

II. Study Area and Survey Methods

Study area and sampling objectives

The Florida Keys comprise an archipelago of limestone islands spanning more than 360 km from south of Miami to the Dry Tortugas. With the exception of isolated banks in the Flower Gardens area in the northwestern Gulf of Mexico, the Florida Keys ecosystem represents the only region of extensive coral reef development in the continental U.S. (Jaap 1984). The islands are part of the larger south Florida shelf, a submerged Pleistocene platform 6-35 km wide and generally < 12 m deep (Lidz et al. 2003). The primary influences on the distribution and development of Florida Keys reefs are paleotopography and fluctuating sea level (Shinn et al. 1989; Lidz et al. 2003). Bedrock throughout south Florida is Pleistocene limestone, either exposed on the seafloor or lying underneath Holocene reefs and sands (Shinn et al. 1989). Proceeding seaward from the shorelines of the Pleistocene islands, a nearshore rock ledge extends ~2.5 km from the shoreline, with the seabed consisting of hard-bottom, seagrass, and isolated inshore patch reefs (FMRI 1998). Seaward of the island platform is Hawk Channel, a broad trough-like depression dominated by mostly non-coralline, non-oolitic grainstone, dotted with several thousand patch reefs whose distribution is affected by the number and width of tidal passes connecting Florida Bay and the Atlantic Ocean (Marszalek et al. 1977; Shinn et al. 1989). Bands of rock ridges exist further offshore along the outer shelf and on the upper slope from 30-40 m depth before the shelf tapers off into the Straits of Florida. The semi-continuous offshore reef tract is emergent in places, in which Holocene reefs sit atop a ridge of Pleistocene corals (~86-78 ka), forming a shelf-margin ledge (Lidz et al. 2003), with a series of outlier reefs seaward of this main reef tract at 30-40 m depth (Lidz 2006). Like inner shelf margin patch reefs, the distribution of platform margin reefs reflects exchange processes between Florida Bay and the Atlantic Ocean (Marszalek et al. 1977; Shinn et al. 1989), which is related to the size and orientation of the Pleistocene islands and thus the presence and size of tidal passes, as well as the proximity of the Florida Current to the platform margin (Pitts 1994; Smith 1994).

The 2011 sampling of *Acropora* corals, other benthic coral reef organisms, and marine debris in the upper Florida Keys National Marine Sanctuary (FKNMS) was undertaken as a spatially intensive effort to document the population status of staghorn and elkhorn corals. The 2011 surveys conducted from May 5 to September 10 were an outgrowth of previous efforts conducted by our program dating back to 1998 to quantify the abundance and condition of coral reef benthos throughout the FKNMS, including the Tortugas region (Miller et al. 2002). Previous surveys in the FKNMS, excluding the Tortugas region, consisted of 80 sites sampled Keys-wide in 1999, 45 sites in the lower Keys region in 2000, 108 sites Keyswide in 2001, 195 sites Keys-wide in 2005, 107 sites in the upper Keys region in 2006, 235 sites Keyswide in 2007, 145 sites Keyswide in 2008, 160 sites Keyswide in 2009, and 120 sites in the upper

Keys region in 2010. Data obtained from these earlier efforts, together with existing habitat mapping information for the FKNMS, were used to guide the sampling of *Acropora* corals, other benthic coral reef organisms, and marine debris in 2011. The overall goals of the 2011 sampling effort were two-fold:

- Collect information on habitat distribution, colony abundance, size, and condition of *Acropora* corals to derive population abundance estimates for the upper FKNMS; and
- Continue the temporal data sets on the abundance and size of non-*Acropora* corals, urchins, anemones and corallimorpharians, and mollusks, as well as the density, length, weight, and impacts of marine debris in the upper FKNMS.

We were able to continue amassing temporal data sets on the population status of several additional groups of benthic invertebrates dating back to 1999 throughout the upper Keys area. The objectives of the 2011 sampling effort were to provide information on:

- Depth and physical structure (maximum vertical relief) of survey sites;
- Distribution, density, size, and condition (bleaching, disease, overgrowth, and predation) of *Acropora* corals;
- Density, size class, percent live tissue vs. dead skeleton, and condition of non-*Acropora* corals;
- Density and size (test diameter) of sea urchins, representing an ongoing effort to monitor recovery of the historically abundant long-spined sea urchin *Diadema antillarum*;
- Density of sea anemones and corallimorpharians, as well as density and size of mollusks such as sea slugs, nudibranchs, and other gastropods (*Coralliophila* sp., *Leucozonia nassa*, *Strombus gigas*, and *Thais deltoidea*); and
- Density, length, weight, and impacts of entangled marine debris, representing a continuation of efforts carried out in 2000-01, 2008, and 2010.

Sampling design and field methodology

The sampling design for assessing *Acropora* corals, other benthic coral reef organisms, and marine debris encompassed 280 sites visited during May-September 2011. Sites were distributed from the southern boundary of Biscayne National Park to Alligator Reef (Figure 2-1). The sampling design included nine habitat types, as well as all 12 no-take zones designated as Sanctuary Preservation Areas (SPA) or Research Only Areas (RO) between northern Key Largo and Alligator Reef (Table 2-2). Table 2-2 lists the sites sampled chronologically during May-September 2011.

The habitat strata sampled during 2011 incorporated most of the hard-bottom and coral reef habitat types from the island platform (e.g. inshore patch reefs such as Tavernier Rocks) inshore of Hawk Channel to ~15 m depth along the reef tract. However, the 2011 effort did not include nearshore hard-bottom, hard-bottom/seagrass matrix habitats, or deeper (> 15 m) fore reef areas, as these areas do not appear to support *Acropora* corals based upon previous surveys. The habitats sampled during 2011 were inshore and mid-channel patch reefs, offshore patch reefs, back reef rubble, shallow (< 6 m) hard-bottom, inner line reef tract spur and groove from Grecian Rocks northward to Turtle Reef, shallow (< 6 m) high-relief spur and groove along the platform margin, and deeper fore-reef habitats from 6-15 m depth. Deeper fore-reef habitats encompassed continuous, low-relief hard-bottom, patchy hard-bottom, and low-relief spur and groove. For the data presented in this report, inshore patch reefs and mid-channel patch reefs were combined, as were inner line reef tract and platform margin spur and groove habitats, as well as deeper (6-15 m) fore-reef habitats. Table 2-3 lists the sites by benthic habitat type and management zone, along with summaries of transect depth sampled and maximum vertical relief. Besides habitat type, sites were further categorized by along-shelf position and management zone (i.e. inside and outside of FKNMS no-take zones). Figures 2-2 to 2-4 show the spatial distribution of sampling locations by habitat type for the 280 sites, along with the boundaries of existing no-take zones in the upper FKNMS. Figures 2-5 to 2-8 illustrate examples of each of the hard-bottom and coral reef habitat types sampled during 2011.

A geographic information system (GIS) containing digital layers for benthic habitat (FMRI 1998), bathymetry, and FKNMS no-take zone boundaries was used to facilitate delineation of the sampling survey domain, strata, and sample units. Existing resolution of benthic habitats is such that the survey domain was divided into a grid of individual cells 200 m by 200 m (40,000 m²) in area that serve as primary sampling units. A two-stage sampling scheme we adapted (Smith et al 2011) following Cochran (1977) was employed to control for spatial variation in population metrics at scales smaller than the grid cell minimum mapping unit. Grid cells containing targeted reef and hard-bottom habitats were designated as primary sample units. A second-stage sample unit was defined as a belt transect of fixed area (15-m x 1-m in dimension) within a primary sample unit. The size of an individual primary sampling unit allowed divers to swim to the location of any given second-stage sampling unit from a moored or anchored vessel.

To control for spatial variation in the benthic variables assessed, the upper Florida Keys survey domain was partitioned into strata based upon: 1) habitat class, 2) geographic region (along-shelf position), and 3) management zones of the Florida Keys National Marine Sanctuary (FKNMS). A grid system constructed in a geographic information system (GIS) was used to overlay the existing habitat map of the Florida Keys. Cells or blocks 200 m x 200 m in dimension were used to randomly select sites from the

combination of habitat type, regional sector, and management zone. Habitats were designated using regional benthic habitat maps (FMRI 1998). The habitat classification scheme accounted for features that correlate with benthic fauna distributions, including cross-shelf position, topographic complexity, and the proportion of sand interspersed among hard-bottom structures. A geographic regional stratification variable was used to account for oceanographic and geological features in the Florida Keys that may influence the distribution and community composition of hard-bottom and reef habitats (Marszalek et al. 1977; Shinn et al. 1989). We have previously defined regional sectors as follows: upper Florida Keys (BNP boundary south to Pickles Reef), middle Florida Keys (Conch Reef southwest to Moser Channel), and lower Florida Keys (Big Pine Shoal west to Satan Shoal). FKNMS no-take zones are incorporated as a third stratification variable that delineates areas open and closed to consumptive activities. Within each no-take zone, a minimum of two replicate sites are sampled in a given habitat type. The power of the stratified random sampling approach is essentially two-fold: 1) the habitats comprising the most area are initially allocated more sites than those with less area (i.e., a proportional design); and 2) habitats exhibiting more variability with respect to particular metrics (e.g. coral density) are allocated more sites than those with less variability. The ultimate power of this approach is derived more from the number of sites sampled rather than the effort expended per site.

The underwater surveys consisted first of locating randomly selected, pre-determined coordinates with a differential global positioning system. A Garmin® global positioning system receiver (model GPS76) was used to determine the position at each site. The original sampling list encompassed 300 sampling locations, with an additional 156 alternate sites between Alligator Light and the northern FKNMS boundary. If the original waypoint was not the intended habitat type, based on visual assessment by a snorkeler, the closest alternate site was sampled instead. Once on-site, usually a two-person diver team oriented two transect tapes 15-m in length, marked in 10-cm increments, along the bottom. A 1-m wide belt centered on each 15-m long transect tape was surveyed at each site for most of the benthic variables described below, with a total of 60-m² surveyed (Figure 2-10). At all 280 sites sampled during 2011, 15-m² belt transect areas were surveyed for:

- Minimum and maximum depth;
- Maximum vertical relief of the substratum such as ledges, spur edges, crevices, coral heads, and sponges;
- Number of colonies, skeletal unit size, live tissue surface area, and condition (bleaching, disease, predation, overgrowth) of *Acropora* corals;
- Numbers and test diameters of sea urchins;

- Numbers of anemones and corallimorpharians;
- Numbers and total lengths or shell lengths of nudibranchs, the lettuce sea slug (*Elysia crispata*), and the gastropods *Coralliophila* sp., *Leucozonia nassa*, and *Thais deltoidea*; and
- The frequency of marine debris and the numbers of benthic organisms exhibiting abrasion stress (partial mortality due to tissue loss).

Smaller belt transect areas (10-m x 1-m) were surveyed for the numbers of colonies, sizes (binned by size class), percent live tissue vs. dead skeleton, and condition of all other scleractinian corals greater than 4 cm in maximum diameter. Finally, 15-m x 2-m belt transect areas were surveyed for the density of marine debris, the length of all angling gear and lobster/crab trap rope encountered, the numbers of benthic organisms exhibiting abrasion stress (partial mortality due to tissue loss), and the wet weight of all debris collected per transect. Data were collected using pencils and pre-printed slates that facilitate efficient recording (Figure 2-10). At the end of the day, slates were scanned for archival purposes and then data were entered and checked using pre-formatted spreadsheets.

Training and Partnerships

The 2011 field effort was facilitated by participation of scientists from Grays Reef National Marine Sanctuary (Sarah Fangman) and the Florida Keys National Marine Sanctuary Damage Assessment Restoration and Research Program (DAARP) (Table 1). One day of in-water training on May 19 was used to review sampling protocols with five personnel in the Pickles Reef area. This represents the beginning of a partnership-effort with the FKNMS that we expect will continue in 2012. A Field Protocol Manual was drafted in June to assist with training. An updated version of the Field Protocol Manual was completed in December 2011 and was provided to colleagues in the U.S. Virgin Islands and Puerto Rico, who will sample *Acropora* populations in 2012.

Logistics Summary

Twenty-nine (29) field days were required to sample 280 sites from northern Key Largo to Alligator Reef. Fourteen days during May and August were supported by ARB-UNCW day-boat support out of Key Largo aboard the R/V *Research Diver* and R/V *George F. Bond* (captained by T. Roberts), in which 112 sites were sampled by a 2-person team. Six field days (6/13-6/18) were supported by a private vessel charter (R/V *Expedition II*, captained by B. Altmeier); 61 sites were sampled by either a 3- or 4-person team (Chiappone, Fangman and Rutten, with Anderson and Bailey alternating). Six days (6/19-6/23 and 9/10) were supported by a private vessel charter (Quiescence Q-1), in which 50 sites were sampled by a 3-person team (Bailey, Fangman, and Rutten). The upper Keys office of the FKNMS supported seven

days (6/20-6/24 and 8/11-8/12) of fieldwork (Sea-Vee, captained by D. Mooney and J. Halas), in which a 2-person (Chiappone and Rutten) or a 3-person team (Anderson, Chiappone and Goodwin) sampled 57 sites.

A total of 762 dives were completed by participants during 29 days of fieldwork, in which divers logged a combined total of just over 381 hours of underwater bottom time (Table 2-4). The depth range of dives ranged from 5 feet to 53 feet. The sampling effort depended upon 6 to 7 hours in the water daily by a two- or three-person benthic team to complete an average of eight (8) sites per day. Typically 30-40 minutes per site were needed to sample the targeted benthic variables.

Figure 2-1. Sampling locations for *Acropora* corals, other benthic coral reef organisms, and marine debris in the upper Florida Keys National Marine Sanctuary from the southern boundary of Biscayne National Park to Alligator Reef during May-September 2011.

