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Effects of EMF Emissions from Undersea Electric Cables on Coral Reef Fishes

Robert F. Jermain
Nova Southeastern University, rj469@nova.edu

NOVA SOUTHEASTERN UNIVERSITY
HALMOS COLLEGE OF NATURAL SCIENCES AND OCEANOGRAPHY

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By

Robert F. Jermain

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Approved:

Thesis Committee

Major Professor :______________________________
Richard Spieler, Ph.D.

Committee Member :___________________________
Tracy Sutton, Ph.D.

Committee Member :___________________________
Manhar Dhanak, Ph.D.

Committee Member :___________________________

Kirk Kilfoyle, M. S.

Project Abstract

The objective of this project was to determine if the electromagnetic field (EMF) emissions from undersea power cables impacted the local and transient marine life, with an emphasis on reef fishes. The work was done at South Florida Ocean Measurement Facility of Naval Surface Warfare Center, Carderock Division, Broward County, Florida. This facility functions as the hub for a range of active undersea detection and data transmission cables. EMF emissions from a selected cable were created during SCUBA fish surveys. During the surveys the transmission of either alternating current (AC) or Direct Current (DC) was randomly intiated by the facility with no transmitted current (OFF) provided a control. The surveys were conducted using standardized transect and stationary point count methods to acquire reef fish abundances prior to and immediately after a change in transmission frequency (the divers were aware of the time of frequency change but not the specific frequencies). The divers were also tasked to note the reaction of the reef fishes to the immediate change in the EMFs emitting from the cable during a power switch. An analysis of the data primarily did not find statistical differences among power states and any variables. However, this may be a Type II error as there are strong indications of a potential difference of a higher abundance of reef fishes at the sites when the power was off. There are a number of caveats to consider with this finding: the data set needs to be larger in terms of numbers of: counts, sites and eletro-sensitive species to allow for rigorous statistical analysis; also a longer time between frequency changes to allow for slower, but nonetheless important, reactions to differing EMFs might lead to differing conclusions. Obviously, more research is required to confirm the results of this study.

Keywords: EMF, electromagnetic field, MHK, marine hydrokinetic device, undersea electric cable, renewable energy, coral reef fish, elasmobranchs, florida, point count, visual survey

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Project Introduction

The emissions from undersea power cables may have an impact on marine life. Many marine organisms, principally fishes, marine turtles and marine mammals, possess an inherent sensitivity to electromagnetic fields (EMFs). Elasmobranch fishes in particular are known for their acute sensitivity to EMFs. Kalmijn has shown as early as 1971 that sharks and rays are electrically sensitive and may rely heavily on this sensory system (Kalmijn 1971, 1982). Some bony fishes also use electroreception and are sensitive to electromagnetic fields (Bullock, 1973). Marine hydrokinetic (MHK) devices, such as wave power devices, current power devices and ocean thermal energy conversion (OTEC) devices and devices using other sources of energy that operate on cables (offshore windmills, solar farms) utilize submarine power cables to transmit electric power which emit EMFs of varying strengths and frequencies. Some of the EMFs that surround these cables are in the range detectable by some vertebrates (Öhman et al., 2007, Westerberg and Langenfelt, 2008). The effects of EMFs on the organisms that inhabit the marine habitats surrounding these fields have received little study to date; however, the ability to harness offshore energy using MHK devices and the resulting EMFs they produce may have impacts on the health of both resident and transient fauna. The EMFs may potentially attract or repel sensitive species, which could, in turn, impact their behavior, potentially altering feeding routines, reproductive tendencies, local movements, and possibly even long-distance migrations (Lohmann et al., 2001, Boles et al., 2003, Fisher and Slater, 2010). The objectives of this preliminary study are: 1) to examine if specific EMF emissions from selected offshore cables have any influence (attract or repel) on an *in situ* assemblage of routinely monitored coral reef fishes, 2) To determine if further study is warranted.

A database of field measurements of EMF emissions and associated potential organismal response(s) was created and used to identify the possible relationships between any observed changes in the resident and transient reef fish assemblages and the EMF emissions and to assess the potential ecological impact (if any) of EMF emissions on individual organisms and/or species assemblages in the study area. An additional goal was to establish monitoring procedures applicable to any location where a MHK device may be sited and to generate results that are relevant to predicting and assessing impacts to marine communities that may exist in the vicinity of any current and future MHK project.

Project Description

EMF Background

Marine hydrokinetic devices emit EMFs, therefore a better understanding of the effects of EMF radiation to marine biota will be useful in the future to enable site selection/placement and location of MHK facilities so that the health of the surrounding marine ecosystems is maintained and minimal impacts occur. Concerns with EMF emissions include that they may they may attract or repel elasmobranchs, attract/repel other electro-sensitive species, act as a barrier to local movements and long distance migration, may cause disorientation in some species, and they may cause a change in community structure and ecosystem function (Dhanak et al., 2015). Marine Hydrokinetic Devices such as fixed, floating or submerged oscillating wave energy converters, oscillating water column generators, submerged or floating point absorbers, floating attenuator-rotational joints, floating or submerged turbines, hydrofoils and rotors all produce varying levels of power, and should therefore emit varying levels of EMFs (Cada et al., 2011). EMF emissions from submerged cables vary depending on: transmitted power, whether the power supply is AC or DC, the frequency and amplitude of the AC current, cable construction, and whether the cable is monopole, bipole or tri-axial (Slater, 2010). EMF characteristics also depend on whether the cable is buried, lying on top of the seabed, or suspended in the water column, as well as whether a seawater ground or a two-wire ground is used. EMF emission levels from a power-carrying cable decays inversely with distance from it. The electric field depends on the potential across the cable and increases with it while the magnetic field depends on the flow of current through the cable and increases with the magnitude of the current. A Collaborative Offshore Wind Research into the Environment report (CMACS, 2003) concluded that the current state of knowledge regarding EMFs emitted by subsea power cables is too variable and inconclusive to make an informed assessment of any possible environmental impact of EMF emissions in the range of values likely to be detected by organisms sensitive to electric and magnetic fields. There is a clear need for field data on EMF emissions from submarine cables in order to develop appropriate models and future generations of (hopefully) low-impact and highly efficient MHK devices. In addition to wind generators, there is growing interest in wave and current generators, as wave and current energy is the dominant MHK resource available to the United States (Reed, 2013). For example, the Florida Current can be considered the start of the Gulf Stream, running northerly along the eastern coast of the United States and the entire current has been assessed as generating an estimated 25 GW of hydrokinetic power (Duerr, 2012). In 2013 the average annual electricity consumption for a U.S. residential utility customer was 10,908 kilowatt hours (kWh); 25 GW can power 20,090,323 U.S. homes a year (http://www.eia.gov). The potential inherent in the Florida Current and the current need for alternative energy sources make this exciting contemporary work in the local area.

EMFs and marine organisms

Studies have shown that diverse aquatic species are electrosensitive (see Fisher and Slater, 2010 for a review). Many fishes, seabirds, sea turtles and marine mammals, can either detect, navigate by, or are otherwise affected by EMFs. All possess various sensitivities, and their behavior may be impacted by anthropogenic EMF emissions in the water column. Some fishes, turtles, crustaceans, whales, and dolphins are known to use the earth's magnetic field to provide orientation during long distance migrations. There is a significant lack of research into the potential impacts of EMFs to sea turtles and marine mammals. Available studies (Kirschvink et al., 1986) suggest that many whale and dolphin species are sensitive to stranding when Earth's magnetic field variation is less than 50 nano Teslas (nT). The electric senses of sharks and rays are used for multiple species-dependent functions, such as: feeding, predator avoidance, reproduction, and orientation (Helfman et al., 2009). In laboratory studies, sharks have been shown to alter behavior patterns to move either towards or away from electric fields (Gill and Taylor, 2001). Electric fields from a submarine lightwave system cable even elicited an exploratory bite response from a shark (Marra, 1989). Stingrays have been shown to orient relative to uniform electric fields similar to those produced by ocean currents (Kalmijn, 1982.) Sharks, rays and skates are known to have the highest sensitivity to electric fields, with sensitivities in the range of 0.5–1000 micro volts per meter (μV/m);some elasmobranch species have sensitivities as low as 0.001 μV/m. Electric field emissions in the range of 0.5–100 μV/m appear to attract some species, and those over 100 μV/m repulse them (Gill and Taylor, 2001).

Sharks play an important role as apex predators in coastal and oceanic ecosystems around the world. On coral reefs, sharks are strongly interacting apex predators and play a key role in maintaining healthy reef ecosystems (Robbins et al., 2006). The removal of these key predators produces a trophic cascade effect and may lead to ecological succession, a change in the ecological community (Myers, 2007.) Overfishing, exploitation and underfunded or ineffective regulation and enforcement have led to a drastic decline of sharks and rays (Baum et al., 2003; Worm et al., 2013) and an increase in the number of projects that are focused on elasmobranch ecology/physiology/behavior. Insight into how EMFs may affect sharks and rays will give us a better understanding of how these predators might act when they encounter submerged MHK-related infrastructure in the future.

Rays and skates are typically demersal generalist predators (Quinn. 1996). Several recent studies of batoid elasmobranchs using active tracking and passive monitoring techniques and archival tags have established long-term site fidelity, repetitive seasonal movements, and extensive periods of residency within limited areas (Hunter et al. 2005; Collins et al. 2007; Dewar et al.2008; Le Port et al. 2008, Spieler, 2013). One of the most abundant batoids in South Florida is the Yellow Ray, *Urobatis jamaicensis*, which resides in and is primarily associated with hardbottom and reef habitats (Sulikowski 1996; Fahy 2004). The demersal tendencies and high-site residency and fidelity of rays and skates offer a stark contrast to the movements of sharks. Shark tagging projects have revealed the spatial ecology for oceanic and coastal sharks varies, including a consistently high level of movement (Kohler et al. 1998, Kohler and Turner, 2001, Schlaff et al., 2014). The impacts of EMF emissions on both groups of locally occurring and transient elasmobranch species and coral reef fishes were monitored in this study.

Location

Nova Southeastern University's (NSU) Halmos College of Natural Sciences and Oceanography's Guy Harvey Oceanographic Center (GHOC), located in Dania Beach, Florida, is in a prime location for direct assessments of the health and function of the local coral reef ecosystem which lies, in part, offshore. This local reef system is part of a larger system, known as the Florida Reef Tract (FRT), which runs from Port St. Lucie in the north down to the Dry Tortugas in the south. NSU and the GHOC have been involved in the marine sciences around the globe and specifically in the southeast Florida coral reef ecosystems since the 1970's. The reefs off of Broward, Miami-Dade, Palm Beach, and Martin counties have received a great deal of attention from NSU in the form of targeted/experimental research that focuses on both natural and artificial reefs, such as long term monitoring projects, ecosystem restoration projects, and baseline assessments. The entire northern portion of the FRT and much of the southern FRT has been mapped, along with characterizations of topographic complexity and essential habitats (Ettinger et al., 1999, Banks 2007, 2008, Finkl et al., 2008, Walker, 2008).

Conveniently (for the purposes of this study) within the reef tract and located directly adjacent to the NSU GHOC is the Navy's South Florida Ocean Measurement Facility (SFOMF) of Naval Surface Warfare Center, Carderock Division (NSWC-CD). This is a permitted, cabled offshore in-water range serving as an Ocean Magnetics Observatory that consists of bottom-mounted acoustic and EMF sensors used to identify and characterize submarine signatures. The mission of SFOMF is to perform electromagnetic signature tests of Navy assets by providing the ability to monitor surface ship, submarine, and remote vehicle signatures in the near shore environment (Venezia et al., 2003).

This facility functions as the hub for a range of active undersea detection and data transmission cables. It has multiple active submarine power cables that extend several miles offshore, it includes a number of junction boxes, and it transmits a range of power. The cables deliver power and enable data transmission to and from a range of acoustic and EMF sensors. The cables, which extend from areas of shallow (<10 m) to deep (>400 m) water, lie directly on the seabed, are buried in the sand, or are suspended in the water column (Venezia et al., 2003). The SFOMF therefore provides an ideal setting to assess the effect of EMF emissions on aquatic species. The full purpose of the Depatment of Energy (DOE) grant, of which this study was a part, was to characterize EMF emissions on the range as a representative of a location where a MHK device may be sited, and to assess and monitor the effects of the emissions on the behavior of local marine species.

The SFOMF provides a varied set of conditions for characterizing EMF emissions from undersea cables of the type that would be used for power transmission from a potential offshore MHK device. A MHK device may also have associated with it multiple components and various associated cables strung throughout the water column and on the seafloor, which may potentially increase the level of EMF emissions (beyond that of a single cable). The relative significance and EMF emissions from a single cable compared to a system of cables are also not known.

A number of long term coral research and monitoring surveys have been underway in the area (Gilliam et al., 2015; Kilfoyle et al., 2015). A number of cable and benthic impact assessments for the SFOMF have already been conducted in the area (Gilliam and Walker, 2011, Messing et al., 2012). There is rich literature on the geology and biology associated with the SFOMF and the surrounding area and an abundant and diverse marine community including teleost fishes, elasmobranchs and turtles has been documented (Ferro, 2003; Baron et al., 2004; Banks et al., 2008; Walker et al., 2008; Bryan et al., 2013; Kilfoyle et al., 2015; Spieler et al., 2013; Gilliam, 2015). The southeastern continental shelf and shelf edge off Florida supports diverse and economically important reef-fish communities (Ferro et al., 2005; Bryan et al., 2013.) Numerous shallow and deep water fish surveys have been ongoing for more than 20 years (Kilfoyle et al., 2015; Bryan et al., 2013). 289 species of marine fishes have been documented from the reefs of the FRT (Kilfoyle et al., 2015), and a compiled total of 354 species have been recorded in Broward County from multiple studies over the course of the past 20+ years (Spieler et al., unpublished data); including multiple electric-sensitive species such as sharks and rays that are residents in the area and/or migrate through on the way to or from breeding sites (Schwartz, 1990; Castro, 1996). The yellow stingray (*Urobatis jamaicensis)* is very abundant in the area with a home range that includes the area within the SFOMF (Spieler et al., 2013). The electric senses of elasmobranchs impact most, if not all species-dependent functions; disruption of electro-reception could have significant consequences for these animals.

Aquatic species surveys by divers on SCUBA Major Activities

Aquatic species surveys were conducted on a quarterly basis. During implementation of each quarter's Coordinated Survey Plan, SCUBA divers conducted *in-situ* visual surveys at three sampling locations offshore of the South Florida Ocean Measurement Facility (SFOMF) on an identified cable where AC or DC power could be applied. These sites were designated as Shallow, Middle, and Deep, and were in water depths of approximately 5, 10, and 15 m, respectively. The locations were selected based on their robust reef fish community and are representative of each of the three primary hardbottom coral reef habitats in the local offshore environment: the Inner (Shallow), Middle, and Outer (Deep) reef tracts (Banks et al., 2007). Divers on SCUBA primarily assessed the resident coral reef fishes but also transient species including elasmobranchs. SCUBA-based surveys used two standardized methods, stationary point-counts and transect-counts, to record fish species, size, and abundance. In the stationary point-count, all fishes within an imaginary cylinder, 15 m in diameter, that extends from the reef substrate to the water surface, were identified and counted. The diver performed the count by staying in the center of the cylinder and rotating 360° to record species information. For the first 5 minutes of the survey, only species names were recorded. After the 5-min species-count was completed, the total abundance (N) and the mean, minimum, and maximum fork length (FL) for each species were recorded. For the transect-counts, a set of two 30-m sections of the target cable that lay across the appropriate representative habitats at each of the 3 study sites was delineated using a transect tape and subsurface buoys were installed directly on the cable at 7.5 m intervals to mark distance and position along the transects and cylinder center and edge points for the point-counts. In the transect-counts the diver swam along the cable, recording all fishes within 1 m to either side and 1 m above the cable (an imaginary 60 m^3 tunnel). Abundances and fork length (FL) (by size class: <2, ≥2-5, ≥5-10, ≥10-20, ≥20-30, ≥30-50 and ≥50 cm) of fish species were recorded. In both types of counts the diver carried a 1-m ‘‘T’’-rod, with the size classes marked off, to aid in fish length and transect width estimation. These two survey methods have been statistically validated and produce data amenable to rigorous statistical analysis, both parametric and non-parametric. The methods are used routinely by NSU researchers and researchers from other organizations to examine both differences in community structure as well as species-specific site differences (Bohnsack and Bannerot, 1986; Baron et al., 2004; Ferro et al., 2005; Kilfoyle et al., 2015).

Two pairs of visual surveys, a stationary point-count and transect-count, were performed during each segment of a blind randomized sequence of ambient (OFF) and energized AC and DC (ON) cable power states. In addition, survey divers monitored the behavior of the fish community in the immediate vicinity of the cable for “unusual” or unexpected movements or reactions during the exact moment of power transition from ambient (OFF) to energized AC or DC (ON), and vice versa. Prior to beginning surveys at each site, divers positioned tripod-mounted stationary video cameras directly over the cable with the field of view aimed parallel to the axis of the cable to record the movements and behaviors of the fish community. The cameras captured continuous video of the cable and associated fish assemblages at each site, including segments of time during which the *in-situ* visual surveys were being conducted, and continued until either the camera was recovered at the end of the field effort or the battery power was exhausted for each day of surveys.

Specific Objectives

Progressive examination of the quarterly sampling results and a final analysis were performed on the dataset to determine if the presence of an SFOMF generated EMF field alters: (1) abundance, species richness, and assemblage structure of coral reef fishes, (2) the behavior of fishes. Diver observations were also used in an attempt to discern if there were any noticeable immediate organismal responses during the transitional period between ambient OFF to energized AC or DC power states, and video footage was intended to augment the *in-situ* visual survey data and aid in interpretation of the results.

Methods: Data Collection, Processing, and Analysis

The results presented here represent combined data from five quarters: Quarter 2 (July 2014), Quarter 3 (September 2014), Quarter 4 (November 2014), Quarter 5 (March 2015), and Quarter 6 (June 2015). No data were collected during the first quarter of the grant as this time was used for project start-up activities, such as: logistical coordination, cable and EMF emissions identification, site selection and preparation, and refinement of sampling methods. During the entire period, a total of 263 surveys were conducted: 132 transect-counts and 131 point-counts; 80 AC counts (40 transects, 40 point-counts), 67 DC counts (34 transects, 33 point-counts) and 116 OFF counts (58 transects, 58 point-counts). Each site had a total of 88 total counts, 44 transect-counts and 44 point-counts, with the exception of the Deep site which had 44 transect-counts and 43 point-counts due to inclement weather.

Data recorded during visual surveys were entered into Microsoft Excel and analyzed with Statistica (StatSoft Inc., Tulsa, Oklahoma, USA). Examination of the raw (untransformed) abundance revealed unequal variance between groups and, therefore, these data were log(x+1) transformed prior to analysis. A one-way analysis of variance (ANOVA) was performed on the transformed abundance and the untransformed species richness data. If the ANOVA indicated a difference among groups a Student-Newman-Keuls (SNK) test was used to examine differences among group means. For examination of assemblage structure, non-metric multi-dimensional scaling (MDS) plots were constructed using Bray-Curtis similarity indices of log(x+1) transformed abundance data (PRIMER v6; Clarke and Warwick, 2001).

As an additional exploratory measure, a selection of hyper-abundant schooling species [Masked/Glass Goby (*Coryphopterus personatus/hyalinus),* Blue Runner *(Caranx crysos)*, and Ballyhoo *(Hemiramphus brasiliensi*s)] were removed from a secondary analysis of abundance and density due to their potential to mask underlying trends or patterns of community structure that might be occurring and to determine whether their removal yields results that lead to more robust conclusions. Removal or treatment of outliers is a commonly employed statistical procedure that can be particularly useful for the interpretation of summary statistics that may be heavily skewed when extreme values are present. Masked Gobies are a diminutive planktivorous species (Maximum length 4.0 cm TL) (Lieske and Myers, 1994) with limited swimming capabilities that, when present, can occur in shoals numbering in the tens to hundreds. As such they are a species that is easy to over- or under-estimate, potentially making the detection of any calculable or behavioral change in response to EMF alteration more difficult. This species was encountered in almost every survey on the Middle and Deep reef sites, and were the single most abundant species recorded during all power states (23.1% of the combined total). Blue Runner, a fast moving reef-associated pelagic species and the fourth most abundant in this dataset (8.3% of the total), was encountered on multiple Deep site surveys in schools exceeding 800-1000 individuals. Ballyhoo, the 11th most abundant species (1.5% of the total), are often attracted to the upwelling produced by divers' bubbles as they rise to the surface and may congregate in schools of hundreds there.

Results

Species richness: During the course of this project, a total of 151 species representing 35 families were recorded from all three survey locations (Table 1). When the entire dataset is examined, no significant differences were detected between power states (ANOVA, $p = 0.39$) (Figure 1).

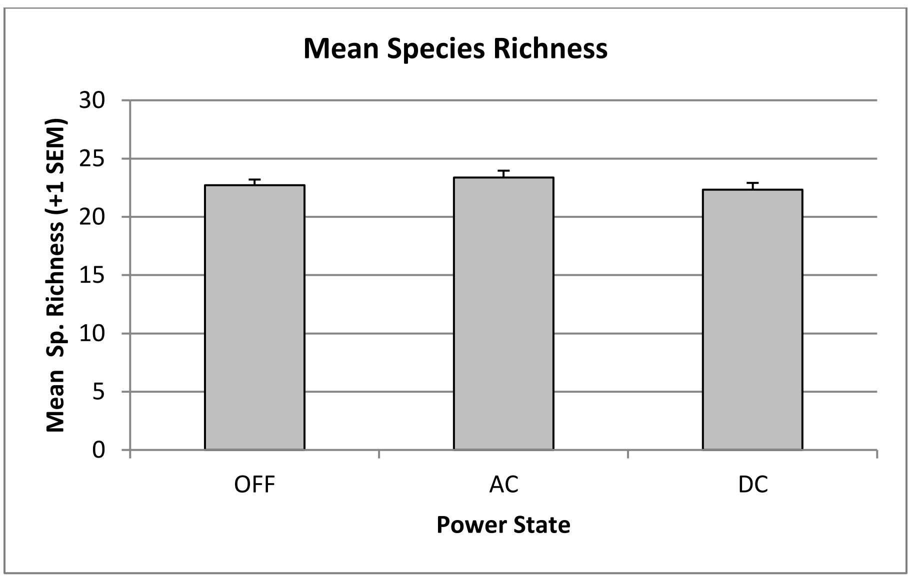

Figure 1. Mean species richness, by power state, using the full data set, during each power state (ambient OFF, energized AC, and energized DC); entire species assemblage with all quarters and sites combined. Error bars associated with the mean indicate the standard error of the mean (SEM). No significant difference was found (ANOVA, $p=0.39$).

