Reef Environmental Education Foundation (REEF) Monitoring of the Artificial Reef *Gen. Hoyt S Vandenberg*
2011 Annual Project Report
Submitted to Florida Fish and Wildlife Conservation Commission Artificial Reef Program

Background

The Gen. Hoyt S. *Vandenberg* is a 523' steel hulled missile tracking ship that was intentionally sunk seven miles off Key West, Florida, on May 27, 2009, to serve as a recreational diving and fishing artificial reef. The ship lies in 140' of water; at its broadest point the deck is 71' wide, creating habitat from 45' to the sandy bottom. The *Vandenberg* is the largest artificial reef in the Florida Keys National Marine Sanctuary and the second largest in the world. The City of Key West, the Artificial Reefs of the Keys (ARK), Florida Fish and Wildlife Conservation Commission (FWC), and the Florida Keys National Marine Sanctuary (FKNMS) worked closely to obtain, clean, scuttle and sink the vessel, as well as raise funds for the effort.

Prior to the sinking, the Reef Environmental Education Foundation (REEF) was contracted by the FWC to conduct a study with pre- and post-deployment monitoring of the fish assemblages associated with the *Vandenberg* and adjacent reef areas. A Year One report that summarized the cumulative survey effort of five survey events in 2009 and 2010 was compiled and is available on the REEF website (http://www.REEF.org/reef_files/Vandenberg_1year_finalreport_w_appendicies.pdf). The FWC artificial reef program is supporting continued monitoring by REEF, on an annual basis, through 2012. This report summarizes the 2011 results.

REEF is an international non-profit marine conservation organization that runs hands-on grassroots activities designed to educate and engage local communities in conservation-focused activities. REEF is based in Key Largo, Florida, with West Coast offices in California and Washington. The mission of REEF is to conserve marine ecosystems for their recreational, commercial, and intrinsic value by educating, enlisting and enabling SCUBA divers and other marine enthusiasts to become active stewards and citizen scientists. REEF links the diving community with scientists, resource managers and conservationists through marine-life data collection and related activities. REEF coordinates the Volunteer Survey Project, which has trained and involved over 14,000 divers and snorkelers in marine life identification and the collection of useful population and distribution data. This citizen science program has generated one of the largest marine life databases in the world, with over 150,000 surveys conducted to date. REEF's active surveyors achieve one of four ratings of expertise and the most accomplished of these ratings (Levels 4/5) are considered Experts. Active members holding Expert surveyor status make up our Advanced Assessment Team (AAT) and take part in high level assessments for the State of Florida, National Park Service, NOAA and other international organizations. REEF AAT members who contributed data during the 2011 Vandenberg surveys were: Lillian Kenney, Dave Grenda, Pam Wade, Brenda Hitt, Kathryn Tidemann, Alison Johnson, Catherine Whitaker, Bill Horn (FWC), and Alecia Adamson (REEF staff).

Monitoring Objectives

The *Vandenberg* project monitoring objectives remain the same as in 2009/2010: to descriptively and comparatively quantify the fish assemblages over time at the *Vandenberg* and nearby reefs as a

method to document changes as a result of increased habitat provided by the sinking of the *Vandenberg*. Efforts to document the occurrence of any non-native marine fishes (including Lionfish, *Pterois volitans)*, orange cup coral (*Tubastraea coccinea*), and titan acorn barnacles (*Megabalanus coccopoma*) were included to facilitate early detection and rapid response removal efforts of non-native species.

Methods and Survey Effort

This monitoring project employs two methods to quantify fish assemblages; roving diver technique surveys (RDT; Schmitt & Sullivan 1996) and stationery visual counts (SV; Bohnsack and Bannerot, 1986). A team of 6-8 REEF AAT members conducted RDT surveys at the *Vandenberg* and 7 nearby natural and artificial reefs; SV surveys were conducted at the *Vandenberg* and one nearby artificial reef (Joe's Tug).

The RDT is a visual survey method specifically designed to generate a comprehensive species list and sighting frequency and relative abundance estimates. During RDT surveys, divers swim freely throughout a dive site and record every observed fish species. During each survey, divers assign each recorded species one of four log10 abundance categories [single (1); few (2-10), many (11-100), and abundant (>100)]. The RDT survey methodology is employed by the REEF Volunteer Fish Survey Project, and all survey data are archived in the REEF Marine Life Sightings Database (www.REEF.org). Following each survey dive, the surveyor enters their species data along with survey time, depth (from dive computers), temperature (from dive computers), and other environmental information, including habitat type, current, and visibility (estimated) into the REEF database via on-line data entry. During entry and prior to final uploading, data undergo QC/QA checks including automated and human reviews. Once uploaded into the REEF database, summary data can be accessed by the public on the Internet at REEF's homepage (http://www.REEF.org) by geographic location. In addition to a species list, the following metrics can be calculated from survey data for each site:

1) **Sighting Frequency (%SF)** = number of surveys reporting species of interest / total number of surveys at that site
2) **Density Score (DEN)**= [(nSx1)+(nFx2)+(nMx3)+(nAx4)] / (nS + nF + nM + nA) Where n is the number of times each abundance category was assigned and s=single, f=few, m=many and a=abundant (the four categories of abundance recorded during RDT surveys).
3) **Abundance Score** (ABS) = %SF * DEN By multiplying the sighting frequency with the density score a weighted measure of abundance can be derived.

The RDT method does not include size estimates and documenting changes in size structure is not be possible from this dataset. Stationary Visual Count surveys were conducted at the *Vandenberg* and one other site to document sizes of fish over time along with a more precise measure of density for conspicuous, non-cryptic species. During SV surveys the diver is stationery in the middle of an imaginary cylinder with a radius of 7.5m, recording all species present in the cylinder for a period of 5 minutes. Following the 5 minute list compilation, an abundance count and the corresponding minimum, maximum, and mean sizes are recorded for each species present in the cylinder area. Additional information on time of day, depth, current, and visibility are recorded. All SV surveys are conducted on the same day, towards the end of the week-long monitoring effort. Surveyors are given

PVC measuring sticks to aid with size estimation. Prior to the SV surveys, REEF surveyors practiced estimating fish length to the nearest centimetre and estimates among surveyors were calibrated.

