

**INVESTIGATING HOW CORAL RECRUITMENT AND JUVENILE  
SURVIVORSHIP VARIES ALONG THE FLORIDA REEF TRACT  
FINAL REPORT**

**A Report of the Fish & Wildlife Research Institute/  
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**Project Title:** Investigating how coral recruitment and juvenile survivorship varies along the Florida Reef Tract

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- 1. HIGHLIGHTS AND ACCOMPLISHMENTS:** The information contained in this report summarizes the accomplishments for the entirety of the project and spans two MOAs (MOA 2010-026 & MOA 2015-047). The project time period runs between August 8, 2014 thru September 30, 2019 and covers three project years. Tile retrieval and juvenile census surveys were completed at all 30 sites every year. The total number of juvenile stony corals and octocorals recorded for all project years are included in this report. Live scans and post-bleaching scans of all tiles were completed, and the total number of recruits recorded for all project years are included in this report.

## 2. TASK TIMELINES

<u>Task #</u>	<u>Task</u>	<u>2014</u>	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>
1	Project planning	X	X	X	X	-	-
2	Installation of hardware	X	X	-	-	-	-
3	Tile deployment	-	X	X	X	-	-
4	Juvenile census surveys	-	X	X	X	X	-
5	Tile Retrieval	-	-	X	X	X	-
6	Recruit identification	-	-	X	X	X	X

## 3. TASK ACCOMPLISHMENTS

### Task 1 – Project planning

**Planned work:** Organize meetings and conference calls with co-Principal Investigators Dr. Danny Gleason of Georgia Southern University (GSU) and Dr. Nicole Fogarty of Nova Southeastern University (NSU). Develop plans and protocols for all aspects of the project including installation of project hardware, conducting juvenile census surveys, deploying and retrieving tiles, performing live scans of stony coral and octocoral recruits in field labs, and completing post-bleaching scans for stony coral recruits at GSU and NSU labs.

**Completed work:** Multiple in person meetings and conference calls were held annually. The focus of those meetings can be reviewed in previously submitted annual reports. In person meetings were also held to perform cross-training across institutions to ensure installation techniques, survey protocols, and field and lab methods for identifying corals were standardized and consistent for all project personnel. Procedures for improving juvenile census surveys, tile retrieval operations and coral identification techniques in the laboratory were implemented in each successive year of the project. The new procedures were agreed to by all project PIs and circulated among the project team to outline standardized methods in tile retrieval, deployment, and processing.

**Problems:** None

### Task 2 – Installation of Hardware

**Planned work:** Install 32 sets of stainless-steel hardware for securing tiles to the substratum and demarcate with masonry nails 32 quadrats (0.5 m x 0.5 m) for juvenile coral surveys at each CREMP or SECREMP study site (18 in the FL Keys and 12 in SE FL [Miami-Dade and Broward Counties]).

**Completed Work:** Installation of hardware to secure tiles to the substratum at all 30 study sites in the FL Keys and SE Florida was completed on the dates listed in Table 1. During

tile retrieval for Project Year 3 tiles (PY3), the final project year tile deployment hardware was removed from the reef after the tiles were collected.

**Problems:** Annual maintenance was required to replace missing masonry nails or hardware used for securing tiles to the substrate.

### **Task 3 – Tile Deployment**

**Planned work:** Deploy 32 sets of tiles (each set equals two tiles placed back to back) at all 30 project sites annually. The 30 total project sites equal 18 CREMP sites in the Florida Keys and 12 SECREMP sites in the SE FL region.

**Completed work:** Tile deployment was successfully completed in all project years. The dates of tile deployment are listed in Table 1. Tile deployment was completed at a subset of three sites in hopes of securing funding to continue tile deployment and retrieval for long-term data collection and analyses. The three sites chosen were DC8, Molasses Deep, and Sombrero Deep.

