Year 1 Interim Report
SFW01-0097 Fisheries Monitoring Plan
WP2: Beam trawl Monitoring Survey

Reporting Period: 1 October 2020 to 31 September 2021

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Executive Summary

The Commercial Fisheries Research Foundation (CFRF) and collaborators have completed the first year of the South Fork Wind Farm pre-development fisheries monitoring beam trawl survey. The survey is conducted within the South Fork Wind Farm development area as well as two nearby reference areas. The survey gear consists of a 3 m beam trawl outfitted with a 2.4 cm knotless nylon liner, and the monthly survey samples three twenty-minute tows in each area for a total of nine tows per month. For each tow, the entire catch is enumerated and weighed, and size measurements are taken of individual fish and selected invertebrate species. Stomach samples are collected from select commercially valuable fish species for prey composition analysis. Oceanographic conditions including salinity, water temperature, and weather conditions are recorded each haul. Preliminary results from the first year of sampling suggest the eastern reference area has been dominated by crabs, skate, and a handful of flatfish, the western reference area was rocky with many small invertebrates, high catches of scallop and skate with a few summer and winter flounder and the proposed wind farm area had the highest biodiversity with predominantly little skate, scup, and sea robins, with few scallops.

Introduction

The Commercial Fisheries Research Foundation, in partnership with local fishermen and the University of Rhode Island, is conducting pre-construction fisheries monitoring surveys of the South Fork Wind Offshore Wind Farm near Cox Ledge. Due to the differences in selectivity of different gear types, four different surveys, each using a different gear type, are currently being conducted: beam trawl survey, gillnet survey, ventless trap survey, and fish pot survey. One of the primary methods for assessing anthropogenic impacts on natural habitats is the Before-After-Control-Impact design. The ideal design for this experiment requires baseline information before impact in multiple control areas from several points in time. This asymmetrical design is needed not only to evaluate the variation in animals and habitat within impact areas before and after development, but also to ensure changes in variation can be attributed to the anthropogenic impact. The current beam trawl survey aims to provide the pre-impact data on fish and invertebrate species that are commonly selected by this gear type. Such data is needed to apply the asymmetrical Before-After-Control-Impact design to the South Fork Wind Farm (Figure 1). The survey will also collect data on the oceanic conditions associated with catch which may help to interpret results in the context of a changing environment and provide general information about animal ecology. The survey began in October 2020 with sampling occurring once per month year-round through September 2022. This report details the methods of the survey and summarizes the results from the first year of sampling.

