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The Across-Shelf Larval, Postlarval, and Juvenile Fish Assemblages Collected at Offshore Oil and Gas Platforms West of the Mississippi River Delta

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Abstract.—A cross-shelf transect of three oil and gas platforms in the north-central Gulf was sampled to examine the role that platforms (hard substrate habitat) may play in the early life history stages of reef-dependent and reef-associated fishes. The ichthyoplankton and juvenile fish assemblages were sampled at Green Canyon 18 (219-m depth, shelf slope), Grand Isle 94 (60-m depth, mid-shelf), and South Timbalier 54 (22-m depth, inner shelf) with passive plankton nets and light traps. At all sites, clupeiforms were the dominant taxa collected, comprising 59–97% of the total catch. Reef-dependent fishes (e.g., pomacentrids and scarids) were relatively rare at all platforms, while reef-associated taxa (e.g., serranids, carangids, and blenniids) were generally more common. High numbers of piscivorous juveniles (synodontids, scombrids, and carangids) were collected, indicating that predation during early life history stages may be important in determining local reef assemblages. Similarity indices indicated that the larval and juvenile fish assemblages collected at the platforms differed across the shelf. Overall, across-shelf patterns in reef fish larval and juvenile fish distributions were similar to those of the adults. Taxonomic richness (genus level) was highest at the mid-shelf platform, possibly a result of its proximity to a high density of upstream and surrounding platforms, which may create generally favorable conditions for the recruitment of reef fishes. There were no significant differences in taxonomic diversity among the platforms in plankton net collections, but light trap diversity was significantly highest at the mid-shelf platform. With the limited amount of hard-substrate habitat available in the northern Gulf, the addition of artificial habitats (platforms) may increase the chances of adult fishes finding suitable spawning habitat, as well as increase the number of settlement sites for juvenile fishes, particularly where platforms are most dense (mid- and inner shelf).

Introduction

The Gulf of Mexico (Gulf) yields about 40% of the commercial fish landings (NOAA/NMFS 1993) in

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the United States and supports 33% of the country's recreational fishery (Essig et al. 1991; Van Voorhies et al. 1992). The region also possesses the vast majority of the nation's coastal wetlands. Louisiana alone has more than 3.8 million acres (>40% of the nation's total wetlands), but these areas are disappearing at an alarming rate (i.e., Louisiana land loss represents 60–80% of the nation's total annual coastal wetland loss; Boesch et al. 1994). The continual loss of Gulf estuarine habitats that serve as the nursery grounds for a large number of commercially and recreationally important fisheries makes knowledge of the potential nursery function of other habitats critical.

The introduction and proliferation of offshore oil and gas structures in the northern Gulf has undoubtedly affected the marine ecosystem. There are approximately 5,000 oil and gas structures in the northern Gulf, about 4,000 of which are in federal waters (Stanley and Wilson 2000). The central and western Gulf is dominated by a mud/silt/sand bottom with little relief or hard bottom habitat. Parker et al. (1983) reported only 2,780 km^2 of natural available reef in the central and western Gulf. Gallaway (1998) calculated that oil and gas platforms in the northern Gulf provide 11.7 km^2 (or <0.4%) of the total "reef" habitat. Although this estimate seems low, the fact that platforms represent vertical, hard substrate that extends from the bottom to the surface (photic zone), regardless of location and depth, increases their significance.

The adult fish communities around oil and gas platforms (platforms) in the Gulf are fairly well known (Rooker et al. 1997; Stanley and Wilson 2000), as is their fish aggregation value (CDOP 1985). However, biologists still disagree as to whether platforms (i.e., artificial reefs) contribute significantly to new fish production or simply attract and concentrate existing fish biomass (Pickering and Whitmarsh 1997; Bortone 1998). Existing data on adult fishes support both sides of the debate (Stone et al. 1979; Alevizon et al. 1985). Bohnsak (1989) theorized that reef effects fall along a continuum between attraction of existing organisms and production, with increased productivity occurring for reef-dependent species in areas of limited hard substrate habitat.

Few studies have attempted to compare the ichthyofaunal assemblages collected at oil and gas platforms in the north-central Gulf across wide depth zones, and the information that is available primarily concerns adult fishes and not their early life history stages. Sonnier et al. (1976) surveyed oil and gas platforms (18–55-m depth) off Louisiana as well as inshore (37–59 m) and offshore (110–155 m) reefs and described the deeper reefs as being more speciose than inshore reefs or platforms. This greater offshore reef species richness was primarily due to the presence of southern Gulf-Caribbean taxa (e.g., butterflyfishes, parrotfishes, and cleaning gobies) and taxa common to reefs in the northwestern Gulf off Texas. The authors suggested that the lower temperatures that occur at the inshore reefs and platforms are a limiting factor in the number of species, particularly tropicals, which inhabit inshore habitats. Gallaway et al. (1980) and Gallaway (1981) reviewed previous descriptions of invertebrate and vertebrate faunal assemblages from the north-central Gulf's continental shelf. They characterized differences largely upon different bottom types (fluvial/terrigenous sediments west of the Mississippi River Delta and carbonaceous sediments to the east), circulation patterns, climate, and related hydrographic conditions.

Even fewer baseline, ecological ichthyoplankton studies within the oil field have been published (Finucane et al. 1979a, 1979b; Bedinger et al. 1980), and none have been published that focus upon platform infrastructure. To our knowledge, only one study has investigated the ichthyoplankton community found even in proximity to petroleum platforms. Finucane et al. (1979b), using bongo and neuston nets, sampled within 30–90 m of two oil platforms and two satellite (well) jackets, all within a 5-km radius of each other and in 17 m of water southeast of Galveston, Texas. Three, 2-d cruises collected primarily engraulids, sciaenids, and bothids. Species richness was found to be greatest at the platform sites in July and October and at the satellite structures in February. Overall, of the 68 taxa identified to genus, 38 were associated exclusively with at least one of the structure sites, while another 29 were found near both structure sites and control sites. Dominant taxa at the structure sites included unidentified engraulids, *Anchoa* spp., *Cynoscion* spp., *Syacium* spp., *Micropo-gonias undulatus*, and unidentified clupeids. Based on eggs and larval abundance, the petroleum field was determined to be an active spawning area for anguilliforms, callionymids, clupeids, sciaenids, scombrids, and soleids, but reef fish eggs and larvae were not abundant.

This study was part of a larger, coordinated research program investigating the overall importance of platforms as habitat for larval and juvenile fishes (Hernandez 2001; Tolan 2001) as well as adult fishes (Stanley and Wilson 2000). The overall focus of this study had three main objectives. The first was to provide more basic biological information on reef fish (e.g., larval, postlarval, and juvenile taxonomy, seasonality, lunar periodicity, distribution [vertical and across shelf], and relative abundance). Second, we wished to provide much needed information on the role that platforms (hard substrate habitat) may play as recruitment grounds and/or refugia for postlarval and juvenile fish, which could contribute to fish production. Finally, as a long-term objective, we wished to evaluate the ecological significance that this artificial habitat building, which has occurred on an unprecedented scale in the north-central Gulf, may have had on the early life stages of fish. This paper reports results on the across-shelf distribution of larval and juvenile fishes collected at three platforms, with comments on seasonality, taxonomic diversity and similarity, relative abundances, and the potential importance of platforms to the early life history stages of fishes. Other stated objectives are addressed elsewhere (Hernandez 2001; Hernandez et al. 2001; Hernandez and Shaw 2003, this volume).

Methods

Study Sites

Data collection and analyses focused on three offshore oil and gas platforms in the north-central Gulf west of the Mississippi River Delta (Figure 1). Platform site selection was based upon the work of Gallaway et al. (1980), Gallaway (1981), and Continental Shelf Associates (1982) who reported that nekton communities around platforms could be categorized by water depth in the northern Gulf. Three communities were characterized: a coastal assemblage (3–20 m), an offshore assemblage (20–60 m), and a bluewater/tropical assemblage (>60 m). The platforms selected encompass all three zones. The outer shelf site, Mobil's Green Canyon (GC) 18, lies in 219 m of water on the shelf slope (27°56'37"N, 91°01'45"W). The mid-shelf site, Mobil's Grand Isle (GI) 94B, lies in 60 m of water (28°30'57"N, 90°07'23"W). The inner shelf site, Exxon's South Timbalier (ST) 54G, lies in 22 m of water (28°50'01"N, 90°25'00"W). All platforms had very similar structural complexity. GC 18 is a very large six-pile (column or leg) production platform, while GI 94 and ST 54 are eight-pile production platforms. Although the platforms varied in age (installation for GC 18 in 1988, GI 94 in 1975, and ST 54 in 1956), all had ample time for the development of mature biofouling communities as confirmed by diver observation.

Sampling Procedure

Sampling protocols for the outer shelf, mid-shelf, and inner shelf platforms were similar. The number of samples collected by trip, gear type, and depth/location for all platforms is summarized in Table 1. At the outer shelf site (GC 18), 11 monthly sampling trips were taken over 2–3-night periods coinciding with

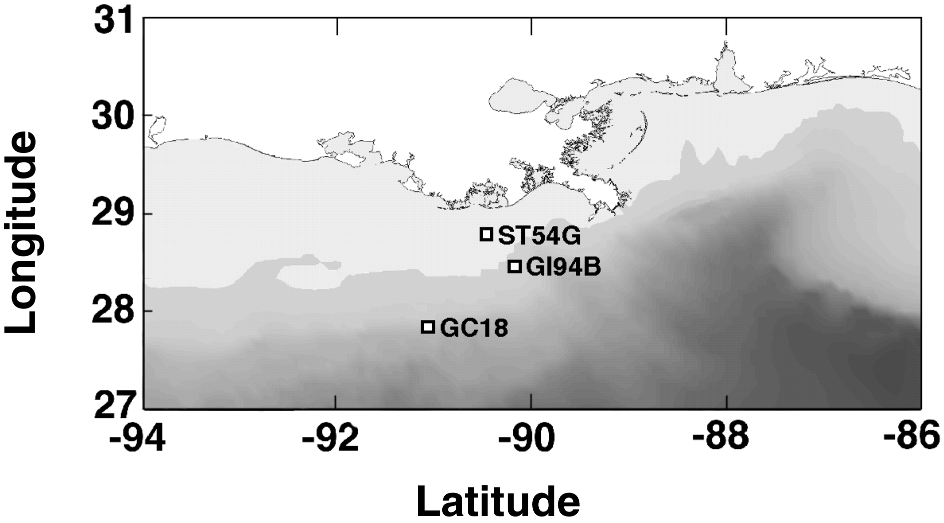


FIGURE 1. Location of the oil and gas platforms sampled during the course of this study.

TABLE 1. Number of samples collected at each site by date, gear type, and depth/location.

	Subsurface net	Surface net	Subsurface light-trap	Surface light-trap	Off-platform light-trap	Push net
			Outer shelf platform (GC 18) 1995–1996			
26–29 Jul (N)	0	9	18	18	5	
25–28 Aug (N)	0	12	18	18	9	
24–25 Sept (N)	0	12	12	12	6	
23–25 Oct (N)	9	9	18	18	9	
21–23 Nov (N)	9	9	18	17	9	
19 Jan (N)	3	3	6	6	3	
17–18 Feb (N)	5	5	10	6	4	
15–18 Apr (N)	0	0	0	0	15	
17–20 May (N)	2	9	5	5	18	
18–21 Jun (N)	13	16	14	13	9	
Totals	41	84	119	113	87	
			Mid-shelf (GI 94) 1996			
16–18 Apr (N)	6	6	4	8	8	
26–29 Apr (1)	18	18	18	18	18	
10–12 May (3)	10	12	12	12	12	
17–20 May (N)	18	18	18	18	18	
24–26 May (1)	12	13	12	13	11	
14–17 Jun (N)	18	18	18	18	18	
28 Jun–1 Jul (F)	17	17	13	12	13	
12–15 Jul (N)	17	17	15	13	16	
29 Jul–1 Aug (F)	11	13	11	12	12	
12–15 Aug (N)	16	17	15	17	17	
26–29 Aug (F)	18	19	18	18	18	
Totals	161	168	154	159	161	
			Inner shelf platform (ST 54) 1997			
7–8 Apr (N)	7	7	5	6	8	
5–8 May (N)	0	15	0	16	12	
20–23 May (F)	0	18	12	18	10	
4–5 Jun (N)	0	6	6	6	5	
20–21 Jun (F)	0	8	6	9	9	
3–5 Jul (N)	0	5	7	7	3	
17–20 Aug (F)	0	13	4	12	14	
3–5 Sept (N)	0	10	9	10	0	
Totals	7	82	49	84	61	
				148		149

(Lunar phases: N, new moon; F, full moon; 1, first quarter; 3, last quarter)

new moon phases from July 1995–June 1996, with the exception of the month of December (adverse weather). New moon phases were targeted at this platform because they have been associated with the peak recruitment periods of many reef-dependent fishes (Johannes 1978; Robertson et al. 1988). All sampling began 1 h after sunset and was completed 1 h before sunrise. The major sampling station for each platform was located in the internal central region along a stainless steel, small diameter guidewire (vertical monorail) tethered to the first set of the platform's underwater, cross-member, support structures. At this central station, replicate light trap collections (*n* = 2) were taken three times each night at near-surface and at a depth between 15 and 23 m, depending upon the depths of the other platforms' first set of underwater cross-member supports. Subsurface samples were collected by lowering a light trap without floatation. Light traps were deployed for 10-min periods. Replicate passive, horizontal plankton net collections (*n* = 2) were taken three times at both depths during each night at the central station using a metered (General Oceanics flowmeter model 2030 with slow velocity rotor), 60-cm-diameter, 333-μm mesh net dyed dark green. The nets had a vane (to help orient into the current) that was fixed to a gimbled attachment on the net ring, allowing the net to be set and retrieved closed for the at depth deployment. In addition, three collections each night were made with a floating light trap, which was tethered and free drifted away (off-platform) from the platform (approximately 20 m) on the down-current side of the platform. For light traps sampled at depth or off-platform, the trap was deployed with the light off, fished with the light on, and then retrieved with the light off.