The full dataset was broken down further to examine the contribution that each site made to mean species richness. For species richness there were no differences noted among power states within either the Shallow or Middle sites, but curiously there was a difference for the Deep DC (SNK, $p<0.05$, Figure 2). With all power states combined, species richness on the Deep and Middle sites was significantly greater than on the Shallow site (SNK, $p<0.05$) (Figure 3).

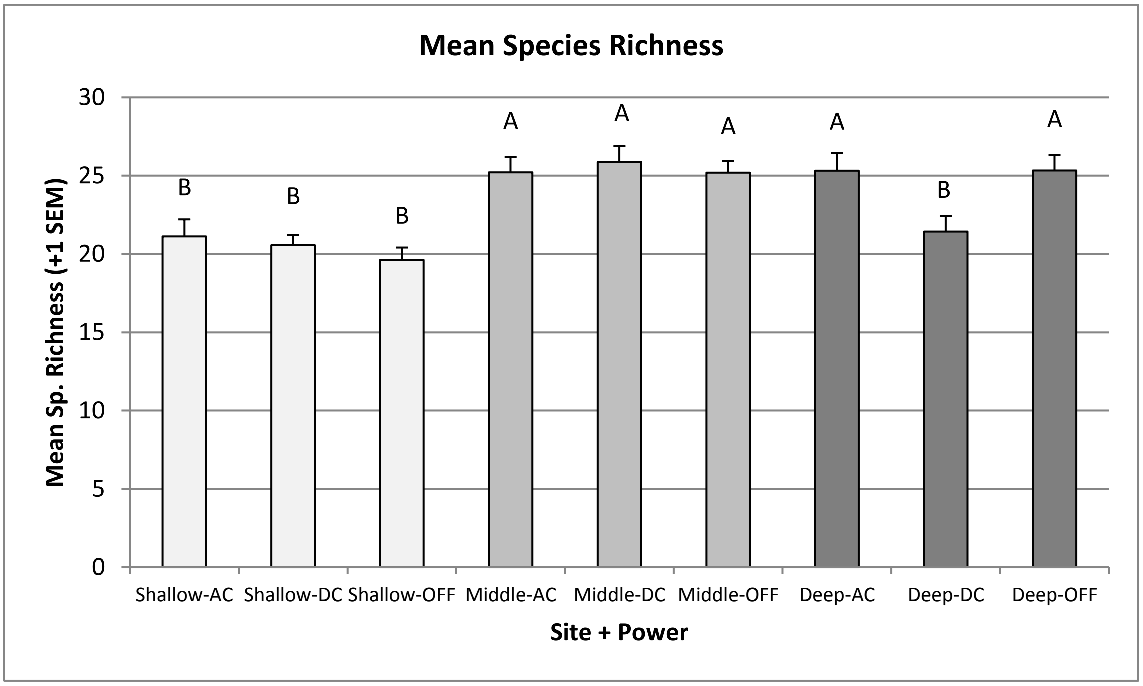

Figure 2. Mean species richness of fishes, using the full dataset, from each site during each power state (ambient OFF, energized AC, and energized DC); entire species assemblage with all quarters and sites combined. Letters indicate significant differences and shared groupings (SNK, $p<0.05$).

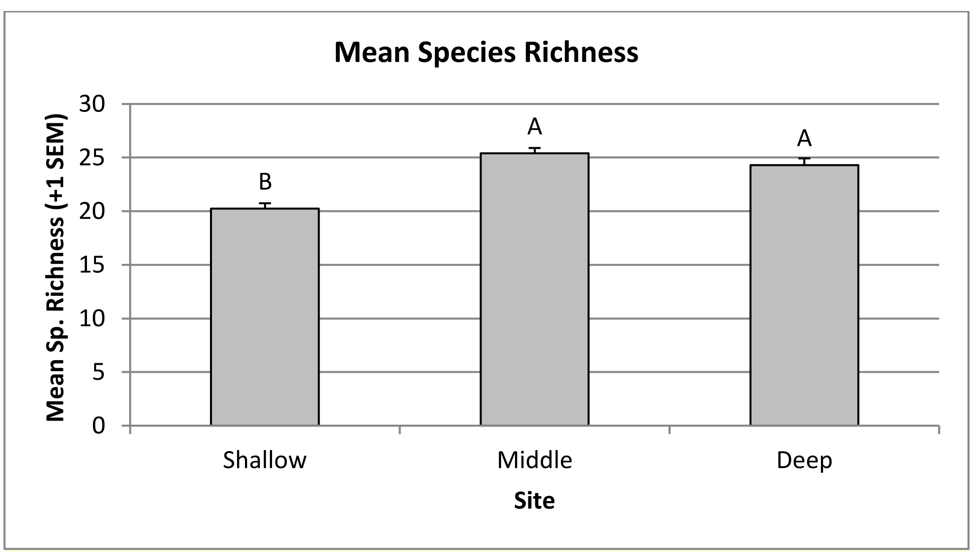

Figure 3. Mean Species Richness of fishes, by site using the full dataset, with all power states combined; entire species assemblage with all quarters combined. Letters indicate significant differences and shared groupings (SNK, $p<0.05$).

With the assumption that fishes in closer proximity to the cable receive stronger EMF emissions and might therefore be more inclined to alter their behavior or movements in response, a comparison of point-count to transect-count data was also made and indicated more species were recorded with point-counts (SNK, $p<0.05$) (Figure 4).

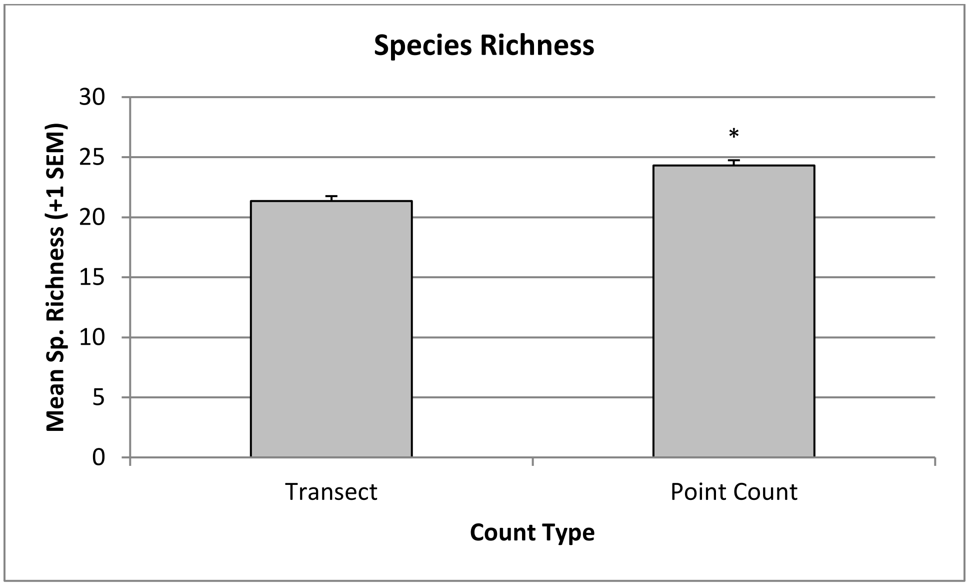

Figure 4. Comparison of mean species richness of fishes between visual survey types. The asterisk signifies a significant difference (SNK, $p<0.05$).

Few species were recorded only in one power state. Of the 29 species that were found only in a single power state, 13 were only counted once as individual fish, and the rest were isolated occurrences of 2-5 individuals or in a single count (i.e., a school of 30 Lane Snapper) (Table 1). Slightly more of these species were found during ambient (OFF) conditions (13), than in the other power states (AC 11 total, DC 9 total). Only two elasmobranch species were encountered during the visual surveys, the Yellow Stingray (*Urobatis jamaicensis)* and Southern Stingray (*Dasyatis americanus*). The Yellow Stingray was counted exclusively during ambient (OFF) conditions, although only 5 individuals were recorded. The Southern Stingray was counted once during energized AC (ON) and once during ambient (OFF) conditions.

Abundance: There were 24,473 fishes counted during transect-count surveys. When abundance is standardized by the relative number of samples taken within each power state, 44% of the fishes were counted during ambient (OFF) surveys compared to 29% for AC and 27% for DC. For point-counts, 36,115 fishes were counted, 39% of which were during ambient (OFF) surveys compared to 33% for AC and 28% for DC (Table 1). Although more fish were recorded during the ambient (OFF) sequences for both count types, with all quarters and sites combined there were no statistical differences detected (ANOVA, $p = 0.21$) (Figure 5). Likewise, on a quarterly basis the abundance of fishes did not differ significantly among power states (ANOVA, $p>0.05$) (Table 2). Note the figures for abundance were generated using untransformed abundance data to provide a visual comparison of means, whereas the ANOVAs used to test for differences between the means were performed with transformed data. When the modified dataset is examined (with select gobies, jacks, and ballyhoo removed), visually, the abundance relationships between the power states are balanced more equally and remain statistically non-significant (ANOVA, $p=0.81$) (Figure 6).

However, it is noteworthy that the greatest total abundance in both transect-counts and point-counts was recorded during ambient (OFF) conditions (Figures 5 and 7). Likewise, fish density was higher during ambient (OFF) conditions (Table 1). The majority of species recorded during this study, from both count types combined, had their highest abundance during ambient (OFF) conditions (AC 33%, DC 25%, OFF 42%).

There were 23 species with higher abundances recorded from both count types during ambient (OFF) conditions, and the total number of fishes counted during OFF conditions comprise 40.9% of the total recorded during the entire project for all power states. Comparatively, there were only 10 species that had higher numbers for both count types in AC, and 9 species for DC comprising 31.6% and 27.6% of the total abundance, respectively.

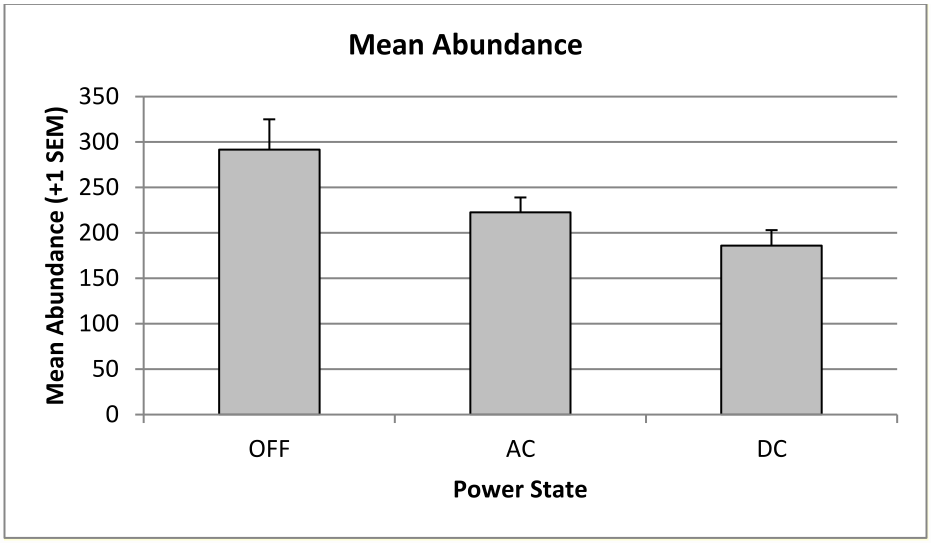

Figure 5. Mean abundance of fishes, using the full data set, during each power state (ambient OFF, energized AC, and energized DC); entire species assemblage with all quarters and sites combined. No significant difference was found (ANOVA, p=0.21).

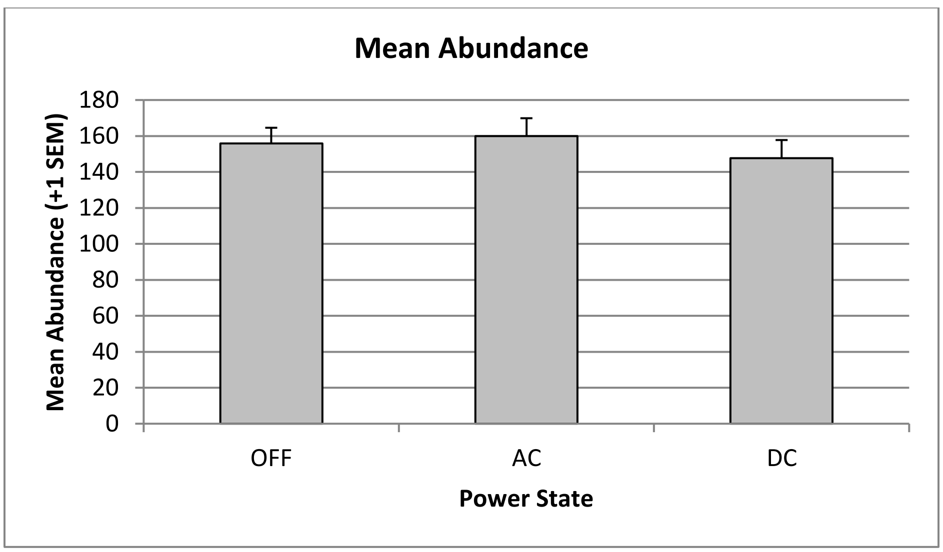

Figure 6. Mean abundance of fishes, using the dataset with Masked/Glass Goby, Blue Runner and Ballyhoo removed, during each power state (ambient OFF, energized AC, and energized DC); all quarters and sites combined. No significant difference was found (ANOVA, p=0.81).

When the dataset is broken down further to examine the contribution each site made to mean abundance, there were minor differences between power states at the Shallow site, but the Middle and Deep sites had greater values during ambient OFF conditions (SNK, $p<0.05$) (Figure 7). Also, using the modified dataset (with Masked/Glass Goby, Blue Runner, and Ballyhoo removed), no significant differences were noted for abundance (Figure 8) at the Shallow and Middle sites, but Deep OFF once again stands out with slightly greater values (SNK, p<0.05). As was also the case with species richness, comparison of count types indicated more fishes were recorded with point-counts than with transect-counts (SNK, p<0.05) (Figure 4, 11).

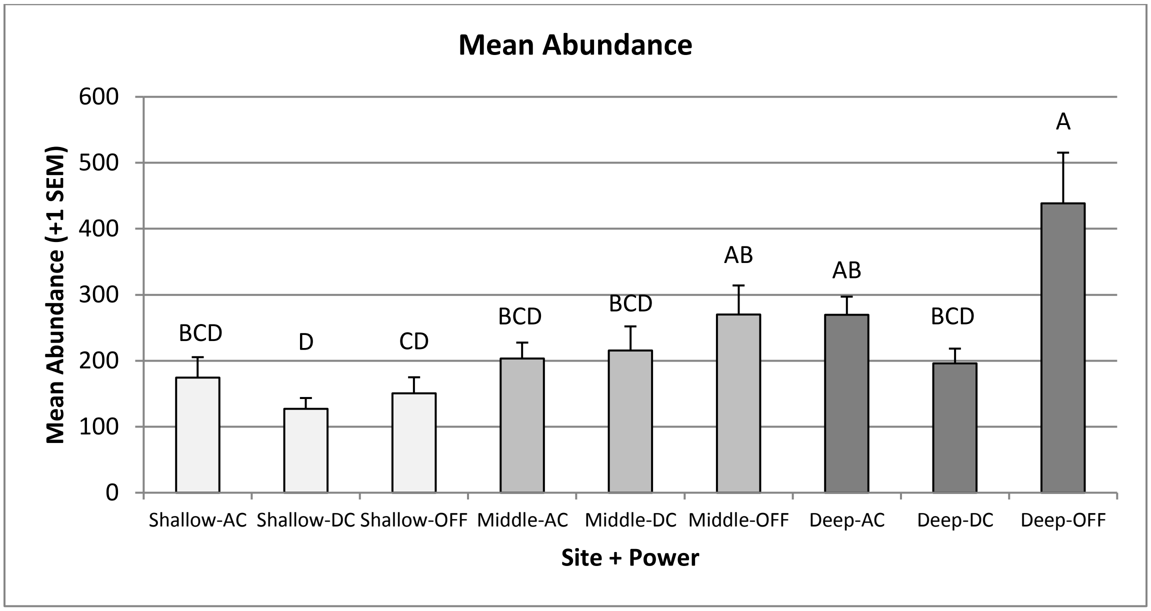

Figure 7. Mean abundance of fishes using the full data set, from each site during each power state (ambient OFF, energized AC, and energized DC); entire species assemblage with all quarters and sites combined. Letters indicate significant differences and shared groupings (SNK, p<0.05).

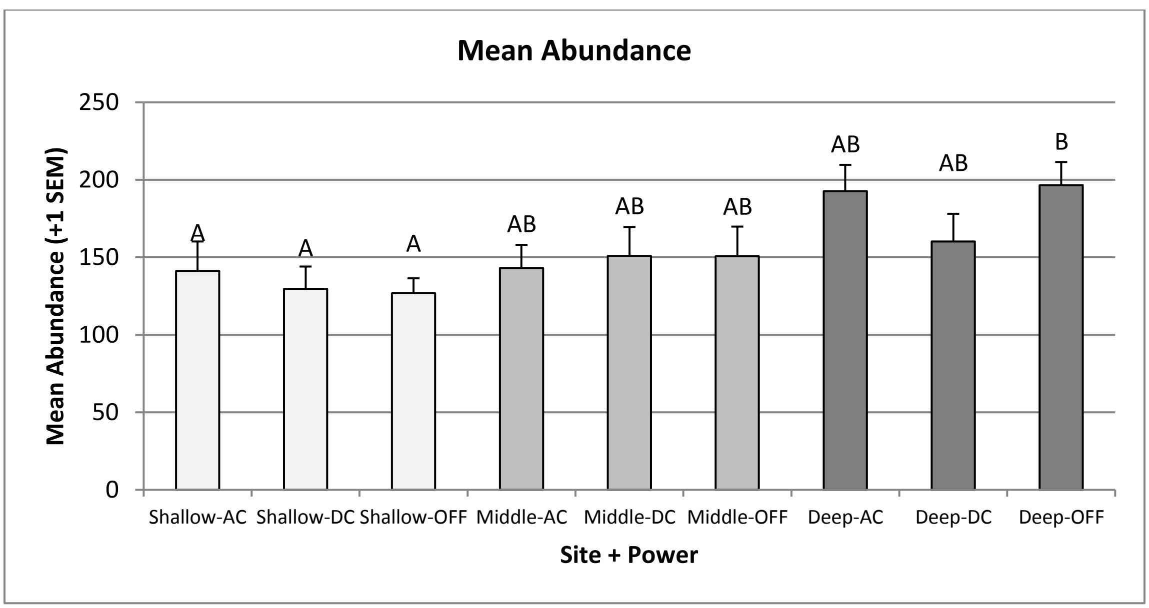

Figure 8. Mean abundance of fishes, using the dataset with Masked/Glass Goby, Blue Runner and Ballyhoo removed, from each site during each power state (ambient OFF, energized AC, and energized DC); entire species assemblage with all quarters and sites combined. Letters indicate significant differences and shared groupings (SNK, p<0.05).

If, for abundance, all power states are combined, both versions of the dataset (complete and modified) had, like richness, differences among sites and were significantly greater at the Deep site (SNK, $p<0.05$) (Figures 9 and 10).

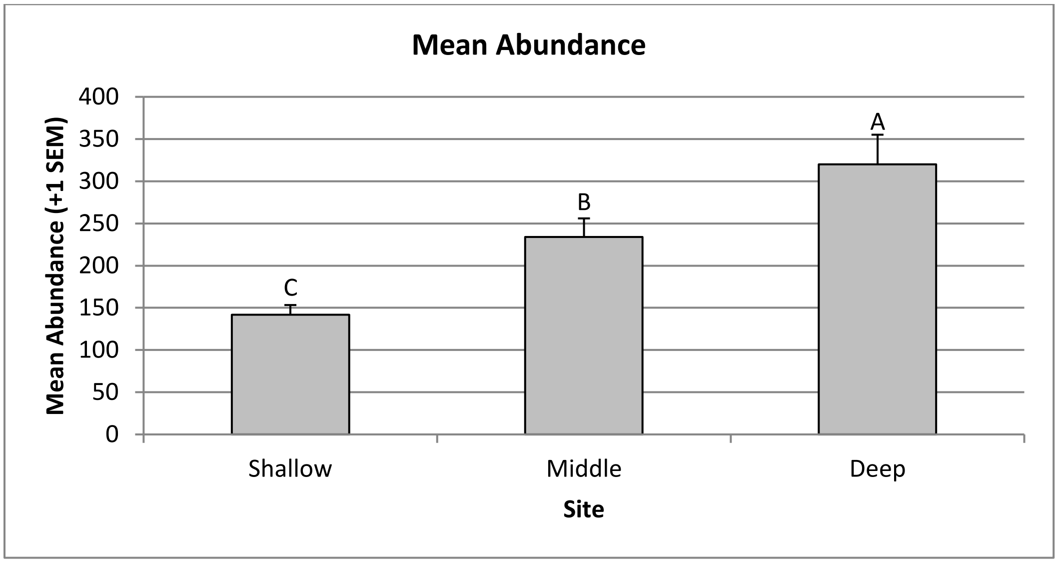

Figure 9. Mean Abundance of fishes, using the full dataset, from each site with all power states combined; entire species assemblage with all quarters combined. Letters indicate significant differences and shared groupings (SNK, $p<0.05$).