**Problems:** None

### **Task 4 – Juvenile Coral Surveys**

**Planned work:** Conduct juvenile census surveys at all 30 project sites annually. Survey 32, 0.25m<sup>2</sup> permanently established quadrats at 18 CREMP sites in the FKNMS and 12 SECREMP sites in the SE FL region.

**Completed work:** Juvenile surveys were successfully completed in all project years. The dates in which the juvenile surveys were completed are listed in Table 1. The last juvenile survey was completed on 2/27/18 in SE FL. This report presents the total number of juvenile (<4cm) corals and octocorals counted at all sites across all project years in Table 2. Combined for all three years and both project regions 8,998 corals and 8,565 octocorals were recorded in the juvenile surveys. In SE FL 1,723 corals and 2,787 octocorals were recorded for a total of 4,510 juveniles. In the Florida Keys, 7,275 corals and 5,778 octocorals were recorded for a total of 13,053 juveniles (Table 2). Some of the juveniles represented in these totals were the same individual recorded across all three years. The deeper forereefs in the Florida Keys contained the highest number of juveniles with Sombrero Reef and Sand Key with the greatest number recorded for all three years (1,348 and 1,216 juveniles respectively).

**Problems:** None

### **Task 5 – Tile Retrieval**

**Planned work:** Retrieve 32 sets of tiles (each set equals two tiles placed back to back) at all 30 project sites annually. The 30 total project sites equal 18 CREMP sites in the Florida Keys and 12 SECREMP sites in the SE FL region.

**Completed work:** Tile retrieval was successfully completed in all project years. The dates of tile retrieval are listed in Table 1. In Project Year 1, >95% of the tiles were retrieved in both SE FL and the Florida Keys. The return rate increased in Project Year 2 and was >98%. However, in Year 3, tile retrieval decreased to ~90% due to Hurricane IRMA. Some study sites were severely impacted. For example, less than 60% of the tiles were recovered at both the shallow and deep forereef sites at Tennessee Reef. At all other sites, both in SE FL and the Florida Keys >75% of the tiles were recovered in Project Year 3.

**Problems:** None

## **Task 6 – Recruit Identification**

**Planned work:** Identify coral recruits on tiles collected from all 30 sites annually. Perform “live” scans of tiles to provide preliminary estimate of coral and octocoral recruitment on 32 sets of tiles deployed at 18 CREMP sites in the Florida Keys and 12 SECREMP sites in the SE FL region. Conduct “post-bleaching” scans to identify coral recruits missed during the “live” scans.

**Completed work:** Recruit identification is accomplished through two processes, “live” scans and “post-bleaching” scans. Live scans of the tiles were completed one or two days post collection. Live scans focused on finding all living recruits. Post-bleaching scans were conducted after the tiles were bleached to remove encrusting organisms (e.g., tunicates, sponges) and to preserve the tile for long-term storage. Post-bleaching scans of the tiles allow for the identification of stony corals that may have settled on the tile but were obscured during the live scans due to being overgrown by another soft bodied colonial organism. Only stony corals could be identified during the post-bleaching scans because octocorals were destroyed during the bleaching process. Live scans and post bleaching scans were successfully completed in all project years.

The dates in which the tiles were recovered are listed in Table 1. The last site tiles were collected at was Porter Patch and on 4/11/18 in the Florida Keys. This report presents the total number of corals and octocorals recruits counted for all tiles recovered for all project years (Table 3). Combined for all three years and both project regions 11,660 corals and 1,358 octocorals recruits were counted. In SE FL, 1,787 corals and 673 octocorals were observed totaling 2,460 recruits. In the Florida Keys, 9,873 corals and 685 octocorals were recorded for a total of 10,558 recruits (Table 3). The patch reefs in the Florida Keys had the highest number of recruits with three sites having >1,000 recruits settle pooled for all project years (Table 3).

