

**Results of Epibiotic Surveys of Nearshore Rock Outcrops in the
Mid Reach Project Area in Brevard County, Florida**

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INTRODUCTION

Nearshore rock features along the central Brevard County coastline are coquina outcrops, formed from lithified shell fragments, quartz sand, and calcium carbonate. The outcrops parallel the shoreline, extending from Patrick Air Force Base (AFB) south through Indian Harbor Beach, and provide diverse habitat for shallow water marine flora and fauna (Continental Shelf Associates, Inc., 1990). These coquina outcrops extend from the intertidal to subtidal zones and range from wide expanses of tabular ledges with up to 2 to 3 ft of relief at the southern end of Patrick AFB to small isolated rocks in northern Indian Harbor. In the higher relief areas, the ledges are tipped up toward the beach, exhibiting exposed vertical faces and overhangs along the shoreward edges.

The rock outcrops are colonized by various species of algae, the sabellariid reef-building polychaete *Phragmatopoma caudata* (= *P. lapidosa*), sponges, mollusks, crustaceans, bryozoans, and ascidians (Gore et al., 1978; Zale and Merrifield, 1989). Relatively high densities of the green alga *Caulerpa prolifera* and varying densities of unidentified green filamentous algae have been observed along the crests of these outcrops (Continental Shelf Associates, Inc., 1990). The sabellariid polychaete *P. caudata* is found throughout this area, building scattered mounds on nearshore rock outcrops south to Key Biscayne (Kirtley, 1966; Kirtley and Tanner, 1968; Young, 1975; McCarthy, 2001). The wormreef colonies are typically found in both the low intertidal and subtidal zones and are somewhat ephemeral, being negatively impacted by both storm waves and burial by sediments. The crabs *Menippe nodifrons* and *Pachygrasus transversus* have been noted as having some abundance in wormreef areas north of Melbourne, along with limited occurrence of *Plagusia depressa* (Young, 1975). Van Montfrans (1981) collected eight decapod species on wormreef mounds in the intertidal zone and subtidally off Patrick AFB in Satellite Beach.

The objectives of this study were to further characterize this specific habitat throughout the Mid Reach area and provide additional information for the Supplemental Environmental Impact Statement. This information will then be used to determine potential impacts to the existing hard bottom communities from various beach nourishment alternatives.

METHODS

The Brevard County coastline is a relatively high-energy area, exposed to both winter and tropical storms (Tanner, 1960). The almost constant wave and ocean swell impacts create a nearshore environment with nearly year-round suspended sediments and high turbidity. This combination of rough water and low underwater visibility creates problems in the visual assessment of benthic communities associated with hard bottom.

Continental Shelf Associates, Inc. (CSA) scientific staff were tasked with surveying and characterizing the epibiotic assemblages associated with the nearshore hard bottom in the Mid Reach Project Area along the Brevard County coastline. As

previously described, the nearshore area is exposed to nearly continuous wave and/or ocean swell activity with resulting turbidity, yielding less than optimal sampling conditions. Because of these conditions, attempts were made to limit data collection to periods of low tidal levels on days with minimal winds and nearly flat sea states. Even on the few days of optimal conditions, there was still nearshore wave activity and associated surge, causing sediment suspension and less than ideal conditions for video data collection and *in situ* observations. Selected nearshore outcrops were surveyed from the vicinity of Florida Department of Environmental Protection (FDEP) Monument R 78 at Seagull Park, just south of Patrick AFB, to near Monument R 117, near the southern end of the Mid Reach (**Figure 1**).

Field teams collected digital video data from transects along and across the rock outcrops using a Sony DCR-TRV900 digital videocamera within an Amphibico aluminum underwater housing. Video was utilized for data collection because of the great difficulty associated with collecting *in situ* data such as quadrat counts and measurements in this high energy environment. The videocamera can collect continuous data segments under fairly extreme conditions, with the camera being held closer to the substrate if turbid water conditions are encountered. The data may then be used to determine relative abundance of species or taxonomic groups. By using a random point analysis technique, percent botal cover determinations can be made and data compared between areas.

Transects were established on the rock outcrops and extended generally parallel to the shoreline, with individual video segments taken at random distances along and east or west of the transect centerlines. The transect layouts and distances between video segments became more haphazard than random as wave heights increased and visibility decreased. Video data were collected on outcrops exposed to the air at low tide as well as on hard bottom below the water level. The videocamera was held a fixed distance of 35 cm above the rock surface, with converging lasers used to maintain the distance. In areas of turbid water, the camera-to-rock distance was decreased to approximately 20 cm to allow the collection of acceptable images. Video segments were obtained while holding the camera as motionless as possible at each randomly selected location. Specimens of algae from several of the surveyed sites were collected and preserved for subsequent identification.

