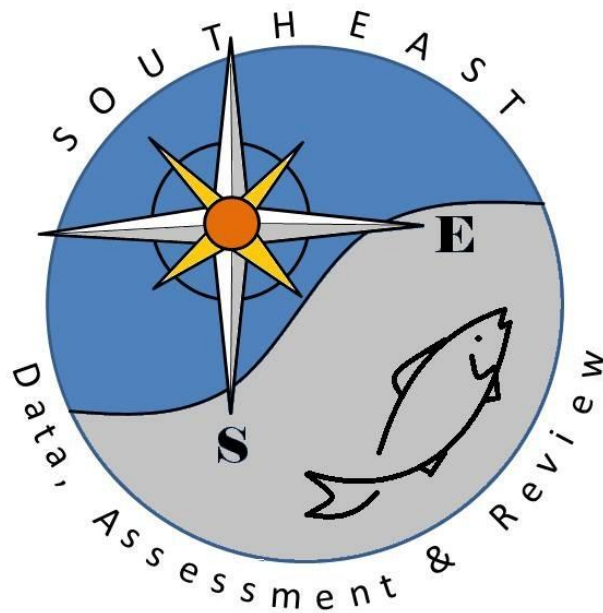


Catch and bycatch of gag grouper in the Gulf of Mexico shark and reefish bottom longline fishery based on observer data

Simon J.B. Gulak and John K. Carlson

SEDAR33-DW23

20 May 2013



This information is distributed solely for the purpose of peer review. It does not represent and should not be construed to represent any agency determination or policy.

Please cite as:

Gulak, S.J.B. and J.K. Carlson. 2013. Catch and bycatch of gag grouper in the Gulf of Mexico shark and reefish bottom longline fishery based on observer data. SEDAR33-DW23. SEDAR, North Charleston, SC. 28 pp.

Catch and bycatch of gag grouper in the Gulf of Mexico shark and reef fish bottom longline fishery based on observer data

Simon J.B. Gulak
John K. Carlson
National Marine Fisheries Service
Southeast Fisheries Science Center-Panama City Laboratory
3500 Delwood Beach Rd
Panama City, FL

Introduction

In the Gulf of Mexico, two fisheries utilize bottom longline gear to harvest Federally managed species. The shark bottom longline fishery currently has about 100 active vessels in the south Atlantic and Gulf of Mexico out of about 218 vessels that possess directed shark fishing permits. Depending on regulations, commercial shark fishers target and land sandbar shark, *Carcharhinus plumbeus*, blacktip shark, *Carcharhinus limbatus*, bull shark, *Carcharhinus leucas* and hammerhead sharks, *Sphyrna spp.* The commercial reef fish involves about 819 permitted vessels that target groupers, snappers, and other reef fish species with approximately 130 vessels reported using bottom longline gear. Details of the shark bottom longline fishery and its operations can be found in Hale et al. (2012 and reference therein) and for the reef fish fishery in Scott-Denton et al. (2011).

Data collected by the NMFS-Panama City Laboratory in the shark bottom longline fishery by on-board observers began in 2005 (Hale and Carlson, 2007). Regardless of the target species, if a vessel was selected during the coverage period it was required to carry an observer. Thus, while the focus of the observer program was on shark directed trips, observers also boarded bottom longline fishing trips that targeted

grouper, snapper, and tilefish as well as shark. Because of the overlap observed in 2005 with grouper/snapper targeted longline sets and those vessels possessing directed shark permits (some vessels hold both shark and reefish permits), the vessel pool covered all bottom longline vessels regardless if they reported fishing for sharks with bottom longline gear.

The objectives are to report observations on the catch and bycatch of gag grouper, *Mycteroperca microlepis*, in Gulf of Mexico shark and reefish targeted bottom longline sets from 2005–2012.

Methods

Vessel selection

NMFS observers were placed on bottom longline vessel targeting shark or reefish throughout the Gulf of Mexico based season and region. Observer coverage is based on proportional sampling effort, based on coastal logbook data, among seasons in the Gulf of Mexico.

Selection letters requiring observer coverage were issued to permit holders via U.S. certified mail approximately one month prior to the upcoming season. Once the permit holder received the selection letter, he or she was required to contact the observer coordinator and indicate intent to fish during the upcoming fishing season. If the permit holder intended to fish, the observer coordinator deployed an observer to the port of departure (Hale et al. 2012).

Observer Protocol

For consistency among longline observer programs throughout the Southeast Fisheries Science Center, observers complete three data forms: Longline Gear Characteristic Log, Longline Haul Log, and Individual Animal Log. The Longline Gear Characteristic Log is used to record the type and length of the mainline used, number and length of gangions, and make and model of hooks used. The Longline Haul Log is used to record the length, location, and time duration for each set and haulback, as well as environmental information and the type(s) of bait used. The Individual Animal Log records all species caught, condition on capture (e.g. alive, dead, damaged, or unknown) when brought to the vessel, and the final condition on release (e.g. kept, released, finned, etc.). When an animal is brought aboard the vessel, the observer records species, condition on capture, sex (when possible), and length.

Results and Discussion

Observer coverage summary

A total of 332 trips on 61 vessels (2217 sets) were observed in the Gulf of Mexico region from July of 2005 through December of 2012 (Figure 1). All sets utilized bottom longline gear with 76.7% (1699 sets) targeting reef fish (grouper, snapper), 21.0% (466 sets) targeting shark, 1.5% (33 sets) targeting tilefish, 0.6% (14 sets) targeting mixed species (shark and reef fish within the same set) and 0.2% (5 sets) targeting eel for bait. Due to low sample sizes, sets targeting tilefish, mixed species or bait are not described here in further detail. More in-depth catch information is reported in a yearly technical memorandum from the observer program (eg. Hale et al. 2012 and references therein). A

total of 37 vessels were observed on 73 trips (average trip length was 11.7 days with an average of 25.8 sets per trip) targeting reef fish, while a total of 30 vessels were observed on 263 trips (average trip length was 2.0 days with an average of 2.4 sets per trip) targeting shark. Based on Richards (2008), the percent observed of the total reef fish bottom longline effort was 0.75-2.1% for 2006-2007. Some vessels targeted different species on different trips within the same year or between years. Of the 2217 sets observed (all targets combined), 638 sets (28.8%) caught gag grouper.

Gear description

In shark-targeted sets, the length of the mainline ranged from 0.4 – 35.2 km with an average length of 12.1 km (± 7.8 Standard Deviation (S.D.)). Number of hooks set ranged from 25 - 1354, with an average of 390 hooks (± 280 S.D.) per set. Depth ranged from 2 - 227 m with an average depth of 48.8 m (± 34.8 S.D.). The gear was soaked an average of 12.9 hrs (± 9.1 S.D.). The majority of longline vessels utilized circle hooks (80.7%). Some sets (14.3%) used two different hooks with 4.3% using a combination of circle and J-hooks. The most commonly used hooks were 18.0 and 16.0 circle hooks (51.5% and 24.3% respectively). Total hook effort was 181,631 hooks while total hook hours were 2,272,436.2 hours.

