Global Reef Expedition: San Andres Archipelago, Colombia

April 9-24, 2012

Field Report

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Front cover: Dr. Judy Lang conducting coral assessments within the *Montastraea* zone on a lagoonal reef at Bajo Nuevo. Photo by Andrew Bruckner.

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The information in this Field Report summarizes the operations conducted during the San Andres, Colombia research mission. Data sets have not been fully analyzed or finalized as of the writing of this report and only observations and general trends are presented. The Living Oceans Foundation cannot accept any legal responsibility or liability for any errors.

June 1, 2012.

Citation: Bruckner, A. (2012) Global Reef Expedition: San Andres Archipelago, Colombia. Field Report. April 9-24, 2012. Khaled bin Sultan Living Oceans Foundation, Landover MD. pp. 52

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SUMMARY

The Khaled bin Sultan Living Oceans Foundation (KSLOF), in partnership with CORALINA, completed a 15 day research mission (April 9-24) on three remote banks (Bajo Nuevo, Banco Alicia, Banco Serranilla) at the northern end of the San Andres archipelago. The research team included scientists from KSLOF; Colombian researchers from CORALINA, the Maritime Directorate (DIMAR), the Fisheries Secretariat, and the Fisheries and Agriculture Department; a Jamaican scientist from The Nature Conservancy; and international scientists from the National Coral Reef Institute (NCRI), the Florida Aquarium and the Atlantic and Gulf Rapid Reef Assessment Program. The main objectives of the mission were to 1) characterize and map the shallow marine habitats and 2) assess the diversity, abundance and health of important reef building corals, reef fishes and large motile invertebrates within these habitats. The non-invasive SCUBA surveys provided baseline data on the condition of coral reefs, with emphasis on organisms that are critical in maintaining healthy and resilient reef ecosystems, and on commercially important invertebrates and food fish species. Using a combination of satellite imagery and in situ groundtruthing, habitat types within shallow (<30 m) water were identified and characterized, and the spatial distribution and extent of different marine habitats was determined; these data will be used to develop detailed high resolution habitat maps for the three banks.

The researchers were divided into the groundtruthing team (2) operating out of the Twin V, the conch team (8) operating out of two tenders and the coral team (12) operating out of the Calcutta. A total of 520 dives were completed for a total of 452 hours underwater. This includes 93 coral reef assessment (82 hours) and 38 conch survey (27 hours) dives on Alice; 164 coral assessment (160 hours) and 45 conch survey (67.5 hours) dives on Nuevo; and 93 coral reef assessment (85 hours) and 21 conch survey (31.5 hours) dives.

The three banks contained coral reef habitats, sand flats and hardground areas with seagrass beds identified only on Serranilla. Each bank differed dramatically in structure. While many of the common species of reef fish and invertebrates overlapped between the banks, there were unique species. In total, 200 species of reef fish and 38 species of stony corals were identified.

Alice, a completely submerged bank, lacked true coral reefs, mangroves and seagrass beds. Most of the bank is a hardground with low relief ridges and small patches of sand.

- Coral communities developed on ridges, hardground areas and adjacent to depressions and grooves. Corals were mostly healthy, with little recent or old mortality. One high relief spur identified with extensive old mortality; coral skeletons covered with CCA
- Corals were often loosely attached (held in place by sponges/algae) or free living. Many species that normally attach firmly to the bottom consisted of “rolling stones” – round colonies covered with living tissue

- High cover of macroalgae, especially wave resistant brown algae (*Sargassum*, *Turbinaria*, *Stypopodium*, *Lobophora*) and green calcareous algae (*Halimeda*) and high cover of crustose coralline algae (CCA).
- High abundance and diversity of sponges
- Reef fish communities were diverse, with 124 species identified. Species dependent on seagrasses and mangroves, including groupers, snappers and grunts, were rare or absent

Serranilla had several small islands and a ridge at the seaward edge (northeast side). The site lacked mangroves, but had several small grassbeds. The outer perimeter of the bank sloped gradually into deep water, lacking a prominent shelf edge build up of corals. No true spur and groove reef system; corals colonized ridges in shallow water (2-8 m depth) that ran perpendicular to the exposed crest, with shallower areas and the deeper reef flat dominated by macroalgae or patches of shallow sand atop a hard ground. Behind the crest was a band of ancient coral rubble. Much of the bank consisted of hardground with low to moderate density of macroalgae and little relief. Hardground areas were separated by sand patches.

- Within the bank, approximately 5-10 km from the perimeter, were extensive small, well developed patch reefs separated by sand patches. These generally consisted of a reef framework built by fused *Porites* (finger corals) and *Agaricia* (lettuce coral) skeletons with patches of live branching, plating and massive corals. In some areas these had 30-40% live coral cover, including large (2-3 m diameter) massive brain corals and star corals, along with a high abundance and diversity of sponges. The corals were mostly healthy, with little disease.
- A few coral species seen here (*Agaricia tenufolia*, *Solenastrea bournoni*) were absent from other banks.
- Macroalgae (especially *Halimeda opuntia*) was overgrowing corals; lots of evidence of bioerosion (boring) and detached corals.
- The highest diversity and size classes of reef fish were observed on the ridges near the crest, as these contained multiple microhabitats and higher relief, while other areas were more uniform.
- Coral areas had higher numbers of lobster, but conch populations were smaller than at Alice.
- Reef fish diversity was higher than Alice, but lower than Nuevo, with 148 species identified. Higher diversity of parrotfish, and large schools of grunts and snappers were seen due to the nearby beds of seagrass.

Nuevo was mostly submerged, with a deep channel separating the bank into two areas and a small sand cay at the edge of the channel. There was a well developed reef crest encircling the northeast, east and south sides of the bank and extensive lagoonal reefs separated by sand patches. Grassbeds and mangroves were absent. A spur and groove reef system occurred at the

western end of the channel and in deeper areas on the southern end, while most of the other outer, exposed sites consisted of hardground areas with some coral development.

- Nuevo had the best developed coral areas, including prominent *Montastraea* reefs within the lagoon. These had high cover (30-70%) dominated by large mountainous star coral (3-5 m diameter) and lobate star coral colonies interspersed with other large massive corals.
- Large patches of endangered staghorn coral (*A. cervicornis*) were found within lagoonal areas. Shallow reef crest and reef flat communities were constructed of elkhorn coral frameworks and isolated living *A. palmata* colonies were seen.
- High prevalence of diseases (especially white plague and yellow band disease) were seen on the massive corals (primarily *Montastraea*) within the lagoon. Reefs varied in health with some showing predominantly old mortality (corals dying in several "waves"), some showing both recent and old, and some showing only extensive recent mortality.
- Some reefs had high cover of macroalgae, while others had little macroalgae. Three spot damselfish were common and often created algal lawns on living corals.
- Bajo Nuevo had the highest diversity of reef fish, with 165 species identified. Predators included a few larger groupers, barracuda, nurse sharks and other predators on each reef.
- Conch and lobster populations were fairly small, with no large aggregates seen.
- Evidence of fishing was apparent, including large numbers of recently cleaned conch, fish traps and a foreign (Nicaragua) fishing boat with 62 divers on board.

BACKGROUND

The San Andres archipelago covers an area of more than 25,000 km^2, and includes remote islands, submerged banks, atoll-like structures and coral reefs surrounded by trenches and faults up to 4500 m deep. It is located in the southwestern Caribbean. The northern end of the archipelago share borders and resources with Nicaragua, Honduras and Jamaica. Through the 1993 Maritime Delimitation Agreement between Jamaica and Colombia, fish stocks and management are shared within a Joint Regime Area which includes Alice Bank, while the maritime area of Serranilla and Nuevo are excluded. A large portion of the San Andres Archipelago has been recently included in the Seaflower Marine Protected Area, the largest MPA in the Caribbean. While the MPA does not include the three areas surveyed during this mission, CORALINA is leading an initiative to declare other zones within the archipelago as World Heritage Sites.

Serranilla, Alice and Nuevo banks were identified as high priorities for CORALINA and were selected as research sites for the Global Reef Expedition for the following reasons: 1) they represent the most isolated and distant reef structures in the Caribbean; 2) they are on the same platform (Nicaragua Rise) as Pedro Bank and share similarities in structure, while lacking many of the human impacts (e.g. heavy fishing pressure) affecting Pedro Bank; and 3) the strategic location and connectivity patterns between insular and continental environments of the region suggest they have the potential to provide a larval supply to Central America, Pedro Bank and other reefs within the San Andres Archipelago.

The research conducted by the Khaled bin Sultan Living Oceans Foundation focused on habitat mapping and coral reef assessments. SCUBA assessments were used to acquire information on: a) zonation patterns and population dynamics of coral taxa and other organisms inhabiting the coral reefs and associated habitats; b) the current status of these ecosystems; c) threats; and d) the health and resilience of these communities. Assessments focused on corals, commercially important reef fishes and invertebrates including conch and lobster, ecologically important species (including herbivores, nuisance species, algae), and substrate cover, type and condition. The second component involved groundtruthing to validate and update existing habitat maps and create new habitat maps and bathymetric maps for the study locations. This included a) an evaluation of existing habitat classes and possible revision and/or addition of habitat classes to correspond to other classification schemes used in the Caribbean; b) the spatial distribution and extent of each habitat type; and c) the bathymetry.

1. Location of Research Sites

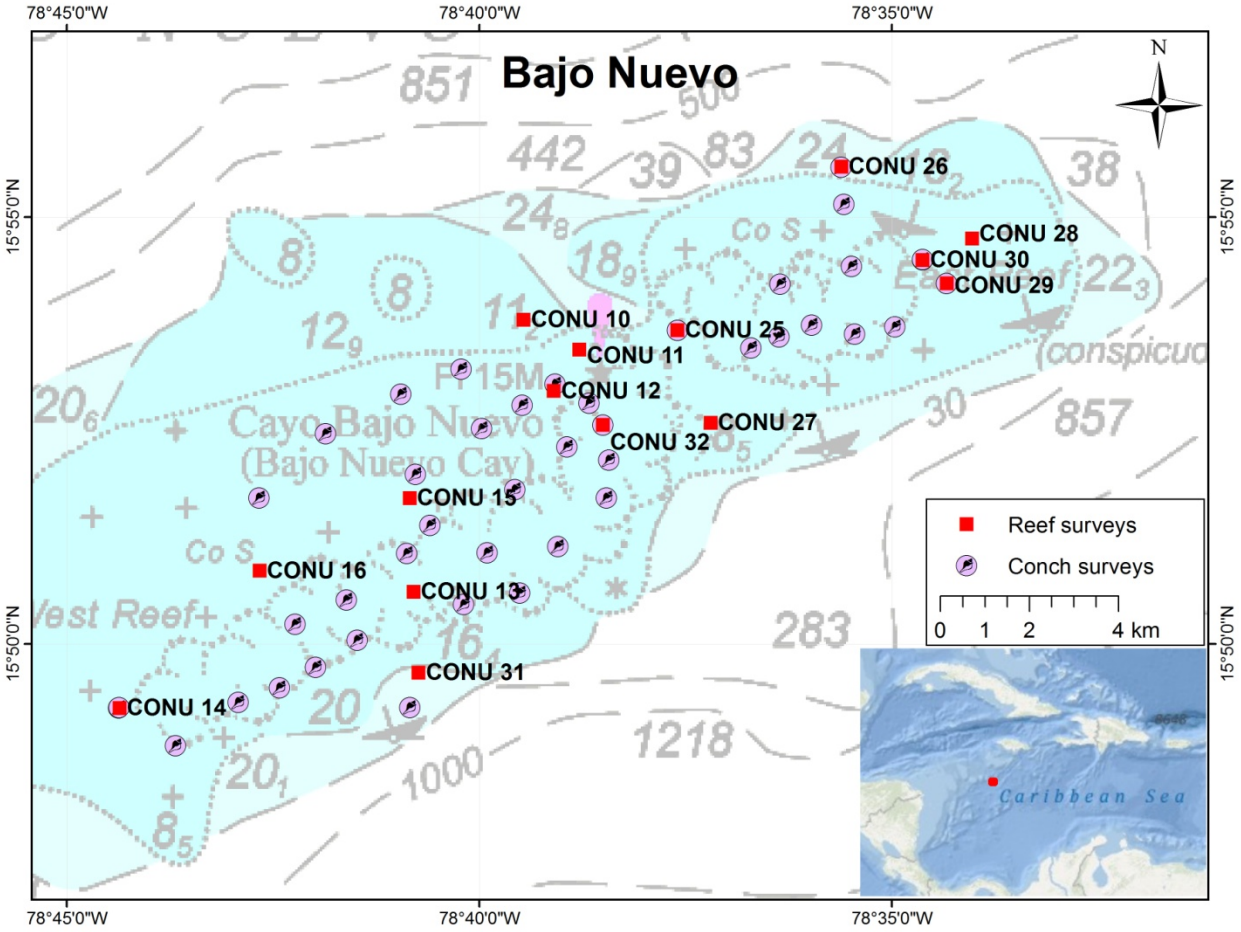

Fig. 1 Location of AGRRA reef surveys (red squares) and queen conch surveys (pink circles) on Bajo Nuevo.

Bajo Nuevo (New Bank) is a shallow platform located 110 km east from Alice Shoal and 235 km southwest from Jamaica. The carbonate platform consists of two separate banks divided by a deep channel of 1.4 km in width and up to 40-45 m depth. The eastern sides of both banks are marked by pronounced emergent reef crests that protect shallow reef environments.

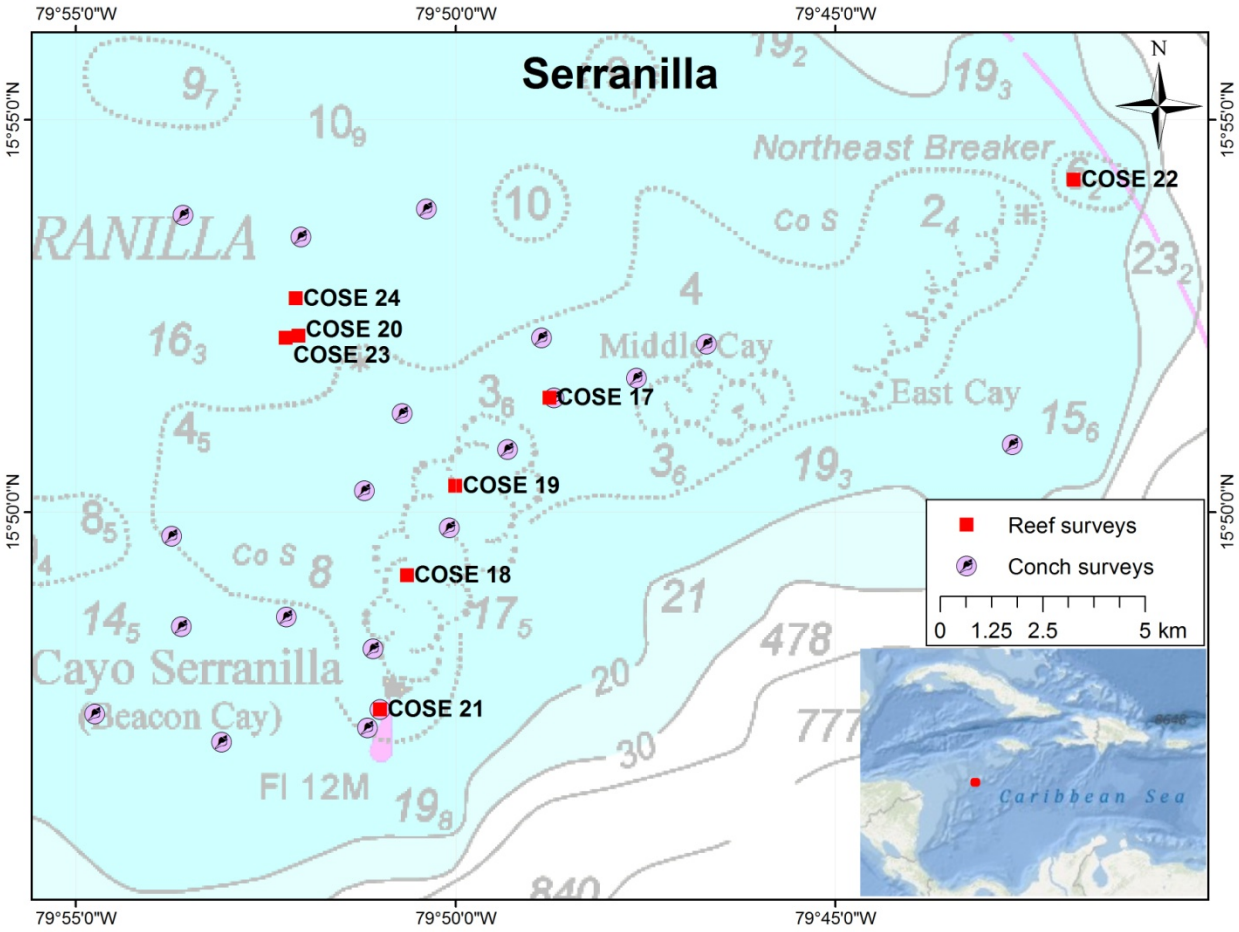

Fig. 2. Location of AGRRA reef surveys (red squares) and queen conch surveys (pink circles) on Serranilla.