Table 1 summarizes the eight research sites that were surveyed and RDT and SV survey effort. Similar to year 1 monitoring efforts, SV surveys were only conducted on *Vandenberg* and Joe's Tug. However, based on recommendations made in the year 1 report, the number of both SV and RDT surveys were doubled at these sites in 2011.

Table 1. 2011 survey effort and study site characteristics.

REEF SITE NAME	Survey Effort	Date	REEF Code	DEPTH	TYPE	LOCATION
Western Sambo Deep	8	6/27/11	34080094	60'-100'	Natural	24º 28.66' N/ -81º 42.93' W
Western Sambos Shallow	8	6/27/11	34080047	15'-30'	Natural	24º 28.75' N/ -81º 42.98' W
Joe's Tug	15 + 5 SV	6/28/11, 6/30/11	34080010	40'-65'	Artificial	24º 27.83' N/ -81º 44.24' W
Marker 32 Deep	8	7/1/11	34080095	60'-100'	Natural	24º 28.25' N/ -81º 44.72' W
Marker 32 Shallow	8	7/1/11	34080023	15'-30'	Natural	24º 28.34' N/ -81º 44.73' W
Eastern Dry Rocks Deep	7	6/29/11	34080096	60'-100'	Natural	24º 27.45' N/ -81º 50.44' W
Eastern Dry Rocks Shallow	7	6/29/11	34080008	15'-30'	Natural	24º 27.52' N/ -81º 50.67 W
Gen. Hoyt S Vandenberg	16 + 5 SV	6/28/11, 6/30/11	34080097	40'-100'	Artificial	24º 27.60' N/ -81º 44.25' W

Site Descriptions

The *Vandenberg* is located on a level sand bottom at a depth of approximately 140'. The seven reference sites were selected in consultation with FWC staff and represent a range of nearby natural and artificial structure (Figure 1 and Table 1). The closest structure to the *Vandenberg* is a small patch of hard coral substrate and remnant sunken vessel rubble (Joe's Tug) located approximately 0.25 miles from the sinking location in a depth of approximately 70'. The nearest substantial reef structures are the natural reef edges at Marker 32 deep and Marker 32 (Topino Buoy), approximately 0.80 miles shoreward of the sinking site. These reefs include a sloping drop-off featuring a sediment covered low profile hardbottom with sparse coverings of small hard corals, soft corals such as gorgonians, and sponges and a shallow spur and groove reef featuring high profile coral ridges and *Montastrea* coral heads separated by narrow sand channels. Located approximately 1.8 miles east of the sinking site are Western Sambo Deep and Western Sambo Shallow (Haystacks buoy). These two sites are similar in depth and structure to the Marker 32 deeper and shallower sites, but differ from all other sites in that they are located inside a no-take Ecological Reserve zone of the FKNMS. The furthest study sites from the *Vandenberg* (6.5 miles west) are Eastern Dry Rocks Deep and Shallow, again featuring a deeper sloping reef similar in depth and structure to the Deep Sambo and Marker 32 site, and a shallow spur and groove site at the west end of Eastern Dry Rocks.