A total of 11 sampling trips were taken at the mid-shelf site (GI 94). Samples were collected twice monthly during new and full moons for three consecutive nights from April to August 1996 (the peak recruitment period for most reef-associated species in the northern Gulf). Sampling at GC 18 and GI 94, therefore, overlapped monthly from April to June 1996. In addition, during May, extra samples during the first quarter and third quarter moon phases were collected, but due to inclement weather, full moon collections were cancelled. At the inner shelf site (ST 54), sampling occurred twice monthly from April to September 1997 (eight trips total), during new and full moon periods over two consecutive nights. Sampling effort was modified at GI 94 and ST 54 to obtain one (rather than two) subsurface, surface, and off-platform light trap collection per set, and to include more sets (six rather than three) per night.

Samples collected at outer and mid-shelf platforms were preserved in ethanol with a subsequent change to fresh ethanol within 12–18 h. Samples collected at the inner shelf platform were fixed in 4% buffered formaldehyde and changed over to ethanol within 8–12 h. Fish were removed from all samples, enumerated, and measured under a dissecting microscope with the aid of an ocular micrometer and identified to the lowest taxonomic level possible using primarily the taxonomy of Robins et al. (1991). Large samples were split using a Folsom plankton splitter (Van Guelpen et al. 1982). In the event that the number of fish in a sample or a split was greater than 50 for any single species, the largest, smallest, and a random subsample of 50 individuals were measured. Preflexion larvae were measured to the end of the notochord (NL), and all postflexion larvae, juveniles, and adults were measured to the posterior end of the vertebral column (SL). Light trap samples were standardized to a catch per unit effort (CPUE) of fish per 10 min. Plankton net samples were standardized to the number of fish per 100 m^3 (density). Sea states, adverse weather, transportation delays, and platform safety concerns often forced us to suspend some sample collections. Only seven subsurface plankton net collections were taken at the inner shelf platform (7–8 April) because of problems with the monorail rigging and biofouling. Similar gear problems reduced the number of subsurface net samples collected at the outer shelf platform.

Data Analyses

Schoener's Index of Similarity was calculated for all sites by combining fish collected by all gears within each site as an indication of the fish assemblage similarity among sites (Schoener 1970). Schoener's Index of Similarity values range from 0 (no similarity) to 1 (identical taxonomic compositions). Only fish identified to at least the genus level were used in the analyses. Since this type of analysis can be heavily influenced by large abundances of a single species, these analyses were conducted without the most dominant taxa included at each site. At times, sampling effort differed temporally among sites (Table 1), so the samples used for comparisons were limited to only those months where samples were collected for both sites in a pairing. For example, only April–August samples were used to compare the outer shelf platform assemblage (GC 18) to the mid-shelf (GI 94) and inner shelf (ST 54) assemblages. Full data sets were used in comparisons between the mid-shelf and inner shelf platforms. Shannon-Weiner diversity indices (Magurran 1988) were calculated for each sample collected at all sampling sites. Only fish identified to at least the genus level were used in the analyses. Differences in diversity among sites were analyzed with analysis of variance (ANOVA) models using site as a main effect (SAS 1989). Post-ANOVA tests (Tukey's Studentized Range, $\alpha = 0.05$) were used to determine which sites where significantly different in mean taxonomic diversity (SAS Institute, Inc. 1989).

Taxonomic richness (either at the family or genus/species level) is used in reference to the number of taxa collected. While many fishes are found in association with natural and artificial reefs in the Gulf of Mexico, we followed the descriptions of Choat and Bellwood (1991) as a guide in defining reef-dependent and reef-associated fishes. Reef-dependent taxa are those that are associated with reef habitat for the duration of their adult life and include individuals from the families Chaetodontidae, Pomacanthidae, Acanthuridae, Scaridae, Pomacentridae, and Labridae. Reef-associated taxa are those commonly found in association with reef habitats and are often exploiting the resources of the reef, but they may occur in other habitats as well. This may encompass many pelagic (e.g., Sphyraenidae, Rachycentridae, Scombridae, Carangidae) and benthic/demersal taxa (e.g., Blenniidae, Gobiidae, Holocentridae, Lutjanidae, Opistognathidae, Muraenidae, Serranidae).

Results

Larval and Juvenile Fish Collected at the Outer Shelf Platform (GC 18)

A total of 5,057 fish were collected at the outer shelf platform (GC 18) over the course of the year (Table 2). Light traps and plankton nets collected 1,114 and 3,943 fish, respectively. Plankton nets collected fish from 45 different families, 15 of which were not collected with light traps. Light traps collected fish from 37 different families, 7 of which were only collected with light traps. Plankton nets collected fish from 64 taxa (identified at least to genus), 25 of which were not collected with light traps, while light traps collected fish from 59 taxa with 18 being unique to light trap collections. Additional information on taxonomic gear selectivity is reported elsewhere (Hernandez and Shaw 2003, this volume).

The ichthyoplankton community at GC 18 (located in 230 m water depth on the shelf slope) was dominated by coastal pelagic species, particularly engraulids and clupeids, which accounted for 33% and 25%, respectively, of the total catch by both gear types. *Opisthonema oglinum* was the dominant species in the mid-to-late summer months, while unidentified engraulids peaked in November. *Engraulis eurystole* was also relatively common throughout the summer and early fall. Gobies and *Mugil cephalus* were among the most common nonclupeiform fishes in the plankton net collections. *Mugil cephalus* was relatively common in the fall–winter months and peaked in November. The carangids *Caranx crysos* and *C. hippos/latus* were relatively common, and though they are usually considered pelagic species, they congregate around platform structures (Gallaway 1981; Stanley and Wilson 1997).

Some of the more abundant demersal taxa included the flatfish *Citharichthys spilopterus*, *Symphurus* spp., and *Syacium* spp., as well as the sciaenid *Sciaenops ocellatus* and bregmacerotid *Bregmaceros cantori*. While not unique to this site, the mesopelagic species, *Cyclothone braueri*, was common in subsurface net collections, and myctophids were present in subsurface light trap collections. Though not abundant, other outer shelf species of note include *Diplophos taenia*, *Chlorophthalamus agassizi*, *Scopelarchoides* spp., *Paralepis atlantica*, and *Lestrolepis intermedia*. While the adults are seldom observed, the planktonic nature of the early life stages of these mesopelagic taxa made them a significant component of the outer shelf ichthyoplankton assemblage at GC 18.

The dominant reef-associated fishes at GC 18 were unidentified gobiids. Second in abundance were serranids, most of which were from the poorly known subfamily Anthiinae. Anthiine adults are residents of rocky reefs on the outer shelf and are not usually found on shallow, inshore reefs (Thresher 1984). Other serranids included *Epinephelus* spp. and *Mycteroperca* spp. Lutjanids were also fairly common among the reef fish taxa, primarily *Pristipomoides aquilonaris*, one of the most common residents of mid- and outer shelf reefs (Hoese and Moore 1977). Other noteworthy taxa included unidentified blennies and *Holocentrus* spp. (reef-associated), as well as unidentified damselfishes and *Pomacentrus* spp. (reef-dependent).

Larval and Juvenile Fish Collected at the Mid-Shelf Platform (GI 94)

A total of 45,754 fish were collected at the mid-shelf platform (GI 94). Light traps collected 31,353 fish and plankton nets collected 14,401 fish (Table 2). Plankton nets collected fish from 40 different families, 6 of which were not collected by light traps. Light traps sampled fish from 37 families, only 3 of which were not sampled by plankton nets. Plankton nets collected fish from 83 taxa (identified at least to genus), 26 of which were not collected in light traps, while light traps collected fish from 90 taxa, 31 of which were not sampled with plankton nets.

At GI 94, coastal pelagic species dominated the catches once again, but there appeared to be a taxonomic shift in dominance. Clupeiforms again dominated the collections, but engraulids became more prominent in abundance (57%) than clupeids (9%). Unidentified engraulids were the most abundant pelagic taxa in the plankton nets, and *Engraulis eurystole* were very common in light trap collections. *Opisthonema oglinum*, which was the most dominant clupeid at the outer shelf platform (GC 18), ranked third in overall abundance at the mid-shelf platform. *Caranx crysos* and *C. hippos/latus* were not as dominant at this site as they were at GC 18, but as a family, the carangids had more species richness at GI 94. *Oligoplites saurus*, *Seriola dumerili/rivoliana*, *S. fasciata*, *Trachinotus carolinus*, and

TABLE 2. Total plankton net density (fish/100 m^3) and light-trap CPUE (fish/10 min) for fish collected at three oil and gas platforms with standard error (se), rank, percent of total catch (%), and months collected for each taxa. For ranks, tied values received the mean of the corresponding ranks.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Osteichthyes							
Unidentified	Feb, Apr–Nov	2.2 (0.9)	0.1 (<0.1)	0.8 (0.4)	0.5 (0.3)	3.6 (3.4)	0.2 (0.2)
		13 (0.6)	8 (3.1)	24 (0.5)	15 (0.8)	12 (<0.1)	12 (0.7)
Albuliformes							
Albulidae							
Albula vulpes	Apr	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)
(bonefish)							64.5 (<0.1)
Elopiformes							
Elopidae							
Elops saurus	Oct	0.1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
(ladyfish)	63.5 (<0.1)						
Anguilliformes							
Unidentified	Jun–Jul, Oct–Nov	2.5 (0.9)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1)
(eel)		9 (0.5)	39 (0.4)	88 (<0.1)			64.5 (<0.1)
Moringuidae							
Neoconger mucronatus	Oct	0.1 (0.1)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
(ridged eel)		57 (0.1)	72.5 (0.1)				
Muraenidae							
Unidentified	May–Oct	<0.1 (<0.1)	<0.1 (<0.1)	0.3 (0.1)	<0.1 (<0.1)	0.4 (0.4)	<0.1 (<0.1)
(moray eel)		94 (<0.1)	32 (0.5)	45 (0.1)	101 (<0.1)	41 (<0.1)	64.5 (<0.1)
Ophichthidae							
Unidentified	Apr–Aug, Oct–Nov	1.7 (0.6)	<0.1 (<0.1)	0.4 (0.2)	<0.1 (<0.1)	0.2 (0.2)	<0.1 (<0.1)
(snake eel)		17 (0.3)	32 (0.5)	32 (0.1)	49 (<0.1)	52 (<0.1)	49 (<0.1)
Myrophis punctatus	Feb	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
(speckled worm eel)		72.5					
Ophichthus spp.	Aug	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(snake eel)					64.5 (<0.1)		
Ophichthus gomesi	Jun–Jul	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(shrimp eel)			39 (0.1)	113 (<0.1)			

Table 2. Continued.