Serranilla Bank (40 km in length and 32 km in width; 1,200 km² area) is carbonate platform located 110 km west of Bajo Nuevo (New Bank) and around 400 km northeast from Isla de San Andrés. Most of the bank is in deep water except for the southeastern portion which contains shallow submerged reef environments, emergent reefs and a few low-lying cays on the eastern side of the bank (Beacon Cay, West Breaker, Middle Cay, and East Cay).

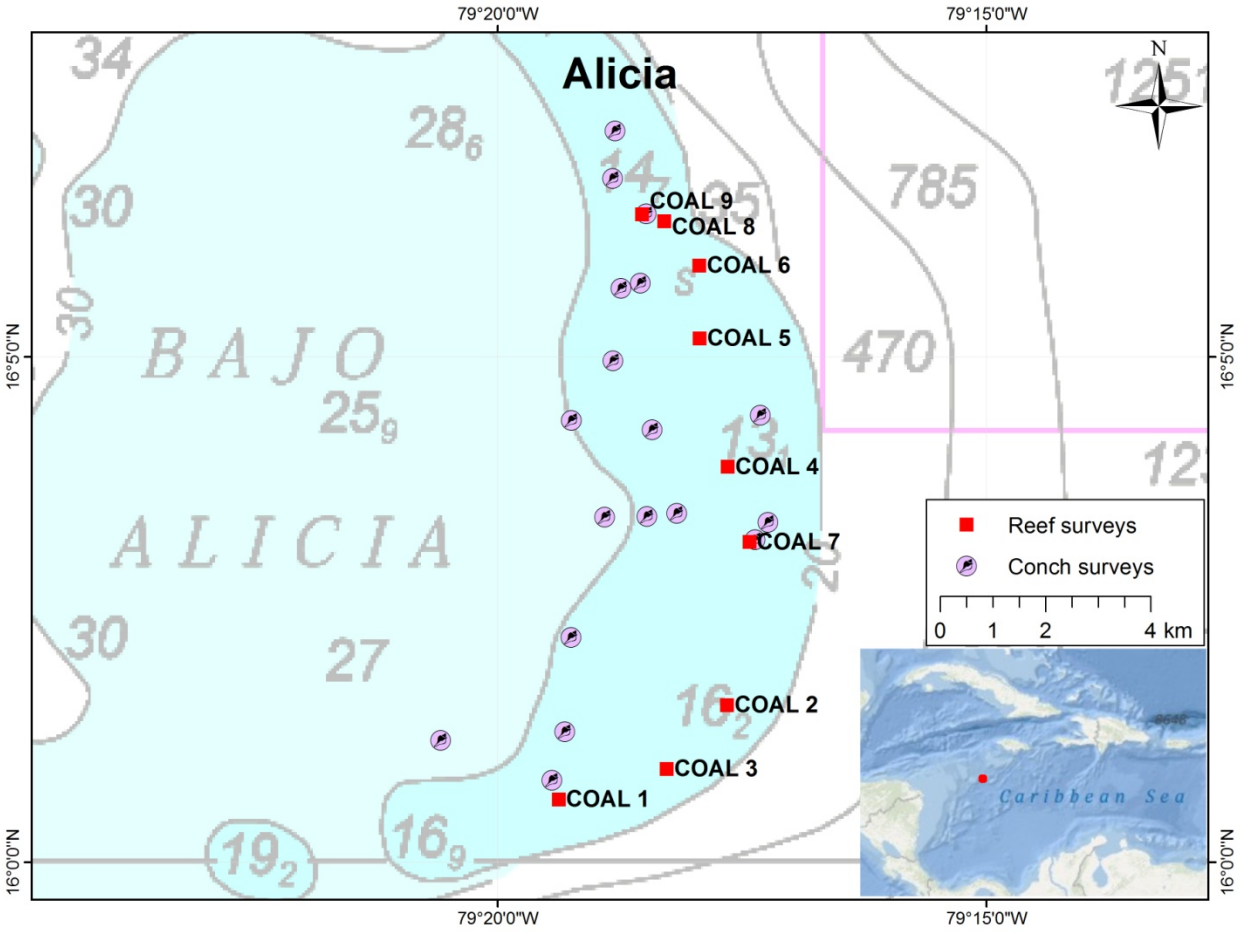

Fig. 3. Location of AGRRA reef surveys (red squares) and queen conch surveys (pink circles) on Bajo Alicia.

Alice Shoal (Banco Alicia or Bajo Alicia) is a completely submerged bank with no emergent reefs or islets. It is located northwest of Serranilla Bank, The bank is approximately 16 km wide and covers an area of about 50 km². It is co-managed by Colombia and Jamaica.

Table 1. Location of AGRRA assessments.

ID	Long_W	Lat_N	Date	Depth_m	Zone
COAL 1	79.322910	16.010370	4/12/2012	19	windward Hardground
COAL 2	79.294230	16.025930	4/12/2012	15	windward Hardground
COAL 3	79.304500	16.015400	4/12/2012	15	windward Hardground
COAL 4	79.294100	16.065200	4/13/2012	19	windward Hardground
COAL 5	79.298870	16.086380	4/13/2012	18	windward Hardground
COAL 6	79.298930	16.098380	4/13/2012	17	windward spur and groove
COAL 7	79.290400	16.052800	4/14/2012	17	windward Hardground
COAL 8	79.304900	16.105700	4/14/2012	15	windward spur and groove
COAL 9	79.308700	16.106800	4/14/2012	18	windward Hardground
CONU 10	78.657700	15.896600	4/15/2012	15	fore reef spur and groove
CONU 11	78.646400	15.890800	4/16/2012	13	fore reef
CONU 12	78.651600	15.882700	4/16/2012	13	lagoonal patch reef
CONU 13	78.679900	15.843500	4/16/2012	9	lagoonal patch reef
CONU 14	78.739300	15.820800	4/17/2012	19	lagoonal patch reef
CONU 15	78.680700	15.861800	4/17/2012	8	lagoonal patch reef
CONU 16	78.711000	15.847600	4/17/2012	19	lagoonal patch reef
COSE 17	79.812700	15.857600	4/18/2012	9	lagoonal ridge
COSE 18	79.844000	15.819900	4/18/2012	7	windward ridge
COSE 19	79.833400	15.838900	4/18/2012	11	lagoonal ridge
COSE 20	79.867800	15.870800	4/19/2012	15	lagoonal patch reef
COSE 21	79.849900	15.791400	4/19/2012	12	fore reef
COSE 22	79.697700	15.903900	4/20/2012	12	windward ridge
COSE 23	79.870600	15.870300	4/20/2012	19	lagoonal patch reef
COSE 24	79.868400	15.878700	4/20/2012	21	lagoonal patch reef
CONU 25	78.626600	15.894600	4/21/2012	24	channel bottom
CONU 26	78.593500	15.926500	4/21/2012	20	windward forereef
CONU 27	78.619900	15.876500	4/21/2012	23	hardground south end of channel
CONU 28	78.567100	15.912500	4/22/2012	9	lagoonal reticulate Montastraea reef
CONU 29	78.572200	15.903700	4/22/2012	12	lagoonal reticulate Montastraea reef
CONU 30	78.577100	15.908300	4/22/2012	14	lagoonal reticulate Montastraea reef
CONU 31	78.678900	15.827700	4/23/2012	25	windward fore reef
CONU 32	78.641700	15.876100	4/23/2012	13	lagoon patch reef

Table 2. Location of *Strombus gigas* (queen conch) surveys.

Long_W	Lat_N	Location	ID	Date	Estacion	Depth_m
-79.321890	16.021560	Alicia	QC1	4/12/2012	26	27.0
-79.343050	16.020150	Alicia	QC2	4/12/2012	27	28.0
-79.324070	16.013580	Alicia	QC3	4/12/2012	1	23.0
-79.320730	16.072900	Alicia	QC4	4/12/2012	23	28.0
-79.320730	16.072900	Alicia	QC5	4/12/2012	10	25.0
-79.313300	16.120600	Alicia	QC6	4/13/2012	4	21.0
-79.313710	16.112740	Alicia	QC7	4/13/2012	5	19.0
-79.309020	16.095510	Alicia	QC8	4/13/2012	6	18.0
-79.315100	16.056960	Alicia	QC9	4/13/2012	21	30.0
-79.307860	16.057070	Alicia	QC10	4/13/2012	9	22.0
-79.313640	16.082710	Alicia	QC11	4/13/2012	3	23.0
-79.307010	16.071320	Alicia	QC12	4/13/2012	2	20.0
-79.288530	16.073720	Alicia	QC13	4/13/2012	15	24.0
-79.287280	16.056080	Alicia	QC14	4/13/2012	16	16.0
-79.302810	16.057580	Alicia	QC15	4/13/2012	8	25.0
-79.289430	16.053220	Alicia	QC16	4/13/2012	13	17.4
-79.312290	16.094670	Alicia	QC17	4/14/2012	14	26.0
-79.320820	16.037120	Alicia	QC18	4/14/2012	23	24.5
-79.308020	16.106920	Alicia	QC19	4/14/2012	7	16.5
-78.644470	15.880360	Bajo Nuevo	QC20	4/15/2012	64	9.1
-78.640460	15.869250	Bajo Nuevo	QC21	4/15/2012	66	3.5
-78.682470	15.882100	Bajo Nuevo	QC22	4/15/2012	68	19
-78.648970	15.871810	Bajo Nuevo	QC23	4/15/2012	46	16
-78.657970	15.879940	Bajo Nuevo	QC24	4/15/2012	16	15.3
-78.697700	15.874370	Bajo Nuevo	QC25	4/16/2012	51	15
-78.679530	15.866490	Bajo Nuevo	QC26	4/16/2012	5	10
-78.676610	15.856520	Bajo Nuevo	QC27	4/16/2012	6	19.6
-78.681330	15.850980	Bajo Nuevo	QC28	4/16/2012	43	21
-78.665080	15.851130	Bajo Nuevo	QC29	4/16/2012	44	10
-78.658460	15.843310	Bajo Nuevo	QC30	4/16/2012	13	3
-78.669850	15.841010	Bajo Nuevo	QC31	4/16/2012	37	4
-78.680440	15.838360	Bajo Nuevo	QC32	4/16/2012	36	5
-78.739460	15.820860	Bajo Nuevo	QC33	4/16/2012	Nuevo	13.3
-78.715330	15.821900	Bajo Nuevo	QC34	4/17/2012	33	15
-78.699720	15.828750	Bajo Nuevo	QC35	4/17/2012	2	6
-78.691280	15.834070	Bajo Nuevo	QC36	4/17/2012	38	8
-78.728030	15.813440	Bajo Nuevo	QC37	4/17/2012	12	7
-78.707030	15.824760	Bajo Nuevo	QC38	4/17/2012	1	5
-78.703850	15.837160	Bajo Nuevo	QC39	4/17/2012	42	12
-78.693450	15.841900	Bajo Nuevo	QC40	4/17/2012	41	14
-78.739420	15.820880	Bajo Nuevo	QC41	4/17/2012	Nuevo1	21.8
-78.680670	15.820880	Bajo Nuevo	QC42	4/17/2012	Nuevo2	12.9
-78.711150	15.861850	Bajo Nuevo	QC43	4/17/2012	Nuevo3	19

-79.893130	15.896430	Serranilla	QC44	4/18/2012	40	21
-79.867220	15.891760	Serranilla	QC45	4/18/2012	21	20.5
-79.839730	15.897700	Serranilla	QC46	4/18/2012	41	23
-79.814450	15.870340	Serranilla	QC47	4/18/2012	19	14
-79.778280	15.869000	Serranilla	QC48	4/18/2012	62	9
-79.793620	15.861790	Serranilla	QC49	4/18/2012	61	11
-79.811720	15.857610	Serranilla	QC50	4/18/2012	Nuevo	
-79.711150	15.847650	Serranilla	QC51	4/19/2012	Nuevo 1	15
-79.849900	15.791400	Serranilla	QC52	4/19/2012	Nuevo 2	
-79.853310	15.837860	Serranilla	QC53	4/19/2012	3	11
-79.895590	15.828210	Serranilla	QC54	4/19/2012	2	19
-79.870410	15.811030	Serranilla	QC55	4/19/2012	64	16
-79.852630	15.787480	Serranilla	QC56	4/19/2012	8	18
-79.851410	15.804290	Serranilla	QC57	4/19/2012	7	14
-79.851410	15.804290	Serranilla	QC58	4/19/2012	63	9
-79.834660	15.830020	Serranilla	QC59	4/19/2012	6	5
-79.821910	15.846660	Serranilla	QC60	4/19/2012	5	10
-79.912500	15.790460	Serranilla	QC61	4/20/2012	27	19.1
-79.884670	15.784510	Serranilla	QC62	4/20/2012	28	16.4
-79.893480	15.809030	Serranilla	QC63	4/20/2012	65	18
-79.845020	15.854320	Serranilla	QC64	4/20/2012	4	12.1
-78.590830	15.893830	Bajo Nuevo	QC65	4/21/2012	54	12
-78.582740	15.895230	Bajo Nuevo	QC66	4/21/2012	25	13
-78.591500	15.907060	Bajo Nuevo	QC67	4/21/2012	26	8
-78.593010	15.919200	Bajo Nuevo	QC68	4/21/2012	30	7
-78.670340	15.887000	Bajo Nuevo	QC69	4/21/2012	50	13
-78.651340	15.884050	Bajo Nuevo	QC70	4/21/2012	65	8
-78.626600	15.894600	Bajo Nuevo	QC71	4/21/2012	Nuevo 4	23.9
-78.593570	15.926450	Bajo Nuevo	QC72	4/21/2012	Nuevo 5	20.7
-78.666180	15.875400	Bajo Nuevo	QC73	4/22/2012	Nuevo 6	11.9
-78.572250	15.903760	Bajo Nuevo	QC74	4/22/2012	Nuevo 7	15
-78.577080	15.908320	Bajo Nuevo	QC75	4/22/2012	Nuevo 8	18
-78.605870	15.903580	Bajo Nuevo	QC76	4/22/2012	24	19
-78.599540	15.895620	Bajo Nuevo	QC77	4/22/2012	23	14
-78.606080	15.893290	Bajo Nuevo	QC78	4/22/2012	57	15
-78.611760	15.891140	Bajo Nuevo	QC79	4/22/2012	55	13
-78.659460	15.863460	Bajo Nuevo	QC80	4/23/2012	45	5
-78.650770	15.852340	Bajo Nuevo	QC81	4/23/2012	39	7
-78.640950	15.861850	Bajo Nuevo	QC82	4/23/2012	14	2
-78.636660	15.878530	Bajo Nuevo	QC83	4/23/2012	40	2.5
-78.577090	15.908380	Bajo Nuevo	QC84	4/23/2012	Nuevo 9	28.7
-78.641650	15.876110	Bajo Nuevo	QC85	4/23/2012	Nuevo 10	20

2. General Methodology

Mapping and groundtruthing

Using multispectral satellite imagery obtained from DigitalGlobe's WorldView 2 satellite, high resolution bathymetric maps and habitat maps will be created for shallow coral communities. Groundtruthing efforts necessary to develop these maps focused on continuous bathymetry measures, drop camera analysis, characterization of sediment and hard substrates and habitat features using two acoustic sub-bottom profiling equipment (Stratabox and Hydrobox), and fine scale photo-transect surveys.

Satellite imagery

WorldView 2 satellite imagery provided an aerial overview of the study areas. The satellite images had a spatial resolution of 2-m by 2-m (i.e., each pixel covers a 4-m^2 area) enabling real-time navigation in the field to locate features of interest and to avoid dangerous features (e.g., emergent reefs). In order to navigate, the team used the scenes in conjunction with a differential GPS device (dGPS). The imagery is being used in conjunction with ground truth data to create bathymetric and benthic habitat maps. We acquired nearly 3200 sq. km. of satellite imagery for the three study locations (Table 7).

Benthic Video

An underwater video camera attached to a cable, called a drop-cam, was used to gather video on the benthic composition at each survey site. At each point, the drop-cam was deployed from the survey boat enabling it to 'fly' along the sea floor as it records video for 15 to 60 seconds. During this time, the laptop operator watched the video in real-time and guided the drop-camera operator to raise or lower the camera. In this manner, we prevented damage to marine life. The video was recorded on a ruggedized laptop, and the geographic position, time, date, boat heading, and boat speed were burned into the video. Drop-cam deployment was limited to depths above 40 m due to the limited length of the tether cable (50 m). The acquired videos will be used in the creation of the benthic habitat maps by providing the necessary information for developing the habitat classification scheme and training of classification models.

Acoustic depth soundings

Depth soundings were gathered along transects between survey sites using Hydrobox, a single-beam acoustic transducer, developed by Syqwest. The instrument emits 3 pings per second. Depths were estimated based on the time the return-pulse's reaches the sounder's head. Geopositional data are simultaneously acquired by the dGPS unit. The estimated depth values and their geographic location were recorded in the ruggedized laptop. The soundings were used to train a water-depth derivation model, which is based on the spectral attenuation of light in the water column. The final topographic map will have the same spatial resolution as the satellite imagery.

