Atlantic Intracoastal Waterway Maintenance Dredging Project in the Vicinity of Jupiter Inlet

Pre-Construction Seagrass Survey

July 2016

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1.0 Background

The Florida Inland Navigation District (FIND) contracted CSA Ocean Sciences Inc. (CSA) in June 2016 to conduct a pre-construction benthic resource survey of the Atlantic Intracoastal Waterway (AIWW) in the vicinity of the Jupiter Inlet. The survey area was delineated by FIND to support the proposed maintenance dredging of the AIWW. The general project area was described by FIND in the Request for Proposals (RFP) (April 29, 2016; Addendum May 2, 2016) with specific instruction to refer to past benthic survey reports provided with the RFP for detailed location information and prescribed survey methods. CSA reviewed the 2007 and 2011 pre-construction and post-construction surveys (Dial Cordy and Associates, Inc. [DCA]), the Florida Department of Environmental Protection (FDEP) permit (Permit Modification No. 0262913-002-EM), and CSA's more recent reports from the 2013 and 2014 surveys prior to and following dredging. The areas depicted in the DCA and CSA reports were slightly different. The DCA 2007/2011 benthic resource survey area extended west of the Highway U.S. 1 bridge and continued south within the AIWW while the CSA 2013/2014 survey area ended just slightly west of the bridge.

To confirm if the current 2016 survey area was to include the portion of the AIWW west and southwest of the U.S.1 Bridge, CSA contacted Taylor Engineering, Inc. (Taylor), FIND's engineering contractor managing the project. In an e-mail (June 16, 2016) from Mr. Bill Aley, a Professional Geologist with Taylor to Ms. Anne McCarthy (CSA), Taylor confirmed the survey boundaries should follow the 2013/2014 efforts because no maintenance dredging was planned west of the bridge. The project area and proposed benthic resource survey transects for Cuts P-1, P-2, and P-3 (no cross-channel transects were planned for Cut P-4)are shown in **Figure 1** and included the following:

- Cut P-1: Station 11+50 to 37+00 (North), Station 66+00 to 81+20.77 (South);
- Cut P-2: Station 23:00 to 26+12.61;
- Cut P-3: All (including settling basins and wideners); and
- Cut P-4: Station 0+00 to 11+00.

2.0 Survey Methodology

CSA conducted a seagrass and benthic survey to determine the presence of seagrass, specifically (but not limited to) *Halophila johnsonii*, in relation to maintenance dredging along the AIWW from 21 June through 24 June 2016. For the survey, CSA used the 2013 survey plan, approved by the National Marine Fisheries Service (NMFS), Southeast Region Habitat Conservation Division for sampling of *Halophila johnsonii.* The plan included visual reconnaissance of the areas in addition to intensive *in situ* sampling as the primary sampling method due to low visibility anticipated in the project area. The survey dates were within the annual timeframe recommended by NMFS for seagrass surveys (1 June through 30 September). The survey was conducted during various tidal conditions, with a max tide height of 2.96 ft relative to Mean Lower Low Water (MLLW) for the project area (source: www.tidesandcurrents.noaa.gov). Tidal conditions affected visibility initially but improved later during the survey period. Surface currents presented a challenge during peak flows, requiring the field team to survey specific areas when currents were at a minimum in areas where strong currents otherwise prevented safe and efficient diving. The visibility ranged from 3 to 6 ft at low/outgoing tide to 15 to 20 ft at high/incoming tide. Weather conditions during the survey consisted of a high temperature of 90°F and wind speeds of 5 mph from the east with maximum wind speeds up to 16 mph (source: www.timeanddate.com).

Figure 1. Jupiter Inlet Benthic Resource Survey Area.

2.1 SURVEY APPROACH FOR CUTS P-1, P-2, P3, AND P4

The survey area was divided into 35 transects distributed among the five cuts (Cuts P-1 [North and South], P-2, and P-3) aligned perpendicular to the axis of the channel and spaced 50 m (167 ft) apart (**Figure 1**). As part of these transects, on either side of the AIWW channel, a 30-m (100-ft) buffer was established to serve as the anchor zone following the recommendation of the NMFS for dredging activities. Due to a lack of historical[1] seagrass habitat directly within P-4 corridor, cross-channel transects within that section of the project area were eliminated from the current survey; seagrass habitat within the P-4 anchor zones (i.e., 100-ft buffer areas) was documented by channel-parallel diver swims only.

2.1.1 Preliminary Visual Reconnaissance

In areas previously void of or sparsely populated with seagrass, preliminary visual reconnaissance swims were performed by a team of scientific divers within the anchor zones to detect any occurrences of *H. johnsonii* prior to the quantitative sampling. Divers towed a taut-line radio telemetry buoy with an attached DGPS antenna positioned over the diver. The exact physical track were the divers conducted their investigative swims was recorded via continual transmission of their position to the hydrographic survey software (Hypack®) on board the survey vessel. This visual reconnaissance was conducted of the south and north anchor zones of Cut P-4 within the crossroads areas; the eastern buffer area of Cut P-1 South; and western anchor zones associated with Cuts P-2 and P-3. Where seagrass was observed, divers recorded the time of day, species composition, percent cover, and estimated patch size (m^2). If the seagrass habitat was large enough to map as an independent polygonal feature (~3-4 m^2), divers would swim the perimeter of the small, discrete seagrass patch with the radio telemetry buoy.

2.1.2 Line Intercept Sampling

Following the visual reconnaissance in areas of observed submerged aquatic vegetation, the dive team conducted the cross-channel line intercept sampling to delineate the seagrass and substrate along the entire length of the transect within the corridor and anchor zones. If determined safe for the divers, the survey was conducted directly from end to end across the AIWW without interruption. Transects extended approximately east-west from the shoreward edge of an anchor zone (30-m wide), across the channel, and to the shoreward side of the opposite anchor zone. CSA used an onboard navigation system to drop a buoy at the edge of the channel and deployed a 30-m (100-ft) lead line, marked in 5-m (16-ft) intervals, to designate the width of the anchor zone along each transect line on both sides of the channel.

Line intercept data were collected by a diver towing the radio telemetry buoy and recording the exact time of day of the beginning and end of the seagrass habitat as it was encountered. Time of day is associated with an exact geographic position by synchronizing the navigation system and the underwater dive computers/watches prior to each dive. Survey data logging began on the beginning edge of the anchor zone, continued across the channel, and ended on the opposite edge of the east anchor zone. If for safety reasons divers were unable to cross the AIWW directly, the transect lines on the east and western sides of the corridor were done separately. Divers also recorded the qualitative estimate of the width (in meters), as far as seagrass could be visually observed perpendicular to the transect of the seagrass habitat, a visual estimate of relative coverage (i.e., sparse, dense) and seagrass species composition, particularly the presence of *H. johnsonii*.