The total number of corals found in Project Year 3 (9,729) was more than seven times the number found in Project Year 2 (1,298) and more than 15 times the number in Project Year 1 (633). This illustrates how stochastic coral recruitment can be on an annual basis. More to that point, 3,217 of the coral recruits in Project Year 3 came from West Washerwoman, a patch reef in the Lower Keys. Project Year 3 was also the only year that octocorals settled on tiles at West Washerwoman and 86 were recorded. In relation to the identification techniques 28.8% of the corals were identified during the live scans. The 71.2% identified after the post bleaching scans.

**Problems:** None

**Table 1.** List of study sites and dates project tasks were completed for all project years.

Site Name	Project Installation	YR1 Tile Deployment	YR1 Juvenile Survey	YR1 Tile Retrieval & YR2 Deployment	YR2 Juvenile Survey	YR2 Tile Retrieval & YR3 Deployment	YR3 Juvenile Survey	YR3 Tile Retrieval
BC1	12/12/14	3/19/15	10/5/15	3/17/16	11/11/16	2/7/17	9/27/17	2/26/18
BC2	11/7/14	4/3/15	10/5/15	4/1/16	12/1/16	2/9/17	9/29/17	2/26/18
BC3	11/12/14	3/30/15	10/8/15	5/5/16	12/2/16	3/21/17	10/31/17	2/28/18
BC4	12/19/14	3/20/15	10/8/15	3/29/16	11/11/16	2/8/17	9/30/17	2/28/18
DC1	10/15/14	4/27/15	10/13/15	4/14/16	11/9/16	2/13/17	10/16/17	2/28/18
DC2	1/22/15	4/27/15	10/13/15	4/25/16	12/7/16	2/14/17	10/31/17	3/2/18
DC3	2/16/15	4/24/15	10/15/15	5/11/16	12/7/16	3/29/17	11/1/17	3/2/18
DC4	10/17/15	4/15/15	10/6/15	5/4/16	12/14/16	3/28/17	11/1/17	3/15/18
DC5	12/16/15	3/23/15	10/7/15	5/12/16	12/1/16	3/22/17	2/27/18	2/27/18
DC6	1/28/15	4/1/15	10/12/15	5/11/16	12/15/16	3/14/17	9/28/17	2/28/18
DC7	2/13/15	4/2/15	10/14/15	5/23/16	12/8/16	3/27/17	10/31/17	3/13/18
DC8	10/16/14	4/17/15	10/9/15	4/13/16	11/16/16	2/17/17	11/1/17	3/16/18
Admiral	10/21/14	3/16/15	9/24/15	3/18/16	9/14/16	3/12/17	7/14/17	4/10/18
Carysfort Deep	10/18/14	3/17/15	9/3/15	3/17/16	9/13/16	3/13/17	7/15/17	4/11/18
Carysfort Shallow	10/17/14	3/17/15	9/3/15	3/17/16	9/13/16	3/13/17	7/15/17	4/11/18
Dustan Rocks	9/18/14	3/20/15	9/1/15	3/19/16	5/14/16	3/1/17	5/16/17	4/2/18
Molasses Deep	10/22/14	3/16/15	9/5/15	3/17/16	9/15/16	4/25/17	8/29/17	4/10/18
Molasses Shallow	10/20/14	3/15/15	9/4/15	3/15/16	9/14/16	3/11/17	8/29/17	4/10/18
Porter Patch	1/21/15	3/18/15	9/1/15	3/14/16	9/15/16	3/10/17	7/11/17	4/11/18
Red Dun Reef	2/24/15	2/24/15	9/26/15	3/29/16	8/19/16	3/21/17	8/18/17	4/7/18
Sand Key Deep	11/15/14	2/23/15	8/13/15	3/25/16	8/17/16	3/22/17	8/19/17	4/6/18
Sand Key Shallow	11/14/14	2/25/15	8/13/15	3/28/16	8/17/16	3/22/17	8/19/17	4/6/18
Sombrero Deep	9/20/14	3/21/15	9/22/15	3/28/16	5/12/16	4/26/17	12/8/17	4/9/18
Sombrero Shallow	9/19/14	3/21/15	9/3/15	3/28/16	5/12/16	3/2/17	12/8/17	3/31/18
Tennessee Deep	9/21/14	3/19/15	9/23/15	3/25/16	5/13/16	3/21/17	5/15/17	4/4/18
Tennessee Shallow	9/22/14	3/19/15	9/23/15	3/25/16	5/13/16	3/22/17	5/15/17	4/4/18
West Turtle Shoal	9/22/14	3/20/15	9/2/15	3/26/16	5/14/16	4/26/17	5/13/17	4/2/18
West Washerwoman	11/12/14	2/27/15	8/14/15	4/7/16	8/19/16	3/2/17	8/17/17	4/7/18
West Sambo Deep	11/13/14	3/22/15	8/12/15	3/29/16	8/18/16	3/2/17	8/24/17	4/5/18
West Sambo Shallow	11/11/14	2/25/15	8/12/15	3/29/16	8/18/16	3/2/17	8/22/17	4/5/18