Acoustic sub-bottom

Profiles of the seafloor's sub-bottom were also gathered along transects using the Stratabox acoustic sounder, also developed by Syqwest. Similar to the bathymetric soundings, the sub-bottom profile emits an acoustic ping which reflects off the seafloor. However, the pulse has a lower frequency (3.5 Khz) enabling it to penetrate the seafloor. The instrument provides observations on stratal geometry beneath the seafloor along the transect lines, allowing estimates of Holocene reef-growth and sediment accumulation to be made. Geopositional data for each ping was simultaneously acquired by dGPS unit; it was recorded in the SEGY file. Profiles are run shore-perpendicular to capture the geometry of the bank flanks and span a depth range of 300 m to 5 m. Total transect length varies with the slope's angle; steeper slopes resulted in shorter transect lines.

Coral reef assessments

Fish surveys

For fish, abundance and size structure were collected for about 70 species of fishes, targeting species that have a major functional role on reefs or are major fisheries targets. Reef fishes were assessed along 2 m X 30 m belt transects. A T square marked in 5 cm increments was used to gauge fish size. A minimum of 6 transects were conducted by each "fish" diver per site. Other indicators recorded along belt transects (both coral and fish transects) included large motile invertebrates (urchins, octopus, lobster, large crabs, queen conch, sea cucumbers).

Benthic cover.

Cover of major functional groups were assessed along 10 m transects using either recorded observations and/or photographic assessments. For recorded observations, a point intercept method was used, whereas the organism and substrate was identified every 10 cm along a 10 m transects (total 100 points/transect), with a minimum of six transects examined per location. Corals were identified to species; sponges and other invertebrates were identified to class and growth form, or species for specific indicator organisms; five groups of algae including macroalgae, crustose coralline algae, fine turfs, turf algae with sediment and cyanobacteria were differentiated and certain macroalgae were identified to genus. Substrate type was identified as hardground, sand, mud, rubble, recently dead coral, bleached coral, and live coral

An additional photographic assessment was also conducted as follows: A 10 m long transect tape was extended along depth contours at 20, 15, 10 and 5 m depth. Continuous digital still photographs were taken from of the reef substrate from a height of approximately 0.6-0.75 meters above the substrate, using a one meter bar divided into 5 cm increments placed perpendicular to the transect tape as a scale bar. Approximately 20 photographs were taken per transect to allow for overlap between adjacent images with two photo transects (each 10 m in length) per depth. Images were downloaded onto a computer, and benthic community composition, coral cover and cover of other organisms and substrate type will be determined by

recording the benthic attribute located directly below a random points with 30-50 points per photograph, using Coral Point Count (CPCE) software developed by the National Coral Reef Institute (NCRI). This software also allows you to trace the outline of individual corals to determine their planar surface area.

Coral assessments

Five measures were recorded for corals: 1) benthic cover (see above); 2) coral diversity and abundance (by species); 3) coral size class distributions (by species); 4) recruitment; and 5) coral condition, including extent of mortality and causes of recent mortality (such as signs of coral disease and predation. All coral assessments were conducted using 10 m X 1 m belt transects. Other indicators recorded along belt transects included large motile invertebrates (urchins, octopus, lobster, large crabs, sea cucumbers); cover and biomass of algae (fleshy macroalgae, turf algae and crustose coralline algae); and prevalence of nuisance species.

Assessment of corals smaller than 4 cm was done using a minimum of five 0.25 m^2 quadrats per transect, with each quadrat located at fixed, predetermined intervals (e.g. 2, 4, 6, 8, 10 m), alternating between right and left side of the transect. Recruits were identified in both point intercept surveys and belt transects. Recruits were divided into two categories: corals up to 2 cm diameter and larger corals, 2-3.9 cm diameter. In addition, all corals settling on dead skeletal surfaces of colonies identified within the belt transects were recorded separately, with a single measure of diameter and an estimate of percent mortality made for those recruits exhibiting partial mortality.

Visual estimates of tissue loss was recorded for each colony over 4 cm in diameter using a 1 m bar marked in 1 cm increments for scale,. If the coral exhibited tissue loss, estimates of the amount of remaining tissue, percent that recently died and percent that died long ago were made based on the entire colony surface. Tissue loss is categorized as recent mortality (occurring within the last 1-5 days), transitional mortality (filamentous green algae and diatom colonization, 6-30 days) and old mortality (>30 days). For each coral with partial or whole colony mortality, the cause of mortality was identified if possible. The diagnosis included an assessment of the type of disease, extent of bleaching, predation, competition, overgrowth or other cause of mortality. Each coral was first carefully examined to identify cryptic predators. Lesions were initially diagnosed into four categories: recent tissue loss, skeletal damage, color change, and unusual growth patterns; an individual colony could have multiple characteristics (e.g. color change and recent tissue loss).

Invertebrate assessments

Specific *Strombus gigas* surveys were conducted using belt transects within permanent sites established in 2011 using the same methodology as applied during previous surveys. Queen conch were also identified along coral belt transects and point intercept surveys within coral sites. A roving survey was also used within coral sites to quantify lobster, crab, sea cucumber and sea urchin abundances.

Fish herbivory and predation studies

A primary research component focused on the collection of information needed to predict the intensity of grazing on reefs as a function of fish density, diversity and benthic composition. These data provide a perspective on the potential resilience compared to other areas in the Caribbean. Components included an assessment of benthic community composition, density of coral juveniles, abundance and size structure of herbivorous fishes and invertebrates, and behavioral studies focusing on feeding behavior of herbivores. In addition to belt transects described above for fish and benthic communities, 10 mini-video cameras were deployed during one dive each day to 1) record grazing intensity on substrate; 2) to characterize relationships between fish grazing and benthic community assemblages to answer questions on intra-habitat variability and the use of habitats as surrogates of biodiversity, and 3) to determine the processes controlling populations and communities of fish and corals.

Oceanographic measures

Current data was recorded using a RDCP deployed at Alice Shoal and Bajo Nuevo. Continuous temperature data was recorded at the seafloor using HOBO temperature meters deployed at each anchorage. A CTD was deployed at each dive site to obtain a profile of temperature and salinity from the surface to the bottom.

2. Research conducted

A. Queen conch surveys

A team of 8 Colombian scientists conducted belt transects to quantify the abundance, life stage and size of *Strombus gigas* molluscs. The surveys focused on sites that had been examined in past years (2011), with several additional sites. In each site, four transects were run, each 30 m in length by 4 m wide. The transects started from a single point and were run to the north, south, east and west. Data collected included number of conch per transect, number of transects without any conch (# of empty), size of each conch, thickness of the flared lip for adults, and the proportion of juvenile vs. adult conch. Data are summarized in Table 3a (Alice), 3b (Nuevo) and 3c (Serranilla).

Overall, very few conch were seen during these surveys. Alice and Bajo Nuevo had more conch than Serranilla. A maximum of 57 animals was observed in one location at Alice, but most of these were juveniles.

Table 3a. Queen conch observations on Alice Shoal.

Site Number	new site	# of transects	# of empty	# of conch	mean size (cm)	mean lip (mm)	# juvenile	# adults	% adults
26	QC1	2	1	3	20.83	11.0	1	2	66.67%
27	QC2	2	0	16	19.06	11.8	6	10	62.50%
1	QC3	2	0	11	16.42	2.0	10	1	9.09%
23 (new)	QC4	2	0	10	20.21	12.5	2	8	80.00%
10	QC5	2	0	7	20.04	7.3	4	3	42.86%
4	QC6	2	0	5	20.20	13.9	1	4	80.00%
5	QC7	2	1	5	18.28	0.0	5	0	0.00%
6	QC8	2	1	1	13.50	0.0	1	0	0.00%
21	QC9	2	0	5	20.94	20.0	1	4	80.00%
9	QC10	4	3	2	21.00	0.0	2	0	0.00%
3	QC11	3	2	2	22.35	15.0	1	1	50.00%
2	QC12	3	2	1	26.90	9.0	0	1	100.00%
15	QC13	2	0	57	16.54	11.7	54	3	5.26%
16	QC14	4	4	0	0.00	0.0	0	0	0.00%
8	QC15	2	0	15	19.93	5.0	9	6	40.00%
13	QC16	4	4	0	0.00	0.0	0	0	0.00%
14	QC17	3	2	2	25.20	19.0	0	2	100.00%
23	QC18	3	0	17	18.60	10.7	10	7	41.18%
7	QC19	1	0	1	19.10	0.0	1	0	0.00%

Table 3b. Queen conch observations on Bajo Nuevo.

Site Number	new site	# of transects	# of empty	# of conch	mean size (cm)	mean lip (mm)	# juvenile	# adults	% adults
1	QC38	4	0	7	20.14	10.33	4	3	43%
2	QC35	3	2	1	19.00	0.00	1	0	0%
5	QC26	3	3	0	0.00	0.00	0	0	0%
6	QC27	4	4	0	0.00	0.00	0	0	0%
12	QC37	4	0	6	22.57	13.00	3	3	50%
13	QC30	1	0	30	19.09	3.00	25	5	17%
14	QC82	4	4	0	0.00	0.00	0	0	0%
16	QC24	3	3	0	0.00	0.00	0	0	0%
23	QC77	3	1	6	20.83	8.80	2	4	67%
24	QC76	4	0	13	18.35	12.50	9	4	31%
25	QC66	3	3	0	0.00	0.00	0	0	0%
26	QC67	4	4	0	0.00	0.00	0	0	0%
30	QC68	3	1	3	23.20	14.00	2	1	33%
33	QC34	2	2	0	0.00	0.00	0	0	0%
36	QC32	2	0	36	16.04	2.50	34	2	6%
37	QC31	4	0	10	15.92	2.00	9	1	10%
38	QC36	3	1	2	21.20	0.00	2	0	0%
39	QC81	4	3	1	20.80	0.00	1	0	0%
40	QC83	3	2	1	19.60	0.00	1	0	0%
41	QC40	2	0	3	24.33	13.33	0	3	100%
42	QC39	4	2	6	22.50	5.25	2	4	67%
43	QC28	2	2	0	0.00	0.00	0	0	0%
44	QC29	4	3	1	24.50	11.00	0	1	100%
45	QC80	4	4	0	0.00	0.00	0	0	0%
46	QC23	3	1	3	23.50	21.33	0	3	100%
50	QC69	4	2	4	20.63	7.33	1	3	75%
51	QC25	4	4	0	0.00	0.00	0	0	0%
54	QC65	4	1	3	23.67	9.00	0	3	100%
55	QC79	4	3	1	24.00	6.00	0	1	100%
57	QC78	4	1	7	13.36	0.00	7	0	0%
64	QC20	2	1	1	28.00	15.00	0	1	100%
65	QC70	3	2	1	24.50	20.00	0	1	100%
66	QC21	2	0	2	24.15	6.00	1	1	50%
68	QC22	3	1	2	24.30	16.50	0	2	100%
nuevo	QC33	2	0	2	24.50	20.00	0	2	100%
nuevo 10	QC85	4	4	0	0.00	0.00	0	0	0%
nuevo 4	QC71	4	1	5	25.26	21.40	0	5	100%
nuevo 5	QC72	4	2	15	22.48	19.00	6	9	60%
nuevo 6	QC73	4	4	0	0.00	0.00	0	0	0%
nuevo 7	QC74	4	2	4	25.73	21.25	0	4	100%
nuevo 8	QC75	4	3	1	26.00	24.00	0	1	100%
nuevo 9	QC84	4	3	1	25.00	14.00	0	1	100%
nuevo1	QC41	2	1	2	24.50	22.50	0	2	100%
nuevo2	QC42	1	0	4	21.48	17.25	0	4	100%
nuevo3	QC43	1	0	3	22.53	14.67	0	3	100%

Table 3c. Queen conch observations on Serranilla.

Site Number	new site	# of transects	# of empty	# of snails	mean size (cm)	mean lip (mm)	# juvenile	# adults	% adults
40	QC44	2	1	3	22.80	21.50	0	3	100.00%
21	QC45	3	3	0	0.00	0.00	0	0	0.00%
41	QC46	3	2	2	22.55	4.00	1	1	50.00%
19	QC47	4	3	1	22.00	9.00	0	1	100.00%
62	QC48	2	1	1	23.20	20.00	0	1	100.00%
61	QC49	4	4	0	0.00	0.00	0	0	0.00%
New site	QC50	4	4	0	0.00	0.00	0	0	0.00%
New site	QC51	3	2	1	27.00	16.00	0	1	100.00%
New site	QC52	4	4	0	0.00	0.00	0	0	0.00%
3	QC53	4	3	2	21.75	14.00	1	1	50.00%
2	QC54	3	1	2	25.15	18.50	0	2	100.00%
64	QC55	3	1	5	26.40	10.60	0	5	100.00%
8	QC56	2	1	1	27.00	4.00	0	1	100.00%
7	QC57	4	4	0	0.00	0.00	0	0	0.00%
63	QC58	2	2	0	0.00	0.00	0	0	0.00%
6	QC59	4	4	0	0.00	0.00	0	0	0.00%
5	QC60	2	1	1	26.10	10.00	0	1	100.00%
27	QC61	3	3	0	0.00	0.00	0	0	0.00%
28	QC62	3	1	7	21.70	4.50	5	2	28.57%
65	QC63	3	3	0	0.00	0.00	0	0	0.00%
4	QC64	4	2	2	24.80	8.00	0	2	100.00%

Cittarium pica (West Indian top shell or magpie shell)

Cittarium pica, or wilks as known in the Archipelago of San Andres Providencia and Santa Catalina, is collected on a small scale on the rocky coastline for human consumption (food). This mollusk is one of the most conspicuous herbivore-detritivores and one of the largest consumers of biomass of algae in the rocky shoreline. It serves as food for other gastropods and octopi, and its shell is used by several species of hermit crabs. It is the second most common mollusk fishery resource after *Strombus gigas* (queen conch). Its population has been affected in different areas of the Caribbean by overharvesting, and has been included in red lists of marine invertebrates in some countries. In Serranilla, a rocky outcrop area was searched, and only 3 individuals of medium size were identified.

B. Coral Reef Assessments

The coral reef team included three scientists assessing corals, two assessing benthic communities, four assessing fish and two assessing motile invertebrates. In addition, several divers searched for lionfish, which were killed and removed from the reef. The surveys included 1) sites identified and surveyed by CORALINA during the 2011 assessments; 2) sites chosen from the satellite imagery based on the identification of species features; 3) sites identified from drop camera videos; and 4) random sites identified through snorkel exploration. An attempt was made to examine representative coral habitats in both leeward and windward locations and back reef and fore reef locations, if present. Hardbottom areas without coral, as well as rubble and sand patches were avoided. Gorgonian hardground areas were examined in areas without well developed reef systems if aggregations of stony corals were observed from the water's surface. All transect surveys were randomly located within each site.

Table. 4. Description of reefs.