[1] Neither the 2007 (DCA) nor the 2013 (CSA) surveys documented seagrass within Cut P-4 area planned for maintenance dredging.

2.1.3 Quadrat Sampling

Only within the anchor zones along each transect, the dive team collected additional data to determine percent cover, abundance, and species composition of seagrass using a quantitative quadrat sampling approach. A 1-m^2 quadrat subdivided into 100, 10-cm^2 cells was placed every 5 m (16 ft) from the edge of the channel toward the 30-m (100-ft) edge of the anchor zone on both the east and west ends of the transect. Quadrat sampling was only conducted if seagrass was present at the 5-m (16-ft) intervals. The abundance of each seagrass species was determined by counting the number of cells containing at least one seagrass shoot. An average Braun-Blanquet cover abundance score (B-B score) was also recorded for each seagrass species, total seagrass, and macroalgae within the entire 1-m^2 quadrat by using the Braun-Blanquet cover-abundance scale (Braun-Blanquet, 1972) shown in **Table 1**. If seagrass was not present at a 5-m (16-ft) interval, zeros were entered for both the B-B scores and cell counts.

Table 1. Braun-Blanquet scale (score) and percent cover scale values (Braun-Blanquet, 1972).

Braun-Blanquet Scale (Score)	Percent Cover (%)
0.0	Not present
0.1	Solitary specimen
0.5	Few with small cover
1	Numerous, but <5
2	5 to 25
3	25 to 50
4	50 to 75
5	75 to 100

3.0 Results

The divers conducted the survey across 201,840 ft^2 (4.63 acres) or 7.1% of the total defined survey area, estimated to be 2,836,035 ft^2 (65.1 acres). The diver survey area was calculated by the linear distance the divers surveyed across each transect with a conservative minimum field of view of 5 ft to either side of the transects, or a total of 10 ft. The total survey area (7.1%) met the minimum required sampling area of 1% to 30% for large project sites following the National Marine Fisheries Service (NMFS), Southeast Region Habitat Conservation Division's the "Recommendations for Sampling *Halophila johnsonii* at a Project Site). Seagrass was observed at depths ranging from 0.25 ft (3 in.) to 15 ft. **Table 2** provides the total survey areas (square feet and acres), total area surveyed by divers, and coverage of seagrass within the project footprint, by survey area. The total coverage of seagrass is ~40,000 ft^2 (0.92 acres) less than quantified during the 2014 post-construction survey (CSA, 2014), with substantial shifts in the location of the extant cover as compared to the previous survey. **Table 3** shows the total area of seagrass habitat within the dredge limits of the channel, specific to Cuts P-1 North and P-1 South. A total of 4,527 ft^2 (0.10 acres), <1% of the seagrass within the survey area, was mapped within the limits of the proposed maintenance dredging project.

Table 2. Total seagrass coverage by survey area.

Survey Area	Total Area (ft^2)	Diver Surveyed Area (ft^2)	Seagrass Coverage (ft^2)			
			Halophila johnsonii (*Hj*)	Mixed Seagrass (with *Hj*)	Mixed Seagrass (No *Hj*)	Total Seagrass
Cut P-1 North	928,095	55,250	1,353	65,068	297,161	363,581
Cut P-1 South	557,418	33,100	0	90,857	26,115	116,971
Cuts P2, and P3	644,322	42,870	1,521	516	1,347	3,384
P4 Buffer Area North	311,800	31,180	1,534	0	0	1,534
P4 Buffer Area South	394,400	39,440	0	517	11	528
Total (ft^2)	**2,836,035**	**201,840**	**4,408**	**156,957**	**324,634**	**485,999**
Total (acres)	**65.1**	**4.63**	**0.10**	**3.60**	**7.45**	**11.2**
Percent of total area surveyed	7.1%					

Table 3. Total seagrass coverage within the limits of the proposed maintenance dredging.

Survey Area	Seagrass Coverage (ft^2 [acres])			
	Halophila johnsonii (Hj)	Mixed Seagrass (with *Hj*)	Mixed Seagrass (No *Hj*)	Total Seagrass
Cut P-1 North	0	0	3,952 (0.091)	3,952 (0.091)
Cut P-1 South	0	147 (0.003)	428 (0.009)	575 (0.013)
Total (ft^2 [acres])	**0**	**147 (0.003)**	**4,380 (0.010)**	**4,527 (0.104)**

Table 4 shows the average B-B scores, converted percent cover, and frequency of occurrence for each species of seagrass within each survey area, arranged from north to south. **Table 5** shows the conversion table used to convert B-B scores to percent cover. Frequency of occurrence is expressed as a percentage and determined by dividing the average number of occupied cells containing seagrass by the total number of cells. *Thalassia testudinum* (turtle grass) occurred at very low coverage (1%) only in the Cut P-1 North almost exclusively on the very eastern edge of the buffer zone. *Syringodium filiforme* (manatee grass) was documented in Cuts P-1 North and P-1 South, primarily on the eastern side in the northern section of P-1 North, transitioning more toward the western edge in the southern section of P-1 North. In P-1 South, *S. filiforme* occurred almost fully on the eastern edge. *Halodule wrightii* (shoal grass) was the most prominent seagrass observed during the survey and was found in all survey areas in shallow water. *Halophila decipiens* (paddle grass) was found mixed with other seagrass species, primarily in shallow waters in the northern portions of the survey area. *H. johnsonii* was found throughout the survey area almost entirely mixed with other seagrass species, with only an occasional patch of mono-specific *H. johnsonii* in the buffer areas around Cuts P-2 and P-3. Overall, seagrass percent cover decreased from 2.5 to 33% during the 2014 post-construction survey (CSA, 2014) to 1 to 12.5% during the current survey.

Table 4. Average Braun-Blanquet scores (B-B scores), converted percent cover (% cover), and frequency of occurrence.

Area	*Thalassia testudinum*			*Syringodium filiforme*			*Halodule wrightii*			*Halophila decipiens*			*Halophila johnsonii*			All Seagrass (Combined)		Total Macroalgae	
	Avg. B-B Score	% Cover	Frequency of Occurrence (%)	Avg. B-B Score	% Cover	Frequency of Occurrence (%)	Avg. B-B Score	% Cover	Frequency of Occurrence (%)	Avg. B-B Score	% Cover	Frequency of Occurrence (%)	Avg. B-B Score	% Cover	Frequency of Occurrence (%)	Avg. B-B Score	% Cover	Avg. B-B Score	% Cover
Cut P-1 North	0.21	1	4.4	0.7	1	16.3	0.6	1	15.0	0.5	1	12.6	0.2	1	5.6	1.6	10	0.3	1
Cut P-1 South	0	0	0	0.4	1	9.8	1.6	10	56.7	0.04	<1	0.8	0.5	1	15.9	1.8	12.5	0.2	1
Cut P-2	0	0	0	0	0	0	0.2	1	7.1	0	0	0	0.3	1	8.3	0.3	1	0	0
Cut P-3	0	0	0	0	0	0	0.3	1	14.9	0	0	0	0.3	1	14.5	0.6	1	0.1	1

Table 5. Interpolation of the Mid-Point Braun-Blanquet (B-B) Score to Percent Cover Conversion Table.