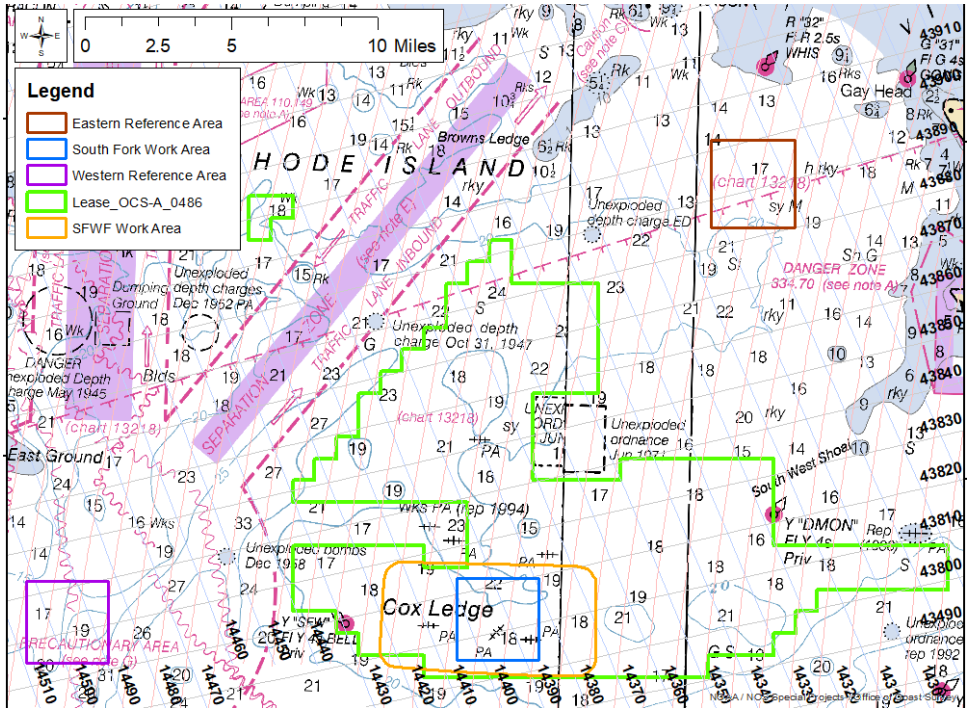

Figure 1. The South Fork Wind Farm (SFWF) development area and the three areas monitored by the beam trawl survey.

Methods

Once per month, three tow locations (stations) in each of three areas, the South Fork Wind Farm impact area, an eastern reference area, and a western reference area (Figure 1), are surveyed. Prior to each survey departure, the six stations in each area are randomly ranked, and the first three stations are selected as the primary stations for that month. Upon arrival at the vessel, the gear is inspected and a temperature logger, recording every 30 seconds, is attached to the frame. A handheld GPS unit is set to record position, heading, and speed every 15 seconds. Upon arrival at the station, the captain and lead scientist determine if there is a gear conflict; if so, the next station on the list is selected as the backup station. If there are no gear conflicts, the gear is deployed. Once the brake has been engaged on the winch, the time, depth and tow start position is recorded. The beam trawl is then towed for 20 minutes at a target speed of 4.5 knots with the wire at a 4:1 scope. Once the tow is complete the sea state, end depth, time, and position are recorded, and then the gear is examined to ensure it was sampling properly and there is no damage. If the tow is deemed invalid, the station is resampled. If the tow is considered valid, the crew members empty the entire cod end onto the deck, and hydrographic data is collected via a conductivity, depth, and temperature sensor (CTD) cast.

The entire catch is then sorted by species. For all species of fish, cephalopods, crustaceans, elasmobranchs and scallops, a subsample of 30 individuals are measured, and then all individuals are counted and aggregated for a total weight (0.01 kg) by species. Fish are measured to the nearest cm, while scallops, squid, and octopus are measured to the nearest 0.1 cm. Cancer crabs and lobsters are measured for carapace width/length to the nearest 0.1 mm then evaluated for shell condition, number of claws, disease status, sex, egg status, and the presence of v-notches for lobsters. The remaining invertebrates are identified to the species level and then counted and weighed by species. Rocks are counted in two size groups, less than 10 inches or greater than 10 inches diameter. In addition, the entire catch or up to 10 individuals of black seabass, codfish, monkfish, winter flounder, and winter skate are selected for stomach analysis. Fish selected for stomach analysis are measured to the nearest cm and individually weighed, and then the stomachs are excised and stored on ice for further analysis. The reproductive stage and sex are also recorded for all codfish during the stomach sampling.

The stomachs selected for further analysis are frozen upon returning to land then processed within two weeks of collection. The entire stomach is weighed prior to dissection, then each prey item is identified to the lowest possible taxonomical unit with the aid of a 5x magnifier or a 25x stereo microscope. If the prey item is intact enough, the total length (carapace width for crabs) is recorded and the individual is weighed to the nearest 0.01 g. Prey items that cannot be measured are aggregated by species for the weight and if possible, the number of individuals is recorded. If prey items cannot be identified to the species level, they are grouped to the lowest possible level and weighed. After the stomach has been fully examined and all prey removed, an empty stomach weight is recorded.