Site	Long	Lat	Description
COAL 1	-79.322910	16.010370	Hardground with well developed coral community at edge of sand depressions. Corals formed a rim around circular depressions, up to 1 m taller than the surrounding hardground. Isolated corals, lots of sponges and macroalgae on hardground. Rim around depression contained a high diversity of branching (*Porites, Madracis*) plating (*Agaricia*) and massive corals, including larger *Montastraea* (0.5- 1 m), *Diploria, Eusmilia* and other species.
COAL 2	-79.294230	16.025930	Low relief hardground with high cover (>50%) macroalgae. Patches of low-relief corals, including 0-5-2 m patches of *Porites porites*, flattened brain corals (*Diploria*), *Porites astreoides, Agaricia*, and starlet corals. A few larger *Meandrina jacksoni* colonies (80-150 cm). Moderate abundance of massive sponges And rope sponges. Also, *Siphonodictyon, Cliona*, and *Tridid*e*mnum* on colonies and large patches of brown *Clion*a and red mats of *Chondrilla*.
COAL 3	-79.304500	16.015400	Low relief reef substrate with moderate cover macroalgae, small Porites astreoides, massive sponges and gorgonians. Occasional larger mounds dominated by *Porites porites, M. faveolata.* Best coral development on rim of sand filled depressions.
COAL 4	-79.294100	16.065200	Hardground with ridges of coral adjacent to sandflat. Coral-dominated areas have large mounds of *Porites porites*, upright branches of *Agaricia*, large *M. cavernosa* and isolated *M. faveolata* colonies. Nice CCA colonization on dead skeletons; also *Halimeda* among corals. Substrate has moderate cover of *Dictyota, Sargassum, Turbinaria* and other brown algae. Coral mounds 1-2 m in height. *Diadema* common.
COAL 5	-79.298870	16.086380	Hardground with large patches of *P. porites*, occasional larger *M. faveolata* colonies, massive and barrel sponges, especially *Ircinia*. Moderate (30-40%) cover of macroalgae.
COAL 6	-79.298930	16.098380	Hardground with some raised areas built of coral skeletons. Dead coral with CCA and dense mats of *Halimeda*. Large *P. porites, M. faveolata* and *Diploria* colonies, occasional larger *Dendrogyra* colonies intermixed with smaller *D. labyrinthiformis, Agaricia*, and *S. siderea* colonies.
COAL 7	-79.290400	16.052800	Complex hardground with low-relief (1-2 m) ridges formed by skeletons of *Agaricia* and *Porites*; dead corals with CCA and moderate cover of *Halimeda*. Patches of *Montastraea, Eusmilia, P. porites, Agaricia, P. astreoides, S. siderea*; many of these have dead CCA encrusted patches.
COAL 8	-79.304900	16.105700	Larger ridges with moderate cover of live coral, including dense patches of *P. porites*, numerous large *M. faveolata colonies, Meandrina Siderastrea* and *Diploria* brain corals. A number of the *Montastraea* colonies have extensive (30-80% old mortality) denuded patches covered with CCA and *Peysonnelia*. Dead skeletons and substrate covered in CCA, *Stypopodium, Dictyota, Halimeda.*

Site	Long	Lat	Description
CONU-10	-78.657700	15.896600	Spur and groove system at the northwestern edge of the channel. Spurs are 2-3m above sand channel; slope gradually to about 25 m and end in sand. Deeper (20-25 m) reef with large plating *Montastraea* and *Agaricia*. High abundance of *M. faveolata* colonies, most in good shape, on tops of spurs at 15-18 m depth. These are intermixed with other massive and plating species and branching gorgonians. Coral cover declines up shallow (10 m), gradually becoming a hardground with isolated gorgonians and large sand patches.
CONU 11	-78.646400	15.890800	Windward reef at northwestern end of channel, seaward of the lighthouse. *Montastraea* reef. No spur and groove formation. Large *M. faveolata* and *M. annularis* colonies in 15-20 m depth; gradual slope to base of reef at 25 m depth. More plating *Agaricia* and *Montastraea* colonies in deeper water. Moderate levels (2-3%) of disease (WP and YBD) on *Montastraea* colonies.
CONU 12	-78.651600	15.882700	Lagoonal patch reef on the southern half of the bank. High density and cover of *M. annularis* and *M. faveolata*. Many form large mountains or pillars extending 2-3 m above reef substrate. Patches of *A. cervicornis* between massive corals. High number of three spot damselfish. Near anchorage, mostly *M. annularis*. As you head west, more large *M. faveolata* (2-3 m). Many colonies (2-3%) with YBD and small white plague lesions. No large patches of recently denuded tissue.
CONU 13	-78.679900	15.843500	Lagoonal *Montastraea* reef on southern half of the bank, near lighthouse. Large *M. faveolata* colonies (some 4 m tall) intermixed with *M. annularis* and other massive corals including 1-2 m tall *Diploria* and *Colpophyllia* colonies. Some large *A. palmata* colonies in shallows and patches of *A. cervicornis* near base of reef. Extensive YBD and white plague on many of the *Montastraea* colonies. Reef is surrounded by a sandflat
CONU 14	-78.7393	15.8208	Deeper lagoonal patch reef located at the southeastern end of the bank. Medium to large size massive and plating corals. Smaller corals in good shape. Larger corals often have patches of old mortality covering 20-30% of their surface, and dead areas colonized by CCA and Dictyota. Large plating *Agaricia, Leptoseris*, columns of *Meandrina*, *A. cervicornis* patches and other colonies. High diversity of corals. Reef substrate high cover of *Dictyota* and *Lobophora*.
CONU 15	-78.680700	15.861800	Lagoonal patch reef on southern half of the bank with moderate abundance of larger corals in deeper (10-15 m water). West of the coral areas in shallow water, isolated *A. palmata* colonies, and a dead *A. palmata* framework interspersed with hardground areas and isolated massive corals. Contains some very large *Montastraea* colonies, many with white plague and extensive patches of old mortality. Also large patches of brown *Cliona*, especially on old dead *Montastraea* colonies. . One moderate size thicket of staghorn coral.

Site	Long	Lat	Description
CONU 16	-78.711000	15.847600	Deeper (20 m) lagoonal reef in southern end of bank. Mixed coral community with large (1-2 m) Colpophyllia and M. annularis colonies, intermixed with smaller massives (30-50 cm) including *M. cavernosa, M. franksi, Diploria* and others, as well as larger *Eusmilia, Madracis decactis* and other species. Good CCA on dead skeletons, many that are 50%-70% dead. Some white plague (low) but also found YBD on *M. annularis*, and BBD on *C. natans*. Sandflat surrounding corals covered with cyanobacterial mats.
COSE 17	-79.812700	15.857600	Hardground ridges in shallow water. Exposed, high surge. Tops (3-4 m) with small *Agaricia, P. astreoides*, patches of *Millepora complenata*, and scattered low densities of larger (20-50 cm) *Diploria strigosa* and *D. clivosa*, *S. siderea*. Dense assemblages of *Turbinaria, Sargassum* and sea fans on upper shallow surfaces; deeper areas have small stands of *P. porites*; found 3 *A. palmata*. Rubble patches in sand between hardground. Area lacked caves and vertical surfaces like that seen in deeper ridges (site 18, 19).
COSE 18	-79.844000	15.819900	Hardground ridges on outside of reef. Large stands of *Agaricia tenuifolia* at the seaward edge on the base of the reef. These were intermixed with *P. porites* colonies. A few *M. faveolata* at the base of the ridges. Large patches of brown clionids on substrate. Several A. *palmata* colonies.
COSE 19	-79.833400	15.838900	Hardground ridges behind the ancient ridge reef. High relief (3-5 m from base to top of ridge. Moderate sized patch of *A. palmata* and an abundance of recruits and small encrusting *A. palmata* on the top; tops of ridges also have *Sargassum, Turbinaria*, some *Millepor*a, *P astreoides*. Sides and bases of ledges with higher abundance of *Agaricia, P. Porites* and areas with massives deeper. Ridges surrounded by a gently sloping hardground with isolated larger (80-100 cm) massives (*M. faveolata* and *Dendrogyra*). Patches of deeper coral framework (fused *Porites* and other species) with lots of holes and crevices; these supported large population (>50) of lobsters.
COSE 20	-79.867800	15.870800	Lagoonal patch reef. Circular "dome" 30 m X 40 m wide with moderate density of corals that slopes gradually on all sides. Patch is surround by sloping hardground with scattered massive corals and gorgonians (corals - 1-2/ meter), gradually transitioning into a sand flat. At 15 m depth found two *Solenastrea* colonies. Coral patch dominated by *Agaricia tenufolia* colonies (30-100 cm diameter), low density of *M. faveolata* and other massive corals. Low cover of macroalgae, except Halimeda in among corals. High abundance of *Cliona delitrix* on massives that encircle the coral patch, including many that have completely killed the corals.

Site	Long	Lat	Description
COSE 21	-79.8499	15.7914	Shallow community adjacent to the island on the southern side. Gently sloping hardground with some ridges and undercut ledges adjacent to a large sand patch. Low cover on hardground; patchy distribution of massives (*Montastraea, Diploria, Siderastrea*) 30-50 cm diameter, some larger *Porites porites* colonies. Edge of ridge with slightly higher cover of *Porites porites*, *Agaricia* and other small massive/plating corals. Sides of ridge have patches *Agaricia* and *Leptoseris* colonies with moderately high cover of macroalgae and patches of CCA. Low cover of gorgonians and sea fans on hardground; substrate covered with low density of macroalgae, including *Stypopodium, Dictyota, Sargassum*.
COSE 22	-79.697700	15.903900	Windward hardground ridges on outside of reef at northeastern end. Ridges 3-5 m tall. Tops with macroalgae and low cover of corals; isolated crustose *A. palmata, Millepora*, small *Agaricia* and *Porites astreoides* on top. Sides and grooves, especially on seaward bases have large *Porites porites* patches and occasional *Agaricia agaricites* and *Agaricia tenuifolia* colonies. Vertical surfaces of ridges dominated by *Agaricia*, with occasional crustose growth of *Montastraea faveolata* and *M. cavernosa, Madracis decactis* and other species. *Lobophora* on vertical and deeper substrates; exposed tops of ridges with *Sargassum, Turbinaria* and some *Dictyota; Halimeda* in among some of corals.
COSE 23	-79.870600	15.870300	Lagoonal patch reef. Series of small coral patches surrounded by sand. Lower cover than site 23, but numerous large massives, plating corals and branching Porites. Large patches of sand between corals. Diverse sponge assemblages. Low macroalgae, except Halimeda in among corals. Very fine silt between corals, easily suspended. Moderately high diversity of corals. First site on Serranilla with *A. cervicornis* patch and a colony of *Mussa*. High prevalence of dark spots on Agaricia. Moderate recruitment. High cover of CCA; CCA has overgrown several corals
COSE 24	-79.868400	15.878700	Lagoonal patch reef. At eastern end, small isolated coral patches, 10-20 m long, 5-10 m wide. Coral patches separated by sand. These increase in size to the west, about 200 m from anchorage, extensive coral patch several hundreds of meters wide. Coral framework is dead *Porites* and *Agaricia*. *Agaricia* dominant corals in terms of abundance. Many small corals, but also settled in clumps on 30-40 cm diameter "rocks" that are either *Porites porites* skeletons or old *Agaricia*. Lettuce coral framework separated by large massives - *M. annularis* (1-2 m in diameter) on some patches, C. natans (1-2 m diameter) on some, and large *M. faveolata* (1-2 m). High diversity of massive, plating and branching corals. First site with *Mycetophyllia ferox*. Branching gorgonians and diverse sponge assemblage in and among corals; corals often settled on sponges, or are held in place only by sponges. Extensive bioerosion of some corals. Low cover of macroalgae; some *Halimeda* at bases of corals.

Site	Long	Lat	Description
CONU 25	78.626600	15.894600	Deeper site in the middle of the channel. Strong current, isolated coral patches, some with 1 m tall corals. Generally low cover with lots of *Xestospongia*, other massive sponges and gorgonians.
CONU 26	78.593500	15.926500	Fore reef site on northeast end of the bank, mostly hardground. Sloping reef with low relief and patchy coral bommies. The bommies are 1-3 m diameter with mostly small corals and some larger (1 m) massive *Siderastrea, Montastraea* and *Dendrogyra* colonies. Away from the reef is more of a hardground with gorgonians
CONU 27	78.619900	15.876500	Deeper hardground in the middle of the channel at the southern end. Fairly low relief with small massive corals, some *Porites, Manacina, Agaricia* and isolated larger (0.7-1 m) brain, starlet and star corals. Scattered gorgonians. Coral cover low. Macroalgae low near survey area, but much higher 200 m to north, with a dominance by *Dictyota*. Coral communities the same, but a sharp transition from no algae to a lot of algae. No *Diadema*. Lots of conch.
CONU 28	78.567100	15.912500	Lagoonal *Montastraea* reef on northern half. Shallow *A. palmata* framework with few live colonies (some fragments, 1-2 older colonies, and several small colonies), mostly fused branches and dead colonies in growth position with very little algae. Reef slopes into deeper *Montastraea* reef. *Montastraea* ridges separated by sand patches. This site had the largest colonies and the largest amount of live *Montastraea*. Many healthy 2-3 m tall colonies, unusually large *M. annularis* and some larger *Siderastrea, Diploria* and *Colpophyllia* colonies. Many patches of *A. cervicornis*. This coral forms small thickets just below the *A. palmata* zone and also occurs between the *Montastraea* colonies in several places. Most have high numbers of damselfish with recent mortality from disease. Some recent white plague (-2-3% prevalence), low (<1%) prevalence of YBD.
CONU 29	78.572200	15.903700	Lagoonal *Montastraea* reef on northern half. High cover of large *M. annularis* and *M. faveolata* colonies. High prevalence of white plague (5-10%), especially on M. faveolata. Medium (3-5%) prevalence of YBD, mostly on *M. annularis*. Extensive patches (1-3 m diameter) of recent and transitional mortality
CONU 30	78.577100	15.908300	Lagoonal *Montastraea* reef on northern half. Shallow *A. palmata* framework with few live colonies (some fragments, 1-2 older colonies, and several small colonies), mostly fused branches and dead colonies in growth position with very little algae. Side of *A. palmata* patch facing the reef crest (south) had very little algae and many large live corals; side we surveyed had a lot of dead corals or mostly dead corals, especially large *M. faveolata* colonies. These corals appear to have died in the last 30-60 days, along with parts that died 6 months to 1 year ago. Lots of *Dictyota* on skeletons, *Lobophora* on vertical surfaces, and cyanobacterial mats on skeletons and substrates, especially at the bases of larger corals. Some white plague and YBD, lower than site 29 but higher than site 28.

Site	Long	Lat	Description
CONU 31	78.678900	15.827700	Deeper spur and groove off the southern end of the bank. Well developed spurs, 1-2 m tall at 20 m depth, increasing to 3-4 m depth between 25-30 m depth. Very gentle slope into deeper water. Moderate cover (20-30%) at 25 m, increasing in deeper water. Deep has large plating *Montastraea* colonies. Mix of *C. natans, M. annularis, M. faveolat*a and other species on spurs interspersed with other massive and plating species. 1 large *Madracis mirabilis* colony and several *A. cervicornis* colonies. Low cover of macroalgae.
CONU 32	78.641700	15.876100	Lagoonal *Montastraea* reef on southern half near lighthouse. *Montastraea* patches surrounded by fine sand. Sand with cyano mats, easily suspended. Dominance of *M. annularis* with some *M. faveolata*, large *P. porites*, and occasional *C. natans* and *D. strigosa*. Very little disease but a lot of old mortality. Highest number of *Stegastes planifrons* seen on the entire trip. Lots of dead and partially dead corals with very thick turf algae within their territories. Corals without damselfish that died have high numbers of colonizers – *Manacina areolata, E. fastigiata, Agaricia, P. astreoides* and *P. porites*. No *Montastraea* recruits. Good CCA cover outside of damselfish territories. Lots of *Pseudopterigorgia* colonized dead *M. annularis* and areas between *M. annularis* lobes.

Table 5. Corals identified at Bajo Alicia.

Abbr	Species	1	2	3	4	5	6	7	8	9
ACER	*Acropora cervicornis*									
APAL	*Acropora palmata*									
AAGA	*Agaricia agaricites*	X	X	X	X	X	X	X	X	X
AFRA	*Agaricia fragilis*									
ALAM	*Agaricia lamarcki*									
ATEN	*Agaricia tenuifolia*									
CNAT	*Colpophyllia natans*							X		X
DCYL	*Dendrogyra cylindrus*	X					X		X	X
DSTO	*Dichocoenia stokesii*	X	X	X	X	X	X		X	X
DCLI	*Diploria clivosa*		X						X	
DLAB	*Diploria labyrinthiformis*	X				X	X		X	
DSTR	*Diploria strigosa*	X	X	X	X	X	X	X	X	X
EFAS	*Eusmilia fastigiata*	X	X	X	X	X	X	X	X	X
IRIG	*Isophyllastrea rigida*	X	X	X			X	X	X	X
ISIN	*Isophyllia sinuosa*								X	X
LCUC	*Leptoseris cucullata*	X	X	X	X					
MDEC	*Madracis decactis*	X	X	X		X				
MAUR	*Madracis (mirabilis)*	X	X	X						
MARE	*Manicina areolata*	X	X	X						
MMEA	*Meandrina meandrites*	X	X	X	X	X	X	X	X	X
MALC	*Millepora alcicornis*	X	X	X		X				X
MCOM	*Millepora complanata*					X	X	X	X	X
MANN	*Montastraea annularis*									
MCAV	*Montastraea cavernosa*	X	X	X	X	X	X	X	X	X
MFAV	*Montastraea faveolata*	X	X	X	X	X	X	X	X	
MFRA	*Montastraea franksi*									
MANG	*Mussa angulosa*									
MFER	*Mycetophyllia ferox*									
MLAM	*Mycetophyllia lamarckiana*	X								
PAST	*Porites astreoides*	X	X	X	X	X	X	X	X	X
PDIV	*Porites divaricata*	X	X	X			X		X	
PFUR	*Porites furcata*	X	X	X	X	X	X	X	X	
PPOR	*Porites porites*	X	X	X				X	X	X
SCUB	*Scolymia cubensis*									
SRAD	*Siderastrea radians*				X					
SSID	*Siderastrea siderea*	X	X	X	X	X	X	X	X	X
SINT	*Stephanocoenia intersepta*	X	X	X		X			X	X
MJAC	*Meandrina jacksoni*	X	X	X	X			X	X	X

Table 5b. Corals Identified at Bajo Nuevo

Abbr	Species	10	11	12	13	14	15	16	25	26	27	28	29	30	31	32
ACER	*Acropora cervicornis*	X		X	X	X	X					X	X	X	X	X
APAL	*Acropora palmata*			X	X							X		X		
AAGA	*Agaricia agaricites*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
AFRA	*Agaricia fragilis*			X	X											
ALAM	*Agaricia lamarcki*	X	X	X											X	
ATEN	*Agaricia tenuifolia*															
CNAT	*Colpophyllia natans*	X	X	X	X	X	X	X				X	X	X	X	X
DCYL	*Dendrogyra cylindrus*	X	X	X												
DSTO	*Dichocoenia stokesii*	X	X			X	X		X		X	X	X	X	X	
DCLI	*Diploria clivosa*											X		X		
DLAB	*Diploria labyrinthiformis*	X	X		X	X	X	X	X	X		X	X	X	X	X
DSTR	*Diploria strigosa*	X		X	X	X	X	X	X	X	X	X	X	X	X	X
EFAS	*Eusmilia fastigiata*	X		X	X				X	X	X	X	X	X	X	X
IRIG	*Isophyllastrea rigida*	X							X						X	
ISIN	*Isophyllia sinuosa*	X														
LCUC	*Leptoseris cucullata*	X	X	X	X	X		X	X					X	X	
MDEC	*Madracis decactis*	X	X	X		X		X	X	X	X	X	X	X	X	X
MAUR	*Madracis mirabilis*			X											X	
MARE	*Manicina areolata*							X			X	X	X	X	X	X
MMEA	*Meandrina meandrites*	X	X		X	X		X	X	X	X	X	X	X	X	X
MALC	*Millepora alcicornis*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MCOM	*Millepora complanata*															
MANN	*Montastraea annularis*	X	X	X	X	X	X	X	X			X	X	X	X	X
MCAV	*Montastraea cavernosa*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MFAV	*Montastraea faveolata*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MFRA	*Montastraea franksi*	X	X					X	X					X	X	
MANG	*Mussa angulosa*							X								
MFER	*Mycetophyllia ferox*	X		X												
MLAM	*Mycetophyllia lamarckiana*	X		X		X		X	X	X		X	X	X	X	
PAST	*Porites astreoides*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PDIV	*Porites divaricata*															
PFUR	*Porites furcata*	X		X	X			X	X		X	X	X		X	
PPOR	*Porites porites*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SCUB	*Scolymia cubensis*					X			X	X		X			X	X
SRAD	*Siderastrea radians*								X							
SSID	*Siderastrea siderea*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SINT	*Stephanocoenia intersepta*	X	X	X				X	X	X	X	X	X	X	X	X
MJAC	*Meandrina jacksoni*	X							X	X	X				X	

Table 5c. Corals identified at Serranilla Bank.