B-B Score	Percent Cover	B-B Score	Percent Cover
0.00	0	2.60	28.50
0.10	1.00	2.70	30.75
0.20	1.00	2.80	33.00
0.30	1.00	2.90	35.25
0.40	1.00	3.00	37.50
0.50	1.00	3.10	40.00
0.60	1.00	3.20	42.50
0.70	1.00	3.30	45.00
0.80	1.00	3.40	47.50
0.90	1.00	3.50	50.00
1.00	2.50	3.60	52.50
1.10	3.75	3.70	55.00
1.20	5.00	3.80	57.50
1.30	6.25	3.90	60.00
1.40	7.50	4.00	62.50
1.50	8.75	4.10	65.00
1.60	10.00	4.20	67.50
1.70	11.25	4.30	70.00
1.80	12.50	4.40	72.50
1.90	13.75	4.50	75.00
2.00	15.00	4.60	77.50
2.10	17.25	4.70	80.00
2.20	19.50	4.80	82.50
2.30	21.75	4.90	85.00
2.40	24.00	5.00	87.50
2.50	26.25		

3.1 CUTS P-1, P-2, AND P-3

Cut P-1 North was located at the north end of the project area (**Figure 1**) and was composed of 17 transects. A total of 363,581 ft^2 (8.35 acres) of seagrass was mapped in Cut P-1 North with 3,952 ft^2 (0.091 acres), or 1.09% located within the dredge limits (**Figure 2**); the area was comprised primarily of mixed seagrass with no *H. johnsonii* (297,161 ft^2 [6.82 acres]) and mixed seagrass with *H. johnsonii* (65,068 ft^2 [1.49 acres]) with only 1,252 ft^2 (0.029 acres)of monospecific *H. johnsonii* outside the limits of dredging. *T. testudinum* was found mixed with *S. filiforme* (**Photo 1**) near the very eastern edge, approximately 50 to 100 ft. from the channel edge. *H. johnsonii* was observed primarily within the buffer area on the west side of the channel (western buffer); it was sparse throughout the survey area and was brown (**Photos 2** and **3**) while *H. decipiens* (**Photo 4**) and the other seagrass species were a vibrant green. Sediments were characterized as fine sands with shell hash. Epiphytic growth on the seagrass and apparent cyanobacterial coatings of the blades were commonly observed.

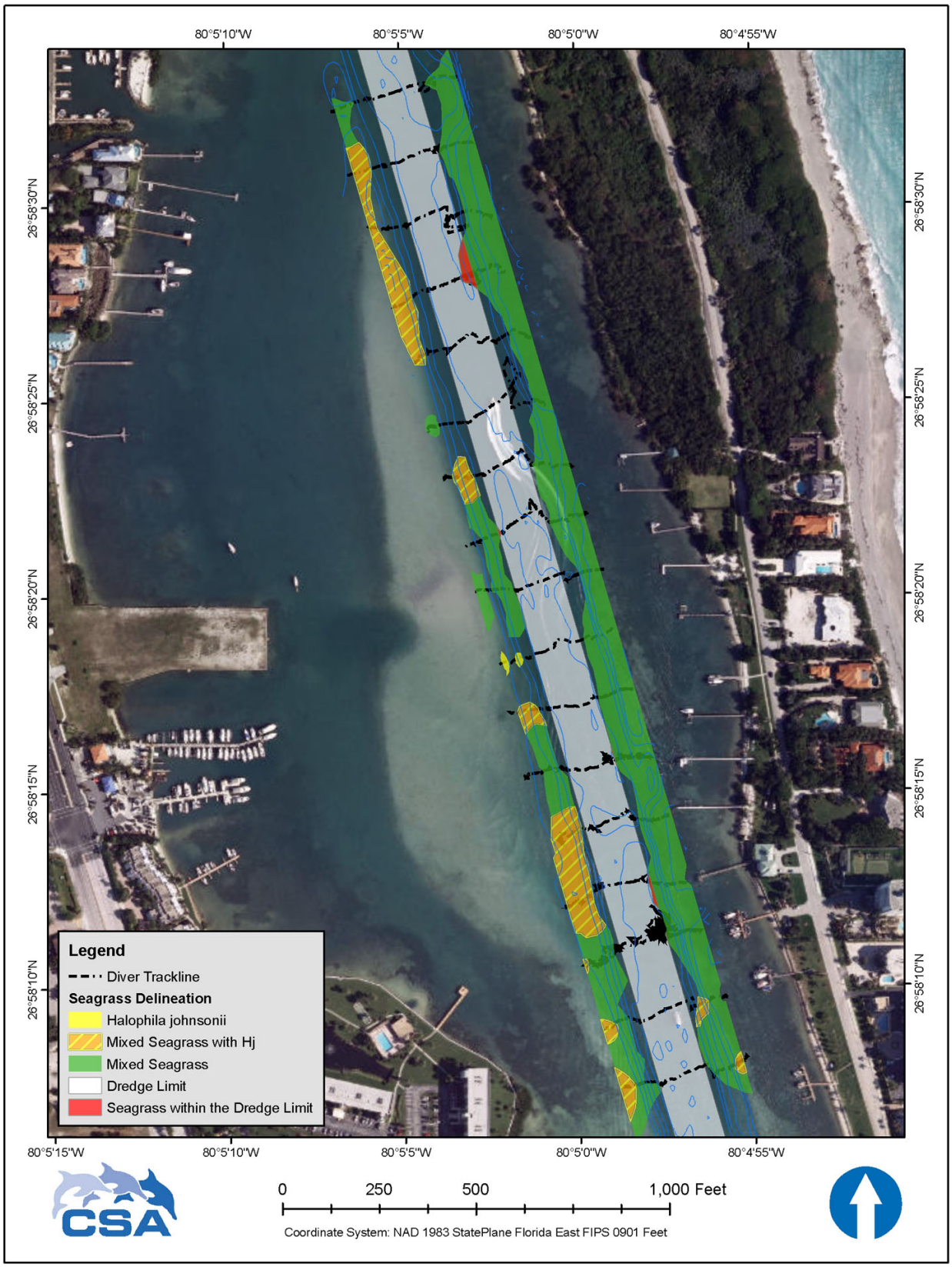

Figure 2. Cut P-1 North pre-construction survey seagrass delineation.