The GPS data, temperature logger data, and CTD data are imported into an Access survey database and linked to each station sampled. Upon completion of data entry, all data is reviewed for accuracy by at least one of the scientists who sampled the data. Data is then submitted to INSPIRE Environmental. For this report the biodiversity was calculated using the Shannon diversity index ($H = \sum_{i=1}^{S} \mathrm{p}_i \ln(p_i)$, where s is the number of species, and p is the proportion of individuals of one species to the total number of individuals) using the aggregated catch by area of all species for all survey trips in the first year.

Preliminary Results:

The data in this reporting period covers the 12 sampling trips during the first year of the beam trawl survey. Each trip was conducted as close to the middle of the month as possible (Table 1). The CTD cast was successful for all except one haul. All data for these trips has been entered into the project database, reviewed for accuracy, and shared with INSPIRE Environmental. Summary analysis of the species composition for the first year is displayed in Figures 1-3. Catches in each area have remained relatively consistent throughout the first 12 months of sampling, and there appear to be differences in species composition among areas. For example, the eastern reference area has been dominated by crabs, skate, and a handful of flatfish. The western reference area is rocky with many small invertebrates with high catches of scallop and skate. The South Fork Wind Farm development area had the highest biodiversity and was predominantly little skate, scup, sea robins, and a few scallops (Figure 4, Table 2 & 3). A total of 50 winter skate, 5 codfish, 97 winter flounder, 35 black sea bass, and 16 monkfish have been processed for stomach content analysis. The monkfish, cod and black sea bass were primarily consuming other fish and crustaceans while the winter skate and winter flounder were primarily consuming amphipods and benthic worms (Table 4). Overall, 3,723 fish, 1,328 scallops, and 1,984 crustaceans were measured for the first year.

Table 1. Trip dates and weather conditions for each survey.

	Average Temperature (C)				Average Beaufort
Survey Date	Air	East Bottom	SF Bottom	West Bottom	Sea State
10/28/2020	13.3	16.5	16.3	16.7	5
11/24/2020	12.5	12.2	13.6	13.4	3
12/19/2020	1.5	8.4	10.4	10.1	2
1/13/2021 *	5.5	6.3	7.2	9.4	2
02/11/2021	-0.6	3.2	4.1	5.2	2
03/18/2021	4.9	3.3	5.1	6.9	2
04/14/2021	9.5	5.7	5.9	6.0	1
05/17/2021	14.0	7.3	7.0	6.5	2
06/17/2021	18.1	11.2	10.2	9.6	3
07/14/2021	19.8	14.5	11.7	11.9	2
08/17/2021	22.7	15.6	12.8	13.4	2
09/16/2021	21.2	18.8	17.7	16.8	4

**The January trip sampled the eastern area on 1/13/21 then had to return to port for repairs before sampling the south fork area and the western area on 1/14/21.*