	Months collected	Outer shelf platform		Mid-shelf platform		Inner shelf platform	
		Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se)	CPUE (se)	Density (se)	CPUE (se)	Density (se)	CPUE (se)
		Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)	Rank (%)
Nettastomatidae							
Hoplunnis macrurus	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(freckled-pike conger)					81 (<0.1)		
Congridae							
Unidentified	Jul	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
(conger eel)		46.5 (0.3)					
Clupeiformes							
Unidentified	Apr–Sept	0.7 (0.6)	<0.1 (<0.1)	1.2 (1.1)	<0.1 (<0.1)	1.8 (1.8)	0 (0)
(herring/anchovy)		26 (0.8)	72.5 (0.1)	19 (0.2)	90 (<0.1)	17 (<0.1)	
Clupeidae							
Unidentified	Apr–May, Aug	0 (0)	0 (0)	0.3 (0.2)	<0.1 (<0.1)	0 (0)	0 (0)
(herring)				44 (<0.1)	81 (<0.1)		
Brevoortia patronus	Jan–Feb, Apr, Nov	1.6 (0.5)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)
(gulf menhaden)		18 (0.3)	35 (0.5)		101 (<0.1)		64.5 (<0.1)
Etrumeus teres	Jan–Feb, Apr	0.8 (0.7)	0 (0)	0.2 (0.1)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)
(round herring)		23 (0.3)		54 (<0.1)	49 (<0.1)	69 (<0.1)	
Harengula jaguana	Apr–Aug	<0.1 (<0.1)	0.1 (<0.1)	0.5 (0.2)	0.5 (0.1)	1.2 (0.5)	0.4 (0.1)
(scaled sardine)		77 (0.1)	17.5 (1.6)	30 (0.1)	16 (0.7)	24 (<0.1)	6 (1.3)
Opisthonema oglinum	Apr–Sept	26.6 (11.1)	0.3 (0.1)	38.7 (18.2)	3.8 (0.6)	3,400 (1,812)	18.2 (4.8)
(Atlantic thread herring)		2 (28.9)	3 (7.6)	2 (14.0)	6 (5.7)	1 (96.5)	1 (57.4)
Sardinella aurita	Apr, Jul–Aug	0 (0)	0 (0)	0.1 (0.1)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)
(Spanish sardine)				62 (<0.1)	51 (<0.1)	75 (<0.1)	64.5 (<0.1)
Engraulidae							
Unidentified	Feb, Apr-Nov	45.1 (11.8)	0.4 (0.1)	151.8 (24.6)	0.6 (0.1)	136.1 (36.6)	0.8 (0.2)
(anchovy)		1 (31.6)	1 (12.3)	1 (57.1)	13 (1.0)	2 (1.5)	4 (2.6)
Anchoa spp.	Apr–Aug	0 (0)	<0.1 (<0.1)	7.9 (4.2)	0.1 (0.1)	0.6 (0.6)	0 (0)
(anchovy spp.)			28.5 (0.7)	6 (3.1)	31 (0.1)	31 (<0.1)	
Anchoa hepsetus	Jun, Aug	0 (0)	0 (0)	0 (0)	0.4 (0.2)	0 (0)	<0.1 (<0.1)
(striped anchovy)					0.7 (0.7)		64.5 (<0.1)

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Anchoa mitchilli (bay anchovy)	Apr–Aug	<0.1 (<0.1) 88.5 (<0.1)	0.1 (<01) 19.5 (1.5)	4.5 (1.3) 8 (1.7)	0.9 (0.3) 11 (1.4)	3.9 (1.5) 11 (<0.1)	0.3 (0.1) 10 (0.9)
Anchoa nasuta (longnose anchovy)	May–Jun, Aug	0 (0)	0 (0)	0 (0)	6.7 (2.8) 4 (10.1)	0 (0)	<0.1 (<0.1) 31 (0.1)
Anchoa nasuta/hepsetus	Apr–Sept, Nov	0 (0)	0.4 (0.1) 2 (12.1)	5.1 (1.7) 7 (2.0)	11.4 (4.2) 2 (17.3)	2.1 (0.7) 16 (<0.1)	5.6 (1.7) 2 (17.8)
Anchoviella perfasciata (flat anchovy)	Apr, Aug	0 (0)	0 (0)	0 (0)	0.1 (<0.1) 35 (0.1)	<0.1 (<0.1) 78.5 (<0.1)	0 (0)
Engraulis eurystole (silver anchovy)	Apr–Oct	3.0 (2.8) 6 (2.4)	0.2 (<0.1) 7 (4.4)	2.2 (1.1) 14 (0.3)	15.2 (4.7) 1 (23.0)	0.2 (0.1) 50 (<0.1)	0.1 (<0.1) 15 (0.4)
Stomiiformes							
Gonostomatidae							
Cyclothone braueri	Jan, Apr–Jul, Oct–Nov	1.7 (0.7)	0.1 (0.1) 16 (0.4)	0.1 (<0.1) 11.5 (2.3)	0 (0) 78 (<0.1)	0.1 (0.1)	0 (0) 60 (<0.1)
Diplophos taenia	Nov	0.3 (0.2) 44 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Vinciguerria nimbaria	Apr	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Aulopiformes							
Chlorophthalmidae							
Chlorophthalmus agassizi (shortnose greeneye)	Jun, Nov	0.2 (0.2) 50 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Scopelarchidae							
Scopelarchoides spp. (pearleye spp.)	Jan	<0.1 (<0.1) 91 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Synodontidae							
Unidentified (lizardfish)	Jan, Apr–Aug, Oct	0.4 (0.2) 40 (0.2)	<0.1 (<0.1) 56 (0.2)	1.1 (0.3) 21 (0.2)	0.4 (0.1) 19 (0.6)	0 (0)	<0.1 (<0.1) 44.5 (<0.1)

TABLE 2. Continued.

	Months collected	Outer shelf platform		Mid-shelf platform		Inner shelf platform	
		Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Saurida brasiliensis	Apr–Aug	<0.1 (<0.1)	0.1 (0.1)	2.7 (0.6)	1.9 (0.2)	0 (0)	0.1 (<0.1)
(largescale lizardfish)		100 (<0.1)	11.5 (2.3)	12 (0.2)	9 (2.9)		24 (0.2)
Saurida normani	Apr–May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(shortjaw lizardfish)					81 (<0.1)		
S. normani/brasiliensis	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
					101 (<0.1)		
Saurida suspicio	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)
					101 (<0.1)		64.5 (<0.1)
Synodus spp.	May–Jun	0 (0)	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)
(lizardfish spp.)				99.5 (<0.1)	38 (0.1)		
Synodus foetens	Apr–Aug	0 (0)	0 (0)	1.4 (0.4)	7.5 (1.8)	0.2 (0.1)	2.2 (0.7)
(inshore lizardfish)				18 (0.3)	3 (11.4)	48 (<0.1)	3 (6.9)
Synodus poeyi	Apr–Aug	0 (0)	0 (0)	0.7 (0.2)	3.8 (0.6)	0.2 (0.2)	<0.1 (<0.1)
(offshore lizardfish)				26 (0.2)	5 (5.8)	49 (<0.1)	64.5 (<0.1)
Synodus synodus	May–Jun	0.2 (0.2)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(red lizardfish)		52 (<0.1)	46.5 (0.3)		81 (<0.1)		
Trachinocephalus myops	Apr–Jun,	0.1 (0.1)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(snakefish)	Aug–Oct	71 (<0.1)	28.5 (0.7)		40.5 (<0.1)		
Paralepidae							
Unidentified	May, Nov	0.3 (0.2)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(barracudina)		46 (0.1)		103.5 (<0.1)			
Paralepis atlantica	Jul	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
(duckbill barracudina)			56 (0.2)				
Lestrolepis intermedia	May–Aug	0 (0)	<0.1 (<0.1)	0.1 (0.1)	<0.1 (<0.1)	0 (0)	0 (0)
			56 (0.2)	77 (<0.1)	64.5 (<0.1)		
Lestrolepis spp.	Aug	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(barracudina spp.)							

TABLE 2. Continued.

	Months collected	Outer shelf platform Plankton net	 Light-trap	Mid-shelf platform Plankton net	 Light-trap	Inner shelf platform Plankton net	 Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Myctophiformes							
Unidentified	Jun	0 (0)	0 (0)	0.1 (0.1) 66.5 (<0.1)	0 (0)	0 (0)	0 (0)
Myctophidae							
Unidentified (lanternfish)	Jan–Feb, Apr–Sept, Nov	0.7 (0.3) 30 (0.4)	0.1(<0.1) 15 (2.0)	0.4 (0.2) 31 (0.1)	<0.1 (<0.1) 37 (0.1)	0.5 (0.3) 35 (<0.1)	<0.1 (<0.1) 44.5 (<0.1)
Gadiformes							
Unidentified	Sept–Oct	0.1 (0.1) 61 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Bregmacerotidae							
Bregmaceros cantori (codlet)	Jan, Apr–Oct	2.0 (0.7) 15 (1.0)	<0.1 (<0.1) 25 (0.8)	8.9 (1.5) 4 (2.5)	0.7 (0.3) 12 (1.1)	1.7 (0.6) 20 (<0.1)	0.1 (<0.1) 28.5 (0.2)
Merluccidae							
Unidentified (whiting)	Nov	0 (0)	<0.1 (<0.1) 72.5 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Ophidiidae							
Unidentified (cuskeel)	May–Jul	<0.1 (<0.1) 97.5 (<0.1)	0 (0)	0.3 (0.1) 40 (0.1)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Lepophidium spp. (cusk-eel spp.)	Apr–May, Jul–Oct	0.7 (0.4) 27 (0.1)	<0.1 (<0.1) 46.5 (0.3)	0.1 (<0.1) 79 (<0.1)	0 (0)	0.4 (0.4) 43.5 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)
Lepophidium profundorum (fawn cusk-eel)	Jun	0 (0)	0 (0)	0.1 (<0.1) 58 (<0.1)	0 (0)	0 (0)	0 (0)
Lepophidium staurophor	Apr–Jun, Aug	0 (0)	0 (0)	<0.1 (<0.1) 83 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Ophidion spp. (cusk-eel spp.)	Apr, Jun	0 (0)	0 (0)	<0.1 (<0.1) 112 (<0.1)	0 (0)	<0.1 (<0.1) 73 (<0.1)	0 (0)
Ophidion nocomis	May–Jun	0 (0)	0 (0)	<0.1 (<0.1) 96 (<0.1)	<0.1 (<0.1) 81 (<0.1)	0 (0)	0 (0)
O. nocomis/selenops (cusk-eel spp.)	May	0 (0)	0 (0)	0.2 (0.1) 50 (<0.1)	<0.1 (<0.1) 101 (<0.1)	2.9 (1.6) 13 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)

Table 2. Continued.

	Months collected	Outer shelf platform Plankton net	 Light-trap	Mid-shelf platform Plankton net	 Light-trap	Inner shelf platform Plankton net	 Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Ophidion robinsi	May	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)
(cusk-eel spp.)							64.5 (<0.1)
Ophidion selenops	May–Jun	0 (0)	0 (0)	0.1 (0.1)	0 (0)	0 (0)	<0.1 (<0.1)
(mooneye cusk-eel)				69 (<0.1)			44.5 (<0.1)
Bythitidae							
Unidentified	May, Oct–Nov	0.4 (0.2)	<0.1 (<0.1)	0 (0)	0 (0)	0.4 (0.4)	0 (0)
(brotula)		41 (0.1)	46.5 (0.3)			43.5 (<0.1)	
Lophiiformes							
Unidentified	May, Aug	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
		100 (<0.1)	72.5 (0.1)				
Caulophrynidae							
Robia legula	Jul	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)
				84 (<0.1)			
Gobiesociformes							
Gobiesocidae							
Gobiesox strumosus	Apr–May, Jul	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)
(skilletfish)			25 (0.8)			70.5 (<0.1)	32 (0.1)
Atheriniformes							
Exocoetidae							
Unidentified	Apr, Jun, Aug–Sept	0.5 (0.3)	<0.1 (<0.1)	0.1 (0.1)	0 (0)	<0.1 (<0.1)	0 (0)
(flyingfish)		32 (0.2)	72.5 (0.1)	64 (0.1)		72 (<0.1)	
Cypselurus spp.	Apr–Jun	0 (0)	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)
(flyingfish spp.)				90 (<0.1)	81 (<0.1)	70.5 (<0.1)	
Cypselurus cyanopterus	Jun–Jul	0 (0)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)6
(margined flyingfish)			72.5 (0.1)		101 (<0.1)		4.5 (<0.1)
Cypselurus furcatus	May	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)
(spotfin flyingfish)							64.5 (<0.1)
C. furcatus/heterurus	May	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
			72.5 (0.1)				

Table 2. Continued.