Sampling location coordinates within the survey area were recorded with a hand-held Garmin differential global positioning system (DGPS) receiver. For rock outcrops extending less than approximately 100 ft along the shoreline, a single set of coordinates was taken at the estimated center of the rock feature. For larger hard bottom features, coordinates were taken at both the northern and southern extents of sampling locations.

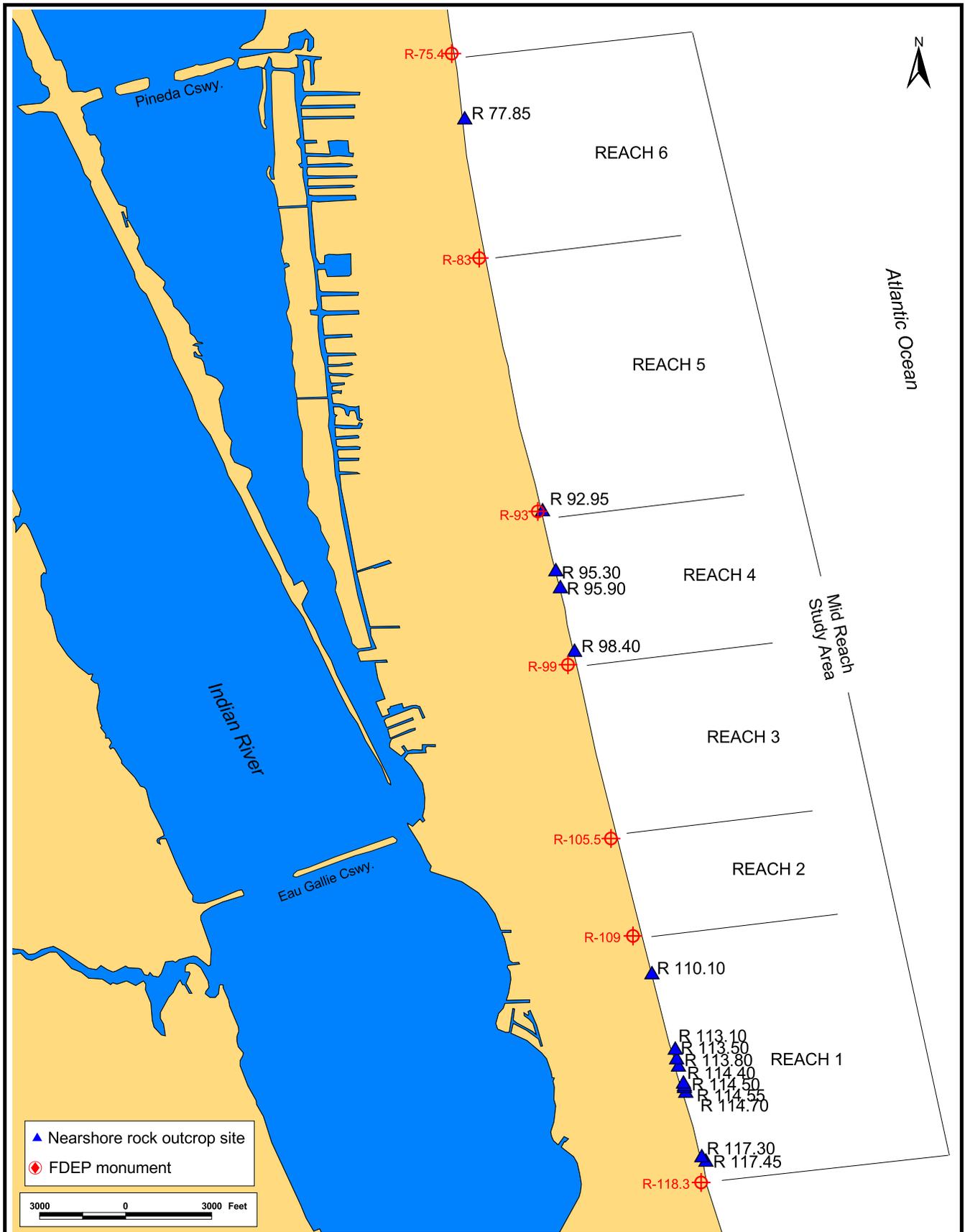


Figure 1. Nearshore rock outcrop sampling sites along the Mid Reach of Brevard County (2005).



The digital video data were reviewed at the office following field data collection to determine the suitability of video frames for analyses. Video segments from each data collection location or point were reviewed, with the acceptable video frames from each location saved as jpeg files for subsequent random point analysis. The selected video images were analyzed using Point Count software, in which random points are placed over each image, then each item (algal species, wormreef, substrate type) beneath a point is identified and counted. The data were entered into a spreadsheet, and percent cover values for biota and substrate were calculated.