Table 2. Total number of juvenile (<4 cm) stony coral and octocoral colonies recorded in each project year.

Site Name	2015			2016			2017			Project Total		
	Corals	Octos	Total	Corals	Octos	Total	Corals	Octos	Total	Corals	Octos	Total
BC1	30	57	87	38	89	127	39	47	86	107	193	300
BC2	20	74	94	16	119	135	39	149	188	75	342	417
BC3	21	139	160	30	104	134	37	116	153	88	359	447
BC4	74	82	156	91	113	204	128	123	251	293	318	611
DC1	58	63	121	63	55	118	101	51	152	222	169	391
DC2	49	59	108	62	63	125	69	98	167	180	220	400
DC3	8	47	55	11	48	59	10	54	64	29	149	178
DC4	23	37	60	29	78	107	31	67	98	83	182	265
DC5	60	58	118	85	35	120	88	62	150	233	155	388
DC6	27	43	70	65	70	135	108	41	149	200	154	354
DC7	39	27	66	47	56	103	68	48	116	154	131	285
DC8	14	121	135	16	116	132	29	178	207	59	415	474
Admiral	28	116	144	46	88	134	33	134	167	107	338	445
Carysfort Deep	150	43	193	102	59	161	127	131	258	379	233	612
Carysfort Shallow	89	141	230	78	104	182	79	284	363	246	529	775
Dustan Rocks	89	79	168	79	59	138	78	71	149	246	209	455
Molasses Deep	132	122	254	102	106	208	105	327	432	339	555	894
Molasses Shallow	72	174	246	69	145	214	80	336	416	221	655	876
Porter Patch	55	155	210	68	106	174	51	92	143	174	353	527
Red Dun Reef	199	20	219	185	24	209	247	36	283	631	80	711
Sand Key Deep	125	210	335	101	183	284	106	491	597	332	884	1216
Sand Key Shallow	141	60	201	122	62	184	142	120	262	405	242	647
Sombrero Deep	419	87	506	357	96	453	299	90	389	1075	273	1348
Sombrero Shallow	93	34	127	69	41	110	58	44	102	220	119	339
Tennessee Deep	196	51	247	124	35	159	155	52	207	475	138	613
Tennessee Shallow	125	165	290	117	158	275	127	208	335	369	531	900
West Turtle Shoal	254	60	314	169	49	218	180	95	275	603	204	807
West Washerwoman	159	14	173	165	14	179	188	5	193	512	33	545
West Sambo Deep	179	82	261	175	77	252	229	166	395	583	325	908
West Sambo Shallow	114	15	129	123	23	146	121	39	160	358	77	435
SE FL	423	807	1230	553	946	1499	747	1034	1781	1723	2787	4510
FL Keys	2619	1628	4247	2251	1429	3680	2405	2721	5126	7275	5778	13053
Total	3042	2435	5477	2804	2375	5179	3152	3755	6907	8998	8565	17563

Table 3. The total number of stony coral and octocoral recruits found on tiles retrieved in each project year. Coral recruits are found during live and post-bleaching scans; the cumulative total is also displayed. Octocorals are found only in live scans.

