<0.01	<0.01
Upeneus parvus	Dwarf Goatfish	0.09	0.06	<0.01	<0.01
Urophycis earllii	Carolina Hake	1.06	0.45	0.03	0.01