VOL 4

NAVASSA

GLOBAL REEF EXPEDITION FINAL REPORT

Khaled bin Sultan Living Oceans Foundation

VOL
4

Global Reef Expedition: Navassa March 25-31, 2012

Global Reef Expedition Final Report

Khaled bin Sultan Living Oceans Foundation

Andrew Bruckner, PhD

Global Reef Expedition: Navassa. Final Report. Volume 4.

Science Without Borders®

The Khaled bin Sultan Living Oceans Foundation (KSLOF) is a nonprofit private operating foundation dedicated to providing science-based solutions to protect and restore ocean health.

The findings presented in this report were collected as part of the Global Reef Expedition through the support provided by His Royal Highness Prince Khaled bin Sultan.

Khaled Bin Sultan Living Oceans Foundation
8181 Professional Place
Landover, MD 20785 USA
Philip G. Renaud, Executive Director

www.livingoceansfoundation.org

First published May 14, 2012.

Citation: Bruckner, A. (2011) Global Reef Expedition: Navassa. Field Report. March 25-31, 2012. Khaled bin Sultan Living Oceans Foundation, Landover MD. 34 pp.

Executive Summary

The Khaled bin Sultan Living Oceans Foundation (KSLOF) conducted a research mission to Navassa Island, as part of the Global Reef Expedition, between March 25-31, 2012. Research participants included AAUS certified scientific divers from the KSLOF, NOAAs Southeast Fishery Science Center, the University of Miami's RSMAS, Nova Southeastern University's National Coral Reef Institute (NCRI), The Atlantic and Gulf Rapid Reef Assessment Program (AGRRA), the Florida Aquarium, Island Conservation, and Foundation for the Protection of Marine Biodiversity (FoProBiM) (Appendix IV). All research was staged from the M/Y Golden Shadow, a 67 m motor yacht; small catamarans and tenders were used as diving platforms. The main focus of the work involved 1) demographic monitoring of shallow (1-5 m depth) *Acropora palmata* plots established in 2006; 2) evaluation of the status of reef fish populations; 3) characterization of benthic structure and species composition of reef habitats; 4) assessment of the demography and health of reef building corals; and 5) socioeconomic assessment of reef fish fisheries. A total of 212 dives were completed within reef habitats, from 1-30 m depth.

The KSLOF AGRRA team assessed the coral reef community structure at 15 sites. At each site at least one 10 m X 1 m phototransect was taken. A subset of reef fish (approx. 70 species) were quantified (abundance and biomass) within 99 belt transects (each 30 m X 2 m). The size and condition of approximately 1500 corals was assessed within 31 belt transects (each 10 m X 1 m). Benthic assessments using a point count method were conducted on 104 transects (each 10 m in length; 100 points). The KSLOF AGRRA team completed 85 dives and a total bottom time of 71 hours. Additional data collected included 1) CTD deployments at each coral survey site; salinity and temperature profiles were obtained from the surface to the bottom; 2) continuous temperature recordings at the anchorage of the Golden Shadow (at 15 m depth); and 3) four days of current data, along with temperature, oxygen and turbidity using a Recording Doppler Current Profiler(RDCP) deployed at 15 m depth at the northwest end of Navassa.

The NOAA team completed demographic surveys of *A. palmata* within five $150m^2$ permanent plots established at two sites. In addition, all colonies of *A. palmata* located along 5.5km of coastline, from 1-5 m depth, were mapped and assessed. Stationary point counts for fish were made at 26 stratified random reef sites along the north and southwest coasts of Navassa and benthic photo-quadrats were collected to provide corresponding habitat information. Coral size-frequency and condition data was collected for approximately 1800 colonies located within sites examined in 2002 and 2004, and in-situ point-intercept transects were completed at three long term sites. The team completed a total of 127 dives for a total bottom time of 85 hours.
Island Conservation and FoProBiM worked with fishers from two fishing boats that were operating around Navassa during the research mission. In addition to interviews, they assessed the catch over the five day study.

Tempe, Arizona based high-school teacher Mike Trimble became the first CREW (Coral Reef Educator on the Water) member of the Khaled bin Sultan Living Oceans Foundation's Global Reef Expedition. CREW activities included interviews with scientists, training in use of underwater communications gear, SKYPE calls to share information on the mission with U.S. high schools, underwater observations of coral research, demonstrations on research methods, and an underwater reef tour and lesson using communication gear with the Chief Scientist.

Background

Navassa Island (18◦24'10'' N, 75◦0'45''W) is a U.S. possession that is approximately 5 km^2 in area. The island lacks permanent human population. The island is comprised of a raised plateau surrounded by steep cliffs reaching to a submarine terrace of approximately 23–30 m in depth (Miller et al. 2003). A second raised terrace on the island and additional drop-offs and terraces at depth yield an overall 'wedding cake' topography to the region (Miller et al. 2008a). The cliffs surrounding the island preclude the standard coastal mosaic of habitat types such as beaches, mangrove shorelines, and seagrasses. Consequently fish groups dependent on these habitats (e.g., grunts (Haemulidae)) are largely absent from the Navassa assemblage. The primary reef habitats are the steep reef walls formed by the cliffs, large boulders located at the base of the wall, patch reefs, a limited amount of low-relief spur and groove, and rubble covering the terrace. Reefs of the island are exploited by transient subsistence Haitian fishers The island lacks local anthropogenic land-based sources of pollution and has minimal terrestrial run-off due to an absence of rivers.

The island's oceanic position exposes it to substantial physical energy, and thus most of the sampling in the past was carried out on the leeward side of the island (SW), with only occasional sampling past the northwest point. Ecological assessment of reefs at Navassa Island began around the turn of the 21st century. The first through assessment of reef habitats, and associated habitat mapping was undertaken beginning in 2002 through multidisciplinary efforts of NOAA, US FWS and partner institutions (Miller and Gerstner 2002). These researchers identified major changes to reef communities due to several catastrophic events including a widespread outbreak of a coral disease (white plague-like condition) in 2004 and a mass bleaching event 2006 (Miller and Williams 2007). Changes in benthic community structure from 2002-2009 include a dramatic loss of coral cover and a *subsequent* dramatic increase in macro-algal cover, particularly in the best-developed reef habitats. The current study focused on an evaluation of patterns of recovery since the last surveys (2009), current impacts affecting the reefs, and characterization of the resilience of these reefs.

Sites examined

The primary habitats examined were 1) the steep reef walls extending from the island at the water's edge, 2) large boulders located at the base of the wall, 3) deeper patch reefs, 4) low-relief spur and groove, and 5) rubble fields along the terrace at the southeastern end of Navassa (Fig. 1; Table 1 and 2).