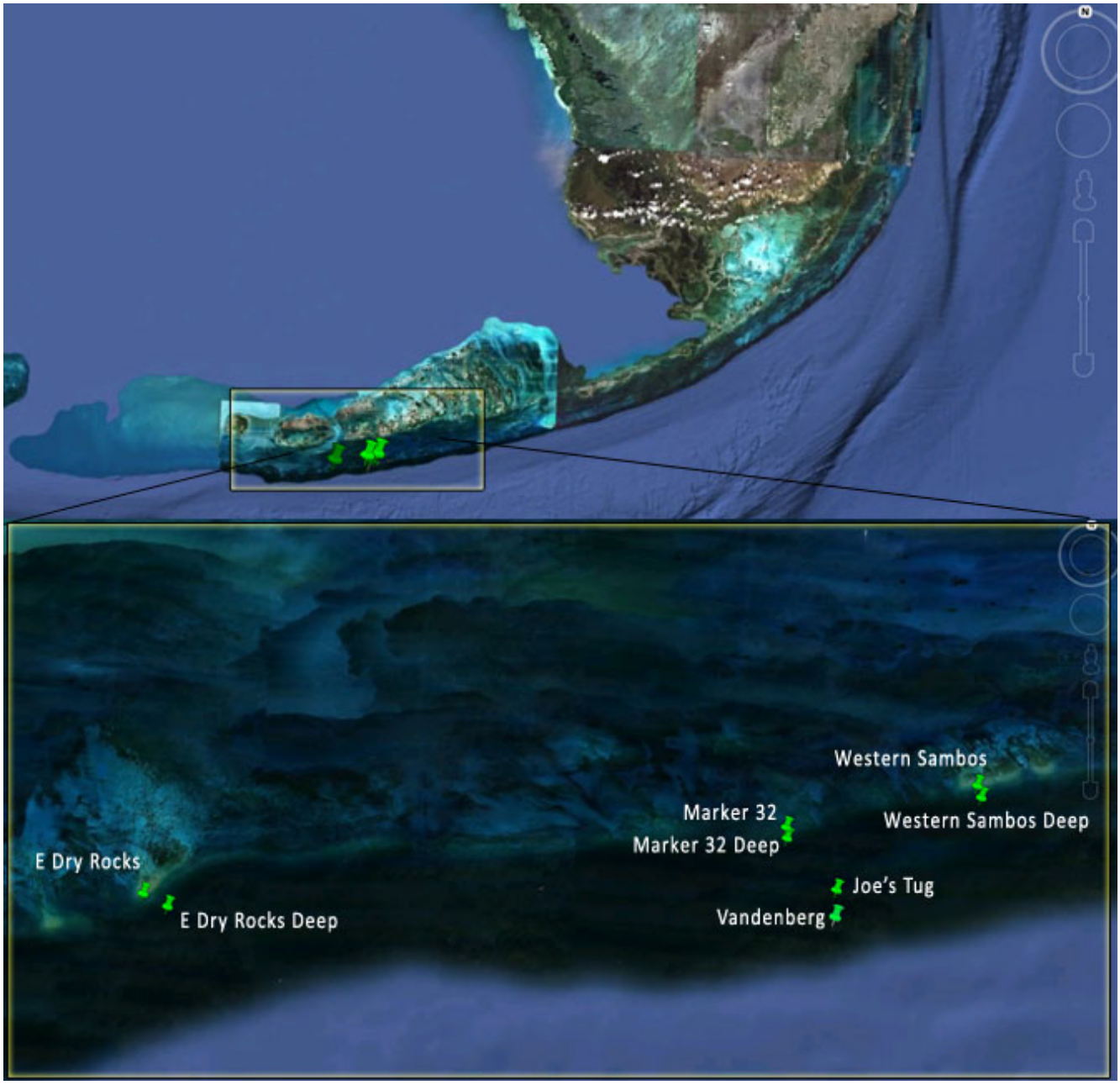

Figure 1. Survey site locations.

Results and Discussion

Survey conditions during the 2011 monitoring event were favorable, with manageable seas, current, and fair visibility at all sites (visibility ranged from approximately 30 feet to 70 feet). A total of 77 RDT surveys and 10 SV surveys were conducted during the monitoring event.

RDT surveys

A total of 115 fish species (and one species of sea turtle) have been documented on the *Vandenberg* during organized monitoring events since REEF started the artificial reef shortly after deployment (Appendix 1). An additional 14 species have been documented by REEF surveyors during other times. A report summarizing all REEF effort and species seen on the *Vandenberg* can be generated online here -- http://www.REEF.org/db/reports/geo/TWA/3408009.

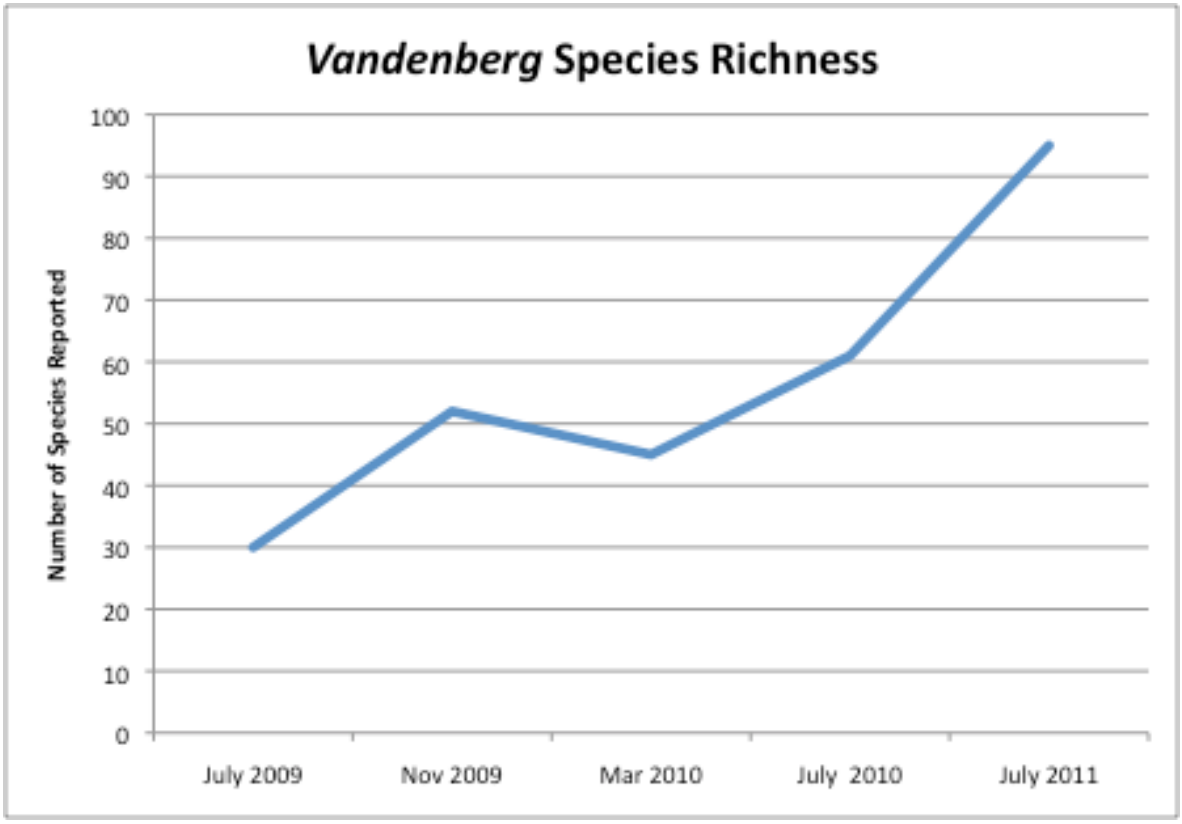

Figure. 2. The number of fish species reported during RDT surveys conducted at the *Vandenberg* artificial reef.

During the July 2011 surveys conducted on the *Vandenberg*, the REEF team reported 95 fish species; 27 of those were new reports for the wreck (Appendix 1), including the invasive Red Lionfish (*P. volitans)*. Also of note was the first sighting of a Goliath grouper. Fish species richness has been steadily increasing on the *Vandenberg* since it was deployed in May 2009 (Figure 2; Appendix 1). The persistence in species present at the *Vandenberg* (the similarity of which species were seen during each monitoring event) as measured by the Jaccard Coefficient (J'), has gradually increased through time (Figure 3). The Jaccard Coefficient measures percent similarity between two samples, either between two sites during a given monitoring event or between two time points at a given site. Relatively low J' values between the first few monitoring events reflect the early colonization of the artificial reef. Over time, the similarity in species present from one year to the next has increased as the fish community on the ship has become more stable (Figure 3).