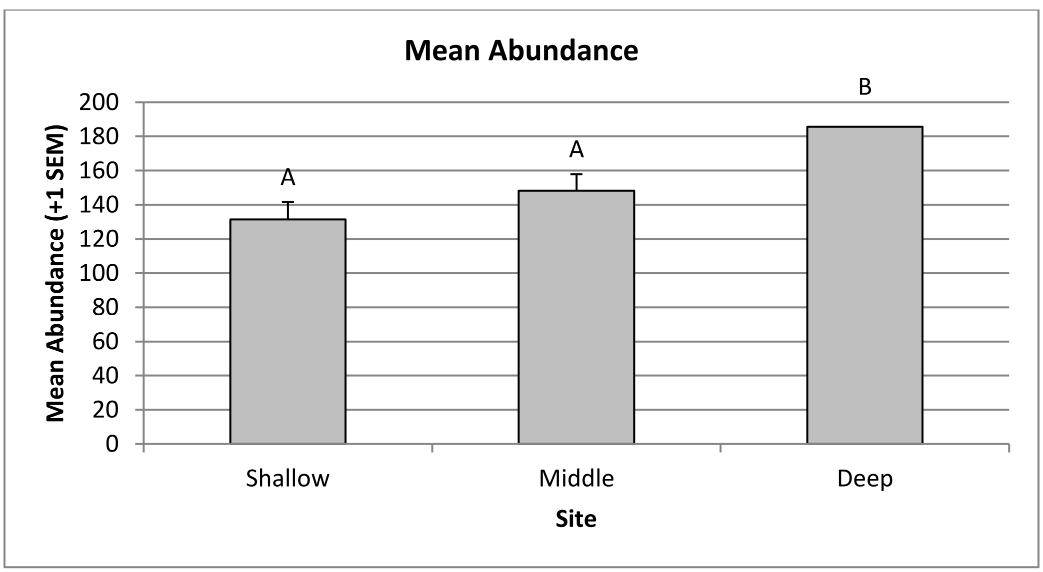

Figure 10. Mean Abundance of fishes, using the dataset with Masked/Glass Goby, Blue Runner and Ballyhoo removed, from each site with all power states combined; entire species assemblage with all quarters combined. Letters indicate significant differences and shared groupings (SNK, $p<0.05$).

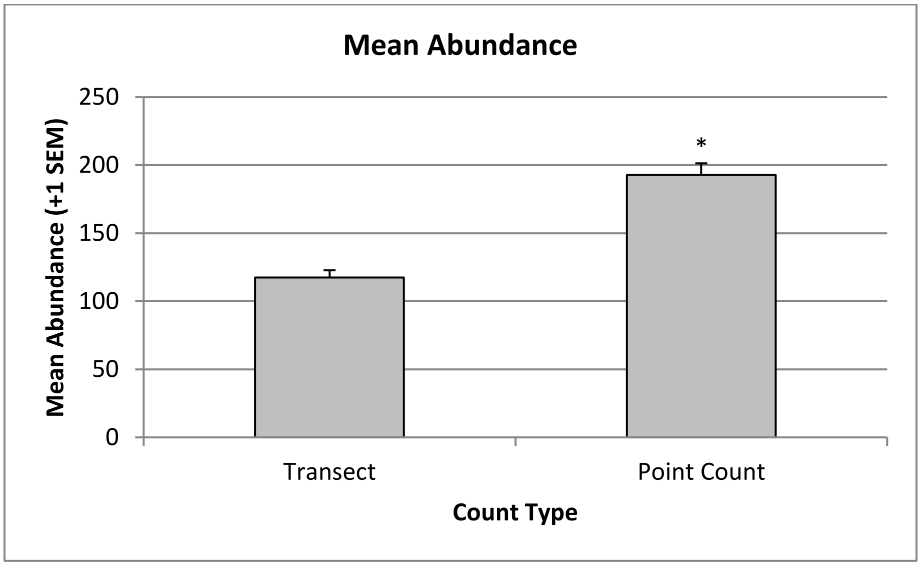

Figure 11. Comparison of mean abundance of fishes between visual survey types (SNK, $p<0.01$).

Community analysis: Assemblage structure was examined with both versions of the dataset (with and without selected species), but results revealed that the patterns of distribution among samples were nearly identical and only the full dataset is presented here. The site differences that were previously noted for richness and abundance (Figures 3, 9, and 10) are also echoed here, with clear separation occurring for each site (Figures 12-16). When all sites and count types are combined, no distinct clustering of assemblage structure can be attributed to any of the individual power states (Figures 13 and 14). However, it does appear that in general the distribution for ambient (OFF) counts was slightly more spread out than either energized AC or energized DC, especially at the Shallow and Deep reef sites.

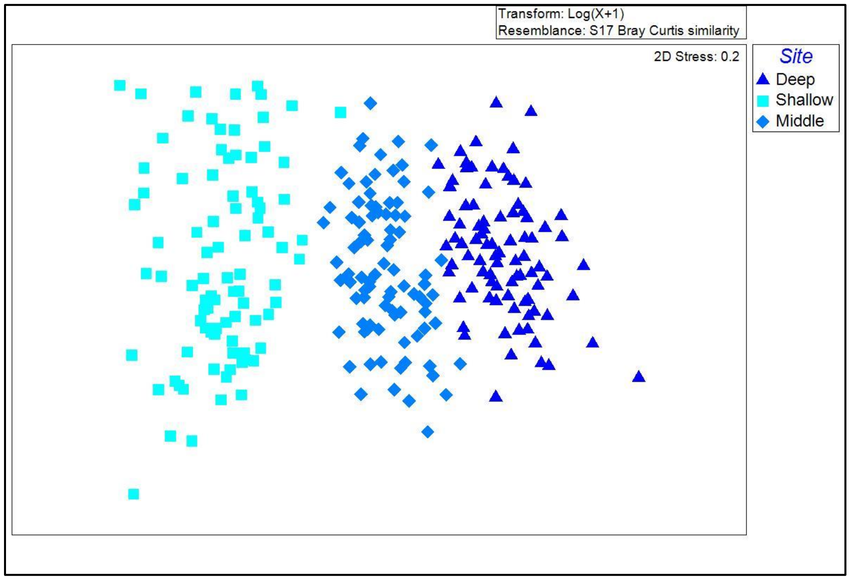

Figure 12. MDS plot of fish assemblages by reef-tract site, all power states combined. The three sites are clearly separated.

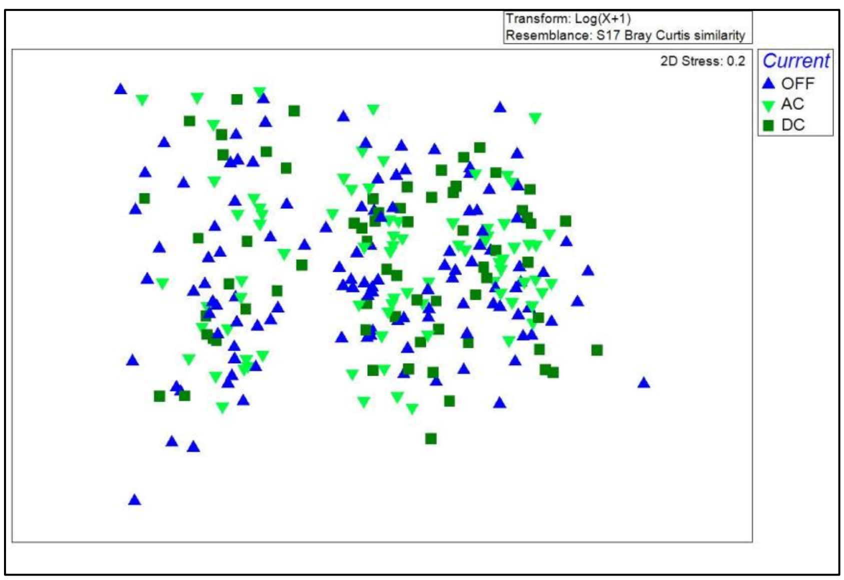

Figure 13. MDS plot of fish abundance by current state (OFF) and (AC) and (DC) for all sites.

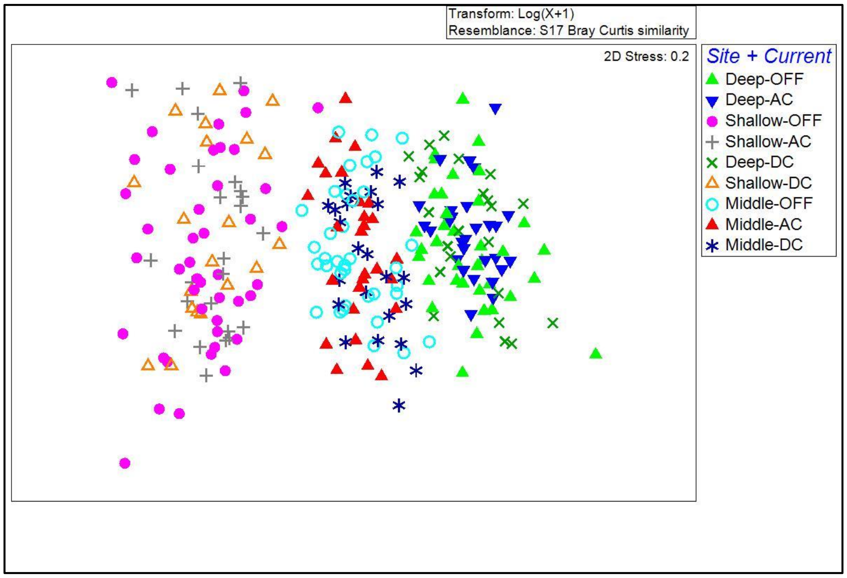

Figure 14. MDS plot of fish assemblages comparing power OFF, AC, and DC for each site.

Distribution of the points for each count type (Figure 15) suggest that point-counts and transect-counts are characterizing separate but slightly overlapping components of the same assemblage, which is to be expected given the nature of each of these two methodologies. When transect-count and point-count count data are analyzed separately (Figure 16), once again a similar pattern of indistinct clustering is noted, which leads to the conclusion that there is subtle but limited evidence for differences in community structure between power states as they were examined here on a community-level scale.

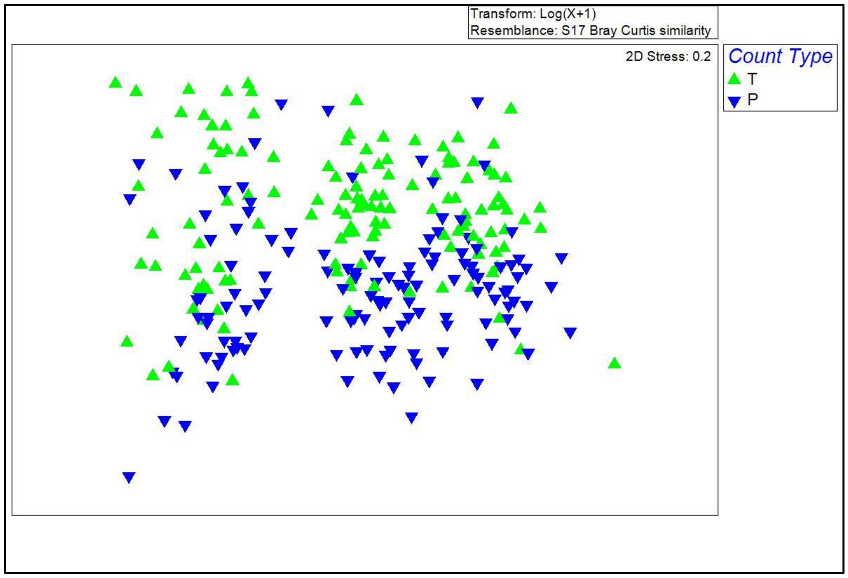

Figure 15. MDS plot of fish assemblages comparing transect-counts (T) to point-counts (P).

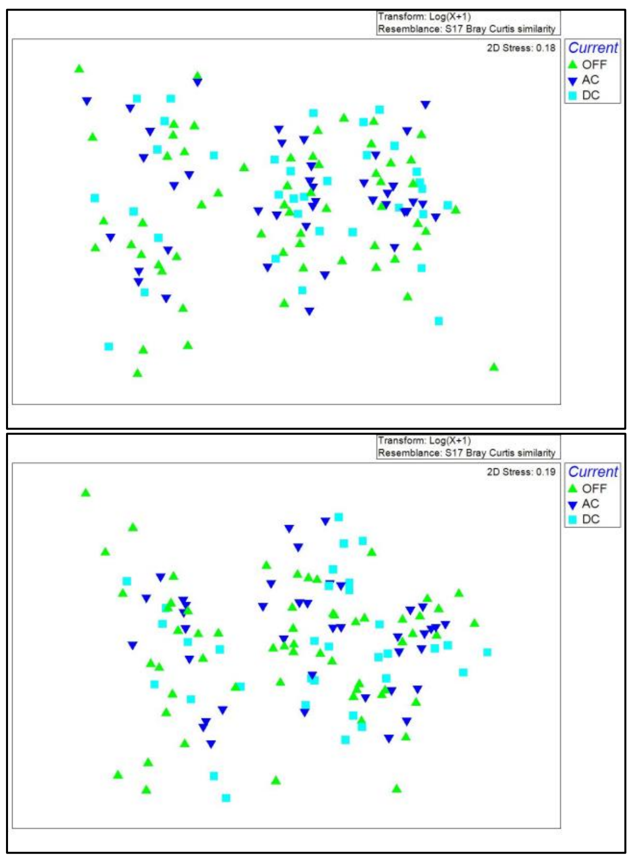

Figure 16. MDS plot of fish assemblages by current, transect-count only (left) and point-count only (right).

Behavior: In order to make in-situ observations of fish movement and behavior at the exact moment of power transition, divers were positioned along the cable prior to each power transition from ambient OFF to energized AC and energized DC and vice versa, although the survey divers were unaware of what the power state was for any given power transition due to the blind survey design. No detectable behavioral responses of fishes or other organisms to power transitions were observed at any of the 3 survey locations.

Stationary video: An analysis of the stationary video footage was attempted, however positive identification and quantification of the fishes within the field of view proved to be problematic and generation of data that could be used to evaluate the fish population on a similar scale as that generated from the in-situ visual surveys was not achieved. Multiple methods, such as taking a snapshot of the video at pre-determined time intervals and magnification of select areas during the video analysis, were utilized with limited success. Underwater visibility (i.e., water clarity and turbidity), distance from the camera to the targets (fishes), and camera resolution were contributing factors that resulted in only a rudimentary identification and quantification of the fishes that were present during each power sequence. Accurate assessment by the video observer was possible for those fishes that were observed within a range of minimum proximity to the camera, fish size, and swimming speed. However, it was decided that the accuracy of assessment did not extend far enough to include the majority of the fishes that were actually present within the field of view during the surveys

Discussion

The site dependent differences in fish richness, abundance, and assemblage structure with the power states combined noted here (Figures 3, 9, 12) are likely the result of species-specific habitat preferences and habitat differences between sites and not due to EMF influences. These site-dependent results are supported by multiple previous data-rich studies in the local area, including those distant from any likely SFOMF influence (Ferro et al, 2005; Gilliam et al., 2013; Kilfoyle et al., 2015).

Likewise, the differences noted between point-counts and transect-counts in richness and abundance, with sites and power states combined, are supported by other studies (Baron et al., 2004). These differences are expected and mainly due to biases of the survey types (and not to EMFs) and are the underlying reason for using two different methodologies. The transect-count is carried out close to the cable, targeting a greater constituency of small, cryptic species and juveniles and effectively excluding or missing many of those highly mobile species that routinely inhabit the water column. Greater total abundance per count is typical of the point-count surveys as the diver is assessing a greater surface area and volume than transect-counts (176.7 m^2 and 60 m^2, respectively).

In terms of richness, it does not appear that power state had a strong overall impact. There was no statistical difference in mean richness among the power states and, with some exceptions, individuals within a species were not restricted to a single power state (Table 1). These results appear to be in accord with the absence of noting any immediate change in behavior with the onset of an EMF stimulus. There was no apparent EMF impact on a population severe enough to provoke an immediate movement towards or away from a particular EMF. The exceptions were restricted to rare occurrences of primarily single encounters and often of single individuals. Nonetheless, it is noteworthy that few elasmobranchs, or other fishes known to be sensitive to E or M fields, were counted during the study. Only 2 species of stingrays were recorded. One of those, the yellow stingray, was only counted in the OFF power state. The yellow stingray is known to be electrosensitive in the range of the SFOMF EMF and may have been avoiding charged cables. However, with only 5 individuals recorded in total this must remain speculation until further research provides additional evidence.

In terms of abundance, our conclusions are not as straight forward as the analyses do not provide for a single clear interpretation of the data. Although when graphed the means for the full study (5 quarters) appear different, the ANOVA analyses of the transformed data do not indicate statistical differences among the power states (Figures 5, 6). However, fish abundance data acquired from visual surveys is typically characterized by high variability, and this dataset is by no means an exception. The low number of counts examined and the high variability within counts provides a high probability of a Type II statistical error, finding no difference among power states when there is one. Thus, we caution some discretion in reaching a concrete conclusion based solely on the ANOVA results. Further, although there were no statistically significant differences detected for total abundance between ambient (OFF) and energized AC or DC (ON) conditions, there is some evidence in the dataset to suggest a preliminary conclusion that some reef fishes may be affected by the presence of EMF emissions. Thus, more fishes were recorded in the OFF power state (interestingly with an ANOVA of the untransformed data this difference was significant ($p=0.035$), and if abundance is examined from a species perspective, more species had their highest number of individuals recorded during the ambient (OFF) state and abundance calculated as percent species population (the distribution of each species within the three power states) was higher during the power OFF condition (Table 1).

These disparate analyses are not easy to reconcile. With the caveat that this study may have inadequately counted, or missed completely, some cryptic and transitory species and that we cannot speak to long-term impact on the community, it appears that species richness and the assemblage structure of resident fishes were likely not immediately altered by the short-term changes in the EMF utilized in this study (Figures 1, 2, 13, 14). Also, no behavioral changes were noted in immediate responses to alterations in EMF. With no difference in richness, structure, and behavior of fishes detected, and given that the literature does not provide much evidence for fishes being EMF sensitive, excluding elasmobranchs or diadromous species, it would be easiest to conclude that the EMFs assessed in this study do not impact coral reef fishes and ascribe the contradictory interpretations to problems in analysis or research design. However, the number of times when abundances were highest during power-off in this blinded study begs the question (Table 1). Thus, although we found no evidence for overt discrete changes in behavior, our data do suggest that the artificial EMF may have led to an overall subtle avoidance of the area affected by the EMF stimuli, leading to possible differences in the distribution of fishes.

In addition to potential emigration out of the area, fishes that remain in the area might also be exhibiting differences in behavior, which would influence their being counted, such as remaining closer to the substrate or taking refuge within the reef when EMF emissions are present. If some species are induced to move as a result of the EMF signal, it could potentially be due to an active avoidance of, or escape from, the EMF due to direct aversive consequences on the organism, or it may be due to a process that involves a gradual moving to/from the area in response to subtle EMF effects on various, less obvious, factors. This accords with other results found with vertebrates, including fishes. In a host of studies, often inconclusive or contradictory, EMFs have been shown to influence variables such as: orientation (Putman et al., 2014), enzymes (Li et al., 2014), hormones (Lewczuk et al., 2014), metabolism (Wang et al., 2016), nerve function (Chagnaud et al., 2008; Varro et al., 2009; Tabor et al., 2014) , anxiety **(**Lee and Yang, 2014), development and mortality (Krylov et al., 2016), activity level (Varanelli and McCleave, 1974; Ward et al., 2014; Lee et al., 2014) or hyperalgesia (Jeong et al., 2005), paresthesia (Sugishita and Takayama, 1993) etc. (for additional references see: Öhman et al., 2007; Lee and Yang, 2014; Lewczuk et al., 2014; Pall 2015). Our study does not provide adequate information to form a viable hypothesis regarding the biological mechanism(s) determining any EMF impact. However, clearly impacting any of the variables above could alter distribution.

Supplemental Ray Enclosure section

An additional series of experimental field trials to augment the data utilized the yellow stingray (*Urobatis jamaicensis*) for behavioral studies. *Urobatis jamaicensis* is a small batoid with a widespread range within the greater Caribbean area; it is relatively abundant in southeast FL and the reefs within the SFOMF and is easy to capture and maintain in captivity. These characteristics made it a good research subject (Spieler, 2013). Spieler and colleagues have produced multiple publications on the yellow ray (Walker and Sherman, 2001; Sherman, 2003; Fahy, 2004; Fahy et al., 2007; Maroni et al., 2009; Spieler, 2013). The locality of these previous studies is the same used by this project. A single yellow ray was placed in a plastic non-conductive enclosure next to or the cable at each of the study locations to assess the animal's state of activity and behavior during repeated modulations of the EMF field. A unique individual was used for each trial. Behavioral reactions, such as distance from the cable, direction traveled in avoidance, orientation, state of movements (agitated or controlled) and confusion or other signs of disturbance were recorded. A total of 3 separate trials were conducted, one at each representative site. During the behavioral trials, current through the cable was switched between AC, DC and OFF power states every 5 minutes for 1 hour. The responses of the ray were recorded by a diver stationed nearby, far enough away from the ray to not influence its actions yet close enough to observe its behavior during the entire trial clearly (Gruber and Myrberg 1977). In each trial, the ray did not display any response apart from a slight undulation of the pectorals or tail to deal with the current. Even when another yellow stingray approached multiple times during one trial in hopes of getting into the enclosure and perhaps mating. The traumatiziation of capture and transport to and from the boat to each trial, is the probable cause for nonmovement. The EMFs may not have been enough to persuade the ray to move towards or away from the cable; however each ray was essentially perpindicular or parallel to the cable throughout the trial.

Conclusion

In conclusion, much of the literature dealing with EMF effects on vertebrates can be summed up as contradictory or inconclusive. This study is in some measures likewise. There are some caveats to consider. We did not see adequate numbers of some species, especially elasmobranchs, known to reside in or transit the area. Thus, some local species might be impacted but our results would not clearly show it. Also, we cannot discount the possibility that the time intervals between power states utilized here (approximately 30 minutes) to assess changes in reef fish populations was too short to capture slow changes that may be occurring as a result of altering the power state and the low sample sizes and high count variability may be obscuring some statistical analyses. These caveats notwithstanding, we did not find that the EMF provided at the SFOMF had dramatic impact on the fish assemblage we examined. Nonetheless, although no behavioral effects were noted, the distribution data does provide evidence that the EMF may be eliciting some short-term impact on fishes leading to their avoidance of both the AC and DC generated EMF. We are reluctant to say this impact is benign. Subtle changes in place preference may result from EMF-induced changes in orientation, anxiety, temperature, etc. The potential long term effect of such impact, if any, on the distributions of fish populations and community structure is not known and further research is needed. Additional studies involving larger sample sizes, longer time intervals with the power remaining constant for each particular current type (OFF vs AC vs DC), different power frequencies/strengths, and sites are required. Because the potential sensitivity of most non-elasmobranch fishes to EMFs appears low, combining such field studies in conjunction with laboratory behavioral studies would likely produce more conclusive results.

