

The following supplement accompanies the article

Fish use of reef structures and adjacent sand flats: implications for selecting minimum buffer zones between new artificial reefs and existing reefs

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Table S1: Descriptions of twenty-four reefs surveyed. Site numbers referenced in Figure 1. Site information includes artificial reef plot number, site name, reef type, mean on-reef depth, distance to nearest shoreline, and description of reef structures. Date indicates month and year (month/year) surveyed.

Number referenced in Fig. 1	Reef plot	Site	Reef type	Depth (m)	Distance to shore (km)	Description	Survey dates
1	330	Vessel	Artificial	17.3	13.9	70 m (200 ft) Deck barge TBM IX	9/15, 12/15, 4/16
2	330	Vessel	Artificial	15.1	14.1	89 m (320 ft) Landing craft repair ship "Indra"	9/15, 12/15, 4/16
3	330	Pipes	Artificial	17.7	14.6	822 tons Concrete pipes	9/15, 12/15
4	345	Reef Balls	Artificial	17.7	14.1	50 Ultra Reef Balls and 1 Reef Ball	10/15, 4/16
5	345	Reef Balls	Artificial	18.8	14.4	75 Reef Balls	10/15, 1/16, 4/16
6	345	Vessel	Artificial	17.3	14.6	35 m (116 ft) Tug boat "Titan"	10/15, 1/16, 4/16
7	364	Vessel	Artificial	13.5	3.6	20 m (65 ft) Tug boat "Captain Jerry"	9/15, 12/15, 3/16
8	364	Vessel	Artificial	15.1	3.6	91 m (297 ft) Barge HT-290	9/15, 12/15, 3/16
9	364	Pipes	Artificial	13.2	3.6	Concrete pipes	12/15
10	364	Atlantic Pods	Artificial	13.2	3.6	200 Concrete pods	9/15, 12/15, 3/16
11	370	Natural reef	Natural	14.8	5.4	Natural hard bottom	9/15, 12/15, 3/16
12	370	Natural reef	Natural	14.9	5.5	Natural hard bottom	9/15, 12/15, 3/16
13	370	Vessel	Artificial	10.7	4.8	134 m (440 ft) Liberty ship "Alexander Ramsey"	9/15, 12/15, 3/16
14	370	Pipes	Artificial	14.9	4.4	155 tons Concrete pipes	9/15, 12/15, 3/16

Number referenced in Fig. 1	Reef plot	Site	Reef type	Depth (m)	Distance to shore (km)	Description	Survey dates
15	370	Atlantic Pods	Artificial	14.6	4.4	200 Concrete pods	9/15, 12/15, 3/16
16	370	Barge	Artificial	14.9	4.2	27 m (90 ft) Barge	9/15
17	372	Atlantic Pods	Artificial	15.8	9.3	200 Concrete pods	9/15, 12/15, 3/16
18	372	Natural reef	Natural	16.8	9.0	Natural hard bottom	9/15, 12/15, 3/16
19	372	Reef Balls	Artificial	15.1	9.4	128 Reef Balls	9/15, 12/15, 3/16
20	372	Natural Reef	Natural	16.0	9.3	Natural hard bottom	9/15, 12/15, 3/16
21	378	Natural Reef	Natural	12.5	2.7	Natural hard bottom	9/15, 1/16, 5/16
22	378	Atlantic Pods	Artificial	12.9	2.2	200 Concrete pods	9/15, 1/16, 3/16
23	378	Pipes	Artificial	11.0	1.8	115 tons Consolidated concrete	9/15, 1/16
24	378	Reef Balls	Artificial	12.5	1.8	100 Reef Balls	9/15, 1/16, 5/16

Table S2: Species list from 230 fish belt-transects conducted on natural and artificial reefs on the NC continental shelf. Bold text indicates fish in the federally managed snapper-grouper complex. Abundance values indicate the total number of each species observed across the 230 transects.