The similarity in species present at each of the sites through time is shown in Table 2. The persistence in species seen from one monitoring event to the next is generally lower at the deeper sites, including the *Vandenberg*. To evaluate the similarity in species composition between the reference sites and the *Vandenberg* (incorporating both species presence and abundance), Spearman Similarity Coefficient values were calculated for each monitoring event (Figure 4). To minimize the effect of rare species, the analysis included the rank abundance scores of species with a sighting frequency of at least 10% at each site. The similarity in species composition to the *Vandenberg* continues to be lowest for the three shallow sites and highest at the deep sites. Lower similarities exhibited during the June 2009 and March 2010 events (Figure 4) may be due to lower than average visibility.

Change in Species Composition at the *Vandenberg* Since Deployment

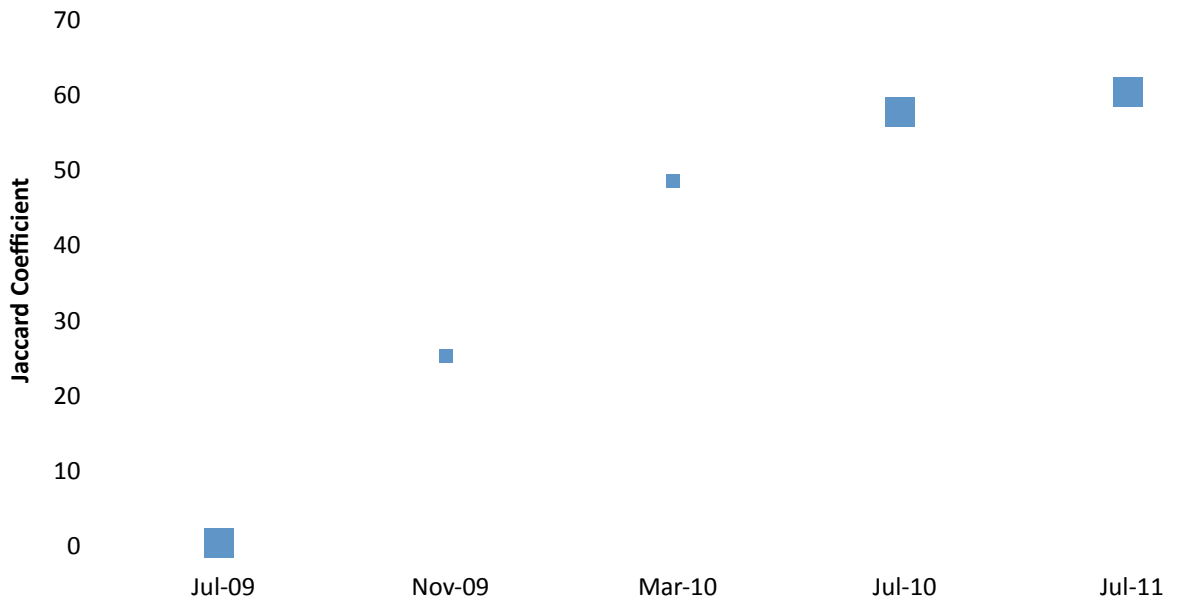

Figure 3. Change in fish species composition at the Vandenberg through time, as measured by the Jaccard Coefficient of each monitoring event compared with species recorded during the previous monitoring event. Large symbols indicate annual July monitoring events.

Table 2. Similarity in species present among monitoring events, measured by percent overlap in species present. Values given are average of mean Jaccard Coefficient (J') values for monitoring times 1-6, as well as the minimum and maximum values.

Site	**Average J'**	**Min, Max J'**
Eastern Dry Rocks	88.5	(84.1, 92.2)
Eastern Dry Rocks Deep	67.7	(63.4, 75.6)
Joe's Tug	67.7	(63.4, 75.6)
Marker 32	79.1	(70.1, 87.4)
Marker 32 Deep	68.2	(55.3, 75.3)
Western Sambo	81.8	(76.7, 85.6)
Western Sambo Deep	69.5	(66.3, 78.8)
Vandenberg	47.7	(25.0, 60.0)

*Value given for the *Vandenberg* does not include the similarity between monitoring time 1 and 2 (which is 0, due to no species sighted).