Table 1: The total abundance (raw/standardized by sample size/percent within count type) of each observed species across all power states and count types, totals from each energized power state (AC and DC) and ambient (OFF). Sample size differed among count types and power states: Transect-counts: AC N=40, DC=34, OFF=58; Point-counts: AC N=40, DC=33, OFF=58. Shaded cells indicate highest counts by power state within a species for each count type. Species names displayed in bold were seen exclusively in one power state.

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
STINGRAYS	**DASYATIDAE**							
Southern Stingray	*Dasyatis americana*	2 / 1.4	1 / 0.8 / 59.1	0	1 / 0.5 / 40.8	0	0	0
Yellow Stingray	***Urobatis jamaicensis***	5 / 2.8	0	0	3 / 1.7 / 100	0	0	2 / 1.1 / 100
MORAY EELS	**MURAENIDAE**							
Goldentail Moray	***Gymnothorax miliaris***	1 / 0.5	0	0	1 / 0.5 / 100	0	0	0
Spotted Moray	*Gymnothorax moringa*	3 / 2.8	0	2 / 2 / 100	0	1 / 0.8 / 100	0	0
LIZARDFISHES	**SYNODONTIDAE**							
Inshore Lizardfish	***Synodus foetens***	2 / 2	0	0	0	0	2 / 2 / 100	0
Sand Diver	*Synodus intermedius*	3 / 2.7	2 / 1.7 / 100	0	0	0	1 / 1 / 100	0
FLYINGFISHES	**EXOCOETIDAE**							
Ballyhoo	*Hemiramphus brasiliensis*	900 / 563.2	0	0	0	200 / 165 / 29.2	0	700 / 398.2 / 70.7
TRUMPETFISHES	**AULOSTOMIDAE**							
Trumpetfish	*Aulostomus maculatus*	21 / 16	4 / 3.4 / 33.4	5 / 5 / 49.2	3 / 1.7 / 17.3	3 / 2.4 / 42	0	6 / 3.4 / 57.9
SCORPIONFISHES	**SCORPAENIDAE**							
Red Lionfish	***Pterois volitans***	1 / 1	0	1 / 1 / 100	0	0	0	0
Spotted Scorpionfish	*Scorpaena plumieri*	20 / 15	4 / 3.4 / 32.3	3 / 3 / 28.5	7 / 4.1 / 39	1 / 0.8 / 18.2	2 / 2 / 44.1	3 / 1.7 / 37.6
SEA BASSES	**SERRANIDAE**							
Graysby	*Cephalopholis cruentata*	110 / 84.3	19 / 16.1 / 45.7	8 / 8 / 22.6	19 / 11.1 / 31.5	19 / 15.6 / 31.9	18 / 18 / 36.7	27 / 15.3 / 31.3
Coney	*Cephalopholis fulvus*	11 / 7.4	0	0	1 / 0.5 / 100	3 / 2.4 / 35.9	1 / 1 / 14.5	6 / 3.4 / 49.5
Rock Hind	***Epinephelus adscensionis***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
Red Grouper	*Epinephelus morio*	3 / 2.1	0	0	0	0	1 / 1 / 46.7	2 / 1.1 / 53.2
Blue Hamlet	*Hypoplectrus gemma*	19 / 12.6	1 / 0.8 / 14.2	1 / 1 / 16.7	7 / 4.1 / 68.9	4 / 3.3 / 49.1	0	6 / 3.4 / 50.8
Shy Hamlet	*Hypoplectrus guttavarius*	3 / 1.9	0	0	2 / 1.1 / 100	1 / 0.8 / 100	0	0

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Butter Hamlet	*Hypoplectrus unicolor*	89 / 66.6	11 / 9.3 / 32.1	8 / 8 / 27.5	20 / 11.7 / 40.3	17 / 14 / 37.3	11 / 11 / 29.3	22 / 12.5 / 33.3
Orangeback Bass	***Serranus annularis***	1 / 0.5	0	0	1 / 0.5 / 100	0	0	0
Lantern Bass	*Serranus baldwini*	14 / 10.7	5 / 4.2 / 39.4	3 / 3 / 27.8	6 / 3.5 / 32.6	0	0	0
Tobaccofish	***Serranus tabacarius***	1 / 0.8	1 / 0.8 / 100	0	0	0	0	0
Harlequin Bass	*Serranus tigrinus*	93 / 73.3	15 / 12.7 / 34.3	15 / 15 / 40.3	16 / 9.3 / 25.2	15 / 12.3 / 34.1	13 / 13 / 35.9	19 / 10.8 / 29.8
JAWFISHES	**OPISTOGNATHIDAE**							
Yellowhead Jawfish	*Opistognathus aurifrons*	5 / 4.1	0	3 / 3 / 71.9	2 / 1.1 / 28	0	0	0
Dusky Jawfish	***Opistognathus whitehursti***	4 / 3.4	4 / 3.4 / 100	0	0	0	0	0
CARDINALFISHES	**APOGONIDAE**							
Flamefish	***Apogon maculatus***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
Dusky Cardinalfish	***Phaeoptyx pigmentaria***	4 / 3.3	0	0	0	4 / 3.3 / 100	0	0
TILEFISHES	**MALACANTHIDAE**							
Sand Tilefish	*Malacanthus plumieri*	2 / 1.4	1 / 0.8 / 59.1	0	1 / 0.5 / 40.8	0	0	0
REMORAS	**ECHENEIDAE**							
Sharksucker	***Echeneis naucrates***	1 / 1	0	0	0	0	1 / 1 / 100	0
JACKS	**CARANGIDAE**							
Yellow Jack	*Carangoides bartholomaei*	22 / 17.6	3 / 2.5 / 46.5	0	5 / 2.9 / 53.4	8 / 6.6 / 54.2	5 / 5 / 41	1 / 0.5 / 4.6
Blue Runner	*Caranx crysos*	5054 / 3076.8	173 / 147 / 22.6	0	855 / 501.2 / 77.3	256 / 211.2 / 8.6	168 / 168 / 6.9	3602 / 2049.4 / 84.3
Bar Jack	*Caranx ruber*	871 / 691.3	80 / 68 / 44.2	84 / 84 / 54.6	3 / 1.7 / 1.1	111 / 91.5 / 17	252 / 252 / 46.8	341 / 194 / 36
Mackerel Scad	*Decapterus macarellus*	50 / 33.5	0	0	0	20 / 16.5 / 49.1	0	30 / 17 / 50.8
Round Scad	*Decapterus punctatus*	20 / 16.6	0	0	0	12 / 9.9 / 59.6	5 / 5 / 30.1	3 / 1.7 / 10.2
Rainbow Runner	*Elagatis bipinnulata*	34 / 20.3	0	0	0	4 / 3.3 / 16.2	0	30 / 17 / 83.7
Greater Amberjack	***Seriola dumerili***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
Almaco Jack	***Seriola rivoliana***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
SNAPPERS	**LUTJANIDAE**							
Mutton Snapper	*Lutjanus analis*	4 / 2.9	0	1 / 1 / 100	0	1 / 0.8 / 42	0	2 / 1.1 / 57.9

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Gray Snapper	*Lutjanus griseus*	37 / 24.6	8 / 6.8 / 62.3	0	7 / 4.1 / 37.6	3 / 2.4 / 18	1 / 1 / 7.2	18 / 10.2 / 74.6
Lane Snapper	***Lutjanus synagris***	30 / 17.5	0	0	30 / 17.5 / 100	0	0	0
Yellowtail Snapper	*Ocyurus chrysurus*	821 / 578.2	31 / 26.3 / 24.9	19 / 19 / 17.9	103 / 60.3 / 57.1	137 / 113 / 23.9	133 / 133 / 28.1	398 / 226.4 / 47.9
GRUNTS	**HAEMULIDAE**							
Black Margate	*Anisotremus surinamensis*	4 / 2.7	0	0	1 / 0.5 / 100	0	1 / 1 / 46.7	2 / 1.1 / 53.2
Porkfish	*Anisotremus virginicus*	381 / 285.2	24 / 20.4 / 32.6	8 / 8 / 12.8	58 / 34 / 54.4	62 / 51.1 / 22.9	96 / 96 / 43	133 / 75.6 / 33.9
White Margate	***Haemulon album***	1 / 0.8	1 / 0.8 / 100	0	0	0	0	0
Tomtate	*Haemulon aurolineatum*	128 / 118	16 / 13.6 / 100	0	0	36 / 29.7 / 28.4	73 / 73 / 69.9	3 / 1.7 / 1.6
Caesar Grunt	*Haemulon carbonarium*	638 / 483.7	81 / 68.8 / 34.2	70 / 70 / 34.8	106 / 62.1 / 30.9	113 / 93.2 / 32.9	86 / 86 / 30.4	182 / 103.5 / 36.6
Smallmouth Grunt	*Haemulon chrysargyreum*	10 / 5.9	0	0	0	1 / 0.8 / 13.8	0	9 / 5.1 / 86.1
French Grunt	*Haemulon flavolineatum*	2735 / 2107	237 / 201.4 / 32.6	198 / 198 / 32.1	370 / 216.8 / 35.1	717 / 591.5 / 39.6	485 / 485 / 32.5	728 / 414.2 / 27.7
Spanish Grunt	***Haemulon macrostomum***	2 / 2	0	1 / 1 / 100	0	0	1 / 1 / 100	0
Sailor's Choice	*Haemulon parra*	2 / 1.3	0	0	0	1 / 0.8 / 59.1	0	1 / 0.5 / 40.8
White Grunt	*Haemulon plumierii*	252 / 190.5	31 / 26.3 / 31.2	28 / 28 / 33.2	51 / 29.8 / 35.4	54 / 44.5 / 41.9	27 / 27 / 25.4	61 / 34.7 / 32.6
Bluestriped Grunt	*Haemulon sciurus*	142 / 105.4	4 / 3.4 / 17.2	4 / 4 / 20.2	21 / 12.3 / 62.4	45 / 37.1 / 43.3	23 / 23 / 26.8	45 / 25.6 / 29.8
Juvenile Grunts	*Haemulon* spp.	440 / 326.9	53 / 45 / 60.6	11 / 11 / 14.8	31 / 18.1 / 24.4	52 / 42.9 / 16.9	100 / 100 / 39.5	193 / 109.8 / 43.4
PORGIES	**SPARIDAE**							
Jolthead Porgy	***Calamus bajonado***	6 / 3.4	0	0	2 / 1.1 / 100	0	0	4 / 2.2 / 100
Saucereye Porgy	*Calamus calamus*	6 / 5	1 / 0.8 / 34.8	1 / 1 / 41	1 / 0.5 / 24	0	2 / 2 / 77.8	1 / 0.5 / 22.1
Sheepshead Porgy	*Calamus penna*	13 / 7.8	0	1 / 1 / 100	0	0	0	12 / 6.8 / 100
Silver Porgy	*Diplodus argenteus*	9 / 7.7	0	0	0	7 / 5.7 / 74.2	2 / 2 / 25.7	0
DRUMS	**SCIAENIDAE**							
Jackknife	***Equetus lanceolatus***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
Spotted Drum	***Equetus punctatus***	1 / 0.5	0	0	0	0	0	1 / 0.5 / 100
Cubbyu	***Equetus umbrosus***	1 / 0.5	0	0	1 / 0.5 / 100	0	0	0
Highhat	*Pareques acuminatus*	40 / 31.6	7 / 5.9 / 65.2	2 / 2 / 21.9	2 / 1.1 / 12.8	15 / 12.3 / 55	5 / 5 / 22.2	9 / 5.1 / 22.7

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
GOATFISHES	**MULLIDAE**							
Spotted Goatfish	*Pseudupeneus maculatus*	175 / 126.6	18 / 15.3 / 32.9	10 / 10 / 21.5	36 / 21.1 / 45.4	40 / 33 / 41	16 / 16 / 19.9	55 / 31.2 / 38.9
SEA CHUBS	**KYPHOSIDAE**							
Bermuda Sea Chub	*Kyphosus sectatrix*	317 / 223.4	1 / 0.8 / 2	6 / 6 / 14.4	59 / 34.5 / 83.4	84 / 69.3 / 38	41 / 41 / 22.5	126 / 71.6 / 39.3
BUTTERFLYFISHES	**CHAETODONTIDAE**							
Foureye Butterflyfish	*Chaetodon capistratus*	150 / 114.5	13 / 11 / 34.3	10 / 10 / 31	19 / 11.1 / 34.6	31 / 25.5 / 31	30 / 30 / 36.4	47 / 26.7 / 32.4
Spotfin Butterflyfish	*Chaetodon ocellatus*	69 / 49.8	4 / 3.4 / 22	5 / 5 / 32.3	12 / 7 / 45.5	16 / 13.2 / 38.3	7 / 7 / 20.3	25 / 14.2 / 41.3
Reef Butterflyfish	*Chaetodon sedentarius*	232 / 177.6	27 / 22.9 / 35.1	20 / 20 / 30.6	38 / 22.2 / 34.1	45 / 37.1 / 33	40 / 40 / 35.5	62 / 35.2 / 31.3
Banded Butterflyfish	*Chaetodon striatus*	31 / 22.7	1 / 0.8 / 12.6	0	10 / 5.8 / 87.3	8 / 6.6 / 41.2	6 / 6 / 37.4	6 / 3.4 / 21.3
ANGELFISHES	**POMACANTHIDAE**							
Blue Angelfish	*Holacanthus bermudensis*	62 / 48.5	6 / 5.1 / 30.3	7 / 7 / 41.6	8 / 4.6 / 27.9	11 / 9 / 28.5	13 / 13 / 40.9	17 / 9.6 / 30.4
Queen Angelfish	*Holacanthus ciliaris*	27 / 20.2	5 / 4.2 / 43.5	2 / 2 / 20.4	6 / 3.5 / 36	3 / 2.4 / 23.6	4 / 4 / 38.2	7 / 3.9 / 38
Townsend Angelfish	*Holacanthus townsendi*	2 / 1.4	0	0	1 / 0.5 / 100	1 / 0.8 / 100	0	0
Rock Beauty	*Holacanthus tricolor*	84 / 63.4	8 / 6.8 / 27.6	9 / 9 / 36.5	15 / 8.7 / 35.7	16 / 13.2 / 33.9	12 / 12 / 30.8	24 / 13.6 / 35.1
Gray Angelfish	*Pomacanthus arcuatus*	87 / 61.7	6 / 5.1 / 31.9	5 / 5 / 31.3	10 / 5.8 / 36.7	17 / 14 / 30.6	9 / 9 / 19.6	40 / 22.7 / 49.7
French Angelfish	*Pomacanthus paru*	67 / 48.5	5 / 4.2 / 26.4	3 / 3 / 18.6	15 / 8.7 / 54.8	14 / 11.5 / 35.5	9 / 9 / 27.6	21 / 11.9 / 36.7
DAMSELFISHES	**POMACENTRIDAE**							
Sergeant Major	*Abudefduf saxatilis*	664 / 497.1	47 / 39.9 / 28.8	45 / 45 / 32.5	91 / 53.3 / 38.5	166 / 136.9 / 38.1	99 / 99 / 27.5	216 / 122.8 / 34.2
Blue Chromis	*Chromis cyanea*	619 / 456.8	52 / 44.2 / 25.8	68 / 68 / 39.8	100 / 58.6 / 34.3	138 / 113.8 / 39.7	55 / 55 / 19.2	206 / 117.2 / 40.9
Yellowtail Reeffish	***Chromis enchrysura***	2 / 1.1	0	0	1 / 0.5 / 100	0	0	1 / 0.5 / 100
Sunshinefish	*Chromis insolata*	522 / 400.4	42 / 35.7 / 28.8	50 / 50 / 40.3	65 / 38.1 / 30.7	138 / 113.8 / 41.1	78 / 78 / 28.1	149 / 84.7 / 30.6
Brown Chromis	*Chromis multilineata*	582 / 440.4	30 / 25.5 / 27	29 / 29 / 30.7	68 / 39.8 / 42.2	157 / 129.5 / 37.4	109 / 109 / 31.4	189 / 107.5 / 31
Purple Reeffish	*Chromis scotti*	228 / 180.9	13 / 11 / 17.8	32 / 32 / 51.7	32 / 18.7 / 30.3	54 / 44.5 / 37.3	45 / 45 / 37.7	52 / 29.5 / 24.8
Yellowtail Damselfish	*Microspathodon chrysurus*	6 / 4.3	3 / 2.5 / 59.1	0	3 / 1.7 / 40.8	0	0	0
Dusky Damselfish	*Stegastes adustus*	188 / 147.2	31 / 26.3 / 38.6	23 / 23 / 33.7	32 / 18.7 / 27.5	42 / 34.6 / 43.7	24 / 24 / 30.3	36 / 20.4 / 25.8
Longfin Damselfish	*Stegastes diencaeus*	35 / 25.9	10 / 8.5 / 41.8	3 / 3 / 14.7	15 / 8.7 / 43.3	3 / 2.4 / 44	2 / 2 / 35.6	2 / 1.1 / 20.2

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Beaugregory	*Stegastes leucostictus*	220 / 172.6	39 / 33.1 / 32.6	45 / 45 / 44.2	40 / 23.4 / 23	34 / 28 / 39.4	18 / 18 / 25.3	44 / 25 / 35.2
Bicolor Damselfish	*Stegastes partitus*	5624 / 4236.3	495 / 420.7 / 34.2	304 / 304 / 24.7	857 / 502.3 / 40.9	1543 / 1272.9 / 42.3	827 / 827 / 27.4	1598 / 909.2 / 30.2
Threespot Damselfish	*Stegastes planifrons*	17 / 14.4	7 / 5.9 / 69.7	2 / 2 / 23.4	1 / 0.5 / 6.8	1 / 0.8 / 13.8	4 / 4 / 67	2 / 1.1 / 19
Cocoa Damslefish	*Stegastes variabilis*	476 / 351.8	64 / 54.4 / 29.9	56 / 56 / 30.7	122 / 71.5 / 39.3	58 / 47.8 / 28.1	51 / 51 / 30	125 / 71.1 / 41.8
WRASSES	**LABRIDAE**							
Spotfin Hogfish	***Bodianus pulchellus***	3 / 3	0	0	0	0	3 / 3 / 100	0
Spanish Hogfish	*Bodianus rufus*	75 / 60.7	7 / 5.9 / 28.2	11 / 11 / 52.2	7 / 4.1 / 19.4	22 / 18.1 / 45.7	13 / 13 / 32.7	15 / 8.5 / 21.5
Creole Wrasse	*Clepticus parrae*	1316 / 1115.1	70 / 59.5 / 19.4	191 / 191 / 62.3	95 / 55.6 / 18.1	240 / 198 / 24.4	467 / 467 / 57.7	253 / 143.9 / 17.7
Slippery Dick	*Halichoeres bivittatus*	863 / 634.7	127 / 107.9 / 33.1	85 / 85 / 26	227 / 133 / 40.8	129 / 106.4 / 34.4	80 / 80 / 25.9	215 / 122.3 / 39.6
Yellowcheek Wrasse	*Halichoeres cyanocephalus*	27 / 19.5	6 / 5.1 / 57.5	2 / 2 / 22.5	3 / 1.7 / 19.8	3 / 2.4 / 23	2 / 2 / 18.6	11 / 6.2 / 58.3
Yellowhead Wrasse	*Halichoeres garnoti*	1412 / 1114.7	304 / 258.4 / 40.3	222 / 222 / 34.6	274 / 160.6 / 25	258 / 212.8 / 44.9	138 / 138 / 29.1	216 / 122.8 / 25.9
Clown Wrasse	*Halichoeres maculipinna*	1247 / 938.7	173 / 147 / 33.4	132 / 132 / 29.9	275 / 161.2 / 36.6	165 / 136.1 / 27.3	178 / 178 / 35.7	324 / 184.3 / 36.9
Rainbow Wrasse	*Halichoeres pictus*	51 / 41.2	0	0	0	14 / 11.5 / 28	20 / 20 / 48.5	17 / 9.6 / 23.4
Blackear Wrasse	*Halichoeres poeyi*	50 / 36.7	10 / 8.5 / 31.1	10 / 10 / 36.6	15 / 8.7 / 32.2	2 / 1.6 / 17.4	1 / 1 / 10.5	12 / 6.8 / 72
Puddingwife	*Halichoeres radiatus*	50 / 35.6	3 / 2.5 / 20.9	2 / 2 / 16.4	13 / 7.6 / 62.6	9 / 7.4 / 31.5	7 / 7 / 29.7	16 / 9.1 / 38.6
Hogfish	*Lachnolaimus maximus*	42 / 28	2 / 1.7 / 7.6	3 / 3 / 13.4	30 / 17.5 / 78.9	2 / 1.6 / 28.5	3 / 3 / 51.8	2 / 1.1 / 19.6
Bluehead Wrasse	*Thalassoma bifasciatum*	6620 / 4947.8	714 / 606.9 / 29.5	690 / 690 / 33.5	1294 / 758.5 / 36.9	1339 / 1104.6 / 38.1	738 / 738 / 25.5	1845 / 1049.7 / 36.2
Green Razorfish	*Xyrichtys splendens*	8 / 6.8	2 / 1.7 / 24.7	4 / 4 / 58.2	2 / 1.1 / 17	0	0	0
PARROTFISHES	**SCARIDAE**							
Bluelip Parrotfish	*Cryptotomus roseus*	333 / 248.9	65 / 55.2 / 43.6	35 / 35 / 27.6	62 / 36.3 / 28.7	61 / 50.3 / 41.1	22 / 22 / 17.9	88 / 50 / 40.9
Parrotfish species	*Scaridae* spp.	1 / 0.5	0	0	0	0	0	1 / 0.5 / 100
Midnight Parrotfish	*Scarus coelestinus*	3 / 2.1	0	0	1 / 0.5 / 100	0	1 / 1 / 63.7	1 / 0.5 / 36.2
Blue Parrotfish	*Scarus coeruleus*	4 / 3.6	1 / 0.8 / 45.9	1 / 1 / 54	0	1 / 0.8 / 45.2	1 / 1 / 54.7	0
Rainbow Parrotfish	*Scarus guacamaia*	14 / 8.9	0	1 / 1 / 100	0	2 / 1.6 / 20.8	0	11 / 6.2 / 79.1
Striped Parrotfish	*Scarus iseri*	800 / 615	106 / 90.1 / 30.4	113 / 113 / 38.2	158 / 92.6 / 31.3	137 / 113 / 35.3	101 / 101 / 31.6	185 / 105.2 / 32.9