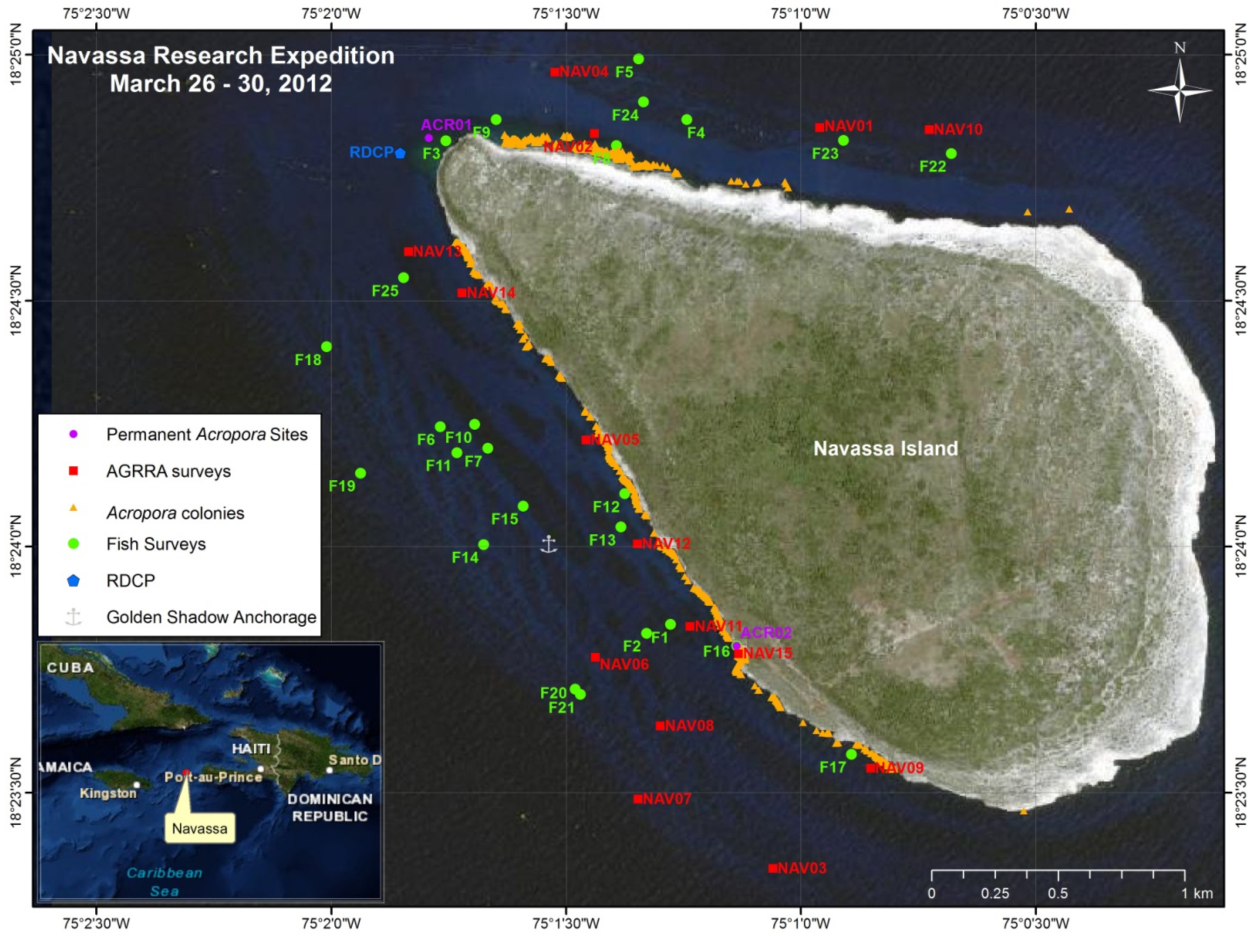

Fig. 1. Locations examined off Navassa. Coral reef surveys (red squares), fish assessments (green circles) and position of living *Acropora* colonies (yellow triangles) are shown.

Table 1. Reef Surveys conducted off Navassa Island

Long	Lat	ID	Date	Depth (m)
-75.016000	18.414200	NAV01	3/26/2012	26
-75.024000	18.414000	NAV02	3/26/2012	19.2
-75.017660	18.389100	NAV03	3/26/2012	29
-75.025410	18.416090	NAV04	3/27/2012	24
-75.024300	18.403620	NAV05	3/27/2012	22
-75.023970	18.396260	NAV06	3/27/2012	26
-75.022450	18.391450	NAV07	3/28/2012	26
-75.021660	18.393930	NAV08	3/28/2012	28
-75.014200	18.392500	NAV09	3/28/2012	24.5
-75.012120	18.414130	NAV10	3/29/2012	28
-75.020600	18.397300	NAV11	3/29/2012	22
-75.022480	18.400100	NAV12	3/29/2012	23
-75.030600	18.410000	NAV13	3/30/2012	25
-75.028700	18.408600	NAV14	3/30/2012	21.2
-75.019300	18.396500	NAV15	3/30/2012	6

Table 2. Stationary fish census conducted off Navassa Island

Long_W	Lat_N	Date	ID	Depth (m)
-75.0213	18.39737	3/26/2012	F1	29.3
-75.0222	18.39707	3/26/2012	F2	27.1
-75.0293	18.41376	3/26/2012	F3	11.3
-75.0207	18.41447	3/26/2012	F4	25.0
-75.0224	18.41653	3/26/2012	F5	28.0
-75.0295	18.40407	3/27/2012	F6	27.7
-75.0278	18.40334	3/27/2012	F7	28.7
-75.0232	18.41359	3/27/2012	F8	9.1
-75.0275	18.41448	3/27/2012	F9	11.9
-75.0283	18.40415	3/27/2012	F10	25.9
-75.0289	18.40319	3/27/2012	F11	29.9
-75.0229	18.4018	3/27/2012	F12	22.0
-75.0231	18.40067	3/27/2012	F13	26.2
-75.0279	18.40008	3/28/2012	F14	27.1
-75.0265	18.40138	3/28/2012	F15	28.0
-75.019	18.39664	3/28/2012	F16	11.6
-75.0149	18.39297	3/28/2012	F17	25.3
-75.0335	18.40678	3/29/2012	F18	27.7
-75.0323	18.4025	3/29/2012	F19	30.5
-75.0247	18.39518	3/29/2012	F20	27.7
-75.0245	18.395	3/29/2012	F21	27.7
-75.0113	18.41333	3/30/2012	F22	29.6
-75.0152	18.41377	3/30/2012	F23	27.4
-75.0223	18.41507	3/30/2012	F24	24.7
-75.0308	18.40912	3/30/2012	F25	28.7

Table 2b. Permanent *Acropora* Sites

Long_W	Lat_N	Date	ID	Depth_m
-75.02987	18.41385	3/26/2012	ACR01	11.0
-75.01895	18.39664	3/26/2012	ACR02	10.7

General findings

Acropora palmata habitat was confined to the shallow shelf areas around Lulu Bay and Northwest Point with numerous colonies colonizing the cliff and ledges in shallow water along much of the southwest and north coasts. Corals growing on the vertical walls and narrow ledges often exhibited an unusual encrusting growth form. Most colonies were in excellent condition with very low levels of mortality. Few colonies were affected by gastropod (Coralliophila abbreviata) predation. Disease was rare and was limited to isolated cases of white patch disease and unidentified white lesions. A very low number of *Stegastes planifrons* algal lawns were observed. Several cases of overgrowth by brown *Cliona* were documented.

Acropora cervicornis was extremely rare, being identified only at two sites. Each location contained a single colony.

Corals experienced a major decline from bleaching and disease between 2002-2008. During these surveys, very few corals with active signs of disease or recent mortality were observed. And bleaching was not noted. Nevertheless, impacts from past events were documented. In particular, very few large, completely live colonies were identified. Many of the medium to large-sized long lived massive reef building corals had extensive patches of old mortality and were subdivided into numerous smaller tissue remnants; often, their exposed skeletal surfaces had dense colonization of macroalgae and encrusting invertebrates. Declines were most notable in *Montastraea, Diploria*, *Colpophyllia*, and other larger species.

Coral cover appears to be increasing on these reefs with surviving corals showing some resheeting and high recruitment of other species. The reefs appear to be undergoing a shift in the dominant species. There were notable increases in the abundance of smaller corals, especially weedy species like *Porites astreoides.* Other corals with high numbers of small colonies included *Stephanocoenia, Siderastre*a and *Meandrina*. A prominent decline in *Agaricia* was also observed.

Cover of macroalgae was very high, although some taxa had lower cover than during previous surveys (*Lobophora*). Certain pest species such as *Stegastes planifrons* damselfish, *Trididemnum*, and the brown overgrowing sponge (*Agelas*) appear to have increased from previous surveys. A very high diversity and abundance of sponges was noted in all locations.

Reef fish populations appear to be fairly stable. As in previous years, there were few grunts and snappers, except for French grunts and Schoolmaster snappers. Only a few large groupers (occasional Nassau and Tiger grouper) were observed. Jacks, hogfish, gobies and fairy basslets appear to have declined, while barracuda were more common. Sharks were rare, except for a few nurse sharks.

The most abundant fishes were planktivores (creole wrasse, blue chromis, black durgon), small invertebrate feeders (yellowhead wrasse, bluehead wrasse) and herbivores (blue tang, dusky damselfish, longfin damselfish, princess parrotfish and red band parrotfish).

A low number of *Diadema* were observed in shallow sites, with a large population found in a rubble field at the eastern end of Navassa. Herbivorous fish were dominated by surgeonfish (blue tang) and parrotfish. Most parrotfish were 30 cm or smaller in size with populations dominated by princess, red band, and stoplight parrotfish respectively.

There were higher number of invasive lionfish than recorded in previous years. Very few lobsters and turtles were seen. No marine mammals were observed.

Table 3. Number of benthic, fish and coral transects examined at each AGRRA site.

Site	**Depth (m)**	**Benthic transects**	**Coral transects**	**Fish transects**
NAV 1	26	6	2	9
NAV 2	19.2	9	2	10
NAV 3	29	2	2	4
NAV 4	24	8	2	10
NAV 5	22	8	2	9
NAV 6	26	6	2	8
NAV 7	26	4	3	6
NAV 8	28	5	2	7
NAV 9	24.5	9	2	8
NAV 10	28	7	2	8
NAV 11	22	7	1	3
NAV 12	23	8	1	4
NAV 13	25	6	2	4
NAV 14	21.2	8	2	4
NAV 15	6	11	4	5

Part II. Summary of NOAA SEFSC/University of Miami research

Compiled by Margaret Miller

Acropora assessment:

Demographic surveys of *A. palmata* were completed for five 150m^2 permanent plots established in 2006. All colonies within the plots were photographed and surveyed for size and condition, and any new colonies were mapped and surveyed. In addition, snorkel-surveys were conducted along ~ 2/3 of the island's coast to GPS-map colonies along entire shorelines. Based on previous observations showing very low abundance of *A. cervicornis* at Navassa, we maintained special lookout at all dive sites on the trip across the entire team.