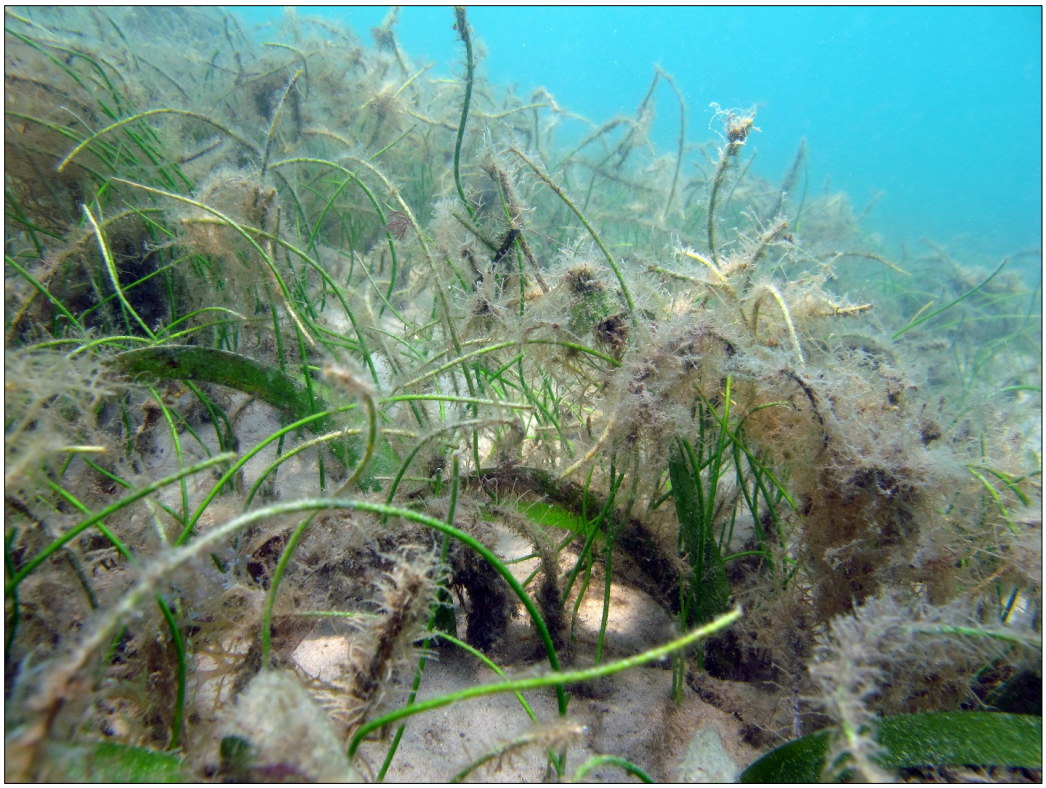

Photo 1. *Thalassia testudinum* and *Syringodium filiforme.*

Photo 2. *Halophila johnsonii* (brown) and *Syringodium filiforme.*

Photo 3. *Halophila johnsonii* (brown) and *Halodule wrightii.*

Photo 4. *Halophila decipiens* and *Halodule wrightii.*

S. filiforme was the dominant seagrass species within Cut P-1 North. Although percent cover was low (1%), the *S. filiforme* frequency of occurrence (16.3%) was higher than other species and was occasionally seen in dense patches (**Photo 5**). The second most commonly observed species, *H. wrightii* (**Photo 6**), also had low (sparse) cover where it occurred and a frequency of occurrence of 15%. These two species were regularly seen forming a mixed bed of seagrass (**Photo 7**).

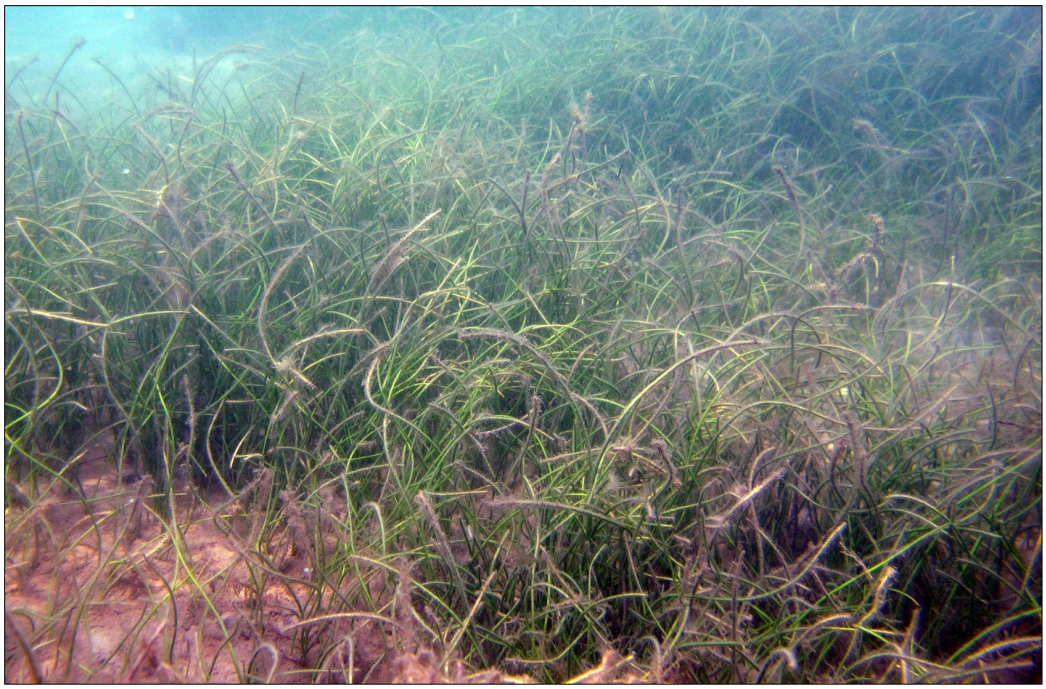

Photo 5. Dense patch of *Syringodium filiforme.*

Photo 6. *Halodule wrightii* in the anchor zone.