	Months collected	Outer shelf platform		Mid-shelf platform		Inner shelf platform	
		Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Parexocoetus brachypterus (sailfin flyingfish)	Jul	0 (0)	<0.1 (<0.1) 39 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)
Atherinidae							
Unidentified (silverside)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	0.3 (0.2) 46 (<0.1)	0 (0)
Membras martinica (rough silverside)	Jun	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 44.5 (<0.1)
Beryciformes							
Holocentridae							
Holocentrus spp. (squirrelfish)	May–Jul	0.1 (0.1) 62 (0.1)	0.1 (<0.1) 17.5 (1.6)	0.1 (<0.1) 70 (0.1)	<0.1 (<0.1) 72 (<0.1)	0 (0)	0 (0)
Melamphaidae							
Melamphaes spp.	Jan, Jun	<0.1 (<0.1) 80 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gasterosteiformes							
Syngnathidae							
Syngnathus spp. (pipefish spp.)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 75 (<0.1)	0 (0)
Syngnathus louisiana (chain pipefish)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 82.5 (<0.1)	0 (0)
Scorpaeniformes							
Unidentified	Oct	0.2 (0.1) 53 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Scorpaenidae							
Unidentified (scorpionfish)	May–Jun, Oct	0.1 (0.1) 74 (<0.1)	0 (0)	0.1 (0.1) 72 (<0.1)	0 (0)	0 (0)	0 (0)
Scorpaena spp. (scorpionfish spp.)	Apr–Aug	0.1 (0.1) 73 (0.1)	0 (0)	0.2 (0.2) 47 (<0.1)	<0.1 (<0.1) 81 (<0.1)	<0.1 (<0.1) 81 (<0.1)	<0.1 (<0.1) 38.5 (<0.1)

Table 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Triglidae							
Unidentified (searobin)	Jul	0 (0)	0 (0)	<0.1 (<0.1) 114 (<0.1)	0 (0)	0 (0)	0 (0)
Prionotus spp (searobin)	Apr–May	<0.1 (<0.1) 95.5 (<0.1)	0 (0)	0.2 (0.1) 55 (<0.1)	<0.1 (<0.1) 81 (<0.1)	0.5 (0.2) 37 (<0.1)	<0.1 (<0.1) 44.5 (<0.1)
Perciformes							
Unidentified	Jan, Apr–Oct	2.2 (0.9) 12 (1.1)	0.1 (<0.1) 21 (1.4)	2.0 (0.5) 15 (0.4)	0.1 (<0.1) 34 (0.1)	10.8 (3.5) 6 (0.1)	0.1 (<0.1) 26 (0.2)
Serranidae							
Unidentified (sea bass/grouper)	Jan, Apr–Jun, Oct–Nov	0.8 (0.4) 25 (0.2)	<0.1 (<0.1) 72.5 (0.1)	0.1 (0.1) 60 (<0.1)	0.1 (<0.1) 34 (0.1)	0.1 (0.1) 66 (<0.1)	0 (0)
Anthinae (sea perch)	Apr–Jun, Nov	0.4 (0.2) 37 (0.7)	<0.1 (<0.1) 46.5 (0.3)	0.3 (0.2) 43 (0.1)	<0.1 (<0.1) 81 (<0.1)	0 (0)	0 (0)
Epinephelinae (grouper)	Apr–Jun	0.4 (0.2) 42 (0.8)	0 (0)	<0.1 (<0.1) 89 (<0.1)	<0.1 (<0.1) 58 (<0.1)	<0.1 (<0.1) 75 (<0.1)	0 (0)
Grammistinae	Jun–Jul	0.1 (<0.1) 75 (0.1)	0 (0)	<0.1 (<0.1) 94 (<0.1)	0 (0)	0 (0)	0 (0)
Serraninae (sea bass)	Apr–Jun, Aug	0 (0)	0 (0)	0.6 (0.2) 28 (0.2)	<0.1 (<0.1) 40.5 (<0.1)	0.3 (0.2) 45 (<0.1)	0 (0)
Priacanthidae							
Unidentified (bigeye)	May–Jun	0.1 (0.1) 68 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Priacanthus spp. (bigeye/glasseye spp.)	May–Jun	0 (0)	<0.1 (<0.1) 72.5 (0.1)	<0.1 (<0.1) 103.5 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Apogonidae							
Unidentified (cardinalfish)	May	<0.1 (<0.1) 97.5 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Apogon spp. (cardinalfish spp.)	May	<0.1 (<0.1) 100 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Pomatomidae							
Pomatomus saltatrix	Apr–May, Sept–Oct	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)
(bluefish)			39 (0.4)	87 (<0.1)	81 (<0.1)		
Rachycentridae							
Rachycentron canadum	May–Jul	0 (0)	0 (0)	0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(cobia)				754 (<0.1)			
Echeneidae							
Unidentified	Jun	0.1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
(remora)		66 (0.1)					
Carangidae							
Unidentified	Apr–Jul	0.4 (0.2)	0 (0)	0.1 (0.1)	<0.1 (<0.1)	0.4 (0.3)	0 (0)
(jack)		43 (0.8)		74 (<0.1)	101 (<0.1)	42 (<0.1)	
Caranx spp.	May–Jun	<0.1 (<0.1)	<0.1 (<0.1)	0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(jack spp.)		88.5 (<0.1)	72.5 (0.1)	74 (0.1)			
Caranx crysos	May–Sept	2.0 (0.9)	0.2 (<0.1)	0.9 (0.3)	0.1 (<0.1)	0 (0)	0.1 (<0.1)
(blue runner)		14 (0.7)	6 (4.9)	23 (0.3)	33 (0.1)		16 (0.4)
Caranx hippos/latus	May–Aug, Oct	2.7 (0.7)	0.1 (<0.1)	0.3 (0.2)	0.1 (<0.1)	2.5 (2.3)	0.2 (0.1)
		8 (2.5)	9 (2.6)	42 (0.1)	30 (0.1)	14 (<0.1)	13 (0.7)
Chloroscombrus chrysurus	May–Sept	0.4 (0.2)	<0.1 (<0.1)	0.7 (0.2)	<0.1 (<0.1)	27.6 (10.2)	0.1 (<0.1)
(Atlantic bumper)		39 (0.4)	46.5 (0.3)	27 (0.2)	53.5 (<0.1)	5 (0.3)	21 (0.3)
Decapterus punctatus	Apr–Aug	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	<0.1 (<0.1)
(round scad)		85.5 (<0.1)	56 (0.2)		43.5 (<0.1)	78.5 (<0.1)	38.5 (<0.1)
Elagatis bipinnulata	May	0.1 (0.1)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)
(rainbow runner)		60 (0.3)	72.5 (0.1)				
Oligoplites saurus	Jun–Jul	0 (0)	0 (0)	0.1 (0.1)	0 (0)	0.55 (0.3)	0 (0)
(leatherjack)				73 (<0.1)		38 (<0.1)	
Selar crumenopthalmus	May-Jul	0.1 (0.1)	0 (0)	0.2 (0.1)	0 (0)	0 (0)	<0.1 (<0.1)
(bigeye scad)		70 (0.1)		46 (0.1)			64.5 (<0.1)
Selene vomer	Jun–Jul, Sept	0.2 (0.2)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(lookdown)		54 (<0.1)		92 (<0.1)			

Table 2. Continued.

	Months collected	Outer shelf platform		Mid-shelf platform		Inner shelf platform	
		Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Selene spp. (moonfish/lookdown spp.)	May	0 (0)	0 (0)	0 (0)	0 (0)	0.6 (0.6) 31 (<0.1)	0 (0)
Seriola spp. (jack spp.)	Apr–Jun, Aug, Oct	0.2 (0.1) 51 (0.2)	<0.1 (<0.1) 72.5 (0.1)	<0.1 (<0.1) 99.5 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1) 80 (<0.1)
Seriola fasciata (lesser amberjack)	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 112 (<0.1)	0 (0)	0 (0)
Seriola dumerili/rivoliana	May–Jun	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)	0 (0)	0 (0)
Trachinotus carolinus (Florida pompano)	May–Jun	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 81 (<0.1)	0 (0)	<0.1 (<0.1) 44.5 (<0.1)
Trachinotus falcatus/goodei	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)	0 (0)	0 (0)
Trachurus lathami (rough scad)	Jan–Feb, Apr–May	0.1 (0.1) 58 (0.2)	<0.1 (<0.1) 46.5 (0.3)	0.1 (0.1) 71 (<0.1)	<0.1 (<0.1) 39 (<0.1)	<0.1 (<0.1) 82.5 (<0.1)	<0.1 (<0.1) 30 (0.1)
Coryphaenidae							
Coryphaena equiselis (pompano dolphin)	May	<0.1 (<0.1) 95.5 (<0.1)	0 (0)	0 (0)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Coryphaena hippurus (dolphin)	May–Jun, Sept	0.1 (0.1) 67 (0.1)	0 (0)	<0.1 (<0.1) 101.5 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Lutjanidae							
Unidentified (snapper)	Feb, May–Jul	<0.1 (<0.1) 78 (0.1)	<0.1 (<0.1) 72.5 (0.1)	0.1 (<0.1) 76 (<0.1)	<0.1 (<0.1) 81 (<0.1)	0.2 (0.2) 54.5 (<0.1)	0 (0)
Lutjanus spp. (snapper spp.)	May–Jul	0.2 (0.1) 55 (0.1)	<0.1 (<0.1) 72.5 (0.1)	0.3 (0.1) 35 (0.2)	<0.1 (<0.1) 64.5 (<0.1)	0.6 (0.4) 31 (<0.1)	0 (0)
Lutjanus apodus/vivanus	Jul	0 (0)	<0.1 (<0.1) 56 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus campechanus (red snapper)	May–Jul, Sept	0 (0)	<0.1 (<0.1) 56 (0.2)	<0.1 (<0.1) 109 (<0.1)	<0.1 (<0.1) 69 (<0.1)	0.6 (0.6) 31 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)
Pristipomoides aquilonaris (wenchman)	Jun, Oct	1.3 (0.3) 21 (0.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Rhomboplites aurorubens (vermillion snapper)	May–Jul	<0.1 (<0.1) 79 (<0.1)	0 (0)	0.4 (0.2) 33 (0.1)	0.1 (<0.1) 28 (0.1)	0 (0)	<0.1 (<0.1) 33.5 (0.1)
Gerreidae							
Unidentified (jenny/mojarra)	May–Aug	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus spp. (jenny/mojarra spp.)	May–Sept	0 (0)	<0.1 (<0.1) 22 (1.4)	0 (0)	<0.1 (<0.1) 53.5 (<0.1)	0 (0)	0 (0)
Haemulidae							
Unidentified (grunt)	May	0 (0)	0 (0)	0 (0)	0 (0)	0.6 (0.6) 31 (<0.1)	0 (0)
Sparidae							
Unidentified (porgy)	Apr–May	<0.1 (<0.1) 88.5 (<0.1)	0 (0)	<0.1 (<0.1) 98 (<0.1)	<0.1 (<0.1) 58 (<0.1)	0.1 (0.1) 58 (<0.1)	0 (0)
Calamus spp. (porgy spp.)	Apr–May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 101 (<0.1)	0.1 (0.1) 61 (<0.1)	0 (0)
Lagodon rhomboides (pinfish)	Jan	0.2 (0.2) 49 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sciaenidae							
Unidentified (drum spp.)	Apr–Aug	0 (0)	0 (0)	<0.1 (<0.1) 115 (<0.1)	0 (0)	0.1 (0.1) 57 (<0.1)	<0.1 (<0.1) 38.5 (<0.1)
Bairdiella chrysoura (silver perch)	Jun	0 (0)	0 (0)	0 (0)	0 (0)	0.1 (0.1) 59 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)
Cynoscion arenarius (sand seatrout)	Apr–Aug	1.0 (0.5) 22 (1.6)	<0.1 (<0.1) 35 (0.5)	2.2 (0.7) 13 (0.3)	<0.1 (<0.1) 70.5 (<0.1)	39.5 (8.0) 3 (0.8)	0.4 (0.1) 7 (1.2)
Larimus fasciatus (banded drum)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	0.1 (<0.1) 67 (<0.1)	0 (0)
Leiostomus xanthurus (spot)	Jan	0 (0)	<0.1 (<0.1) 72.5 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Menticirrhus spp. (kingfish spp.)	Apr–Aug	0 (0)	0 (0)	0.4 (0.3) 34 (<0.1)	0 (0)	1.3 (0.3) 22 (<0.1)	<0.1 (<0.1) 44.5 (<0.1)

TABLE 2. Continued.