Acropora palmata remains in excellent condition at Navassa with very low prevalence of disease, predation, and partial mortality. At the NW point site where colonies grow in a typical branching morphology, growth rates are remarkably slow compared to the colonies at Lulu bay where colonies have a predominantly encrusting morphology and the high-energy environment in which they occur. Some asexual recruitment (fragments was observed but no new sexual recuits were detected within the plots. Some population fluctuation was observed along certain segments of the coastline particularly the Northeast where colonies were sparse and are now absent however there appears to be no appreciable net change in the population.. *Acropora cervicornis* remains extremely rare with only 2 colonies sited over 35 reef dive sites and no colonies sighted on snorkel survey over 60 percent (5.5km surveyed out of 9 km total) of the Navassa shore.

Reef Benthic Assessment:

We conducted in-situ point-intercept transects at three long term sites and photo-quadrats at 18 randomly selected sites (co-located with fish counts) to estimate benthic community composition. The photo quadrats will take time and personnel resources to analyze. However, the three in-situ sites show fairly stable composition from 2009 (Fig 2).

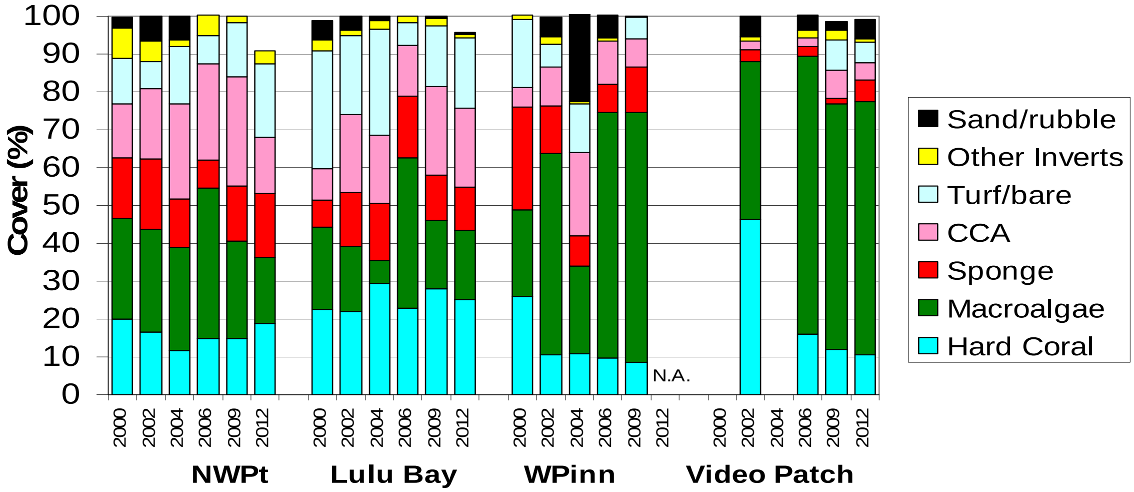

Fig 2: Percent benthic cover estimated from in-situ point-intercept transects at select sites around Navassa over six expeditions. NWPt and Lulu Bay are shallow shelf (~10m depth) whereas the latter two sites are deeper (22-29 m)

ReefFish Visual Census:

Stationary point counts (n=2 at each site; fixed time observations over a 7m radius plot; Fig 3) were made at 26 stratified random reef sites (51 point counts) along the north and southwest coasts of Navassa. Benthic photo-quadrats were collected at most of these sites to provide corresponding habitat information. Overall, reef fish populations appear relatively stable from the previous observations in 2009. Frequency of occurrence is shown in Fig 4, and summary characteristics of the reef fish assemblage are given in Table 5.

Fig 3: Diver pair conducting reef fish visual census counts at Navassa, 2012.

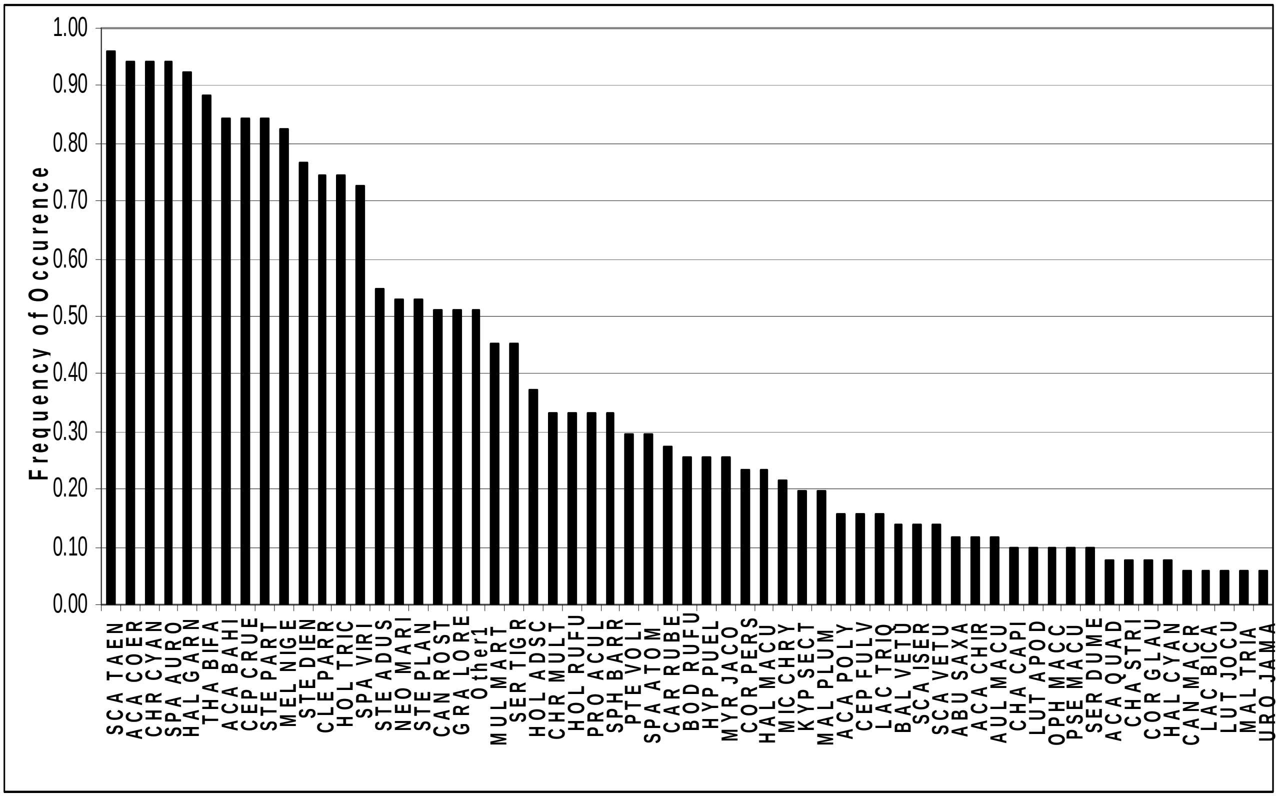

Fig 4: Ranked frequency of occurrence for common species (i.e. sighted in > 0.05 of samples) in Navassa 2012 reefish visual census data. Species abbreviations are first three letters of genus, four letters of species.

Coral demography and species composition:

We focused effort to collect coral size-frequency and condition data (~ 1800 colonies) in order to provide robust comparisons to similar data that was collected during the 2002/2004 cruises. Our observations of drastic coral disturbances from disease and bleaching events in the interim provide a large ‘signal’ of coral population change that we sought to quantify via demographic parameters. We explored tractable demographic metrics that may be of value to the development of NOAA’s National Coral Reef Monitoring (NCRMP) protocol. Expert observers identified and measured all colonies which intersected 10 x 1 m transects which were haphazardly placed at nine sites along the northern and southwest coast (at least two of which were re-sampled from the 02-04 period). Each transect was subsampled by 0.5 m widths since dive times were limited (by depth/diving constraints) and in some cases the entire $10m^2$ area could not be sampled. In these cases, the area sampled was noted and colony density was standardized to this area. Some smaller, weedy species (e.g., *Siderastrea radians*, *Porites astreoides*) were excluded from size measurements, but tallied in order to be included in colony density comparisons.

First, the overall condition of remaining coral colonies across all sites surveyed in 2012 was very good. Observations of recent mortality from any source were extremely rare. Only five colonies out of 1540 (0.3% prevalence) displayed active disease signs with similar proportions noted as pale or with recent predation scars. Though the size data has not been analyzed yet, there were notable shifts in species composition (Table 4). The proportional representation of larger reef-building species such as *Diploria* spp has declined slightly, while the proportion of *Agaricia* spp. has declined substantially. Meanwhile, the representation of *S. siderea*, *M. meandrina* and *S. intercepta* has increased notably due to strong recruitment evidenced by the observation of many small colonies.