In reef fish-targeted sets, the length of the mainline ranged from 0.7 – 25.2 km with an average length of 9.1 km (± 3.6 S.D.). Number of hooks ranged from 30 - 2300, with an average of 766 hooks (± 352 S.D.) per set. Depth ranged from 29 - 355 m with an average depth of 98.8 m (± 68.0 S.D.). The gear was soaked an average of 1.6 hrs (± 2.4 S.D.). Reef fish vessels utilized circle hooks 98.7% of the time, and a combination of circle hooks sizes in 30.9% of sets. The most commonly used hooks were 13.0 and 14.0 circle hooks (46.7% and 32.1% respectively). Total hook effort was 1,301,478 hooks while total hook hours were 2,037,347.3 hours.

Observed Gulf of Mexico catches

Total observed catch composition (percent of numbers caught) of trips targeting shark was 95.4% sharks, 3.8% teleosts, 0.3% batoids, and 0.4% invertebrates, and 0.2% protected resource species (Table 1). Sandbar shark, *Carcharhinus plumbeus*, and

blacktip shark, *Carcharhinus limbatus*, were the most common species caught (28.1% and 19.2% by number respectively). Gag grouper made up 2.4% by number of the teleost species (n = 21). The catch per unit effort (CPUE) for gag grouper was 0.11 per 1000 hooks. The average length of gag grouper caught was 88.3 cm fork length (n = 19). The 91 to 100 cm FL categories had the highest percentage of individuals (42.1%, Table 3). Of the gag grouper, 5.3% were undersized according to current regulations (less than 22 inches or 55.9 cm TL; Gulf of Mexico Fishery Management Council, 2012).

Total observed catch composition (percent of numbers caught) of trips targeting reef fish was 7.6% sharks, 91.8% teleosts, 0.1% batoids, 0.5% invertebrates, and <0.1% protected resource species (Table 2). The most commonly caught species was the red grouper, *Epinephelus morio*, (58.1% by number, n = 60,916) and Atlantic sharpnose shark, *Rhizoprionodon terraenovae*, was the most common shark species (34.6% by number of overall shark species). Gag grouper made up 1.7% by number of the overall teleost species (n = 1622). The CPUE for gag grouper was 1.25 per 1000 hooks. The average length of gag grouper caught was 80.4 cm fork length (Tables 3 & 4, Figure 2). The 71 to 80 cm FL category had the highest percentage of individuals (33.6%). Of the gag grouper, 1.9% were undersized according to current regulations (less than 22 inches or 55.9 cm TL; Gulf of Mexico Fishery Management Council, 2012).

Observed depth range of gag grouper catch

The depth of shark-targeted sets that caught gag grouper ranged between 10 - 121 m with an average depth of 66.1 m. Gag grouper were commonly caught between two depth categories (Table 5): 51-60 (23.8%) and 81-90 m (23.8%). The depth of reef fish-targeted sets that caught gag grouper ranged between 29 - 238 m with an average depth of 71.5 m. Gag grouper were most frequently caught from 71-80 m (35.0%, Table 5, Figure 3). The length of gag grouper increased significantly with depth (Figure 4; $r^2 = 0.02$, $p < 0.0001$), however coefficient of correlation was very low.

Condition on capture of gag grouper

In shark-targeted sets, the majority of gag grouper were alive when brought aboard the vessel (66.7%), with the remainder dead (23.8%) or damaged (9.5%). In reef fish-targeted sets, gag grouper were also frequently alive (94.5%), with the remainder dead (1.2%), damaged (4.2%) or unknown status (0.1%).

In 2011, observers began recording details of barotrauma exhibited by teleost species. The occurrence of a protruding swim bladder or eyes or both was documented. Symptoms of barotrauma were found in 55.4% of gag grouper brought aboard and this was similar to that found by the Galveston Observer Program (61.2%; Scott-Denton et al., 2011). All gag grouper fished from depths greater than 100 m exhibited some form of barotrauma (Figure 5).

Condition on release of gag grouper

In shark-targeted sets, a larger proportion of gag grouper were kept (76.2%), with 9.5% released alive, and 14.3% released dead (Tables 3, 5 & 6). In reef fish-targeted sets, the majority of gag grouper were kept (82.6%), with 14.7% released alive, 2.4% released dead, and 0.3% released with unknown condition (Figures 2, 3 & 6, Tables 3, 5 & 6). In the Galveston Observer Program study, 93.1% gag grouper were kept, 5.7% were released alive, and 1.0% were released dead (Scott-Denton et al., 2011). Most gag grouper, caught in reef fish sets, were vented before release (56.5%; n = 278). The average soak duration of shark-targeted sets for kept gag grouper was 11.9 hrs, for released dead was 9.4 hrs, and for released alive was 6.4 hrs (Table 6). In reef fish-targeted sets, the average soak duration for kept gag grouper was 1.3 hrs, for released dead was 1.0 hrs, and for released alive was 0.8 hrs (Table 6, Figure 6).

Literature Cited

- Gulf of Mexico Fishery Management Council, 2012. Commercial Fishing Regulations for Gulf of Mexico Federal 12/18/12 [pdf]. Available from: <http://www.gulfcouncil.org/Beta/GMFMCWeb/downloads/com%20brochure%202012%20-%20Revised%2012-18-12.pdf>. [Accessed 05/10/2013.]
- Hale, L.F. and J.K. Carlson. 2007. Characterization of the shark bottom longline fishery, 2005-2006. NOAA Technical Memorandum NMFS-SEFSC-554, 28 p.
- Hale, L.F., S.J.B. Gulak, A.N. Mathers, and J.K. Carlson. 2012. Characterization of the shark and reef fish bottom longline fishery, 2011. NOAA Technical Memorandum NMFS- SEFSC-634, 27 p.
- Morgan, A., P. Cooper, T. Curtis, and G. Burgess. 2009. An overview of the United States East Coast Bottom Longline Shark Fishery, 1994-2003. *Marine Fisheries Review* 71(1):23-28.
- National Marine Fisheries Service (NMFS). 2005. 2005 Guide for complying with the regulations for Atlantic Tunas, Swordfish, Sharks, and Billfish. Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, Maryland. 39 pp.
- National Marine Fisheries Service (NMFS). 2007. Amendment 2 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. 726 pp.
- Richards, P. 2008. Estimated Takes of Sea Turtles in the Bottom Longline Portion of the Gulf of Mexico Reef Fish Fishery July 2006 through 2007 Based on Observer Data. NMFS Southeast Fisheries Science Center Contribution PRD-07/08-15
- Scott-Denton, E., Cryer, P.F., Gocke, J.P., Harrelson, M.R., Kinsella, D.L., Pulver, J.R., Smith, R.C., and J.A. Williams. 2011. Descriptions of the U.S. Gulf of Mexico Reef Fish Bottom Longline and Vertical Line Fisheries Based on Observer Data. *Marine Fisheries Review*, 73(2), 26p.