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Princess Parrotfish	*Scarus taeniopterus*	572 / 414	48 / 40.8 / 24.6	47 / 47 / 28.3	133 / 77.9 / 47	96 / 79.2 / 31.8	65 / 65 / 26.1	183 / 104.1 / 41.9
Queen Parrotfish	*Scarus vetula*	63 / 47.1	3 / 2.5 / 53.9	1 / 1 / 21.1	2 / 1.1 / 24.8	19 / 15.6 / 36.9	12 / 12 / 28.2	26 / 14.7 / 34.8
Greenblotch Parrotfish	*Sparisoma atomarium*	447 / 339.9	67 / 56.9 / 29.6	63 / 63 / 32.8	123 / 72.1 / 37.5	64 / 52.8 / 35.7	49 / 49 / 33.1	81 / 46 / 31.1
Redband Parrotfish	*Sparisoma aurofrenatum*	2182 / 1662.3	304 / 258.4 / 35.9	234 / 234 / 32.5	386 / 226.2 / 31.4	397 / 327.5 / 34.7	293 / 293 / 31	568 / 323.1 / 34.2
Redtail Parrotfish	*Sparisoma chrysopterum*	87 / 66.6	2 / 1.7 / 25.6	2 / 2 / 30.1	5 / 2.9 / 44.2	29 / 23.9 / 39.8	19 / 19 / 31.6	30 / 17 / 28.4
Bucktooth Parrotfish	*Sparisoma radians*	253 / 194.7	40 / 34 / 29.2	36 / 36 / 30.9	79 / 46.3 / 39.8	48 / 39.6 / 50.5	24 / 24 / 30.6	26 / 14.7 / 18.8
Redfin Parrotfish	*Sparisoma rubripinne*	48 / 38.4	1 / 0.8 / 8.6	6 / 6 / 61.3	5 / 2.9 / 29.9	27 / 22.2 / 77.6	3 / 3 / 10.4	6 / 3.4 / 11.8
Stoplight Parrotfish	*Sparisoma viride*	309 / 234.1	47 / 39.9 / 34.2	38 / 38 / 32.5	66 / 38.6 / 33.1	39 / 32.1 / 27.3	41 / 41 / 34.8	78 / 44.3 / 37.7
COMBTOOTH BLENNIES	**BLENNIDAE**							
Barred Blenny	*Hypleurochilus bermudensis*	2 / 1.5	0	1 / 1 / 63	1 / 0.5 / 36.9	0	0	0
Redlip Blenny	*Ophioblennius macclurei*	2 / 1.3	0	0	0	1 / 0.8 / 59.1	0	1 / 0.5 / 40.8
Seaweed Blenny	*Parablennius marmoreus*	79 / 60.8	18 / 15.3 / 36.1	10 / 10 / 23.6	29 / 17 / 40.1	10 / 8.2 / 44.5	8 / 8 / 43.1	4 / 2.2 / 12.2
CLINIDS	**CLINIDAE**							
Hairy Blenny	***Labrisomus nuchipinnis***	4 / 3.4	4 / 3.4 / 100	0	0	0	0	0
Rosy Blenny	*Malacoctenus macropus*	87 / 67.3	26 / 22.1 / 40.9	16 / 16 / 29.6	27 / 15.8 / 29.3	4 / 3.3 / 24.5	5 / 5 / 37.2	9 / 5.1 / 38.1
Saddled Blenny	*Malacoctenus triangulatus*	82 / 61.7	22 / 18.7 / 39.2	12 / 12 / 25.1	29 / 17 / 35.6	6 / 4.9 / 35.1	4 / 4 / 28.4	9 / 5.1 / 36.3
Banded Blenny	***Paraclinus fasciatus***	1 / 1	0	1 / 1 / 100	0	0	0	0
TUBE BLENNIES	**CHAENOPSIDAE**							
Roughhead Blenny	*Acanthemblemaria aspera*	10 / 7.7	4 / 3.4 / 43.9	2 / 2 / 25.8	4 / 2.3 / 30.2	0	0	0
Sailfin Blenny	*Emblemaria pandionis*	5 / 4.1	0	2 / 2 / 63	2 / 1.1 / 36.9	0	1 / 1 / 100	0
GOBIES	**GOBIIDAE**							
Colon Goby	*Coryphopterus dicrus*	50 / 37.6	9 / 7.6 / 22.4	13 / 13 / 38	23 / 13.4 / 39.5	1 / 0.8 / 23.3	1 / 1 / 28.3	3 / 1.7 / 48.3
Bridled Goby	*Coryphopterus glaucofraenum*	266 / 211.5	91 / 77.3 / 44.8	53 / 53 / 30.7	72 / 42.2 / 24.4	21 / 17.3 / 44.4	12 / 12 / 30.7	17 / 9.6 / 24.8
Masked/Glass Goby	*Coryphopterus hyalinus/personatus*	14055 / 9954	1381 / 1173.8 / 20.9	1140 / 1140 / 20.3	5605 / 3285.6 / 58.6	2034 / 1678 / 38.5	1068 / 1068 / 24.5	2827 / 1608.4 / 36.9
Spotted Goby	***Coryphopterus punctipectophorus***	1 / 0.5	0	0	1 / 0.5 / 100	0	0	0

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Dash Goby	*Ctenogobius saepepallens*	11 / 8.1	5 / 4.2 / 55.9	1 / 1 / 13.1	4 / 2.3 / 30.8	0	0	1 / 0.5 / 100
Neon Goby	*Elacatinus oceanops*	32 / 22.2	1 / 0.8 / 6.8	4 / 4 / 32	13 / 7.6 / 61.1	2 / 1.6 / 16.8	3 / 3 / 30.7	9 / 5.1 / 52.4
Goldspot Goby	*Gnatholepis thompsoni*	117 / 98.9	22 / 18.7 / 31.3	31 / 31 / 51.9	17 / 9.9 / 16.7	34 / 28 / 71.3	9 / 9 / 22.8	4 / 2.2 / 5.7
Code Goby	*Gobiosoma robustum*	3 / 2.8	1 / 0.8 / 29.8	2 / 2 / 70.1	0	0	0	0
Blue Goby	*Ptereleotris calliura*	3 / 2.4	1 / 0.8 / 34.8	1 / 1 / 41	1 / 0.5 / 24	0	0	0
SPADEFISHES	**EPHIPPIDAE**							
Atlantic Spadefish	*Chaetodipterus faber*	37 / 33.1	0	0	6 / 3.5 / 100	3 / 2.4 / 8.3	26 / 26 / 87.7	2 / 1.1 / 3.8
SURGEONFISHES	**ACANTHURIDAE**							
Ocean surgeon	*Acanthurus bahianus*	3157 / 2418.3	404 / 343.4 / 37.4	241 / 241 / 26.2	568 / 332.9 / 36.2	625 / 515.6 / 34.3	545 / 545 / 36.3	774 / 440.3 / 29.3
Doctorfish	*Acanthurus chirurgus*	649 / 477.9	51 / 43.3 / 22.2	59 / 59 / 30.2	158 / 92.6 / 47.5	85 / 70.1 / 24.7	103 / 103 / 36.4	193 / 109.8 / 38.8
Blue Tang	*Acanthurus coeruleus*	483 / 379.4	59 / 50.1 / 48.8	25 / 25 / 24.3	47 / 27.5 / 26.8	85 / 70.1 / 25.3	127 / 127 / 45.8	140 / 79.6 / 28.7
MACKERELS	**SCOMBRIDAE**							
Cero	*Scomberomoros regalis*	36 / 26.1	6 / 5.1 / 28.7	5 / 5 / 28.2	13 / 7.6 / 43	3 / 2.4 / 29.2	2 / 2 / 23.6	7 / 3.9 / 47
King Mackerel	***Scomberomorous cavalla***	1 / 1	0	0	0	0	1 / 1 / 100	0
TRIGGERFISHES	**BALISTIDAE**							
Gray Triggerfish	*Balistes capriscus*	23 / 16.2	3 / 2.5 / 28.1	3 / 3 / 33	6 / 3.5 / 38.7	2 / 1.6 / 22.9	1 / 1 / 13.8	8 / 4.5 / 63.2
Ocean Triggerfish	***Canthidermis sufflamen***	1 / 0.8	0	0	0	1 / 0.8 / 100	0	0
FILEFISHES	**MONACANTHIDAE**							
Unicorn Filefish	*Aluterus monoceros*	3 / 2.1	0	0	0	0	1 / 1 / 46.7	2 / 1.1 / 53.2
Orange Filefish	***Aluterus schoepfi***	2 / 1.1	0	0	0	0	0	2 / 1.1 / 100
Scrawled Filefish	*Aluterus scriptus*	79 / 61.1	2 / 1.7 / 19.3	3 / 3 / 34	7 / 4.1 / 46.6	17 / 14 / 26.7	23 / 23 / 43.9	27 / 15.3 / 29.3
Orangespotted Filefish	*Cantherhines pullus*	50 / 39.3	6 / 5.1 / 34.4	5 / 5 / 33.8	8 / 4.6 / 31.7	12 / 9.9 / 40.2	9 / 9 / 36.6	10 / 5.6 / 23.1
Fringed Filefish	*Monacanthus ciliatus*	2 / 1.4	0	0	1 / 0.5 / 100	1 / 0.8 / 100	0	0
Slender Filefish	***Monacanthus tuckeri***	1 / 1	0	0	0	0	1 / 1 / 100	0
Planehead Filefish	***Stephanolepis hispidus***	1 / 0.5	0	0	1 / 0.5 / 100	0	0	0
BOXFISHES	**OSTRACIIDAE**							

Table 1 (continued)

Species List			Transects			Point Counts		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Honeycomb Cowfish	*Acanthostracion polygonius*	5 / 4.3	2 / 1.7 / 100	0	0	2 / 1.6 / 62.2	1 / 1 / 37.7	0
Scrawled Cowfish	***Acanthostracion quadricornis***	2 / 1.1	0	0	1 / 0.5 / 100	0	0	1 / 0.5 / 100
Spotted Trunkfish	*Lactophrys bicaudalis*	11 / 8.8	1 / 0.8 / 59.1	0	1 / 0.5 / 40.8	4 / 3.3 / 44.3	3 / 3 / 40.3	2 / 1.1 / 15.2
Smooth Trunkfish	*Lactophrys triqueter*	19 / 13.9	1 / 0.8 / 21.1	2 / 2 / 49.7	2 / 1.1 / 29.1	6 / 4.9 / 49.8	1 / 1 / 10	7 / 3.9 / 40
PUFFERS	**TETRAODONTIDAE**							
Sharpnose Puffer	*Canthigaster rostrata*	716 / 559.7	134 / 113.9 / 35.1	108 / 108 / 33.3	174 / 102 / 31.4	98 / 80.8 / 34.2	93 / 93 / 39.4	109 / 62 / 26.2
Bandtail Puffer	*Sphoeroides spengleri*	5 / 3.3	0	0	0	2 / 1.6 / 49.1	0	3 / 1.7 / 50.8
PORCUPINEFISHES	**DIODONTIDAE**							
Striped Burrfish	*Chilomycterus schoepfi*	9 / 8.1	0	0	0	0	7 / 7 / 86	2 / 1.1 / 13.9
Balloonfish	*Diodon holocanthus*	34 / 24.7	5 / 4.2 / 25.1	5 / 5 / 29.6	13 / 7.6 / 45.1	3 / 2.4 / 31.3	2 / 2 / 25.3	6 / 3.4 / 43.2
Porcupinefish	*Diodon hystrix*	9 / 6.4	0	0	0	2 / 1.6 / 25.4	2 / 2 / 30.7	5 / 2.8 / 43.8
	Total Abundance	**60588 / 44432.5**	**6106 / 5190.1**	**4885 / 4885**	**13482 / 7903.2**	**10715 / 8839.8**	**7354 / 7354**	**18046 / 10267.5**
	Total Species	**151**	**97**	**93**	**108**	**109**	**98**	**107**
	Mean Density (Fish/m^2 ± SEM)	**-**	**0.56 ± 0.16**	**0.53 ± 0.16**	**0.86 ± 0.38**	**0.33 ± 0.09**	**0.27 ± 0.07**	**0.38 ± 0.11**
	Total # of shaded cells	**-**	**35**	**32**	**57**	**49**	**32**	**50**

Table 2. Mean fish per count by quarter, power state, and count type (±SEM).

	Transects			Point-counts		
	AC	**DC**	**OFF**	**AC**	**DC**	**OFF**
Quarter 1	145.3 ±43.9	n/a	218.5 ±59	239.2 ±51.3	n/a	239.2 ±34.4
Quarter 2	250.8 ±43.3	225.8 ±60.7	559.3 ±182	376.3 ±80.4	389.4 ±114.6	466.4 ±126.1
Quarter 3	160 ±31.5	166.2 ±22.2	201.4 ±32.5	343 ±70.6	284.5 ±78.5	475.1 ±127.4
Quarter 4	134.6 ±21.1	107.5 ±18.2	106.1 ±12.5	216.1 ±33.9	183.1 ±24.9	167.2 ±17.4
Quarter 5	120 ±17.2	127.8 ±22.7	130 ±15.1	233.6 ±45.2	150.3 ±12.6	212.6 ±43.8
Mean	152.9 ±13.8	144.7 ±15.7	234.9 ±43.9	281.6 ±24.6	251.8 ±27.1	312.1 ±41.7

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Appendix 1. Fish abundance by count type and power state for Quarter 2 (July 2014). Numbers in each column represent the combined total number of fishes observed from all surveys completed within each power state.

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
STINGRAYS	**DASYATIDAE**																			
Southern stingray	*Dasyatis americana*	1				1														
Yellow stingray	*Urobatis jamaicensis*	1																		1
MORAY EELS	**MURAENIDAE**																			
Goldentail moray	*Gymnothorax miliaris*	1									1									
Spotted moray	*Gymnothorax moringa*	0																		
LIZARDFISHES	**SYNODONTIDAE**																			
Inshore lizardfish	*Synodus foetens*	0																		
Sand diver	*Synodus intermedius*	0																		
FLYINGFISHES	**EXOCOETIDAE**																			
Ballyhoo	*Hemiramphus brasiliensis*	0																		
TRUMPETFISHES	**AULOSTOMIDAE**																			
Trumpetfish	*Aulostomus maculatus*	0																		
SCORPIONFISHES	**SCORPAENIDAE**																			
Red lionfish	*Pterois volitans*	0																		
Spotted scorpionfish	*Scorpaena plumieri*	1				1														
SEA BASSES	**SERRANIDAE**																			
Graysby	*Cephalopholis cruentata*	11				1			3		2			1	1			1		2
Coney	*Cephalopholis fulvus*	2																1		1
Rock hind	*Epinephelus adscensionis*	1										1								
Red grouper	*Epinephelus morio*	0																		
Blue hamlet	*Hypoplectrus gemma*	4									1						1	2		

Appendix 1 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Shy hamlet	*Hypoplectrus guttavarius*	0																		
Hamlet juvenile	*Hypoplectrus* spp.	0																		
Butter hamlet	*Hypoplectrus unicolor*	8				2		2			1				1		1	1		
Orangeback bass	*Serranus annularis*	0																		
Lantern bass	*Serranus baldwini*	2				1			1											
Tobaccofish	*Serranus tabacarius*	0																		
Harlequin bass	*Serranus tigrinus*	15				1		2	4						5		1			2
JAWFISHES	**OPISTOGNATHIDAE**																			
Yellowhead jawfish	*Opistognathus aurifrons*	0																		
Dusky jawfish	*Opistognathus whitehursti*	0																		
CARDINALFISHES	**APOGONIDAE**																			
Flamefish	*Apogon maculatus*	0																		
Dusky cardinalfish	*Phaeoptyx pigmentaria*	0																		
TILEFISHES	**MALACANTHIDAE**																			
Sand tilefish	*Malacanthus plumieri*	0																		
REMORAS	**ECHENEIDAE**																			
Sharksucker	*Echeneis naucrates*	0																		
JACKS	**CARANGIDAE**																			
Yellow jack	*Carangoides bartholomaei*	0																		
Blue runner	*Caranx crysos*	0																		
Bar jack	*Caranx ruber*	2															1	1		
Mackerel scad	*Decapterus macarellus*	0																		
Round scad	*Decapterus punctatus*	0																		

Appendix 1 (continued)

Species List			Transects									Point-counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Rainbow runner	*Elagatis bipinnulata*	0																		
Greater amberjack	*Seriola dumerili*	0																		
Almaco jack	*Seriola rivoliana*	0																		
SNAPPERS	**LUTJANIDAE**																			
Mutton snapper	*Lutjanus analis*	1																		1
Gray snapper	*Lutjanus griseus*	32	5		7							2		18						
Lane snapper	*Lutjanus synagris*	0																		
Yellowtail snapper	*Ocyurus chrysurus*	23						4				2		1	3		13			
GRUNTS	**HAEMULIDAE**																			
Black margate	*Anisotremus surinamensis*	0																		
Porkfish	*Anisotremus virginicus*	76	8		9						1	27		22	4		1			4
White margate	*Haemulon album*	0																		
Tomtate	*Haemulon aurolineatum*	15				15														
Caesar grunt	*Haemulon carbonarium*	9	9																	
Smallmouth grunt	*Haemulon chrysargyreum*	0																		
French grunt	*Haemulon flavolineatum*	207	33		34	3		11				29		50	34		13			
Spanish grunt	*Haemulon macrostomum*	0																		
Sailor's choice	*Haemulon parra*	0																		
White grunt	*Haemulon plumierii*	31	2		1			1	2		6	5		4	3		1	2		4
Bluestriped grunt	*Haemulon sciurus*	44			4							16		23			1			
Juvenile grunts	*Haemulon* spp.	38						30						8						
PORGIES	**SPARIDAE**																			
Jolthead porgy	*Calamus bajonado*	4																		4

Appendix 1 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Saucereye porgy	*Calamus calamus*	0																		
Sheepshead porgy	*Calamus penna*	12															12			
Silver porgy	*Diplodus argenteus*	0																		
DRUMS	**SCIAENIDAE**																			
Jackknife	*Equetus lanceolatus*	0																		
Spotted drum	*Equetus punctatus*	0																		
Cubbyu	*Equetus umbrosus*	1									1									
Highhat	*Pareques acuminatus*	6	1		1										3			1		
GOATFISHES	**MULLIDAE**																			
Spotted goatfish	*Pseudupeneus maculatus*	54	1		1	3		3	1		7	1		1	6		6	3		21
SEA CHUBS	**KYPHOSIDAE**																			
Bermuda sea chub	*Kyphosus sectatrix*	103			33							40		30						
BUTTERFLYFISHES	**CHAETODONTIDAE**																			
Foureye butterflyfish	*Chaetodon capistratus*	13	2					2				1			1			3		4
Spotfin butterflyfish	*Chaetodon ocellatus*	10				1		2	2						2		2	1		
Reef butterflyfish	*Chaetodon sedentarius*	30				1		3	4		5				2		3	7		5
Banded butterflyfish	*Chaetodon striatus*	1				1														
ANGELFISHES	**POMACANTHIDAE**																			
Blue angelfish	*Holacanthus bermudensis*	0																		
Queen angelfish	*Holacanthus ciliaris*	1				1														
Townsend angelfish	*Holacanthus townsendi*	1																1		
Rock beauty	*Holacanthus tricolor*	14							3		5				1		1	1		3
Gray angelfish	*Pomacanthus arcuatus*	2															1	1		

Appendix 1 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	Scientific Name	Total	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF
French angelfish	*Pomacanthus paru*	6			1									3				2		
DAMSELFISHES	**POMACENTRIDAE**																			
Sergeant major	*Abudefduf saxatilis*	56				3		3				10		13	27					
Blue chromis	*Chromis cyanea*	92							3		32						4	13		40
Yellowtail reeffish	*Chromis enchrysura*	1																		1
Sunshinefish	*Chromis insolata*	22						1									6	15		
Brown chromis	*Chromis multilineata*	104				15		12	4		25				1		17	5		25
Purple reeffish	*Chromis scotti*	13				1		4							4		4			
Yellowtail damselfish	*Microspathodon chrysurus*	3				3														
Dusky damselfish	*Stegastes adustus*	7				3		4												
Longfin damselfish	*Stegastes diencaeus*	17	6		6			1				3					1			
Beaugregory	*Stegastes leucostictus*	13				1		3	1		1				4			1		2
Bicolor damselfish	*Stegastes partitus*	580			8	14		41	51		90	1			82		53	135		105
Threespot damselfish	*Stegastes planifrons*	2				2														
Cocoa damslefish	*Stegastes variabilis*	83	18		9	2		3	1			21		27	2					
WRASSES	**LABRIDAE**																			
Spotfin hogfish	*Bodianus pulchellus*	0																		
Spanish hogfish	*Bodianus rufus*	6			1						1				1			2		1
Creole wrasse	*Clepticus parrae*	50							20									30		
Slippery dick	*Halichoeres bivittatus*	159	41		22	6		16				40		16			18			
Yellowcheek wrasse	*Halichoeres cyanocephalus*	0																		
Yellowhead wrasse	*Halichoeres garnoti*	152				15		19	34		12	1			9		14	31		17
Clown wrasse	*Halichoeres maculipinna*	73	6		2	14		8			5	10		12	7		7			2

Appendix 1 (continued)