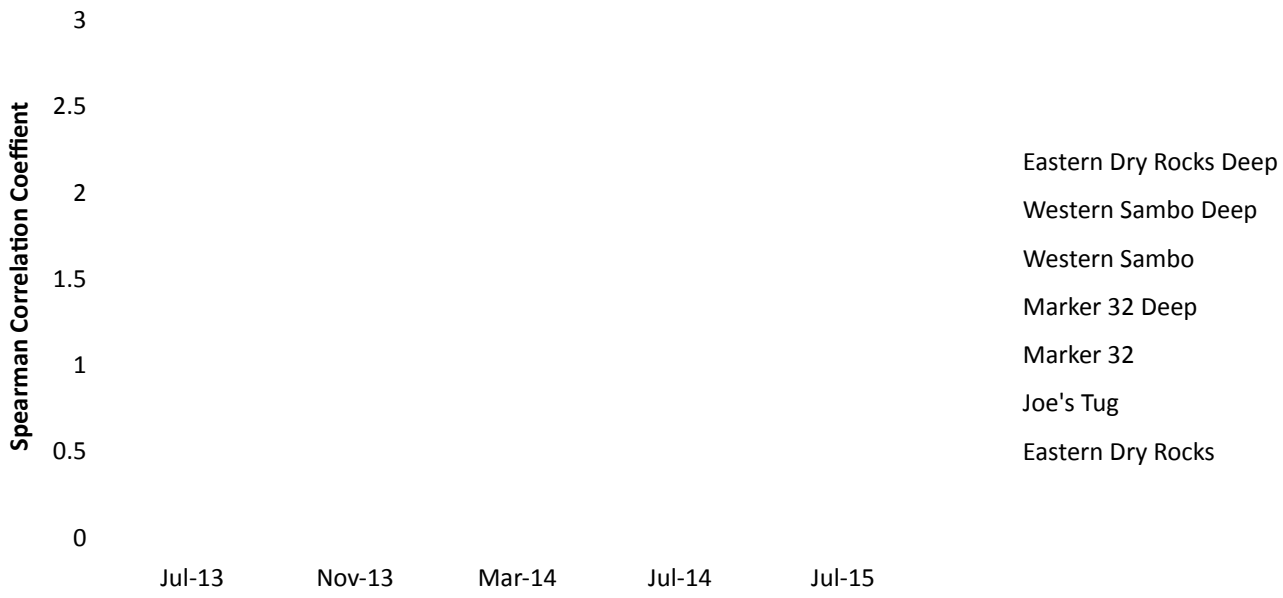

Figure 4. Similarity in species composition between the *Vandenberg* and the reference sites. Values are mean Spearman similarity coefficients for monitoring events 2-6 (pre-deployment monitoring not included because no species were seen at the *Vandenberg* site), based on rank abundance scores. Species seen in at least 90% of surveys at each site were included in the analysis.

A total of 176 species of fish were documented during RDT surveys in the 2011 monitoring (Appendix 2). Species richness counts were 92 (E. Dry Rocks Deep and Marker 32 Deep), 94 (*Vandenberg*), 100 (Western Samobs Shallow), 106 (Joe's Tug), 107 (Western Sambos Deep), and 115 (Eastern Dry Rocks Shallow). Sighting frequency, based on RDT surveys, is shown in Appendix 2.

Point Count Surveys

The top fifteen most numerous species sighted on SV surveys at *Vandenberg* and Joe's Tug are shown in Table 3. For each species, total count (in the 5 SV surveys conducted at each site) and average size are shown. Of the fifteen species, four overlapped on both lists; this highlights the different fish assemblage structure currently found on these two artificial reefs that are of very different size, structure, and age. Joe's Tug was dominated by grunts, with French and Bluestriped Grunts being the top two most abundant species. The *Vandenberg* was dominated by baitfish (scad) and snappers with Round Scad, Gray Snapper, and Yellowtail Snapper being the top 3 most abundant species. These are similar patterns to what was documented during SV surveys conducted during the 2009/2010 monitoring.

The Point Count data will serve as a valuable baseline to evaluate future change in the density and size structure of key fish species, as well as trends in biomass. A more complete summary of size structure and biomass will be presented in the final monitoring report at the end of 2012.

Table 3. Top 15 most numerous species documented in point count surveys. The total number of individuals for each species (of N=5 surveys) and average size (cm) are listed for the *Vandenberg* and Joe's Tug. Species present in both lists are listed in **bold**. A total of 41 species were documented in point counts at the *Vandenberg* and 44 species at Joe's Tug.

	Vandenberg			Joe's Tug	
	Total #	**Avg Size**		**Total #**	**Avg Size**
Round Scad	260	12.0	French Grunt	147	17.3
Gray Snapper	**82**	**37.2**	Bluestriped Grunt	66	26.0
Yellowtail Snapper	**72**	**20.3**	Masked/Glass Goby	55	1.5
Boga	45	10.0	Creole Wrasse	53	12.9
Sharpnose Puffer	29	5.2	Sergeant Major	45	11.2
Mahogany Snapper	27	29.6	**Bicolor Damselfish**	**33**	**5.2**
Bicolor Damselfish	**24**	**6.1**	Atlantic Spadefish	31	38.6
Reef Butterflyfish	21	10.3	Schoolmaster	28	31.1
Bluehead	**19**	**9.1**	Brown Chromis	27	10.4
Redband Parrotfish	10	18.3	Striped Parrotfish	24	13.3
Smallmouth Grunt	10	19.0	**Yellowtail Snapper**	**20**	**30.3**
Blue Angelfish	8	26.0	**Bluehead**	**14**	**9.9**
Great Barracuda	8	88.8	**Gray Snapper**	**14**	**31.1**
Ocean Surgeonfish	7	20.8	Princess Parrotfish	14	22.4
Blue Tang	5	17.6	Porkfish	13	19.8

Non-native Species

Lionfish (*Pterois volitans)* was the only non-native species observed during the project monitoring events. Lionfish were sighted on 6 of the 8 survey sites; the invasive species was not seen on Joe's Tug or Western Sambos Shallow. Both of these sites are popular dive sites and are commonly frequented by dive operators that are known to remove lionfish whenever possible. In all rounds of surveys conducted in 2009 and 2010, lionfish were sighted on only 2 survey sites, both during 2010. This dramatic increase in sightings from 2010 to 2011 is consistent with the rapid progression of the invasion. All lionfish sightings were reported to the Florida Keys National Marine Sanctuary.

Conclusion

Based on the RDT and SV data, it appears that the *Vandenberg* is supporting a robust fish community that is gradually becoming similar to those found on nearby deep reefs. Species richness continued to increase but is likely levelling off. The artificial reef is home to a number of commercially and recreationally important fish, including several species of groupers (Goliath Grouper, Black Grouper, and Scamp).

REEF will coordinate another round of monitoring in August 2012, using the same survey design and effort. Based on difficulty in locating unmarked/unbuoyed sites, the REEF team will use a marker buoy for diver and boat reference to ensure replicate surveying.

Literature Cited

Bohnsack, J. A., and S. P. Bannerot. 1986. A stationary visual census technique for quantitatively assessing community structure of coral reef fishes. NOAA Technical Report NMFS, 41: National Oceanic and Atmospheric Administration, Southeast Science Fisheries Center, Miami, FL. 15 p.

Schmitt, E.F. and K.M. Sullivan, 1996. Analysis of a volunteer method for collecting fish presence and abundance in the Florida Keys. Bulletin of Marine Science. 59(2):404-416

Appendix 1. Abundance Score based on RDT surveys conducted during REEF monitoring events at the Vandenberg. 116 fish species have been documented on the artificial reef since it was deployed in May 2009. During the 2011 montiroing event, REEF surveyors documented 27 new species on the reef (including Loggerhead Sea Turtle).