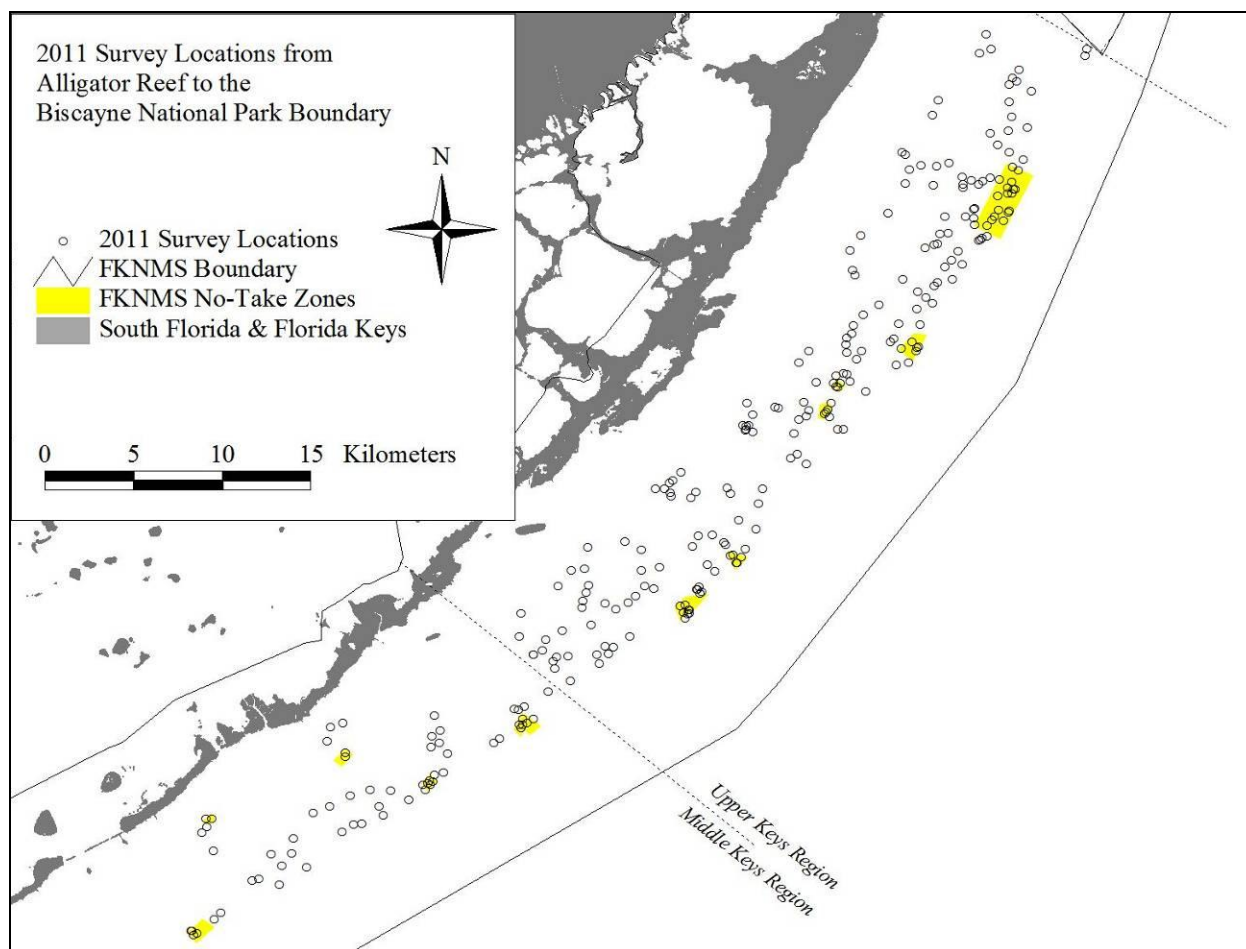


Figure 2-2. Upper Florida Keys sampling locations by benthic habitat type from the southern boundary of Biscayne National Park to the Watsons Reef area during May-September 2011.

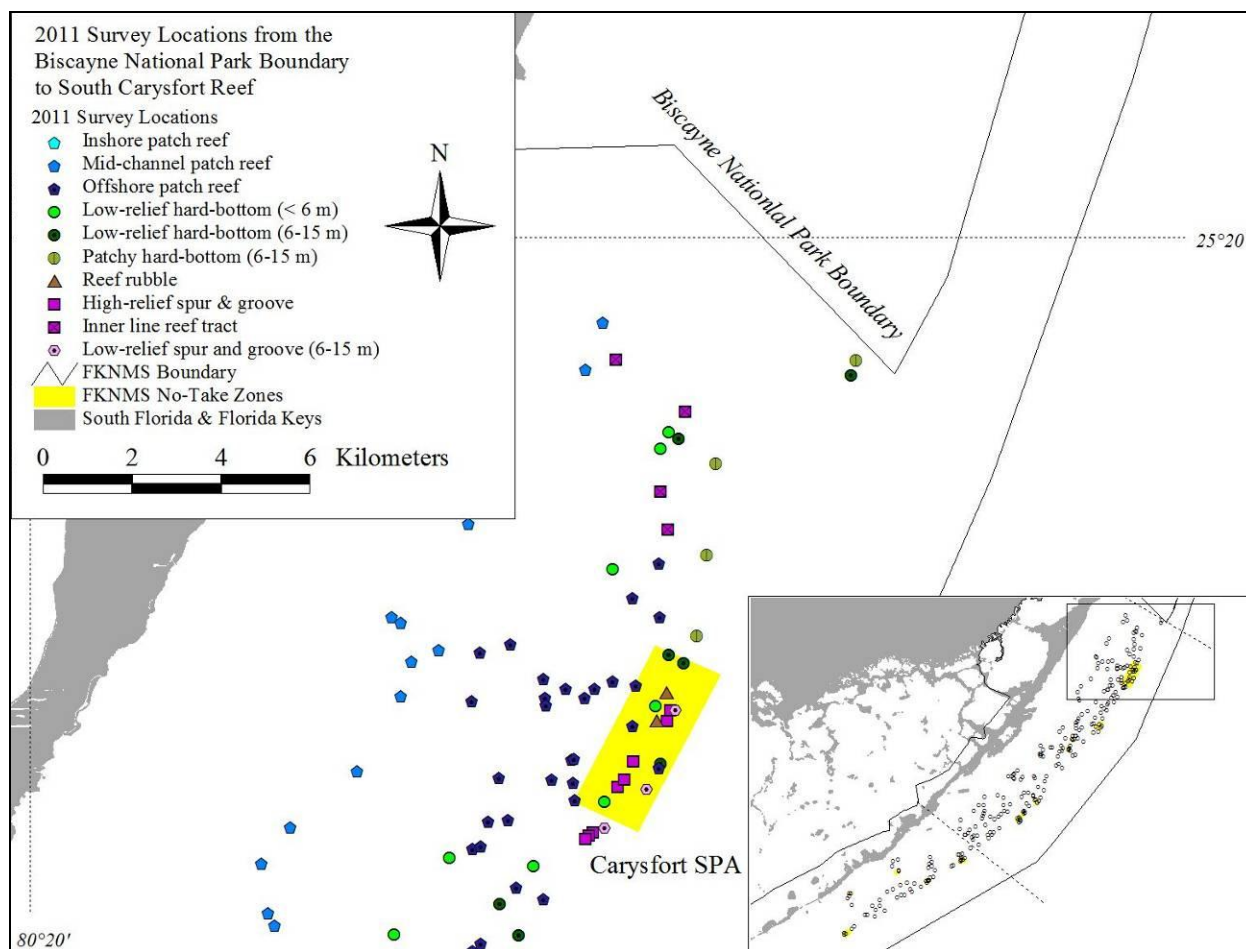


Figure 2-3. Upper Florida Keys sampling locations by benthic habitat type from Elbow Reef to the Pickles Reef area during May-September 2011.

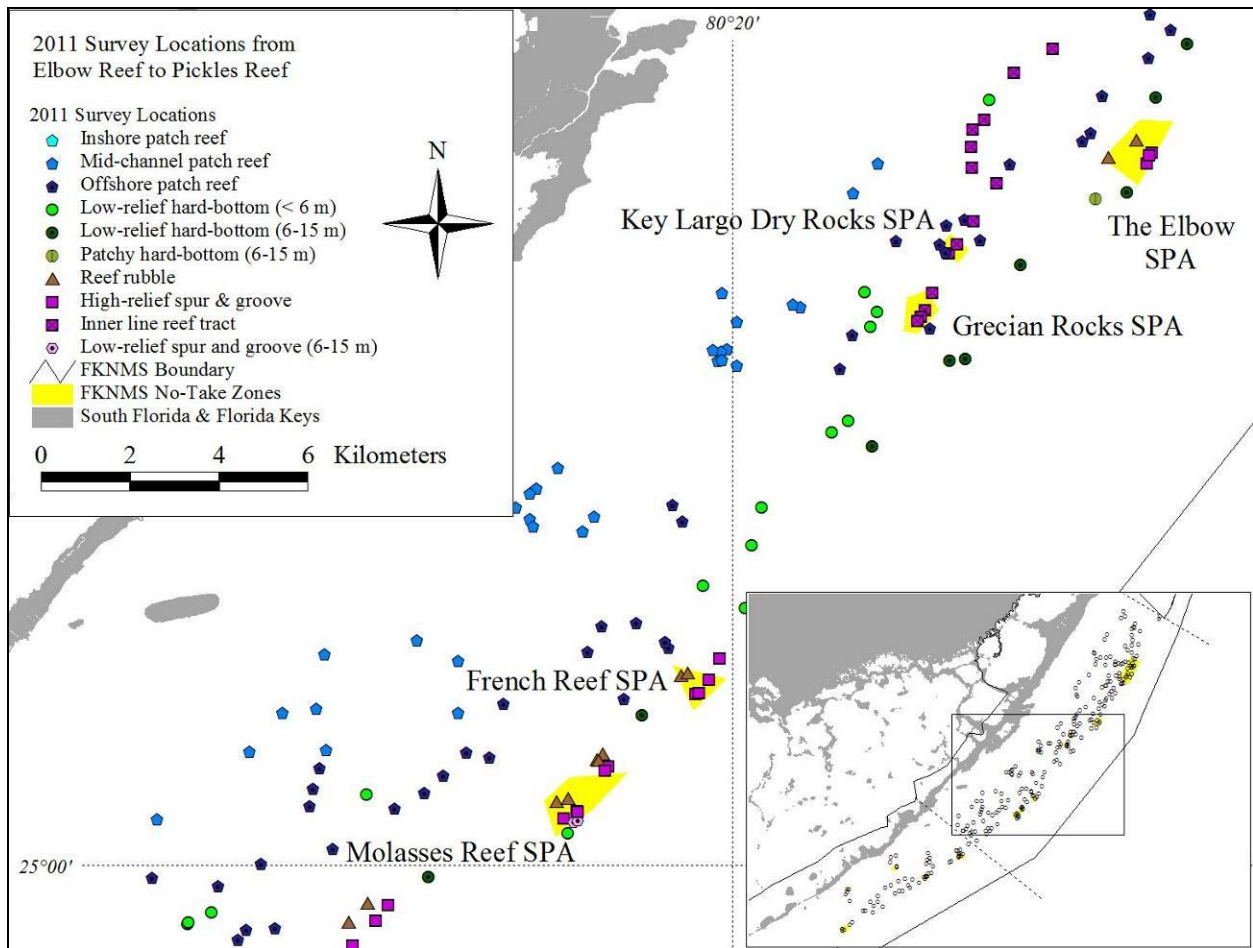


Figure 2-4. Upper Florida Keys sampling locations by benthic habitat type from Conch Reef to Alligator Reef during May-September 2011.

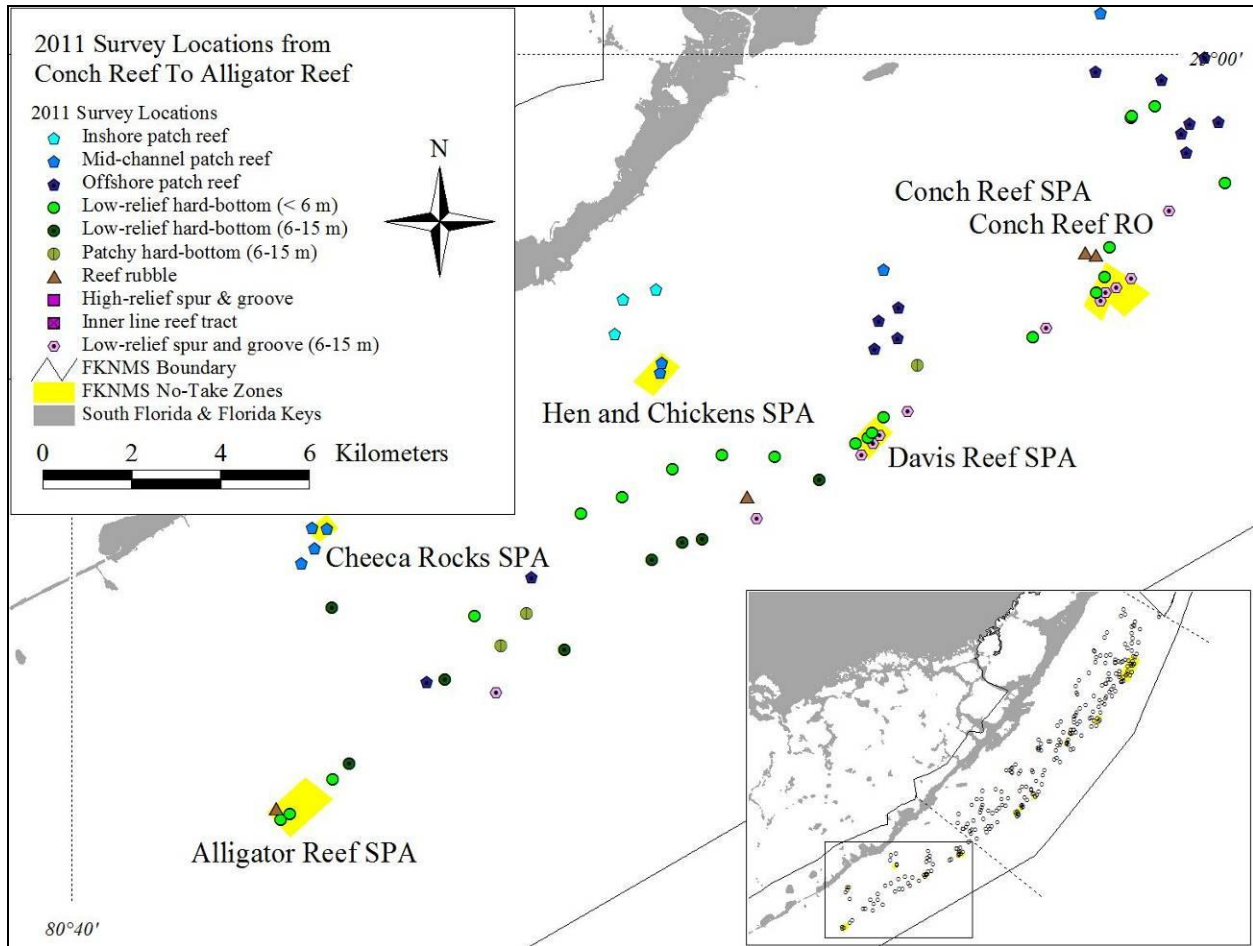


Figure 2-5. Examples of inshore, mid-channel and offshore patch reefs sampled in the upper Florida Keys National Marine Sanctuary during May-September 2011.