Species List			Transects									Point-counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	Scientific Name	Total	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF
Rainbow wrasse	*Halichoeres pictus*	0																		
Blackear wrasse	*Halichoeres poeyi*	7	1					3						2			1			
Puddingwife	*Halichoeres radiatus*	9			1	2		1				3		2						
Hogfish	*Lachnolaimus maximus*	3						1										2		
Bluehead wrasse	*Thalassoma bifasciatum*	749	29		11	27		24	42		74	119		90	15		46	156		116
Green razorfish	*Xyrichtys splendens*	0																		
PARROTFISHES	**SCARIDAE**																			
Bluelip parrotfish	*Cryptotomus roseus*	67	7			7		2	20		6			1	6		1	13		4
Parrotfish species	*Scaridae* spp.	1															1			
Midnight parrotfish	*Scarus coelestinus*	0																		
Blue parrotfish	*Scarus coeruleus*	0																		
Rainbow parrotfish	*Scarus guacamaia*	0																		
Striped parrotfish	*Scarus iseri*	89	1			3		19	8		5	6		4	10		21	2		10
Princess parrotfish	*Scarus taeniopterus*	25						1	4		5				1		1	6		7
Queen parrotfish	*Scarus vetula*	0																		
Greenblotch parrotfish	*Sparisoma atomarium*	67				6		2	10		7	8						16		18
Redband parrotfish	*Sparisoma aurofrenatum*	199	6		8	12		10	11		9	19		5	28		29	43		19
Redtail parrotfish	*Sparisoma chrysopterum*	3																		3
Bucktooth parrotfish	*Sparisoma radians*	20				1		3	4									12		
Redfin parrotfish	*Sparisoma rubripinne*	2																1		1
Stoplight parrotfish	*Sparisoma viride*	6				2			2					1	1					
COMBTOOTH BLENNIES	**BLENNIDAE**																			
Barred blenny	*Hypleurochilus bermudensis*	0																		

Appendix 1 (continued)

Species List			Transects									Point-counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Redlip blenny	*Ophioblennius macclurei*	0																		
Seaweed blenny	*Parablennius marmoreus*	3	2									1								
SCALY BLENNIES	**LABRISOMIDAE**																			
Hairy blenny	*Labrisomus nuchipinnis*	0																		
Rosy blenny	*Malacoctenus macropus*	1	1																	
Saddled blenny	*Malacoctenus triangulatus*	6			1	2		2									1			
Banded blenny	*Paraclinus fasciatus*	0																		
TUBE BLENNIES	**CHAENOPSIDAE**																			
Roughhead blenny	*Acanthemblemaria aspera*	0																		
Sailfin blenny	*Emblemaria pandionis*	0																		
GOBIES	**GOBIIDAE**																			
Frillfin goby	*Bathygobius soporator*	0																		
Colon goby	*Coryphopterus dicrus*	0																		
Bridled goby	*Coryphopterus glaucofraenum*	5						1			3						1			
Masked/Glass goby	*Coryphopterus hyalinus/personatus*	1219				4		407	201		107				20		250	200		30
Spotted goby	*Coryphopterus punctipectophorus*	0																		
Dash goby	*Ctenogobius saepepallens*	0																		
Neon goby	*Elacatinus oceanops*	12						5									7			
Goldspot goby	*Gnatholepis thompsoni*	3						3												
Code goby	*Gobiosoma robustum*	0																		
Blue goby	*Ptereleotris calliura*	0																		

Appendix 1 (continued)

Species List		Total	Transects									Point-counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**		**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
SPADEFISHES	**EPHIPPIDAE**																			
Atlantic spadefish	*Chaetodipterus faber*	0																		
SURGEONFISHES	**ACANTHURIDAE**																			
Ocean surgeon	*Acanthurus bahianus*	221	42		16	11		27	6		7	23		25	14		22	7		21
Doctorfish	*Acanthurus chirurgus*	17			6	5						6								
Blue tang	*Acanthurus coeruleus*	52			3	2		1	1		6	6		15	3		6	4		5
MACKERELS	**SCOMBRIDAE**																			
Cero	*Scomberomorus regalis*	0																		
King mackerel	*Scomberomorus cavalla*	0																		
TRIGGERFISHES	**BALISTIDAE**																			
Gray triggerfish	*Balistes capriscus*	0																		
Ocean triggerfish	*Canthidermis sufflamen*	0																		
FILEFISHES	**MONACANTHIDAE**																			
Unicorn filefish	*Aluterus monoceros*	0																		
Orange filefish	*Aluterus schoepfi*	0																		
Scrawled filefish	*Aluterus scriptus*	7									2				2			1		2
Orangespotted filefish	*Cantherhines pullus*	1									1									
Fringed filefish	*Monacanthus ciliatus*	0																		
Slender filefish	*Monacanthus tuckeri*	0																		
Planehead filefish	*Stephanolepis hispidus*	0																		
BOXFISHES	**OSTRACIIDAE**																			
Honeycomb cowfish	*Acanthostracion polygonius*	0																		
Scrawled cowfish	*Acanthostracion quadricornis*	0																		

Appendix 1 (continued)

			Transects									Point-counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Spotted trunkfish	*Lactophrys bicaudalis*	0																		
Smooth trunkfish	*Lactophrys triqueter*	1																		1
PUFFERS	**TETRAODONTIDAE**																			
Sharpnose puffer	*Canthigaster rostrata*	42	2		1	3		4	8		6	1		4	4		6	3		
Bandtail puffer	*Sphoeroides spengleri*	0																		
PORCUPINEFISHES	**DIODONTIDAE**																			
Striped burrfish	*Chilomycterus schoepfi*	0																		
Balloonfish	*Diodon holocanthus*	0																		
Porcupinefish	*Diodon hystrix*	0																		
Total Abundance		5053	223	0	186	198	0	691	451	0	434	402	0	378	307	0	575	726	0	482
Total Species		155	21	0	23	39	0	40	27	0	30	27	0	25	33	0	38	37	0	33

Appendix 2. Fish abundance by count type and power state for Quarter 3 (September 2014). Numbers in each column represent the combined total number of fishes observed from all surveys completed within each power state.

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
STINGRAYS	**DASYATIDAE**																			
Southern stingray	*Dasyatis americana*	0																		
Yellow stingray	*Urobatis jamaicensis*	2			1						1									
MORAY EELS	**MURAENIDAE**																			
Goldentail moray	*Gymnothorax miliaris*	0																		
Spotted moray	*Gymnothorax moringa*	0																		
LIZARDFISHES	**SYNODONTIDAE**																			
Inshore lizardfish	*Synodus foetens*	0																		
Sand diver	*Synodus intermedius*	1				1														
FLYINGFISHES	**EXOCOETIDAE**																			
Ballyhoo	*Hemiramphus brasiliensis*	0																		
TRUMPETFISHES	**AULOSTOMIDAE**																			
Trumpetfish	*Aulostomus maculatus*	9							3	1	2			1						2
SCORPIONFISHES	**SCORPAENIDAE**																			
Red lionfish	*Pterois volitans*	0																		
Spotted scorpionfish	*Scorpaena plumieri*	5		1	2				1	1										
SEA BASSES	**SERRANIDAE**																			
Graysby	*Cephalopholis cruentata*	26		1					5	2	5					1	1	4		7
Coney	*Cephalopholis fulvus*	3																1		2
Rock hind	*Epinephelus adscensionis*	0																		
Red grouper	*Epinephelus morio*	0																		
Blue hamlet	*Hypoplectrus gemma*	4									1							1		2

Appendix 2 (continued)

			Transects									**Point-counts**								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Shy hamlet	*Hypoplectrus guttavarius*	3									2							1		
Hamlet juvenile	*Hypoplectrus* spp.	0																		
Butter hamlet	*Hypoplectrus unicolor*	23				1	2	7	1		1				2	1	3	1		4
Orangeback bass	*Serranus annularis*	1									1									
Lantern bass	*Serranus baldwini*	3					1		1	1										
Tobaccofish	*Serranus tabacarius*	0																		
Harlequin bass	*Serranus tigrinus*	16				2		2		1					1	2	2	2	1	3
JAWFISHES	**OPISTOGNATHIDAE**																			
Yellowhead jawfish	*Opistognathus aurifrons*	4								2	2									
Dusky jawfish	*Opistognathus whitehursti*	0																		
CARDINALFISHES	**APOGONIDAE**																			
Flamefish	*Apogon maculatus*	0																		
Dusky cardinalfish	*Phaeoptyx pigmentaria*	0																		
TILEFISHES	**MALACANTHIDAE**																			
Sand tilefish	*Malacanthus plumieri*	0																		
REMORAS	**ECHENEIDAE**																			
Sharksucker	*Echeneis naucrates*	0																		
JACKS	**CARANGIDAE**																			
Yellow jack	*Carangoides bartholomaei*	5														4		1		
Blue runner	*Caranx crysos*	2820							170		850							200		1600
Bar jack	*Caranx ruber*	276				20					1				23	82	150			
Mackerel scad	*Decapterus macarellus*	0																		
Round scad	*Decapterus punctatus*	0																		
Rainbow runner	*Elagatis bipinnulata*	0																		
Greater amberjack	*Seriola dumerili*	0																		

Appendix 2 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
SNAPPERS	**LUTJANIDAE**																			
Almaco jack	*Seriola rivoliana*	0																		
Mutton snapper	*Lutjanus analis*	2													1		1			
Gray snapper	*Lutjanus griseus*	2										1	1							
Lane snapper	*Lutjanus synagris*	0																		
Yellowtail snapper	*Ocyurus chrysurus*	142			1	6	1	17	1		1	2	3	4	8	9	13	8	6	62
GRUNTS	**HAEMULIDAE**																			
Black margate	*Anisotremus surinamensis*	1															1			
Porkfish	*Anisotremus virginicus*	62	7	4	18			1			4	5	4	9	1		1	1	1	6
White margate	*Haemulon album*	0																		
Tomtate	*Haemulon aurolineatum*	3												1	1	1				
Caesar grunt	*Haemulon carbonarium*	104	21	15								32	16	20						
Smallmouth grunt	*Haemulon chrysargyreum*	1										1								
French grunt	*Haemulon flavolineatum*	761	53	80	87	1	2	15	7	1	4	54	120	89	205	8	22	9	2	2
Spanish grunt	*Haemulon macrostomum*	0																		
Sailor's choice	*Haemulon parra*	0																		
White grunt	*Haemulon plumierii*	44	4	3	10		1	3	3		2	1	1		1	1	6	3	1	4
Bluestriped grunt	*Haemulon sciurus*	23		1	12		1	1				1	2	4	1					
Juvenile grunts	*Haemulon* spp.	262	50	11								40		61		100				
PORGIES	**SPARIDAE**																			
Jolthead porgy	*Calamus bajonado*	1						1												
Saucereye porgy	*Calamus calamus*	0																		
Sheepshead porgy	*Calamus penna*	0																		
Silver porgy	*Diplodus argenteus*	0																		
DRUMS	**SCIAENIDAE**																			

Appendix 2 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Jackknife	*Equetus lanceolatus*	0																		
Spotted drum	*Equetus punctatus*	0																		
Cubbyu	*Equetus umbrosus*	0																		
Highhat	*Pareques acuminatus*	6													4			1		1
GOATFISHES	**MULLIDAE**																			
Spotted goatfish	*Pseudupeneus maculatus*	37	1		3	4	2	4		3	4	1			5	2	1	5		2
SEA CHUBS	**KYPHOSIDAE**																			
Bermuda sea chub	*Kyphosus sectatrix*	100		4	4			1				19	30	41		1				
BUTTERFLYFISHES	**CHAETODONTIDAE**																			
Foureye butterflyfish	*Chaetodon capistratus*	30				2			2		2		3	5	4		1	4		7
Spotfin butterflyfish	*Chaetodon ocellatus*	15		3		1		2				2			2		2	2		1
Reef butterflyfish	*Chaetodon sedentarius*	43						8	2		4				3	4	7	5	3	7
Banded butterflyfish	*Chaetodon striatus*	11									4				2			4		1
ANGELFISHES	**POMACANTHIDAE**																			
Blue angelfish	*Holacanthus bermudensis*	4									1								1	2
Queen angelfish	*Holacanthus ciliaris*	8				1	1		1		1								2	2
Townsend angelfish	*Holacanthus townsendi*	0																		
Rock beauty	*Holacanthus tricolor*	7									1						1	1	2	2
Gray angelfish	*Pomacanthus arcuatus*	17		1					4		2	1		4						5
French angelfish	*Pomacanthus paru*	15			3						4	2	1	1			3			1
DAMSELFISHES	**POMACENTRIDAE**																			
Sergeant major	*Abudefduf saxatilis*	228	30	12	10		1	23				30	22	46	9	19	26			
Blue chromis	*Chromis cyanea*	207							18	48	24							49	1	67
Yellowtail reeffish	*Chromis enchrysura*	0																		
Sunshinefish	*Chromis insolata*	77							5	3	26							19		24

Appendix 2 (continued)

			Transects									Point-counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Brown chromis	*Chromis multilineata*	95						1			19				1		4	14	21	35
Purple reeffish	*Chromis scotti*	56						1	1	3	17				1	2	2	3	2	24
Yellowtail damselfish	*Microspathodon chrysurus*	3			3															
Dusky damselfish	*Stegastes adustus*	22	3	3	2	2	3	1				3	1	1	3					
Longfin damselfish	*Stegastes diencaeus*	3						2			1									
Beaugregory	*Stegastes leucostictus*	21	2	3			3			2	6	1						1		3
Bicolor damselfish	*Stegastes partitus*	1282	2		2	15	13	58	74	45	201		1		52	113	272	140	60	234
Threespot damselfish	*Stegastes planifrons*	6			1								4					1		
Cocoa damslefish	*Stegastes variabilis*	123	5	8	16	2	7	27	2		1	3	11	22	6	3	8	1	1	
WRASSES	**LABRIDAE**																			
Spotfin hogfish	*Bodianus pulchellus*	1														1				
Spanish hogfish	*Bodianus rufus*	9					2				1				1	2	2	1		
Creole wrasse	*Clepticus parrae*	340								55	20					60	70	60	50	25
Slippery dick	*Halichoeres bivittatus*	173	15	2	26	5	5	31	1		2	10	15	29		10	21			1
Yellowcheek wrasse	*Halichoeres cyanocephalus*	0																		
Yellowhead wrasse	*Halichoeres garnoti*	226				11	13	26	41	25	27	3	1		16	19	11	11		22
Clown wrasse	*Halichoeres maculipinna*	309	20	17	36	14	10	26			6	20	23	35	15	31	33	1	12	10
Rainbow wrasse	*Halichoeres pictus*	0																		
Blackear wrasse	*Halichoeres poeyi*	6	4	2																
Puddingwife	*Halichoeres radiatus*	10			2			4				1	1	2						
Hogfish	*Lachnolaimus maximus*	4		2							1		1							
Bluehead wrasse	*Thalassoma bifasciatum*	1831	57	39	102	30	44	64	70	95	289	38	40	88	48	74	278	190	50	235
Green razorfish	*Xyrichtys splendens*	0																		
PARROTFISHES	**SCARIDAE**																			
Bluelip parrotfish	*Cryptotomus roseus*	133	2	7	1	7	10	16	5	11	8			1	6	1	24	10		24

Appendix 2 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Parrotfish species	*Scaridae* spp.	0																		
Midnight parrotfish	*Scarus coelestinus*	1						1												
Blue parrotfish	*Scarus coeruleus*	1																1		
Rainbow parrotfish	*Scarus guacamaia*	0																		
Striped parrotfish	*Scarus iseri*	133		13	18	9	2	23	2	1	10	6	1	18	3	10	4			13
Princess parrotfish	*Scarus taeniopterus*	145	1			4	8	6	2	10	41	4	2		5	7	1	3	6	45
Queen parrotfish	*Scarus vetula*	3	1		1												1			
Greenblotch parrotfish	*Sparisoma atomarium*	74			16	1	2	12	3	3	10				7	3	8	1		8
Redband parrotfish	*Sparisoma aurofrenatum*	548	15	14	17	28	29	57	15	16	28	26	28	27	34	48	81	25	12	48
Redtail parrotfish	*Sparisoma chrysopterum*	7						2		1	1			1				2		
Bucktooth parrotfish	*Sparisoma radians*	86			16	7		20	7	10	5						2	15		4
Redfin parrotfish	*Sparisoma rubripinne*	1											1							
Stoplight parrotfish	*Sparisoma viride*	50		4	4	5	3	9		1		6	4	4		4	2	1	1	2
COMBTOOTH BLENNIES	**BLENNIDAE**																			
Barred blenny	*Hypleurochilus bermudensis*	0																		
Redlip blenny	*Ophioblennius macclurei*	0																		
Seaweed blenny	*Parablennius marmoreus*	26	1	2	8	1		6	4			2	1	1						
SCALY BLENNIES	**LABRISOMIDAE**																			
Hairy blenny	*Labrisomus nuchipinnis*	0																		
Rosy blenny	*Malacoctenus macropus*	7	5	2																
Saddled blenny	*Malacoctenus triangulatus*	19	1	2	2	3		6	2			1			1	1				
Banded blenny	*Paraclinus fasciatus*	0																		
TUBE BLENNIES	**CHAENOPSIDAE**																			
Roughhead blenny	*Acanthemblemaria aspera*	0																		
Sailfin blenny	*Emblemaria pandionis*	1											1							

Appendix 2 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
GOBIES	**GOBIIDAE**																			
Frillfin goby	*Bathygobius soporator*	0																		
Colon goby	*Coryphopterus dicrus*	3						1												2
Bridled goby	*Coryphopterus glaucofraenum*	76		2		15	7	18	16	3			3		5	5	2			
Masked/Glass goby	*Coryphopterus hyalinus/personatus*	6949			4	370	179	2025	66	285	1820				350	500	500	150		700
Spotted goby	*Coryphopterus punctipectophorus*	0																		
Dash goby	*Ctenogobius saepepallens*	0																		
Neon goby	*Elacatinus oceanops*	1						1												
Goldspot goby	*Gnatholepis thompsoni*	26				3	7			9					2	5				
Code goby	*Gobiosoma robustum*	0																		
Blue goby	*Ptereleotris calliura*	1								1										
SPADEFISHES	**EPHIPPIDAE**																			
Atlantic spadefish	*Chaetodipterus faber*	26														26				
SURGEONFISHES	**ACANTHURIDAE**																			
Ocean surgeon	*Acanthurus bahianus*	527	26	18	46	23	29	57	9	5	19	68	38	26	40	49	40	8	5	21
Doctorfish	*Acanthurus chirurgus*	249	6	12	44			33			13	14	17	38	1		36			35
Blue tang	*Acanthurus coeruleus*	123				1	2	9	1		5	3	2	1	3	65	10	5	3	13
MACKERELS	**SCOMBRIDAE**																			
Cero	*Scomberomorus regalis*	5									1					1	2			1
King mackerel	*Scomberomorus cavalla*	0																		
TRIGGERFISHES	**BALISTIDAE**																			
Gray triggerfish	*Balistes capriscus*	0																		
Ocean triggerfish	*Canthidermis sufflamen*	0																		
FILEFISHES	**MONACANTHIDAE**																			
Unicorn filefish	*Aluterus monoceros*	1																	1	

Appendix 2 (continued)

			Transects									Point-counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Orange filefish	*Aluterus schoepfi*	0																		
Scrawled filefish	*Aluterus scriptus*	17						1		1	1					1	3	1	3	6
Orangespotted filefish	*Cantherhines pullus*	3	1		1															1
Fringed filefish	*Monacanthus ciliatus*	0																		
Slender filefish	*Monacanthus tuckeri*	0																		
Planehead filefish	*Stephanolepis hispidus*	0																		
BOXFISHES	**OSTRACIIDAE**																			
Honeycomb cowfish	*Acanthostracion polygonius*	0																		
Scrawled cowfish	*Acanthostracion quadricornis*	2						1						1						
Spotted trunkfish	*Lactophrys bicaudalis*	4						1					1			1	1			
Smooth trunkfish	*Lactophrys triqueter*	7					1	1							1		1	3		
PUFFERS	**TETRAODONTIDAE**																			
Sharpnose puffer	*Canthigaster rostrata*	171	5	2	13	2	6	19	20	22	24		2		6	13	5	6	8	18
Bandtail puffer	*Sphoeroides spengleri*	0																		
PORCUPINEFISHES	**DIODONTIDAE**																			
Striped burrfish	*Chilomycterus schoepfi*	0																		
Balloonfish	*Diodon holocanthus*	4			2					1		1								
Porcupinefish	*Diodon hystrix*	0																		
	Total Abundance	19364	338	290	534	597	397	2651	565	668	3527	402	402	581	880	1290	1665	976	255	3346
	Total Species	155	26	31	35	32	31	47	34	32	52	33	34	29	40	41	45	46	25	49

Appendix 3. Fish abundance by count type and power state for Quarter 4 (November 2014). Numbers in each column represent the combined total number of fishes observed from all surveys completed within each power state.