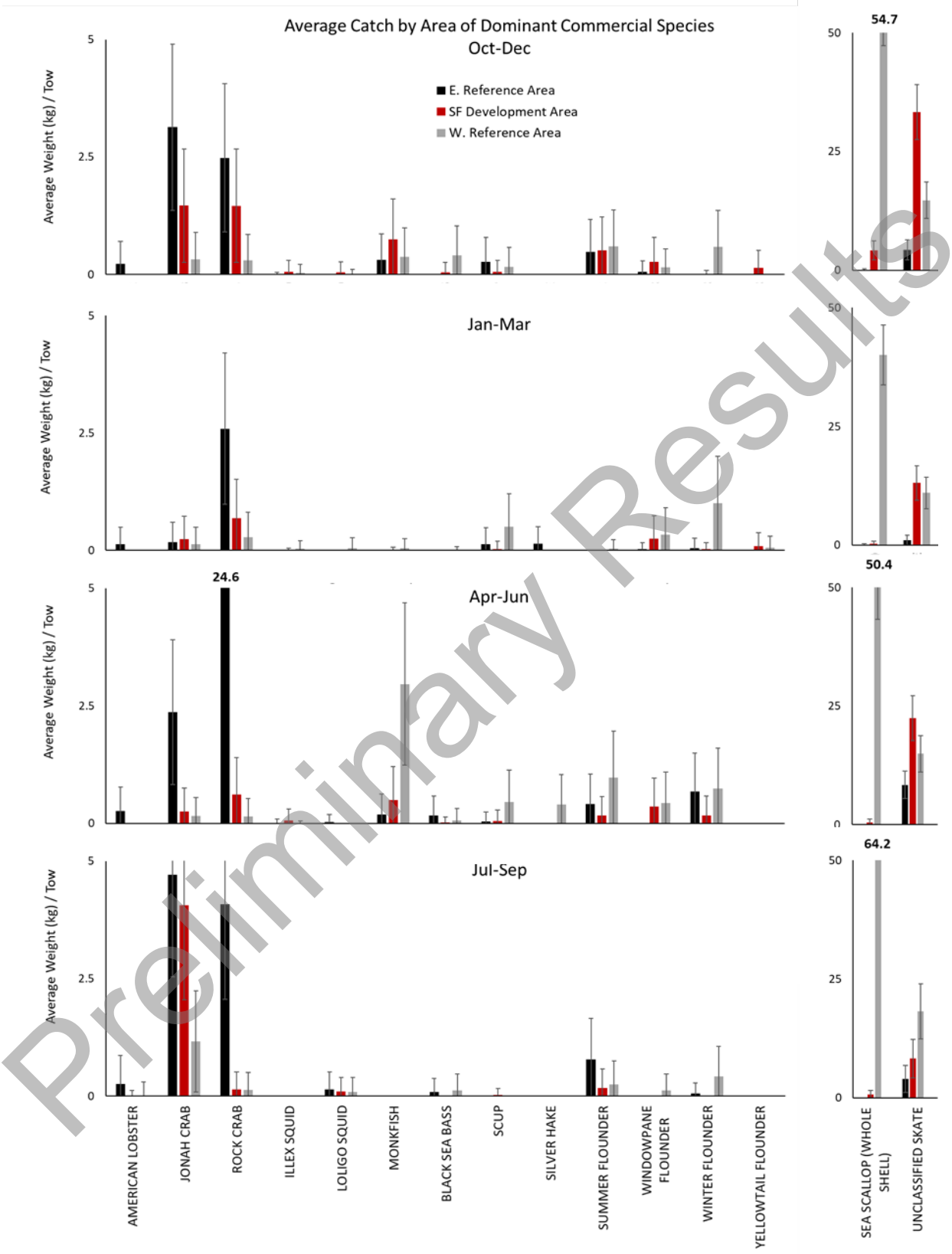

Figure 1. Average weight (kg) of the dominant species sampled each tow during the beam trawl survey for each area by season. Error bars represent +/- one standard deviation.