	July 2009	Nov 2009	Mar 2010	July 2010	July 2011	New Sighting in 2011
Almaco Jack	0.17			0.29	0.44	
Bar Jack		2.33		1.14	2.06	
Barred Cardinalfish	0.17					
Barred Hamlet				0.29		
Beaugregory					0.25	x
Bicolor Damselfish	2.17	3.17	2.60	2.86	2.81	
Black Grouper		0.17	0.20		0.06	
Blackbar Soldierfish					0.13	x
Blackfin Snapper	1.00		1.20		0.13	
Blue Angelfish					0.94	x
Blue Chromis		0.83			0.44	
Blue Runner					0.25	x
Blue Tang		2.00	1.40	2.43	2.00	
Bluehead	1.50	3.33	3.20	3.43	2.81	
Bluelip Parrotfish	0.33			0.43		
Bluestriped Grunt		1.50	0.20	1.86	1.94	
Boga		0.67			1.06	
Bridled Goby		0.17		0.71	1.06	
Brown Chromis		1.50		0.29	1.25	
Butter Hamlet		0.33	1.00	1.00	0.06	
Caesar Grunt					0.25	x
Cero			0.40	1.00	0.63	
Chalk Bass	1.67					
Cherubfish	0.17					
Clown Wrasse		0.50			0.19	
Cocoa Damselfish			0.60		0.19	
Colon Goby				0.14		
Cottonwick			0.60	0.43		
Creole Wrasse	0.50	0.33	2.40	1.57	1.94	
Creole-fish		1.33	1.40	0.14	0.81	
Crevalle Jack					0.13	x
Cubera Snapper					0.06	x
Doctorfish		0.67	0.40	1.29	0.56	
Dusky Damselfish		0.17			0.38	
Foureye Butterflyfish		0.17			0.25	
French Angelfish		0.17		1.29	1.44	
French Grunt				0.57	0.88	

	July 2009	Nov 2009	Mar 2010	July 2010	July 2011	New Sighting in 2011
Goldspot Goby		1.00		0.29	0.88	
Goliath Grouper					0.63	x
Gray Angelfish		0.67		1.43	0.69	
Gray Snapper		1.83	1.60	3.00	2.88	
Graysby		0.33		1.43	1.38	
Great Barracuda	1.50	2.00	2.40	2.57	1.94	
Greater Amberjack	1.33		2.20	0.29		
Greenblotch Parrotfish	0.17	0.33			0.25	
Harlequin Bass	1.00	1.67	0.80	0.57	0.44	
Hogfish		1.33			0.63	
Horse-Eye Jack					0.38	x
Juvenile Grunt	2.17		1.40		0.31	
Lane Snapper					0.38	x
Little Tunny					0.25	x
Loggerhead Sea Turtle					0.19	x
Longfin Damselfish				0.57		
Mackerel Scad	0.67	0.67			2.00	
Mahogany Snapper					0.56	x
Masked Goby/Glass Goby					0.69	x
Midnight Parrotfish		0.67				
Ocean Surgeonfish		1.67	0.60	0.57	2.06	
Orangespotted Filefish					0.06	x
Pallid Goby					0.06	x
Porkfish		1.50	0.80	0.71	1.31	
Princess Parrotfish			0.20	0.71	0.75	
Purple Reeffish	1.83	1.50	1.60	1.86	2.31	
Queen Angelfish		0.50	0.80	2.14	1.63	
Queen Parrotfish				0.14	0.13	
Queen Triggerfish				0.14		
Rainbow Parrotfish		0.67	0.40	1.00	0.81	
Rainbow Runner					0.25	x
Red Hind					0.13	x
Red Lionfish					0.13	x
Redband Parrotfish		0.83	1.80	1.71	2.13	
Redspotted Hawkfish			0.20	0.57		
Redtail Parrotfish		0.17		0.57	0.75	
Reef Butterflyfish	0.33	1.67	1.60	2.43	2.38	
Rock Beauty		0.83	0.60	0.71	0.94	
Rock Hind					0.06	x
Round Scad			4.00	4.00	2.63	
Saddled Blenny	0.33					

	July 2009	Nov 2009	Mar 2010	July 2010	July 2011	New Sighting in 2011
Sailors Choice				0.57	0.56	
Saucereye Porgy					0.06	x
Scamp		0.33	0.20	0.29	0.69	
School Bass	1.67					
Schoolmaster	0.33				0.63	
Scrawled Filefish	0.67	0.50		2.14	0.56	
Seaweed Blenny			0.20	0.86	0.19	
Sergeant Major			0.40		0.31	
Sharpnose Puffer	1.00	2.00	1.60	3.00	2.69	
Silversides, Herrings, Anchovies				1.14		
Slender Filefish		0.67				
Slippery Dick					0.06	x
Smallmouth Grunt			0.60		0.88	
Smooth Trunkfish					0.13	x
Spanish Hogfish		1.17	1.00	1.00	1.63	
Spotfin Butterflyfish		0.33	0.20	0.29	0.63	
Spotfin Hogfish			1.00	1.00	2.44	
Spotted Goatfish	1.00		0.40		0.13	
Spotted Scorpionfish				0.14		
Stoplight Parrotfish		0.50			0.44	
Striped Grunt	2.17		1.40	0.86	2.13	
Striped Parrotfish		1.33	1.20	1.43	1.56	
Sunshinefish	0.83	1.83	0.80	1.29	1.19	
Tobaccofish	1.00	0.17				
Tomtate		1.00	0.60	0.29	0.50	
Townsend Angelfish					0.75	x
Trumpetfish		0.33	0.20	0.43	0.13	
Twospot Cardinalfish	0.33					
White Grunt				0.14	0.50	
White Margate					0.06	x
Yellow Jack	1.00				0.94	
Yellowfin Grouper		0.17				
Yellowhead Wrasse					0.63	x
Yellowmouth Grouper				0.14		
Yellowtai Parrotfish		0.83		0.57	0.31	
Yellowtail Damselfish					0.44	x
Yellowtail Reeffish	0.67		0.40	1.14	0.94	
Yellowtail Snapper	2.83	3.00	2.60	3.86	2.94	
TOTAL SPECIES RICHNESS	**30**	**52**	**45**	**61**	**95**	

Appendix 2. Sighting Frequency during RDT surveys conducted during July 2011 REEF Monitoring at the Vandenberg and 7 nearby sites. 178 species were documented during the survey event, including one species of sea turtle.