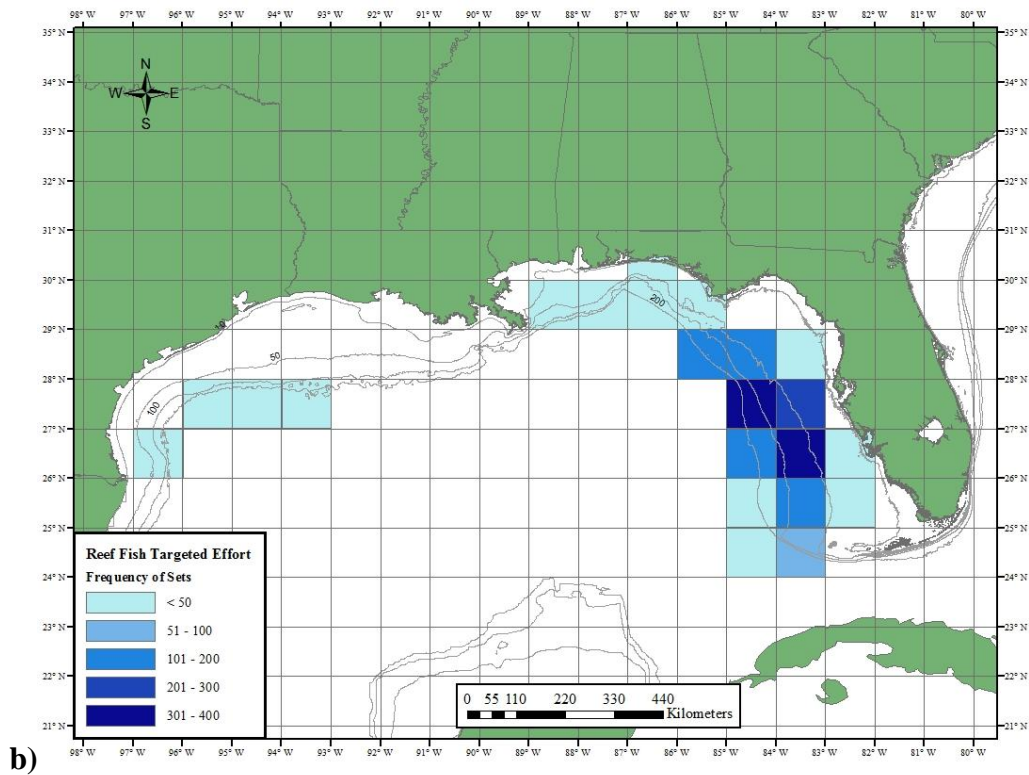
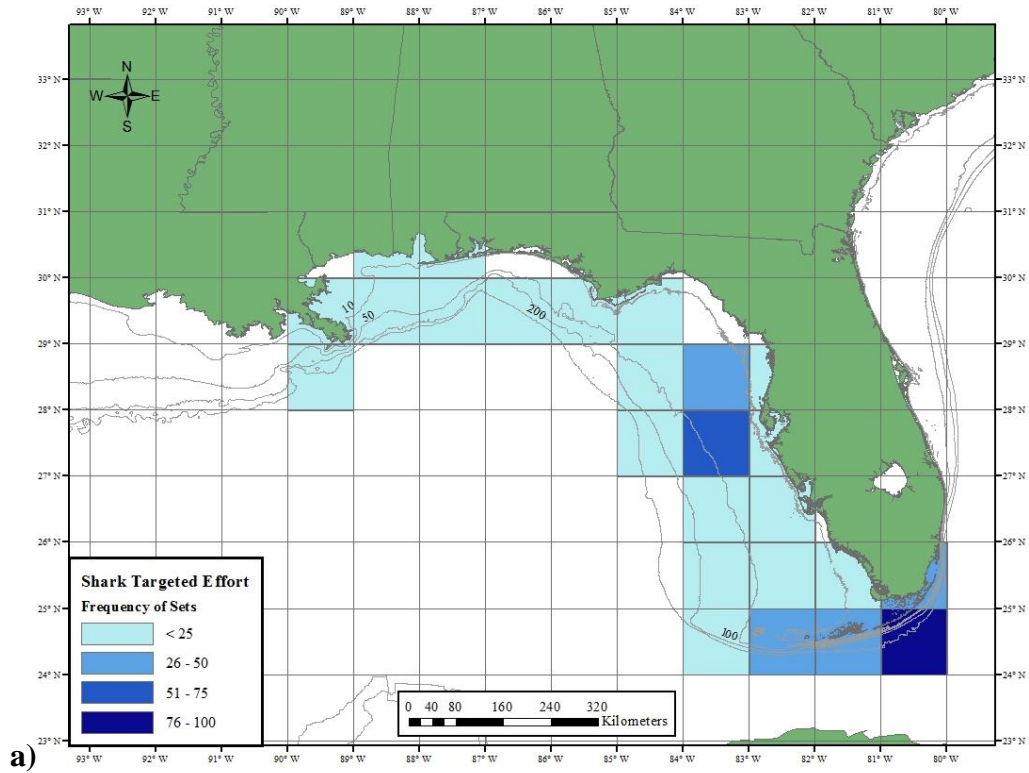


Figure 1. Distribution of observed bottom longline sets for: a) shark targeted sets from 2005-2012 and b) reef fish targeted sets from 2006-2012.

Table 1. Total observed Gulf of Mexico catch and bycatch by species and species disposition in order of decreasing abundance for all shark targeted sets, 2005-2012. Catch disposition is by percent kept (Kept %), percent discarded alive (D.A. %), and percent discarded dead (D.D. %).