Table 4. Number of colonies and proportional composition of corals sampled on 2012 expedition (NOAA team) compared to that sampled in 2004 (M.Vermeij)

	2012			2004	
	# colonies	Proportion		# colonies	Proportion
Agaricia Spp	424	0.235		1979	0.478
C.natans	6	0.003		13	0.003
Diploria spp	5	0.003		47	0.011
D. stokesii	7	0.004		10	0.002
E. fastigiata	46	0.025		80	0.019
M. annularis	6	0.003		17	0.004
M.cavernosa	42	0.023		68	0.016
M fav/fr	83	0.046		235	0.057
M. meandrina	48	0.027		11	0.003
Porites massive	273	0.151		439	0.106
Porites branching	236	0.131		543	0.131
S. intercepta	80	0.044		0	0
S.siderea	368	0.204		435	0.105
Other	182	0.101		266	0.064
TOTAL	1806			4143	

Table 5. Summary statistics for fish surveys (n=51 surveys at 20 sites). Average density is calculated for observations within the first five minutes of the survey. Occurrence rates (% of sites at which the species is present) and lengths are calculated for all observed individuals regardless of time seen.

species	N	% sites present	average density	average density when present ± SD	$L_{average}$ ± SD	L_{min}	L_{max}
Abudefduf saxatilis	7	0.12	0.10 ± 0.36	1.25 ± 0.50	8.71 ± 2.21	5	12
Acanthurus bahianus	187	0.84	3.51 ± 4.13	4.48 ± 4.18	10.84 ± 2.29	3	20
Acanthurus chirurgus	16	0.12	0.31 ± 0.97	2.67 ± 1.37	11.31 ± 1.25	8	16
Acanthurus coeruleus	490	0.94	9.59 ± 22.99	10.40 ± 23.79	10.61 ± 2.56	2	16
Acanthostracion polygonia	10	0.16	0.12 ± 0.43	1.50 ± 0.58	17.70 ± 4.81	11	26
Acanthostracion quadricornis	4	0.08	0.04 ± 0.20	1.00 ± 0.00	14.25 ± 2.06	12	16
Amblycirrhitus pinos	1	0.02	0.02 ± 0.14	1.00	4.00	4	4
Aulostomus maculatus	6	0.12	0.06 ± 0.24	1.00 ± 0.00	22.83 ± 6.18	12	30
Balistes vetula	9	0.14	0.08 ± 0.34	1.33 ± 0.58	26.00 ± 5.36	20	34
Bodianus rufus	19	0.25	0.27 ± 0.63	1.56 ± 0.53	15.53 ± 6.35	8	27
Cantherhines macrocerus	3	0.06	0.02 ± 0.14	1.00	26.00 ± 1.73	25	28
Canthigaster rostrata	45	0.51	0.76 ± 1.34	1.77 ± 1.54	3.96 ± 0.85	2	5
Canthidermis sufflamen	2	0.04	0.00 ± 0.00		35.00 ± 0.00	35	35
Caranx ruber	47	0.27	0.78 ± 4.48	5.71 ± 11.60	12.62 ± 3.73	10	30
Centropyge argi	3	0.04	0.00 ± 0.00		4.33 ± 0.58	4	5
Cephalopholis cruentata	95	0.84	1.47 ± 1.38	2.14 ± 1.14	14.43 ± 4.10	8	30
Cephalopholis fulva	12	0.16	0.20 ± 0.63	1.67 ± 1.03	21.42 ± 3.29	15	30
Chaetodon capistratus	9	0.10	0.14 ± 0.49	1.75 ± 0.50	6.89 ± 1.27	6	9
Chaetodon ocellatus	2	0.02	0.00 ± 0.00		8.00 ± 0.00	8	8
Chaetodon sedentarius	2	0.02	0.04 ± 0.28	2.00	10.00 ± 0.00	10	10
Chaetodon striatus	6	0.08	0.08 ± 0.34	1.33 ± 0.58	8.17 ± 0.75	7	9
Chromis cyanea	563	0.94	110.45 ± 135.91	119.85 ± 137.58	4.10 ± 0.90	1	8
Chromis multilineata	104	0.33	20.43 ± 78.99	74.43 ± 140.25	4.97 ± 0.22	3	7
Chromis scotti	4	0.02	0.08 ± 0.56	4.00	3.00 ± 0.00	3	4
Clepticus parrae	165	0.75	32.27 ± 76.31	48.41 ± 89.54	6.54 ± 3.33	1	20
Coryphopterus eidolon	1	0.02	0.00 ± 0.00		3.00	3	3
Coryphopterus glaucofraenum	6	0.08	0.04 ± 0.20	1.00 ± 0.00	2.17 ± 0.41	1	3
Coryphopterus personatus	101	0.24	1.88 ± 5.16	9.60 ± 8.11	1.93 ± 0.51	1	3
Diodon holocanthus	1	0.02	0.02 ± 0.14	1.00	20.00	20	20
Elagatis bipinnulata	14	0.04	0.00 ± 0.00		75.00 ± 0.00	70	80
Elacatinus oceanops	2	0.04	0.04 ± 0.20	1.00 ± 0.00	3.50 ± 0.71	3	4
Epinephelus striatus	2	0.04	0.02 ± 0.14	1.00	60.00 ± 0.00	60	60
Equetus punctatus	2	0.04	0.02 ± 0.14	1.00	14.50 ± 0.71	14	15
Gnatholepis thompsoni	1	0.02	0.00 ± 0.00		3.00	3	3
Gramma loreto	94	0.51	1.78 ± 3.52	3.96 ± 4.38	4.61 ± 0.66	2	6
Gymnothorax moringa	2	0.04	0.04 ± 0.20	1.00 ± 0.00	65.00 ± 7.07	60	70
Haemulon flavolineatum	2	0.04	0.02 ± 0.14	1.00	16.00 ± 5.66	12	20
Haemulon plumieri	1	0.02	0.02 ± 0.14	1.00	16.00	16	16
Haemulon sciurus	1	0.02	0.02 ± 0.14	1.00	15.00	15	15
Halichoeres cyanocephalus	4	0.08	0.04 ± 0.20	1.00 ± 0.00	13.00 ± 9.20	4	25
Halichoeres garnoti	293	0.92	5.73 ± 5.71	6.35 ± 5.67	6.26 ± 1.48	2	15
Halichoeres maculipinna	40	0.24	0.71 ± 2.87	4.00 ± 6.04	4.23 ± 1.59	2	9
Halichoeres radiatus	2	0.04	0.04 ± 0.20	1.00 ± 0.00	16.50 ± 7.78	11	22
Heteropriacanthus cruentatus	1	0.02	0.00 ± 0.00		23.00	23	23
Holocentrus adscensionis	32	0.37	0.55 ± 1.06	1.87 ± 1.19	14.59 ± 1.92	10	19
Holocentrus rufus	26	0.33	0.47 ± 0.90	1.60 ± 0.99	13.50 ± 2.49	8	18