	Eastern Dry Rocks Deep	**Eastern Dry Rocks Shallow**	**Joe's Tug**	**Marker 32 Shallow**	**Marker 32 Deep**	**Western Sambos**	**Western Sambos Deep**	***Vandenberg***
Almaco Jack								31%
Atlantic Spadefish			53%				50%	
Balloonfish					25%			
Banded Butterflyfish		57%	7%	38%		50%	88%	
Bar Jack	86%	57%	87%	50%	13%	88%	38%	81%
Barfin Blenny				13%				
Barred Blenny		14%		13%		13%		
Barred Cardinalfish						25%		
Barred Hamlet	14%							
Beaugregory	43%	57%	47%	75%	50%	75%	38%	13%
Bermuda Chub/Yellow Chub		86%	20%	25%		75%	88%	
Bicolor Damselfish	100%	100%	87%	88%	100%	88%	100%	100%
Black Grouper	86%	71%			75%	38%		6%
Black Hamlet					25%			
Black Margate		43%			25%	38%	13%	
Blackbar Soldierfish							75%	6%
Blackear Wrasse				25%				
Blackfin Snapper								6%
Blue Angelfish	71%		7%	50%	25%		50%	69%
Blue Chromis	100%	100%	93%	50%	100%	100%	100%	19%
Blue Dartfish			53%	88%		63%	63%	
Blue Hamlet	29%		7%					
Blue Parrotfish		71%		38%	13%	50%	88%	
Blue Runner								13%
Blue Tang	71%	100%	93%	88%	100%	100%	100%	94%
Bluehead	100%	100%	93%	100%	100%	100%	100%	100%
Bluelip Parrotfish			7%	50%	13%			
Bluestriped Grunt	100%	100%	100%	50%	88%	100%	100%	94%

	Eastern Dry Rocks Deep	Eastern Dry Rocks Shallow	Joe's Tug	Marker 32 Shallow	Marker 32 Deep	Western Sambos	Western Sambos Deep	*Vandenberg*
Boga	14%							38%
Bridled Goby	43%	100%	87%	100%	63%	100%	88%	50%
Brown Chromis	14%	100%	87%	50%	38%	88%	100%	44%
Bucktooth Parrotfish				38%		13%		
Butter Hamlet	100%	43%	93%		100%	63%	63%	6%
Caesar Grunt	43%	100%	13%	38%		50%	63%	13%
Cero		14%						50%
Chalk Bass			13%		13%			
Cherubfish							13%	
Clown Wrasse		86%	7%	100%		88%	75%	6%
Cocoa Damselfish	43%	71%	47%	38%	63%	63%	38%	13%
Colon Goby		29%	13%	50%		38%	38%	
Common Snook			20%					
Coney	14%	14%		13%	13%			
Creole Wrasse	86%	86%	93%	13%		88%	100%	69%
Creole-fish			20%					31%
Crevalle Jack								6%
Cubera Snapper					13%			6%
Darkheaded Blenny			7%	13%				
Doctorfish	14%	86%	33%	25%	50%	38%	75%	44%
Dusky Damselfish	43%	100%	13%	50%	25%	50%	25%	19%
Dusky Jawfish				25%				
Dusky Squirrelfish		43%		38%			13%	
Flamefish		14%		25%				
Foureye Butterflyfish	86%	100%	100%	88%	100%	100%	100%	13%
French Angelfish	14%	43%	13%	13%	38%	13%	63%	88%
French Grunt	100%	86%	100%	88%	100%	100%	88%	44%
Gag					25%			
Glassy Sweeper		71%						
Goldentail Moray		43%			13%			

	Eastern Dry Rocks Deep	Eastern Dry Rocks Shallow	Joe's Tug	Marker 32 Shallow	Marker 32 Deep	Western Sambos	Western Sambos Deep	*Vandenberg*
Goldspot Goby	29%	71%	67%	88%	13%	88%	75%	38%
Goliath Grouper	14%							56%
Gray Angelfish	57%	57%	20%	13%	50%	38%	88%	44%
Gray Snapper	57%	100%	87%	25%	38%	63%	100%	88%
Graysby	100%	86%	93%	63%	100%	88%	100%	81%
Great Barracuda	14%	71%	53%	50%	13%	50%	38%	94%
Greater Soapfish			7%					
Green Moray		43%			13%			
Green Razorfish		14%		100%				
Greenblotch Parrotfish	29%		53%	100%	38%	25%	63%	13%
Hamlet - Juvenile	14%	14%	20%	13%	25%			
Harlequin Bass		86%	80%	100%	13%	88%	50%	25%
Highhat	43%	43%	93%	38%	75%	13%	88%	
Hogfish	86%	43%	67%	50%	100%	88%	100%	44%
Horse-Eye Jack		14%					38%	19%
Hovering Dartfish			7%	25%	13%			
Indigo Hamlet							25%	
Jolthead Porgy							13%	
Juvenile Grunt	14%	29%	7%	25%		13%	13%	19%
Knobbed Porgy	29%	29%		25%	13%	25%	50%	
Lancer Dragonet		14%	7%					
Lane Snapper	29%				88%		13%	19%
Lantern Bass	14%	29%	7%	88%		13%	13%	
Leopard Goby	14%			13%		13%		
Little Tunny								13%
Littlehead Porgy					13%			
Loggerhead Sea Turtle								19%
Longfin Damselfish	14%	71%	7%	50%		63%		
Longjaw Squirrelfish	14%	14%				13%	25%	
Longsnout Butterflyfish	14%							