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	Scientific Name	Total	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF	AC	DC	OFF
STINGRAYS	**DASYATIDAE**																			
Southern stingray	*Dasyatis americana*	0																		
Yellow stingray	*Urobatis jamaicensis*	1			1															
MORAY EELS	**MURAENIDAE**																			
Goldentail moray	*Gymnothorax miliaris*	0																		
Spotted moray	*Gymnothorax moringa*	3					2											1		
LIZARDFISHES	**SYNODONTIDAE**																			
Inshore lizardfish	*Synodus foetens*	1														1				
Sand diver	*Synodus intermedius*	0																		
FLYINGFISHES	**EXOCOETIDAE**																			
Ballyhoo	*Hemiramphus brasiliensis*	900										200		700						
TRUMPETFISHES	**AULOSTOMIDAE**																			
Trumpetfish	*Aulostomus maculatus*	2						1						1						
SCORPIONFISHES	**SCORPAENIDAE**																			
Red lionfish	*Pterois volitans*	0																		
Spotted scorpionfish	*Scorpaena plumieri*	2													1	1				
SEA BASSES	**SERRANIDAE**																			
Graysby	*Cephalopholis cruentata*	25							2	2	6					1	3	4	3	4
Coney	*Cephalopholis fulvus*	5									1							1	1	2
Rock hind	*Epinephelus adscensionis*	0																		
Red grouper	*Epinephelus morio*	3											1	2						
Blue hamlet	*Hypoplectrus gemma*	6							1	1	3							1		

Appendix 3 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Shy hamlet	*Hypoplectrus guttavarius*	0																		
Hamlet juvenile	*Hypoplectrus* spp.	0																		
Butter hamlet	*Hypoplectrus unicolor*	18					1	3	1	2	2				1	1	3	1	1	2
Orangeback bass	*Serranus annularis*	0																		
Lantern bass	*Serranus baldwini*	0																		
Tobaccofish	*Serranus tabacarius*	1							1											
Harlequin bass	*Serranus tigrinus*	9				1		1		1	2					1	1	1	1	
JAWFISHES	**OPISTOGNATHIDAE**																			
Yellowhead jawfish	*Opistognathus aurifrons*																			
Dusky jawfish	*Opistognathus whitehursti*	1	1																	
CARDINALFISHES	**APOGONIDAE**																			
Flamefish	*Apogon maculatus*	0																		
Dusky cardinalfish	*Phaeoptyx pigmentaria*	0																		
TILEFISHES	**MALACANTHIDAE**																			
Sand tilefish	*Malacanthus plumieri*	0																		
REMORAS	**ECHENEIDAE**																			
Sharksucker	*Echeneis naucrates*	1														1				
JACKS	**CARANGIDAE**																			
Yellow jack	*Carangoides bartholomaei*	7									3	1			3					
Blue runner	*Caranx crysos*	2162														160	2			2000
Bar jack	*Caranx ruber*	99				2						30		20		19	22	1		5
Mackerel scad	*Decapterus macarellus*	0																		
Round scad	*Decapterus punctatus*	3															3			
Rainbow runner	*Elagatis bipinnulata*	30																		30
Greater amberjack	*Seriola dumerili*	1										1								

Appendix 3 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Almaco jack	*Seriola rivoliana*	0																		
SNAPPERS	**LUTJANIDAE**																			
Mutton snapper	*Lutjanus analis*	0																		
Gray snapper	*Lutjanus griseus*	0																		
Lane snapper	*Lutjanus synagris*	30									30									
Yellowtail snapper	*Ocyurus chrysurus*	442				4	9	9	12		62	1				1	10	58	36	240
GRUNTS	**HAEMULIDAE**																			
Black margate	*Anisotremus surinamensis*	0																		
Porkfish	*Anisotremus virginicus*	171	2	2	11			1		1	10	9	73	51	1		1	1	1	7
White margate	*Haemulon album*	0																		
Tomtate	*Haemulon aurolineatum*	100													30	70				
Caesar grunt	*Haemulon carbonarium*	255	28	34	66							30	31	66						
Smallmouth grunt	*Haemulon chrysargyreum*	0																		
French grunt	*Haemulon flavolineatum*	687	61	40	78	3	25	3				75	43	120	60	89	87		3	
Spanish grunt	*Haemulon macrostomum*	0																		
Sailor's choice	*Haemulon parra*	0																		
White grunt	*Haemulon plumierii*	50	2	1	7	1	2	4	3		3	8	1	3	1	2	4	2	2	4
Bluestriped grunt	*Haemulon sciurus*	8	2									3		1			2			
Juvenile grunts	*Haemulon* spp.	120															120			
PORGIES	**SPARIDAE**																			
Jolthead porgy	*Calamus bajonado*	1									1									
Saucereye porgy	*Calamus calamus*	1																		1
Sheepshead porgy	*Calamus penna*	1		1																
Silver porgy	*Diplodus argenteus*	0																		
DRUMS	**SCIAENIDAE**																			

Appendix 3 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Jackknife	*Equetus lanceolatus*	0																		
Spotted drum	*Equetus punctatus*	0																		
Cubbyu	*Equetus umbrosus*	0																		
Highhat	*Pareques acuminatus*	3	1										1	1						
GOATFISHES	**MULLIDAE**																			
Spotted goatfish	*Pseudupeneus maculatus*	23		1				1			8		1		1	1	2	1	1	6
SEA CHUBS	**KYPHOSIDAE**																			
Bermuda sea chub	*Kyphosus sectatrix*	22			20								1	1						
BUTTERFLYFISHES	**CHAETODONTIDAE**																			
Foureye butterflyfish	*Chaetodon capistratus*	33							2	2	7				1	1	2	2	6	10
Spotfin butterflyfish	*Chaetodon ocellatus*	9					2	2						1				2		2
Reef butterflyfish	*Chaetodon sedentarius*	43				2	4	6		3	3				4	4	8	2	2	5
Banded butterflyfish	*Chaetodon striatus*	7						4												3
ANGELFISHES	**POMACANTHIDAE**																			
Blue angelfish	*Holacanthus bermudensis*	18					1		1	1	6					1		2		6
Queen angelfish	*Holacanthus ciliaris*	7						1	1	1	1						1			2
Townsend angelfish	*Holacanthus townsendi*	1									1									
Rock beauty	*Holacanthus tricolor*	20							2	3	6						1	2	1	5
Gray angelfish	*Pomacanthus arcuatus*	22							1		4			1		1	3	2	4	6
French angelfish	*Pomacanthus paru*	19	1	3	1				2		4	1		5						2
DAMSELFISHES	**POMACENTRIDAE**																			
Sergeant major	*Abudefduf saxatilis*	113	3	11	17			3				8	14	10	18	7	22			
Blue chromis	*Chromis cyanea*	88				1	1	1	14	3	22							13	4	29
Yellowtail reeffish	*Chromis enchrysura*	0																		
Sunshinefish	*Chromis insolata*	72							6	4	4						1	8	15	34

Appendix 3 (continued)

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Brown chromis	*Chromis multilineata*	33					1				1				20	5	2			4
Purple reeffish	*Chromis scotti*	25				1			3	1	3				6	1	2	3	1	4
Yellowtail damselfish	*Microspathodon chrysurus*	0																		
Dusky damselfish	*Stegastes adustus*	54	8	2	4	1	2	2				11	6	12	3	3				
Longfin damselfish	*Stegastes diencaeus*	3		1	1								1							
Beaugregory	*Stegastes leucostictus*	13	1	1	3		1	2	2		1			1						1
Bicolor damselfish	*Stegastes partitus*	800	3	3	7	19	35	24	42	32	142	1	3	4	38	32	74	94	68	179
Threespot damselfish	*Stegastes planifrons*	2												2						
Cocoa damslefish	*Stegastes variabilis*	92	3	6	12	6	7	13	1		2	3	10	12	3		9	1	1	3
WRASSES	**LABRIDAE**																			
Spotfin hogfish	*Bodianus pulchellus*	0																		
Spanish hogfish	*Bodianus rufus*	4					1				1		1		1					
Creole wrasse	*Clepticus parrae*	206							20	15	38					3	7	32	55	36
Slippery dick	*Halichoeres bivittatus*	243	8	31	29	11	11	8	1		8	23	22	56	11	5	16			3
Yellowcheek wrasse	*Halichoeres cyanocephalus*	4							1		1								1	1
Yellowhead wrasse	*Halichoeres garnoti*	172			3	5	11	17	12	4	18	9	4	10	7	11	26	11	17	7
Clown wrasse	*Halichoeres maculipinna*	212	16	7	26	5	3	20	3	1	12	26	12	32	4	8	26	3	6	2
Rainbow wrasse	*Halichoeres pictus*	1															1			
Blackear wrasse	*Halichoeres poeyi*	16	1	3	3							1	1	6						1
Puddingwife	*Halichoeres radiatus*	5			1							1	1	2						
Hogfish	*Lachnolaimus maximus*	25	1								24									
Bluehead wrasse	*Thalassoma bifasciatum*	1247	12	13	38	14	45	82	104	61	145	34	18	47	56	49	124	115	92	198
Green razorfish	*Xyrichtys splendens*	0																		
PARROTFISHES	**SCARIDAE**																			
Bluelip parrotfish	*Cryptotomus roseus*	34	1		3			6	9		4			4	5					2

Appendix 3 (continued)

			Transects									Point Counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Parrotfish species	*Scaridae* spp.	0																		
Midnight parrotfish	*Scarus coelestinus*	2											1				1			
Blue parrotfish	*Scarus coeruleus*	0																		
Rainbow parrotfish	*Scarus guacamaia*	5															5			
Striped parrotfish	*Scarus iseri*	154		13	19	9	19	5	2	2	10	18	9	21	1	2	20		2	2
Princess parrotfish	*Scarus taeniopterus*	168		1			8	9	6	3	38	33		18		2	16	3	8	23
Queen parrotfish	*Scarus vetula*	3	1									1					1			
Greenblotch parrotfish	*Sparisoma atomarium*	102	6	2	4	4	4	4	3	14	11	11				4	8	14	13	
Redband parrotfish	*Sparisoma aurofrenatum*	319	9	8	7	15	23	43	15	8	23	4	9	25	19	15	54	19	11	12
Redtail parrotfish	*Sparisoma chrysopterum*	5									2						3			
Bucktooth parrotfish	*Sparisoma radians*	91		2	9	14	13	2			7		10	16	6	8	2			2
Redfin parrotfish	*Sparisoma rubripinne*	8	1	1							2							4		
Stoplight parrotfish	*Sparisoma viride*	105	10	5	2	5	9	13	3		5	10	11	8	2	2	15			5
COMBTOOTH BLENNIES	**BLENNIDAE**																			
Barred blenny	*Hypleurochilus bermudensis*	0																		
Redlip blenny	*Ophioblennius macclurei*	0																		
Seaweed blenny	*Parablennius marmoreus*	7	1		2			2					1	1						
SCALY BLENNIES	**LABRISOMIDAE**																			
Hairy blenny	*Labrisomus nuchipinnis*	0																		
Rosy blenny	*Malacoctenus macropus*	4			2									2						
Saddled blenny	*Malacoctenus triangulatus*	11	1	1	1			2				3		2			1			
Banded blenny	*Paraclinus fasciatus*	0																		
TUBE BLENNIES	**CHAENOPSIDAE**																			
Roughhead blenny	*Acanthemblemaria aspera*	1	1																	
Sailfin blenny	*Emblemaria pandionis*	1			1															

Appendix 3 (continued)

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
GOBIES	**GOBIIDAE**																			
Frillfin goby	*Bathygobius soporator*	0																		
Colon goby	*Coryphopterus dicrus*	6			3	1							1		1					
Bridled goby	*Coryphopterus glaucofraenum*	16		1		1		1	5						5	1	2			
Masked/Glass goby	*Coryphopterus hyalinus/personatus*	2843				111	140	232	150	165	450				400	300	300	200	145	250
Spotted goby	*Coryphopterus punctipectophorus*	0																		
Dash goby	*Ctenogobius saepepallens*	0																		
Neon goby	*Elacatinus oceanops*	2						1								1				
Goldspot goby	*Gnatholepis thompsoni*	18			2	1	2	2	2	2	2				2	1		1	1	
Code goby	*Gobiosoma robustum*	0																		
Blue goby	*Ptereleotris calliura*	0																		
SPADEFISHES	**EPHIPPIDAE**																			
Atlantic spadefish	*Chaetodipterus faber*	8									6									2
SURGEONFISHES	**ACANTHURIDAE**																			
Ocean surgeon	*Acanthurus bahianus*	628	40	15	68	15	20	49	13	13	54	82	15	57	32	13	53	11	24	54
Doctorfish	*Acanthurus chirurgus*	154	17	16	25		1				1	29	15	46		2			2	
Blue tang	*Acanthurus coeruleus*	97	1	4	2		2	4	3	1	4	7	6	4	1	1	7	10	9	31
MACKERELS	**SCOMBRIDAE**																			
Cero	*Scomberomorus regalis*	10		1	1						2	1		2	1			1		1
King mackerel	*Scomberomorus cavalla*	0																		
TRIGGERFISHES	**BALISTIDAE**																			
Gray triggerfish	*Balistes capriscus*	6		1	2							1		2						
Ocean triggerfish	*Canthidermis sufflamen*	0																		
FILEFISHES	**MONACANTHIDAE**																			
Unicorn filefish	*Aluterus monoceros*	0																		

Appendix 3 (continued)

			Transects									Point Counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Orange filefish	*Aluterus schoepfi*	0																		
Scrawled filefish	*Aluterus scriptus*	10						1			2	1				2	1		1	2
Orangespotted filefish	*Cantherhines pullus*	1							1											
Fringed filefish	*Monacanthus ciliatus*	0																		
Slender filefish	*Monacanthus tuckeri*	0																		
Planehead filefish	*Stephanolepis hispidus*																			
BOXFISHES	**OSTRACIIDAE**																			
Honeycomb cowfish	*Acanthostracion polygonius*	0																		
Scrawled cowfish	*Acanthostracion quadricornis*	0																		
Spotted trunkfish	*Lactophrys bicaudalis*	1														1				
Smooth trunkfish	*Lactophrys triqueter*	3															1	1		1
PUFFERS	**TETRAODONTIDAE**																			
Sharpnose puffer	*Canthigaster rostrata*	86	3	3	6	3	7	4	8	5	10	1	2	3		2	8	7	7	7
Bandtail puffer	*Sphoeroides spengleri*	0																		
PORCUPINEFISHES	**DIODONTIDAE**																			
Striped burrfish	*Chilomycterus schoepfi*	0																		
Balloonfish	*Diodon holocanthus*	5	1		1								1	2						
Porcupinefish	*Diodon hystrix*	0																		
	Total Abundance	13717	247	234	488	255	412	588	458	351	1218	678	326	1380	745	836	1083	635	545	3238
	Total Species	153	32	32	38	26	31	39	37	27	53	35	32	42	33	43	48	37	34	48

Appendix 4. Fish abundance by count type and power state for Quarter 5 (March 2015). Numbers in each column represent the combined total number of fishes observed from all surveys completed within each power state.

			Transects									**Point Counts**								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
STINGRAYS	**DASYATIDAE**																			
Southern stingray	*Dasyatis americana*	0																		
Yellow stingray	*Urobatis jamaicensis*	1																		1
MORAY EELS	**MURAENIDAE**																			
Goldentail moray	*Gymnothorax miliaris*	0																		
Spotted moray	*Gymnothorax moringa*	0																		
LIZARDFISHES	**SYNODONTIDAE**																			
Inshore lizardfish	*Synodus foetens*	1														1				
Sand diver	*Synodus intermedius*	2							1										1	
FLYINGFISHES	**EXOCOETIDAE**																			
Ballyhoo	*Hemiramphus brasiliensis*	0																		
TRUMPETFISHES	**AULOSTOMIDAE**																			
Trumpetfish	*Aulostomus maculatus*	5		2			1		1	1										
SCORPIONFISHES	**SCORPAENIDAE**																			
Red lionfish	*Pterois volitans*	1								1										
Spotted scorpionfish	*Scorpaena plumieri*	7			1				2		1			1					1	1
SEA BASSES	**SERRANIDAE**																			
Graysby	*Cephalopholis cruentata*	24		1	1	1			3	2	4				1	2	1	2	3	3
Coney	*Cephalopholis fulvus*	1																		1
Rock hind	*Epinephelus adscensionis*	0																		
Red grouper	*Epinephelus morio*	0																		
Blue hamlet	*Hypoplectrus gemma*	1																		1

Appendix 4 (continued)

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Shy hamlet	*Hypoplectrus guttavarius*	0																		
Hamlet juvenile	*Hypoplectrus* spp.	1													1					
Butter hamlet	*Hypoplectrus unicolor*	21				2	1		1		1				3	3	2	3	3	2
Orangeback bass	*Serranus annularis*	0																		
Lantern bass	*Serranus baldwini*	3						2	1											
Tobaccofish	*Serranus tabacarius*	0																		
Harlequin bass	*Serranus tigrinus*	35				3	8	7	2	1	1				1	5	1	3		3
JAWFISHES	**OPISTOGNATHIDAE**																			
Yellowhead jawfish	*Opistognathus aurifrons*	1					1													
Dusky jawfish	*Opistognathus whitehursti*	2				2														
CARDINALFISHES	**APOGONIDAE**																			
Flamefish	*Apogon maculatus*	0																		
Dusky cardinalfish	*Phaeoptyx pigmentaria*	0																		
TILEFISHES	**MALACANTHIDAE**																			
Sand tilefish	*Malacanthus plumieri*	0																		
REMORAS	**ECHENEIDAE**																			
Sharksucker	*Echeneis naucrates*																			
JACKS	**CARANGIDAE**																			
Yellow jack	*Carangoides bartholomaei*	7				3									3				1	
Blue runner	*Caranx crysos*	9						5							4					
Bar jack	*Caranx ruber*	231				55				18					15	100	27		10	6
Mackerel scad	*Decapterus macarellus*	20																20		
Round scad	*Decapterus punctatus*	17														2		12	3	
Rainbow runner	*Elagatis bipinnulata*	4													4					
Greater amberjack	*Seriola dumerili*	0																		

Appendix 4 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Almaco jack	*Seriola rivoliana*	1																1		
SNAPPERS	**LUTJANIDAE**																			
Mutton snapper	*Lutjanus analis*	0																		
Gray snapper	*Lutjanus griseus*	3				3														
Lane snapper	*Lutjanus synagris*	0																		
Yellowtail snapper	*Ocyurus chrysurus*	132				2	4	6				1		2	25	68	20	1	1	2
GRUNTS	**HAEMULIDAE**																			
Black margate	*Anisotremus surinamensis*	1									1									
Porkfish	*Anisotremus virginicus*	47	7		2							7	8	15		1		1	3	3
White margate	*Haemulon album*	1							1											
Tomtate	*Haemulon aurolineatum*	9													5	2	2			
Caesar grunt	*Haemulon carbonarium*	190	23	21	35							27	29	53	2					
Smallmouth grunt	*Haemulon chrysargyreum*	0																		
French grunt	*Haemulon flavolineatum*	515	23	30	67	10	10	11	1			50	44	79	50	79	58	1	1	1
Spanish grunt	*Haemulon macrostomum*	1								1										
Sailor's choice	*Haemulon parra*	0																		
White grunt	*Haemulon plumierii*	66	1			4	2	1	4	8	10	1	1	2	3	5	5	5	4	10
Bluestriped grunt	*Haemulon sciurus*	12		1	2	1		1				2		1	2	2				
Juvenile grunts	*Haemulon* spp.	6				3									3					
PORGIES	**SPARIDAE**																			
Jolthead porgy	*Calamus bajonado*	0																		
Saucereye porgy	*Calamus calamus*	5		1					1		1		2							
Sheepshead porgy	*Calamus penna*	0																		
Silver porgy	*Diplodus argenteus*	9													7	2				
DRUMS	**SCIAENIDAE**																			

Appendix 4 (continued)

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Jackknife	*Equetus lanceolatus*	1													1					
Spotted drum	*Equetus punctatus*	0																		
Cubbyu	*Equetus umbrosus*	0																		
Highhat	*Pareques acuminatus*	14		1		1						1	1	1				3	2	4
GOATFISHES	**MULLIDAE**																			
Spotted goatfish	*Pseudupeneus maculatus*	29				3	2	2			1	1	1	4	4	3	2	2	2	2
SEA CHUBS	**KYPHOSIDAE**																			
Bermuda sea chub	*Kyphosus sectatrix*	27	1	2								1	1	4	15	1	2			
BUTTERFLYFISHES	**CHAETODONTIDAE**																			
Foureye butterflyfish	*Chaetodon capistratus*	42				2			1	4	6			2	1	3	1	7	8	7
Spotfin butterflyfish	*Chaetodon ocellatus*	17						1			4			2		2				8
Reef butterflyfish	*Chaetodon sedentarius*	52				4	2	4	9	3	1				2	8	1	8	5	5
Banded butterflyfish	*Chaetodon striatus*	4																2	2	
ANGELFISHES	**POMACANTHIDAE**																			
Blue angelfish	*Holacanthus bermudensis*	14					1		1	1							2	4	2	3
Queen angelfish	*Holacanthus ciliaris*	5						1			1			1	2					
Townsend angelfish	*Holacanthus townsendi*	0																		
Rock beauty	*Holacanthus tricolor*	30				1	1		2	4	1				5	5	4	2	2	3
Gray angelfish	*Pomacanthus arcuatus*	17			2			1						2	1		2	3		6
French angelfish	*Pomacanthus paru*	9	1		1								2	2		2		1		
DAMSELFISHES	**POMACENTRIDAE**																			
Sergeant major	*Abudefduf saxatilis*	116	5	5	10	2	6	5				8	8	19	30	3	15			
Blue chromis	*Chromis cyanea*	90				1	2		7	3	9				2	7	4	21	12	22
Yellowtail reeffish	*Chromis enchrysura*	0																		
Sunshinefish	*Chromis insolata*	154							10	12	20							50	25	37

Appendix 4 (continued)

Species List		Total	Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Brown chromis	*Chromis multilineata*	156					2		8	4	8				15	11	16	38	31	23
Purple reeffish	*Chromis scotti*	82				1			4	16	5				2	1	1	10	30	12
Yellowtail damselfish	*Microspathodon chrysurus*	0																		
Dusky damselfish	*Stegastes adustus*	55	2	5	8	6	4	1				2	6	10	9	1		1		
Longfin damselfish	*Stegastes diencaeus*	2												1		1				
Beaugregory	*Stegastes leucostictus*	69	1	3	2	9	7	4	3	5	3	1		6	2	2	5	3	8	5
Bicolor damselfish	*Stegastes partitus*	1512	1	3	5	34	30	28	111	73	115	1	2	3	184	109	67	278	200	268
Threespot damselfish	*Stegastes planifrons*	7				5	2													
Cocoa damslefish	*Stegastes variabilis*	135	12	16	21	4	7	5	1		4	7	14	26	4	3	7	1		3
WRASSES	**LABRIDAE**																			
Spotfin hogfish	*Bodianus pulchellus*	0																		
Spanish hogfish	*Bodianus rufus*	38				5	3	1							14	8	6	1		
Creole wrasse	*Clepticus parrae*	404				6		2	18	21	34	2		8	1	1	1	70	195	45
Slippery dick	*Halichoeres bivittatus*	92	5	7	22	5	5	13	1				8	11	9	1	4	1		
Yellowcheek wrasse	*Halichoeres cyanocephalus*	20				3			2		2	1		8	2					2
Yellowhead wrasse	*Halichoeres garnoti*	485	1	2		33	33	16	65	83	68	26	15	12	16	14	19	34	27	21
Clown wrasse	*Halichoeres maculipinna*	309	21	29	53	11	15	5				5	26	79	31	11	13	3	2	5
Rainbow wrasse	*Halichoeres pictus*	50										14	20	16						
Blackear wrasse	*Halichoeres poeyi*	7		2	4	1														
Puddingwife	*Halichoeres radiatus*	15	1	2	1			1				2	3	5						
Hogfish	*Lachnolaimus maximus*	5							1		2		1							1
Bluehead wrasse	*Thalassoma bifasciatum*	1710	16	41	103	90	80	99	110	98	81	25	93	115	213	110	120	90	117	109
Green razorfish	*Xyrichtys splendens*	8	2	2	1		1			1	1									
PARROTFISHES	**SCARIDAE**																			
Bluelip parrotfish	*Cryptotomus roseus*	71			5		5		2		3	10	17	20		4	3			2