RESULTS

Video data and observations were successfully collected on nearshore rock outcrops in the vicinity of Seagull Park, Pelican Park, Sunrise Avenue, Bicentennial Park, Paradise Park, and south of Paradise Park in the period from 2 July through 22 August 2005 (**Table 1**). Several survey attempts also were made at High Tower Park (R 82.5), Millenium Park (R 103.0), and Canova Beach (R 105.0), but turbid water conditions prevented collection of acceptable video data. In most instances the video data were not clear enough to make species-level identifications for algae, aside from certain large-bladed or visually distinct species such as *C. prolifera*, *Caulerpa racemosa*, *Ulva lactuca*, *Bryopsis plumosa*, and *Padina gymnospora*. Several other algal taxa were identifiable to genus-level, but due to the thin blades and small sizes of most of the algae and the somewhat turbid water and effects of wave action on camera steadiness, detailed identifications were problematic. An average of 20 video images underwent percent cover analyses at each of the sampling sites. In the specific site descriptions and characterizations, both the video data analyses and *in situ* observations and specimen collections were utilized.

A total of 22 species of algae, at least two sponge species, a gastropod mollusk, a crab, and unidentified hydroids and ascidians was identified within the project area rock habitat (**Table 2**). Percent cover analyses from the 14 surveyed sites showed total green algal cover ranging from 0.0% to 30.4% (11.4% average), total red algal cover from 4.7% to 47.0% (22.2% average), and total algal cover from 16.3% to 54.5% (39.1% average) at individual locations (**Table 3**). The two most abundant green algae species were *C. prolifera* and *U. lactuca*, which had percent cover values ranging from 0.0% to 24.4% (5.9% average) and 0.0% to 12.5% (2.3% average), respectively. *Bryocladia cuspidata* was the only abundant species of red algae that could be consistently identified from the video data set, and its percent cover at specific sites ranged from 0.0% to 41.6% (6.5% average). At several of the sampling sites, however, turbid water may have resulted in this species being identified only to the level of unidentified red algae, causing an underestimation of its actual percent cover. Wormreef (*P. caudata*) was observed at nine of the sampling locations and had percent cover values ranging from 0.0% to 27.2%, and 5.2% cover for all sites averaged. The following site descriptions were compiled from field observations and video data analysis.

Table 1. Hard bottom sampling locations within the Mid Reach Project Area.

Monument	Latitude	Longitude	Easting	Northing	Description
R 77.85	28°12'22.8"	80°35'44.1"	786419.03	1407936.67	Seagull Park
R 92.95	28°10'07.4"	80°35'14.3"	789131.64	1394271.24	Pelican Park
R 95.30	28°09'46.7"	80°35'09.5"	789568.36	1392182.16	Sunrise Avenue subtidal
R 95.90	28°09'40.9"	80°35'07.5"	789749.36	1391597.01	Sunrise Avenue intertidal
R 98.40	28°09'18.8"	80°35'02.0"	790249.28	1389366.77	Bicentennial Park
R 110.10	28°07'27.5"	80°34'33.0"	792884.28	1378135.32	Paradise Park
R 113.10	28°07'01.4"	80°34'23.4"	793753.07	1375502.44	South of Paradise Park
R 113.50	28°06'58.1"	80°34'22.9"	793799.01	1375169.33	South of Paradise Park
R 113.80	28°06'55.6"	80°34'22.1"	793871.53	1374917.10	South of Paradise Park
R 114.40	28°06'49.7"	80°34'20.2"	794043.75	1374321.84	South of Paradise Park
R 114.50	28°06'48.7"	80°34'19.9"	794070.97	1374220.95	South of Paradise Park
R 114.55	28°06'48.1"	80°34'19.8"	794080.14	1374160.38	South of Paradise Park
R 114.70	28°06'46.5"	80°34'19.3"	794125.48	1373998.95	South of Paradise Park
R 117.30	28°06'24.2"	80°34'11.9"	794796.07	1371749.18	South of Paradise Park
R 117.45	28°06'22.7"	80°34'11.6"	794823.47	1371597.78	South of Paradise Park

Table 2. Benthic taxa in phylogenetic order identified at hard bottom sites within the Mid Reach Project Area in July/August 2005.