Abbr	Species	17	18	19	20	21	22	23	24
ACER	*Acropora cervicornis*	X						X	
APAL	*Acropora palmata*		X	X	X	X	X		
AAGA	*Agaricia agaricites*	X	X	X	X	X	X	X	X
AFRA	*Agaricia fragilis*								X
ALAM	*Agaricia lamarcki*								
ATEN	*Agaricia tenuifolia*		X	X	X	X	X		
CNAT	*Colpophyllia natans*				X	X		X	X
DCYL	*Dendrogyra cylindrus*			X					
DSTO	*Dichocoenia stokesii*			X	X	X	X	X	X
DCLI	*Diploria clivosa*	X	X	X	X	X	X		
DLAB	*Diploria labyrinthiformis*			X	X	X	X	X	X
DSTR	*Diploria strigosa*	X	X	X	X	X	X	X	X
EFAS	*Eusmilia fastigiata*				X	X		X	X
IRIG	*Isophyllastrea rigida*	X	X	X	X	X	X	X	X
ISIN	*Isophyllia sinuosa*		X		X	X			
LCUC	*Leptoseris cucullata*					X	X	X	X
MDEC	*Madracis decactis*			X	X	X	X	X	X
MAUR	*Madracis auretenra (mirabilis)*		X						
MARE	*Manicina areolata*								
MMEA	*Meandrina meandrites*		X		X	X	X	X	X
MALC	*Millepora alcicornis*		X		X	X		X	X
MCOM	*Millepora complanata*	X	X	X	X	X	X		
MANN	*Montastraea annularis*				X	X		X	X
MCAV	*Montastraea cavernosa*	X	X	X	X	X	X	X	X
MFAV	*Montastraea faveolata*		X		X	X	X	X	X
MFRA	*Montastraea franksi*							X	X
MANG	*Mussa angulosa*							X	
MFER	*Mycetophyllia ferox*								X
MLAM	*Mycetophyllia lamarckiana*		X			X		X	X
PAST	*Porites astreoides*	X	X	X	X	X	X	X	X
PDIV	*Porites divaricata*					X			
PFUR	*Porites furcata*	X			X	X	X		X
PPOR	*Porites porites*	X	X	X	X	X	X	X	X
SCUB	*Scolymia cubensis*							X	X
SRAD	*Siderastrea radians*					X			
SSID	*Siderastrea siderea*	X	X	X	X	X	X	X	X
SINT	*Stephanocoenia intersepta*		X	X	X	X	X	X	X
MJAC	*Meandrina jacksoni*		X	X	X	X	X	X	X

Table 6a . Fish species observed at Bajo Alicia. S - 1; F- 2-10; M- 11-100; A- >100 and X = present.

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
Sergeant Major	*Abudefduf saxatilis*											0
	Abudefduf taurus											0
Roughhead Blenny	*Acanthemblemaria aspera*								S			1
Medusa Blenny	*Acanthemblemaria medusa*											0
	Acanthemblemaria sp.											0
Spinyhead Blenny	*Acanthemblemaria spinosa*											0
Scrawled Cowfish	*Acanthostracion quadricornis*			S					S			2
Honeycomb Cowfish	*Acanthostracion polygonius*	F	S	F	x	S	S	F	F	F		9
Ocean Surgeonfish	*Acanthurus bahianus*	M	M	M	F	M	M	F	M	M		9
Doctorfish	*Acanthurus chirurgus*	M	F	M	F	F	F	F	F	F		9
Blue Tang	*Acanthurus coeruleus*	M	F	F	F	F	F	M	F	F		9
	Aetobatus narinari							x				1
	Alectis cilliaris										x	1
Scrawled Filefish	*Aluterus scriptus*	S	S		S							3
Redspotted Hawkfish	*Amblycirrhitus pinos*	S	M	F	F	S	F	F	F	F		9
Porkfish	*Anisotremus virginicus*											0
Barred Cardinalfish	*Apogon binotatus*											0
Flamefish	*Apogon maculatus*		S									1
Twospot Cardinalfish	*Apogon pseudomaculatus*			S	x			x				3
	Astrapogon stellatus											0
Trumpetfish	*Aulostomus maculatus*					S			S	S		3
Queen Triggerfish	*Balistes vetula*	F	F	M	M	M	M	M	S	F		9
Spanish Hogfish	*Bodianus rufus*	F	F	S	S	F	F	F	F	F		9
Peacock Flounder	*Bothus lunatus*								x		x	2
Saucereye Porgy	*Calamus calamus*							S		F		2
Whitespotted Filefish	*Cantherhines macrocerus*	F	F		F		F	S	S	S		7
Orangespotted Filefish	*Cantherhines pullus*	S	F	F	S	F	x	F	F	S		9
Ocean Triggerfish	*Canthidermis sufflamen*	F	F	x	S	S	F	F	S	S		9
Sharpnose Puffer	*Canthigaster rostrata*	F	F	F	F	F	M	M	F	F		9
Yellow Jack	*Caranx bartholomaei*									S		1
Blue Runner	*Caranx crysos*											0
crevale jack	*Caranx hippos*										x	1
Horse-eye Jack	*Caranx latus*						S		F			2
Black Jack	*Caranx lugubris*								F			1

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
Bar Jack	*Caranx ruber*	A	F	F	F	M	F	F	M	F		9
	Caranx sp.											0
Cherubfish	*Centropyge argi*	F	F	M	F	M	F	F	F			8
Graysby	*Cephalopholis cruentata*	F	x	S	F	S	F	S	F	F		9
Coney	*Cephalopholis fulva*	M	F	M	M	F	F	M	F	M		9
Yellowface Pikeblenny	*Chaenopsis limbaughi*											0
Foureye Butterflyfish	*Chaetodon capistratus*		F	F			F	F				4
Spotfin Butterflyfish	*Chaetodon ocellatus*	F	F	F		F		x		F		6
	Chaetodon sedentarius				x							1
Banded Butterflyfish	*Chaetodon striatus*	F	F	F	F	F	F	F	S	F		9
Bridled Burrfish	*Chilomycterus antennatus*											0
Blue Chromis	*Chromis cyanea*	A	F	F	M	F	M	S	M	M		9
Sunshinefish	*Chromis insolata*											0
Brown Chromis	*Chromis multilineata*	A	F		M	M	M	M	M	F		8
Creole Wrasse	*Clepticus parrae*	M		M		F	M	M	A	F		7
Colon Goby	*Coryphopterus dicrus*									F		1
Pallid Goby	*Coryphopterus eidolon*											0
Bridled Goby	*Coryphopterus glaucofraenum*	F	F	F	F	S	S	F	F	F		9
Kuna Goby	*Coryphopterus retrospinis*											0
Masked Goby	*Coryphopterus personatus*											0
Bluelip Parrotfish	*Cryptotomus roseus*			F	F							2
Southern Stingray	*Dasyatis americana*											0
Mackerel Scad	*Decapterus macarellus*			M		A	A					3
Balloonfish	*Diodon holocanthus*							S				1
Porcupinefish	*Diodon hystrix*	S			x			S				3
Sharknose Goby	*Elacatinus evelynae*		x		S		F	F		x		5
	Elacatinus genie									x		1
Yellowline Goby	*Elacatinus horsti*	F	F	F	F	F	F	F	F	F		9
	Elacatinus illecebrosus/ Gobiosoma sp.											0
	Elacatinus louisae											0
Broadstripe Goby	*Elacatinus prochilos*	M	F	F	F	F	F	F	F	F		9
	Elacatinus sp.											0
Sailfin Blenny	*Emblemaria pandionis*											0
Lofty Triplefin	*Enneanectes altivelis*											0
Roughhead Triplefin	*Enneanectes boehlkei*											0
Red Hind	*Epinephelus guttatus*				S					S		2
Jewfish	*Epinephelus itajara*								S			1

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
	Equetus lanceolatus											0
Spotted Drum	*Equetus punctatus*					S	S		F			3
Nurse Shark	*Ginglymostoma cirratum*				S			S		S		3
Goldspot Goby	*Gnatholepis thompsoni*	M	F	F	F	F	S	M	F	M		9
Goby sp	*Gobidae sp1*											0
Orangeside Goby	*Gobiosoma dilepis*											0
Fairy Basslet	*Gramma loreto*	M			F		M	F	M	F		6
Goldentail Moray	*Gymnothorax miliaris*		S		F			S		x		4
Spotted Moray	*Gymnothorax moringa*		F		S	S	S	S	S			6
White Margate	*Haemulon album*	F	F	F	F	F	F	F	F	F		9
Tomtate	*Haemulon aurolineatum*											0
Caesar Grunt	*Haemulon carbonarium*						F	F	F	S		4
Spanish Grunt	*Haemulon macrostomum*							x				1
Smallmouth Grunt	*Haemulon chrysargyreum*									S		1
French Grunt	*Haemulon flavolineatum*	F		x			F	F	F	F		6
Cottonwick	*Haemulon melanurum*	F	F	M	S	F	F	F	F	F		9
Sailors Choice	*Haemulon parra*			s								1
White Grunt	*Haemulon plumierii*			S		S						2
	Haemulon sciurus											0
Slippery Dick	*Halichoeres bivittatus*	M	F	F	M	F	F	F	A	F		9
Yellowcheek Wrasse	*Halichoeres cyanocephalus*			S		F	F					3
Yellowhead Wrasse	*Halichoeres garnoti*	A	F	F	M	F	F	A	F	A		9
Clown Wrasse	*Halichoeres maculipinna*	F	F	F	F	F	M	F	F	F		9
Rainbow Wrasse	*Halichoeres pictus*				F	F	M	M	M			5
Blackear Wrasse	*Halichoeres poeyi*											0
Puddingwife	*Halichoeres radiatus*	F	F	F	F	F	F	F	F	F		9
Balllyhoo	*Hemiramphus cf. brasiliensis*											0
Brown Garden Eel	*Heteroconger longissimus*											0
Glasseye Snapper	*Heteropriacanthus cruentatus*				S	S	F	x	M	S		6
Queen Angelfish	*Holacanthus ciliaris*	S	S		S	x	S		x			6
Rock Beauty	*Holacanthus tricolor*	F	F	M	F	F	F	F	F	F		9
Squirrelfish	*Holocentrus adscensionis*	F	F	F	F	M	M	F	F	S		9
Reef Squirrelfish	*Holocentrus coruscum*											0
Longspine Squirrelfish	*Holocentrus rufus*	M	F	F	F	F	F	F	F	F		9
Yellowbelly Hamlet	*Hypoplectrus aberrans*											0
Yellowtail Hamlet	*Hypoplectrus chlorurus*											0

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
Shy Hamlet	*Hypoplectrus guttavarius*											0
Indigo Hamlet	*Hypoplectrus indigo*											0
Black Hamlet	*Hypoplectrus nigricans*											0
Masked Hamlet	*Hypoplectrus providencianus*											0
Barred Hamlet	*Hypoplectrus puella*	S	x									2
	Hypoplectrus sp. (nigricans hibrido)											0
Hybrid Hamlet	*Hypoplectrus sp. (planifrons)*											0
Tan Hamlet	*Hypoplectrus randallorum (tan hamlet)*											0
Hybrid Hamlet	*Hypoplectrus sp. (variabilis)*											0
Butter Hamlet	*Hypoplectrus unicolor*											0
Boga	*Inermia vittata*						A					1
	Istiophorus albicans										x	1
Bermuda Chub/Yellow Chub	*Kyphosus spp.*	F	x	F			F	F	M	S		7
Downy Blenny	*Labrisomus kalisherae*											0
	Labrisomus sp.											0
	Lachnolaimus maximus											0
Spotted Trunkfish	*Lactophrys bicaudalis*							S	F			2
Trunkfish	*Lactophrys trigonus*											0
Smooth Trunkfish	*Lactophrys triqueter*				F	S	F	F	x	F		6
Peppermint Basslet	*Lipoproma rubre*											0
	Lucayablennius zingaro											0
Schoolmaster	*Lutjanus apodus*								x			1
Mahogany Snapper	*Lutjanus mahogoni*											0
Lane Snapper	*Lutjanus synagris*											0
Sand Tilefish	*Malacanthus plumieri*	F		F	F	F	F	F	F	F		8
Goldline Blenny	*Malacoctenus aurolineatus*											0
Diamond Blenny	*Malacoctenus boehlkei*			S								1
Rosy Blenny	*Malacoctenus macropus*											0
	Malacoctenus sp.											0
Barfin Blenny	*Malacoctenus versicolor*											0
Saddled Blenny	*Malacoctenus triangulatus*	F	M	F	F	F	F	F	F	F		9
Black Durgon	*Melichthys niger*	A	F	F	F	M	M	M	M	S		9
	Microgmathus ensenadae											0
Yellowtail Damselfish	*Microspathodon chrysurus*	M	F	F	F	F	F	F	F	F		9
Slender Filefish	*Monacanthus tuckeri*											0

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
Yellow Goatfish	*Mulloidichthys martinicus*	S					F	F	F	S		5
Yellowmouth Grouper	*Mycteroperca interstitialis*											0
	Mycteroperca phenax											0
Tiger Grouper	*Mycteroperca tigris*											0
Yellowfin Grouper	*Mycteroperca venenosa*											0
Sharptail Eel	*Myrichthys breviceps*		S									1
Blackbar Soldierfish	*Myripristis jacobus*	M			F	F	F	F	M	F		7
Longjaw Squirrelfish	*Neoniphon marianus*	S					F	F	F			4
Orangespotted Goby	*Nes longus*											0
Yellowtail Snapper	*Ocyurus chrysurus*											0
	Odontoscion dentex											0
Redlip Blenny	*Ophioblennius atlanticus (macrurei)*	S	S					x	F	x		5
Yellowhead Jawfish	*Opistognathus aurifrons*	F	S	S	M	M	A	M	M	S		9
	Opistognathus macrognathus											0
Creole - fish	*Paranthias furcifer*											0
Highhat	*Pareques acuminatus*						x			S		2
Glassy Sweeper	*Pempheris schomburgki*											0
Lionfish	*PEZ LEON (Pterois volitans)*	S	F		F		F	S	M	F		7
Dusky Cardinalfish	*Phaeoptyx pigmentaria*											0
Sponge Cardinalfish	*Phaeoptyx xenus*											0
Cardinal Soldierfish	*Plectrypops retrospinis*											0
Gray Angelfish	*Pomacanthus arcuatus*			S	F		S			F		4
French Angelfish	*Pomacanthus paru*	S	F	S	F	S	S	F	x			8
Longsnout Butetrflyfish	*Prognathodes aculeatus*											0
Spotted Goatfish	*Pseudupeneus maculatus*	F	S	F	S	F	F	F		F		8
Greater Soapfish	*Rypticus saponaceus*		x		S	S			S	S		5
Spotted Soapfish	*Rypticus subbifrenatus*											0
Dusky Squirrelfish	*Sargocentron vexillarium*					x		S	F			3
Midnight Parrotfish	*Scarus coelestinus*							S				1
	Scarus coeruleus											0
Striped Parrotfish	*Scarus iseri*	F	F	F	F	F	F	x	F			8
Princess Parrotfish	*Scarus taeniopterus*	M	F	F	F	F	M	F	F	F		9
Queen Parrotfish	*Scarus vetula*	S	S			S	S	S	F			6
Reef Scorpionfish	*Scorpaenodes caribbaeus*											0