	Months collected	Outer shelf platform Plankton net	Outer shelf platform Light-trap	Mid-shelf platform Plankton net	Mid-shelf platform Light-trap	Inner shelf platform Plankton net	Inner shelf platform Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Micropogonias undulatus (Atlantic croaker)	Oct	0.4 (0.2) 38 (0.1)	<0.1 (<0.1) 35 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)
Sciaenops ocellatus (red drum)	Sept	2.8 (1.3) 7 (2.8)	<0.1 (<0.1) 72.5 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Stellifer lanceolatus (star drum)	Apr, Aug	0 (0)	0 (0)	<0.1 (<0.1) 86 (<0.1)	0 (0)	0.4 (0.2) 40 (<0.1)	0 (0)
Mullidae							
Unidentified (goatfish)	Apr–Jul	0 (0)	<0.1 (<0.1) 72.5 (0.1)	0.1 (0.1) 59 (<0.1)	<0.1 (<0.1) 45 (<0.1)	0 (0)	0 (0)
Mullus auratus (red goatfish)	Apr–May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 46 (<0.1)	0 (0)	0 (0)
Pseudupeneus maculatus (spotted goatfish)	Apr–May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 47 (<0.1)	0 (0)	0 (0)
Upeneus parvus (dwarf goatfish)	Apr–Jun	0 (0)	<0.1 (<0.1) 72.5 (0.1)	0 (0)	0.1 (<0.1) 25 (0.2)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Ephippidae							
Chaetodipterus faber (Atlantic spadefish)	May, Jul	<0.1 (<0.1) 81 (0.1)	0 (0)	0 (0)	0 (0)	0.8 (0.4) 25 (<0.1)	0 (0)
Chaetodontidae							
Unidentified (butterfly fish)	May–Jun	<0.1 (<0.1) 85.5 (<0.1)	0 (0)	<0.1 (<0.1) 107 (<0.1)	0 (0)	0 (0)	0 (0)
Pomacentridae							
Unidentified (damselfish)	May–Jun	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 58 (<0.1)	0 (0)	0 (0)
Abudefduf saxatilis (sergeant major)	May–Jun, Aug	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 58 (<0.1)	0 (0)	<0.1 (<0.1) 33.5 (0.1)
Abudefduf taurus (night sergeant)	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 81 (<0.1)	0 (0)	0 (0)
Chromis spp. (chromis spp.)	May–Jun	0 (0)	0 (0)	0.1 (0.1) 56 (0.1)	0.1 (<0.1) 24 (0.2)	0 (0)	0 (0)

Table 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Pomacentrus spp. (damselfish spp.)	May–Aug	0 (0)	0.1 (<0.1) 16 (1.9)	0.1 (<0.1) 81 (<0.1)	0.2 (<0.1) 23 (0.3)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Mugilidae							
Mugil cephalus (striped mullet)	Jan–Feb, Apr, Oct–Nov	16.0 (6.0) 3 (2.0)	0.1 (<0.1) 19.5 (1.5)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Mugil curema (white mullet)	May–Jun	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 53.5 (<0.1)	0 (0)	<0.1 (<0.1) 36 (0.1)
Sphyraenidae							
Sphyraena borealis (northern sennet)	May	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 81 (<0.1)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Sphyraena guachancho (guaguanche)	Jun–Aug	0.3 (0.3) 45 (0.2)	<0.1 (<0.1) 39 (0.4)	0.9 (0.3) 22 (0.4)	<0.1 (<0.1) 68 (<0.1)	0 (0)	0 (0)
Labridae							
Unidentified (wrasse)	May–Jun, Aug	0 (0)	0 (0)	0.1 (0.1) 66.5 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Scaridae							
Unidentified (parrotfish)	Apr, Aug–Nov	7.3 (2.1) 4 (1.5)	<0.1 (<0.1) 28.5 (0.7)	0 (0)	0 (0)	<0.1 (<0.1) 78.5 (<0.1)	0 (0)
Opisthognathidae							
Unidentified (jawfish)	Apr–Jun	0 (0)	0 (0)	0.5 (0.2) 29 (0.2)	0.2 (0.1) 22 (0.3)	0 (0)	0 (0)
Opisthognathus spp. (jawfish spp.)	May	0 (0)	0 (0)	<0.1 (<0.1) 95 (<0.1)	0 (0)	0 (0)	0 (0)
Opisthognathus aurifrons (yellowhead jawfish)	May	0 (0)	0 (0)	<0.1 (<0.1) 93 (<0.1)	<0.1 (<0.1) 61 (<0.1)	0 (0)	0 (0)
Opisthognathus lonchurus (moustache jawfish)	May	0 (0)	0 (0)	<0.1 (<0.1) 82 (<0.1)	0 (0)	0 (0)	0 (0)
Blenniidae							
Unidentified (blenny)	Apr–Oct	0.6 (0.3) 31 (0.2)	0.1 (0.1) 10 (2.4)	3.0 (2.0) 11 (1.4)	0.3 (0.1) 21 (0.4)	2.4 (0.8) 15 (<0.1)	0.1 (<0.1) 23 (0.2)

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Hypsoblennius invemar (tessellated blenny)	Apr–Jul, Oct	<0.1 (<0.1) 84 (<0.1)	<0.1 (<0.1) 72.5 (0.1)	<0.1 (<0.1) 97 (<0.1)	3.4 (0.6) 7 (5.1)	0.6 (0.6) 31 (<0.1)	0.2 (0.1) 14 (0.6)
H. hentz/ionthas	Apr–Jun	0 (0)	0 (0)	0 (0)	0.6 (0.2) 14 (0.9)	0.2 (0.2) 54.5 (<0.1)	0.3 (0.1) 0.1 (0.8)
Ophioblennius atlanticus (redlip blenny)	Jun, Aug, Oct	0.4 (0.3) 36 (0.1)	<0.1 (<0.1) 56 (0.2)	0.2 (0.2) 48 (0.1)	0 (0)	0 (0)	0 (0)
Parablennius marmoreus (seaweed blenny)	Apr–Jul	0 (0)	0 (0)	<0.1 (<0.1) 108 (<0.1)	3.0 (0.4) 8 (4.6)	0.2 (0.2) 53 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)
Scartella/Hypleurochilus (blenny spp.)	Apr–Jul	0 (0)	0 (0)	0.1 (0.1) 577 (<0.1)	0.4 (0.1) 18 (0.6)	1.7 (1.2) 19 (<0.1)	0.3 (0.1) 9 (0.9)
Eleotridae							
Dormitator maculatus (fat sleeper)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 78.5 (<0.1)	0 (0)
Callionymidae							
Unidentified (dragonet)	Jul	0 (0)	0 (0)	<0.1 (<0.1) 101.5 (<0.1)	0 (0)	0 (0)	0 (0)
Foetorepus agassizi (spotfin dragonet)	Aug	<0.1 (<0.1) 82 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paradiplogramus bairdi (lancer dragonet)	Aug	<0.1 (<0.1) 93 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiidae							
Unidentified (goby)	Jan–Feb, Apr–Aug, Oct–Nov	6.7 (1.8) 5 (2.6)	0.2 (0.1) 4 (5.8)	8.2 (1.0) 5 (2.7)	0.1 (<0.1) 27 (0.1)	27.7 (11.7) 4 (0.1)	0.1 (<0.1) 18 (0.3)
Bollmannia communis (ragged goby)	Jun	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 81 (<0.1)	0 (0)	0 (0)
Gobionellus oceanicus (highfin goby)	Jun, Aug	0 (0)	0 (0)	<0.1 (<0.1) 105 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Microdesmidae							
Microdesmus spp. (wormfish spp.)	Apr–Aug	0.3 (0.2) 48 (0.1)	0 (0)	0.2 (0.1) 53 (0.1)	0 (0)	0.5 (0.4) 36 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Microdesmus lanceolatus	Apr-Aug	0.5 (0.3)	0 (0)	0.8 (0.2)	<0.1 (<0.1)	1.2 (0.8)	0 (0)
(lancetail wormfish)		34 (0.3)		25 (0.3)	53.5 (<0.1)	23 (<0.1)	
Microdesmus longipinnis	Apr–May, Jul	<0.1 (<0.1)	<0.1 (<0.1)	0.3 (0.1)	0 (0)	0 (0)	0 (0)
(pink wormfish)		76 (0.1)	28.5 (0.7)	39 (0.1)			
Trichiuridae							
Gempylus spp.	Jul	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)
(snake mackerel spp.)				111 (<0.1)			
Trichiurus lepturus	Apr–Aug	0 (0)	0 (0)	0.3 (0.1)	<0.1 (<0.1)	<0.1 (<0.1)	0.1 (<0.1)
(Atlantic cutlassfish)				37 (0.1)	43.5 (<0.1)	68 (<0.1)	28.5 (0.2)
Scombridae							
Unidentified	Apr–Sept	1.4 (0.7)	<0.1 (<0.1)	0.3 (0.1)	0.1 (<0.1)	0.2 (0.2)	0 (0)
(mackerel)		19 (2.2)	46.5 (0.3)	41 (<0.1)	36 (0.1)	47 (<0.1)	
Acanthocybium solandri	Jun	<0.1 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
(wahoo)		83 (<0.1)					
Auxis spp.	Apr–Sept	1.3 (0.3)	0.2 (<0.1)	4.0 (1.3)	0.3 (0.1)	0 (0)	0.1 (0.1)
(mackerel spp.)		20 (1.7)	5 (5.4)	10 (1.6)	20 (0.5)		19 (0.3)
Euthynnus alletteratus	May–Oct	0.5 (0.2)	0.1 (<0.1)	4.3 (0.8)	1.3 (0.2)	0.4 (0.3)	0.5 (0.2)
(little tunny)		35 (0.6)	14 (2.1)	9 (1.6)	10 (2.0)	39 (<0.1)	5 (1.6)
Katsuwonus pelamis	May	0 (0)	0 (0)	<0.1 (<0.1)	<0.1 (<0.1)	0 (0)	0 (0)
(skipjack tuna)				91 (<0.1)	42 (<0.1)		
Scomber japonicus	Apr	0 (0)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(chub mackeral)					70.5 (<0.1)		
Scomberomorus cavalla	Apr–Aug	0.1 (0.1)	<0.1 (<0.1)	0.1 (<0.1)	0.1 (<0.1)	5.0 (2.9)	0.1 (<0.1)
(king mackerel)		72 (0.1)	32 (0.5)	68 (0.1)	26 (0.2)	10 (<0.1)	26 (0.2)
Scomberomorus maculatus	Apr–Aug	0.5 (0.3)	<0.1 (<0.1)	0.3 (0.1)	0.1 (<0.1)	6.1 (1.9)	0.3 (0.1)
(Spanish mackerel)		33 (0.5)	56 (0.2)	38 (0.1)	29 (0.1)	9 (0.1)	8 (1.1)
Thunnus spp.	May–Jun, Aug	0.1 (<0.1)	<0.1 (<0.1)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(tuna spp.)		69 (0.1)	46.5 (0.3)		81 (<0.1)		
Thunnus thynnus	May–Jun	0.1 (0.1)	0 (0)	0 (0)	<0.1 (<0.1)	0 (0)	0 (0)
(bluefin tuna)		65 (0.1)			81 (<0.1)		

TABLE 2. Continued.