ALGAE	PORIFERA
Chlorophyta	<i>Cliona</i> sp.
<i>Ulva lactuca</i>	Unidentified sponge
<i>Bryopsis plumosa</i>	
<i>Caulerpa prolifera</i>	HYDROZOA
<i>Caulerpa racemosa</i>	Unidentified hydroid
<i>Codium decortcatum</i>	
Phaeophyta	ANNELIDA
<i>Dictyota pinnatifida</i>	<i>Phragmatopoma caudata</i>
<i>Padina gymnospora</i>	
Rhodophyta	MOLLUSCA
<i>Scinaia complanata</i>	<i>Thais haemastoma floridana</i>
<i>Gelidiopsis planicaulis</i>	
<i>Dudresnya crassa</i>	ARTHROPODA
<i>Halymenia floresia</i>	<i>Plagusia depressa</i>
<i>Gracilaria tikvahiae</i>	
<i>Solieria filiformis</i>	ASCIDEACEA
<i>Agardhiella subulata</i>	Unidentified ascidians
<i>Gelidium pusillum</i>	
<i>Centroceras clavulatum</i>	
<i>Bryocladia cuspidata</i>	
<i>Chondria capillaris</i>	
<i>Chondria dasyphylla curvilineata</i>	
<i>Chondrocanthus acicularis</i>	
<i>Laurencia intricata</i>	
<i>Laurencia poiteaui</i>	

Table 3. Percent cover results from video data analyses for the 14 sites surveyed along the Mid Reach Project Area.

Taxa	Florida Department of Environmental Protection Monument														Project Area Average
	R 77.85*	R 92.95	R 95.30*/ R 95.90*	R 98.40	R 110.10	R 113.10	R 113.50	R 113.80	R 114.40	R 114.50	R 114.55	R 114.70	R 117.30	R 117.45	
GREEN ALGAE (CHLOROPHYTA)															
Calcareous Green Algae	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Caulerpa prolifera</i>	24.4	0.0	5.4	0.7	16.6	0.0	0.0	0.0	8.6	3.0	0.0	0.0	23.8	0.4	5.9
<i>Caulerpa racemosa</i>	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Codium decortcatum</i>	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Ulva lactuca</i>	0.4	2.9	12.5	9.7	0.4	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	2.3
Filamentous Green	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified Green	5.6	6.4	2.9	1.2	4.8	12.0	0.0	0.0	2.7	2.7	1.3	0.0	2.9	0.8	3.1
TOTAL GREEN ALGAE	30.4	9.6	21.8	11.5	21.9	12.0	0.0	0.0	17.3	5.7	1.3	0.0	26.7	1.1	11.4
RED ALGAE (RHODOPHYTA)															
<i>Agardhiella subulata</i>	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.2	3.0	0.3
<i>Bryocladia cuspidata</i>	0.0	0.0	0.0	0.0	0.0	0.0	41.6	36.8	0.2	0.0	2.3	0.0	3.2	6.4	6.5
Filamentous Red	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Laurencia</i> sp.	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Solieria filiformis</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.0
Red Turf Algae	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified Red	13.1	11.8	9.7	4.5	8.8	34.5	2.1	10.0	21.2	17.1	5.7	38.7	2.1	36.1	15.4
TOTAL RED ALGAE	13.3	12.0	10.1	4.7	8.8	35.0	43.7	47.0	21.6	17.1	8.0	38.7	5.5	45.8	22.2

Table 3. (Continued).

Taxa	Florida Department of Environmental Protection Monument														Project Area Average
	R 77.85*	R 92.95	R 95.30*/ R 95.90*	R 98.40	R 110.10	R 113.10	R 113.50	R 113.80	R 114.40	R 114.50	R 114.55	R 114.70	R 117.30	R 117.45	
BROWN ALGAE (PHAEOPHYTA)															
<i>Dictyota</i> sp.	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL BROWN ALGAE	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unidentified Algae	2.6	4.6	2.4	0.2	1.5	7.5	0.0	1.3	5.9	12.4	12.7	0.0	20.0	5.6	5.5
TOTAL ALGAE	46.6	26.2	34.3	16.3	32.2	54.5	43.7	48.3	44.9	35.2	22.0	38.7	52.2	52.5	39.1
EPIFAUNA															
Wormreef	9.9	27.2	8.0	5.0	0.0	0.0	0.0	0.0	8.3	3.0	12.0	0.0	0.0	0.0	5.2
TOTAL EPIFAUNA	9.9	27.2	8.0	5.0	0.0	0.0	0.0	0.0	8.3	3.0	12.0	0.0	0.0	0.0	5.2
SUBSTRATE	23.0	18.7	50.1	64.7	59.6	42.5	47.2	47.8	41.3	45.0	58.3	42.7	45.1	43.4	44.9
TOTAL SUBSTRATE	23.0	18.7	50.1	64.7	59.6	42.5	47.2	47.8	41.3	45.0	58.3	42.7	45.1	43.4	44.9
OTHER															
Other Unidentified Bottom Features**	20.5	27.8	7.5	14.0	8.2	3.0	9.1	4.0	5.5	16.8	7.7	18.7	2.7	4.1	10.8
TOTAL OTHER	20.5	27.8	7.5	14.0	8.2	3.0	9.1	4.0	5.5	16.8	7.7	18.7	2.7	4.1	10.8

* Average percent cover for intertidal and subtidal areas at this site.