species	N	% sites present	average density	average density when present ± SD	$L_{average}$ ± SD	L_{min}	L_{max}
Holacanthus tricolor	56	0.75	1.00 ± 0.89	1.55 ± 0.62	9.79 ± 4.05	3	24
Hypoplectrus chlorurus	2	0.04	0.02 ± 0.14	1.00	7.50 ± 0.71	7	8
Hypoplectrus guttavarius	1	0.02	0.00 ± 0.00		7.00	7	7
Hypoplectrus nigricans	1	0.02	0.02 ± 0.14	1.00	8.00	8	8
Hypoplectrus puella	16	0.25	0.25 ± 0.56	1.30 ± 0.48	6.38 ± 1.36	4	8
Hypoplectrus (species)	2	0.04	0.02 ± 0.14	1.00	8.50 ± 0.71	8	9
Hypoplectrus unicolor	2	0.04	0.04 ± 0.20	1.00 ± 0.00	7.50 ± 0.71	7	8
Kyphosus sectatrix	96	0.20	1.88 ± 6.47	9.60 ± 12.26	13.38 ± 1.76	10	20
Lactophrys bicaudalis	3	0.06	0.02 ± 0.14	1.00	17.00 ± 4.58	13	22
Lachnolaimus maximus	1	0.02	0.00 ± 0.00		50.00	50	50
Lactophrys triqueter	9	0.16	0.12 ± 0.33	1.00 ± 0.00	13.67 ± 2.96	10	18
Lutjanus apodus	5	0.10	0.08 ± 0.27	1.00 ± 0.00	28.80 ± 4.66	24	35
Lutjanus griseus	3	0.02	0.00 ± 0.00		23.00 ± 0.00	20	26
Lutjanus jocu	4	0.06	0.06 ± 0.31	1.50 ± 0.71	38.25 ± 15.11	28	60
Lutjanus mahogoni	1	0.02	0.00 ± 0.00		30.00	30	30
Malacanthus plumieri	11	0.20	0.14 ± 0.40	1.17 ± 0.41	23.91 ± 7.15	10	35
Malacoctenus triangulatus	5	0.06	0.08 ± 0.39	2.00 ± 0.00	3.00 ± 0.00	3	3
Melichthys niger	367	0.82	7.12 ± 14.05	9.31 ± 15.45	14.86 ± 3.83	6	28
Microspathodon chrysurus	77	0.22	1.51 ± 3.71	7.00 ± 5.16	7.71 ± 2.12	1	12
Mulloidichthys martinicus	139	0.45	2.55 ± 5.85	6.84 ± 8.01	16.39 ± 5.36	8	28
Mycteroperca interstitialis	2	0.04	0.04 ± 0.20	1.00 ± 0.00	30.00 ± 7.07	25	35
Mycteroperca tigris	1	0.02	0.00 ± 0.00		35.00	35	35
Myripristis jacobus	52	0.25	0.96 ± 2.41	4.90 ± 3.28	10.38 ± 2.67	6	18
Neoniphon marianus	55	0.53	0.94 ± 1.41	2.29 ± 1.31	9.76 ± 2.35	5	14
Ocyurus chrysurus	3	0.04	0.04 ± 0.28	2.00	29.00 ± 1.73	27	34
Ophioblennius macclurei	29	0.10	0.55 ± 2.56	7.00 ± 6.98	3.72 ± 0.96	3	6
Opistognathus aurifrons	1	0.02	0.00 ± 0.00		6.00	6	6
Prognathodes aculeatus	21	0.33	0.29 ± 0.58	1.25 ± 0.45	5.48 ± 0.60	5	7
Pseudupeneus maculatus	6	0.10	0.08 ± 0.34	1.33 ± 0.58	11.33 ± 2.50	8	16
Pterrois volitans	19	0.29	0.24 ± 0.59	1.33 ± 0.71	28.58 ± 4.13	23	40
Scarus iseri	17	0.14	0.33 ± 1.14	2.43 ± 2.23	8.88 ± 3.04	5	15
Scarus taeniopterus	397	0.96	7.73 ± 6.85	8.38 ± 6.74	12.53 ± 4.92	3	32
Scarus vetula	16	0.14	0.29 ± 1.04	2.50 ± 2.07	15.19 ± 8.47	6	35
Seriola dumerili	63	0.10	0.02 ± 0.14	1.00	92.70 ± 2.81	80	120
Serranus tabacarius	3	0.04	0.00 ± 0.00		6.67 ± 1.15	6	8
Serranus tigrinus	30	0.45	0.43 ± 0.81	1.38 ± 0.89	6.07 ± 0.78	5	8
Sparisoma atomarium	27	0.29	0.35 ± 0.89	1.80 ± 1.23	5.26 ± 0.94	3	10
Sparisoma aurofrenatum	352	0.94	6.90 ± 6.74	7.33 ± 6.71	11.99 ± 3.23	4	28
Sparisoma chrysopterum	2	0.04	0.02 ± 0.14	1.00	26.00 ± 5.66	22	30
Sparisoma rubripinne	1	0.02	0.02 ± 0.14	1.00	21.00	21	21
Sparisoma viride	93	0.73	1.55 ± 2.10	2.63 ± 2.16	17.46 ± 8.86	3	38
Sphyraena barracuda	18	0.33	0.27 ± 0.49	1.08 ± 0.28	77.22 ± 21.57	40	115
Stegastes adustus	165	0.55	3.22 ± 5.69	6.07 ± 6.65	4.76 ± 1.09	2	8
Stegastes diencaeus	170	0.76	3.29 ± 3.22	4.54 ± 2.93	4.43 ± 0.89	2	7
Stegastes leucostictus	1	0.02	0.02 ± 0.14	1.00	6.00	6	6
Stegastes partitus	110	0.84	21.57 ± 47.02	26.19 ± 50.72	3.52 ± 0.70	2	6
Stegastes planifrons	78	0.53	1.41 ± 2.46	3.27 ± 2.83	4.44 ± 0.82	3	7
Stegastes variabilis	2	0.04	0.04 ± 0.20	1.00 ± 0.00	4.50 ± 0.71	4	5
Thalassoma bifasciatum	391	0.88	7.47 ± 6.85	8.66 ± 6.63	4.75 ± 0.92	1	9
Urobatis jamaicensis	4	0.06	0.08 ± 0.34	1.33 ± 0.58	22.75 ± 3.95	17	26

Part III: Island Conservation report

Aurora Alifano

The Island

Species sighted:

- Brown boobies (adults and juveniles with grey-brown coloring) and Red-footed boobies were observed returning to the island each evening.
- Frigate birds frequently circled the island (N= 10-24 at different times), and harassed boobies returning to the island.
- Flock of Great Blue Herons arrived from the Southwest and landed on Navassa (3/28/12 @ 3pm).
- No target species were observed from the vessel (rats, cats, dogs, goats), and we did not access the island interior as a US Fish and Wildlife permit had not been obtained by the Living Oceans Foundation.

Weather

A handful of brief rain showers passed over Navassa between March 25th and 31th. Temperature ranged from 25-27 °C and wind was typically 5-10 kts with occasional gusts up to 22 kts during the squalls. Currents surrounding the island were extremely strong at times and caution should be exercised for marine activities during operations. Currents were especially strong at the Northwest and Southwest tips of the island, and were subject to change without warning.

Access

The island is bordered entirely by limestone cliffs reaching 20 meters or more. These steep cliffs are undercut by crashing waves; make it impossible to access the island by boat in most locations (Fig 5). The North face of the island consists of a gradual slope leading to intertidal benches but is also difficult to access due submerged shallow rocks and no safe harbor in which to tie up a boat. The top of the island is a flat plateau and can be accessed in select areas by helicopter.

Figure 5: Steep undercut cliffs make boat access to Navassa impossible in most places.

Access is limited to Lulu Bay, a small recession in the cliffs on the Southwest side of Navassa. There is a small rock platform where humans could leap from boat to shore if correctly timed with the swell. The island's terrain is rugged and the lack of a natural and permanent freshwater source (Proctor 1959) and other natural resources make it uninhabitable by humans. There are no beaches and the surrounding water is very deep, averaging 36 meters in depth directly around the island perimeter.

Observations

Evidence exists of a recent fire (at least 2 months ago) on Northwest side of island, the damage extends up onto the ridgeline and possibly over. It is unknown whether the fire was intentionally set by Haitians clearing land for farming or started by an unknown cause such as lightning (Fig 6). Fire damage was observed from the vessel at several places around the island, usually concentrated in valleys where strong winds likely directed the blaze. It is unknown whether the fire spread across the majority of the islands interior area, but seems likely due to the widespread nature of the locations where fire swept down over the ridge towards the island perimeter.

Figure 6: Evidence of fire damage on the Northwestern side of Navassa Island.

Island Visitors

Haitian fishermen

Haitians have been making the 50 km voyage from Haiti to Navassa Island for generations and are continuous visitors to the island. It is estimated that 300 to 400 Haitian artisanal fishers frequent Navassa Island when not fishing close to the mainland of Haiti (FoProBiM 2009). If Haitian fishers are approached and asked if they travel to Navassa, not all will answer truthfully, for suspicion of why they are being asked. The exploitation of Navassa's marine resources is considered an extremely important source of income for the fishermen of the Southwestern tip of Haiti.

Who we met

During five days at anchor off Navassa Island, we encountered two fishing boats. Each one was led by a fisherman that Jean Wiener knew from previous interactions. Both are fishers that frequent Navassa; Jean interacted with them on almost all of his Navassa trips.
On March 25th, 2012, a fishing boat from Anse d'Hainault arrived at Navassa. Four fishermen were aboard. One man named Pa Bon, meaning "no good", was familiar with Jean Wiener from previous trips. The other adult was unfamiliar, and said this was his second trip to Navassa. Two young teenagers accompanied them. They intend to fish at Navassa for ten days.

On March 27th, 2012, a second boat from the same fishing village arrived. This boat had 5 people aboard. Edner is also familiar with Jean from previous Navassa trips, as well as Luckner. Both boats represent serious Navassa fishermen who frequent the island, the crews may change or the leaders may join up with other fishermen. It's difficult to determine how many fishers like this exist, but Jean estimates that 50 or 60 persons fish Navassa frequently.

Fish are not the only commodity that fishermen obtain from Navassa. Fishers have been known to gather scraps of metal leftover from mining operations, old batteries from the lighthouse, and anything else that can be carried away and sold for profit in Haiti; although presently not much is left. In 2009, at least two boats from Anse were lost after the crew lifted railroad tracks from Navassa and put them on their boats in order to sell them back in Haiti (due to the high price commanded for scrap metal at the time). The boats apparently capsized before returning to Haiti with the loss of all crews, at least 6 people (FoProBiM 2009).

Rivalry between fishermen

Fishermen from other communities can be hostile, both towards foreign visitors and towards other fishermen. There have been incidents reported within the fishing communities, fighting, boats disappearing, etc.