		Outer shelf platform		Mid-shelf platform		Inner shelf platform	
	Months collected	Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Stromateidae							
Ariomma spp. (driftfish spp.)	Apr–May	0.7 (0.4) 28 (1.8)	<0.1 (<0.1) 56 (0.2)	0 (0)	0 (0)	0.1 (0.1) 63 (<0.1)	0 (0)
Ariomma regulus (spotted driftfish)	Aug	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Centrolophus medusophagus (brown ruff)	Apr	0 (0)	0 (0)	0.2 (0.1) 52 (<0.1)	<0.1 (<0.1) 81 (<0.1)	0 (0)	0 (0)
Cubiceps pauciradiatus (bigeye cigarfish)	May	<0.1 (<0.1) 92 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Peprilus alepidotus (harvestfish)	Apr–May, Jul–Aug	0 (0)	0 (0)	1.5 (0.8) 17 (0.1)	0 (0)	1.8 (0.7) 18 (<0.1)	0.1 (<0.1) 22 (0.2)
Peprilus burti (gulf butterfish)	Jan, Apr–Jun, Aug, Oct–Nov	0.8 (0.3) 24 (0.3)	<0.1 (<0.1) 25 (0.8)	0.1 (<0.1) 80 (<0.1)	<0.1 (<0.1) 49 (<0.1)	1.5 (1.1) 21 (<0.1)	0.1 (<0.1) 17 (0.3)
Tetragonuridae							
Tetragonurus atlanticus (bigeye squaretail)	Nov	0.1 (0.1) 59 (<0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Pleuronectiformes							
Unidentified	Aug	0 (0)	0 (0)	<0.1 (<0.1) 85 (<0.1)	0 (0)	0 (0)	0 (0)
Bothidae							
Unidentified (lefteye flounder)	Apr–May, Jul, Oct–Nov	0.7 (0.5) 29 (0.1)	<0.1 (<0.1) 72.5 (0.1)	0.1 (0.1) 61 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0.8 (0.8) 26 (<0.1)	0 (0)
Bothus spp. (flounder spp.)	May, Sept–Nov	0.1 (0.1) 63.5 (0.1)	<0.1 (<0.1) 46.5 (0.3)	0 (0)	<0.1 (<0.1) 101 (<0.1)	0 (0)	0 (0)
Citharichthys spilopterus (baywhiff)	Feb, Apr–Jul,	2.3 (0.9) 10 (0.5)	<0.1 (<0.1) 72.5 (0.1)	0.2 (0.1) 51 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0.2 (0.1) 51 (<0.1)	<0.1 (<0.1) 38.5 (<0.1)
Cyclopsetta fimbriata (spotfin flounder)	May	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Cyclopsetta spp. (flounder spp.)	Jun–Jul	0 (0)	0 (0)	0.3 (0.2) 36 (<0.1)	0 (0)	0 (0)	0 (0)

TABLE 2. Continued.

	Months collected	Outer shelf platform		Mid-shelf platform		Inner shelf platform	
		Plankton net	Light-trap	Plankton net	Light-trap	Plankton net	Light-trap
		Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)	Density (se) Rank (%)	CPUE (se) Rank (%)
Engyophrys senta (spiny flounder)	Jul	0 (0)	0 (0)	<0.1 (<0.1)	0 (0) 110 (<0.1)	0 (0)	0 (0)
Etropus crossotus (fringed flounder)	Apr–Aug, Nov	0.3 (0.3) 47 (<0.1)	<0.1 (<0.1) 72.5 (0.1)	1.2 (0.3) 20 (0.4)	<0.1 (<0.1) 58 (<0.1)	7.1 (2.7) 8 (<0.1)	0.1 (<0.1) 26 (0.2)
Monolene sessilicauda (deepwater flounder)	Feb	0 (0)	<0.1 (<0.1) 72.5 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)
Syacium spp. (flounder spp.)	Apr–Sept	0.1 (0.1) 56 (0.1)	<0.1 (<0.1) 23 (1.1)	2.0 (0.6) 16 (0.4)	<0.1 (<0.1) 64.5 (<0.1)	0.6 (<0.1) 31 (<0.1)	0 (0)
Soleidae							
Unidentified (sole)	Jun–Jul	0 (0)	0 (0)	0 (0)	0 (0)	0.1 (0.1) 64.5 (<0.1)	<0.1 (<0.1) 64.5 (<0.1)
Achirus lineatus (lined sole)	Apr–May, Jul	0 (0)	0 (0)	0.1 (<0.1) 63 (<0.1)	0 (0)	0.2 (0.1) 56 (<0.1)	<0.1 (<0.1) 44.5 (<0.1)
Gymnachirus spp. (sole spp.)	May	0 (0)	0 (0)	0 (0)	0 (0)	0.1 (0.1) 62 (<0.1)	0 (0)
Trinectes maculatus (hogchoker)	Apr–May	0 (0)	0 (0)	0 (0)	0 (0)	0.6 (0.4) 27 (<0.1)	0 (0)
Symphurus spp. (tonguefish spp.)	Feb, Apr–Oct	2.3 (0.8) 11 (1.6)	0.1 (<0.1) 13 (2.1)	11.8 (2.0) 3 (3.4)	0.1 (<0.1) 32 (0.1)	8.2 (3.5) 7 (<0.1)	<0.1 (<0.1) 35 (0.1)
Tetraodontiformes							
Balistidae							
Unidentified (leatherjacket)	Jul	0 (0)	0 (0)	<0.1 (<0.1) 106 (<0.1)	0 (0)	0 (0)	0 (0)
Tetraodontidae							
Sphoeroides parvus (least puffer)	Apr	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	<0.1 (<0.1) 64.5 (<0.1)
Sphoeroides spp. (puffer spp.)	Apr–Jul	<0.1 (<0.1) 88.5 (<0.1)	0 (0)	0.2 (0.1) 49 (<0.1)	<0.1 (<0.1) 101 (<0.1)	0.1 (0.1) 64.5 (<0.1)	0.1 (<0.1) 20 (0.3)

T. falcatus/goodei were all present at GI 94 but absent at the outer shelf platform (GC 18). Similarly, *Rachycentron canadum*, although not very common, were also collected at GI 94 and not at GC 18. As with the carangids, *R. canadum* is also considered to be a reef-associated species.

Second in abundance to the pelagic forms at the mid-shelf platform (GI 94) were demersal taxa, particularly synodontids which comprised 14.7% of the total catch and were approximately equal to the total catch of all perciform fishes combined (15.1%). Unidentified synodontids, *Saurida brasiliensis*, *Synodus foetens*, and *Synodus poeyi* were very common in the late spring and summer months. Like the carangids, this group was more species rich at GI 94, with seven taxa identified to species as compared to three at the outer shelf platform (GC 18). Other common demersal taxa included *Symphurus* spp., *Syacium* spp., and *Bregmaceros cantori*. Mesopelagic species were not as speciose and abundant as those at GC 18, but some were collected, including *Cyclothone braueri*, *Vinciguerria nimbaria*, and *Lestrolepis intermedia*.

Overall, there was greater taxonomic richness among reef fishes at the mid-shelf platform than the outer shelf or inner shelf sites. Blenniids and gobiids were relatively common, as well as taxa that were not collected at the other sites, such as *Chromis* spp. and opistognathids. Also noteworthy was the relatively high abundance of mullids collected at GI 94 (only one individual was collected at GC 18), particularly *Upeneus parvus*, a common species on the mid-to-inner shelf (Hoese and Moore 1977). Lutjanids were also relatively common at this site, with *Rhomboplites aurorubens* the dominant species, followed by *Lutjanus* spp. While *Pristipomoides aquilonaris* was the primary lutjanid collected at the outer shelf site, none were collected at the mid-shelf site. With regards to serranids, the dominant group was serraniines (e.g., *Diplectrum* spp., *Centropristis* spp., and *Serranus* spp.), while relatively few anthiines were collected.

Larval and Juvenile Fish Collected at the Inner Shelf Platform (ST 54)

A total of 97,697 fish were collected at the inner shelf platform (ST 54). Light traps collected 6,116 fish, and plankton nets collected 91,583 fish (Table 2). Due to problems with the deploying the subsurface net at this site (Table 1), the plankton net catch is almost exclusively from the surface. The plankton nets collected fish from 34 families, 8 of which were not present in light trap collections. Light traps also collected fish from a total of 34 families, 8 of which were not collected with plankton nets. The plankton nets caught fish from 59 taxa (identified at least to genus), 19 of which were not in light trap samples. Light traps caught fish from 65 taxa, 27 of which were not in plankton net collections.

At the inner shelf platform, clupeiform fishes (mostly clupeids) overwhelmed the plankton net and light trap collections and comprised 97% of the total catch (all gears combined). The dominant clupeid was *Opisthonema oglinum*, which alone comprised 94% of the total catch. *Harengula jaguana*, though present at the mid-shelf site (GI 94), were more prominent at the inner shelf platform. This trend of increasing dominance of clupeiform fishes continued as sampling efforts moved inshore. In general, it is difficult to discuss the abundances of the other taxa except in very relative terms, since no family of fishes (with the exception of clupeids and engraulids) comprised over 1% of the total catch. Among pelagic fishes, the reef-associated carangids and scombrids were relatively abundant, particularly *Caranx hippos/latus*, *Euthynnus alletteratus*, and *Scomberomorus maculatus*.

Similar to the mid-shelf platform (GI 94), the second most abundant group of fishes at the inner shelf site was composed of demersal species. However, unlike GI 94, where synodontids dominated, sciaenids were the most dominant family, primarily *Cynoscion arenarius*, which was collected throughout the sampling season. Not only did the number of sciaenids increase, but the number of their taxa increased as well, from three at the mid-shelf site to five at the inner shelf site. Although *C. arenarius* dominated the plankton net catches, synodontids, primarily *Synodus foetens*, dominated the light trap collections. Synodontids were not as prominent at the inner shelf site as they were at the mid-shelf platform, and the number of taxa decreased from seven to four. Other demersal taxa collected included unidentified myctophiforms, *Trichiurus lepturus*, *Symphurus* spp., and *Etropus crossotus*.

The most abundant reef/structure-associated fishes were blenniids and gobiids. Unlike GI 94, *Parablennius marmoreus* was relatively uncommon. The dominant species at ST 54 were *Scartella/Hypleurochilus* spp., *Hypsoblennius hentz/ionthas*, and *H. invemar*. Difficulties in identification prevent us from confidently separating *H. hentz* from *H. ionthas* and *Scartella* spp. from *Hypleurochilus* spp., but all of these taxa are common in nearshore areas and hard-bottomed habitats, such as oyster reefs and pilings (Hoese and Moore 1977). In general, at the inner shelf platform, reef fish, although not abundant, were relatively well represented in terms of number of taxa, rivaling that of the mid-shelf site. However, other than blenniids and gobiids, abundances of other reef fish were very low (less than a total of 10 individuals collected per taxa) but included *Rhomboplites aurorubens* and unidentified pomacentrids, serranids, and ephippids.

Overall Taxonomic Richness and Seasonality

A total of 67 families were represented in the plankton net and light trap collections from the three platform sites. The number of families represented in passive plankton net collections was 45 at GC 18 (outer shelf), 40 at GI 94 (mid-shelf), and 34 at ST 54 (inner shelf). In general, trends in seasonality were consistent for taxa collected at the different sites across the shelf (Ditty et al. 1988). Many groups (e.g., clupeiforms, carangids, and scombrids) were present throughout the sampling periods for the mid- and inner shelf platforms and throughout the spring–summer at the outer shelf platform (GC 18). At GC 18, the only site that included fall and winter sampling, only a few taxa were represented solely during these months and included *Etremeus teres* (January–February), *Diplophos taenia* (November), and *Mugil cephalus* (October–November and January–February), among others.

Reef-dependent and reef-associated fish (Choat and Bellwood 1991) made up a relatively small percentage of the total plankton net and light trap collections (even with clupeiforms removed from the total catch) at the three platforms (Table 2). At the outer shelf platform (GC 18), these groups of fishes comprised 18% and 32% of the plankton net and light trap collections, respectively. Dominant groups included gobiids, scombrids, and carangids. At the mid-shelf platform (GI 94), reef-dependent and reef-associated fishes comprised 10% of the plankton net catch and 17% of the light trap catch. Blenniids were prominent (in both plankton net and light trap collections) as were gobiids (plankton nets) and scombrids (light traps). At the inner shelf platform (ST54), reef fishes comprised less than 1% of the plankton net collections and only 8% of the light trap collections. Carangids (particularly *Chloroscombrus chrysurus*), gobiids, and scombrids dominated plankton net collections, while scombrids and blenniids dominated light trap collections.

Similarity and Diversity of Larval and Juvenile Fish Assemblages between Sites

Similarity values among the sites were relatively low (Table 3), with the highest similarity (0.45) occurring between the mid-shelf site (GI 94) and the inner shelf site (ST 54). The next highest value (0.35) was between outer shelf (GC 18) and inner shelf site (ST 54), followed by then mid-shelf site and outer shelf site (0.29). Shannon-Weiner diversity results were similar along the three-platform transect. There was no significant difference in the diversity of the plankton net samples among the sites ($\alpha = 0.05$; Figure 2). The light trap samples at the outer shelf (GC 18) had significantly lower mean Shannon-Weiner diversity index values, while the mid-shelf platform (GI 94) had significantly higher mean diversity values than the other locations (Tukey's Studentized Range test, $\alpha = 0.05$; Figure 2).