FISH SPECIES		1	2	3	4	5	6	7	8	9	other	All
Spotted Scorpionfish	*Scorpaena plumieri*					S		x				2
Lantern bass	*Serranus baldwini*			S								1
Tobaccofish	*Serranus tabacarius*											0
Harlequin Bass	*Serranus tigrinus*	F	F	S	F	F				F		6
Greenblotch Parrotfish	*Sparisoma atomarium*	M	F	M	A	F	F	F	M	F		9
Redband Parrotfish	*Sparisoma aurofrenatum*	A	A	F	F	F	F	F	F	F		9
Redtail Parrotfish	*Sparisoma chrysopterum*	S	S	S	S	F	F	S	F	F		9
Bucktooth Parrotfish	*Sparisoma radians*											0
Yellowtail Parrotfish	*Sparisoma rubripinne*		x					F		x		3
Stoplight Parrotfish	*Sparisoma viride*	M	F	F	F	M	F	F	F	F		9
Bandtail Puffer	*Sphoeroides spengleri*											0
Great Barracuda	*Sphyraena barracuda*	S	S	x	S	S	F		M	S		8
	Sphyrna mokarran										x	1
Dwarf Blenny	*Starksia cf. nanodes*											0
Dusky Damselfish	*Stegastes adustus*	S				x	F	F	F	S		6
Longfin Damselfish	*Stegastes diencaeus*	F	F			F	F	F	F	S		7
Beaugregory	*Stegastes leucostictus*		F	F	F	F	F	F	F	F		8
Bicolor Damselfish	*Stegastes partitus*	A	M	F	M	M	F	S	M	A		9
Threespot Damselfish	*Stegastes planifrons*	F	S		S	F	M	F	F			7
Cocoa Damselfish	*Stegastes variabilis*		S		F	S	S	F	F	F		7
Sand Diver	*Synodus intermedius*											0
Bluestriped Lizardfish	*Synodus saurus*											0
Red Lizardfish	*Synodus synodus*				F							1
	Synodus sp.											0
Bluehead	*Thalassoma bifasciatum*	A	M	M	M	A	S	S	M	M		9
	Trachinotus falcatus							x				1
Yellow Stingray	*Urobatis jamaicensis*							x				1
Sargassum Triggerfish	*Xanthichthys ringens*			S	F	F			x			4
Rosy Razorfish	*Xyrichtys martinicensis*											0
Green Razorfish	*Xyrichtys splendens*				S	F	M	S	F	F		6
Total		**66**	**67**	**63**	**73**	**71**	**77**	**85**	**81**	**76**		**124**

Table 6b. Fish species observed at Bajo Nuevo.

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
Sergeant Major	*Abudefduf saxatilis*			F	F			F				M		M	F		6
	Abudefduf taurus																0
Roughhead Blenny	*Acanthemblemaria aspera*		S	S	S	S											4
Medusa Blenny	*Acanthemblemaria medusa*																0
	Acanthemblemaria sp.												S				1
Spinyhead Blenny	*Acanthemblemaria spinosa*		F	F	S		M	F					S				6
Scrawled Cowfish	*Acanthostracion quadricornis*																0
Honeycomb Cowfish	*Acanthostracion polygonius*	S	F	F	S	S	S		F	S	F	S		F	F		12
Ocean Surgeonfish	*Acanthurus bahianus*	F	F	M	F	M	M	F	M	M	M	F	F	M	M	F	15
Doctorfish	*Acanthurus chirurgus*	F	F		F		F		F		F	F	S	M			9
Blue Tang	*Acanthurus coeruleus*	M	M	F	F	M	F	F	F	F	F	M	F	M	F	M	15
	Aetobatus narinari																0
	Alectis cilliaris																0
Scrawled Filefish	*Aluterus scriptus*		S		S		S					S		F	X		6
Redspotted Hawkfish	*Amblycirrhitus pinos*	F							F		S				S		4
Porkfish	*Anisotremus virginicus*																0
Barred Cardinalfish	*Apogon binotatus*																0
Flamefish	*Apogon maculatus*																0
Twospot Cardinalfish	*Apogon pseudomaculatus*																0
	Astrapogon stellatus											S					1
Trumpetfish	*Aulostomus maculatus*	F	F	S	F	S	S			F		F	F	F	F	X	12
Queen Triggerfish	*Balistes vetula*	F	M	F	S	F	F	S	F	M	F	M	S	F	M	X	15
Spanish Hogfish	*Bodianus rufus*	F	F	F	S	S			S	F	F	M	F	F	S	X	13
Peacock Flounder	*Bothus lunatus*												S				1
Saucereye Porgy	*Calamus calamus*					S	F			S							3
Whitespotted Filefish	*Cantherhines macrocerus*	S	S		X	S	F	F		F		S	F	F	F		11
Orangespotted Filefish	*Cantherhines pullus*	S	F	F	S	S	F		S	S		S		F	F		11
Ocean Triggerfish	*Canthidermis sufflamen*		F		S	F	S							F	F		6
Sharpnose Puffer	*Canthigaster rostrata*	F	F	F	F	F	F	F	M	F	F	F	F	F	M	M	15
Yellow Jack	*Caranx bartholomaei*			S			F							F			3
Blue Runner	*Caranx crysos*			S	F	F						F	F	F			6
crevale jack	*Caranx hippos*																0
Horse-eye Jack	*Caranx latus*																0
Black Jack	*Caranx lugubris*	S	F	S											F		4

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
Bar Jack	*Caranx ruber*	F	F	F	F	F	F	F	F	F	F	F	F	F	F	S	15
	Caranx sp.						F										1
Cherubfish	*Centropyge argi*									F	F				X		3
Graysby	*Cephalopholis cruentata*	F	F	F	F	F	F	F	F	F	F	S	S	F	F	S	15
Coney	*Cephalopholis fulva*	F	F			F			F	M	F	F		S	M	X	10
Yellowface Pikeblenny	*Chaenopsis limbaughi*			F													1
Foureye Butterflyfish	*Chaetodon capistratus*	F	F	F	F	F	F	F	F	F	F	F	F	F	F	X	15
Spotfin Butterflyfish	*Chaetodon ocellatus*		S	S	F				F	S		F	S	F	X		9
	Chaetodon sedentarius																0
Banded Butterflyfish	*Chaetodon striatus*	S	F	F	F	F		F	F	S	F	F	F	F	F	X	14
Bridled Burrfish	*Chilomycterus antennatus*									S							1
Blue Chromis	*Chromis cyanea*	M	S	M	M	M	M	M	M	M	F	S	M	S	A	X	15
Sunshinefish	*Chromis insolata*														M		1
Brown Chromis	*Chromis multilineata*	M	S	M	M	F	M	F			F	M	M	M	F	M	13
Creole Wrasse	*Clepticus parrae*	M	S	M	M	M	M	M	F			M	M	S	S	M	13
Colon Goby	*Coryphopterus dicrus*											F	F	S	F	X	5
Pallid Goby	*Coryphopterus eidolon*			F	S	F	S					F					5
Bridled Goby	*Coryphopterus glaucofraenum*	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	15
Kuna Goby	*Coryphopterus retrospinis*				S	F											2
Masked Goby	*Coryphopterus personatus*	S		F	M	M	F	M				M	M	M	X	M	11
Bluelip Parrotfish	*Cryptotomus roseus*					F											1
Southern Stingray	*Dasyatis americana*			S			M					S					3
Mackerel Scad	*Decapterus macarellus*	A	A												A		3
Balloonfish	*Diodon holocanthus*												S				1
Porcupinefish	*Diodon hystrix*	S		S	S							S	S				5
Sharknose Goby	*Elacatinus evelynae*		F		X	S		F				F	S			X	7
	Elacatinus genie																0
Yellowline Goby	*Elacatinus horsti*	F	F	S	F	F	F	S	F	F	M	M	F	F	X	F	15
	Elacatinus illecebrosus/																0
	Elacatinus louisae																0
Broadstripe Goby	*Elacatinus prochilos*	F	F	M	F	F	S	F	F	F	F	F	S	F	F	F	15
	Elacatinus sp.																0
Sailfin Blenny	*Emblemaria pandionis*																0
Lofty Triplefin	*Enneanectes altivelis*							F									1
Roughhead Triplefin	*Enneanectes boehlkei*																0
Red Hind	*Epinephelus guttatus*		S					F					S				3
Jewfish	*Epinephelus itajara*																0

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
	Equetus lanceolatus														S		1
Spotted Drum	*Equetus punctatus*			S	X								S		S		4
Nurse Shark	*Ginglymostoma cirratum*			S	F		S	S				F	S	F	S	X	9
Goldspot Goby	*Gnatholepis thompsoni*	F	F	M	F	F	F	S	F		F	F	F	F	F	F	14
Goby sp	*Gobidae sp1*					S											1
Orangeside Goby	*Gobiosoma dilepis*			S													1
Fairy Basslet	*Gramma loreto*	F	F	F	F	F	F	F	F	F	F	M	M	M	M	M	15
Goldentail Moray	*Gymnothorax miliaris*				S										X		2
Spotted Moray	*Gymnothorax moringa*		S		X			S	S			F				X	6
White Margate	*Haemulon album*			M	S		F	S	F		F	F	F			F	9
Tomtate	*Haemulon aurolineatum*					F					F					X	3
Caesar Grunt	*Haemulon carbonarium*		F						F						F		3
Spanish Grunt	*Haemulon macrostomum*																0
Smallmouth Grunt	*Haemulon chrysargyreum*	F															1
French Grunt	*Haemulon flavolineatum*	F	F	F	F	F	F	F	F	F	F	F	S	F	M	F	15
Cottonwick	*Haemulon melanurum*										S	F					2
Sailors Choice	*Haemulon parra*																0
White Grunt	*Haemulon plumierii*		S			S	F										3
	Haemulon sciurus																0
Slippery Dick	*Halichoeres bivittatus*	F		F	F	F	F	M			M	F	F	F		X	11
Yellowcheek Wrasse	*Halichoeres cyanocephalus*										F				S		2
Yellowhead Wrasse	*Halichoeres garnoti*	F	F	F	A	F	F	F	F	M	F	F	F	F	F	F	15
Clown Wrasse	*Halichoeres maculipinna*	S	M	F	F	F				F	F	F	F	F			10
Rainbow Wrasse	*Halichoeres pictus*											F		F	X	X	4
Blackear Wrasse	*Halichoeres poeyi*																0
Puddingwife	*Halichoeres radiatus*	F	S	S	M	F	F	F	F	F	S	F	F	F	X	X	15
Balllyhoo	*Hemiramphus cf. brasiliensis*					M	M										2
Brown Garden Eel	*Heteroconger longissimus*			M		M											2
Glasseye Snapper	*Heteropriacanthus cruentatus*	S	S	S	S				S								5
Queen Angelfish	*Holacanthus ciliaris*	S		S					S		F	F	F	S	X	X	9
Rock Beauty	*Holacanthus tricolor*	F	F	F	F	F	F	F	F	F	F	F	F	F	X	F	15
Squirrelfish	*Holocentrus adscensionis*	F	S	S		F		F			F	S	S	F	F		10
Reef Squirrelfish	*Holocentrus coruscum*				S									S		F	3
Longspine Squirrelfish	*Holocentrus rufus*	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	15
Yellowbelly Hamlet	*Hypoplectrus aberrans*	S	S		X	S							S			X	6
Yellowtail Hamlet	*Hypoplectrus chlorurus*											0					

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
Shy Hamlet	*Hypoplectrus guttavarius*	S						S*									2
Indigo Hamlet	*Hypoplectrus indigo*	F	F	S	S	F		S		S		S	F			X	10
Black Hamlet	*Hypoplectrus nigricans*		F	S	S	S	S										5
Masked Hamlet	*Hypoplectrus providencianus*	S	F	F	M	F	M	M				M	M	M	X	F	12
Barred Hamlet	*Hypoplectrus puella*	S		F	F	S	M	F				F	S	M		S	10
	Hypoplectrus sp. (nigricans hibrido)	F	F	F	F	S	S	S		S		F	F	F	X	S	13
Hybrid Hamlet	*Hypoplectrus sp. (planifrons)*			S				S									2
Tan Hamlet	*Hypoplectrus randallorum (tan hamlet)*				S												1
Hybrid Hamlet	*Hypoplectrus sp. (variabilis)*	S		S	X	F	S	F				S		S		S	9
Butter Hamlet	*Hypoplectrus unicolor*	S		S		S		S									4
Boga	*Inermia vittata*	F	S			S				S		S			X		6
	Istiophorus albicans		M		F						M						3
Bermuda Chub/Yellow	*Kyphosus spp.*																0
Downy Blenny	*Labrisomus kalisherae*		M	M	F									M		X	5
	Labrisomus sp.																0
	Lachnolaimus maximus																0
Spotted Trunkfish	*Lactophrys bicaudalis*													S			1
Trunkfish	*Lactophrys trigonus*		S	F	S	S	S	S	S				S			S	9
Smooth Trunkfish	*Lactophrys triqueter*						F										1
Peppermint Basslet	*Lipoproma rubre*		F	S	F	S			F	F	S	S	F	S	X	S	12
	Lucayablennius zingaro											S					1
Schoolmaster	*Lutjanus apodus*															X	1
Mahogany Snapper	*Lutjanus mahogoni*													S			1
Lane Snapper	*Lutjanus synagris*			F	S												2
Sand Tilefish	*Malacanthus plumieri*																0
Goldline Blenny	*Malacoctenus aurolineatus*	S	F		X	S			S	S	S	F			F	X	10
Diamond Blenny	*Malacoctenus boehlkei*																0
Rosy Blenny	*Malacoctenus macropus*	F			X					S		F	F	S		X	7
	Malacoctenus sp.							S									1
Barfin Blenny	*Malacoctenus versicolor*																0
Saddled Blenny	*Malacoctenus triangulatus*											F					1
Black Durgon	*Melichthys niger*	F	S	F	F	M			S	S	S	F	F	F	X	X	13
	Microgmathus ensenadae	S	S	F	F	M		F	M	M	M	F	F	F	S	F	14
Yellowtail Damselfish	*Microspathodon chrysurus*																0
Slender Filefish	*Monacanthus tuckeri*	F	F	M	F	F	F	F	F	F	F	F	F	M	M	X	15

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
Yellow Goatfish	*Mulloidichthys martinicus*	F	F	F	M	F	F	F	F	F	F	F	M	M	M	F	15
Yellowmouth Grouper	*Mycteroperca interstitialis*			S	S												2
	Mycteroperca phenax					S	S										2
Tiger Grouper	*Mycteroperca tigris*							S									1
Yellowfin Grouper	*Mycteroperca venenosa*			F											X		2
Sharptail Eel	*Myrichthys breviceps*																0
Blackbar Soldierfish	*Myripristis jacobus*	F		F		F			F	S		F	F	F	F	X	10
Longjaw Squirrelfish	*Neoniphon marianus*	F	S	F	F	F		F		F			F	F	S		10
Orangespotted Goby	*Nes longus*				S											F	2
Yellowtail Snapper	*Ocyurus chrysurus*				S		F	S				S		F		S	6
	Odontoscion dentex																0
Redlip Blenny	*Ophioblennius atlanticus (macleayi)*											F		F			2
Yellowhead Jawfish	*Opistognathus aurifrons*	F	F			F						F					4
	Opistognathus macrognathus															S	1
Creole - fish	*Paranthias furcifer*														S		1
Highhat	*Pareques acuminatus*		S														1
Glassy Sweeper	*Pempheris schomburgki*													F			1
Lionfish	*PEZ LEON (Pterois volitans)*	S				S		S	F	F		F			F (2)	F (2)	8
Dusky Cardinalfish	*Phaeoptyx pigmentaria*																0
Sponge Cardinalfish	*Phaeoptyx xenus*					S	S	F									3
Cardinal Soldierfish	*Plectrypops retrospinis*				S	S		S									3
Gray Angelfish	*Pomacanthus arcuatus*																0
French Angelfish	*Pomacanthus paru*					S			F		S	F				X	5
Longsnout Butetrflyfish	*Prognathodes aculeatus*	F	M			S		S	F	F		S			X		8
Spotted Goatfish	*Pseudupeneus maculatus*	F	S	F	F	F	F	F	F	F	F	F	S	F	F	F	15
Greater Soapfish	*Rypticus saponaceus*				F										S		2
Spotted Soapfish	*Rypticus subbifrenatus*							F									1
Dusky Squirrelfish	*Sargocentron vexillarium*					S						F		S	X	F	5
Midnight Parrotfish	*Scarus coelestinus*					S	F										2
	Scarus coeruleus																0
Striped Parrotfish	*Scarus iseri*	F	F	F	F	M	F	M	S	F	F	F	F	M	F	F	15
Princess Parrotfish	*Scarus taeniopterus*	F	F	F	F	F	F	M	F	F	F	M	M	F	F	F	15
Queen Parrotfish	*Scarus vetula*		F	F	S	F	F	F		F	F	M	F	M	F	F	13
Reef Scorpionfish	*Scorpaenodes caribbaeus*																0
Spotted Scorpionfish	*Scorpaena plumieri*											F	F				2