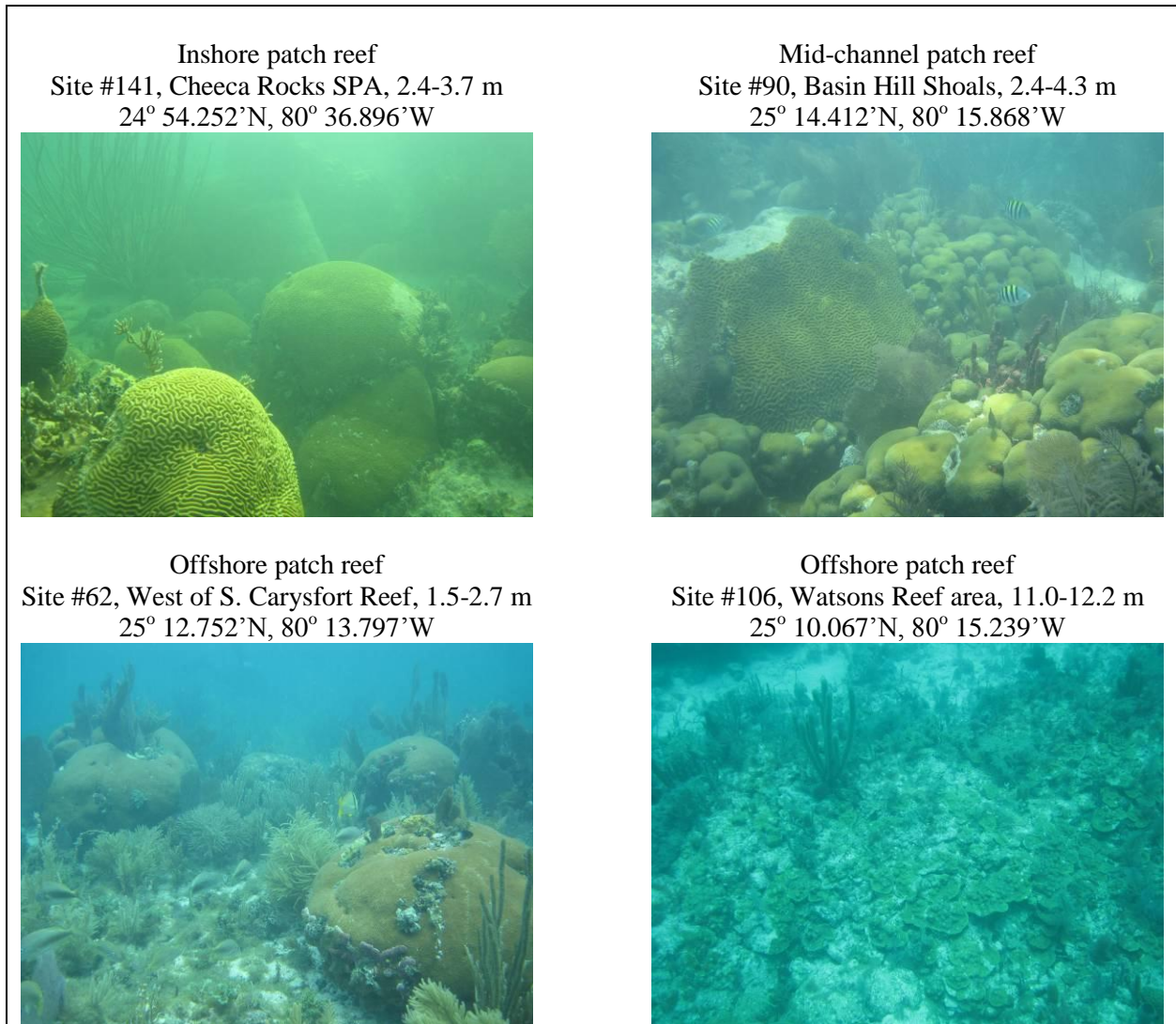


Figure 2-6. Examples of back-reef rubble and shallow (< 6 m) low-relief hard-bottom sites sampled in the upper Florida Keys National Marine Sanctuary during May-September 2011.

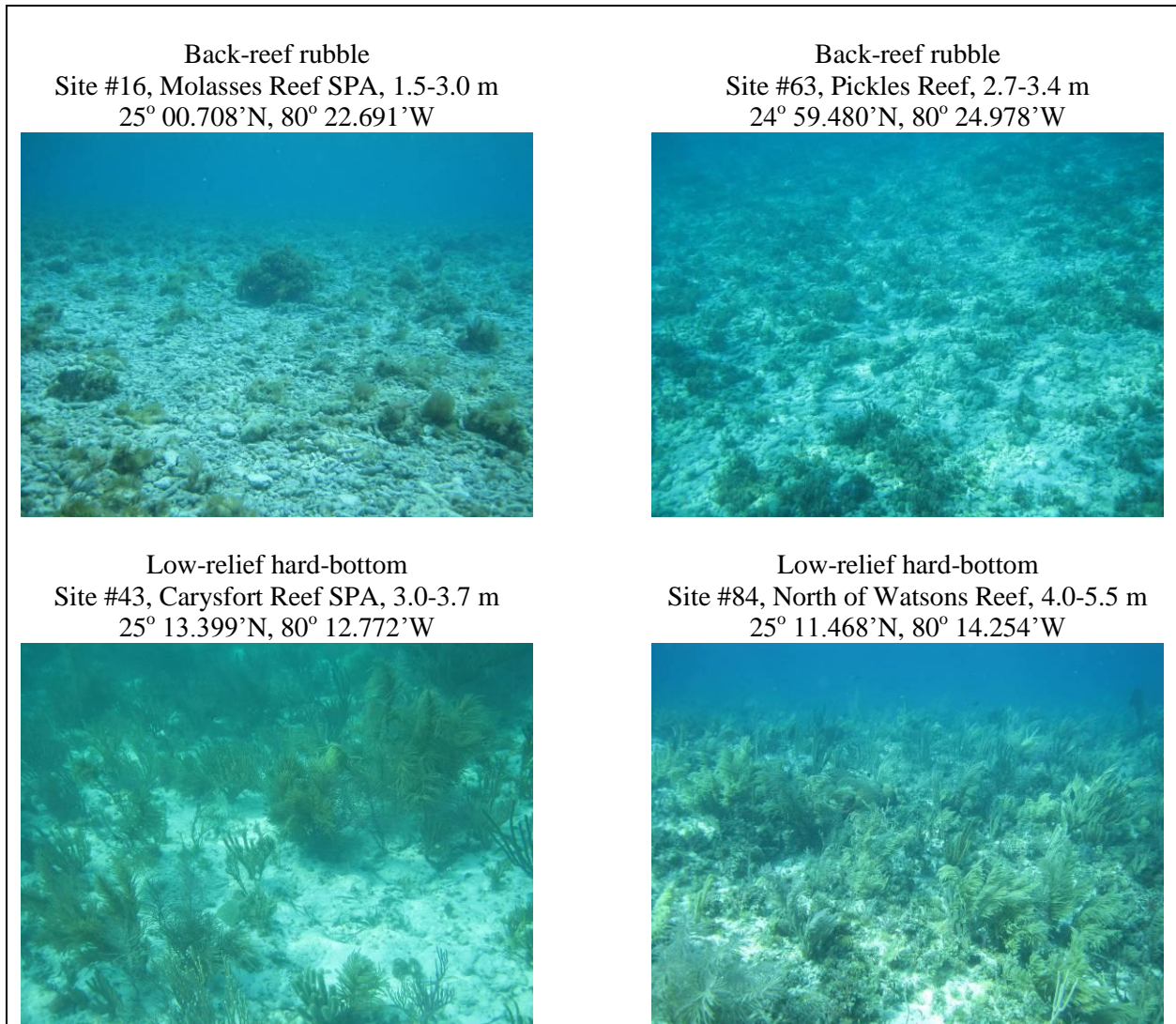


Figure 2-7. Examples of high-relief spur and groove reefs sampled in the upper Florida Keys National Marine Sanctuary during May-September during 2011.

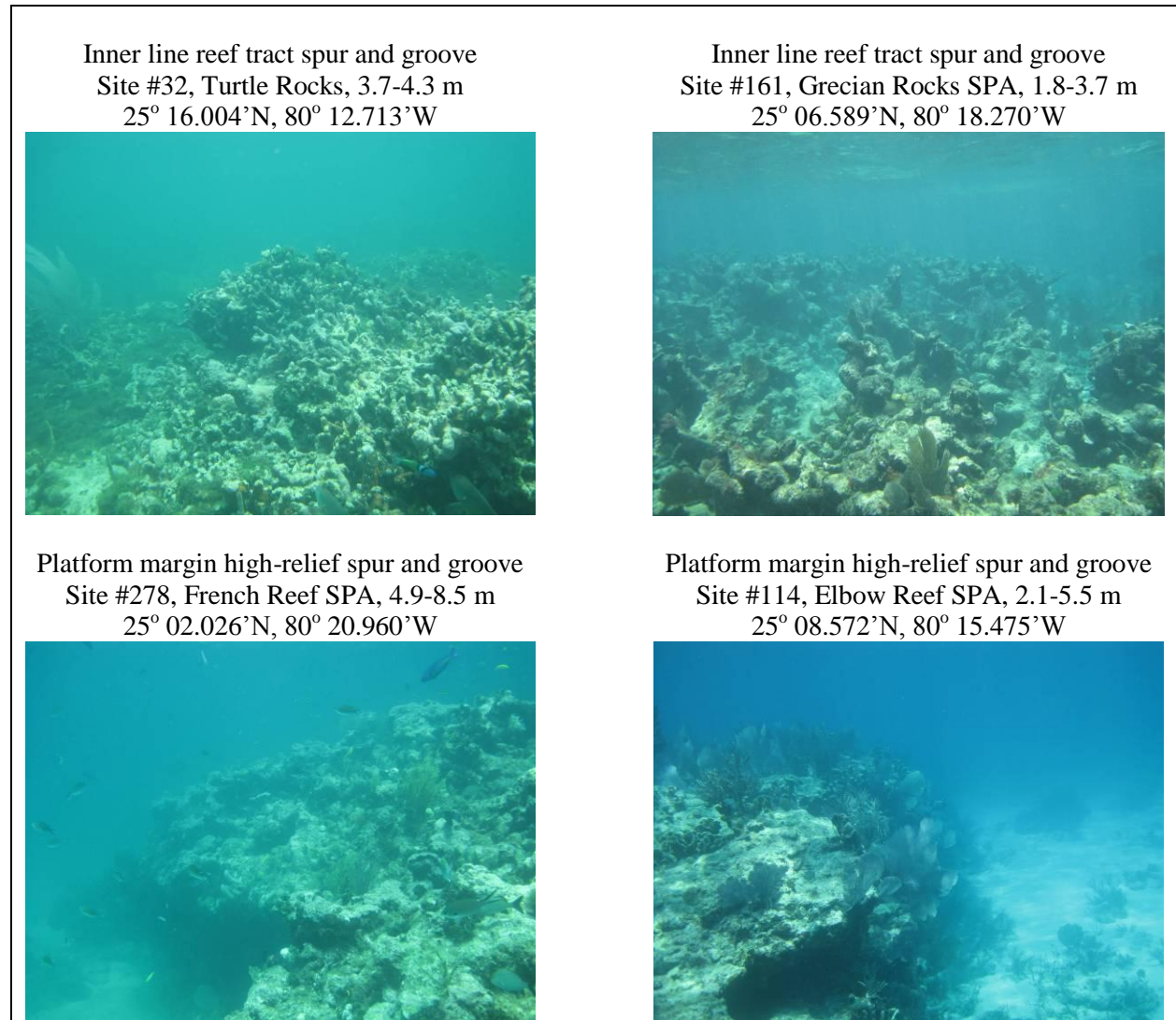


Figure 2-8. Examples of deeper (6-15 m) fore-reef habitats sampled in the upper Florida Keys National Marine Sanctuary during 2011.

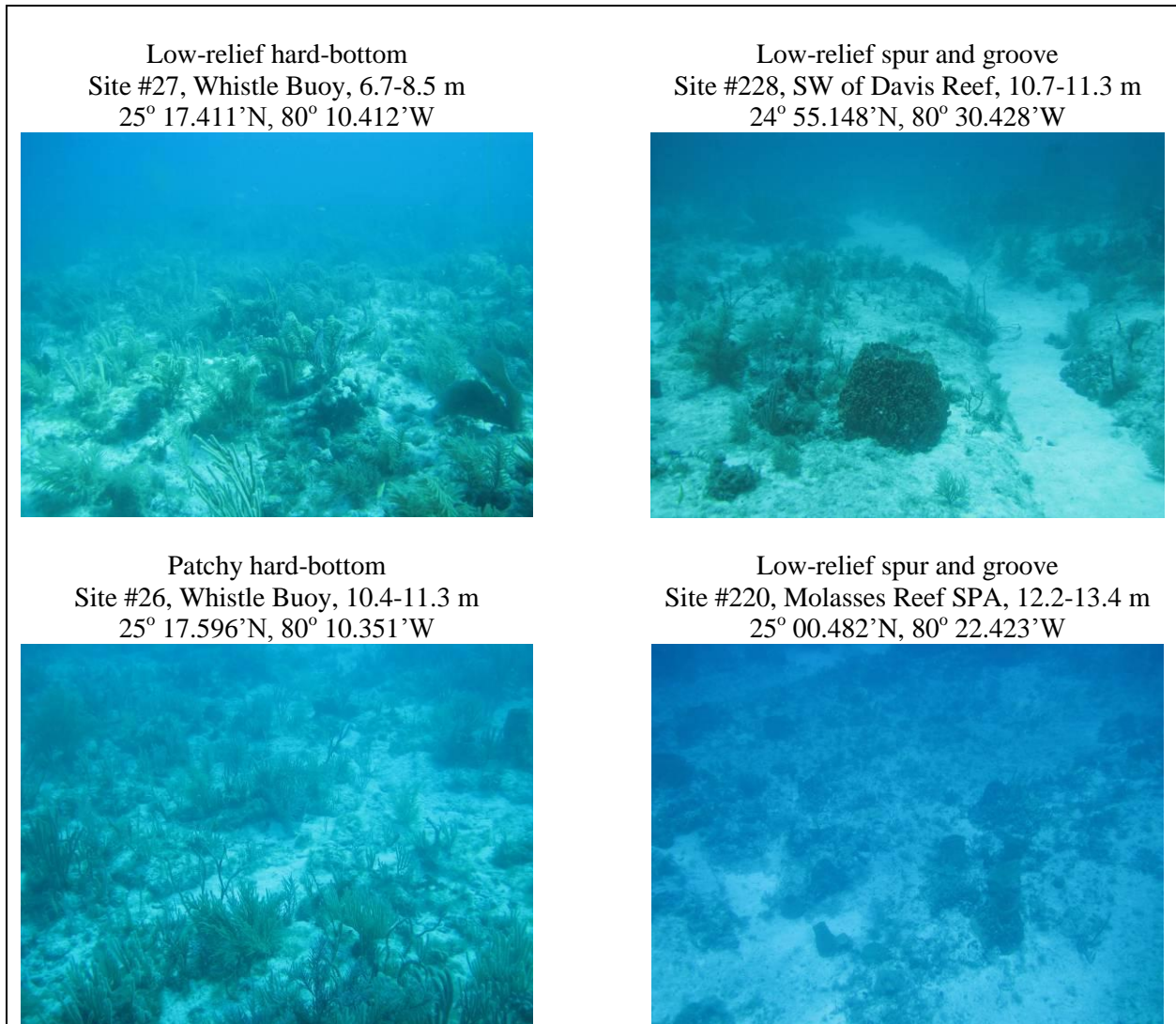


Figure 2.9. The two-stage stratification designed for the Florida Keys: (A) incorporates habitat type (cross-shelf position and depth), geographic region (along-shelf position), and management zone, utilizing a grid of 200-m x 200-m cells overlain onto existing habitat and bathymetry maps. (B) The example below shows an example of the two-stage stratification approach, where first- or primary-stage units shown as squares with a targeted habitat type are randomly selected based upon the three stratification variables. (C) An enlarged view of the sample grid with the arrow indicating a 200-m x 200-m cell containing a targeted benthic habitat type. (D) An enlarged view of one sample cell where second-stage units (transects) are deployed at random GPS points within a particular cell. Note that in 2011 we deployed two 15-m transects in each cell (site) surveyed.