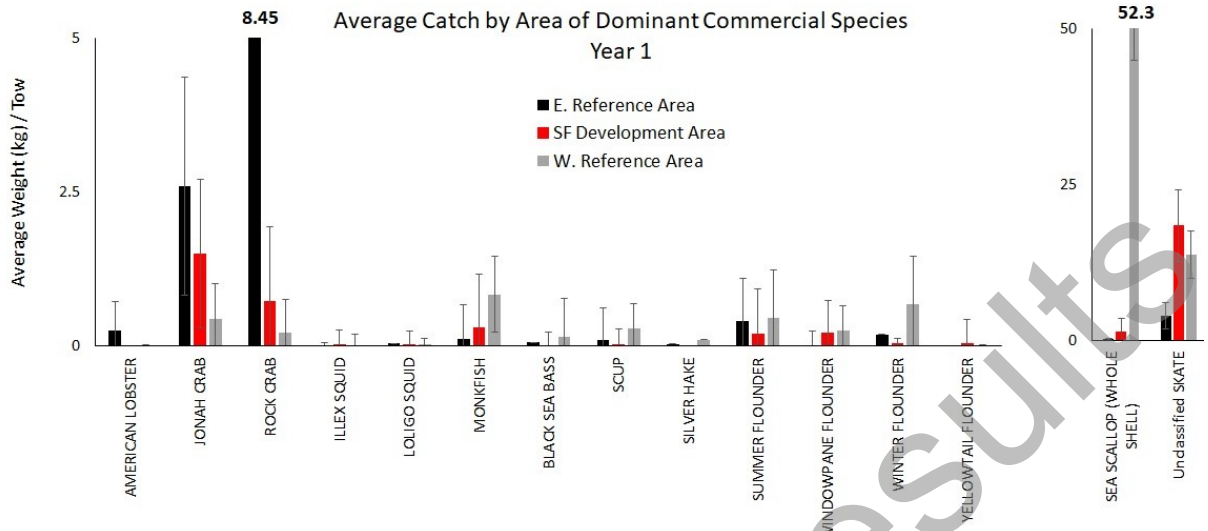

Figure 2. Average weight of commercial dominate species by tow for first year of the beam trawl survey.

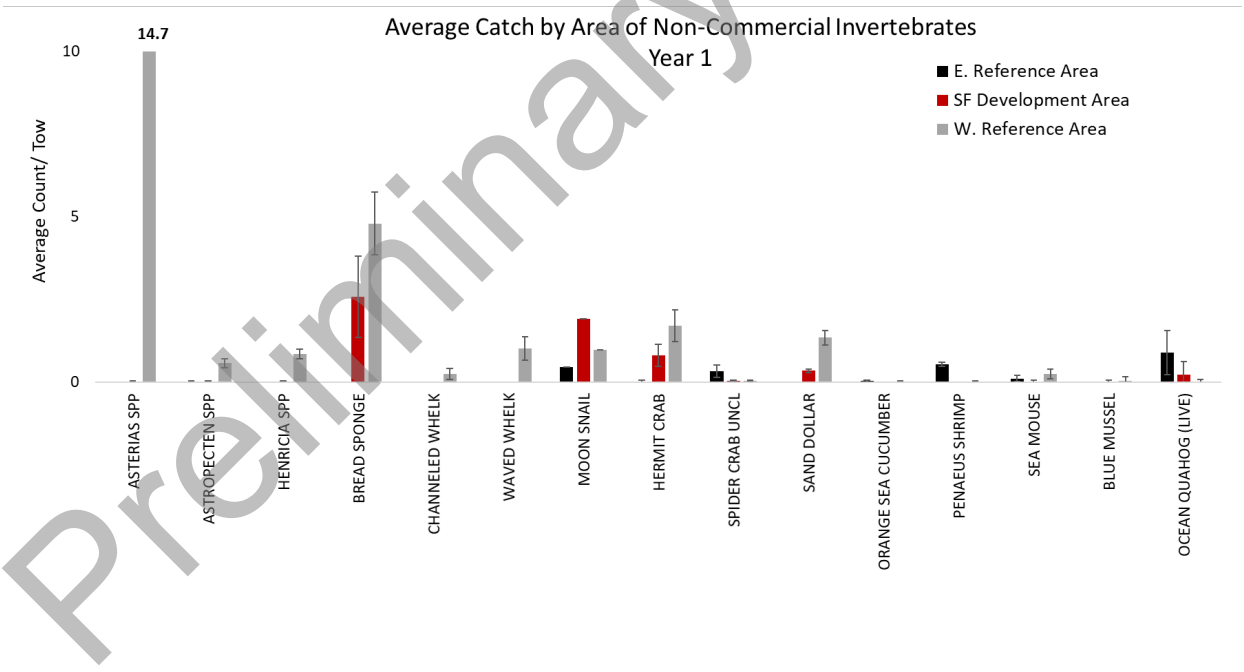

Figure 3. Average total catch of non-commercial invertebrates by tow for first year of the beam trawl survey.