A common mentality in the fishing community is every boat for themselves, and fishermen will not share water, clothes, gifts, etc. with other fishermen that they come across. The rivalry creates obstacles for uniting projects for common good in fishing communities. One example involves the cistern in the old lighthouse keeper's deteriorating home that could serve as a freshwater source. However, the roof on the house is missing and there is much debris around the cistern, including bat and bird guano (Fig 7).

Figure 7: The home of the old lighthouse keeper, abandoned since 1976.

While Jean was camping on the island with the FWS in 2008, fishermen came to the lighthouse and collected the severely contaminated water for drinking. When asked why they didn't clean up the water collection site to reduce contamination, the fishermen replied, "I'm not going to clean it up just so he (other fishermen) can use it!". Due to the exhaustive effort required to make a living from fishing in hard, dangerous conditions, fishermen are not likely to participate in projects that may give fishers from other communities a competitive edge.

Fishing Conditions and Equipment

Navigation

Depending on weather and sailing conditions, it may take anywhere from ½ day and 3 days for Haitians to sail a small wooden boat to/from Haiti and Navassa. In general, Haitians fishers do not swim, and they never physically get in the water during their visits to Navassa unless absolutely necessary. Fishermen navigate by dead reckoning, using the sun and stars when possible, and previously navigated using the Navassa lighthouse when it was in working condition.

Boats

Fishermen rarely own their own boats. Boats, motors, and fishing equipment are frequently rented from boat owners (often women who had enough money to buy them). Women frequently work as fish marketers, selling the catch and handling the money. Some have created extra business by renting equipment to fishermen for a price or a percent of their catch or both. The fishermen erect a mast and sail on small (~12 ft) wooden boats and sail from Haiti to Navassa. The boats we encountered carried neither fuel nor an engine (Fig 8).


Figure 8: Fishing boat from Anse d'Hainault

Upon arrival, the fishermen often lift the sail and mast up jagged cliffs onto a flattened shelf, and leave it there until they are ready to sail home. The sail takes up valuable space in a small boat and is cumbersome during fishing activities. The fishermen use heavy wooden oars to row around the island while they constantly battle wind and currents. One boat elected to keep their sail aboard because the wind was blowing 22 kts on the day they arrived, and they feared the wind might overpower their ability to row to fishing locations.

Island access

To access the island, fishermen tie up to old ropes on the near shore rocks, or if unavailable will sometimes just tie off to the rocks themselves (Fig 9).

Figure 9: Fishing boat tied up to ropes hanging from the cliffs at Lulu Bay.

The boats remain anchored throughout the night, usually in Lulu Bay N (18° 23' 47 W 75° 1' 9), allowing the fishermen to rest (Figure 10). The fishermen we spoke with said that they do not sleep on the island. Both fishing boats tied up in Lulu Bay overnight, and sometimes began to fish at dawn, though other times simply fished by hand line while still tied up until wind and weather conditions were right. Smoke from the boats signaled that they were cooking breakfast right there in the small boat, evidence that they do not require island access to cook, although it is unknown if other fishers do so.

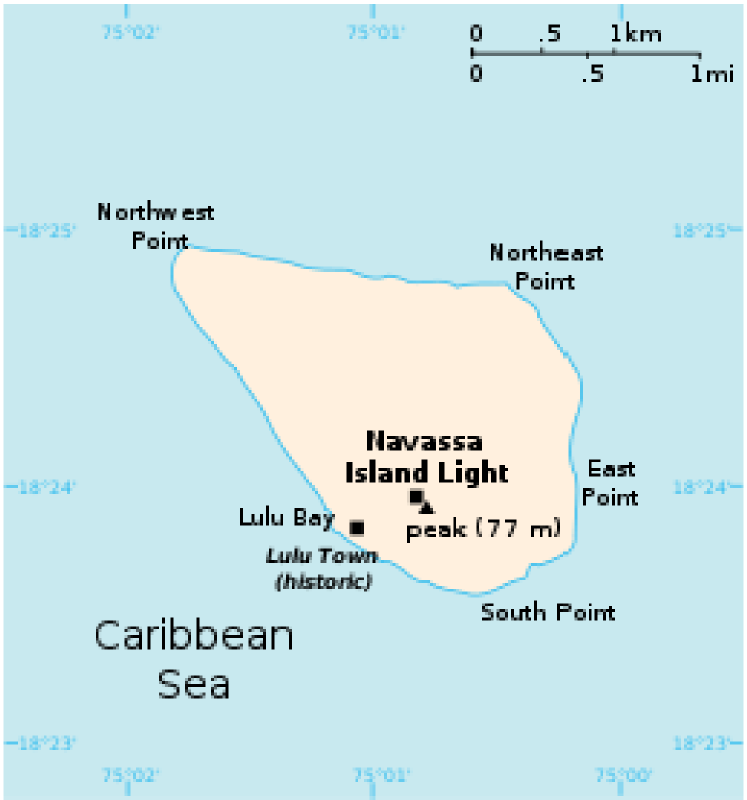

Figure 10: Map of Navassa Island depicting Lulu Bay.

The currents around the island can be incredibly strong, and Lulu Bay is the most sheltered place for them to spend the night. During daylight hours, fishermen go may ashore to repair their sails, gather firewood, and assemble traps. By keeping traps in pieces during transit, they can pack twice as many into each small boat. Fishermen carry trap parts (mesh, frames, and lines) up the cliff to a flatter spot on the island. It is the same place where supplies were historically delivered to maintain the mining and lighthouse operations.

Fishing gear and practices

Haitian fishermen that were observed at Navassa during this cruise used two primary methods for fishing; handline fishing and trapping. Handline fishing uses a single fishing line held in the hands. One or more lures or baited hooks are attached to the line, with optional weights and floats. The line can be jigged up and down in a series of short movements near the reef to attract fish which are hauled up once caught on the hook. Haitian fishermen reuse old discarded fishing line which is tied together obtain a desired length, and wrapped around empty plastic bottles. Small fish that become hooked dangle alive in the water, and are later used to catch larger fish. Typical fish traps consist of a wooden frame with fiber mesh wrapped around it (Fig 11).

Figure 11: Example of fish trap.

The trap opening tapers into the inside of the trap, luring fish in but making escape difficult. Fish traps are tied to a line that is buoyed by discarded empty plastic jugs and bottles. Preferred soak time for traps is 3 days (FoProBiM 2009), but some are left in up to 15 days or more. Occasionally traps are lost if the floats disengage from the line, depriving fishers of both the catch and the cost of the trap, and creating a semi-permanent hazard for fish.
Fish that are gutted, dried and salted do not acquire a premium price like fresh fish (FoProBiM 2009).

Interviews With Fishermen

Invasive species

The fishermen confirmed the presence of rats, cats, dogs, and goats on Navassa Island. All stated that they have never seen a rat in their boat. The fishermen described a large number of cats on the island, and several dogs. They stated that more dogs currently exist on the island than before, and some may be large and vicious now. While fishermen may go ashore during the day, fishermen do not sleep on the island and cite the dogs as one reason. They confirmed the presence of goats on the island- goats are sighted but cannot be approached or successfully hunted by fishermen due to their skittish nature.

The fishermen state that they do not carry mammals on board with them, and do not know how any of the invasive animals got onto the island. One boat was quick to blame fishermen from other communities. They said that rats, cats, dogs, and goats must have been brought there by malicious people, and were defensive of their integrity.

In previous dialogue with the fishermen both at Navassa and in their community in Haiti, Jean Wiener told the fishermen that the U.S. was interested in the island and that if the fishermen didn't manage the island well it would be taken away from them. He instructed them that proper management of the island included careful selective fishing without leaving traps soaking for too long and using hand line technique instead of nets. They were reminded not to burn vegetation on the island, bring plants from the mainland, or plant items to harvest. The fishermen insisted that they were complying with everything they've been told, but plead that the other communities must also be educated in the same way "tell them like you told us".

The fishermen we interviewed would not resist the removal of all invasive species from the island; they are of the opinion that removal of such species would make Navassa a nicer place to go. Fishers are amiable to project involvement and could help prevent invasive species from returning to Navassa by warning other fishermen not to bring things onto the island. However, this exchange would not occur unless there was an official mandate or incentive for the fishermen to do so. The fishermen welcome job opportunities, but would require the education and the means to perform these duties. In general, fishermen do not interfere with other fishermen even if they are seen doing something bad.

Collaboration with Haitians

Haitians will do almost anything to maintain their income. When not fishing, they work farm or construction jobs. Jean describes them as flexible; it would be easy for them to engage in other activities (such as island protection).

If fishermen were asked about daily income, each would provide varying answers. Estimations range from $1.5 USD per day to $10,000 USD per day. Jean explained that fishermen don't know much about finances (typically handled by women), and in general do not keep track of how much comes or goes. If fishermen were to be hired to work on a Navassa project, an extremely good income would be $100 US per day. The logistics of tax payment and money exchange would need to be sorted in advance.