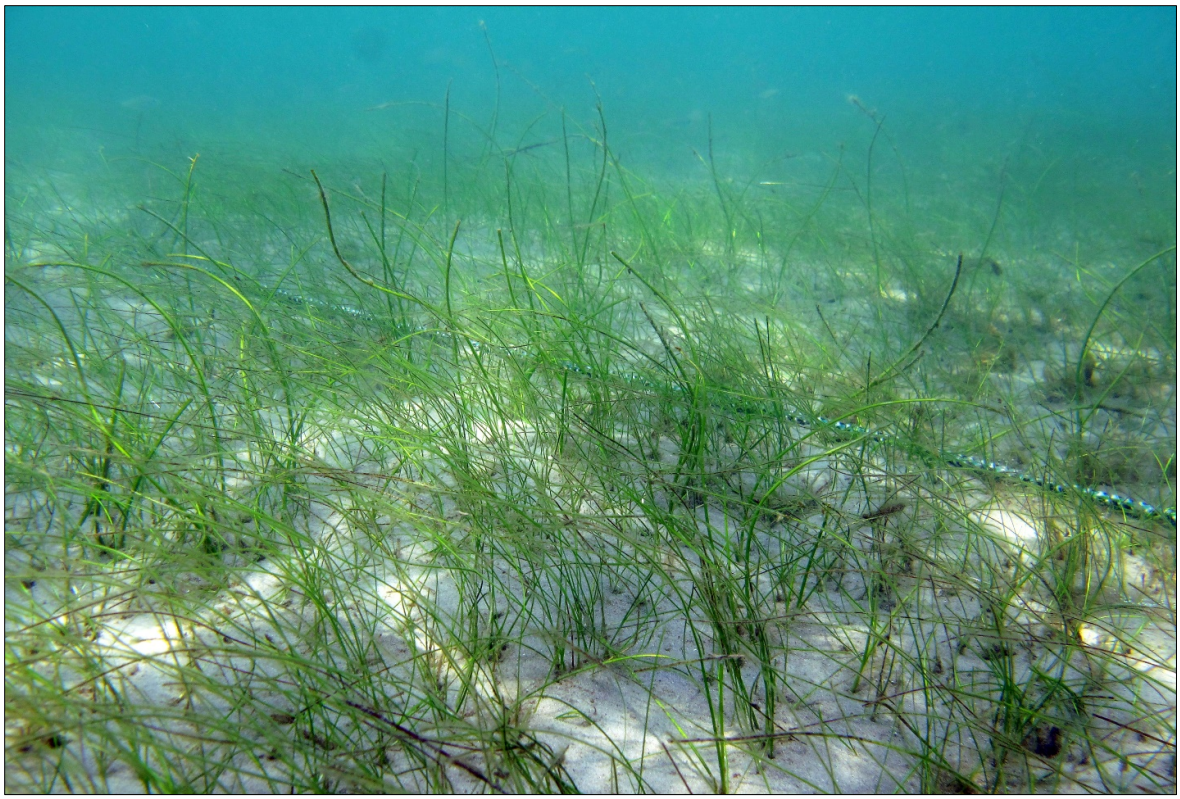

Photo 7. Mix of *Halodule wrightii* and *Syringodium filiforme* in the anchor zone.

Cut P-1 South was centrally located (**Figure 1**) and was composed of 10 transects (**Figure 3**), with the majority of seagrass located in the anchor zone on the west side of the channel (west zone). A total of 116,971 ft^2 (2.69 acres) of seagrass was mapped in Cut P-1 South, including 575 ft^2 (0.013 acre) within the dredge limits. A majority of the seagrass [90,857 ft^2 (2.09 acres)] was mixed species of brown *H. johnsonii* (**Table 2**) and *H. wrightii*, located only in the western buffer area with 147 ft^2 (0.003 acres), or 0.16% extending into the boundaries of the dredging limits in the far northern portion of Cut P-1 South. The dominant species was *H. wrightii* with an average percent cover of 10% and a frequency of occurrence of 56.7% (**Table 3**). Near the southern end of Cut P-1 South, *H. johnsonii* was not observed but a bed of mixed seagrass *S. filiforme* and *H. wrightii* was documented, including 575 ft^2 (0.013 acres) within the dredging limits. Fine sand was the primary sediment type with some sand and shell occurrences.

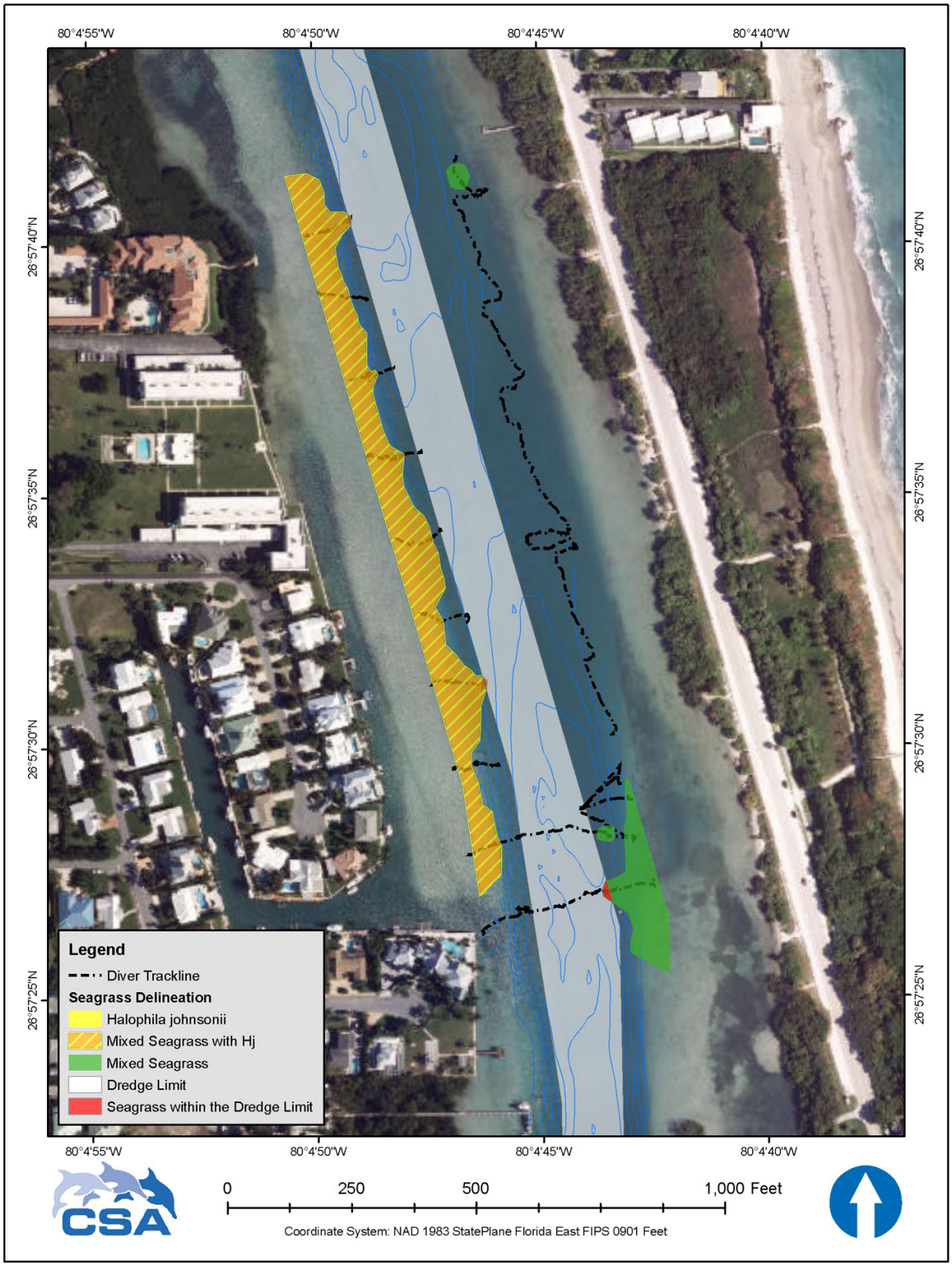

Figure 3. Cut P-1 South pre-construction survey seagrass delineation.