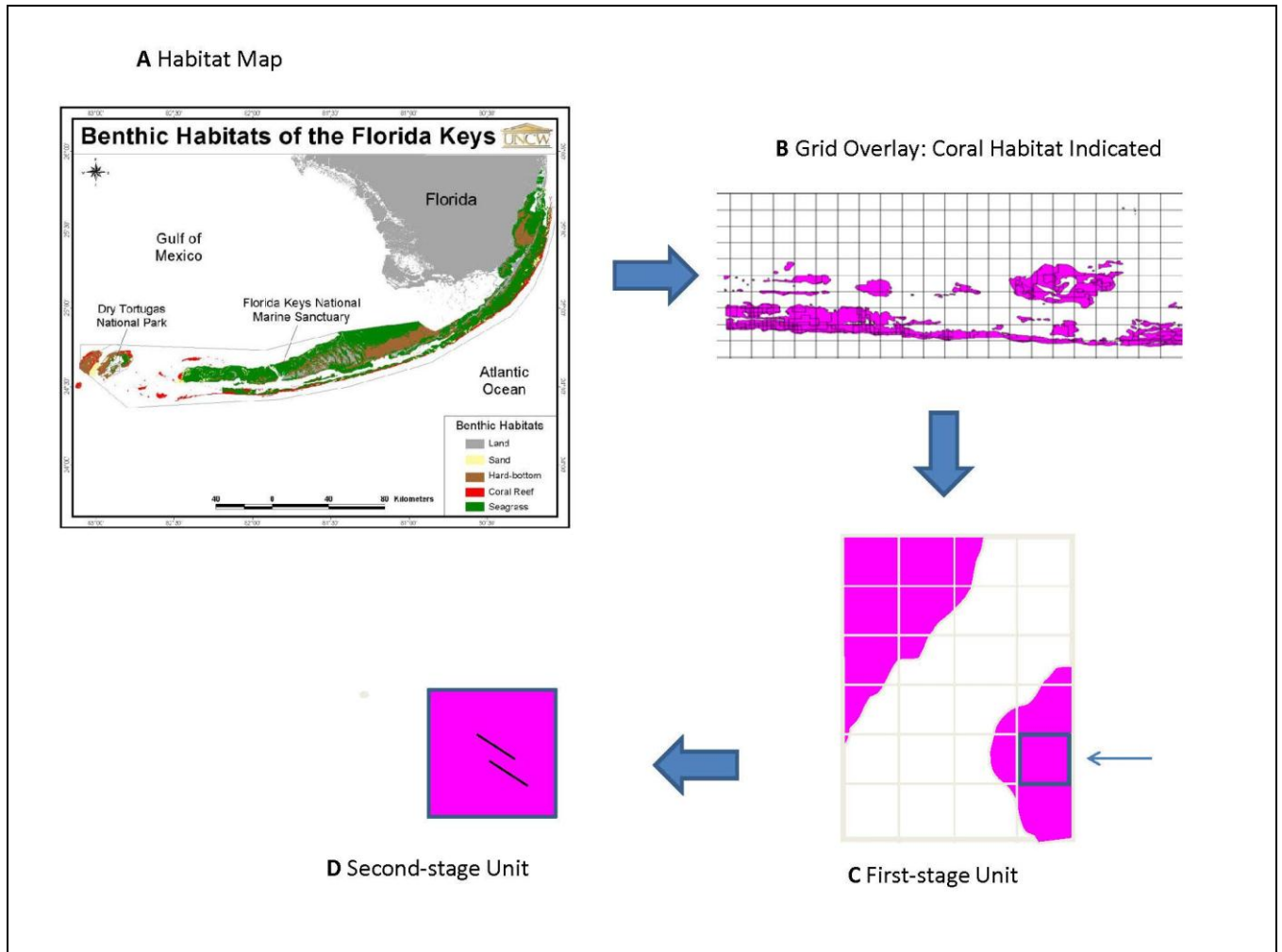


Figure 2-10. Examples of benthic survey methods used by this program.

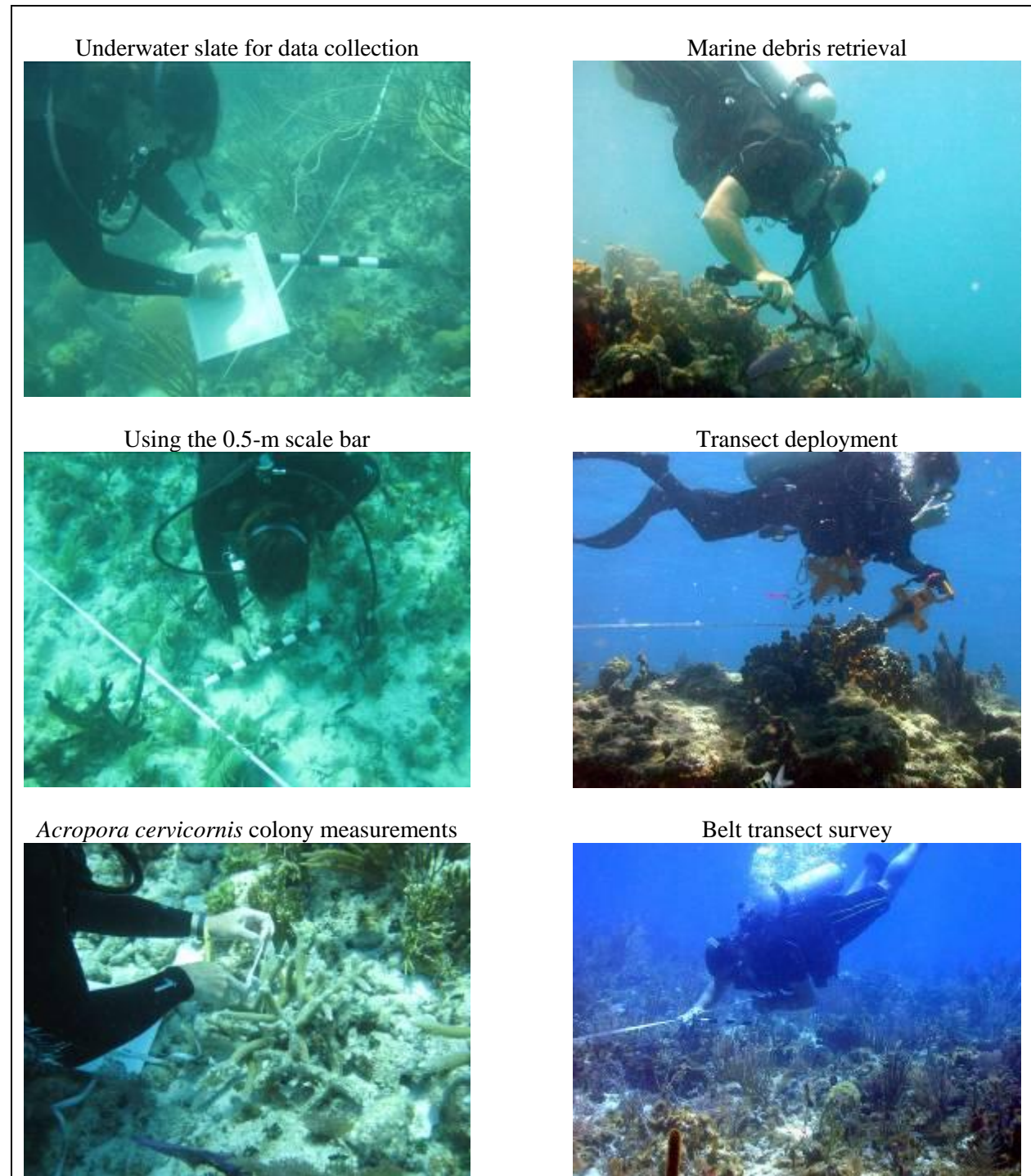


Table 2-1. Sampling effort for *Acropora* corals, other benthic coral reef organisms, and marine debris in the upper Florida Keys National Marine Sanctuary during May-September 2011. At each site, replicate 15-m x 1-m transects were surveyed per site for all variables, except for non-*Acropora* corals (two 10-m x 1-m belt transect areas) and marine debris (two 15-m x 2-m belt transect areas). High-relief spur and groove sites include inner line reef tract (Grecian Rocks to Turtle Reef) and offshore spur and groove (Carysfort Reef to Pickles Reef) sites. Deeper fore-reef habitats included patchy hard-bottom, continuous low-relief hard-bottom, and low-relief spur and groove.

Habitat type/region/protection	No. sites	Depth range (m)	% of Effort	No. transects	Area sampled (m ²)
<i>Inshore and mid-channel patch reefs</i>					
Reference areas	50	0.9-8.2	17.86	100	1,500
No-take zones	4	1.8-6.7	1.43	8	120
Total	54	0.9-8.2	19.29	108	1,620
<i>Offshore patch reefs</i>					
Reference areas	73	1.5-12.8	26.07	146	2,190
No-take zones	4	3.7-7.0	1.43	8	120
Total	77	1.5-12.8	27.50	154	2,310
<i>Back-reef rubble</i>					
Reference areas	8	1.5-5.5	2.86	16	240
No-take zones	10	1.2-6.4	3.57	20	300
Total	18	1.2-6.4	6.43	36	540
<i>Shallow (< 6 m) hard-bottom</i>					
Reference areas	33	1.8-7.0	11.79	66	990
No-take zones	8	3.0-7.0	2.86	16	240
Total	41	1.8-7.0	14.64	82	1,230
<i>High-relief spur and groove</i>					
Reference areas	22	2.7-7.6	7.86	44	660
No-take zones	19	1.2-8.5	6.79	38	570
Total	41	1.2-8.5	14.64	82	1,230
<i>Deeper fore reef</i>					
Reference areas	36	5.8-11.6	12.86	72	1,080
No-take zones	13	5.5-15.8	4.64	26	390
Total	49	5.5-15.8	17.50	98	1,470
<i>All habitat types</i>					
Reference areas	222	0.9-12.8	79.29	444	6,660
No-take zones	58	1.2-15.8	20.71	116	1,740
Total	280	0.9-15.8	100.00	560	8,400

Table 2-2. Chronological list of the 280 sites surveyed for *Acropora* corals, other benthic coral reef organisms, and marine debris in the upper Florida Keys National Marine Sanctuary during May-September 2011. Asterisked sites (**) are within Sanctuary no-take zones (SPAs or ROs).

Site #	Date	Site location	Latitude (N)	Longitude (W)	Habitat type
1	5/5/2011	South of Cannon Patch	25° 06.522	80° 20.496	Mid-channel patch reef
2	5/5/2011	South of Cannon Patch	25° 06.193	80° 20.619	Mid-channel patch reef
3	5/5/2011	South of Cannon Patch	25° 06.168	80° 20.684	Mid-channel patch reef
4	5/5/2011	South of Cannon Patch	25° 06.052	80° 20.726	Mid-channel patch reef
5	5/5/2011	Mosquito Bank	25° 04.511	80° 22.926	Mid-channel patch reef
6	5/5/2011	Mosquito Bank	25° 04.443	80° 23.008	Mid-channel patch reef
7	5/5/2011	Mosquito Bank	25° 04.142	80° 23.007	Mid-channel patch reef
8	5/5/2011	Mosquito Bank	25° 04.048	80° 22.967	Mid-channel patch reef
9	5/5/2011	Mosquito Bank	25° 04.280	80° 23.172	Mid-channel patch reef
10	5/5/2011	Mosquito Bank	25° 04.265	80° 23.437	Mid-channel patch reef
11	5/6/2011	Inshore of Pickles Reef	24° 59.184	80° 26.096	Offshore patch reef
12	5/6/2011	Triangles area	25° 01.320	80° 26.400	Mid-channel patch reef
13	5/6/2011	Triangles area	25° 01.343	80° 25.480	Mid-channel patch reef
14	5/6/2011	Molasses Reef Channel	25° 01.028	80° 24.054	Offshore patch reef
15	5/6/2011	Wolf Reef	25° 01.311	80° 23.773	Offshore patch reef
16	5/6/2011	Molasses Reef**	25° 00.708	80° 22.691	Reef rubble
17	5/6/2011	Molasses Reef**	25° 00.753	80° 22.548	Reef rubble
18	5/6/2011	Sand Island	25° 01.219	80° 22.192	Reef rubble
19	5/6/2011	Sand Island	25° 01.284	80° 22.130	Reef rubble
20	5/8/2011	Turtle Harbor	25° 16.041	80° 14.857	Mid-channel patch reef
21	5/8/2011	Turtle Harbor	25° 15.611	80° 15.042	Mid-channel patch reef
22	5/8/2011	Turtle Rocks	25° 17.477	80° 13.624	Mid-channel patch reef
23	5/8/2011	Turtle Reef	25° 17.603	80° 13.258	Inner line reef tract
24	5/8/2011	Turtle Rocks	25° 18.055	80° 13.419	Mid-channel patch reef
25	5/8/2011	Turtle Reef	25° 16.973	80° 12.412	Inner line reef tract
26	5/8/2011	Whistle Buoy	25° 17.596	80° 10.351	Patchy hard-bottom (6-15 m)
27	5/8/2011	Whistle Buoy	25° 17.411	80° 10.412	Low-relief hard-bottom (6-15 m)
28	5/12/2011	Turtle Rocks	25° 16.718	80° 12.612	Low-relief hard-bottom (< 6 m)
29	5/12/2011	Turtle Rocks	25° 16.638	80° 12.496	Low-relief hard-bottom (6-15 m)
30	5/12/2011	Turtle Rocks	25° 16.521	80° 12.720	Low-relief hard-bottom (< 6 m)
31	5/12/2011	Turtle Rocks	25° 16.338	80° 12.051	Patchy hard-bottom (6-15 m)
32	5/12/2011	Turtle Rocks	25° 16.004	80° 12.713	Inner line reef tract
33	5/12/2011	Turtle Rocks	25° 15.545	80° 12.630	Inner line reef tract
34	5/12/2011	East of Turtle Rocks	25° 15.228	80° 12.153	Patchy hard-bottom (6-15 m)
35	5/13/2011	North of Carysfort Reef	25° 15.133	80° 12.740	Offshore patch reef
36	5/13/2011	North of Carysfort Reef	25° 15.059	80° 13.293	Low-relief hard-bottom (< 6 m)
37	5/13/2011	North of Carysfort Reef	25° 14.713	80° 13.053	Offshore patch reef
38	5/13/2011	North of Carysfort Reef	25° 14.487	80° 12.722	Offshore patch reef
39	5/13/2011	North of Carysfort Reef	25° 14.252	80° 12.280	Patchy hard-bottom (6-15 m)
40	5/13/2011	Carysfort Reef**	25° 14.027	80° 12.616	Low-relief hard-bottom (6-15 m)
41	5/13/2011	Carysfort Reef**	25° 13.919	80° 12.433	Low-relief hard-bottom (6-15 m)
42	5/13/2011	Carysfort Reef**	25° 13.568	80° 12.645	Reef rubble
43	5/13/2011	Carysfort Reef**	25° 13.399	80° 12.772	Low-relief hard-bottom (< 6 m)
44	5/13/2011	Carysfort Reef**	25° 13.350	80° 12.599	High-relief spur and groove
45	5/14/2011	Carysfort Reef**	25° 13.219	80° 12.632	High-relief spur and groove
46	5/14/2011	Carysfort Reef**	25° 13.651	80° 13.015	Offshore patch reef
47	5/14/2011	NW of Carysfort Lighthouse	25° 13.161	80° 13.056	Offshore patch reef
48	5/14/2011	West of Carysfort Lighthouse	25° 13.704	80° 13.293	Offshore patch reef
49	5/14/2011	West of Carysfort Lighthouse	25° 13.611	80° 13.517	Offshore patch reef
50	5/14/2011	West of Carysfort Lighthouse	25° 13.508	80° 13.635	Offshore patch reef
51	5/14/2011	West of Carysfort Lighthouse	25° 13.613	80° 13.862	Offshore patch reef
52	5/14/2011	West of Carysfort Lighthouse	25° 13.507	80° 14.117	Offshore patch reef
53	5/14/2011	West of Carysfort Lighthouse	25° 13.410	80° 14.103	Offshore patch reef
54	5/14/2011	West of Carysfort Lighthouse	25° 13.730	80° 14.138	Offshore patch reef