FISH SPECIES		10	11	12	13	14	15	16	25	26	27	28	29	30	31	32	All
Lantern bass	*Serranus baldwini*																0
Tobaccofish	*Serranus tabacarius*	S			S	F	S	F			F			S	F	S	9
Harlequin Bass	*Serranus tigrinus*		F		F		F		S	F		F	S	F	F	F	10
Greenblotch Parrotfish	*Sparisoma atomarium*	F	F	M	M	M	M	F	M	M	F	S	F	M	X	F	15
Redband Parrotfish	*Sparisoma aurofrenatum*	F	F	F	F	M	F	F	F	M	A	M	M	M	F	F	15
Redtail Parrotfish	*Sparisoma chrysopterum*				F	S	F	F	F	F	F	F		S	F		10
Bucktooth Parrotfish	*Sparisoma radians*														X		1
Yellowtail Parrotfish	*Sparisoma rubripinne*				F				F		F	F		F	F	X	7
Stoplight Parrotfish	*Sparisoma viride*	F	F	F	F	F	M	F	F	F	F	M	F	M	F	F	15
Bandtail Puffer	*Sphoeroides spengleri*					S						F					2
Great Barracuda	*Sphyraena barracuda*		F		S		F		F		F	F	S	M	F	X	10
	Sphyrna mokarran																0
Dwarf Blenny	*Starksia cf. nanodes*																0
Dusky Damselfish	*Stegastes adustus*	F	F	F		F	F	F				M	F	F		M	10
Longfin Damselfish	*Stegastes diencaeus*	S	F	F	F	S	F	M	F	M	F	F	M	M	F	F	15
Beaugregory	*Stegastes leucostictus*	F	F	F	F	F	F	F		S		F	F	F	X	F	13
Bicolor Damselfish	*Stegastes partitus*	M	M	F	F	M	F	M	M	M	M	F	M	F	X	M	15
Threespot Damselfish	*Stegastes planifrons*	F	F	F	M	F	F	F				M	F	M	M	M	12
Cocoa Damselfish	*Stegastes variabilis*	F	F	S	F			F				F	F	S		F	9
Sand Diver	*Synodus intermedius*							S				S	F	S			4
Bluestriped Lizardfish	*Synodus saurus*													S		X	2
Red Lizardfish	*Synodus synodus*																0
	Synodus sp.																0
Bluehead	*Thalassoma bifasciatum*	M	M	M	M	M	M		M		M	M	M	M	X	M	13
	Trachinotus falcatus													S			1
Yellow Stingray	*Urobatis jamaicensis*								S	S	S	F				S	5
Sargassum Triggerfish	*Xanthichthys ringens*	F							S								2
Rosy Razorfish	*Xyrichtys martinicensis*																0
Green Razorfish	*Xyrichtys splendens*	S										S					2
Total		**75**	**78**	**81**	**91**	**88**	**69**	**70**	**58**	**56**	**57**	**94**	**75**	**84**	**82**	**78**	**165**

Table 6c. Fish species observed at Serranilla

FISH SPECIES		17	18	19	20	21	22	23	24	All
Sergeant Major	***Abudefduf saxatilis***	A	S	S	X	F				5
	Abudefduf taurus									0
Roughhead Blenny	***Acanthemblemaria aspera***			S	F	S		S	S	5
Medusa Blenny	***Acanthemblemaria medusa***	S			F					2
	Acanthemblemaria sp.									0
Spinyhead Blenny	***Acanthemblemaria spinosa***				F					1
Scrawled Cowfish	***Acanthostracion quadricornis***									0
Honeycomb Cowfish	***Acanthostracion polygonius***	S	F	F	S	S	F		F	7
Ocean Surgeonfish	***Acanthurus bahianus***	M	M	F	F	M	M	F	F	8
Doctorfish	***Acanthurus chirurgus***	F	F	F	F	S	M	F	M	8
Blue Tang	***Acanthurus coeruleus***	M	F	M	F	M	F	F	M	8
	Aetobatus narinari									0
	Alectis cilliaris									0
Scrawled Filefish	***Aluterus scriptus***			S						1
Redspotted Hawkfish	***Amblycirrhitus pinos***	F	F	S	F	S	S	X	S	8
Porkfish	***Anisotremus virginicus***			F						1
Barred Cardinalfish	***Apogon binotatus***			F		F				2
Flamefish	***Apogon maculatus***	S		F		M	M			4
Twospot Cardinalfish	***Apogon pseudomaculatus***			S						1
	Astrapogon stellatus				X					1
Trumpetfish	***Aulostomus maculatus***		F		F	S	S		X	5
Queen Triggerfish	***Balistes vetula***	F	F	F	F	M	F	S	S	8
Spanish Hogfish	***Bodianus rufus***	F	F	S	F	F	F	F	F	8
Peacock Flounder	***Bothus lunatus***									0
Saucereye Porgy	***Calamus calamus***	S	S	F	S	F		S	F	7
Whitespotted Filefish	***Cantherhines macrocerus***					S	F			2
Orangespotted Filefish	***Cantherhines pullus***	F	S	F	S	F	S		S	7
Ocean Triggerfish	***Canthidermis sufflamen***	F		F		F	F	X		5
Sharpnose Puffer	***Canthigaster rostrata***	F	F		F	F	F	F	M	7
Yellow Jack	***Caranx bartholomaei***		F			F				2
Blue Runner	***Caranx crysos***	S		M						2
crevale jack	***Caranx hippos***									0
Horse-eye Jack	***Caranx latus***									0
Black Jack	***Caranx lugubris***									0

FISH SPECIES		17	18	19	20	21	22	23	24	All
Bar Jack	*Caranx ruber*	F	F	S	S	F	F	X	F	8
	Caranx sp.									0
Cherubfish	*Centropyge argi*			M		F		F	F	4
Graysby	*Cephalopholis cruentata*		S	F	F	F	F	F	F	7
Coney	*Cephalopholis fulva*	S	F	F		F	F	S	F	7
Yellowface Pikeblenny	*Chaenopsis limbaughi*							F		1
Foureye Butterflyfish	*Chaetodon capistratus*				S			F	F	3
Spotfin Butterflyfish	*Chaetodon ocellatus*						X	X	X	3
	Chaetodon sedentarius									0
Banded Butterflyfish	*Chaetodon striatus*	S	F	S		F	F	F		6
Bridled Burrfish	*Chilomycterus antennatus*									0
Blue Chromis	*Chromis cyanea*	M	F	M	M	M	M	M	M	8
Sunshinefish	*Chromis insolata*								F	1
Brown Chromis	*Chromis multilineata*	M	M	M	F	M	M	X	F	8
Creole Wrasse	*Clepticus parrae*	F	M	M	S	M	F	M	S	8
Colon Goby	*Coryphopterus dicrus*	S		S	F	F	S	F	F	7
Pallid Goby	*Coryphopterus eidolon*									0
Bridled Goby	*Coryphopterus glaucofraenum*	M		F	X	F	F	F	F	7
Kuna Goby	*Coryphopterus retrospinis*				F	F				2
Masked Goby	*Coryphopterus personatus*	F						X	F	3
Bluelip Parrotfish	*Cryptotomus roseus*							F		1
Southern Stingray	*Dasyatis americana*		S							1
Mackerel Scad	*Decapterus macarellus*									0
Balloonfish	*Diodon holocanthus*									0
Porcupinefish	*Diodon hystrix*						S			1
Sharknose Goby	*Elacatinus evelynae*					F		S		2
	Elacatinus genie									0
Yellowline Goby	*Elacatinus horsti*				F	F	F	F	S	5
	Elacatinus illecebrosus/ Gobiosoma sp.				S					1
	Elacatinus louisae									0
Broadstripe Goby	*Elacatinus prochilos*	M	F	F	F	F	F	F	F	8
	Elacatinus sp.				X					1
Sailfin Blenny	*Emblemaria pandionis*						S			1
Lofty Triplefin	*Enneanectes altivelis*									0
Roughhead Triplefin	*Enneanectes boehlkei*	S								1
Red Hind	*Epinephelus guttatus*									0
Jewfish	*Epinephelus itajara*									0

FISH SPECIES		17	18	19	20	21	22	23	24	all
	Equetus lanceolatus									0
Spotted Drum	***Equetus punctatus***									0
Nurse Shark	***Ginglymostoma cirratum***	F		S	S	S	F		S	6
Goldspot Goby	***Gnatholepis thompsoni***		S	F				F	F	4
Goby sp	***Gobidae sp1***									0
Orangeside Goby	***Gobiosoma dilepis***									0
Fairy Basslet	***Gramma loreto***	M	F	M	F	M	M	F	M	8
Goldentail Moray	***Gymnothorax miliaris***			S		S	S	S		4
Spotted Moray	***Gymnothorax moringa***			S						1
White Margate	***Haemulon album***		S	S			F	X	F	5
Tomtate	***Haemulon aurolineatum***		M	M				M	F	4
Caesar Grunt	***Haemulon carbonarium***	M	M	F	F	M	M	F	F	8
Spanish Grunt	***Haemulon macrostomum***									0
Smallmouth Grunt	***Haemulon chrysargyreum***								F	1
French Grunt	***Haemulon flavolineatum***	M	F	F	F	M	M	F	F	8
Cottonwick	***Haemulon melanurum***		F	F						2
Sailors Choice	***Haemulon parra***								S	1
White Grunt	***Haemulon plumierii***	F	F	S	S	F	M	F	F	8
	Haemulon sciurus		F							1
Slippery Dick	***Halichoeres bivittatus***	F	F	F	A	F	M	M	F	8
Yellowcheek Wrasse	***Halichoeres cyanocephalus***									0
Yellowhead Wrasse	***Halichoeres garnoti***	F	A	F	A	A	A	M	F	8
Clown Wrasse	***Halichoeres maculipinna***	F	S	F	X	F	F	F	X	8
Rainbow Wrasse	***Halichoeres pictus***			M	F	M	M	S	F	6
Blackear Wrasse	***Halichoeres poeyi***			F						1
Puddingwife	***Halichoeres radiatus***	F	F	F	F	F	M	X	X	8
Balllyhoo	***Hemiramphus cf. brasiliensis***					X				1
Brown Garden Eel	***Heteroconger longissimus***									0
Glasseye Snapper	***Heteropriacanthus cruentatus***	F				F				2
Queen Angelfish	***Holacanthus ciliaris***		S	S	S	S	F	F	F	7
Rock Beauty	***Holacanthus tricolor***	S	F	F	F	F	F	F	S	8
Squirrelfish	***Holocentrus adscensionis***	F	F	F	F	F	F	F		7
Reef Squirrelfish	***Holocentrus coruscum***						X			1
Longspine Squirrelfish	***Holocentrus rufus***	F	F	F	F	F	F	F	F	8
Yellowbelly Hamlet	***Hypoplectrus aberrans***								X	1
Yellowtail Hamlet	***Hypoplectrus chlorurus***									0

FISH SPECIES		17	18	19	20	21	22	23	24	All
Shy Hamlet	*Hypoplectrus guttavarius*								S	1
Indigo Hamlet	*Hypoplectrus indigo*									0
Black Hamlet	*Hypoplectrus nigricans*								F	1
Masked Hamlet	*Hypoplectrus providencianus*								S	1
Barred Hamlet	*Hypoplectrus puella*				S			F	F	3
	Hypoplectrus sp. (nigricans hibrido)									0
Hybrid Hamlet	*Hypoplectrus sp. (planifrons)*									0
Tan Hamlet	*Hypoplectrus randallorum (tan*									0
Hybrid Hamlet	*Hypoplectrus sp. (variabilis)*								F	1
Butter Hamlet	*Hypoplectrus unicolor*									0
Boga	*Inermia vittata*							X		1
	Istiophorus albicans									0
Bermuda Chub/Yellow	*Kyphosus spp.*	F		F	F	F				4
Downy Blenny	*Labrisomus kalisherae*						S			1
	Labrisomus sp.	S								1
	Lachnolaimus maximus									0
Spotted Trunkfish	*Lactophrys bicaudalis*		S	S				S	S	4
Trunkfish	*Lactophrys trigonus*									0
Smooth Trunkfish	*Lactophrys triqueter*	S	S	F		S		X		5
Peppermint Basslet	*Lipoproma rubre*					S			S	2
	Lucayablennius zingaro									0
Schoolmaster	*Lutjanus apodus*		S	S			F			3
Mahogany Snapper	*Lutjanus mahogoni*	S	F				X		S	4
Lane Snapper	*Lutjanus synagris*									0
Sand Tilefish	*Malacanthus plumieri*			F			S	S	S	4
Goldline Blenny	*Malacoctenus aurolineatus*						F			1
Diamond Blenny	*Malacoctenus boehlkei*									0
Rosy Blenny	*Malacoctenus macropus*	S								1
	Malacoctenus sp.						S			1
Barfin Blenny	*Malacoctenus versicolor*									0
Saddled Blenny	*Malacoctenus triangulatus*	F	S	F	S	F	F	F	S	8
Black Durgon	*Melichthys niger*	M	M	F	F	M	M		F	7
	Microgmathus ensenadae									0
Yellowtail Damselfish	*Microspathodon chrysurus*	F	M	F	F	F	F	F	F	8
Slender Filefish	*Monacanthus tuckeri*									0

FISH SPECIES		17	18	19	20	21	22	23	24	All
Yellow Goatfish	***Mulloidichthys martinicus***			F	F	M	S			4
Yellowmouth Grouper	***Mycteroperca interstitialis***									0
	Mycteroperca phenax									0
Tiger Grouper	***Mycteroperca tigris***									0
Yellowfin Grouper	***Mycteroperca venenosa***									0
Sharptail Eel	***Myrichthys breviceps***									0
Blackbar Soldierfish	***Myripristis jacobus***	S	F		F	F	F	F	F	7
Longjaw Squirrelfish	***Neoniphon marianus***		F			S	F		F	4
Orangespotted Goby	***Nes longus***									0
Yellowtail Snapper	***Ocyurus chrysurus***			S	X		S		F	4
	Odontoscion dentex									0
Redlip Blenny	***Ophioblennius atlanticus (macleayi)***	S	S	S		X	M	F		6
Yellowhead Jawfish	***Opistognathus aurifrons***			F	F	F		F		4
	Opistognathus macrognathus									0
Creole - fish	***Paranthias furcifer***									0
Highhat	***Pareques acuminatus***								X	1
Glassy Sweeper	***Pempheris schomburgki***	M								1
Lionfish	***PEZ LEON (Pterois volitans)***			F		F (4)		F	S	4
Dusky Cardinalfish	***Phaeoptyx pigmentaria***						M			1
Sponge Cardinalfish	***Phaeoptyx xenus***				S			F		2
Cardinal Soldierfish	***Plectrypops retrospinis***				X					1
Gray Angelfish	***Pomacanthus arcuatus***								F	1
French Angelfish	***Pomacanthus paru***	F	S		X	F		X	F	6
Longsnout Butetrflyfish	***Prognathodes aculeatus***	F						S		2
Spotted Goatfish	***Pseudupeneus maculatus***	F		F	F	S		F	F	6
Greater Soapfish	***Rypticus saponaceus***					X	X			2
Spotted Soapfish	***Rypticus subbifrenatus***						S			1
Dusky Squirrelfish	***Sargocentron vexillarium***	F	F		S		F		X	5
Midnight Parrotfish	***Scarus coelestinus***					F	S			2
	Scarus coeruleus									0
Striped Parrotfish	***Scarus iseri***	M	F	M	F	F	M	F	F	8
Princess Parrotfish	***Scarus taeniopterus***	S	M	M	F	F	F	M	F	8
Queen Parrotfish	***Scarus vetula***	F	S	F	M	F	F	S	M	8
Reef Scorpionfish	***Scorpaenodes caribbaeus***	S								1

FISH SPECIES		17	18	19	20	21	22	23	24	All
Spotted Scorpionfish	*Scorpaena plumieri*						S			1
Lantern bass	*Serranus baldwini*							S		1
Tobaccofish	*Serranus tabacarius*			S	S			S		3
Harlequin Bass	*Serranus tigrinus*			F		S		F		3
Greenblotch Parrotfish	*Sparisoma atomarium*	F	F	F	F	F	F	M	F	8
Redband Parrotfish	*Sparisoma aurofrenatum*	F	F	F	F	F	F	F	F	8
Redtail Parrotfish	*Sparisoma chrysopterum*	F		F	X		S			4
Bucktooth Parrotfish	*Sparisoma radians*	S			M					2
Yellowtail Parrotfish	*Sparisoma rubripinne*	F	M	S	M	F	M			6
Stoplight Parrotfish	*Sparisoma viride*	F	F	M	F	F	F	F	F	8
Bandtail Puffer	*Sphoeroides spengleri*			F						1
Great Barracuda	*Sphyraena barracuda*			S		S	S	S		4
	Sphyrna mokarran									0
Dwarf Blenny	*Starksia cf. nanodes*						S			1
Dusky Damselfish	*Stegastes adustus*	F	M	M	F	S	F	F	F	8
Longfin Damselfish	*Stegastes diencaeus*	A	M	F	F	M	F	F	F	8
Beaugregory	*Stegastes leucostictus*	F	M	F	F	S	F	F	F	8
Bicolor Damselfish	*Stegastes partitus*	M	F	M	M	M	S	F	M	8
Threespot Damselfish	*Stegastes planifrons*	F	F	A	M	M	M	F	M	8
Cocoa Damselfish	*Stegastes variabilis*	F	M	F	F	F	F	F	F	8
Sand Diver	*Synodus intermedius*								S	1
Bluestriped Lizardfish	*Synodus saurus*									0
Red Lizardfish	*Synodus synodus*									0
	Synodus sp.									0
Bluehead	*Thalassoma bifasciatum*	S	M	M	M	M	M	M	M	8
	Trachinotus falcatus									0
Yellow Stingray	*Urobatis jamaicensis*									0
Sargassum Triggerfish	*Xanthichthys ringens*									0
Rosy Razorfish	*Xyrichtys martinicensis*							M		1
Green Razorfish	*Xyrichtys splendens*	F		F		S	S	F		5
Total		**72**	**65**	**84**	**74**	**82**	**82**	**79**	**81**	**148**

3. Herbivory studies

Khaled bin Sultan Living Oceans Foundation Postdoctoral Fellow Sonia Bejarano, quantified the abundance and the grazing intensity of herbivorous reef fish in the remote banks of the Colombian Caribbean. Abundance of herbivorous reef fish was determined using the standard belt-transect technique, running 5-8 transects of 30 x 4 m per site. Fish within the transects were identified to a species level, with life phase recorded for parrotfishes, and size as total length was visually estimated. Fish census were conducted in a total of 16 sites, five of which were located in Bajo Alicia, two in Bajo Nuevo and three in Serranilla.