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Carcharhinus plumbeus</i>	Sandbar shark	6615	87.5	9.1	2.8	0.6
<i>Carcharhinus limbatus</i>	Blacktip shark	4524	84.8	2.3	12.0	0.9
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	2463	17.4	1.3	80.2	1.1
<i>Ginglymostoma cirratum</i>	Nurse shark	1933	0.9	97.4	1.3	0.4
<i>Galeocerdo cuvier</i>	Tiger shark	1409	28.7	61.5	8.7	1.1
<i>Carcharhinus acronotus</i>	Blacknose shark	1359	69.2	2.7	27.8	0.3
<i>Carcharhinus leucas</i>	Bull shark	1072	92.0	5.1	0.4	2.5
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	997	90.5	1.9	6.9	0.7
<i>Carcharhinus brevipinna</i>	Spinner shark	510	81.8	4.9	12.7	0.6
<i>Sphyrna mokarran</i>	Great hammerhead shark	460	92.8	2.0	4.5	0.7
<i>Negaprion brevirostris</i>	Lemon shark	435	92.6	1.6	0.7	5.1
<i>Epinephelus morio</i>	Red grouper	282	50.7	27.7	20.9	0.7
<i>Carcharhinus falciformis</i>	Silky shark	240	78.3	2.1	17.9	1.7
<i>Ophichthus rex</i>	King snake eel	162	7.4	0.0	91.4	1.2
<i>Carcharhinus obscurus</i>	Dusky shark	143	4.2	25.9	67.8	2.1
<i>Epinephelus itajara</i>	Goliath grouper	58	1.7	84.5	12.1	1.7
<i>Mustelus canis</i>	Smooth dogfish	53	11.3	18.9	69.8	0.0
<i>Lutjanus analis</i>	Mutton snapper	47	87.2	0.0	12.8	0.0
<i>Carcharhinus signatus</i>	Night shark	45	4.4	0.0	95.6	0.0
<i>Epinephelus niveatus</i>	Snowy grouper	38	86.8	0.0	13.2	0.0
<i>Seriola dumerili</i>	Greater amberjack	34	58.8	11.8	29.4	0.0
<i>Scianops ocellatus</i>	Red drum	32	6.3	81.3	9.3	3.1
<i>Carcharhinus perezii</i>	Caribbean reef shark	29	34.5	20.7	44.8	0.0
<i>Lutjanus campechanus</i>	Red snapper	29	37.9	17.3	44.8	0.0
<i>Sphyrna tiburo</i>	Bonnethead shark	28	32.1	0.0	67.9	0.0
<i>Squalus mitsukurii</i>	Shortspine dogfish	28	14.3	50.0	35.7	0.0
<i>Callinectes sapidus</i>	Blue crab	27	0.0	96.3	3.7	0.0
<i>Squalidae</i>	Dogfish family	27	3.7	51.9	3.7	40.7
<i>Bagre marinus</i>	Gafftopsail catfish	25	44.0	0.0	56.0	0.0
<i>Sphyaena barracuda</i>	Great barracuda	24	37.5	4.2	54.1	4.2
<i>Pristis pectinata</i>	Smalltooth sawfish	22	0.0	95.5	4.5	0.0
<i>Carcharhinidae</i>	Requiem shark family	21	0.0	0.0	57.1	42.9
<i>Dasyatis americana</i>	Southern stingray	21	0.0	95.2	4.8	0.0
<i>Lutjanus cyanopterus</i>	Cubera snapper	21	90.5	0.0	0.0	9.5
<i>Mycteroperca microlepis</i>	Gag grouper	21	76.2	9.5	14.3	0.0
<i>Dasyatis sp.</i>	Stingrays	20	0.0	85.0	15.0	0.0
<i>Anthozoa</i>	Coral	19	0.0	0.0	100.0	0.0
<i>Elasmobranchii</i>	Sharks	17	5.9	17.7	58.8	17.6

Table 1. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Carcharhinus isodon</i>	Finetooth shark	16	87.5	6.3	6.2	0.0
<i>Porifera</i>	Sponges	16	6.3	12.5	74.9	6.3
<i>Mycteroperca bonaci</i>	Black grouper	15	73.3	6.7	20.0	0.0
<i>Rachycentron canadum</i>	Cobia	14	64.3	21.4	14.3	0.0
<i>Caretta caretta</i>	Loggerhead sea turtle	12	0.0	50.0	41.7	8.3
<i>Epinephelus flavolimbatus</i>	Yellowedge grouper	12	100.0	0.0	0.0	0.0
<i>Echeneidae</i>	Remora family	11	9.1	90.9	0.0	0.0
<i>Seriola rivoliana</i>	Almaco jack	11	72.7	0.0	27.3	0.0
<i>Mollusca</i>	Molluscs	9	0.0	88.9	11.1	0.0
<i>Muraenidae</i>	Moray eel family	9	0.0	11.1	88.9	0.0
<i>Anguilliformes</i>	Eels	8	25.0	25.0	50.0	0.0
<i>Echeneis naucrates</i>	Sharksucker	7	0.0	85.7	14.3	0.0
<i>Hexanchus griseus</i>	Sixgill shark	7	0.0	100.0	0.0	0.0
<i>Unknown animal</i>	Unknown animal	7	14.3	0.0	0.0	85.7
<i>Dasyatis centroura</i>	Roughtail stingray	6	0.0	100.0	0.0	0.0
<i>Sphyrna zygaena</i>	Smooth hammerhead shark	6	100.0	0.0	0.0	0.0
<i>Aetobatis narinari</i>	Spotted eagle ray	5	0.0	100.0	0.0	0.0
<i>Congridae</i>	Conger eels	5	0.0	0.0	100.0	0.0
<i>Gymnothorax funebris</i>	Green moray eel	5	40.0	0.0	60.0	0.0
<i>Asteroidea</i>	Sea stars	4	0.0	100.0	0.0	0.0
<i>Cancer spp.</i>	Cancer crabs	4	0.0	100.0	0.0	0.0
<i>Caranx hippos</i>	Crevalle jack	3	0.0	0.0	100.0	0.0
<i>Epinephelus nigritus</i>	Warsaw grouper	3	66.7	0.0	33.3	0.0
<i>Gymnothorax moring</i>	Spotted moray eel	3	0.0	0.0	100.0	0.0
<i>Isurus oxyrinchus</i>	Shortfin mako shark	3	100.0	0.0	0.0	0.0
<i>Raja eglanteria</i>	Clearnose skate	3	33.3	33.4	33.3	0.0
<i>Rajiformes</i>	Skates and rays	3	0.0	100.0	0.0	0.0
<i>Calappa flammea</i>	Flame box crab	2	0.0	100.0	0.0	0.0
<i>Sphyraenidae</i>	Barracuda family	2	50.0	0.0	50.0	0.0
<i>Sphyrna sp.</i>	Hammerhead sharks	2	0.0	0.0	100.0	0.0
<i>Batrachoididae</i>	Toadfish family	1	0.0	100.0	0.0	0.0
<i>Carcharodon carcharias</i>	Great white shark	1	0.0	0.0	100.0	0.0
<i>Cephalopoda</i>	Octopus	1	0.0	100.0	0.0	0.0
<i>Coryphaena hippurus</i>	Dolphinfish	1	100.0	0.0	0.0	0.0
<i>Dasyatis sabina</i>	Atlantic stingray	1	0.0	100.0	0.0	0.0
<i>Epinephelus drummondhayi</i>	Speckled hind	1	0.0	100.0	0.0	0.0
<i>Istiophorus platypterus</i>	Sailfish	1	100.0	0.0	0.0	0.0
<i>Isurus paucus</i>	Longfin mako shark	1	0.0	100.0	0.0	0.0
<i>Lutjanidae</i>	Snapper family	1	100.0	0.0	0.0	0.0