Family	Genus	Species	Common name	Total abundance per transect				Total abundance
				On-reef	0-30 m from reef	30-60 m from reef	60-90 m from reef	
Acanthuridae	<i>Acanthurus</i>	sp.	Surgeonfish sp.	1	0	0	0	1
Balistidae	<i>Canthidermis</i>	<i>sufflamen</i>	Ocean triggerfish	1	0	0	0	1
Batrachoididae	<i>Opsanus</i>	<i>tau</i>	Oyster toadfish	15	0	1	1	17
Blenniidae	<i>Blenniidae</i>	sp.	Blenny sp.	15	0	0	0	15
Blenniidae	<i>Ophioblennius</i>	<i>macclurei</i>	Redlip blenny	8	0	0	0	8
Blenniidae	<i>Parablennius</i>	<i>marmoreus</i>	Seaweed blenny	2	0	0	0	2
Carangidae	<i>Carangoides</i>	<i>bartholomaei</i>	Yellow jack	5	2	0	0	7
Carangidae	<i>Caranx</i>	<i>crysos</i>	Blue runner	0	10	0	0	10
Carangidae	<i>Carangoides</i>	sp.	Jack sp.	6	1	0	0	7
Carangidae	<i>Caranx</i>	<i>ruber</i>	Bar jack	10	11	10	1	32
Carangidae	<i>Decapterus</i>	<i>macarellus</i>	Mackerel scad	1,152	250	0	0	1,402
Carangidae	<i>Decapterus</i>	<i>punctatus</i>	Round scad	500	0	0	0	500

Family	Genus	Species	Common name	Total abundance per transect				Total abundance
				On-reef	0-30 m from reef	30-60 m from reef	60-90 m from reef	
Carangidae	<i>Decapterus</i>	sp.	Scad sp.	7,560	2,170	1,450	2	11,182
Carangidae	<i>Seriola</i>	<i>dumerili</i>	Greater amberjack	30	7	7	0	44
Carangidae	<i>Seriola</i>	<i>fasciata</i>	Lesser amberjack	13	21	25	1	60
Carangidae	<i>Seriola</i>	<i>rivoliana</i>	Almaco jack	3	0	0	2	5
Chaetodontidae	<i>Chaetodontidae</i>	sp.	Butterflyfish sp.	1	0	0	0	1
Chaetodontidae	<i>Chaetodon</i>	<i>ocellatus</i>	Spotfin butterflyfish	4	0	0	0	4
Diodontidae	<i>Chilomycterus</i>	<i>schoepfii</i>	Striped burrfish	1	0	0	0	1
Ephippidae	<i>Chaetodipterus</i>	<i>faber</i>	Atlantic spadefish	74	0	0	0	74
Gerreidae	<i>Gerreidae</i>	sp.	Mojarra sp.	0	2	0	0	2
Gobiidae	<i>Coryphopterus</i>	<i>glaucofraenum</i>	Bridled goby	3	0	0	0	3
Gobiidae	<i>Coryphopterus</i>	<i>punctipectophorus</i>	Spotted goby	1	0	0	0	1
Gobiidae	<i>Gnatholepis</i>	<i>thompsoni</i>	Goldspot goby	1	0	0	0	1
Gobiidae	<i>Gobiidae</i>	sp.	Goby sp.	1	0	0	1	2
Haemulidae	<i>Haemulon</i>	sp.	Grunt sp.	13	76	1	0	90
Haemulidae	<i>Haemulon</i>	<i>album</i>	White margate	1	0	0	0	1
Haemulidae	<i>Haemulon</i>	<i>aurolineatum</i>	Tomtate	5,582	3,171	216	13	8,982
Haemulidae	<i>Haemulon</i>	<i>plumierii</i>	White grunt	17	1	0	0	18
Labridae	<i>Halichoeres</i>	<i>bivittatus</i>	Slippery dick	303	30	43	45	421
Labridae	<i>Tautoga</i>	<i>onitis</i>	Tautog	10	2	2	0	14
Labridae	<i>Labridae</i>	sp.	Wrasse sp.	1	0	0	0	1
Monacanthidae	<i>Stephanolepis</i>	<i>hispidus</i>	Planehead filefish	1	0	0	0	1
Mullidae	<i>Mullidae</i>	sp.	Goatfish sp.	4	9	3	0	16
Mullidae	<i>Mulloidichthys</i>	<i>martinicus</i>	Yellow goatfish	2	4	0	0	6
Mullidae	<i>Pseudupeneus</i>	<i>maculatus</i>	Spotted goatfish	4	0	1	0	5
Mullidae	<i>Upeneus</i>	<i>parvus</i>	Dwarf goatfish	0	2	0	0	2
Osteichthyes	<i>Osteichthyes</i>	sp.	Unknown fish species	25	2	2	10	39
Paralichthyidae	<i>Paralichthys</i>	<i>albigutta</i>	Gulf flounder	4	1	0	0	5
Paralichthyidae	<i>Paralichthys</i>	<i>dentatus</i>	Summer flounder	7	1	1	1	10
Paralichthyidae	<i>Paralichthys</i>	<i>lethostigma</i>	Southern flounder	0	1	0	0	1
Paralichthyidae	<i>Paralichthys</i>	sp.	Flounder sp.	3	0	0	0	3
Pomacentridae	<i>Abudefduf</i>	<i>saxatilis</i>	Sergeant-major	1	0	0	0	1