Appendix 4 (continued)

			Transects									Point Counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Parrotfish species	*Scaridae* spp.	0																		
Midnight parrotfish	*Scarus coelestinus*	0																		
Blue parrotfish	*Scarus coeruleus*	1					1													
Rainbow parrotfish	*Scarus guacamaia*	9					1							6	2					
Striped parrotfish	*Scarus iseri*	207	2		2	24	10	15	2	13	1	6	4	6	39	10	18	8	27	20
Princess parrotfish	*Scarus taeniopterus*	168	5	5	17	6		1	6	3	8	2	16	24	8	5	9	16	12	25
Queen parrotfish	*Scarus vetula*	46			1							14	9	20	1	1				
Greenblotch parrotfish	*Sparisoma atomarium*	136		2	6	3	10	21	7	18	11			16	2	17	10		11	2
Redband parrotfish	*Sparisoma aurofrenatum*	484	9	12	11	39	27	18	38	22	46	13	27	24	33	12	25	33	37	58
Redtail parrotfish	*Sparisoma chrysopterum*	51	2							1		9	17	18				1		3
Bucktooth parrotfish	*Sparisoma radians*	6					3						1			1		1		
Redfin parrotfish	*Sparisoma rubripinne*	12			1		5							4	1			1		
Stoplight parrotfish	*Sparisoma viride*	71	4	1	5	5	6	8	1	1	2	4	4	8	3	3	9	1	2	4
COMBTOOTH BLENNIES	**BLENNIDAE**																			
Barred blenny	*Hypleurochilus bermudensis*	1			1															
Redlip blenny	*Ophioblennius macclurei*	0																		
Seaweed blenny	*Parablennius marmoreus*	20	2	5	7							3	2	1						
SCALY BLENNIES	**LABRISOMIDAE**																			
Hairy blenny	*Labrisomus nuchipinnis*	0																		
Rosy blenny	*Malacoctenus macropus*	27	4	8	10								2	3						
Saddled blenny	*Malacoctenus triangulatus*	22	1	3	5	4	1	3		2			2	1						
Banded blenny	*Paraclinus fasciatus*	1		1																
TUBE BLENNIES	**CHAENOPSIDAE**																			
Roughhead blenny	*Acanthemblemaria aspera*	3	1	1				1												
Sailfin blenny	*Emblemaria pandionis*	3		1	1		1													

Appendix 4 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
GOBIES	**GOBIIDAE**																			
Frillfin goby	*Bathygobius soporator*	0																		
Colon goby	*Coryphopterus dicrus*	17		1	1	3	4	6			2									
Bridled goby	*Coryphopterus glaucofraenum*	58	1	1	3	18	5	7	2	3	3			2	11	2				
Masked/Glass goby	*Coryphopterus hyalinus/personatus*	770				67	61	62	54	113	57				114	80	107	40		15
Spotted goby	*Coryphopterus punctipectophorus*	0																		
Dash goby	*Ctenogobius saepepallens*	1						1												
Neon goby	*Elacatinus oceanops*	10		1		1	3	2							1	1			1	
Goldspot goby	*Gnatholepis thompsoni*	47	1	3	2	4	4	2	1		1			3	26					
Code goby	*Gobiosoma robustum*	2					2													
Blue goby	*Ptereleotris calliura*	1									1									
SPADEFISHES	**EPHIPPIDAE**																			
Atlantic spadefish	*Chaetodipterus faber*	3																3		
SURGEONFISHES	**ACANTHURIDAE**																			
Ocean surgeon	*Acanthurus bahianus*	925	39	28	33	57	44	32	27	29	46	29	102	112	56	78	97	29	33	54
Doctorfish	*Acanthurus chirurgus*	71	2	5	11	8	1					10	12	12	7	3				
Blue tang	*Acanthurus coeruleus*	128	1		1	2	2	2	43	4	6		2	4	1	4	6	14	15	21
MACKERELS	**SCOMBRIDAE**																			
Cero	*Scomberomorus regalis*	0																		
King mackerel	*Scomberomorus cavalla*	1																	1	
TRIGGERFISHES	**BALISTIDAE**																			
Gray triggerfish	*Balistes capriscus*	0																		
Ocean triggerfish	*Canthidermis sufflamen*	1													1					
FILEFISHES	**MONACANTHIDAE**																			

Appendix 4 (continued)

			Transects									Point Counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Unicorn filefish	*Aluterus monoceros*	0																		
Orange filefish	*Aluterus schoepfi*	0																		
Scrawled filefish	*Aluterus scriptus*	25				2	1					1		1	4	5		4	2	5
Orangespotted filefish	*Cantherhines pullus*	18		2	1		1		1			1	1	2			2	4	3	
Fringed filefish	*Monacanthus ciliatus*	2									1							1		
Slender filefish	*Monacanthus tuckeri*	1																	1	
Planehead filefish	*Stephanolepis hispidus*	1									1									
BOXFISHES	**OSTRACIIDAE**																			
Honeycomb cowfish	*Acanthostracion polygonius*	2							1									1		
Scrawled cowfish	*Acanthostracion quadricornis*	0																		
Spotted trunkfish	*Lactophrys bicaudalis*	1															1			
Smooth trunkfish	*Lactophrys triqueter*	6					1				1					1	1	1		1
PUFFERS	**TETRAODONTIDAE**																			
Sharpnose puffer	*Canthigaster rostrata*	183	4	5	10	7	7	7	21	23	19	5	7	9	5	4	2	15	21	12
Bandtail puffer	*Sphoeroides spengleri*	3																2		1
PORCUPINEFISHES	**DIODONTIDAE**																			
Striped burrfish	*Chilomycterus schoepfi*	9											7	2						
Balloonfish	*Diodon holocanthus*	12	1	1	5						1		1	1				1		1
Porcupinefish	*Diodon hystrix*	9										2	2	5						
	Total Abundance	10820	202	262	480	566	436	410	578	592	595	294	520	794	1009	810	698	858	867	849
	Total Species	154	33	39	41	49	49	40	42	33	44	35	39	53	57	52	41	52	41	48

Appendix 5. Fish abundance by count type and power state for Quarter 6 (June 2015). Numbers in each column represent the combined total number of fishes observed from all surveys completed within each power state.

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
STINGRAYS	**DASYATIDAE**																			
Southern stingray	*Dasyatis americana*	1						1												
Yellow stingray	*Urobatis jamaicensis*	0																		
MORAY EELS	**MURAENIDAE**																			
Goldentail moray	*Gymnothorax miliaris*	0																		
Spotted moray	*Gymnothorax moringa*	0																		
LIZARDFISHES	**SYNODONTIDAE**																			
Inshore lizardfish	*Synodus foetens*	0																		
Sand diver	*Synodus intermedius*	0																		
FLYINGFISHES	**EXOCOETIDAE**																			
Ballyhoo	*Hemiramphus brasiliensis*	0																		
TRUMPETFISHES	**AULOSTOMIDAE**																			
Trumpetfish	*Aulostomus maculatus*	5													2			1		2
SCORPIONFISHES	**SCORPAENIDAE**																			
Red lionfish	*Pterois volitans*	0																		
Spotted scorpionfish	*Scorpaena plumieri*	5					1	2			1						1			
SEA BASSES	**SERRANIDAE**																			
Graysby	*Cephalopholis cruentata*	24				1		1	3					1	2	2	1	4	6	3
Coney	*Cephalopholis fulvus*	0																		
Rock hind	*Epinephelus adscensionis*	0																		
Red grouper	*Epinephelus morio*	0																		
Blue hamlet	*Hypoplectrus gemma*	4									2									2

Appendix 5 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Shy hamlet	*Hypoplectrus guttavarius*	0																		
Hamlet juvenile	*Hypoplectrus* spp.	1					1													
Butter hamlet	*Hypoplectrus unicolor*	17				1	1	1	2		2				3	1	3		1	2
Orangeback bass	*Serranus annularis*	0																		
Lantern bass	*Serranus baldwini*	6					1	2	1		2									
Tobaccofish	*Serranus tabacarius*	0																		
Harlequin bass	*Serranus tigrinus*	18				2	4	1							2	3	6			
JAWFISHES	**OPISTOGNATHIDAE**																			
Yellowhead jawfish	*Opistognathus aurifrons*	0																		
Dusky jawfish	*Opistognathus whitehursti*	2	2																	
CARDINALFISHES	**APOGONIDAE**																			
Flamefish	*Apogon maculatus*	1																1		
Dusky cardinalfish	*Phaeoptyx pigmentaria*	4													4					
TILEFISHES	**MALACANTHIDAE**																			
Sand tilefish	*Malacanthus plumieri*	2				1					1									
REMORAS	**ECHENEIDAE**																			
Sharksucker	*Echeneis naucrates*	0																		
JACKS	**CARANGIDAE**																			
Yellow jack	*Carangoides bartholomaei*	3									2						1			
Blue runner	*Caranx crysos*	63				3									36	7		16	1	
Bar jack	*Caranx ruber*	264			1		2	2	3	64			1	22	40	34	3	1	6	85
Mackerel scad	*Decapterus macarellus*	30																		30
Round scad	*Decapterus punctatus*	0																		
Rainbow runner	*Elagatis bipinnulata*	0																		
Greater amberjack	*Seriola dumerili*	0																		

Appendix 5 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Almaco jack	*Seriola rivoliana*	0																		
SNAPPERS	**LUTJANIDAE**																			
Mutton snapper	*Lutjanus analis*	1								1										
Gray snapper	*Lutjanus griseus*	0																		
Lane snapper	*Lutjanus synagris*	0																		
Yellowtail snapper	*Ocyurus chrysurus*	100	4	2	14	3	3	1	3	2		13	4	14		3	16	15	2	1
GRUNTS	**HAEMULIDAE**																			
Black margate	*Anisotremus surinamensis*	2														1	1			
Porkfish	*Anisotremus virginicus*	30		1	4			1		1		3	3	11		1	2	2	1	
White margate	*Haemulon album*	0																		
Tomtate	*Haemulon aurolineatum*	1	1																	
Caesar grunt	*Haemulon carbonarium*	86	4		7							22	10	43						
Smallmouth grunt	*Haemulon chrysargyreum*	9												9						
French grunt	*Haemulon flavolineatum*	649	30	2	76	41	8	34	1	2	2	65	26	128	80	70	77	5		2
Spanish grunt	*Haemulon macrostomum*	1																	1	
Sailor's choice	*Haemulon parra*	2										1		1						
White grunt	*Haemulon plumierii*	63	1		2	1	2	2	4	9		3	1	6	3	3	4	13	5	4
Bluestriped grunt	*Haemulon sciurus*	57		1	2	1	1					19	16	11	1	3	2			
Juvenile grunts	*Haemulon* spp.	22			9							3			6		4			
PORGIES	**SPARIDAE**																			
Jolthead porgy	*Calamus bajonado*	0																		
Saucereye porgy	*Calamus calamus*	0																		
Sheepshead porgy	*Calamus penna*	0																		
Silver porgy	*Diplodus argenteus*	0																		
DRUMS	**SCIAENIDAE**																			

Appendix 5 (continued)

			Transects									**Point Counts**								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Jackknife	*Equetus lanceolatus*	0																		
Spotted drum	*Equetus punctatus*	1															1			
Cubbyu	*Equetus umbrosus*	0																		
Highhat	*Pareques acuminatus*	12	2		1	3				1				1		1		2		1
GOATFISHES	**MULLIDAE**																			
Spotted goatfish	*Pseudupeneus maculatus*	32				2		1	3	2	1	3	1		3	2	6	4	2	2
SEA CHUBS	**KYPHOSIDAE**																			
Bermuda sea chub	*Kyphosus sectatrix*	86	2	1	19							9	7	48						
BUTTERFLYFISHES	**CHAETODONTIDAE**																			
Foureye butterflyfish	*Chaetodon capistratus*	32					2		2	2	2			2	3	6	4	4	3	2
Spotfin butterflyfish	*Chaetodon ocellatus*	20			2						1					4	4	5	1	3
Reef butterflyfish	*Chaetodon sedentarius*	64				3	6	3	2	2	1	1			5	8	16	6	6	5
Banded butterflyfish	*Chaetodon striatus*	8									2								4	2
ANGELFISHES	**POMACANTHIDAE**																			
Blue angelfish	*Holacanthus bermudensis*	26							4	3	1							5	9	4
Queen angelfish	*Holacanthus ciliaris*	6							1		1					1		1	1	1
Townsend angelfish	*Holacanthus townsendi*	0																		
Rock beauty	*Holacanthus tricolor*	13						1		1	1				2	1	1	2	1	3
Gray angelfish	*Pomacanthus arcuatus*	30		1			1		1	3	1	2		6	4		2	3	4	2
French angelfish	*Pomacanthus paru*	18	1								1	2	2	2	2	2	2	4		
DAMSELFISHES	**POMACENTRIDAE**																			
Sergeant major	*Abudefduf saxatilis*	187	12		39	4	10	5				17	10	47	9	16	18			
Blue chromis	*Chromis cyanea*	142						2	8	11	10					3	2	40	28	38
Yellowtail reeffish	*Chromis enchrysura*	1									1									
Sunshinefish	*Chromis insolata*	197					2		21	29	14					1		46	37	47

Appendix 5 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Brown chromis	*Chromis multilineata*	194					2		3	20	2				14	21	25	49	20	38
Purple reeffish	*Chromis scotti*	52				1		2	1	12					1	3	3	24	5	
Yellowtail damselfish	*Microspathodon chrysurus*	3		3																
Dusky damselfish	*Stegastes adustus*	62	7	10	10	1	2	2				10	5	9		2	4			
Longfin damselfish	*Stegastes diencaeus*	2	1		1															
Beaugregory	*Stegastes leucostictus*	101	2		4	10	13	10	6	5	1	11		8		7	5	10	1	8
Bicolor damselfish	*Stegastes partitus*	1452		1	1	34	22	23	95	48	113				82	76	59	455	163	280
Threespot damselfish	*Stegastes planifrons*	0																		
Cocoa damslefish	*Stegastes variabilis*	59	7	7	9	4	5	4			1	3	8	7	3		1			
WRASSES	**LABRIDAE**																			
Spotfin hogfish	*Bodianus pulchellus*	2														2				
Spanish hogfish	*Bodianus rufus*	18				2	4	1		1	1			1		2	5	1		
Creole wrasse	*Clepticus parrae*	316							6	100	1				4			41	103	61
Slippery dick	*Halichoeres bivittatus*	211	28	10	49	10	13	6		1		27	18	39	8	1	1			
Yellowcheek wrasse	*Halichoeres cyanocephalus*	3								2									1	
Yellowhead wrasse	*Halichoeres garnoti*	378		1		35	21	35	52	30	33	1	1	1	26	19	29	57	10	27
Clown wrasse	*Halichoeres maculipinna*	287	18	19	37	21	18	12		6	1	28	23	45	12	16	19		8	4
Rainbow wrasse	*Halichoeres pictus*	0																		
Blackear wrasse	*Halichoeres poeyi*	21	6	2	9		1					1		2						
Puddingwife	*Halichoeres radiatus*	14	1		4							2	2	4			1			
Hogfish	*Lachnolaimus maximus*	5						1		1	1								1	1
Bluehead wrasse	*Thalassoma bifasciatum*	1115	32	27	117	12	87	49	61	65	51	69	25	120	33	10	67	138	60	92
Green razorfish	*Xyrichtys splendens*	0																		
PARROTFISHES	**SCARIDAE**																			
Bluelip parrotfish	*Cryptotomus roseus*	32		4		1		2	4	2	6	7						4		2

Appendix 5 (continued)

			Transects									Point Counts								
Species List			**Shallow**			**Middle**			**Deep**			**Shallow**			**Middle**			**Deep**		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Parrotfish species	*Scaridae* spp.	0																		
Midnight parrotfish	*Scarus coelestinus*	0																		
Blue parrotfish	*Scarus coeruleus*	2							1				1							
Rainbow parrotfish	*Scarus guacamaia*	0																		
Striped parrotfish	*Scarus iseri*	200	7	9	14	24	23	4	4	7	6	16	15	12	16	14	15	6	7	1
Princess parrotfish	*Scarus taeniopterus*	67			1	6		2	8	9	5	1		1	7	3	10	7	4	3
Queen parrotfish	*Scarus vetula*	12	1			1				1		2		3	1	2	1			
Greenblotch parrotfish	*Sparisoma atomarium*	68				12	6	10	12	2	9			2			5	5	1	4
Redband parrotfish	*Sparisoma aurofrenatum*	616	19	5	23	44	46	47	30	19	27	18	16	62	40	44	63	43	34	36
Redtail parrotfish	*Sparisoma chrysopterum*	21												1			1	17	2	
Bucktooth parrotfish	*Sparisoma radians*	53	1	1	1	7	6	16		2	1				6	3		8	1	
Redfin parrotfish	*Sparisoma rubripinne*	25									2			1				20	2	
Stoplight parrotfish	*Sparisoma viride*	86	2	2	14	10	8	8			1	4	5	12	2	3	8	5	2	
COMBTOOTH BLENNIES	**BLENNIDAE**																			
Barred blenny	*Hypleurochilus bermudensis*	1					1													
Redlip blenny	*Ophioblennius macclurei*	3	1									1		1						
Seaweed blenny	*Parablennius marmoreus*	27	7	5	5		1					3	3	1	1	1				
SCALY BLENNIES	**LABRISOMIDAE**																			
Hairy blenny	*Labrisomus nuchipinnis*	4	2			2														
Rosy blenny	*Malacoctenus macropus*	51	20	6	14							4	3	4						
Saddled blenny	*Malacoctenus triangulatus*	20	5		5	2	1	1				1		4		1				
Banded blenny	*Paraclinus fasciatus*	0																		
TUBE BLENNIES	**CHAENOPSIDAE**																			
Roughhead blenny	*Acanthemblemaria aspera*	13	4	4	3			1		1										
Sailfin blenny	*Emblemaria pandionis*	2			2															

Appendix 5 (continued)

			Transects									Point Counts								
Species List			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
GOBIES	**GOBIIDAE**																			
Frillfin goby	*Bathygobius soporator*	1		1																
Colon goby	*Coryphopterus dicrus*	17	1	1	1	1	4	5		2	1			1						
Bridled goby	*Coryphopterus glaucofraenum*	102	6	2	4	18	12	20	6	15	8		1	4			5			1
Masked/Glass goby	*Coryphopterus hyalinus/personatus*	2274				80	82	229	278	115	212				130	43	175	430		500
Spotted goby	*Coryphopterus punctipectophorus*	1						1												
Dash goby	*Ctenogobius saepepallens*	10				5	1	3									1			
Neon goby	*Elacatinus oceanops*	15	1	1	8			1			1	1		2						
Goldspot goby	*Gnatholepis thompsoni*	25	4		1	6			2	4	2	1	1			1	1	2		
Code goby	*Gobiosoma robustum*	1				1														
Blue goby	*Ptereleotris calliura*	1				1														
SPADEFISHES	**EPHIPPIDAE**																			
Atlantic spadefish	*Chaetodipterus faber*	0																		
SURGEONFISHES	**ACANTHURIDAE**																			
Ocean surgeon	*Acanthurus bahianus*	860	9	30	65	27	20	31	41	4	27	133	140	126	48	35	38	45	13	28
Doctorfish	*Acanthurus chirurgus*	159	3	6	14	6	9	8	1	11	5	18	31	12		13	9		8	5
Blue tang	*Acanthurus coeruleus*	84			1		3	1	4	7	3	1	2	1	11	6	7	16	12	9
MACKERELS	**SCOMBRIDAE**																			
Cero	*Scomberomorus regalis*	5			2						1					1				1
King mackerel	*Scomberomorus cavalla*	0																		
TRIGGERFISHES	**BALISTIDAE**																			
Gray triggerfish	*Balistes capriscus*	10		1	1							1	1	6						
Ocean triggerfish	*Canthidermis sufflamen*	0																		
FILEFISHES	**MONACANTHIDAE**																			
Unicorn filefish	*Aluterus monoceros*	2																		2

Appendix 5 (continued)

Species List			Transects									Point Counts								
			Shallow			Middle			Deep			Shallow			Middle			Deep		
Common Name	**Scientific Name**	**Total**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**	**AC**	**DC**	**OFF**
Orange filefish	*Aluterus schoepfi*	2																		2
Scrawled filefish	*Aluterus scriptus*	20								1			1	1	3	4			4	6
Orangespotted filefish	*Cantherhines pullus*	28			1	3	2	5				1	1		5	4	4	1		1
Fringed filefish	*Monacanthus ciliatus*	0																		
Slender filefish	*Monacanthus tuckeri*	0																		
Planehead filefish	*Stephanolepis hispidus*	0																		
BOXFISHES	**OSTRACIIDAE**																			
Honeycomb cowfish	*Acanthostracion polygonius*	3							1									1	1	
Scrawled cowfish	*Acanthostracion quadricornis*	0																		
Spotted trunkfish	*Lactophrys bicaudalis*	5				1						1			2			1		
Smooth trunkfish	*Lactophrys triqueter*	2				1											1			
PUFFERS	**TETRAODONTIDAE**																			
Sharpnose puffer	*Canthigaster rostrata*	230	14	3	7	10	10	9	28	12	30	3	5	8	9	11	4	33	11	23
Bandtail puffer	*Sphoeroides spengleri*	2												2						
PORCUPINEFISHES	**DIODONTIDAE**																			
Striped burrfish	*Chilomycterus schoepfi*	0																		
Balloonfish	*Diodon holocanthus*	16	1		3	2	3	3	1			1		1			1			
Porcupinefish	*Diodon hystrix*	0																		
	Total Abundance	11821	269	169	607	467	471	612	704	638	601	533	389	856	671	521	745	1599	593	1376
	Total Species	155	38	31	44	47	44	48	37	44	48	43	33	49	41	50	53	46	43	45