In seven of the surveyed sites, Sonia also quantified the grazing intensity of the herbivorous fish community in the absence of divers. With this purpose, she fixed 10 high-definition video cameras on the substratum and programmed them to record continuously all fish activity for 2.5 hours in the afternoon, when grazing tends to be maximum. The position of each camera was selected haphazardly, but ensuring that distance from others was at least 5 m, and that a 1 m^2 reef plot dominated by algal turfs could be adequately framed.

Footage will be replayed back in the Marine Spatial Ecology Lab in the University of Queensland, and data on the bite rate (bites per minute) of individual fish will be extracted. Mean grazing intensity (m^2 grazed per hour) of the entire fish community, as well as the contribution of individual species to the grazing function, a key process in maintaining the resilience of reefs, will be quantified.

4. Groundtruthing

The groundtruthing team used a combination of Ikonos imagery (provided by CORALINA) and Digital Globe's WorldView 2 imagery to identify features of interest and to navigate through the study area. The total amount of imagery purchased is shown in Table 7.

Table 7. Total area of WorldView 2 4 band multispectral satellite imagery acquired for this project.

Location	Site	Polygon area (sq km)
COLOMBIA	All	3198
	Serranilla	2387.4
	Bajo Nuevo	369.72
	Alice Shoals	440.27

During surveys at Alice, the team collected a total of 69 Dropcam videos and 226473 depth soundings. The groundtruthing track is shown in Fig.4. During surveys at Bajo Nuevo the team collected a total of 108 Dropcam videos and 60227 depth soundings. The groundtruthing track is shown in Fig. 5. During surveys at Serranilla the team collected a total of 70 Dropcam videos and 78071 depth soundings. The groundtruthing track is shown in Fig. 6.

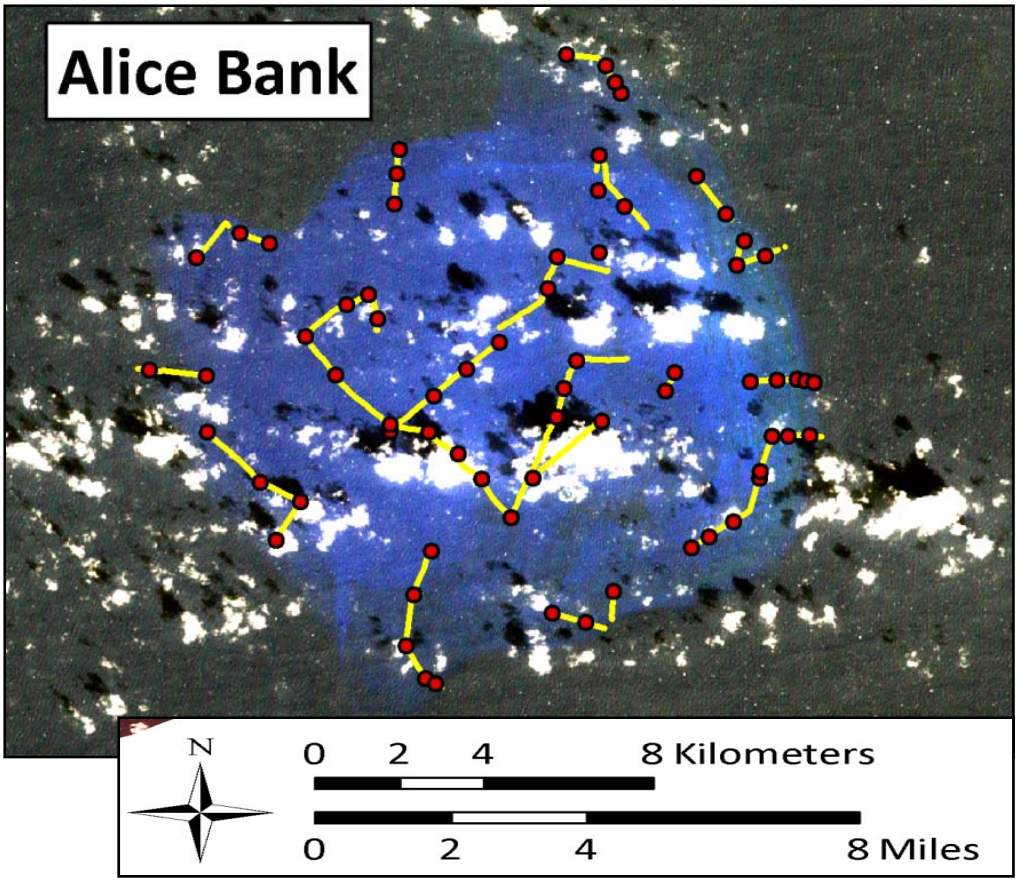

Fig. 4. Route taken by the twin V (yellow line) on Alice Bank and location of drop camera deployments (red dots) during groundtruthing efforts.

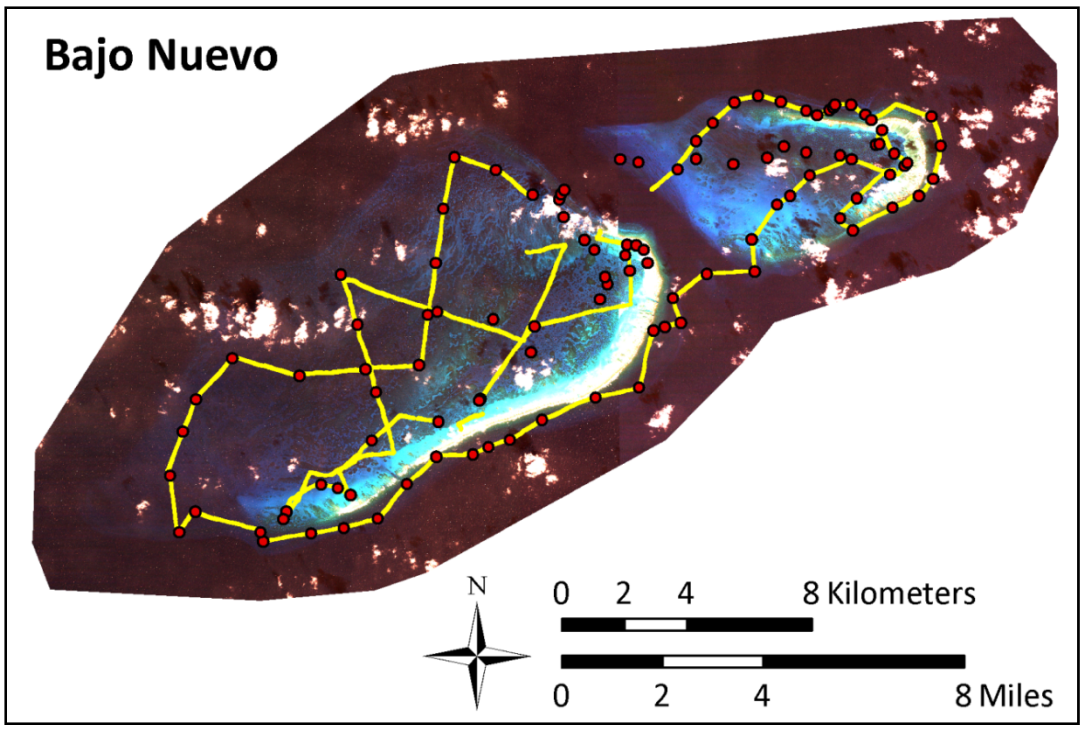

Fig. 5. Route taken by the twin V (yellow line) on Bajo Nuevo and location of drop camera deployments (red dots) during groundtruthing efforts.

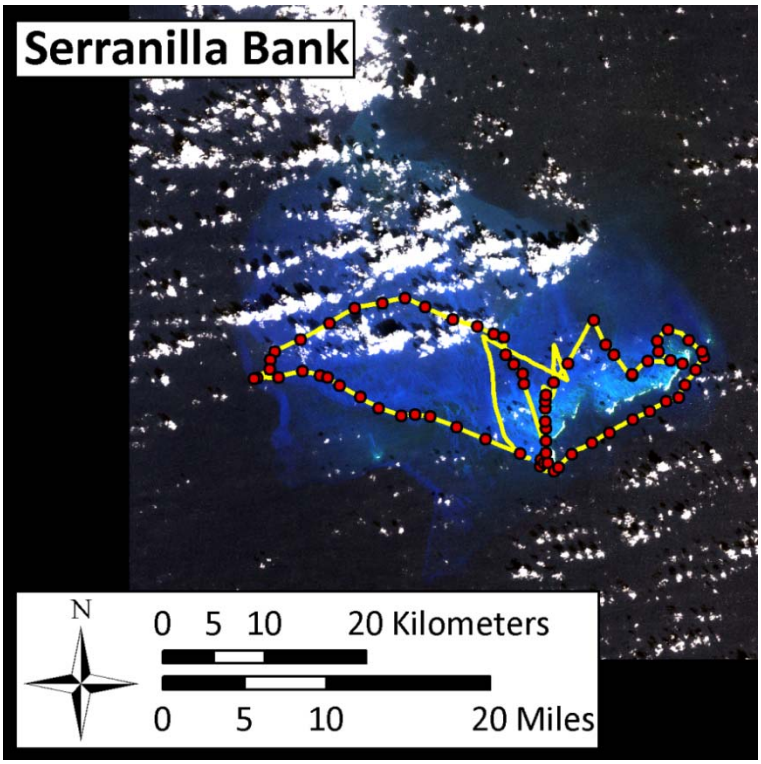

Fig. 6. Route taken by the Twin V (yellow line) on Serranilla and location of drop camera deployments (red dots) during groundtruthing efforts.

5. Turtles and mammals

Between 11th y 23 of April of 2012 Judy Pacheco collected data on birds, turtles and mammals during surveys of reef complexes of Serranilla, Alicia and New, in the north of the Seaflower Biosphere Reserve, Colombia. She identified 15 species of birds, most of them marine habits, 2 species of turtles and 1 species of dolphin. Most of the birds observed during the expedition are boreal species in migratory habitats (from North America) or species that migrate in the Caribbean. The ducks were traveling in groups of 50 individuals in South to North direction. In the archipelago of San Andrés there are 6 species reported to nest on the Cays, but only 2 were observed during this Expedition (*Sula leucogaster and Fregata magnificens*).

Table 8. Species observed during coral reef assessments.

Class	Scientific Name	English Name	Status**	Indiv	Place		
					Alicia	Nuevo	Serranilla
BIRDS	*Anas sp.*	Duck	M	124	x	x	X
	Egretta thula	Snowy egret	M	1			X
	Falco peregrinus	Peregrine falcus	M	2			X
	Fregatta magnificens	Fregatebird	R	71	X	X	X
	Hirundo rustica	Barn swallow	M	24	X	X	X
	Larus atricilla	Laughing Gull	R	14	X	X	X
	Stercorarius parasiticus	Parasitic Jaeger	M	1	X		
	Sterna maxima	Royal Tern	M	12		X	X
	Pandion haliaetus	Osprey	M	1		X	
	Dendroica palmarum	Palm warbler	M	1			X
	Columba livia	Rock Pigeon*		1			X
	Phaethon aethereus	Red-billed Tropicbird	R	2		X	
	Arenaria interpres	Ruddy turnstone	M	6			X
	Sula leucogaster	Brown Booby	R	12		X	
	Plegadis falcinellus	Glossy Ibis	M	10	X		
TURTLES	*Caretta caretta*	Loggerhead	M	6		X	X
	Eretmochelys imbricata	Hawksbill	M	3		X	X
DOLPHIN	*Tursiops truncatus*	Bottlenose Dolphin		36	X	X	X

* Common dove, with color ring in your foots.
** Status: M=Migratory; R=Resident

In addition, the conch team had six sitings of dolphins and three sitings of turtles (Table 9).

Table 9. Sitings of mammals and turtles.

Date	Area	Site #	Latitude	Longitude	Depth (M)	#	Species
4/18/12	Serranilla	62	15.86179	-79.79362	11	12	*T. truncatus*
4/18/12	Serranilla	64	15.81103	-79.87041	16	1	*T. truncatus*
	Serranilla		15.859659	-79.847361	surface	2-3	Unid. dolphin
	Serranilla		15.886975	-79.876932	surface	2-3	Unid dolphin
	Serranilla		15.876448	-80.092548	surface	1	*T. truncatus*
4/22/12	Bajo Nuevo	23	15.89562	-78.59954	14	3	*T. truncatus*
	Bajo Nuevo		15.912454	-78.56678	surface	1	Unidentified turtle
	Bajo Nuevo		15.842895	-78.639409	surface	2	Unidentified turtle
4/17/12	Bajo Nuevo	CONU 15	15.861800	-78.680700	surface	2	Mating *Chelonia mydas*

Acknowledgements

This project represents a collaboration between the Khaled bin Sultan Living Oceans Foundation and CORALINA. I am grateful for all of the assistance provided by Martha Prada, without whom this project would never have been possible. Martha assisted with all aspects related to permitting, identified Colombian team members, assisted in identifying priorities for research, and remained engaged throughout the project period. The research team was dedicated and hard working and accomplished a considerable amount in a very short time. This work was conducted under a permit issued by the Republica de Colombia, Ministerio de Defensa Nacional, Direccion General Maritima, Resolucion No. 184, 12 April, 2012. Additional authorization for work within the Joint Regime Area was obtained from the Ministry of Foreign Affairs and Foreign Trade (Ref. 358/505/209, 16th March, 2012). No oil spills, groundings or damage to the marine environment occurred during this research.

Fig. 7. The science team.

Appendix 1. List of participants, agencies and responsibility.

Full Name	Institution	Role
Andy Bruckner	LOF	Chief scientist, coral surveys
Brian Beck	LOF	Benthic surveys
Judy Lang	AGRRA	Coral surveys
David Grenda	FL Aquarium	Fish surveys
Alex Dempsey	NCRI	Benthic surveys
Jeremy Kerr	NOVA/NCRI	Groundtruthing
Anastasios Stathakopoulos	NOVA/NCRI	Groundtruthing
Joyce Schulke	AGRRA	Fish surveys
Michael Haley	Eco Reefs	Benthic surveys
Nathalie Zenny	TNC Jamaica	Invertebrate surveys
Sonia Bejarano	LOF Fellow	Fish herbivory
Nacor Bolanos	CORALINA	Fish surveys
Alfredo Abril	CORALINA	Administrative Coordinator & Investigator (Fish Survey)
Judy A. Pacheco	CORALINA	Researcher & Observer
Omar Abril	Agriculture and Fishery secretary	Diver, Industrial Designing
Leonidas Cabeza	CORALINA	Conch surveys
Alfredo Colmenares	CORALINA	Conch surveys
Heins Bent	CORALINA	Scientific Diver
Gloria Hinestroza	CORALINA	Conch surveys
Trisha Forbes	Fishery and Agriculture Department	Conch surveys
Luis Olarte	Armada Nacional de Colombia - Dirección General Marítima	Observer
Nick Cautin	LOF	DSO