Family	Genus	Species	Common name	Total abundance per transect				Total abundance
				On-reef	0-30 m from reef	30-60 m from reef	60-90 m from reef	
Pomacentridae	<i>Pomacentridae</i>	sp.	Damselfish sp.	10	2	0	0	12
Pomacentridae	<i>Stegastes</i>	sp.	Damselfish (cocoa or beaugregory)	14	1	0	0	15
Rajidae	<i>Raja</i>	<i>eglanteria</i>	Clearnose skate	0	1	0	0	1
Sciaenidae	<i>Pareques</i>	<i>umbrosus</i>	Cubbyu	66	2	3	0	71
Scombridae	<i>Scomberomorus</i>	<i>maculatus</i>	Atlantic Spanish mackerel	5	0	0	1	6
Serranidae	<i>Centropristis</i>	<i>ocyurus</i>	Bank sea bass	25	7	0	1	33
Serranidae	<i>Centropristis</i>	<i>striata</i>	Black sea bass	1,076	136	52	53	1,317
Serranidae	<i>Diplectrum</i>	<i>formosum</i>	Sand perch	59	22	28	21	130
Serranidae	<i>Mycteroperca</i>	<i>microlepis</i>	Gag	96	11	1	0	108
Serranidae	<i>Mycteroperca</i>	<i>phenax</i>	Scamp	2	0	0	0	2
Serranidae	<i>Rypticus</i>	<i>maculatus</i>	Whitespotted soapfish	5	0	0	0	5
Serranidae	<i>Serranus</i>	<i>subligarius</i>	Belted sandfish	197	15	4	10	226
Sparidae	<i>Archosargus</i>	<i>probatocephalus</i>	Sheepshead	130	27	2	8	167
Sparidae	<i>Calamus</i>	<i>arctifrons</i>	Grass porgy	1	0	0	0	1
Sparidae	<i>Calamus</i>	<i>calamus</i>	Saucereye porgy	13	3	0	5	21
Sparidae	<i>Calamus</i>	<i>nodosus</i>	Knobbed porgy	9	1	0	0	10
Sparidae	<i>Calamus</i>	<i>penna</i>	Sheepshead porgy	0	2	0	0	2
Sparidae	<i>Diplodus</i>	<i>holbrookii</i>	Spottail pinfish	1,653	334	67	22	2,076
Sparidae	<i>Lagodon</i>	<i>rhomboides</i>	Pinfish	4	1,004	9	4	1,021
Sparidae	<i>Sparidae</i>	sp.	Porgy sp.	21	7	0	0	28
Sparidae	<i>Stenotomus</i>	sp.	Longspine porgy or scup	4,297	3,361	802	145	8,605
Sparidae	<i>Stenotomus</i>	<i>chrysops</i>	Scup	126	157	11	20	314
Sphyraenidae	<i>Sphyraena</i>	<i>barracuda</i>	Great barracuda	6	8	1	6	21
Sphyrnidae	<i>Sphyrna</i>	sp.	Hammerhead sp.	1	0	0	0	1
Synodontidae	<i>Synodus</i>	<i>foetens</i>	Inshore lizardfish	5	5	4	2	16
Synodontidae	<i>Synodus</i>	<i>intermedius</i>	Sand diver	0	1	0	0	1
Synodontidae	<i>Synodus</i>	sp.	Lizardfish sp.	0	2	0	0	2
Tetraodontidae	<i>Sphoeroides</i>	<i>spengleri</i>	Bandtail puffer	9	0	0	0	9
Tetraodontidae	<i>Canthigaster</i>	sp.	Pufferfish sp.	0	0	0	1	1

Table S3: Similarity percentages (SIMPER) analysis results for off-reef fish communities. Fish species presented in this table are those with higher mean abundance off-reef than on-reef. Percentages and asterisks are defined as in Table 1.