** Includes shadows, glare from water, and unidentifiable objects.

R 77.85 (Seagull Park)

The hard bottom at Seagull Park was surveyed on 7 July and 5 August 2005. The survey area extended from the intertidal zone to the eastern edge of hard bottom and approximately 180 ft along the beach. At the outer edge of the rock outcrops, water depths ranged from 4 to 6 ft and the outcrops graded into the sand. Unidentified red algae were the dominant biotal group within the intertidal zone with 23.0% cover. Unidentified green algae, probably a combination of small *B. plumosa* and *U. lactuca*, had an intertidal zone percent cover of 4.7%. The green alga *C. prolifera* also was observed at low densities intertidally with 0.7% cover. Total intertidal percent algal cover was 29.7%. Small colonies of the polychaete *P. caudata* also were noted in the intertidal zone with 14.0% cover. The gastropod mollusk *Thais haemastoma floridana* was associated with the wormreef colonies in several locations.

The green alga *C. prolifera* was the dominant subtidal species at the site, occurring at very high densities on the shallower upper edges of the outcrops and colonizing the rock substrate from the lower intertidal zone out to the eastern edge of hard bottom. This species approached 100% cover in large areas of the site, and analyses of the video imagery yielded a subtidal percent cover of 48.2% for this species. Other algal groups contributing significantly to the percent cover totals within the subtidal area included unidentified green algae (6.6%) and unidentified red algae (3.3%). The unidentified red algae species category from the video data analyses included the species *Chondria capillaris*, *Chondria dasyphylla curvilineata*, *Halymenia floresia*, and *Scinaia complanata*. Green algae included *B. plumosa*, *Codium decorticatum*, and *U. lactuca*, and brown algae consisted of *Dictyota pinnatifida* and *P. gymnospora*. Total subtidal percent algal cover at this site was 63.5%.

The polychaete *P. caudata* also was observed subtidally, attached to the shallower nearshore edges of the subtidal rock ledges. Analyses of the video data showed subtidal wormreef with 5.9% cover at the site. Other epifauna included several species of encrusting ascidians that were observed under overhangs or ledges on the nearshore sides of the outcrops. Several encrusting (*Cliona* sp.) and unidentified low profile sponges also were present under these ledges. The ascidians and sponges were observed only on the nearshore sides of rock ledges and were generally under the overhangs, protected from direct wave impacts. Because of their positions, they were not easily viewed with the videocamera, and percent cover estimates were not obtained.

R 92.95 (Pelican Park)

The hard bottom off Pelican Park was surveyed on 7 July 2005 and included an area extending approximately 400 ft along the beach. Due to turbid water conditions, video data were concentrated in the intertidal and shallow subtidal zones. Dominant algae included unidentified red algae with a total of 12.0% cover, unidentified green algae with 6.4% cover, and *U. lactuca* with 2.9% cover. Much of the unidentified green algae may have been small specimens of *U. lactuca* not identified due to cloudy water.

Total percent algal cover at the site was 26.2%. Colonies of *P. caudata* were relatively common intertidally in this area and had a percent cover of 27.2%.

R 95.30 and R 95.90 (Sunrise Avenue)

This hard bottom area off the east end of Sunrise Avenue was surveyed on 2 July and 5 August 2005. On 2 July, data were collected during a low tide period within a large intertidal and shallow subtidal area extending approximately 640 ft along the shoreline. The surveyed intertidal hard bottom was largely composed of extensive flat outcrops and higher relief boulder-shaped outcrops up to 6-ft diameter by 2-ft height. The flat, tabular outcrops often had western edges that tilted up slightly toward the shoreline, with resulting small ledges. During the 5 August survey, video data were collected approximately 250 ft further to the north on subtidal rock ledge features with a vertical relief of up to 2 ft.

Within the intertidal area, the green algae *U. lactuca* was the dominant species with a biotal cover of 24.7%, with *C. racemosa* also identified with 1.3% cover. Unidentified red algae had 6.8% cover. Total intertidal algae percent cover at this location was 35.0%. Wormreef colonies (*P. caudata*) were relatively abundant at this intertidal site, with some colonies approaching 2-ft diameter and having a percent cover of 12.0%. The grapsoid crab *Plagusia depressa* and the gastropod mollusk *T. h. floridana* also were observed associated with the wormreef colonies at this site.