Site #	Date	Site location	Latitude (N)	Longitude (W)	Habitat type
55	5/15/2011	South Carysfort Reef**	25° 12.389	80° 12.885	Low-relief spur and groove (6-15 m)
56	5/15/2011	South Carysfort Reef**	25° 12.700	80° 12.717	Low-relief hard-bottom (6-15 m)
57	5/15/2011	South Carysfort Reef**	25° 12.734	80° 13.051	High-relief spur and groove
58	5/15/2011	South Carysfort Reef**	25° 12.421	80° 13.241	High-relief spur and groove
59	5/15/2011	South of South Carysfort Reef**	25° 12.244	80° 13.394	Low-relief hard-bottom (< 6 m)
60	5/15/2011	SW Carysfort Reef SPA**	25° 12.266	80° 13.761	Offshore patch reef
61	5/15/2011	West of South Carysfort Reef	25° 12.478	80° 13.781	Offshore patch reef
62	5/15/2011	West of South Carysfort Reef	25° 12.752	80° 13.797	Offshore patch reef
63	5/19/2011	Pickles Reef	24° 59.480	80° 24.978	Reef rubble
64	5/19/2011	Pickles Reef	24° 59.251	80° 25.210	Reef rubble
65	5/19/2011	Pickles Reef	24° 58.973	80° 25.158	High-relief spur and groove
66	5/19/2011	Pickles Reef	24° 59.271	80° 24.876	High-relief spur and groove
67	5/19/2011	Pickles Reef	24° 59.458	80° 24.724	High-relief spur and groove
68	5/19/2011	Pickles Reef	24° 59.796	80° 24.231	Low-relief hard-bottom (6-15 m)
69	5/20/2011	Carysfort Reef**	25° 13.357	80° 12.541	Low-relief spur and groove (6-15 m)
70	5/20/2011	Carysfort Reef**	25° 13.228	80° 12.766	Reef rubble
71	5/20/2011	West of South Carysfort Reef	25° 12.768	80° 13.766	Offshore patch reef
72	5/20/2011	West of South Carysfort Reef	25° 12.651	80° 12.736	Offshore patch reef
73	5/20/2011	West of South Carysfort Reef	25° 12.512	80° 14.040	Offshore patch reef
74	5/20/2011	West of South Carysfort Reef	25° 12.536	80° 14.672	Offshore patch reef
75	5/20/2011	South of South Carysfort Reef	25° 11.923	80° 13.395	Low-relief spur and groove (6-15 m)
76	5/20/2011	Maitland area	25° 11.878	80° 13.536	High-relief spur and groove
77	5/20/2011	Maitland area	25° 11.835	80° 13.589	High-relief spur and groove
78	5/21/2011	Maitland area	25° 11.796	80° 13.630	High-relief spur and groove
79	5/21/2011	North of Watsons Reef	25° 12.024	80° 14.563	Offshore patch reef
80	5/21/2011	North of Watsons Reef	25° 12.002	80° 14.804	Offshore patch reef
81	5/21/2011	North of Watsons Reef	25° 11.566	80° 15.277	Low-relief hard-bottom (< 6 m)
82	5/21/2011	North of Watsons Reef	25° 11.676	80° 14.995	Offshore patch reef
83	5/21/2011	North of Watsons Reef	25° 11.704	80° 14.891	Offshore patch reef
84	5/21/2011	North of Watsons Reef	25° 11.468	80° 14.254	Low-relief hard-bottom (< 6 m)
85	5/21/2011	Watsons Reef	25° 11.068	80° 14.133	Offshore patch reef
86	5/22/2011	Basin Hill Shoals	25° 14.156	80° 14.535	Offshore patch reef
87	5/22/2011	Basin Hill Shoals	25° 14.050	80° 14.905	Offshore patch reef
88	5/22/2011	Basin Hill Shoals	25° 13.465	80° 15.007	Offshore patch reef
89	5/22/2011	Basin Hill Shoals	25° 14.484	80° 15.975	Mid-channel patch reef
90	5/22/2011	Basin Hill Shoals	25° 14.412	80° 15.868	Mid-channel patch reef
91	5/22/2011	Basin Hill Shoals	25° 14.087	80° 15.401	Mid-channel patch reef
92	5/22/2011	Basin Hill Shoals	25° 13.940	80° 15.731	Mid-channel patch reef
93	5/22/2011	Basin Hill Shoals	25° 13.519	80° 15.861	Mid-channel patch reef
94	6/13/2011	Basin Hill Shoals	25° 12.617	80° 16.395	Mid-channel patch reef
95	6/13/2011	South of Basin Hill Shoals	25° 11.937	80° 17.205	Mid-channel patch reef
96	6/13/2011	South of Basin Hill Shoals	25° 11.496	80° 17.554	Mid-channel patch reef
97	6/13/2011	South of Basin Hill Shoals	25° 10.893	80° 17.472	Mid-channel patch reef
98	6/13/2011	South of Basin Hill Shoals	25° 10.740	80° 17.390	Mid-channel patch reef
99	6/13/2011	Inshore of Watsons Reef	25° 10.633	80° 15.943	Low-relief hard-bottom (< 6 m)
100	6/13/2011	Watsons Reef	25° 11.208	80° 14.462	Offshore patch reef
101	6/14/2011	Watsons Reef	25° 11.004	80° 14.663	Low-relief hard-bottom (6-15 m)
102	6/14/2011	Watsons Reef	25° 10.625	80° 14.433	Low-relief hard-bottom (6-15 m)
103	6/14/2011	Watsons Reef	25° 10.524	80° 14.894	Offshore patch reef
104	6/14/2011	Watsons Reef	25° 10.435	80° 14.994	Offshore patch reef
105	6/14/2011	Watsons Reef	25° 10.255	80° 15.491	Offshore patch reef
106	6/14/2011	Watsons Reef	25° 10.067	80° 15.239	Offshore patch reef
107	6/14/2011	Watsons Reef	25° 09.893	80° 15.043	Low-relief hard-bottom (6-15 m)
108	6/14/2011	Watsons Reef	25° 09.727	80° 15.512	Offshore patch reef
109	6/14/2011	North of Elbow Reef	25° 09.243	80° 15.417	Low-relief hard-bottom (6-15 m)
110	6/14/2011	NW of Elbow Reef	25° 09.269	80° 16.065	Offshore patch reef
111	6/15/2011	South of Elbow Reef	25° 08.014	80° 16.153	Patchy hard-bottom (6-15 m)
112	6/15/2011	South of Elbow Reef	25° 08.100	80° 15.769	Low-relief hard-bottom (6-15 m)
113	6/15/2011	Elbow Reef**	25° 08.449	80° 15.534	High-relief spur and groove
114	6/15/2011	Elbow Reef**	25° 08.572	80° 15.475	High-relief spur and groove

Site #	Date	Site location	Latitude (N)	Longitude (W)	Habitat type
115	6/15/2011	Elbow Reef**	25° 08.725	80° 15.657	Reef rubble
116	6/15/2011	Elbow Reef**	25° 08.513	80° 15.996	Reef rubble
117	6/15/2011	West of Elbow Reef	25° 08.714	80° 16.308	Offshore patch reef
118	6/15/2011	West of Elbow Reef	25° 08.817	80° 16.208	Offshore patch reef
119	6/15/2011	Inshore of Watsons Reef	25° 09.839	80° 16.667	Inner line reef tract
120	6/15/2011	Inshore of Watsons Reef	25° 09.547	80° 17.140	Inner line reef tract
121	6/16/2011	NW of Elbow Reef	25° 09.219	80° 17.444	Low-relief hard-bottom (< 6 m)
122	6/16/2011	North of Horseshoe Reef	25° 08.975	80° 17.501	Inner line reef tract
123	6/16/2011	North of Horseshoe Reef	25° 08.857	80° 17.643	Inner line reef tract
124	6/16/2011	North of Horseshoe Reef	25° 08.648	80° 17.657	Inner line reef tract
125	6/16/2011	North of North-North Dry Rocks	25° 08.437	80° 17.191	Offshore patch reef
126	6/16/2011	North-North Dry Rocks	25° 08.207	80° 17.349	Inner line reef tract
127	6/16/2011	Inshore of North Dry Rocks	25° 07.765	80° 17.742	Offshore patch reef
128	6/16/2011	Inshore of Dry Rocks	25° 07.696	80° 17.962	Offshore patch reef
129	6/16/2011	North Dry Rocks	25° 07.749	80° 17.632	Inner line reef tract
130	6/16/2011	East of Dry Rocks	25° 07.511	80° 17.547	Offshore patch reef
131	6/17/2011	NE of Alligator Reef	24° 52.785	80° 34.026	Low-relief hard-bottom (6-15 m)
132	6/17/2011	NE of Alligator Reef	24° 52.265	80° 34.854	Low-relief spur and groove (6-15 m)
133	6/17/2011	NE of Alligator Reef	24° 52.428	80° 35.476	Low-relief hard-bottom (6-15 m)
134	6/17/2011	NE of Alligator Reef	24° 52.398	80° 35.689	Offshore patch reef
135	6/17/2011	NE of Alligator Reef	24° 51.404	80° 36.633	Low-relief hard-bottom (6-15 m)
136	6/17/2011	NE of Alligator Reef	24° 51.212	80° 36.828	Low-relief hard-bottom (< 6 m)
137	6/17/2011	Alligator Reef**	24° 50.730	80° 37.460	Low-relief hard-bottom (< 6 m)
138	6/17/2011	Alligator Reef**	24° 50.797	80° 37.353	Low-relief hard-bottom (< 6 m)
139	6/17/2011	Alligator Reef**	24° 50.855	80° 37.519	Reef rubble
140	6/17/2011	Alligator Reef**	24° 50.852	80° 37.516	Reef rubble
141	6/17/2011	Cheeca Rocks**	24° 54.252	80° 36.896	Mid-channel patch reef
142	6/17/2011	Cheeca Rocks**	24° 54.260	80° 37.081	Mid-channel patch reef
143	6/18/2011	SW of Cheeca Rocks	24° 54.009	80° 37.055	Mid-channel patch reef
144	6/18/2011	SW of Cheeca Rocks	24° 53.833	80° 37.207	Mid-channel patch reef
145	6/18/2011	South of Cheeca Rocks	24° 53.298	80° 36.841	Low-relief hard-bottom (6-15 m)
146	6/18/2011	NE of Alligator Reef	24° 53.191	80° 35.114	Low-relief hard-bottom (< 6 m)
147	6/18/2011	NE of Alligator Reef	24° 52.830	80° 34.787	Patchy hard-bottom (6-15 m)
148	6/18/2011	NE of Alligator Reef	24° 53.223	80° 34.484	Patchy hard-bottom (6-15 m)
149	6/18/2011	NE of Alligator Reef	24° 53.666	80° 34.421	Offshore patch reef
150	6/18/2011	West of Crocker Reef	24° 54.431	80° 33.825	Low-relief hard-bottom (< 6 m)
151	6/18/2011	West of Crocker Reef	24° 54.634	80° 33.325	Low-relief hard-bottom (< 6 m)
152	6/18/2011	SW of Crocker Reef	24° 53.871	80° 32.963	Low-relief hard-bottom (6-15 m)
153	6/18/2011	SW of Crocker Reef	24° 54.082	80° 32.593	Low-relief hard-bottom (6-15 m)
154	6/18/2011	SW of Crocker Reef	24° 54.125	80° 32.357	Low-relief hard-bottom (6-15 m)
155	6/19/2011	Key Largo Dry Rocks**	25° 07.356	80° 17.927	Inner line reef tract
156	6/19/2011	Key Largo Dry Rocks**	25° 07.461	80° 17.833	Inner line reef tract
157	6/19/2011	Key Largo Dry Rocks**	25° 07.466	80° 18.038	Offshore patch reef
158	6/19/2011	Key Largo Dry Rocks**	25° 07.363	80° 17.973	Offshore patch reef
159	6/19/2011	North of Grecian Rocks	25° 06.880	80° 18.126	Inner line reef tract
160	6/19/2011	Grecian Rocks**	25° 06.665	80° 18.218	Inner line reef tract
161	6/19/2011	Grecian Rocks**	25° 06.589	80° 18.270	Inner line reef tract
162	6/19/2011	South of Three Heads Reef	25° 07.504	80° 18.564	Offshore patch reef
163	6/19/2011	Higdons Reef	25° 08.086	80° 19.090	Mid-channel patch reef
164	6/19/2011	Higdons Reef	25° 08.447	80° 18.784	Mid-channel patch reef
165	6/20/2011	East of Dry Rocks	25° 07.214	80° 17.060	Low-relief hard-bottom (6-15 m)
166	6/20/2011	East of Grecian Rocks	25° 06.445	80° 18.161	Offshore patch reef
167	6/20/2011	Southeast of Grecian Rocks	25° 06.073	80° 17.730	Low-relief hard-bottom (6-15 m)
168	6/20/2011	Southeast of Grecian Rocks	25° 06.060	80° 17.923	Low-relief hard-bottom (6-15 m)
169	6/20/2011	West of Grecian Rocks	25° 06.643	80° 18.800	Low-relief hard-bottom (< 6 m)
170	6/20/2011	West of Grecian Rocks	25° 06.889	80° 18.951	Low-relief hard-bottom (< 6 m)
171	6/20/2011	West of Grecian Rocks	25° 06.470	80° 18.879	Low-relief hard-bottom (< 6 m)
172	6/20/2011	West of Grecian Rocks	25° 06.370	80° 19.099	Offshore patch reef
173	6/20/2011	Southwest of Grecian Rocks	25° 05.954	80° 19.246	Offshore patch reef
174	6/20/2011	North of Cannon Patch	25° 06.872	80° 20.681	Mid-channel patch reef