Table 1. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Myliobatis sp.</i>	Eagle rays	1	0.0	100.0	0.0	0.0
<i>Ophichthus ocellatus</i>	Pale-spotted eel	1	0.0	100.0	0.0	0.0
<i>Polychaeta</i>	Worms	1	0.0	100.0	0.0	0.0
<i>Portunidae</i>	Portunid crabs	1	0.0	100.0	0.0	0.0
<i>Prionace glauca</i>	Blue shark	1	100.0	0.0	0.0	0.0
<i>Seriola fasciata</i>	Lesser amberjack	1	100.0	0.0	0.0	0.0
<i>Seriola sp.</i>	Amberjacks	1	0.0	100.0	0.0	0.0
<i>Seriola zonata</i>	Banded rudderfish	1	0.0	0.0	100.0	0.0
<i>Squalus cubensis</i>	Cuban dogfish	1	0.0	100.0	0.0	0.0
<i>Urophycis floridana</i>	Southern hake	1	100.0	0.0	0.0	0.0

Table 2. Total observed Gulf of Mexico catch and bycatch by species and species disposition in order of decreasing abundance for all reef fish targeted sets, 2006-2012. Catch disposition is by percent kept (Kept %), percent discarded alive (D.A. %), and percent discarded dead (D.D. %).

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Epinephelus morio</i>	Red grouper	60916	52.5	41.7	5.5	0.3
<i>Epinephelus flavolimbatus</i>	Yellowedge grouper	8249	98.3	0.9	0.8	0.0
<i>Caulolatilus microps</i>	Blueline tilefish	5368	61.4	7.1	31.1	0.4
<i>Lutjanus campechanus</i>	Red snapper	5321	37.1	55.3	7.3	0.3
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	2764	1.0	78.6	20.2	0.2
<i>Mycteroperca phenax</i>	Scamp grouper	2520	96.1	2.3	1.5	0.1
<i>Lopholatilus chamaeleonticeps</i>	Tilefish	2126	46.0	49.3	4.6	0.1
<i>Mycteroperca microlepis</i>	Gag grouper	1622	82.6	14.7	2.4	0.3
<i>Mustelus canis</i>	Smooth dogfish	1219	0.6	92.3	6.9	0.2
<i>Carcharhinus acronotus</i>	Blacknose shark	1183	1.4	90.3	8.1	0.2
<i>Ophichthus rex</i>	King snake eel	1064	0.4	22.2	76.3	1.1
<i>Epinephelus niveatus</i>	Snowy grouper	1029	94.8	3.3	1.9	0.0
<i>Urophycis floridana</i>	Southern hake	987	2.0	5.6	92.1	0.3
<i>Muraenidae</i>	Moray eel family	875	1.9	11.4	86.2	0.5
<i>Lutjanus analis</i>	Mutton snapper	682	99.3	0.5	0.1	0.1
<i>Epinephelus drummondhayi</i>	Speckled hind	595	80.2	16.5	3.0	0.3
<i>Squalus cubensis</i>	Cuban dogfish	487	0.0	90.8	9.2	0.0
<i>Pagrus pagrus</i>	Red porgy	465	78.3	9.2	12.5	0.0
<i>Carcharhinus plumbeus</i>	Sandbar shark	440	3.2	94.3	1.4	1.1
<i>Seriola dumerili</i>	Greater amberjack	364	25.0	51.7	22.8	0.5
<i>Galeocerdo cuvier</i>	Tiger shark	312	1.9	93.6	3.2	1.3
<i>Calamus bajonado</i>	Jolthead porgy	238	92.0	3.0	5.0	0.0
<i>Squalidae</i>	Dogfish family	223	2.2	96.0	1.8	0.0
<i>Sphyrna barracuda</i>	Great barracuda	207	15.0	38.6	45.4	1.0
<i>Neomerinthe hemingwayi</i>	Spinycheek scorpionfish	205	91.2	2.0	6.8	0.0
<i>Anthozoa</i>	Coral	195	0.5	3.1	82.0	14.4
<i>Ginglymostoma cirratum</i>	Nurse shark	191	1.6	96.3	0.5	1.6
<i>Carcharhinidae</i>	Requiem shark family	180	1.1	93.9	2.2	2.8
<i>Carcharhinus falciformis</i>	Silky shark	171	3.5	66.7	29.8	0.0
<i>Opsanus pardus</i>	Leopard toadfish	158	2.5	34.8	60.8	1.9
<i>Echeneis naucrates</i>	Sharksucker	152	1.3	81.6	17.1	0.0
<i>Seriola sp.</i>	Amberjacks	146	17.8	32.2	49.3	0.7
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	145	4.1	73.1	21.4	1.4
<i>Carcharhinus limbatus</i>	Blacktip shark	139	6.5	74.8	16.5	2.2
<i>Sparidae</i>	Porgy family	139	79.1	10.8	9.4	0.7
<i>Lutjanus griseus</i>	Gray snapper	135	89.6	7.4	3.0	0.0
<i>Ophichthus ocellatus</i>	Pale-spotted eel	135	1.5	14.8	83.7	0.0
<i>Hexanchus vitulus</i>	Bigeye sixgill shark	133	0.0	82.7	17.3	0.0

<i>Muraena retifera</i>	Reticulate moray eel	129	2.3	3.1	94.6	0.0
-------------------------	----------------------	-----	-----	-----	------	-----