The slightly deeper subtidal outcrops were dominated by the green alga *C. prolifera* with 10.7% cover. As noted at the Seagull Park site, *C. prolifera* had its highest density at the crests of the western edges of the outcrops and along the upper edges of east-west breaks in the ledges. Unidentified red algae from the video data analyses had 12.6% cover and may have included the species *Agardhiella subulata*, *B. cuspidata*, *Centroceras clavulatum*, *Gelidiopsis planicaulis*, *Laurencia intricata*, and *Solieria filiformis*, which were identified from specimens collected during the survey. *C. decorticatum* (0.6% cover) and *U. lactuca* (0.4% cover) also were noted on the subtidal outcrops. Total subtidal algae percent cover was 33.7%, similar to the algal cover observed in the intertidal area. Wormreef colonies were somewhat smaller than noted intertidally and were represented by 4.0% cover. Other epifauna included at least two species of encrusting ascidians that were observed under ledges on the nearshore sides of the outcrops, along with the encrusting sponge *Cliona* sp.

R 98.40 (Bicentennial Park)

The hard bottom off Bicentennial Park was surveyed on 2 July 2005 and included an intertidal area extending approximately 200 ft along the beach. The bottom was primarily low-relief tabular outcrops with small wormreef colonies. The green alga *U. lactuca* was the most abundant species with 9.7% cover, followed by unidentified red algae (4.5% cover), unidentified green algae (1.2% cover), and *C. prolifera* (0.7% cover). Total algal cover at this intertidal site was 16.3%, lower than that observed at the three

locations to the north. Wormreef percent cover was 5.0%. No other epifaunal species were noted at this location.

R 110.10 (Paradise Park)

The subtidal rock features at this location were surveyed on 5 August 2005. The outcrops consisted of tabular ledges tilted up toward the shoreline, with the extensive undercutting and overhangs along the western edges having vertical relief of from 1 to 3 ft. Small colonies of wormreef were observed during the survey, although the species was not detected in the video data set. The most abundant species was the green alga *C. prolifera* with 16.6% cover, followed by unidentified red algae (8.8% cover), unidentified green algae (4.8% cover), and *U. lactuca* (0.4% cover). Other algal species observed included *B. plumosa*, *B. cuspidata*, and *D. pinnatifida*. Total subtidal algal cover at this site was 32.2%. Unidentified encrusting sponges and tunicates were observed along the rock outcrop western faces and under the ledges.

Hard Bottom Sites South of Paradise Park

Subtidal rock features associated with the following monuments were surveyed on 19 and 22 August 2005.

R 113.10

This hard bottom site was a narrow subtidal rock ridge approximately 180 ft in length with about 1 ft of relief on both the inshore and offshore edges. Identifications of algae in the video data were limited primarily to either green or red algae due to minimal water clarity at the site during the survey. Unidentified red algae had 34.5% cover, unidentified green algae had 12.0% cover, and total algal cover was 54.5% at this site. Species of algae visually identified at the site included *U. lactuca*, *B. cuspidata*, and *A. subulata*. No wormreef was observed either in the video data set or during field observations.

R 113.50

This site extended for 130 ft along the beach and consisted of wide low-relief rock slabs grading into the sand in the nearshore and narrower subtidal ledges tilted slightly up toward the shoreline with up to 1 ft of relief. The intertidal rock was partially covered by a thin layer of sand and colonized primarily by the red alga *B. cuspidata*. This species had a percent cover of 41.6% at the site, making it the dominant algae present. Total algal cover at this location was 43.7%. No wormreef was observed either in the video data set or during field observations.

R 113.80

This location was 250 ft south of the previous hard bottom site and was similar in structure and appearance. The rock feature extended for approximately 130 ft

along the beach and had low-relief intertidal rock platforms with an intermittent thin sand veneer adjacent to narrower subtidal ledges with up to 1 ft of relief along the east and west sides. The red alga *B. cuspidata* had a percent cover of 36.8%, followed by unidentified red algae with a cover of 10.0%. Total algal cover was 48.3%. No wormreef, sponges, or ascidians were observed during the visual survey of the site.

R 114.40

This hard bottom site had large slabs and tabular ledges covering a length of about 35 ft along the beach and extending up to 25 ft offshore. There were three sections of rock from west to east, with the most seaward section tilted up toward the beach. This eastern outcrop had the highest algal density and richness, including *C. prolifera*, *U. lactuca*, *B. cuspidata*, *S. filiformis*, and red filamentous algae. Unidentified red algae had the highest percent cover at 21.2%, likely primarily *B. cuspidata* that could not be readily identified to species due to turbid water conditions during video data collection. Other algal taxa occurring at relatively high densities included *C. prolifera* with 8.6% cover, *U. lactuca* at 5.9% cover, and unidentified green algae with 2.7% cover. Total algal percent cover was 44.9%. Wormreef also was present at the site with a percent cover of 8.3%. No sponges or ascidians were observed during the visual survey of the site.