Site #	Date	Site location	Latitude (N)	Longitude (W)	Habitat type
175	6/20/2011	Northeast of Cannon Patch	25° 06.710	80° 19.724	Mid-channel patch reef
176	6/20/2011	Northeast of Cannon Patch	25° 06.741	80° 19.822	Mid-channel patch reef
177	6/20/2011	East of Cannon Patch	25° 06.001	80° 20.496	Mid-channel patch reef
178	6/20/2011	East of Cannon Patch	25° 06.066	80° 20.682	Mid-channel patch reef
179	6/20/2011	Cannon Patch	25° 06.189	80° 20.784	Mid-channel patch reef
180	6/20/2011	White Bank	25° 04.304	80° 21.273	Offshore patch reef
181	6/20/2011	White Bank	25° 04.108	80° 21.159	Offshore patch reef
182	6/21/2011	Southwest of Grecian Rocks	25° 05.012	80° 18.856	Low-relief hard-bottom (6-15 m)
183	6/21/2011	Southwest of Grecian Rocks	25° 05.326	80° 19.145	Low-relief hard-bottom (< 6 m)
184	6/21/2011	Southwest of Grecian Rocks	25° 05.183	80° 19.350	Low-relief hard-bottom (< 6 m)
185	6/21/2011	North of Dixie Shoal	25° 04.274	80° 20.198	Low-relief hard-bottom (< 6 m)
186	6/21/2011	North of Dixie Shoal	25° 03.817	80° 20.316	Low-relief hard-bottom (< 6 m)
187	6/21/2011	Dixie Shoal	25° 03.327	80° 20.912	Low-relief hard-bottom (< 6 m)
188	6/21/2011	Dixie Shoal	25° 03.056	80° 20.396	Low-relief hard-bottom (< 6 m)
189	6/21/2011	Northeast of French Reef	25° 02.450	80° 20.711	High-relief spur and groove
190	6/21/2011	Northeast of French Reef	25° 02.577	80° 21.331	Offshore patch reef
191	6/21/2011	Northeast of French Reef	25° 02.651	80° 21.365	Offshore patch reef
192	6/21/2011	Mosquito Bank	25° 04.168	80° 22.222	Mid-channel patch reef
193	6/21/2011	Mosquito Bank	25° 04.759	80° 22.668	Mid-channel patch reef
194	6/21/2011	Mosquito Bank	25° 03.988	80° 22.364	Mid-channel patch reef
195	6/21/2011	North of White Bank/Dry Rocks	25° 02.836	80° 22.134	Offshore patch reef
196	6/21/2011	White Bank/Dry Rocks	25° 02.875	80° 21.721	Offshore patch reef
197	6/21/2011	White Bank/Dry Rocks	25° 02.528	80° 22.309	Offshore patch reef
198	6/21/2011	Molasses Reef Channel	25° 01.899	80° 23.331	Offshore patch reef
199	6/21/2011	Three Sisters	25° 01.791	80° 23.873	Mid-channel patch reef
200	6/22/2011	French Reef**	25° 02.184	80° 20.837	High-relief spur and groove
201	6/22/2011	French Reef**	25° 02.015	80° 21.000	High-relief spur and groove
202	6/22/2011	French Reef**	25° 02.234	80° 21.179	Reef rubble
203	6/22/2011	French Reef**	25° 02.266	80° 21.097	Reef rubble
204	6/22/2011	SW of French Reef	25° 01.757	80° 21.649	Low-relief hard-bottom (6-15 m)
205	6/22/2011	Sand Island	25° 01.134	80° 22.057	High-relief spur and groove
206	6/22/2011	Sand Island	25° 01.213	80° 22.174	Reef rubble
207	6/22/2011	Molasses Reef**	25° 00.601	80° 22.439	High-relief spur and groove
208	6/22/2011	Crocker Reef	24° 54.374	80° 31.690	Low-relief spur and groove (6-15 m)
209	6/22/2011	Crocker Reef	24° 54.630	80° 31.816	Reef rubble
210	6/22/2011	Inshore of Crocker Reef	24° 54.975	80° 32.710	Low-relief hard-bottom (< 6 m)
211	6/22/2011	Inshore of Crocker Reef	24° 55.143	80° 32.113	Low-relief hard-bottom (< 6 m)
212	6/22/2011	Northeast of Crocker Reef	24° 55.126	80° 31.478	Low-relief hard-bottom (< 6 m)
213	6/22/2011	Northeast of Crocker Reef	24° 54.848	80° 30.929	Low-relief hard-bottom (6-15 m)
214	6/22/2011	Davis Reef**	24° 55.284	80° 30.287	Low-relief spur and groove (6-15 m)
215	6/22/2011	Davis Reef**	24° 55.378	80° 30.203	Low-relief spur and groove (6-15 m)
216	6/22/2011	Davis Reef**	24° 55.349	80° 30.349	Low-relief hard-bottom (< 6 m)
217	6/22/2011	Davis Reef**	24° 55.411	80° 30.298	Low-relief hard-bottom (< 6 m)
218	6/23/2011	Molasses Reef**	25° 00.511	80° 22.598	High-relief spur and groove
219	6/23/2011	Molasses Reef**	25° 00.455	80° 22.478	Low-relief spur and groove (6-15 m)
220	6/23/2011	Molasses Reef**	25° 00.482	80° 22.423	Low-relief spur and groove (6-15 m)
221	6/23/2011	Southwest of Molasses Reef	25° 00.333	80° 22.548	Low-relief hard-bottom (< 6 m)
222	6/23/2011	Molasses Reef Channel	25° 00.803	80° 24.982	Low-relief hard-bottom (< 6 m)
223	6/23/2011	Molasses Reef Channel	25° 00.625	80° 24.648	Offshore patch reef
224	6/23/2011	Molasses Reef Channel	25° 00.820	80° 24.281	Offshore patch reef
225	6/23/2011	Molasses Reef Channel	25° 01.251	80° 23.497	Offshore patch reef
226	6/23/2011	North of Davis Reef	25° 55.283	80° 30.490	Low-relief hard-bottom (< 6 m)
227	6/23/2011	North of Davis Reef	25° 55.600	80° 30.159	Low-relief hard-bottom (< 6 m)
228	6/23/2011	Southwest of Davis Reef	25° 55.148	80° 30.428	Low-relief spur and groove (6-15 m)
229	6/23/2011	Hen and Chickens Reef**	25° 56.139	80° 32.860	Mid-channel patch reef
230	6/23/2011	Hen and Chickens Reef**	25° 56.262	80° 32.847	Mid-channel patch reef
231	6/23/2011	Tavernier Rocks	25° 56.610	80° 33.411	Inshore patch reef
232	6/24/2011	Northeast of Davis Reef	25° 55.675	80° 29.866	Low-relief spur and groove (6-15 m)
233	6/24/2011	Northeast of Davis Reef	25° 56.229	80° 29.740	Patchy hard-bottom (6-15 m)
234	6/24/2011	North of Davis Reef	25° 56.563	80° 29.987	Offshore patch reef

Site #	Date	Site location	Latitude (N)	Longitude (W)	Habitat type
235	6/24/2011	North of Davis Reef	24° 56.433	80° 30.261	Offshore patch reef
236	6/24/2011	North of Davis Reef	24° 56.770	80° 30.219	Offshore patch reef
237	6/24/2011	North of Davis Reef	24° 56.937	80° 29.974	Offshore patch reef
238	6/24/2011	North of Davis Reef	24° 57.388	80° 30.151	Mid-channel patch reef
239	6/24/2011	Tavernier Rocks	24° 57.033	80° 33.308	Inshore patch reef
240	6/24/2011	Tavernier Rocks	24° 57.153	80° 32.914	Inshore patch reef
241	8/11/2011	Little Conch Reef	24° 56.572	80° 28.347	Low-relief hard-bottom (< 6 m)
242	8/11/2011	Little Conch Reef	24° 56.681	80° 28.185	Low-relief spur and groove (6-15 m)
243	8/11/2011	Conch Reef**	24° 57.176	80° 27.336	Low-relief spur and groove (6-15 m)
244	8/11/2011	Conch Reef**	24° 57.282	80° 27.156	Low-relief spur and groove (6-15 m)
245	8/11/2011	Conch Reef**	24° 57.014	80° 27.526	Low-relief spur and groove (6-15 m)
246	8/11/2011	Conch Reef**	24° 57.109	80° 27.470	Low-relief spur and groove (6-15 m)
247	8/11/2011	Conch Reef**	24° 57.114	80° 27.571	Low-relief hard-bottom (< 6 m)
248	8/11/2011	Conch Reef**	24° 57.302	80° 27.471	Low-relief hard-bottom (< 6 m)
249	8/12/2011	Conch Reef	24° 57.594	80° 27.718	Reef rubble
250	8/12/2011	Conch Reef	24° 57.663	80° 27.420	Low-relief hard-bottom (< 6 m)
251	8/12/2011	Conch Reef	24° 57.559	80° 27.586	Reef rubble
252	8/12/2011	NE of Conch Reef	24° 58.105	80° 26.697	Low-relief spur and groove (6-15 m)
253	8/12/2011	SW of Pickles Reef	24° 58.441	80° 26.016	Low-relief hard-bottom (< 6 m)
254	8/12/2011	West of Pickles Reef	24° 59.039	80° 26.541	Offshore patch reef
255	8/12/2011	West of Pickles Reef	24° 59.160	80° 26.444	Offshore patch reef
256	8/12/2011	West of Pickles Reef	24° 58.811	80° 26.485	Offshore patch reef
257	8/27/2011	Triangles area	25° 00.502	80° 27.525	Mid-channel patch reef
258	8/27/2011	West of Pickles Reef	24° 59.789	80° 27.583	Offshore patch reef
259	8/27/2011	West of Pickles Reef	24° 59.234	80° 27.157	Low-relief hard-bottom (< 6 m)
260	8/27/2011	West of Pickles Reef	24° 59.249	80° 27.145	Low-relief hard-bottom (< 6 m)
261	8/27/2011	West of Pickles Reef	24° 59.374	80° 26.869	Low-relief hard-bottom (< 6 m)
262	8/27/2011	West of Pickles Reef	24° 59.689	80° 26.781	Offshore patch reef
263	8/27/2011	NW of Pickles Reef	24° 59.961	80° 26.263	Offshore patch reef
264	8/27/2011	NW of Pickles Reef	25° 00.144	80° 25.391	Offshore patch reef
265	8/28/2011	Triangles area	25° 00.655	80° 25.676	Offshore patch reef
266	8/28/2011	Triangles area	25° 00.870	80° 25.639	Offshore patch reef
267	8/28/2011	Triangles area	25° 01.117	80° 25.559	Offshore patch reef
268	8/28/2011	South of Rodriguez Key	25° 01.785	80° 26.001	Mid-channel patch reef
269	8/28/2011	South of Rodriguez Key	25° 01.834	80° 25.598	Mid-channel patch reef
270	8/28/2011	Marker G37	25° 02.501	80° 25.491	Mid-channel patch reef
271	8/28/2011	Admiral's Reef	25° 02.422	80° 23.877	Mid-channel patch reef
272	9/05/2011	South Carysfort Reef**	25° 12.517	80° 13.158	High-relief spur and groove
273	9/05/2011	Elbow Reef**	25° 08.544	80° 15.504	High-relief spur and groove
274	9/05/2011	Horseshoe Reef	25° 08.394	80° 17.649	Inner line reef tract
275	9/05/2011	West of Mosquito Bank	25° 02.668	80° 24.371	Mid-channel patch reef
276	9/10/2011	Molasses Reef**	25° 00.591	80° 22.426	High-relief spur and groove
277	9/10/2011	Sand Island	25° 01.084	80° 22.097	High-relief spur and groove
278	9/10/2011	French Reef**	25° 02.026	80° 20.960	High-relief spur and groove
279	9/10/2011	West of French Reef	25° 01.961	80° 21.866	Offshore patch reef
280	9/10/2011	Grecian Rocks**	25° 06.536	80° 18.312	Inner line reef tract

Table 2-3. Physical data summary for sites surveyed in the upper Florida Keys National Marine Sanctuary during May-September 2011. Sites are arranged from NE to SW by habitat type and management zone. Asterisked sites (**) are Sanctuary no-take zones (SPAs or ROs). Mean \pm 1 SE transect depth, maximum vertical relief, and mean maximum vertical relief are based upon two 15-m x 1-m transects per site.

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
<i>Inshore and mid-channel patch reefs</i>					
Reference areas					
24 - Turtle Rocks	25° 18.055	80° 13.419	3.2 \pm 0.0	35	35 \pm 1
22 - Turtle Rocks	25° 17.477	80° 13.624	3.7 \pm 0.1	58	54 \pm 4
20 - Turtle Harbor	25° 16.041	80° 14.857	3.6 \pm 0.1	35	33 \pm 3
21 - Turtle Harbor	25° 15.611	80° 15.042	3.9 \pm 0.1	60	48 \pm 13
89 - Basin Hill Shoals	25° 14.484	80° 15.975	3.2 \pm 0.2	85	83 \pm 3
90 - Basin Hill Shoals	25° 14.412	80° 15.868	3.2 \pm 0.3	110	98 \pm 13
91 - Basin Hill Shoals	25° 14.087	80° 15.401	3.8 \pm 0.0	90	75 \pm 15
92 - Basin Hill Shoals	25° 13.940	80° 15.731	1.9 \pm 0.1	80	58 \pm 23
93 - Basin Hill Shoals	25° 13.519	80° 15.861	2.7 \pm 0.2	108	100 \pm 8
94 - Basin Hill Shoals	25° 12.617	80° 16.395	3.4 \pm 0.1	80	70 \pm 10
95 - South of Basin Hill Shoals	25° 11.937	80° 17.205	3.9 \pm 0.1	48	46 \pm 3
96 - South of Basin Hill Shoals	25° 11.496	80° 17.554	4.1 \pm 0.2	55	48 \pm 8
97 - South of Basin Hill Shoals	25° 10.893	80° 17.472	3.9 \pm 0.1	110	83 \pm 28
98 - South of Basin Hill Shoals	25° 10.740	80° 17.390	2.0 \pm 0.0	30	28 \pm 3
164 - Higdon's Reef	25° 08.447	80° 18.784	2.4 \pm 0.2	140	130 \pm 10
163 - Higdon's Reef	25° 08.086	80° 19.090	2.1 \pm 0.1	90	73 \pm 18
174 - North of Cannon Patch	25° 06.872	80° 20.681	4.6 \pm 0.2	150	120 \pm 30
176 - Northeast of Cannon Patch	25° 06.741	80° 19.822	6.1 \pm 0.0	200	163 \pm 38
175 - Northeast of Cannon Patch	25° 06.710	80° 19.724	5.3 \pm 0.2	150	135 \pm 15
1 - South of Cannon Patch	25° 06.522	80° 20.496	3.4 \pm 0.2	64	50 \pm 15
2 - South of Cannon Patch	25° 06.193	80° 20.619	3.0 \pm 0.2	65	60 \pm 5
179 - Cannon Patch	25° 06.189	80° 20.784	4.0 \pm 0.1	65	54 \pm 11
3 - South of Cannon Patch	25° 06.168	80° 20.684	2.8 \pm 0.1	60	52 \pm 9
178 - East of Cannon Patch	25° 06.066	80° 20.682	2.4 \pm 0.1	80	69 \pm 12
4 - South of Cannon Patch	25° 06.052	80° 20.726	3.9 \pm 0.1	65	60 \pm 5
177 - East of Cannon Patch	25° 06.001	80° 20.496	7.3 \pm 0.0	112	106 \pm 6
193 - Mosquito Bank	25° 04.759	80° 22.668	2.7 \pm 0.2	135	118 \pm 18
5 - Mosquito Bank	25° 04.511	80° 22.926	1.9 \pm 0.1	145	128 \pm 18
6 - Mosquito Bank	25° 04.443	80° 23.008	1.9 \pm 0.1	100	92 \pm 9
9 - Mosquito Bank	25° 04.280	80° 23.172	1.4 \pm 0.1	80	65 \pm 15
10 - Mosquito Bank	25° 04.265	80° 23.437	1.9 \pm 0.1	50	46 \pm 4
192 - Mosquito Bank	25° 04.168	80° 22.222	2.4 \pm 0.0	55	47 \pm 9
7 - Mosquito Bank	25° 04.142	80° 23.007	1.3 \pm 0.1	95	88 \pm 8
8 - Mosquito Bank	25° 04.048	80° 22.967	1.6 \pm 0.1	90	68 \pm 23
194 - Mosquito Bank	25° 03.988	80° 22.364	2.4 \pm 0.2	100	98 \pm 3
275 - West of Mosquito Bank	25° 02.668	80° 24.371	3.1 \pm 0.1	45	43 \pm 3
270 - Marker G37	25° 02.501	80° 25.491	2.4 \pm 0.1	75	59 \pm 16
271 - Admiral's Reef	25° 02.422	80° 23.877	2.7 \pm 0.1	40	38 \pm 3
269 - South of Rodriguez Key	25° 01.834	80° 25.598	4.0 \pm 0.0	50	49 \pm 1
199 - Three Sisters	25° 01.791	80° 23.873	5.6 \pm 0.1	115	105 \pm 10
268 - South of Rodriguez Key	25° 01.785	80° 26.001	4.6 \pm 0.0	55	48 \pm 8
13 - Triangles area	25° 01.343	80° 25.480	2.8 \pm 0.1	85	60 \pm 25
12 - Triangles area	25° 01.320	80° 26.400	3.3 \pm 0.2	65	58 \pm 8
257 - Triangles area	25° 00.502	80° 27.525	4.4 \pm 0.0	90	75 \pm 15
238 - North of Davis Reef	24° 57.388	80° 30.151	3.6 \pm 0.1	125	85 \pm 40
240 - Tavernier Rocks	24° 57.153	80° 32.914	3.1 \pm 0.1	195	185 \pm 10
239 - Tavernier Rocks	24° 57.033	80° 33.308	2.7 \pm 0.1	140	133 \pm 8
231 - Tavernier Rocks	24° 56.610	80° 33.411	3.4 \pm 0.1	160	138 \pm 23
143 - SW of Cheeca Rocks	24° 54.009	80° 37.055	3.4 \pm 0.1	185	168 \pm 18
144 - SW of Cheeca Rocks	24° 53.833	80° 37.207	4.0 \pm 0.0	220	160 \pm 60
Reference area total (50)			3.3 \pm 0.2	94 \pm 6	81 \pm 6