3.2 CUTS P-2, P-3, AND P-4

Cuts P-2 and P-3 (**Figure 1** and **Figure 4**) had seagrass that consisted of only small isolated patches of mixed *H. johnsonii* and *H. wrightii* in approximately equal percentages but with slightly higher frequency of occurrence at P-3 (**Table 3**). As shown in **Figure 4** and discussed in **Section 2.1.1**, divers conducted preliminary reconnaissance dives along the western buffer area of Cuts P-2 and P-3 and as anticipated, did not observe any seagrass within that area. Similarly, divers conducted surveys along 10 perpendicular transects and/or conducted perimeter swims of small discrete seagrass patches along the eastern section of the survey area. Due to minimal water depths along the eastern shoreline, seagrass patches were easily seen from the surface and could be quickly identified for mapping. The total delineated area of seagrass was 3,384 ft^2 (0.08 acre) on the eastern side of the AIWW (**Figure 4**) and was predominantly in very shallow water adjacent to residential docks and shorelines with mangrove habitat (**Photo 8**). Sand was the primary sediment with some areas containing muck and rubble.

The results from past surveys determined that seagrass was present only within the northern anchor zone of Cut P-4. To confirm this, visual reconnaissance dives were conducted and divers again documented seagrass within the northern and southern edges of the anchor zone (**Figure 4**). Both seagrass patches in the anchor zones were a mix of *H. johnsonii* mixed and *H. wrightii*.

Photo 8. Mangrove habitat on the east side of Cut P-3 in the buffer area.

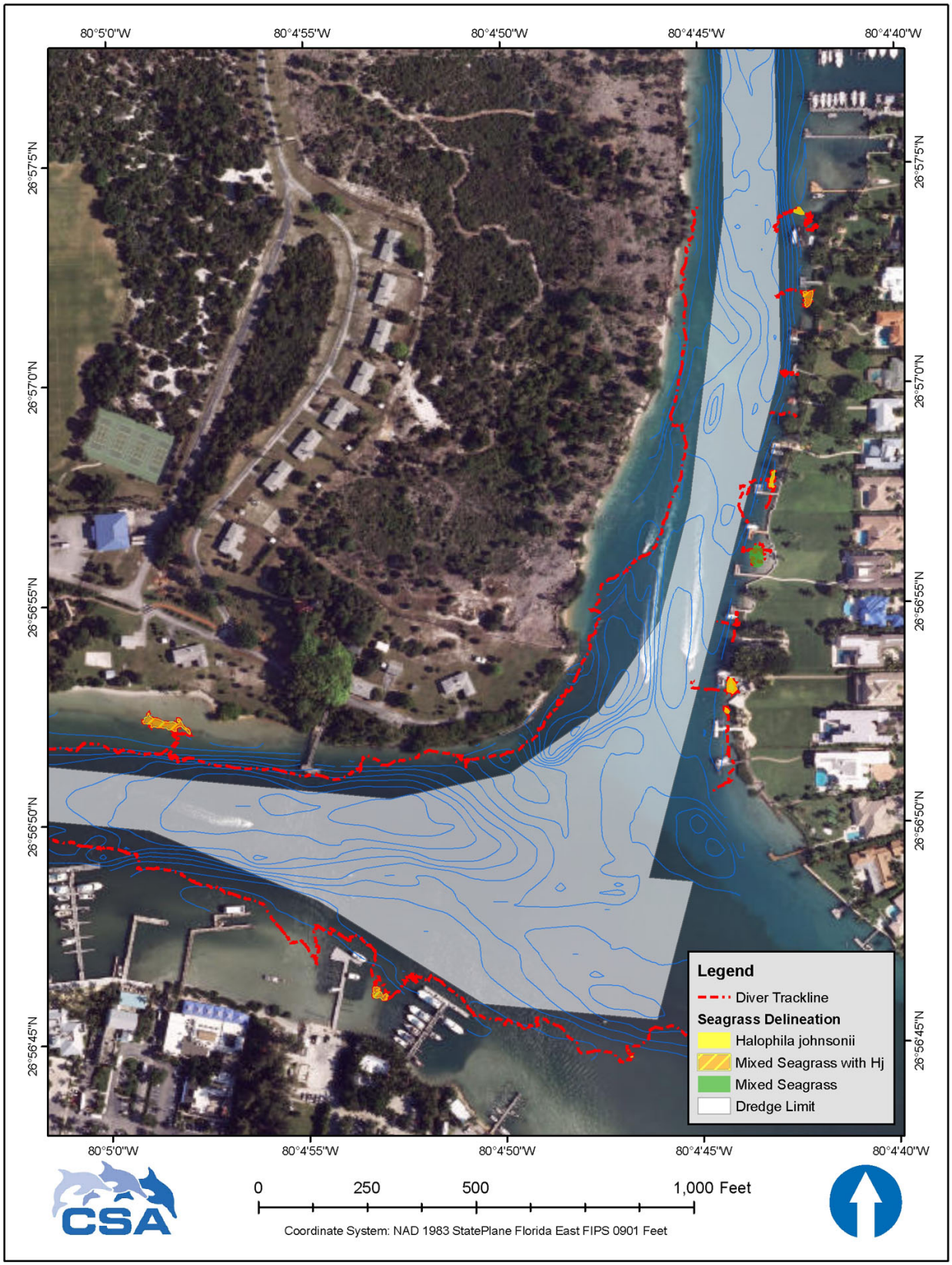

Figure 4. Cuts P-2, P-3, and P-4 pre-construction survey seagrass delineation.

3.3 WILDLIFE OBSERVATIONS

Wildlife observations within the survey areas included a West Indian manatee (*Trichechus manatus*), a nine-armed sea star (*Luidia senegalensis*; **Photo 9**), West Indian sea eggs (urchin; *Tripneustes ventricosus*; **Photo 10**), variegated urchins (*Lytechinus variegates*; **Photo 11**), Florida spiny lobsters (*Panulirus argus*; **Photo 12**), and cushion starfish (*Oreaster reticulatus*; **Photo 13** and **14**).