Table 2. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Mycteroperca bonaci</i>	Black grouper	118	96.6	2.6	0.8	0.0
<i>Triakidae</i>	Houndsharks	112	1.8	97.3	0.9	0.0
<i>Rhomboplites aurorubens</i>	Vermillion snapper	106	45.3	29.2	25.5	0.0
<i>Urophycis cirrata</i>	Gulf hake	106	6.6	16.0	75.5	1.9
<i>Brotula barbata</i>	Bearded brotula	104	96.2	1.0	1.8	1.0
<i>Echeneidae</i>	Remora family	103	2.9	73.8	23.3	0.0
<i>Euthynnus alletteratus</i>	Little tunny	102	4.9	6.9	87.2	1.0
<i>Elasmobranchii</i>	Sharks	101	2.0	83.2	11.8	3.0
<i>Congridae</i>	Conger eels	96	2.1	10.4	87.5	0.0
<i>Lutjanus synagris</i>	Lane snapper	92	59.8	33.7	6.5	0.0
<i>Epinephelus nigritus</i>	Warsaw grouper	85	98.8	0.0	1.2	0.0
<i>Gymnothorax moring</i>	Spotted moray eel	77	1.3	2.6	96.1	0.0
<i>Majidae</i>	Spider crabs	76	2.6	92.2	2.6	2.6
<i>Seriola rivoliana</i>	Almaco jack	74	85.1	13.5	1.4	0.0
<i>Seriola zonata</i>	Banded rudderfish	67	9.0	76.1	14.9	0.0
<i>Rachycentron canadum</i>	Cobia	66	69.7	25.8	4.5	0.0
<i>Balistes caprisicus</i>	Gray triggerfish	65	81.5	15.4	3.1	0.0
<i>Merluccius sp.</i>	Silver Hakes	65	3.1	3.1	93.8	0.0
<i>Anguilliformes</i>	Eels	61	0.0	26.2	73.8	0.0
<i>Haemulon album</i>	Margate grunt	61	95.1	3.3	1.6	0.0
<i>Porifera</i>	Sponges	55	0.0	1.8	87.3	10.9
<i>Asteroidea</i>	Sea stars	54	3.7	48.1	24.1	24.1
<i>Trachinocephalus myops</i>	Snakefish	54	1.9	25.9	72.2	0.0
<i>Raja eglanteria</i>	Clearnose skate	52	0.0	76.9	23.1	0.0
<i>Coryphaena hippurus</i>	Dolphinfish	51	76.5	0.0	23.5	0.0
<i>Synodus foetens</i>	Inshore lizardfish	50	0.0	10.0	90.0	0.0
<i>Synodontidae</i>	Lizardfish family	47	2.1	29.8	68.1	0.0
<i>Carcharhinus brevipinna</i>	Spinner shark	44	4.5	70.5	25.0	0.0
<i>Tetraodontidae</i>	Puffer family	41	2.4	92.7	4.9	0.0
<i>Sarda sarda</i>	Bonito	36	2.8	0.0	97.2	0.0
<i>Synodus intermedius</i>	Sanddiver lizardfish	34	0.0	17.6	82.4	0.0
<i>Calamus proridens</i>	Littlehead porgy	32	93.8	0.0	6.2	0.0
<i>Serranidae</i>	Grouper family	31	90.3	3.2	6.5	0.0
<i>Lutjanus vivanus</i>	Silk snapper	30	100.0	0.0	0.0	0.0
<i>Carcharhinus signatus</i>	Night shark	29	3.4	44.9	51.7	0.0
<i>Pristipomoides aquilonaris</i>	Wenchman snapper	28	28.6	3.6	67.8	0.0
<i>Holocentrus sp.</i>	Squirrelfishes	27	18.5	51.9	25.9	3.7
<i>Thunnus sp.</i>	Tunas	26	15.4	7.7	76.9	0.0
<i>Centropristis sp.</i>	Seabass family	25	20.0	36.0	44.0	0.0

Table 2. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Scyliorhinus retifer</i>	Chain catshark	25	0.0	88.0	12.0	0.0
<i>Calappa flammea</i>	Flame box crab	24	12.5	87.5	0.0	0.0
<i>Thunnus atlanticus</i>	Blackfin tuna	23	60.9	8.7	30.4	0.0
<i>Carcharhinus leucas</i>	Bull shark	22	0.0	100.0	0.0	0.0
<i>Seriola fasciata</i>	Lesser amberjack	22	9.1	77.3	13.6	0.0
Unknown animal	Unknown animal	22	36.4	27.3	9.0	27.3
<i>Carcharhinus obscurus</i>	Dusky shark	21	0.0	90.5	9.5	0.0
<i>Sphyrnaeidae</i>	Barracuda family	21	9.5	28.6	61.9	0.0
<i>Batrachoididae</i>	Toadfish family	20	5.0	60.0	35.0	0.0
<i>Caulolatilus chrysops</i>	Goldface tilefish	20	100.0	0.0	0.0	0.0
<i>Lutjanidae</i>	Snapper family	19	84.2	10.5	5.3	0.0
<i>Malacanthus plumieri</i>	Sand tilefish	18	5.6	72.2	22.2	0.0
<i>Phycidae</i>	Phycid Hakes	17	0.0	0.0	100.0	0.0
<i>Holothuroideae</i>	Sea cucumber	16	0.0	0.0	93.7	6.3
<i>Diplectrum formosum</i>	Sand perch	15	0.0	40.0	60.0	0.0
<i>Gymnothorax funebris</i>	Green moray eel	15	6.7	20.0	73.3	0.0
<i>Mollusca</i>	Molluscs	15	0.0	20.0	80.0	0.0
<i>Paralichthys sp.</i>	Flounders	15	40.0	46.7	13.3	0.0
<i>Sphyrna sp.</i>	Hammerhead sharks	15	0.0	86.7	6.6	6.7
<i>Scomberomorus cavalla</i>	King mackerel	14	0.0	14.3	85.7	0.0
<i>Scorpaenidae</i>	Scorpionfish family	14	92.9	7.1	0.0	0.0
<i>Etelis oculatus</i>	Queen snapper	13	92.3	0.0	7.7	0.0
<i>Caretta caretta</i>	Loggerhead sea turtle	12	0.0	41.7	41.6	16.7
<i>Epinephelus itajara</i>	Goliath grouper	12	0.0	33.3	66.7	0.0
<i>Dasyatis americana</i>	Southern stingray	11	0.0	45.5	54.5	0.0
<i>Decapoda</i>	Crabs	11	9.1	72.7	0.0	18.2
<i>Haemulon plumieri</i>	White grunt	11	100.0	0.0	0.0	0.0
<i>Centropristis ocyurus</i>	Bank seabass	10	0.0	70.0	30.0	0.0
<i>Scianops ocellatus</i>	Red drum	10	0.0	100.0	0.0	0.0
<i>Cancer spp.</i>	Cancer crabs	9	0.0	66.7	33.3	0.0
<i>Dasyatis sp.</i>	Stingrays	9	0.0	77.8	22.2	0.0
<i>Caranx hippos</i>	Crevalle jack	8	12.5	0.0	87.5	0.0
<i>Hexanchus griseus</i>	Sixgill shark	8	0.0	87.5	12.5	0.0
<i>Acanthocybium solanderi</i>	Wahoo	7	57.1	0.0	42.9	0.0
<i>Ocyurus chrysurus</i>	Yellowtail snapper	7	85.7	14.3	0.0	0.0
<i>Caranx crysos</i>	Bluerunner jack	6	0.0	16.7	83.3	0.0
<i>Gymnothorax kolpos</i>	Blacktail Moray	6	0.0	0.0	100.0	0.0
<i>Squalus mitsukurii</i>	Shortspine dogfish	6	0.0	33.3	66.7	0.0
<i>Carcharhinus isodon</i>	Finetooth shark	5	0.0	80.0	20.0	0.0