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
No-take zones					
230 - Hen and Chickens Reef**	24° 56.262	80° 56.262	5.3 ± 0.1	245	225 ± 20
229 - Hen and Chickens Reef**	24° 56.139	80° 56.139	5.6 ± 0.2	190	180 ± 10
142 - Cheeca Rocks**	24° 54.260	80° 54.260	3.5 ± 0.2	130	115 ± 15
141 - Cheeca Rocks**	24° 54.252	80° 54.252	2.9 ± 0.2	160	129 ± 32
No-take zone total (4)			4.3 ± 0.7	181 ± 25	162 ± 25
Mid-channel Patch Reef Total (54)			3.4 ± 0.2	101 ± 7	87 ± 6
<i>Offshore patch reefs</i>					
Reference areas					
35 - North of Carysfort Reef	25° 15.133	80° 12.740	5.0 ± 0.1	95	83 ± 13
37 - North of Carysfort Reef	25° 14.713	80° 13.053	3.4 ± 0.2	80	73 ± 8
38 - North of Carysfort Reef	25° 14.487	80° 12.722	6.5 ± 0.1	90	83 ± 8
86 - Basin Hill Shoals	25° 14.156	80° 14.535	2.6 ± 0.2	170	110 ± 60
87 - Basin Hill Shoals	25° 14.050	80° 14.905	3.4 ± 0.0	70	59 ± 11
54 - West of Carysfort Lighthouse	25° 13.730	80° 14.138	2.5 ± 0.1	80	65 ± 15
48 - West of Carysfort Lighthouse	25° 13.704	80° 13.293	2.9 ± 0.2	110	88 ± 23
51 - West of Carysfort Lighthouse	25° 13.613	80° 13.862	2.4 ± 0.1	85	65 ± 20
49 - West of Carysfort Lighthouse	25° 13.611	80° 13.517	3.8 ± 0.0	90	75 ± 15
50 - West of Carysfort Lighthouse	25° 13.508	80° 13.635	2.4 ± 0.0	95	75 ± 20
52 - West of Carysfort Lighthouse	25° 13.507	80° 14.117	2.5 ± 0.1	100	86 ± 14
88 - Basin Hill Shoals	25° 13.465	80° 15.007	2.0 ± 0.0	60	43 ± 18
53 - West of Carysfort Lighthouse	25° 13.410	80° 14.103	3.1 ± 0.2	80	68 ± 13
47 - NW of Carysfort Lighthouse	25° 13.161	80° 13.056	3.7 ± 0.2	60	53 ± 7
71 - West of South Carysfort Reef	25° 12.768	80° 13.766	3.4 ± 0.0	50	48 ± 3
62 - West of South Carysfort Reef	25° 12.752	80° 13.797	2.1 ± 0.2	75	64 ± 11
72 - West of South Carysfort Reef	25° 12.651	80° 12.736	2.7 ± 0.2	50	49 ± 2
74 - West of South Carysfort Reef	25° 12.536	80° 14.672	2.9 ± 0.0	45	44 ± 1
73 - West of South Carysfort Reef	25° 12.512	80° 14.040	4.3 ± 0.2	80	60 ± 20
61 - West of South Carysfort Reef	25° 12.478	80° 13.781	3.4 ± 0.2	93	74 ± 19
79 - North of Watsons Reef	25° 12.024	80° 14.563	3.9 ± 0.1	120	107 ± 14
80 - North of Watsons Reef	25° 12.002	80° 14.804	3.1 ± 0.1	105	73 ± 33
83 - North of Watsons Reef	25° 11.704	80° 14.891	3.7 ± 0.1	95	72 ± 23
82 - North of Watsons Reef	25° 11.676	80° 14.995	3.6 ± 0.1	90	85 ± 5
100 - Watsons Reef	25° 11.208	80° 14.462	5.8 ± 0.2	55	45 ± 10
85 - Watsons Reef	25° 11.068	80° 14.133	7.6 ± 0.0	55	49 ± 7
103 - Watsons Reef	25° 10.524	80° 14.894	11.8 ± 0.2	85	80 ± 5
104 - Watsons Reef	25° 10.435	80° 14.994	11.3 ± 0.0	55	53 ± 3
105 - Watsons Reef	25° 10.255	80° 15.491	5.6 ± 0.4	85	73 ± 13
106 - Watsons Reef	25° 10.067	80° 15.239	11.7 ± 0.2	130	120 ± 10
108 - Watsons Reef	25° 09.727	80° 15.512	10.0 ± 0.1	60	58 ± 3
110 - NW of Elbow Reef	25° 09.269	80° 16.065	4.2 ± 0.2	190	140 ± 50
118 - West of Elbow Reef	25° 08.817	80° 16.208	11.4 ± 0.1	62	56 ± 6
117 - West of Elbow Reef	25° 08.714	80° 16.308	9.4 ± 0.0	95	78 ± 18
125 - North of N-N Dry Rocks	25° 08.437	80° 17.191	8.4 ± 0.2	130	95 ± 35
127 - Inshore of North Dry Rocks	25° 07.765	80° 17.742	5.3 ± 0.2	70	59 ± 11
128 - Inshore of Dry Rocks	25° 07.696	80° 17.962	5.4 ± 0.1	120	90 ± 30
130 - East of Dry Rocks	25° 07.511	80° 17.547	9.1 ± 0.1	47	44 ± 4
162 - South of Three Heads Reef	25° 07.504	80° 18.564	3.8 ± 0.2	185	165 ± 20
166 - East of Grecian Rocks	25° 06.445	80° 18.161	7.0 ± 0.2	75	50 ± 25
172 - West of Grecian Rocks	25° 06.370	80° 19.099	3.2 ± 0.0	150	133 ± 18
173 - Southwest of Grecian Rocks	25° 05.954	80° 19.246	3.0 ± 0.2	50	48 ± 3
180 - White Bank	25° 04.304	80° 21.273	3.6 ± 0.1	95	80 ± 15
181 - White Bank	25° 04.108	80° 21.159	2.8 ± 0.2	40	38 ± 3
196 - White Bank/Dry Rocks	25° 02.875	80° 21.721	3.7 ± 0.1	150	135 ± 15
195 - N. of White Bank/Dry Rocks	25° 02.836	80° 22.134	3.4 ± 0.0	140	125 ± 15
191 - Northeast of French Reef	25° 02.651	80° 21.365	5.3 ± 0.2	55	45 ± 10
190 - Northeast of French Reef	25° 02.577	80° 21.331	8.5 ± 0.1	55	45 ± 10
197 - White Bank/Dry Rocks	25° 02.528	80° 22.309	3.9 ± 0.1	95	70 ± 25
279 - West of French Reef	25° 01.961	80° 21.866	8.2 ± 0.0	48	47 ± 2

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
198 - Molasses Reef Channel	25° 01.899	80° 23.331	3.6 ± 0.1	50	40 ± 10
15 - Wolf Reef	25° 01.311	80° 23.773	4.3 ± 0.2	96	71 ± 26
225 - Molasses Reef Channel	25° 01.251	80° 23.497	8.6 ± 0.1	95	95 ± 0
267 - Triangles area	25° 01.117	80° 25.559	3.4 ± 0.1	85	83 ± 3
14 - Molasses Reef Channel	25° 01.028	80° 24.054	4.8 ± 0.1	40	40 ± 0
266 - Triangles area	25° 00.870	80° 25.639	3.7 ± 0.1	70	68 ± 3
224 - Molasses Reef Channel	25° 00.820	80° 24.281	6.6 ± 0.1	150	140 ± 10
265 - Triangles area	25° 00.655	80° 25.676	4.1 ± 0.2	62	52 ± 11
223 - Molasses Reef Channel	25° 00.625	80° 24.648	5.9 ± 0.1	150	140 ± 10
264 - NW of Pickles Reef	25° 00.144	80° 25.391	4.8 ± 0.1	40	35 ± 5
263 - NW of Pickles Reef	24° 59.961	80° 26.263	3.7 ± 0.1	55	52 ± 4
258 - West of Pickles Reef	24° 59.789	80° 27.583	3.8 ± 0.0	138	112 ± 27
262 - West of Pickles Reef	24° 59.689	80° 26.781	4.6 ± 0.1	110	82 ± 29
11 - Inshore of Pickles Reef	24° 59.184	80° 26.096	7.8 ± 0.1	125	93 ± 33
255 - West of Pickles Reef	24° 59.160	80° 26.444	6.0 ± 0.1	60	49 ± 11
254 - West of Pickles Reef	24° 59.039	80° 26.541	6.6 ± 0.2	52	50 ± 2
256 - West of Pickles Reef	24° 58.811	80° 26.485	8.5 ± 0.0	60	51 ± 9
237 - North of Davis Reef	24° 56.937	80° 29.974	4.3 ± 0.0	74	54 ± 21
236 - North of Davis Reef	24° 56.770	80° 30.219	4.6 ± 0.0	45	43 ± 3
234 - North of Davis Reef	24° 56.563	80° 29.987	5.6 ± 0.2	52	48 ± 4
235 - North of Davis Reef	24° 56.433	80° 30.261	5.3 ± 0.1	55	54 ± 1
149 - NE of Alligator Reef	24° 53.666	80° 34.421	6.5 ± 0.1	90	90 ± 0
134 - NE of Alligator Reef	24° 52.398	80° 35.689	6.4 ± 0.2	33	33 ± 1
Reference area total (73)			5.2 ± 0.3	85 ± 4	72 ± 3
No-take zones					
46 - Carysfort Reef**	25° 13.651	80° 13.015	6.6 ± 0.1	95	93 ± 3
60 - SW Carysfort Reef SPA**	25° 12.266	80° 13.761	4.2 ± 0.1	95	78 ± 18
157 - Key Largo Dry Rocks**	25° 07.466	80° 18.038	5.3 ± 0.0	50	40 ± 10
158 - Key Largo Dry Rocks**	25° 07.363	80° 17.973	6.1 ± 0.0	70	60 ± 10
No-take zone total (4)			5.6 ± 0.5	78 ± 11	68 ± 11
Offshore Patch Reef Total (77)			5.2 ± 0.3	85 ± 4	72 ± 4
<i>Back reef rubble</i>					
Reference areas					
19 - Sand Island	25° 01.284	80° 22.130	2.1 ± 0.3	30	30 ± 0
18 - Sand Island	25° 01.219	80° 22.192	2.5 ± 0.2	14	12 ± 2
206 - Sand Island	25° 01.213	80° 22.174	2.6 ± 0.2	40	28 ± 13
63 - Pickles Reef	24° 59.480	80° 24.978	3.1 ± 0.2	20	20 ± 1
64 - Pickles Reef	24° 59.251	80° 25.210	3.4 ± 0.3	35	25 ± 10
249 - Conch Reef	24° 57.594	80° 27.718	1.7 ± 0.0	20	19 ± 1
251 - Conch Reef	24° 57.559	80° 27.586	2.0 ± 0.0	40	35 ± 5
209 - Crocker Reef	24° 54.630	80° 31.816	5.3 ± 0.0	25	20 ± 5
Reference area total (8)			2.8 ± 0.4	28 ± 3	24 ± 3
No-take zones					
42 - Carysfort Reef**	25° 13.568	80° 12.645	3.8 ± 0.0	50	37 ± 14
70 - Carysfort Reef**	25° 13.228	80° 12.766	6.0 ± 0.1	22	21 ± 1
115 - Elbow Reef**	25° 08.725	80° 15.657	2.3 ± 0.0	15	14 ± 2
116 - Elbow Reef**	25° 08.513	80° 15.996	3.9 ± 0.1	22	20 ± 2
203 - French Reef**	25° 02.266	80° 21.097	2.5 ± 0.1	10	8 ± 3
202 - French Reef**	25° 02.234	80° 21.179	2.7 ± 0.2	25	20 ± 5
17 - Molasses Reef**	25° 00.753	80° 22.548	1.5 ± 0.2	16	13 ± 3
16 - Molasses Reef**	25° 00.708	80° 22.691	2.2 ± 0.2	20	8 ± 8
139 - Alligator Reef**	24° 50.855	80° 37.519	5.0 ± 0.0	30	28 ± 3
140 - Alligator Reef**	24° 50.852	80° 37.516	2.6 ± 0.0	30	30 ± 0
No-take zone total (10)			3.3 ± 0.4	24 ± 4	20 ± 3
Back-reef rubble Total (18)			3.1 ± 0.3	26 ± 2	21 ± 2