R 114.50

This hard bottom feature was 100 ft south of the previous feature and had large tabular ledges tilted up slightly toward the shore. The ledges extended about 25 ft along the beach and 8 ft offshore. Attached algae included *C. prolifera*, *U. lactuca*, *B. cuspidata*, and unidentified red filamentous algae. Analyses of video data showed unidentified red algae with 17.1% cover, unidentified algae at 12.4%, *C. prolifera* at 3.0% cover, and unidentified green algae at 2.7% cover. Total algal percent cover was 35.2%. Wormreef was present at the site with a percent cover of 3.0%. No sponges or ascidians were observed during the visual survey of the site.

R 114.55

This was a small outcrop approximately 10-ft (alongshore) by 4-ft in size with a thin sand veneer. Unidentified algae at 12.7% cover was the dominant biotal group, followed by unidentified red algae (5.7% cover), *B. cuspidata* (2.3% cover), and unidentified green algae (1.3% cover). Total percent algal cover was 22.0%. Wormreef also was present at the site with a percent cover of 12.0%. No sponges or ascidians were observed during the visual survey of the site.

R 114.70

This was a tabular subtidal ledge feature about 160 ft south of the previous site. The red alga *B. cuspidata*, the green alga *U. lactuca*, and other unidentified red algal species were present at this location. Due to the poor water clarity, algae could not be identified to species from the video data, and the percent cover data showed unidentified

red algae with a cover of 38.7%, also the percentage for total algal cover. Although several small wormreef colonies were observed at the site, they were not sampled during video data collection, and thus wormreef percent cover was 0.0%. No sponges or ascidians were observed during the visual survey of the site.

R 117.30

This site was located near the southern end of the Mid Reach Project Area, off the beach access south of The Dunes condominium. This was a small subtidal tabular outcrop with about 1 ft of relief. Attached algal species were similar to previous sites with *C. prolifera*, *U. lactuca*, *B. cuspidata*, *A. subulata*, and unidentified red algae observed on the outcrop. The green alga *C. prolifera* was the dominant species with a percent cover of 23.8%, followed by unidentified algae (20.0% cover), *B. cuspidata* (3.2% cover), unidentified green algae (2.9% cover), and unidentified red algae (2.1% cover). Total percent algal cover at the site was 52.2%. No wormreef, sponges, or ascidians were observed during the visual survey of the site.

R 117.45

This site was primarily a subtidal ledge with approximately 1 ft of relief, along with a small amount of barely exposed intertidal rock with a sand veneer. Algal species identified at the site included *C. prolifera*, *U. lactuca*, *B. cuspidata*, *A. subulata*, and *S. filiformis*. Unidentified red algae, with 36.1% cover, was the most abundant taxa at the site, followed by *B. cuspidata* (6.4% cover), unidentified algae (5.6% cover), and *A. subulata* (3.0% cover). Total percent algal cover at the site was 52.5%. No wormreef, sponges, or ascidians were observed during the visual survey of the site.

DISCUSSION

The nearshore rock outcrops in the Mid Reach Project Area of Brevard County provide physical structure for algal communities and a few hardy invertebrate species able to withstand the high-energy wave activity of the area. The hard bottom surveys conducted at 14 sites along the Mid Reach Project Area during the late summer of 2005 identified 22 species of marine algae along with sponges, hydroids, mollusks, crabs, and ascidians. The observed taxa, well-adapted to this habitat, are similar to those reported from nearshore coastal hard bottom communities further to the south in Brevard and Indian River Counties (Clark, 1978; Irlandi, 2001), St. Lucie County (Seabyte Inc., 1994; Continental Shelf Associates, Inc., 1997, 2002, 2004; Dial Cordy and Associates Inc., 2000), and Martin County (Continental Shelf Associates, Inc., 1985).

Monitoring surveys conducted in association with inlet maintenance dredging and sand placement on beaches south of Sebastian Inlet in southern Brevard County assessed adjacent nearshore hard bottom communities (Clark, 1978; Irlandi, 2001). As observed in the Mid Reach Project Area, the nearshore rock outcrops were dominated by species of green, red, and brown macroalgae, along with colonies of *P. caudata* and

occasional boring sponges (*Cliona* sp.). During monitoring in 2000 to 2001, total algae percent cover for this area averaged higher than 74% (20.3% for green algae, 22.8% for red algae, and 31.3% for brown algae).