Educating Haitians on how to minimize the risk of invasive species returning to Navassa is one possible strategy to ensure long-term success on Navassa. There are 10-15 fishing communities of different sizes that may be using Navassa, however more may need to be targeted. Other communities say they never fish there, but it is unknown if this is true. Fishermen from one community will not listen to a fisherman from another community; therefore use of fishermen to spread information is not effective. Fishermen are more likely to listen to outside agencies- this has been successful in the past if the intentions of the project are adequately explained. The fishermen will likely say "it's not us, you need to tell those other guys". Fishermen must be assured that everyone receives the same information and is asked to abide by the same regulations.

The concepts of invasive species, their impacts on island populations and the potential for islands without invasive species are "alien" concepts to the Haitians. Working to communicate the concepts and inspire participation will take time in each community. One option involves stationing people in each community for a few weeks at a time. Jean Wiener believes it is vital to ensuring the longevity of project success. This may be an opportunity to partner with the Foundation pour la Protection de la Biodiversity Marine (FoProBiM). This non-government, non-profit, a-political organization was founded and is based in Haiti and has worked with coastal area inhabitants including farmers, fishers, and those making use of coastal and marine environments through a wide variety of sectors such as tourism, transportation, marketing, and seafood processing.

In over 20 years of working with multiple stakeholders in Haiti searching for and implementing solutions, FoProBiM has provided technical services spanning project design, management, and execution, as well as education, advocacy, research and capacity building activities. FoProBiM has been successful at (1) raising awareness concerning needed changes in regulations and attitudes concerning the environment, 2) increased knowledge and capabilities at the government, community and individual levels in order to make sustainable improvements in the coastal and marine environment and, (3) conducting educational programs as well as scientific research to promote a better understanding and the improved management and use of resources in Haiti. It has also undertaken projects for a wide variety of institutions ranging from UNDP, UNEP, IDB, the Ministry of Environment of Haiti, OAS, NOAA, USFWS, NFWF, to private funding agencies and the private sector.

References

Bohnsack, J., Bannerot, S.P. 1986. A stationary visual census technique for quantitatively assessing community structure of coral reef fishes. NOAA Tech. Rep. NMFS 41, 1–15.

Brandt, M.E., Zurcher, N., Acosta, A., Ault, J.S., Bohnsack, J.A., Feeley, M.W., Harper, D.E., Hunt, J.E., Kellison, T., McClellan, D.B., Patterson, M.E., Smith, S.G., 2009. A cooperative multi-agency reef fish monitoring protocol for the Florida Keys coral reef ecosystem. Natural Resource Report NPS/SFCN/NRR–2009/150. National Park Service, Fort Collins, Colorado.

Fondation pour la Protection de la Biodiversité Marine, 2009. Rapid Survey of Haitian Fishing Villages Exploiting Resources at Navassa Island. For the United States Department of Commerce, National Marine Fisheries Sevice, and the Southeast Fisheries Science Center.

Karnauskas, M., McClellan D.B.,. Wiener, J.W., Miller, M.W., Babcock, E.A.2011. Inferring trends in a small-scale, data-limited tropical fishery based on fishery-independent data. Fish. Res. doi:10.1016/j.fishres.2011.06.010

McClellan, D.B., Miller, G.M., 2003. Reef fish abundance, biomass, species composition, and habitat characteristics of Navassa Island. In: Miller, M.W. (Ed.), Status of Reefs of Navassa Island. NOAA Tech. Memo, NMFS-SEFSC-501.

Miller, M.W., Gerstner, C.L. 2002. Reefs of an uninhabited Caribbean island: fishes, benthic habitat, and opportunities to discern reef fishery impact. Biol Conserv 106:37–44

Miller, M.W., McClellan, D.B., Begin, C. 2003. Observations on fisheries activities at Navassa Island. Mar. Fish. Rev. 65: 43–49.

Miller, M.W., Williams, D.E. 2007. Coral disease outbreak Navassa , a remote Caribbean island. Coral Reefs 26:97–101.

Miller, M.W., McClellan, D.B., Wiener, J.W., Stoffle, B. 2008a. Apparent rapid fisheries escalation at a remote Caribbean island. Environ. Conserv. 34, 92–94. Miller, M.W., Halley, R.B., Gleason, A., 2008a. Biology and geology of Navassa Island. In: Riegl, B., Dodge, R.E. (Eds.), Coral Reefs of the USA. Springer, pp. 407–433.

Miller, M.W., Gleason, A., McClellan, D., Piniak, G., Williams, D., Wiener, J., Gude, A., Schwagerl, J., 2008b. The state of coral reef ecosystems of Navassa Island. In: Waddell, J.E., Clarke, A.M. (Eds.), The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2008. NOAA Technical Memorandum NOS NCCOS 73. NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team, Silver Spring, pp. 117–229.

Wiener, J.W. 2005. Oral History and Contemporary Assessment of Navassa Island Fishermen. Report for the United States Department of Commerce National Oceanic and Atmospheric Administration – National Marine Fisheries Service.

Appendix I. Summary of fisheries assessments

Jean W. Wiener, Director Fondation pour la Protection de la Biodiversite Marine (FoProBiM) – Haiti)

<u>March 26, 2012</u> – calm seas

0630 Arrive at Navassa

- Anchored about 200m on the lee from NW point
- One fisher boat along the coast just north of Lulu Bay 4 fishers

1025

- Boat pulling up traps approx. half way up the west coast and 100m from the island.
- Noticed a large burned spot of vegetation about 2/3 of the way north on the west coast with several other places singed along the ridge tops both north and south of that location. Perhaps 1-2 months old

1400

- Fisher's boat has pulled alongside the GS
- 4 Crew: Pa Bon, adult on 2nd trip to Navassa, and two older teenage boys (Pa Bon known from several previous trips)
- From Anse d'Hainault
- Said fishing was good
- Were hand lining
- Had just checked traps
- Were not using nets
- Questioned about knowledge of rats, cats, dogs, goats on the island:
    - Were not really aware/concerned about the rats
    - Were very concerned about the dogs; said there were more now than ever before; more ferocious, and would not sleep on the island because of the dogs;
    - Saw many cats
    - Saw the goats cannot catch them
    - Would be open to helping with the eradication process with Island Conservation and FoProBiM
    - Said we would have to warn other fishermen from as far away as Port Salut not to bring any animals on the island
    - Accused fishermen from other communities of being responsible for the invasive animals
- Said that because of JW they have warned other fishers to be careful with how they fish, don't fish with nets anymore themselves

<u>March 27, 2012</u>

0800 – weather: calm

- Pa Bon and his crew came to the GS
- Gave them 1 cooler w/ice and a GPS unit to track them
- Had not started fishing yet
- Were going to start hand-lining and collect from their traps

0950

- Pa Bon fishing approx. 400-500m west of Lulu Bay

1400

- Edner +4 from Anse d'Hainault arrived at Lulu Bay
- Does not go out fishing but comes to the GS to say hello

<u>March 28, 2012</u>

0630 – weather: 1-1.5m breakers and rollers, very high winds overnight

- Pa Bon at Lulu
- Edner about half way up the West Coast and struggling to move north
- GS moved closer to Lulu Bay

0730

- Pa Bon came by, said they had processed the fish from last night, was given a new cooler and GPS
- Told him we would come by later that night to examine the catch

0830

- Edner came by and was given a cooler and GPS
- Edner is only fishing with hand lines; no traps or nets
- Kept his sail on his boat because of the strong currents and waves (in case of emergency)
- Told we would come by later to examine the catch

0900

- Both boats at Lulu Bay
- Edner's boat has started a fire aboard for cooking
- Noticed a large burned spot just south of the rail path at Lulu Bay, wondering if it is part of a larger fire which includes the burned area seen on March 26th (above)

1130

- Took a tender out to talk to the fishermen with Aurora – both boats were at Lulu
- Discussed possibilities of working with them on eradication processes
- They are interested but unconcerned

1200

- Finished at Lulu and both fishing boats immediately went out to fish
- Pa Bon and Edner north along the west coast
- Pa Bon checked a couple of traps and returned to Lulu by 1400
- Edner went straight out west and returned to Lulu by 1430

1430

- Both Edner and Pa Bon back at Lulu despite weather having improved

1750

- Took a tender out to examine the catches at Lulu.
- Since fishermen were not able to fish much or go lift traps there was not much to examine (some Mackerel – see Dave and Mandy's report)

<u>March 29</u>

0630 – weather: seas calming 1m rollers, slight breeze

- Edner about half way up the west coast where he spent the night
- Pa Bon at Lulu where he spent the night

0800

- Pa Bon lifted one trap at 0800 and then came over to the GS and picked up ice and GPS

0830

- Edner came to the GS to pick up ice and GPS
- Both out fishing along the west coast

1600

- Asked for a tender to collect data from the fishers and was denied

1700

- Pa Bon came by and dropped off his cooler containing fish from two traps
- Fish was sorted and measured by Dave and Mandy

1720

- Edner came by and dropped off his cooler containing his catch from hand-lining
- Fish was sorted and measured by Dave and Mandy
- Due to somewhat rough seas the boats were told to drop off their catch quickly and that we would measure their fish, ice them, and return them the following day

<u>March 30</u>

0600

- Both boats out fishing near Lulu

0830

- Pa Bon came by for the return of his fish and told he can keep the coolers (4) and was given water and clothes

0845

- Edner came by for the return of his fish and told he can keep the coolers (3) and was given water and clothes

0900

- Realized we had not recovered the GPS unit from Pa Bon's boat and went out with Nick to recover

0915

- Finished activities with the fishers

Appendix II: Questions and responses received from the Haitian Fishermen interviewed.