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
<i>Low-relief hard-bottom (< 6 m)</i>					
Reference areas					
28 - Turtle Rocks	25° 16.718	80° 12.612	3.9 ± 0.1	35	28 ± 8
30 - Turtle Rocks	25° 16.521	80° 12.720	3.4 ± 0.1	48	37 ± 12
36 - North of Carysfort Reef	25° 15.059	80° 13.293	2.7 ± 0.1	45	36 ± 9
81 - North of Watsons Reef	25° 11.566	80° 15.277	3.1 ± 0.1	40	37 ± 4
84 - North of Watsons Reef	25° 11.468	80° 14.254	4.7 ± 0.0	40	38 ± 3
99 - Inshore of Watsons Reef	25° 10.633	80° 15.943	3.4 ± 0.2	70	55 ± 15
121 - Northwest of Elbow Reef	25° 09.219	80° 17.444	5.0 ± 0.0	95	72 ± 24
170 - West of Grecian Rocks	25° 06.889	80° 18.951	3.5 ± 0.2	60	55 ± 5
169 - West of Grecian Rocks	25° 06.643	80° 18.800	4.0 ± 0.1	35	28 ± 8
171 - West of Grecian Rocks	25° 06.470	80° 18.879	3.8 ± 0.2	80	78 ± 3
183 - Southwest of Grecian Rocks	25° 05.326	80° 19.145	5.9 ± 0.1	35	30 ± 5
184 - Southwest of Grecian Rocks	25° 05.183	80° 19.350	5.7 ± 0.1	20	20 ± 0
185 - North of Dixie Shoal	25° 04.274	80° 20.198	4.8 ± 0.1	20	18 ± 3
186 - North of Dixie Shoal	25° 03.817	80° 20.316	5.8 ± 0.0	35	35 ± 0
187 - Dixie Shoal	25° 03.327	80° 20.912	4.2 ± 0.1	40	38 ± 3
188 - Dixie Shoal	25° 03.056	80° 20.396	6.1 ± 0.2	30	28 ± 3
222 - Molasses Reef Channel	25° 00.803	80° 24.982	3.4 ± 0.0	50	33 ± 18
221 - Southwest of Molasses Reef	25° 00.333	80° 22.548	3.5 ± 0.2	45	45 ± 0
261 - West of Pickles Reef	24° 59.374	80° 26.869	4.1 ± 0.0	32	31 ± 1
260 - West of Pickles Reef	24° 59.249	80° 27.145	4.1 ± 0.2	50	40 ± 10
259 - West of Pickles Reef	24° 59.234	80° 27.157	4.1 ± 0.0	24	20 ± 4
253 - Southwest of Pickles Reef	24° 58.441	80° 26.016	6.2 ± 0.1	30	26 ± 4
250 - Conch Reef	24° 57.663	80° 27.420	2.2 ± 0.1	40	38 ± 3
241 - Little Conch Reef	24° 56.572	80° 28.347	5.8 ± 0.2	35	34 ± 2
227 - North of Davis Reef	24° 55.600	80° 30.159	2.9 ± 0.0	50	48 ± 3
226 - North of Davis Reef	24° 55.283	80° 30.490	6.6 ± 0.1	50	43 ± 8
211 - Inshore of Crocker Reef	24° 55.143	80° 32.113	5.6 ± 0.1	72	52 ± 20
212 - Northeast of Crocker Reef	24° 55.126	80° 31.478	6.5 ± 0.1	47	36 ± 11
210 - Inshore of Crocker Reef	24° 54.975	80° 32.710	6.2 ± 0.0	38	32 ± 7
151 - West of Crocker Reef	24° 54.634	80° 33.325	6.4 ± 0.2	40	33 ± 8
150 - West of Crocker Reef	24° 54.431	80° 33.825	6.6 ± 0.0	20	20 ± 0
146 - NE of Alligator Reef	24° 53.191	80° 35.114	5.6 ± 0.1	52	46 ± 6
136 - NE of Alligator Reef	24° 51.212	80° 36.828	5.9 ± 0.0	32	31 ± 1
Reference area total (33)			4.7 ± 0.2	43 ± 3	37 ± 2
No-take zones					
43 - Carysfort Reef**	25° 13.399	80° 12.772	3.4 ± 0.0	57	48 ± 9
59 - South of South Carysfort Reef**	25° 12.244	80° 13.394	4.0 ± 0.2	75	63 ± 13
248 - Conch Reef**	24° 57.302	80° 27.471	5.3 ± 0.2	70	60 ± 10
247 - Conch Reef**	24° 57.114	80° 27.571	4.4 ± 0.2	45	45 ± 0
217 - Davis Reef**	24° 55.411	80° 30.298	5.6 ± 0.2	50	49 ± 1
216 - Davis Reef**	24° 55.349	80° 30.349	6.6 ± 0.0	45	43 ± 2
138 - Alligator Reef**	24° 50.797	80° 37.353	4.4 ± 0.3	85	75 ± 10
137 - Alligator Reef**	24° 50.730	80° 37.460	6.2 ± 0.2	55	43 ± 13
No-take zone total (8)			5.0 ± 0.4	60 ± 5	53 ± 4
Shallow hard-bottom Total (41)			4.8 ± 0.2	47 ± 3	40 ± 2
<i>High-relief spur and groove</i>					
Reference areas					
23 - Turtle Reef	25° 17.603	80° 13.258	4.5 ± 0.2	110	90 ± 20
25 - Turtle Reef	25° 16.973	80° 12.412	4.0 ± 0.1	90	68 ± 23
32 - Turtle Rocks	25° 16.004	80° 12.713	3.8 ± 0.2	70	67 ± 4
33 - Turtle Rocks	25° 15.545	80° 12.630	3.4 ± 0.2	50	49 ± 1
76 - Maitland area	25° 11.878	80° 13.536	4.6 ± 0.2	105	99 ± 7
77 - Maitland area	25° 11.835	80° 13.589	3.5 ± 0.0	83	77 ± 7
78 - Maitland area	25° 11.796	80° 13.630	4.8 ± 0.1	110	105 ± 5
119 - Inshore of Watsons Reef	25° 09.839	80° 16.667	3.4 ± 0.0	70	65 ± 5

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
120 - Inshore of Watsons Reef	25° 09.547	80° 17.140	4.6 ± 0.0	100	90 ± 10
122 - North of Horseshoe Reef	25° 08.975	80° 17.501	4.9 ± 0.2	120	105 ± 15
123 - North of Horseshoe Reef	25° 08.857	80° 17.643	4.6 ± 0.0	85	83 ± 3
124 - North of Horseshoe Reef	25° 08.648	80° 17.657	5.4 ± 0.2	105	95 ± 10
274 - Horseshoe Reef	25° 08.394	80° 17.649	4.2 ± 0.2	185	138 ± 48
126 - North-North Dry Rocks	25° 08.207	80° 17.349	5.3 ± 0.2	120	115 ± 5
129 - North Dry Rocks	25° 07.749	80° 17.632	4.1 ± 0.2	145	130 ± 15
159 - North of Grecian Rocks	25° 06.880	80° 18.126	6.9 ± 0.2	170	150 ± 20
189 - Northeast of French Reef	25° 02.450	80° 20.711	3.5 ± 0.0	50	48 ± 3
205 - Sand Island	25° 01.134	80° 22.057	4.3 ± 0.2	200	190 ± 10
277 - Sand Island	25° 01.084	80° 22.097	4.0 ± 0.1	90	85 ± 5
67 - Pickles Reef	24° 59.458	80° 24.724	3.7 ± 0.2	70	53 ± 18
66 - Pickles Reef	24° 59.271	80° 24.876	3.4 ± 0.1	55	54 ± 1
65 - Pickles Reef	24° 58.973	80° 25.158	6.5 ± 0.1	52	51 ± 1
Reference area total (22)			4.4 ± 0.2	102 ± 9	91 ± 8
No-take zones					
44 - Carysfort Reef**	25° 13.350	80° 12.599	4.4 ± 0.0	180	160 ± 20
45 - Carysfort Reef**	25° 13.219	80° 12.632	4.8 ± 0.1	145	128 ± 18
57 - South Carysfort Reef**	25° 12.734	80° 13.051	4.9 ± 0.2	230	210 ± 20
272 - South Carysfort Reef**	25° 12.517	80° 13.158	2.1 ± 0.0	155	133 ± 23
58 - South Carysfort Reef**	25° 12.421	80° 13.241	3.4 ± 0.4	95	88 ± 8
114 - Elbow Reef**	25° 08.572	80° 15.475	3.7 ± 0.7	190	160 ± 30
273 - Elbow Reef**	25° 08.544	80° 15.504	4.3 ± 0.4	165	128 ± 38
113 - Elbow Reef**	25° 08.449	80° 15.534	5.7 ± 0.2	120	93 ± 28
156 - Key Largo Dry Rocks**	25° 07.461	80° 17.833	4.3 ± 0.1	95	78 ± 18
155 - Key Largo Dry Rocks**	25° 07.356	80° 17.927	3.4 ± 0.2	95	83 ± 13
160 - Grecian Rocks**	25° 06.665	80° 18.218	2.1 ± 0.0	110	108 ± 3
161 - Grecian Rocks**	25° 06.589	80° 18.270	2.9 ± 0.2	120	95 ± 25
280 - Grecian Rocks**	25° 06.536	80° 18.312	2.8 ± 0.2	110	105 ± 5
200 - French Reef**	25° 02.184	80° 20.837	5.9 ± 0.1	150	108 ± 43
278 - French Reef**	25° 02.026	80° 20.960	6.6 ± 0.1	290	220 ± 70
201 - French Reef**	25° 02.015	80° 21.000	5.9 ± 0.0	45	38 ± 8
207 - Molasses Reef**	25° 00.601	80° 22.439	5.7 ± 0.1	350	285 ± 65
276 - Molasses Reef**	25° 00.591	80° 22.426	6.5 ± 0.2	210	173 ± 38
218 - Molasses Reef**	25° 00.511	80° 22.598	4.4 ± 0.0	70	65 ± 5
No-take zone total (19)			4.4 ± 0.3	154 ± 17	129 ± 14
High-relief spur & groove Total (41)			4.4 ± 0.2	126 ± 10	109 ± 8
<i>Deeper fore-reef habitats (6-15 m)</i>					
Reference areas					
26 - Whistle Buoy	25° 17.596	80° 10.351	10.7 ± 0.1	95	75 ± 20
27 - Whistle Buoy	25° 17.411	80° 10.412	7.9 ± 0.3	50	41 ± 10
29 - Turtle Rocks	25° 16.638	80° 12.496	6.3 ± 0.1	65	60 ± 5
31 - Turtle Rocks	25° 16.338	80° 12.051	10.4 ± 0.1	55	53 ± 3
34 - East of Turtle Rocks	25° 15.228	80° 12.153	8.3 ± 0.1	49	40 ± 10
39 - North of Carysfort Reef	25° 14.252	80° 12.280	10.3 ± 0.1	70	68 ± 3
75 - South of South Carysfort Reef	25° 11.923	80° 13.395	10.4 ± 0.1	40	39 ± 1
101 - Watsons Reef	25° 11.004	80° 14.663	7.6 ± 0.0	55	53 ± 3
102 - Watsons Reef	25° 10.625	80° 14.433	8.8 ± 0.3	60	58 ± 3
107 - Watsons Reef	25° 09.893	80° 15.043	10.4 ± 0.2	60	53 ± 8
109 - North of Elbow Reef	25° 09.243	80° 15.417	9.1 ± 0.4	68	54 ± 14
112 - South of Elbow Reef	25° 08.100	80° 15.769	8.6 ± 0.1	53	48 ± 6
111 - South of Elbow Reef	25° 08.014	80° 16.153	10.9 ± 0.1	50	50 ± 0
165 - East of Dry Rocks	25° 07.214	80° 17.060	7.8 ± 0.2	50	48 ± 3
167 - Southeast of Grecian Rocks	25° 06.073	80° 17.730	7.8 ± 0.1	55	40 ± 15
168 - Southeast of Grecian Rocks	25° 06.060	80° 17.923	9.4 ± 0.1	40	40 ± 0
182 - Southwest of Grecian Rocks	25° 05.012	80° 18.856	7.3 ± 0.0	35	30 ± 5
204 - Southwest of French Reef	25° 01.757	80° 21.649	10.4 ± 0.1	45	43 ± 3

Site number/site location (no. sites)	Latitude (N)	Longitude (W)	Mean depth (m)	Max. vertical relief (cm)	Mean max. vertical relief (cm)
68 - Pickles Reef	24° 59.796	80° 24.231	6.9 ± 0.2	48	47 ± 2
252 - NE of Conch Reef	24° 58.105	80° 26.697	8.5 ± 0.3	50	40 ± 10
242 - Little Conch Reef	24° 56.681	80° 28.185	7.8 ± 0.2	85	68 ± 18
233 - Northeast of Davis Reef	24° 56.229	80° 29.740	6.8 ± 0.1	45	40 ± 5
232 - Northeast of Davis Reef	24° 55.675	80° 29.866	7.8 ± 0.1	53	49 ± 4
228 - Southwest of Davis Reef	24° 55.148	80° 30.428	11.1 ± 0.2	50	50 ± 0
213 - Northeast of Crocker Reef	24° 54.848	80° 30.929	6.7 ± 0.5	90	60 ± 30
208 - Crocker Reef	24° 54.374	80° 31.690	8.2 ± 0.2	40	37 ± 3
154 - SW of Crocker Reef	24° 54.125	80° 32.357	9.1 ± 0.1	42	33 ± 10
153 - SW of Crocker Reef	24° 54.082	80° 32.593	7.5 ± 0.0	38	32 ± 7
152 - SW of Crocker Reef	24° 53.871	80° 32.963	9.6 ± 0.0	40	35 ± 5
145 - South of Cheeca Rocks	24° 53.298	80° 36.841	6.6 ± 0.0	42	41 ± 1
148 - NE of Alligator Reef	24° 53.223	80° 34.484	6.2 ± 0.1	45	33 ± 13
147 - NE of Alligator Reef	24° 52.830	80° 34.787	7.8 ± 0.1	40	36 ± 4
131 - NE of Alligator Reef	24° 52.785	80° 34.026	8.4 ± 0.0	23	22 ± 2
133 - NE of Alligator Reef	24° 52.428	80° 35.476	7.1 ± 0.2	50	44 ± 6
132 - NE of Alligator Reef	24° 52.265	80° 34.854	8.3 ± 0.1	34	31 ± 3
135 - NE of Alligator Reef	24° 51.404	80° 36.633	7.2 ± 0.1	20	17 ± 3
Reference area total (36)			8.5 ± 0.2	51 ± 3	44 ± 2
No-take zones					
40 - Carysfort Reef**	25° 14.027	80° 12.616	8.4 ± 0.3	80	65 ± 15
41 - Carysfort Reef**	25° 13.919	80° 12.433	8.5 ± 0.3	110	78 ± 33
69 - Carysfort Reef**	25° 13.357	80° 12.541	7.6 ± 0.0	42	39 ± 4
56 - South Carysfort Reef**	25° 12.700	80° 12.717	5.8 ± 0.2	52	35 ± 17
55 - South Carysfort Reef**	25° 12.389	80° 12.885	8.8 ± 0.2	43	33 ± 10
220 - Molasses Reef**	25° 00.482	80° 22.423	12.9 ± 0.1	75	53 ± 23
219 - Molasses Reef**	25° 00.455	80° 22.478	12.0 ± 0.2	50	48 ± 3
244 - Conch Reef**	24° 57.282	80° 27.156	15.0 ± 0.1	70	45 ± 25
243 - Conch Reef**	24° 57.176	80° 27.336	13.3 ± 0.1	50	45 ± 6
246 - Conch Reef**	24° 57.109	80° 27.470	9.7 ± 0.1	60	58 ± 3
245 - Conch Reef**	24° 57.014	80° 27.526	11.2 ± 0.2	31	26 ± 6
215 - Davis Reef**	24° 55.378	80° 30.203	10.7 ± 0.0	42	39 ± 4
214 - Davis Reef**	24° 55.284	80° 30.287	11.0 ± 0.0	30	30 ± 0
No-take zone total (13)			10.4 ± 0.7	57 ± 6	45 ± 4
Deeper Fore-reef Total (49)			9.0 ± 0.3	52 ± 3	45 ± 2

Table 2-4. SCUBA diving effort for benthic coral reef surveys in the upper Florida Keys National Marine Sanctuary during May-September 2011.

Scientific Diver	Affiliation	No. of dives	Depth range (ft.)	Bottom time (hrs.)
Mark Chiappone	CMS/UNCW	245	5-53	125.60
Leanne Rutten	CMS/UNCW	248	6-51	131.77
Lonny Anderson	FKNMS-DARRP	58	7-37	25.50
Hatsue Bailey	FKNMS-DARRP	58	7-44	30.00
Sarah Fangman	GRNMS	110	6-44	3.08
Alicia Farrer	FKNMS-DARRP	5	9-24	49.75
Bill Goodwin	FKNMS-DARRP	38	10-38	15.63
Total all divers		762	5-53	381.33