Off-reef communities	Scientific name	Common name	Demersal or pelagic	Functional group	% Contribution to dissimilarity
0-30 m from reefs	<i>Stenotomus chrysops</i>	Scup	Demersal	Benthic carnivore	3.9%
	<i>Lagodon rhomboides</i>	Pinfish	Demersal	Omnivore	< 2%
	<i>Haemulon</i> sp.	Grunt sp.	Demersal	Omnivore	< 2%
	<i>Sparidae</i> sp.	Porgy sp.	Demersal	Omnivore	< 1%
	<i>Synodus foetens</i>	Inshore lizardfish	Demersal	Piscivore	< 1%
	<i>Seriola fasciata</i>	Lesser amberjack	Pelagic	Carnivore	< 1%
	<i>Caranx ruber</i>	Bar jack	Pelagic	Carnivore	< 1%
	<i>Mullidae</i> sp.	Goatfish sp.	Demersal	Benthic carnivore	< 1%
	<i>Caranx crysos</i>	Blue runner	Pelagic	Carnivore	< 1%
	<i>Mulloidichthys martinicus</i>	Yellow goatfish	Demersal	Benthic carnivore	< 1%
	<i>Sphyraena barracuda</i>	Great barracuda	Pelagic	Piscivore	< 1%
	<i>Synodus</i> sp.	Lizardfish sp.	Demersal	Piscivore	< 1%
	<i>Calamus penna</i>	Sheepshead porgy	Demersal	Benthic carnivore	< 1%
	<i>Synodus intermedius</i>	Sand diver	Demersal	Carnivore	< 1%
	<i>Upeneus parvus</i>	Dwarf goatfish	Demersal	Benthic carnivore	< 1%
	<i>Paralichthys lethostigma</i>	Southern flounder	Demersal	Benthic carnivore	< 1%
	<i>Gerreidae</i> sp.	Mojarra sp.	Demersal	Omnivore	< 1%
<i>Raja eglanteria</i>	Clearnose skate	Demersal	Benthic carnivore	< 1%	
30-60 m from reefs	<i>Diplectrum formosum</i>	Sand perch	Demersal	Carnivore	2.9%
	<i>Lagodon rhomboides</i>	Pinfish	Demersal	Omnivore	< 2%
	<i>Caranx ruber</i>	Bar jack	Pelagic	Carnivore	< 1%
	<i>Seriola fasciata</i>	Lesser amberjack	Pelagic	Carnivore	< 1%
	<i>Synodus foetens</i>	Inshore lizardfish	Demersal	Piscivore	< 1%
	<i>Mullidae</i> sp.	Goatfish sp.	Demersal	Benthic carnivore	< 1%
	<i>Pseudupeneus maculatus</i>	Spotted goatfish	Demersal	Benthic carnivore	< 1%
60-90 m from reefs	<i>Calamus calamus</i>	Saucereye porgy	Demersal	Benthic carnivore	* < 2%
	<i>Osteichthyes</i> sp.	Unknown fish sp.	-	-	< 1%
	<i>Lagodon rhomboides</i>	Pinfish	Demersal	Omnivore	< 1%
	<i>Sphyraena barracuda</i>	Great barracuda	Pelagic	Piscivore	< 1%

<i>Scomberomorus maculatus</i>	Atlantic Spanish mackerel	Pelagic	Piscivore	< 1%
<i>Gobiidae</i> sp.	Goby sp.	Demersal	Omnivore	< 1%
<i>Seriola rivoliana</i>	Almaco jack	Pelagic	Piscivore	< 1%
<i>Cathigaster</i> sp.	Pufferfish sp.	Demersal	Omnivore	< 1%