Table 2. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Echinodermata</i>	Sea urchins	5	0.0	60.0	20.0	20.0
<i>Epinephelus adscensionis</i>	Rock hind	5	80.0	0.0	0.0	20.0
<i>Lagocephalus laevigatus</i>	Smooth puffer	5	60.0	40.0	0.0	0.0
<i>Osteichthyes</i>	Unknown teleost	5	40.0	0.0	60.0	0.0
<i>Rajiformes</i>	Skates and rays	5	0.0	60.0	40.0	0.0
<i>Balistes vetula</i>	Queen triggerfish	4	100.0	0.0	0.0	0.0
<i>Leiostomus xanthurus</i>	Spot	4	100.0	0.0	0.0	0.0
<i>Menticirrhus littoralis</i>	Gulf kingfish	4	25.0	0.0	75.0	0.0
<i>Opsanus beta</i>	Gulf toadfish	4	0.0	100.0	0.0	0.0
<i>Paralichthys lethostigma</i>	Southern flounder	4	75.0	25.0	0.0	0.0
<i>Polychaeta</i>	Worms	4	0.0	100.0	0.0	0.0
<i>Sphyrna mokarran</i>	Great hammerhead shark	4	0.0	50.0	50.0	0.0
<i>Thunnus obesus</i>	Bigeye tuna	4	50.0	0.0	50.0	0.0
<i>Carangidae</i>	Jack family	3	0.0	33.3	66.7	0.0
<i>Caranx sp.</i>	Jacks	3	66.7	0.0	33.3	0.0
<i>Dipturus garricki</i>	San Blas skate	3	0.0	100.0	0.0	0.0
<i>Echeneis neucratoides</i>	Whitfin sharksucker	3	0.0	100.0	0.0	0.0
<i>Gymnothorax saxicola</i>	Ocellated moray eel	3	0.0	0.0	100.0	0.0
<i>Lutjanus buccanella</i>	Blackfin snapper	3	100.0	0.0	0.0	0.0
<i>Mustelus norrisi</i>	Florida smoothhound shark	3	0.0	33.3	66.7	0.0
<i>Nephropidae</i>	Lobsters	3	0.0	66.7	0.0	33.3
<i>Rhinoptera bonasus</i>	Cownose ray	3	0.0	0.0	100.0	0.0
<i>Thunnus albacares</i>	Yellowfin tuna	3	66.7	0.0	33.3	0.0
<i>Trachinotus falcatus</i>	Permit	3	0.0	100.0	0.0	0.0
<i>Xiphius gladius</i>	Swordfish	3	100.0	0.0	0.0	0.0
<i>Antennariidae</i>	Frogfish family	2	0.0	50.0	50.0	0.0
<i>Calamus calamus</i>	Saucereye porgy	2	50.0	50.0	0.0	0.0
<i>Centropristis philadelphica</i>	Rock seabass	2	0.0	0.0	100.0	0.0
<i>Crustacea</i>	Sand fleas	2	0.0	0.0	100.0	0.0
<i>Cynoscion sp.</i>	Seatrouts	2	0.0	0.0	100.0	0.0
<i>Dasyatis centroura</i>	Roughtail stingray	2	0.0	50.0	50.0	0.0
<i>Epinephelus guttatus</i>	Red hind	2	50.0	0.0	50.0	0.0
<i>Hexanchidae</i>	Cow sharks	2	0.0	100.0	0.0	0.0
<i>Isurus sp.</i>	Mako sharks	2	0.0	50.0	50.0	0.0
<i>Lagocephalus lagocephalus</i>	Oceanic puffer	2	0.0	100.0	0.0	0.0
<i>Pelecanus occidentalis</i>	Brown pelican	2	0.0	0.0	100.0	0.0
<i>Pomatomus saltatrix</i>	Bluefish	2	0.0	0.0	100.0	0.0
<i>Pontinus longispinis</i>	Longspine scorpionfish	2	0.0	50.0	50.0	0.0
<i>Sphyrna tiburo</i>	Bonnethead shark	2	0.0	100.0	0.0	0.0

Table 2. Continued.

Species	Common Name	Total Number Caught	Kept (%)	D. A. (%)	D. D. (%)	U. (%)
<i>Squatina dumeril</i>	Atlantic angel shark	2	0.0	100.0	0.0	0.0
<i>Auxis thaza</i>	Frigate mackerel	1	0.0	0.0	100.0	0.0
<i>Calamus nodosus</i>	Knobbed porgy	1	100.0	0.0	0.0	0.0
<i>Cancer irroratus</i>	Atlantic rock crab	1	0.0	100.0	0.0	0.0
<i>Caulolatilus cyanops</i>	Blackline tilefish	1	0.0	100.0	0.0	0.0
<i>Cephalopoda</i>	Octopus	1	0.0	0.0	100.0	0.0
<i>Cookeolus japonicus</i>	Bulleye	1	100.0	0.0	0.0	0.0
<i>Elagatis bipinnulata</i>	Rainbow runner	1	0.0	0.0	100.0	0.0
<i>Epinephelus cruentatus</i>	Graysby grouper	1	0.0	100.0	0.0	0.0
<i>Fistularia petimba</i>	Red Cornetfish	1	0.0	100.0	0.0	0.0
<i>Fistularia tabacaria</i>	Bluespotted cornetfish	1	0.0	100.0	0.0	0.0
<i>Gymnothorax vicinus</i>	Purplemouth moray eel	1	0.0	0.0	100.0	0.0
<i>Gymnura sp.</i>	Butterfly ray	1	0.0	100.0	0.0	0.0
<i>Heptranchias perlo</i>	Sevengill shark	1	0.0	100.0	0.0	0.0
<i>Isurus oxyrinchus</i>	Shortfin mako shark	1	100.0	0.0	0.0	0.0
<i>Labridae</i>	Wrasse family	1	0.0	0.0	100.0	0.0
<i>Lagodon rhomboides</i>	Pinfish	1	0.0	0.0	100.0	0.0
<i>Larinae sp.</i>	Gulls	1	0.0	0.0	100.0	0.0
<i>Larus argentatus</i>	Herring gull	1	0.0	0.0	100.0	0.0
<i>Larus auricilla</i>	Laughing gull	1	0.0	0.0	100.0	0.0
<i>Lobotes surinamensis</i>	Tripletail	1	0.0	100.0	0.0	0.0
<i>Lophius sp.</i>	Monkfish anglerfish	1	0.0	0.0	100.0	0.0
<i>Lutjanus cyanopterus</i>	Cubera snapper	1	100.0	0.0	0.0	0.0
<i>Lutjanus jocu</i>	Dog snapper	1	100.0	0.0	0.0	0.0
<i>Manta birostris</i>	Manta ray	1	0.0	0.0	0.0	100.0
<i>Mycteroperca interstitialis</i>	Yellowmouth grouper	1	100.0	0.0	0.0	0.0
<i>Narcine brasiliensis</i>	Lesser electric ray	1	100.0	0.0	0.0	0.0
<i>Negaprion brevirostris</i>	Lemon shark	1	0.0	100.0	0.0	0.0
<i>Paguroidea</i>	Hermit crabs	1	0.0	0.0	100.0	0.0
<i>Paralichthys albigutta</i>	Gulf flounder	1	100.0	0.0	0.0	0.0
<i>Peprilus alepidotus</i>	Harvestfish	1	0.0	0.0	100.0	0.0
<i>Peprilus triacanthus</i>	Atlantic butterflyfish	1	100.0	0.0	0.0	0.0
<i>Prionotus sp.</i>	Searobins	1	0.0	100.0	0.0	0.0
<i>Pterois sp.</i>	Lionfish	1	100.0	0.0	0.0	0.0
<i>Scyphozoa</i>	Jellyfish	1	0.0	100.0	0.0	0.0
<i>Sea bird</i>	Sea birds	1	0.0	0.0	100.0	0.0
<i>Squid</i>	Squid	1	0.0	0.0	100.0	0.0

Table 3. Condition on release (in number) of gag grouper captured in the bottom longline fishery by fork length (cm) for shark-target sets (SHX) and reef fish-target sets (REF). Cut for bait is included with Released dead and unknown condition is excluded.