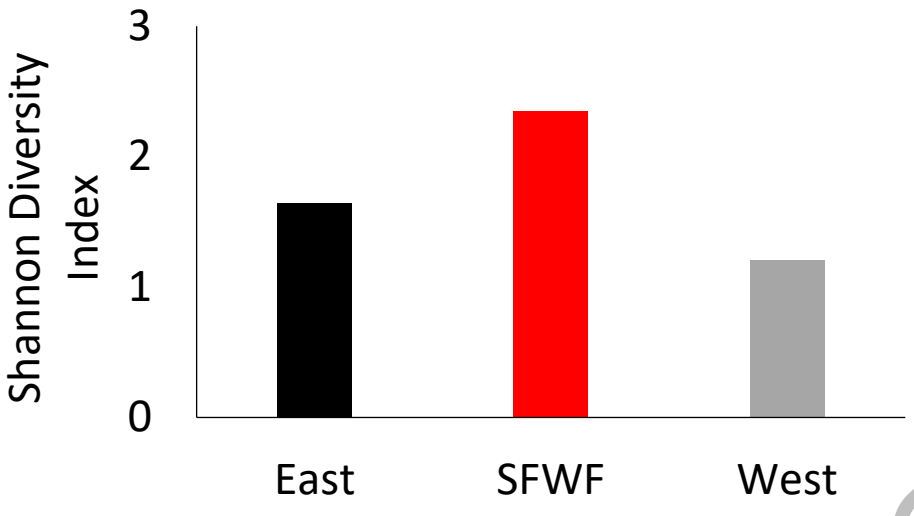

Figure 4. Shannon diversity index for each area of the first year from the beam trawl survey. $H = \sum_{i=1}^{S} \mathrm{p}_i \ln(p_i)$, where s is the number of species, and p is the proportion of individuals of one species to the total number of individuals.

Table 2. Total number of each species caught for each area sampled during the first year of the beam trawl survey.

Species	East	SFWF	West
ALEWIFE	1		
AMERICAN LOBSTER	22	1	2
ASTERIAS SPP		2	1590
ASTROPECTEN SPP	3	2	62
ATLANTIC COD	1		4
BARNDOOR SKATE	13	5	5
BLACK SEA BASS	5	4	32
BLUE MUSSEL		1	5
BREAD SPONGE		279	518
BUTTERFISH		8	
BUTTERFLY BOBTAIL SQUID		4	8
CHANNELED WHELK			27
CUNNER			1
FOURSPOT FLOUNDER	40	11	13
GRAY TRIGGERFISH			1
GULFSTREAM FLOUNDER	26	10	7
HENRICIA SPP		3	92
HERMIT CRAB	2	88	184
HORSESHOE CRAB	1		
ILLEX SQUID	6	27	14
JONAH CRAB	595	383	131
LOLIGO SQUID	103	32	22
LONGHORN SCULPIN	14	7	39
MAHI MAHI	1		
MANTIS SHRIMP	7		
MONKFISH	4	5	10
MOON SNAIL	50	207	105
NORTH ATLANTIC OCTOPUS			1
NORTHERN SEAHORSE	1	1	1
NORTHERN PIPEFISH	13		1
NORTHERN SAND LANCE	4		
NORTHERN SEAROBIN	10	47	37
NUDIBRANCH			12
OCEAN POUT	8	3	12
OCEAN QUAHOG (LIVE)	96	24	2
ORANGE SEA CUCUMBER	4		2
PENAEUS SHRIMP	59		2
RED HAKE	58	26	75
ROCK CRAB	2962	206	127

Table 2 Cont. Total number of each species caught for each area sampled during the first year of the beam trawl survey.