Site Name	2016				2017				2018				Project Total			
	Corals			Octos	Corals			Octos	Corals			Octos	Corals			Octos
	Live Scan	Post-Bleach Scan	Total	Total (Live)	Live Scan	Post-Bleach Scan	Total	Total (Live)	Live Scan	Post-Bleach Scan	Total	Total (Live)	Live Scan	Post-Bleach Scan	Total	Total (Live)
BC1	1	18	19	3	3	10	13	3	3	9	12	4	7	37	44	10
BC2	5	16	21	5	8	24	32	4	15	48	63	6	28	88	116	15
BC3	5	7	12	8	5	20	25	5	12	111	123	7	22	138	160	20
BC4	9	8	17	0	12	73	85	3	24	30	54	4	45	111	156	7
DC1	8	2	10	1	6	11	17	0	10	10	20	2	24	23	47	3
DC2	5	17	22	1	4	5	9	10	57	125	182	8	66	147	213	19
DC3	2	7	9	3	1	8	9	4	75	236	311	12	78	251	329	19
DC4	0	11	11	1	4	20	24	7	22	163	185	8	26	194	220	16
DC5	13	4	17	1	18	22	40	0	25	42	67	3	56	68	124	4
DC6	9	13	22	1	3	9	12	1	22	7	29	1	34	29	63	3
DC7	4	7	11	18	5	7	12	16	112	119	231	5	121	133	254	39
DC8	5	6	11	78	6	9	15	267	28	7	35	173	39	22	61	518
Admiral	0	8	8	1	2	5	7	1	7	116	123	1	9	129	138	3
Carysfort Deep	8	16	24	2	59	19	78	85	66	59	125	17	133	94	227	104
Carysfort Shallow	8	30	38	1	10	19	29	41	8	18	26	9	26	67	93	51
Dustan Rocks	6	5	11	3	12	33	45	5	142	812	954	7	160	850	1010	15
Molasses Deep	18	25	43	2	103	17	120	73	44	39	83	9	165	81	246	84
Molasses Shallow	40	21	61	3	40	39	79	28	45	16	61	5	125	76	201	36
Porter Patch	3	10	13	1	11	12	23	1	17	55	72	3	31	77	108	5
Red Dun Reef	4	20	24	0	4	2	6	3	331	1280	1611	10	339	1302	1641	13
Sand Key Deep	3	16	19	12	34	31	65	47	13	37	50	11	50	84	134	70
Sand Key Shallow	25	26	51	2	61	89	150	11	36	66	102	3	122	181	303	16
Sombrero Deep	30	12	42	0	47	22	69	80	150	505	655	6	227	539	766	86
Sombrero Shallow	3	2	5	0	13	4	17	0	41	87	128	1	57	93	150	1
Tennessee Deep	9	4	13	0	80	19	99	27	100	52	152	0	189	75	264	27
Tennessee Shallow	1	8	9	4	25	15	40	7	15	199	214	4	41	222	263	15
West Turtle Shoal	6	29	35	1	58	21	79	15	193	475	668	8	257	525	782	24
West Washerwoman	3	9	12	0	6	13	19	0	724	2493	3217	86	733	2515	3248	86
West Sambo Deep	11	6	17	8	16	16	32	22	59	42	101	18	86	64	150	48
West Sambo Shallow	11	15	26	0	17	31	48	1	33	42	75	0	61	88	149	1
SE FL	66	116	182	120	75	218	293	320	405	907	1312	233	546	1241	1787	673
FL Keys	189	262	451	40	598	407	1005	447	2024	6393	8417	198	2811	7062	9873	685
Total	255	378	633	160	673	625	1298	767	2429	7300	9729	431	3357	8303	11660	1358