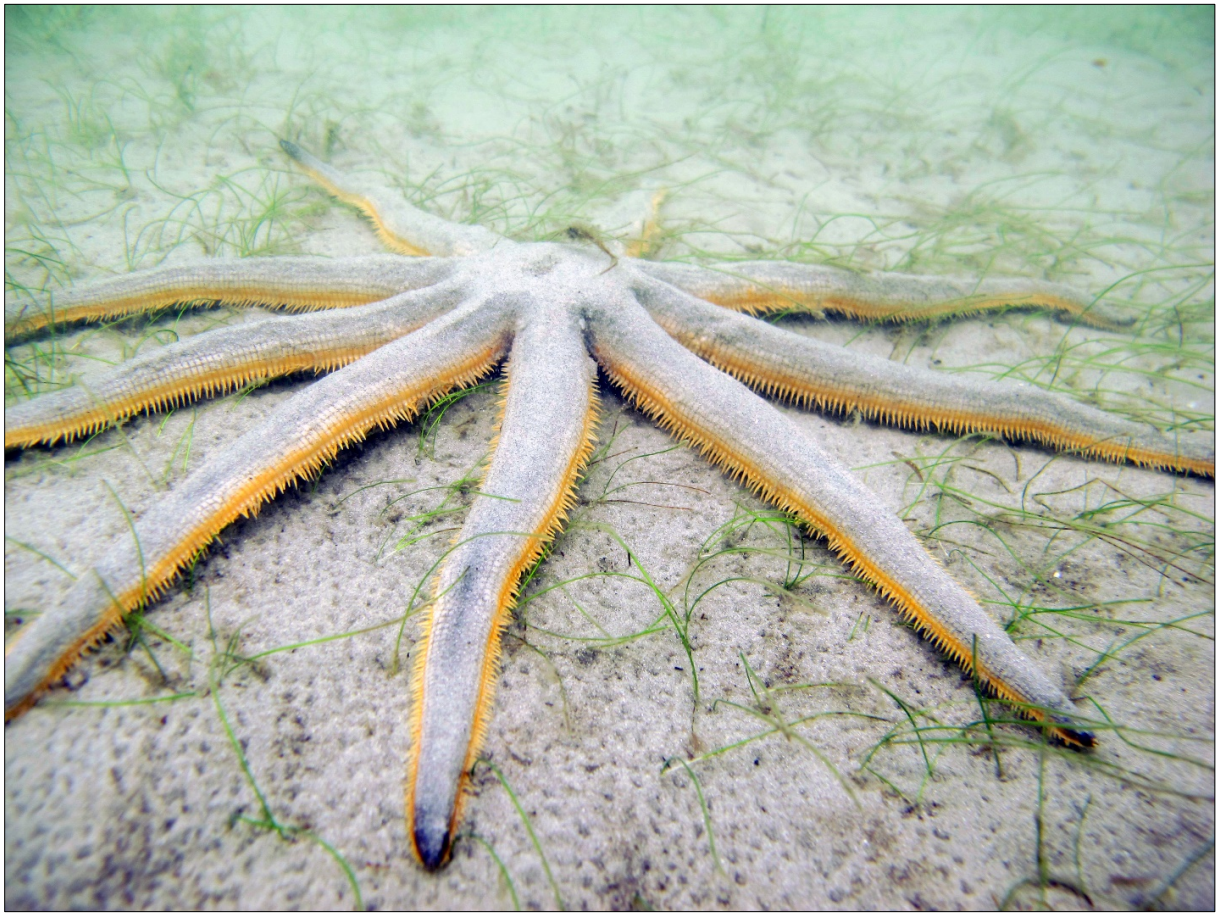

Photo 9. Nine-armed sea star (*Luidia senegalensis*).

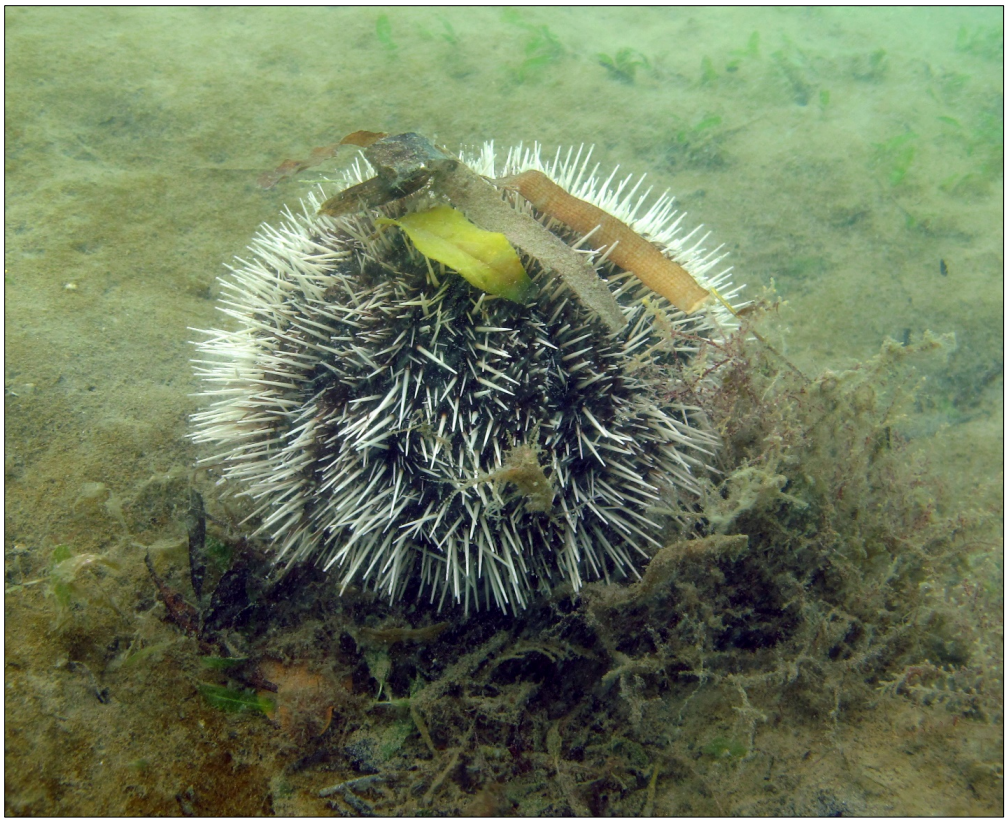

Photo 10. West Indian sea egg (*Tripneustes ventricosus*).