Species	East	SFWF	West
SAND DOLLAR		37	145
SCUP	8	130	85
SEA MOUSE	12	1	26
SEA RAVEN			1
SEA SCALLOP	6	207	16225
SEA SCALLOP (CLAPPER)		5	129
SEA URCHIN			1
SILVER HAKE	77	42	29
SMOOTH ASTARTE			6
SMOOTH DOGFISH		1	
SPIDER CRAB UNCL	35	4	5
SPINY DOGFISH		1	3
SPONGE UNIDENTIFIED		4	
SPOTTED HAKE	15	16	22
SUMMER FLOUNDER	22	10	22
SURF CLAM (LIVE)		4	7
UNCLASSIFIED LITTLE/WINTER SKATE	383	1947	1336
WAVED WHELK			109
WEAKFISH		1	1
WHITE HAKE	1		
WINDOWPANE FLOUNDER	6	42	43
WINTER FLOUNDER	33	6	65
YELLOWTAIL FLOUNDER		4	2

Table 3. Total number of rocks caught for each area sampled during the first year of the beam trawl survey

Classification	East	SFWF	West
BOULDER (>25 cm diameter)			36
COBBLE (<25 cm diameter)		66	1248

Table 4. Total weight (g) of prey items and percent of predators with this prey item present grouped by predator for the first year of the beam trawl survey.

	Predator				
Prey	Atlantic Cod	Black Sea Bass	Monkfish	Winter Flounder	Winter Skate
Amphipod Spp.	0	0 (3%)	0	23.2 (26%)	7 (28%)
Cestode Spp.	0	0	2.3 (13%)	2.7 (3%)	2.1 (4%)
Clam, Razor	0	0	0	0	7 (2%)
Clam, Surf	0	0	0	0.7 (1%)	0
Crab, Cancer Spp.	12.2 (40%)	2.8 (11%)	0	0	0
Crab, Hermit	0	2.6 (6%)	0	0	0
Crab, Jonah	7.5 (40%)	2.6 (6%)	0	0.5 (3%)	1.8 (2%)
Crab, Pea	0	0	0	0.1 (1%)	0
Crab, Rock	4.9 (20%)	42.9 (6%)	0	0	0.2 (2%)
Fish, Gulf Stream Fl.	30.9 (20%)	0	0	0	0
Fish, Hake Spp.	0	0	12.4 (6%)	0	0
Fish, Red Hake	0	6 (3%)	105 (13%)	0	0
Fish, Sand Lance	0	0	141.2 (13%)	0	336.1 (14%)
Fish, Silver Hake	2.5 (20%)	0	51.4 (13%)	0	0
Fish, Unidentified	12.9 (40%)	2.1 (6%)	214.8 (25%)	0	0
Isopod Spp.	0	0 (3%)	0	0.1 (1%)	0 (2%)
Nematode Spp.	0	0	0	0	0 (2%)
Plastic	0	0 (3%)	0	0	0
Polychaete Spp.	0	0.2 (6%)	0	26.4 (16%)	22.4 (18%)
Sand Dollar	0	0	0	0.1 (1%)	0
Sea Cucumber Spp.	0	0	0	0.4 (1%)	0.3 (2%)
Sea Scallop	0	0	0	2.8 (2%)	0
Shrimp, Unidentified	2.8 (40%)	0.8 (6%)	0.1 (6%)	0 (1%)	0
Squid, Unidentified	0	0	0	2 (2%)	1.3 (2%)
Plant Material	0	0	0	7.4 (2%)	0.1 (2%)
Well Digested Prey	5.6 (60%)	4.2 (23%)	28.5 (13%)	82.2 (44%)	51.4 (52%)
Number Sampled	5	35	16	97	50
Number Empty	0	15	6	28	13

Outreach:

The CFRF maintains a project website at http://www.cfrfoundation.org/sfwf-beam-trawl-survey where data summaries are uploaded as the survey progresses. This survey has also been highlighted twice in the CFRF quarterly newsletter (November 2020 and November 2021). Additionally, the year one results of this survey were presented at the 151st annual meeting of the American Fisheries Society in Baltimore, Maryland.