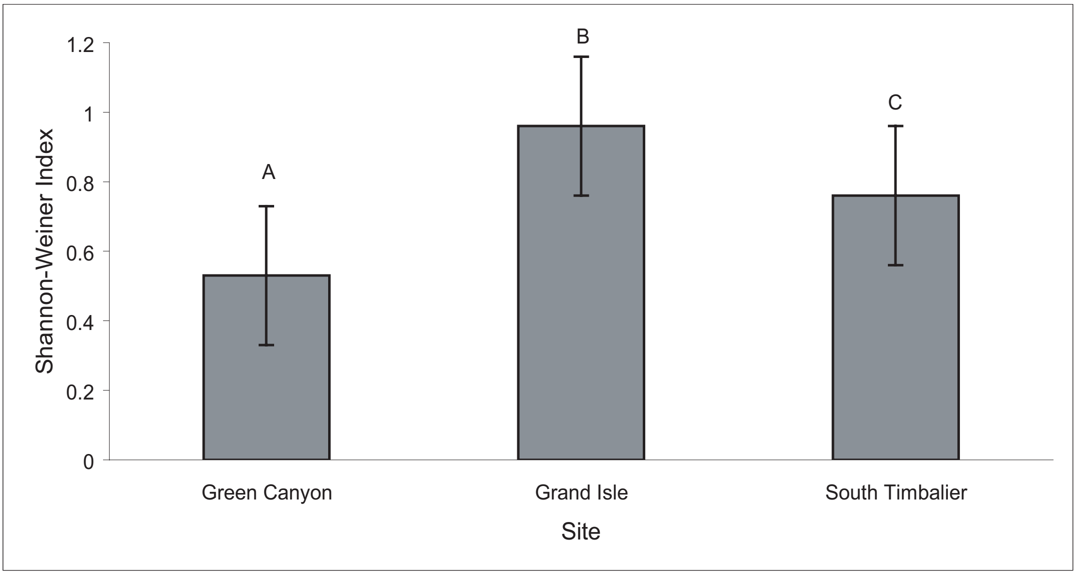
Discussion

This study, and a companion project addressing different questions (Tolan 2001), represents the first comprehensive investigations of the across shelf ichthyoplankton and juvenile fish assemblages collected within oil and gas platforms in the Gulf of Mexico

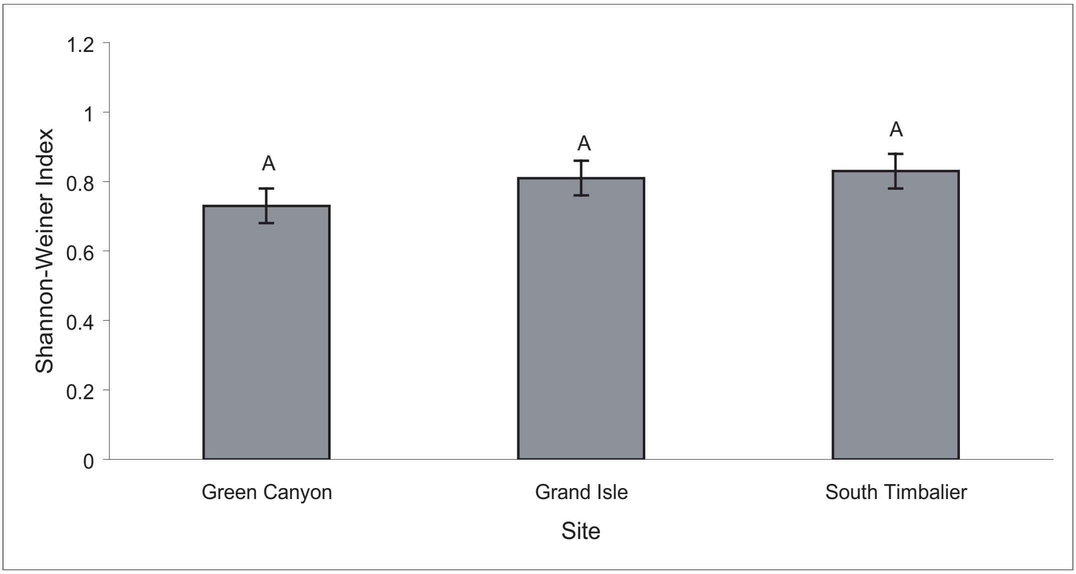
TABLE 3. Schoener's similarity indices for all sampling sites. Values range from 0 to 1 (no similarity–identical) and include taxa (at least to the level of genus) from all gears used at each site. Values represent indices calculated with the most dominant taxa from each site removed.

	Outer shelf platform	Mid-shelf platform	Inner shelf platform
Outer shelf platform	1	–	–
Mid-shelf platform	0.29[a]	1	–
Inner shelf platform	0.35[a]	0.45	1

[a] Indices computed with April–August samples only.



LIGHT-TRAPS



PLANKTON NETS

FIGURE 2. Mean Shannon-Weiner diversity indices (with standard error bars) for light trap and plankton net collections from each platform. The same letter above each bar indicates no significant difference between the sites based on Tukey's Studentized Range tests (α = 0.05). Different letters indicate significant differences.

(Gulf) and, to our knowledge, the world. It is also a first (yet, preliminary) attempt at comparing such assemblages across different depth zones. It is apparent that a diverse assemblage of recently spawned larvae, postlarval, and juvenile fishes occurs in the waters within and immediately downstream of platforms and that these structures may be important to overall reef fish population dynamics. Based on the results of this study, two obvious conclusions stand out: the peak in taxonomic richness and diversity at the mid-shelf platform (GI 94) and the relatively low abundance of reef-associated and reef-dependent postlarvae and juveniles present at the platforms (as is the case with historical shelf-wide ichthyoplankton surveys).

In general, while reef-associated and reef-dependent taxa were collected at all platform sites, taxonomic richness and diversity was highest at GI 94 (mid-shelf). Due to the pelagic nature of most reef-dependent eggs and larvae, dispersal in the oceanic environment plays a large role in the eventual settlement and recruitment of postlarvae and juveniles to adult environments. While some studies have determined mechanisms of larval retention in reef environments (Swearer et al. 1999; Cowen et al. 2000), it is widely believed that recruitment is variable and dependent, in part, on the supply from nearby, upstream reefs (Sale 1980; Richards and Lindeman 1987; Doherty and Williams 1988; Doherty 1991). In the northern Gulf, most oil and gas platforms are concentrated along the inner and mid-shelf region, where 93% of the structures are located in water depths ranging from 0 to 75 m (Grace Hawayek, Minerals Management Service, New Orleans Office, personal communication). At GI 94, which was the mid-shelf platform (60-m depth), the proximity to the high density of surrounding platforms may have created generally favorable conditions for the recruitment of reef taxa. The general area of the platform transect, being somewhat near the Mississippi River's sediment plume, is relatively devoid of natural reef or hard bottom features (Tolan 2001). The presence, proximity, and concentration of upstream reefs (natural or artificial) and spawning habitats is known to play an important role in the eventual makeup of the preadult assemblages.

One of the most dominant reef-associated fish taxa at GI 94 were blenniids, particularly *Parablennius marmoreus* and *Hypsoblennius invemar*. These fishes are perhaps one of the most common taxa affiliated with platforms but are probably underestimated in visual surveys due to there small size, cryptic coloration, and tendency to hide in attached barnacle shells. Blenniids differ from other common reef-associated fishes in that they have demersal eggs and pelagic, yet fairly competent, larvae that appear to be able to feed immediately and are attracted to light (Thresher 1984). If the same early life history attributes are true for the blennies collected at the platform sites, then these traits may combine to form a mechanism by which these taxa are retained and concentrated around platform structures. Other reef taxa that hatch from demersal eggs and have demonstrated photopositive behavior include gobies and pomacentrids, although these larvae are not as competent upon hatching (Thresher 1984). At the mid-shelf platform, unidentified gobiids and pomacentrids, primarily *Chromis* spp. and *Pomacentrus* spp., ranked next in abundance.

Unique to the mid-shelf site (GI 94) was the collection of opisthognathids in surface waters (plankton nets as well as surface and off-platform light traps) during the spring–early summer. Adult *Opisthognathus aurifrons* are reported to be tropical (south Florida, Bahamas, northern South America) and rarely collected on the mid-to-outer shelf (Hoese and Moore 1977; Robins et al. 1986). Adult *O. lonchurus* are also reported to inhabit the northeast Gulf as well as tropical waters (Robins et al. 1986). The presence of these larvae reinforces the notion that oil and gas platforms may play a role in extending the ranges of more tropical forms that would otherwise be habitat-limited in the north-central Gulf.

The relatively low abundance of reef fish larvae and juveniles compared to pelagic species at the outer shelf platform (GC 18) is in contrast to the adult community described by Gallaway (1981). Unfortunately, the inability to confidently identify many of these early life history stages to species limits comparisons with known adult distributions across the shelf. For example, epinephelines were either *Mycteroperca* spp. or *Epinephelus* spp., which represent 10–12 and 7–8 possible species, respectively. When identifications were possible, however, larval and juvenile data generally agreed with adult across-shelf distributions. Anthiines were believed to be mostly *Hemanthias vivanus* and *Protogrammus martinicensus*, both of which occur on deep, offshore reef environments (Hoese and Moore 1977). In contrast, most of the serranids collected at the mid-shelf platform were serranines (sea basses), including many juveniles. Again, most of these could only be identified to the genus level: *Centropristis* spp. (three species), *Diplectrum* spp. (two species), and *Serranus* spp. (four species). Many of these fishes, however, are relatively common along the mid-shelf and inner shelf environments (Hoese and Moore 1977). Similar patterns were observed with lutjanids, of which several were identified to the species level. Many preflexion *Pristipomoides aquilonaris* larvae were collected at the outer shelf platform. These lutjanids are among the most common fishes associated with mid- and outer shelf hard-bottom areas (Hoese and Moore 1977). Across-shelf collections of *Rhomboplites aurorubens* (mid- and inner shelf platforms) and *Lutjanus campechanus* (inner shelf platform) were also in agreement with known adult distributions. Overall, across-shelf distribution patterns in reef-dependent and reef-associated larval and juvenile distributions were as expected.

At GC 18 (shelf break), the relatively low abundance of reef fish larvae and juveniles may likewise be due to a combination of depth (>200 m), distance from other natural/artificial reefs, and oligotrophic, open ocean waters devoid of possible recruits. Reefs and platforms located on the shelf slope would theoretically have significantly fewer upstream sources of potential recruits than those on the mid-shelf, where other natural hard-bottom or reef habitats may be more abundant or where the density of platforms is orders of magnitude greater. Similarly, the close proximity of ST 54 (inner shelf) to the coastal boundary current and hydrologic interactions with the Mississippi River plume (e.g., low salinity and high turbidity), along with its shallow water depth (20 m), which makes it more susceptible to rapid cooling during winter cold fronts, may result in fluctuating conditions generally unfavorable for most reef-associated or reef-dependent fishes but more suitable for estuarine and coastal pelagic taxa, which dominated the collections. Even though an inner shelf platform would be downstream from potentially more offshore and along-shelf sources of larvae and recruits (greater density of platforms), the potentially less favorable inshore environmental conditions result in increased mortality (Leis 1991).

In general, the similarity index values indicate that the sites were not very similar, with the highest similarity value between any two sites being 0.45 for mid-shelf platform (GI 94) and inner shelf platform (ST 54). This is not unexpected since sampling sites were purposely chosen to be in different depth zones across the shelf where faunal transitions were expected (Gallaway et al. 1980; Gallaway 1981). Similarity indices for the mid-shelf platform (GI 94) displayed the expected cross-shelf transitional pattern. The highest similarity index for the outer shelf platform (GC 18), however, was with the inner shelf platform (ST 54), whereas one might have expected GC 18 to be most similar to GI 94 (mid-shelf platform). This somewhat unexpected result is probably due to the large number of reef taxa collected at the mid-shelf site (GI 94) that were unique to that site (Table 2). Reef fish taxa, such as *Chromis* spp., *Abudefduf taurus, Mullus auratus, Ophioblennius atlantica, Pseudopeneus maculatus, Opisthognathus aurifrons*, and *Opisthognathus lonchurus*, were collected only at the mid-shelf platform (GI 94). Other taxa (ephippids and scarids) were collected at the outer shelf and inner shelf platforms (GC 18 and ST 54) but not at the mid-shelf platform (GI 94).

While using a similarity index to characterize assemblages helps to synthesize large amounts of information, the analyses are confounded by several problems that can make the results difficult to interpret. First of all, the index is highly influenced by large numbers of individuals of a single taxon, and confidence intervals can be quite large (Ricklefs and Lau 1980). This is why analyses were run without the most dominant taxa from each site, which helped to identify trends that may have otherwise been overwhelmed in the complete data set. Second, in any comparison between two sites, samples were only used when seasonality overlapped in sampling efforts. In this way, the same species pool would theoretically be available for collection. However, at times, this led to large disparities in sampling effort between sites within a comparison. Finally, taxa utilized in the analyses were limited by the inability to identify many of the larval fishes collected over the course of the study. Since an attempt was made to analyze the taxonomic assemblage at the lowest level possible, large numbers of fish that could not be identified to genus were eliminated from the analyses. Overall, however, the index provides some idea of the similarity in community assemblages across the shelf.