1) *Have you ever had a rat on board your boat?*
   - No- the fishermen state they have never seen a rat on board. The open nature of their small wooden vessels would make it difficult for a rodent to hide anywhere.

2) *Do you ever carry animals with you on board?*
   - Some fishermen have an impression that dogs were brought to the island for the purpose of hunting goats 15-20 years ago, but dogs in Haiti are not known for or likely capable of hunting.
   - Fishermen believe that cats arrived when the Coastguard built the lighthouse on the island, for the purpose of controlling rats.
   - Currently, fishermen do not bring animals on fishing trips for any purpose, and have been instructed not to put any animals or plants onto the island.

3) *Do you ever go on to the island? How often? Does anyone else visit the island?*
   - Yes- they go onto the island depending on the needs of the trip.
   - No- other than Ham radio operators, they are unaware of anyone else on the island.

4) *What do you on the island?*
   - Fishermen go onto the island for several purposes:
     - To store their sails, creating room on board for fishing around the island.
     - To lay fish out on cement pads to dry in the sun
     - To gather wood to repair things or for firewood
     - To assemble the traps they bring from Haiti in pieces.

5) *How long do you normally stay?*
   - Fishermen have stayed at Navassa for 21 days, but typical trips range from 6 to 8 days.

6 *What do you take with you onto the island?*
   - Fishermen bring few items onto the island:
     - Machete for wood collection
     - Sails
     - Fish to dry
     - Trap mesh, frames, rope and other components to assemble.

6) *Do you harvest anything while on the island?*
- Fishermen are rumored to plant watermelon on the island and collect it to eat during their fishing trips; however the fishermen we asked said they haven’t planted any yet.

- Fishermen are unlikely to plant things that other fishermen could harvest- there is some rivalry among the fishing communities.
- Fishermen currently are not known to harvest any of the invasive or native vertebrates on the island except for some of the birds and eggs. Evidence of cooking and burned bones have been found, although fishermen typically deny taking or consuming the birds.

7) *Do you ever take animals onto the island? What for?*
- No, animals are not brought on fishing trips.

8) *What would you think if goats, cats and rats were removed from the island? Would you restock the island with goats or any other animals?*
- The fishermen have no use for the invasive mammals, they cannot track or catch the goats and the dogs scare them. In short, the eradication would not affect them, and the removal of all these mammals would simply make Navassa a nicer place to go.
- If the removal of these species could benefit the fishermen in some way, like payment for working on the project or for maintaining the protection of the island, all the better.

9) *Would you be interested in being involved in the restoration of the island?*
- Yes, if there was some benefit to them (financially), otherwise the animals are the last thing on their minds.

10) *How could you help prevent reintroductions from happening?*
- Fishermen would help by warning others on the mainland about the purpose of the project and the new rules that must be followed (if it is made worth their time to do so).

11) *If you were not allowed to bring traps and fishing gear onto the island for repair, how would that impact your work? Are there other solutions?*
- Fishermen will likely always need access to the island. They tie up to it at night to prevent being set adrift in open ocean by wind and strong currents.
- They need to be able to get onto the island in case of emergency.
- They need access to assemble and repair traps, and store their sails.

12) *Are there seasons (months) that the island cannot be accessed?*
- No- there are some days when they are less inclined to come out and fish due to weather, but on every trip they found a calm time to access the island.

13) *What challenges exist for camping (field camp) on the island?*
- No fresh water- One boat says they would drink the water out of the contaminated cistern at the lighthouse if they had to. The other boat said they would not.
- Heat- the island can be sweltering at all times of year (no breeze).

Appendix III: Coral Reef Educator on the Water (CREW) Summary

Tempe, Arizona based high-school teacher Mike Trimble became the first CREW (Coral Reef Educator on the Water) member of the Khaled bin Sultan Living Oceans Foundation's Global Reef Expedition. From March 25th-30th he joined the Foundation's research ship the *M/Y Golden Shadow* and a team of international scientists as they conducted coral reef research round Navassa Island in the Caribbean.

CREW

The Foundation spent 5 days collecting data on the reefs round Navassa Island. They completed SCUBA surveys of the coral reef habitat, fish, and benthic communities in addition to socioeconomic work with Haitian fishermen who fish on Navassa's reefs. The research was carried out in conjunction with team members from the National Oceanic and Atmospheric Administration and the United States Fish and Wildlife Service.

During the mission, CREW activities included:

Diving

- Dive 1. Aborted due to current
- Dive 2. Observed benthic survey teams.
- Dive 3. Test of full face-mask communications gear.
- Dive 4. Reef tour with Dr. Andy Bruckner
- Dive 5. Survey of coral survey and benthic survey teams.
- Dive 6. Survey of benthic survey teams.

Interviews

- Interview with Jean Wiener, Executive Director of the Foundation for the Protection of Marine Biodiversity. Fluent in Creole, Jean served as the mission's liaison to local fishers coming over from Haiti to fish around Navassa.
- Interview with Aurora Alifano, Program Associate with the Island Conservation., to discuss her organization's interest in conducting invasive species management on Navassa Island.

Skype Calls

Skype calls allowed Mike Trimble the opportunity to share his experience with high schools in Arizona and Washington.

- Two 30-minute Skype calls with Corona del Sol High School in Tempe, Arizona
- Two 30-minute Skype calls with Gig Harbor High School in Gig Harbor, Washington

Q&A with Science Team

Both high schools had the opportunity to submit questions to the research team. Answers were incorporated into two daily blog posts: Virtual Connections and Final Reflections from Navassa.

Appendix IV. List of Participants

Name	Institution	Task
Phil Renaud	LOF	executive director/ phototransects
Andy Bruckner	LOF	chief scientist/coral surveys
Brian Beck	LOF	benthic surveys
Judy Lang	AGGRA	coral surveys
David Grenda	FL Aquarium	fish surveys
Margaret Miller	NOAA/NMFS/SEFSC	SEFSC coordinator and benthic lead
Dana Williams	Univ of Miami/CIMAS	Acropora survey and benthic sampling
Dave McClellan	NOAA/NMFS/SEFSC	RVC (fish count) lead and fish counter
Jack Javech	NOAA/NMFS/SEFSC	NOAA dive supervisor and fish counter
Jennifer Schull	NOAA/NMFS/SEFSC	Fish counter/NOAA-CRCP coordinator
Mandy Karnauskas	NOAA/NMFS/SEFSC	Fish counter and fishery interactions
Greg Piniak	NOAA/NOS/Beaufort	Benthic sampling
Brittany Huntington	NRC Postdoc (SEFSC)	Acropora survey and benthic sampling
Allan Bright	Univ of Miami/CIMAS	Acropora survey and benthic sampling
Aurora Alifano	Island Conservation	socioeconomics (fisheries)
Jeremiah Blondeau	Univ of Miami/CIMAS	Fish Counter and GIS
Jean Wiener	FoProBIM	socioeconomics (fisheries)
Alex Dempsey	NCRI	benthic surveys
Eddie Gonzalez	LOF	education director
John Tremble	LOF	Coral Reef Educator on the Water (CREW)
Nick Cautin	LOF	DSO

The Science Team, left to right. **Front:** Alexandra Dempsey – Nova Southeastern University, Andrew Bruckner – Living Oceans Foundation, Phil Renaud – Living Oceans Foundation, Nick Cautin – Living Oceans Foundation, Eddie Gonzalez – Living Oceans Foundation. **Row 2:** Judy Lang – AGRRA, Jeremiah Blondeau – NOAA, Brittany Huntington – NOAA, David McClellan – NOAA, Margaret W. Miller – NOAA, Jennifer Schull – NOAA, , Mandy Karnauskas – NOAA, Dana Williams – NOAA, Aurora Alifano – Island Conservation; **Row 3:** Jack Javech – NOAA, Greg Piniak – NOAA, Jean Wiener – FoProBiM, Brian Beck – Living Oceans Foundation, Allan Bright – NOAA, Dave Grenda – REEF; The Florida Aquarium, Mike Trimble – Coral Reef Educator on the Water (CREW).

Khaled bin Sultan
Living Oceans
Foundation