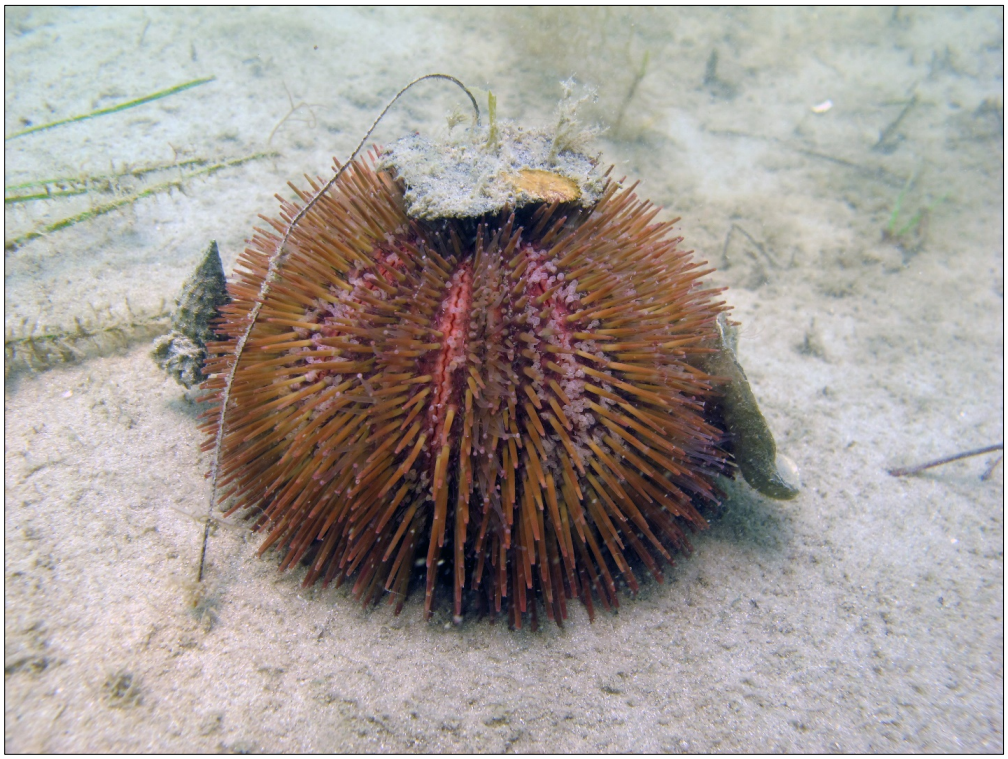

Photo 11. Variegated urchin (*Lytechinus variegates*).

Photo 12. Florida spiny lobster (*Panulirus argus*).

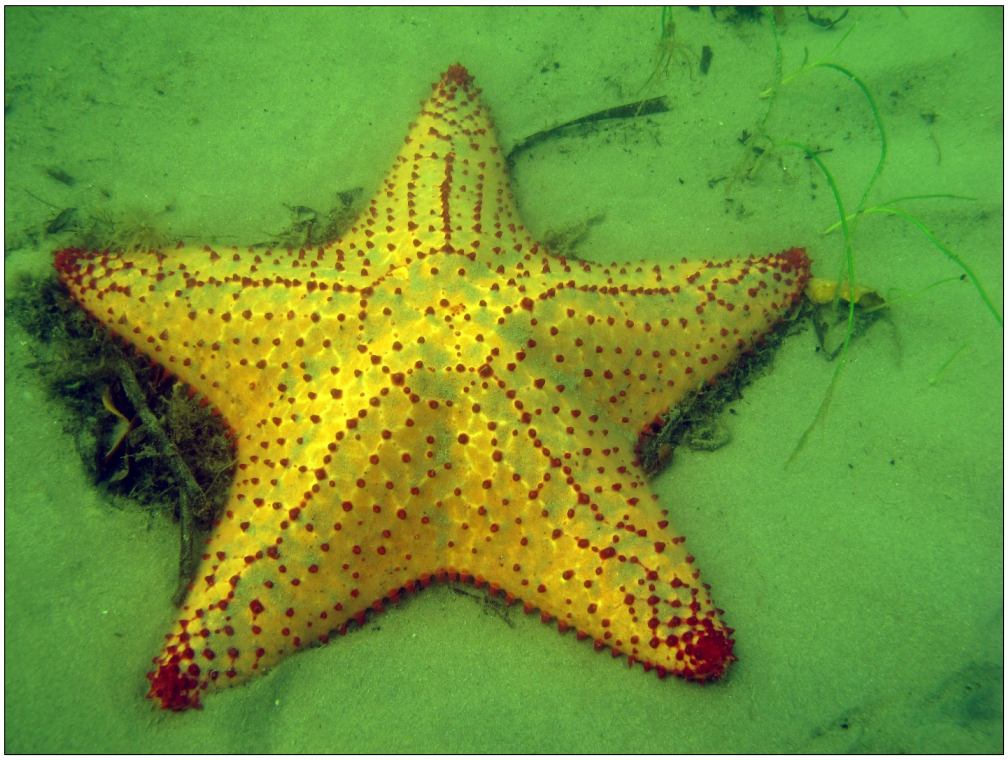

Photo 13. Yellow colored variety of a cushion starfish (*Oreaster reticulatus*).

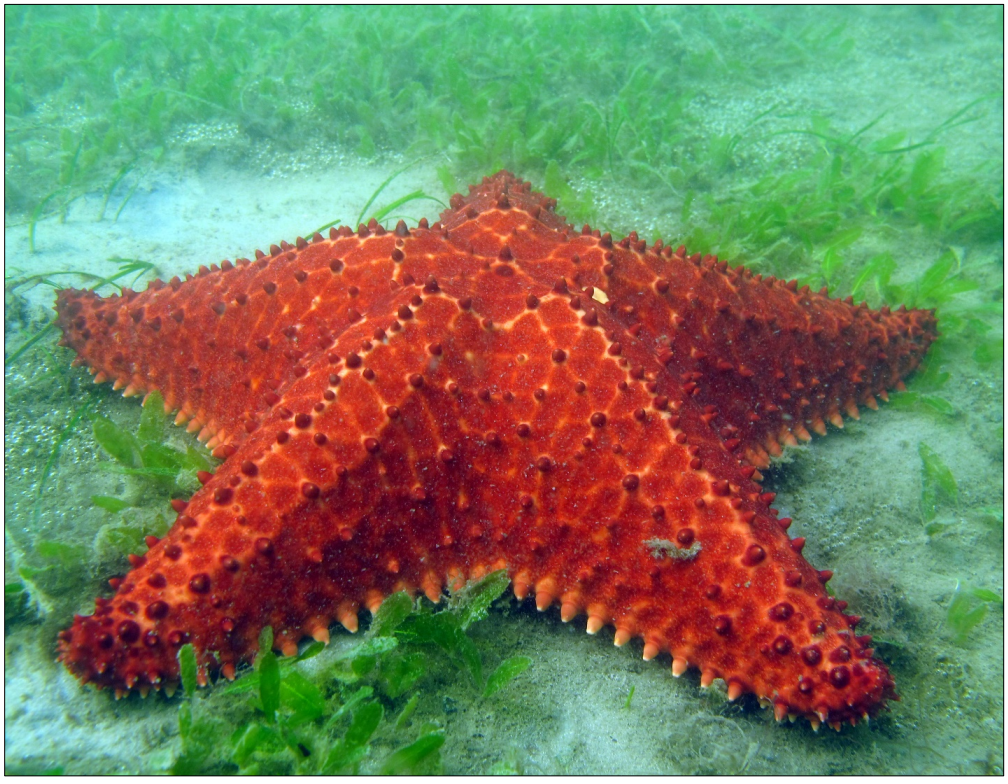

Photo 14. Orange colored variety of a cushion starfish (*Oreaster reticulatus*).

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