The mean diversity indices based on plankton net collections taken at the platforms were not significantly different from each other, ranging from 0.73 to 0.83. They were, however, slightly higher than those for the light trap collections, with the exception of GI 94. In general, observed statistical differences in Shannon-Weiner diversity indices between sites were limited to light trap collections. Light trap collections were significantly more diverse at the mid-shelf platform (GI 94), a result of being less dominated by clupeiform fishes than the inner shelf platform (ST 54) and of collecting more taxa, particularly reef fish species, than the outer shelf platform (GC 18). In general, taxonomic richness in light traps was highest at the mid-shelf platform (GI 94), with 90 taxa identified to genus as compared to 65 taxa at the inner shelf platform (ST 54), the platform with the second highest number of light trap of taxa. Inshore areas are generally characterized as having lower diversity than adjacent shelf waters and are dominated by a few highly abundant taxa (Nybakken 1988). This pattern is generally attributed to the fluctuating nature of the nearshore environment, particularly with regards to salinity and temperature and the lack of physiological specializations needed to deal with this estuarine environmental variability (Nybakken 1988). This, in part, may explain the relatively low diversity indices for the inner shelf platform (ST 54). In contrast, species richness and abundance is generally relatively low on the outer shelf, due to the homogeneity of the bottom substrate (Bond 1996). Topographical relief is disjunct throughout the north-central Gulf (especially west of the Delta), and the sea floor is basically dominated by expanses of mud and silt. This homogeneity and the lack of a large amount of upstream supply of larvae may, in part, explain the low taxonomic diversity observed in the light trap collections at the outer shelf platform (GC 18).

The relatively low abundances of reef-dependent and reef-associated taxa, particularly lutjanids and serranids, is not surprising for several reasons. First of all, due to the high mortality rates experienced by pelagic larvae prior to settlement (approaching 100%), reef-dependent juveniles are relatively rare in general (Leis 1991). This, coupled with potentially high predation rates at the settlement site itself (see below), may result in very low abundance of early life stages available for capture. Second, recruitment events for these taxa can be extremely episodic (Choat et al. 1993; Rooker et al. 1996), with most of the reef fish replenishment occurring over the course of 1–3 nights (Thorrold et al. 1994; Rooker et al. 1996). Although peak times of settlement and recruitment (new and full moon periods) were targeted for 2–3-night periods twice monthly, it is still very possible that settlement peaks were missed during the course of the study. Finally, although light traps were used as a means of collecting larger postlarvae and juveniles, light-aggregation devices can be very taxon-selective. While some reef-dependent taxa, such as pomacentrids, have been collected in large numbers, few research efforts have been able to collect many lutjanids or serranids with light-aggregation devices (Dennis et al. 1991; Choat et al. 1993; Brogan 1994; Rooker et al. 1996; Hernandez and Lindquist 1999).

A popular justification for artificial reefs is that they increase fish populations by improving recruitment (Bohnsak et al. 1994). The occurrence of extremely large numbers of postlarvae and newly settled juveniles on new reefs, which are devoid of high numbers of adults, suggests that there is a pool of opportunistic surplus larvae (Bohnsak et al. 1994). Numerous observations on the subsequent, rapid disappearance of these newly settled juveniles, however, support the “wall of mouths hypothesis” (Emery 1973; Hamner et al. 1988) and the “limited shelter hypothesis” (Shulman 1985; Hixon and Beets 1989). These theories state that, for postlarval reef fish, the time of settlement, especially in the absence of suitable shelter, is characterized by exceedingly high predation-mortality rates by the larger, predominately carnivorous resident population, many of which are conspecifics. Thus, the presence of presettlement postlarvae and postsettlement juveniles may often be “displaced” from the most favorable reef habitat by this intensive, on-site, adult predation (Frederick 1997).

While much of the evidence for the “wall of mouths” and related hypotheses has been collected from natural reefs, there is some supporting evidence from platform studies. Bull and Kendall (1994) studied juvenile recruitment and colonization on three offshore platforms that were converted to artificial reefs. Two platforms were explosively toppled in place and had virtually all of their resident fish community lethally concussed. These sites subsequently served as recruitment sites for juveniles/immature reef fish. A third rig was toppled during a hurricane and experienced minimum impact to its adult fish communities and did not serve as a recruitment site (i.e., virtually all fish observed were adults; Bull and Kendall 1994).

It is with this paradigm in mind (increased production by improving recruitment) that light traps were used within the sampling design in an effort to collect settlement-stage postlarvae and juveniles (Hernandez and Shaw 2003, this volume). The presence of these larger, more competent individuals could provide indirect evidence for the nursery area/refuge function of the petroleum platforms. The adult populations of reef fish at the sites are well known. Stanley and Wilson (2000) have documented reef-dependent adults at the outer shelf platform (GC 18: *Epinephelus inermis, Mycteroperca phenax, Paranthias furcifer, Pristipomoides aquilonaris, Balistes capriscus*), the mid-shelf platform (GI 94: *Epinephelus fulvus, E. inermis, Mycteroperca bonaci, M. microlepis, M. phenax, M. venenosa, P. furcifer, Lutjanus campechanus, L. griseus, Rhomboplites aurorubens, B. capriscus*), and the inner shelf platform (ST 54: *Epinephelus adscensionis, L. campechanus, L. griseus, B. capriscus*). However, few reef-dependent, settlement-size postlarvae and juveniles were collected, mostly pomacentrids and blenniids.

The abundance of postlarval and juvenile synodontids and scombrids near the platforms suggests that even the early life stage predatory field is probably high (i.e., postlarvae/juvenile predation on other postlarvae and juveniles, plus cannibalism). Most synodontids and scombrids are piscivorous as early as the postlarval stage (Naughton and Saloman 1981; Uchida 1981; Sweatman 1984; Thresher et al. 1986). Larvae and juveniles of synodontids were frequently collected in the light trap samples (as were scombrids to a lesser extent) and were observed preying on other organisms retained in the cod end. Small, cryptic species such as synodontids are often overlooked in surveys, and therefore, their abundances are usually unknown. The presence of a large population of synodontids may have a major impact on fish community dynamics, since they prey directly on postlarvae and juveniles of many commercially—and recreationally—important species (Thresher et al. 1986). Observations on piscivory by a synodontid suggest that new recruits can face a 65% annual chance of predation from just a single species of lizardfish (Sweatman 1984). The high numbers of piscivorous juveniles collected in this study, primarily with light traps, indicate that predation is important in determining local reef assemblages.

With the limited amount of hard-substrate habitat available in the north-central Gulf, the addition of artificial habitats (platforms) may increase suitable spawning habitat and subsequently improve the chances of finding suitable settlement habitat, particularly where platforms are most dense (mid- and inner shelf). The available natural hard-bottom habitats in the Gulf are widely scattered and relatively deep, particularly for many reef-dependent taxa accustomed to shallow water habitats. The chances of encountering a platform in the northern Gulf (especially west of the Mississippi River Delta) is probably relatively high compared to those of encountering a natural reef or hard-bottom. Also, since most larval and juvenile fishes are in the upper water column, the encounter rate is potentially enhanced by the vertical nature of platform structures (i.e., the "vertical benthos"). Platforms may not equal natural hard-bottom banks in terms of settlement area or suitable porosity/rugosity, but they potentially serve as a settlement site for fishes that otherwise might be "lost" from the system.

From a management perspective, fish early life history data from a cross-shelf study of petroleum platforms can provide useful information in deciding the future placement of artificial structures (Shinn and Wicklund 1989) and in determining whether or not the platforms serve as refugia for reef species (Steimle and Meier 1997). While platforms may be very suitable habitat for adult fishes, the physical meso- and microstructure of these artificial reefs may not be ideal for settling postlarvae and juveniles. Previous studies have shown that smaller reefs tend to hold greater cumulative numbers of total and resident species, higher fish densities, and more settlers (Bohnsak et al. 1994). The higher carrying capacity and settlement success of smaller reefs is probably a function of their (1) greater edge effect (higher ratio of perimeter to reef area; Bohnsak et al. 1994); (2) lower vertical relief, which often favors juvenile over adult reef fish (West et al. 1994); and (3) greater porosity or availability of small shelter holes (≤ a few cm), which has been repeatedly shown to be important for postsettlement survival (Shulman 1985; Hixon and Beets 1989; West et al. 1994). Petroleum platforms, in contrast, are large reefs and are generally characterized as having a higher profile (high vertical relief), less complexity, and lower porosity than natural reefs.

The lack of microscale structural complexity of platforms, combined with the high, on-site predation pressures, results in a habitat that is not very suitable for a settling juvenile. The "wall of mouths" predation pressure is enhanced by the large constant light fields associated with platforms that allow for additional nocturnal surface feeding by visual predators. Some opportunistic settlement events undoubtedly occur, as evident by the presence of settlement-sized juveniles at the platforms and by the presence of sedentary, reef-dependent adult species (e.g., chaetodontids and labrids). However, the major value of platforms as artificial habitat may lie in their increased carrying capacity for adult fishes and potential as spawning habitat. The vertical structure of the platform, while unique, is not as important for most larval and juvenile fishes.

It is apparent that much has yet to be learned about the role platforms may play as habitat for early life stages of reef-associated and reef-dependent fishes. One aspect that should be investigated further is the near-bottom vertical structure of the platforms. Logistically, this study was limited in its sampling scope to the surface and near-surface waters (15–23-m depth as determined by the first level of structural cross members). While some taxa may settle in relatively shallow waters and remain on a platform's upper support structures as adults (e.g., pomacentrids, chaetodontids, and blenniids), others are more demersal as adults and probably recruit to the bottom support structures and pilings (e.g., serranids and lutjanids) as late-stage juveniles or even sub-adults. In addition, any low-relief benthic modification that may result from platform placement/construction (e.g., foundational bottom hardening, shell pads) or subsequent production (e.g., bottom oil or gas distributional pipelines) may also represent potentially valuable recruitment habitat. This platform-related, benthic sphere of influence may be further enhanced by the no trawling halo that is enforced immediately adjacent to all platforms. Future investigations should attempt to sample the deeper hard-bottom habitat provided by platforms.

Another important consideration in artificial reef studies is the degree to which organisms associated with the hard substrate habitat interact with pelagic species and contribute to off-reef production (Lindberg 1997). The scombrids, for example, are pelagic but often structure-associated, and the juveniles are competent swimmers and highly piscivorous. If these juveniles, which were relatively abundant in the collections, are actively feeding in association with the platforms, then they and similar taxa (e.g., carangids) could serve as an important trophic link between the reef and pelagic environments. Blennies, for example, could be an important link between production at the platforms and pelagic, transient predators. Blennies are structure-dependent and are attracted to the numerous habitats created by the biofouling community (e.g., barnacles) on the platform legs and cross members, as well as the to the associated zooplankton food resources (Gallaway 1981; Bohnsak and Sutherland 1985). Some blennies have been cited as important components of the diets of fishes such as *Archosargus probatocephalus* (Gallaway 1980) and *Seriola rivoliana* (Gallaway and Martin 1980).

The importance of platform primary and secondary production in different trophic pathways could be elucidated with the use of stable isotopes analyses (Thomas and Cahoon 1993). Since the sessile invertebrates (and associated meiofauna and macrofauna) on platforms represent "vertical benthos," it is likely that there is a distinct platform isotopic signature in the fishes that utilize these food resources. Pelagic predatory taxa, such as carangids and scombrids, with more generalized habitat requirements may be attracted to the concentrations of zooplankton and forage fish that are dependent on the platforms (Keenan et al. 2003, this volume). The use of stable isotope analyses could help to determine the relative contribution of platform versus off-platform food resources in these trophic pathways.

A major problem for managing reef resources is the incomplete understanding of the interactions between recruitment and habitat structure. Although habitat space may ultimately be limiting, many reef fish populations are not at the carrying capacity of their environment, and changes in abundance may be controlled by settlement from the plankton or by early postsettlement mortality. Virtually nothing is known about the relationship between offshore petroleum platforms and the early life history stages of fishes anywhere in the world. These findings, therefore, represent an important first step towards this aspect of artificial reef research.

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