Baseline characterization surveys and monitoring studies associated with beach nourishment activities conducted on nearshore rock outcrops south of the Fort Pierce Inlet in St. Lucie County and along Jupiter Island in Martin County showed similar biotal communities (Continental Shelf Associates, Inc., 1985, 2002, 2004; Seabyte Inc., 1994). Off Fort Pierce, the nearshore hard bottom was dominated by algae, with 20 species identified along 15 survey transects across these features. Percent algal cover along the transects ranged from 7% to 31% in 1994, from 14% to 81% in 2002, and from 1% to 48% in 2004. Wormreef also was associated with the outcrops in several locations with percent cover as high as 24%. Other attached epifauna, including encrusting sponges, hydroids, and ascidians, were observed at low densities. During each of the surveys, the highest species abundance was noted in areas of higher vertical relief.

On Jupiter Island, coquina rock outcrops similar to those in the Mid Reach Project Area were colonized by algal/sponge-dominated communities (Continental Shelf Associates, Inc., 1985). Total algae percent cover values ranged from 26% to 79% along transects in the nearshore zone during a characterization survey conducted in 1985. The sponge *Cliona* sp. also was present, with a percent cover of more than 20% on one of the shallower outcrops. Wormreef, although present in the area, was not detected during sampling along the established transects.

During a nearshore survey of the Mid Reach Project Area in 1989, extensive outcrops emerging 2 to 3 ft above the surrounding bottom were observed between FDEP Monuments R 78 and R 93, with lower relief rock outcropping both to the north and south. Well-defined ledges were noted, with the green alga *C. prolifera* growing in high densities along the crests.

Currently within the Brevard County Mid Reach Project Area, percent cover analyses from the summer 2005 diver video data showed wide variability in algal distribution and density both within and between surveyed outcrops. Along virtually any cross-reef transect extending from the intertidal zone to the offshore edge of rock bottom, algal percent cover could vary from 0% up to nearly 100%, depending on water depth, height of rock surface above the surrounding sand, sand overburden, and rock physical shape and orientation to wave action. For example, large areas of low-relief intertidal rock in the northern segment of the Mid Reach could exhibit minimal algal cover, possibly due to air exposure at low tide, intermittent sand burial, or sand scour, while immediately adjacent higher profile sections of the reef in slightly deeper water could have dense algal cover.

Areas typically exhibiting higher percent algal cover included 1) low-relief platforms in the lower intertidal and upper subtidal zone, where high abundances of red filamentous and branching algae and the green alga *U. lactuca* were noted, and 2) the inshore edges of subtidal rock ledges that were tilted up toward the shoreline and

east-west breaks between these longshore ledges, both of which had the highest number of algal species and density within the project area. The green alga *C. prolifera* was very abundant along these subtidal rock edges, in many areas occurring in wide dense bands covering 100% of the bottom. Larger, thin-branching red algae such as *A. subulata* and *S. filiformis* and the brown algae *Dictyota* sp. and *P. gymnospora* also were fairly common along these margins. The red algae *B. cuspidata* was a widely distributed species, occurring on the shallow intertidal platforms as well as on deeper subtidal ledges throughout the length of the Mid Reach Project Area. Along the offshore margins of the tabular outcrops where the rock typically graded into the adjacent sand bottom, the algal density generally declined with increasing amounts of sand overburden.

Total algal percent cover during the 2005 surveys within the Mid Reach Project Area ranged from 16.3% to 54.5% at individual sampling sites, with green algal cover ranging from 0.0% to 30.4% and red algal cover from 4.7% to 47.0%. These algal percent cover ranges and species compositions are similar to those reported during the previously described surveys of nearshore hard bottom in counties immediately south of the project area.

Algae species richness appeared to be higher in the more physically complex subtidal rock areas. Although high percent algal cover was often noted on the large flat rock platforms in the low intertidal zone, there appeared to be fewer species present, and the individual alga thalli were most often smaller in size than for the subtidal specimens. Most of the species observed within the intertidal areas also occurred subtidally, although the reverse was not necessarily evident.

Epifaunal species including sponges, hydroids, and ascidians were primarily distributed along the western margins and under rock ledges with a vertical relief of greater than 1 ft. This provided protection from the direct impact of high-energy waves prevalent throughout much of the year. Wormreef colonies (*P. caudata*) were observed in relatively low abundance at nine of the sampling locations and had percent cover values ranging from 0.0% to 27.2%. Most colonies were less than 2 ft in diameter, and abundance may have declined following hurricane impacts to the shoreline in August and September 2004. Associated with the wormreef colonies were the grapsoid crab *P. depressa* and the gastropod mollusk *T. h. floridana*.

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