	Eastern Dry Rocks Deep	Eastern Dry Rocks Shallow	Joe's Tug	Marker 32 Shallow	Marker 32 Deep	Western Sambos	Western Sambos Deep	*Vandenberg*
Longspine Squirrelfish	43%	86%	20%	38%		50%	63%	
Mackerel Scad								63%
Mahogany Snapper	57%	86%	20%	25%		63%	88%	19%
Masked Goby/Glass Goby	86%	57%	93%	75%	100%	100%	75%	25%
Midnight Parrotfish		86%		25%	13%		13%	
Mutton Snapper	14%			13%	13%	13%	13%	
Nassau Grouper						13%		
Neon Goby	71%	86%	73%	100%	100%	100%	88%	
Nurse Shark		57%				13%	13%	
Ocean Surgeonfish	71%	100%	87%	100%	100%	100%	100%	100%
Orangespotted Filefish		57%	7%	38%		25%		6%
Pallid Goby	14%		27%	38%	38%	13%	13%	6%
Porcupinefish			20%	13%			13%	
Porkfish	86%	100%	100%	38%	100%	100%	100%	69%
Princess Parrotfish	71%	86%	100%	63%	100%	100%	88%	50%
Puddingwife		86%	7%	100%		75%	50%	
Purple Reeffish	86%	57%	80%	25%	88%	75%	63%	81%
Queen Angelfish	57%	57%	73%	63%		13%	38%	81%
Queen Parrotfish		86%	93%	38%	13%	88%	75%	6%
Rainbow Parrotfish		100%		13%	13%	25%		50%
Rainbow Runner								13%
Rainbow Wrasse		14%		63%				
Red Hind	43%	29%	13%		13%		38%	6%
Red Lionfish	57%			13%	13%		50%	13%
Redband Parrotfish	100%	100%	93%	100%	88%	100%	100%	100%
Redlip Blenny		86%		13%				
Redspotted Hawkfish		29%		13%		25%	13%	
Redtail Parrotfish	29%	100%	33%	38%	38%	75%	25%	44%
Reef Butterflyfish	86%	14%	87%	25%	100%	38%	38%	100%
Reef Croaker	29%	43%						

	Eastern Dry Rocks Deep	Eastern Dry Rocks Shallow	Joe's Tug	Marker 32 Shallow	Marker 32 Deep	Western Sambos	Western Sambos Deep	*Vandenberg*
Reef Squirrelfish		14%	7%	13%				
Rock Beauty	100%	71%	100%	50%	100%	75%	100%	69%
Rock Hind	29%	29%	13%	13%	50%	50%	13%	6%
Rosy Blenny		14%		38%				
Roughhead Blenny	14%	29%	7%	88%	25%	25%	25%	
Round Scad								75%
Saddled Blenny	14%	100%	7%	88%		38%	13%	
Sailors Choice	14%	71%	7%	25%		63%	100%	31%
Sand Diver		14%		13%	25%		25%	
Saucereye Porgy	43%	29%		63%	63%	75%	75%	6%
Scamp	14%							44%
School Bass	14%							
Schoolmaster	71%	86%	87%	38%	13%	38%	100%	31%
Scrawled Cowfish			27%		13%		25%	
Scrawled Filefish		29%	53%	38%	13%	38%		38%
Seaweed Blenny		57%	13%	88%		38%	13%	13%
Sergeant Major	14%	100%	93%	50%	13%	100%	88%	13%
Sharksucker		14%		13%		25%		
Sharpnose Puffer	86%	100%	100%	100%	100%	100%	100%	94%
Silversides, Herrings, Anchovies		29%						
Slender Filefish				25%				
Slippery Dick		100%	27%	100%	25%	100%	88%	6%
Smallmouth Grunt		14%	7%				25%	38%
Smooth Trunkfish			67%	13%		75%	50%	13%
Southern Stingray						13%	63%	
Spanish Grunt	71%	71%	13%	25%	50%	25%	50%	
Spanish Hogfish	100%	100%	80%	75%	88%	100%	88%	94%
Spotfin Butterflyfish	100%	86%	87%	75%	88%	75%	100%	38%
Spotfin Hogfish	57%				63%			94%
Spotted Drum	57%			38%				

	Eastern Dry Rocks Deep	Eastern Dry Rocks Shallow	Joe's Tug	Marker 32 Shallow	Marker 32 Deep	Western Sambos	Western Sambos Deep	*Vandenberg*
Spotted Goatfish	14%	57%	73%	75%	88%	75%	63%	6%
Spotted Moray		14%	7%		25%		13%	
Spotted Trunkfish			7%	13%				
Squirrelfish	14%	100%	27%	38%		50%	88%	
Stoplight Parrotfish	86%	100%	73%	100%	88%	100%	100%	25%
Striped Grunt			13%					63%
Striped Parrotfish	100%	100%	73%	100%	88%	88%	88%	75%
Sunshinefish	86%		40%		75%			56%
Tarpon						13%		
Threespot Damselfish	14%	71%	13%	38%	38%	75%	25%	
Tobaccofish		14%	20%		38%	13%	13%	
Tomtate	71%	14%	7%		75%	25%		25%
Townsend Angelfish	14%	14%			25%		13%	44%
Trumpetfish	29%		40%	25%	25%	63%	88%	13%
Twospot Cardinalfish			7%	13%				
White Grunt	100%	100%	87%	75%	100%	88%	100%	25%
White Margate		29%		13%			13%	6%
Whitespotted Filefish	29%					13%		
Wrasse Blenny		14%		25%				
Yellow Goatfish	29%	86%	13%	38%	13%	50%	88%	
Yellow Jack		14%	7%		25%		13%	50%
Yellowcheek Wrasse			33%	25%			13%	
Yellowfin Grouper		14%						
Yellowhead Jawfish		29%	87%	88%		75%	63%	
Yellowhead Wrasse	57%	100%	93%	100%	100%	100%	100%	38%
Yellowmouth Grouper	14%	29%						
Yellowtail Parrotfish	29%	100%	20%	50%	38%	88%	50%	19%
Yellowtail Damselfish	14%	100%	73%	63%	25%	100%	75%	25%
Yellowtail Reeffish			20%		50%			56%
Yellowtail Snapper	100%	100%	93%	100%	100%	88%	88%	94%