SHX n	SHX Kept	SHX Released Alive	SHX Released Dead	Total Length Bins (cm)	REF n	REF Kept	REF Released Alive	REF Released Dead
0	0	0	0	31-40	3	0	1	2
1	0	1	0	41-50	9	4	5	0
0	0	0	0	51-60	52	18	31	3
0	0	0	0	61-70	215	175	38	2
5	4	1	0	71-80	518	439	70	9
2	1	0	1	81-90	465	396	60	8
8	8	0	0	91-100	206	185	18	3
3	3	0	0	101-110	62	57	4	0
0	0	0	0	111-120	10	9	1	0
0	0	0	0	121-130	3	2	0	1

Table 4. Average fork length of gag grouper captured in the reef fish-target bottom longline fishery from 2006-2012.

Year	n	Average FL (cm)	Minimum FL (cm)	Maximum FL (cm)	Standard Deviation
2006	22	79.1	52	106	15.3
2007	144	87.1	45	119	13.1
2008	95	83.8	53	107	10.3
2009	2	85.5	82	89	4.9
2010	464	79.4	31	120	11.7
2011	139	78.2	54	114	11.5
2012	677	79.6	32	127	11.0
All	1543	80.4	31	127	11.7

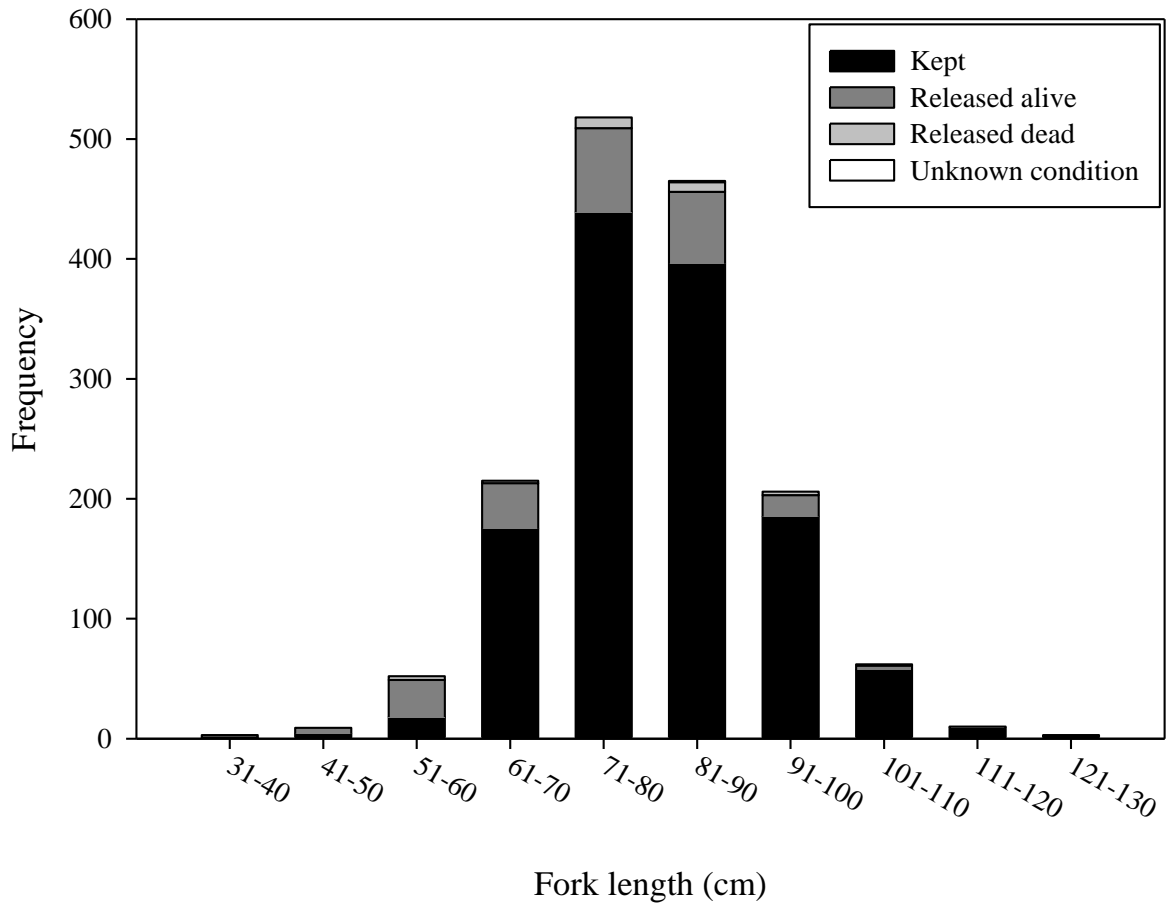


Figure 2. Length frequency (FL in cm) of gag grouper caught in the reef fish-target bottom longline fishery with condition on release.

Table 5. Condition on release (in number) of gag grouper captured in the bottom longline fishery by average depth (m) for shark-target sets (SHX) and reef fish-target sets (REF). Cut for bait is included with Released dead and unknown condition is excluded.

SHX n	SHX Kept	SHX Released Alive	SHX Released Dead	Depth Bins (m)	REF n	REF Kept	REF Released Alive	REF Released Dead
1	0	1	0	11-20	0	0	0	0
1	0	1	0	21-30	2	2	0	0
1	1	0	0	31-40	87	78	9	0
1	1	0	0	41-50	114	103	9	2
5	5	0	0	51-60	116	100	16	0
4	3	0	1	61-70	417	374	38	5
0	0	0	0	71-80	540	393	126	19
5	4	0	1	81-90	130	115	15	0
3	2	0	1	91-100	50	41	7	2
0	0	0	0	101-110	27	27	0	0
0	0	0	0	111-120	20	19	1	0
0	0	0	0	121-130	0	0	0	0
0	0	0	0	131-140	2	2	0	0
0	0	0	0	141-150	22	15	7	0
0	0	0	0	151-160	4	4	0	0
0	0	0	0	161-170	7	7	0	0
0	0	0	0	171-180	0	0	0	0
0	0	0	0	181-190	0	0	0	0
0	0	0	0	191-200	0	0	0	0
0	0	0	0	201-210	0	0	0	0
0	0	0	0	211-220	5	5	0	0

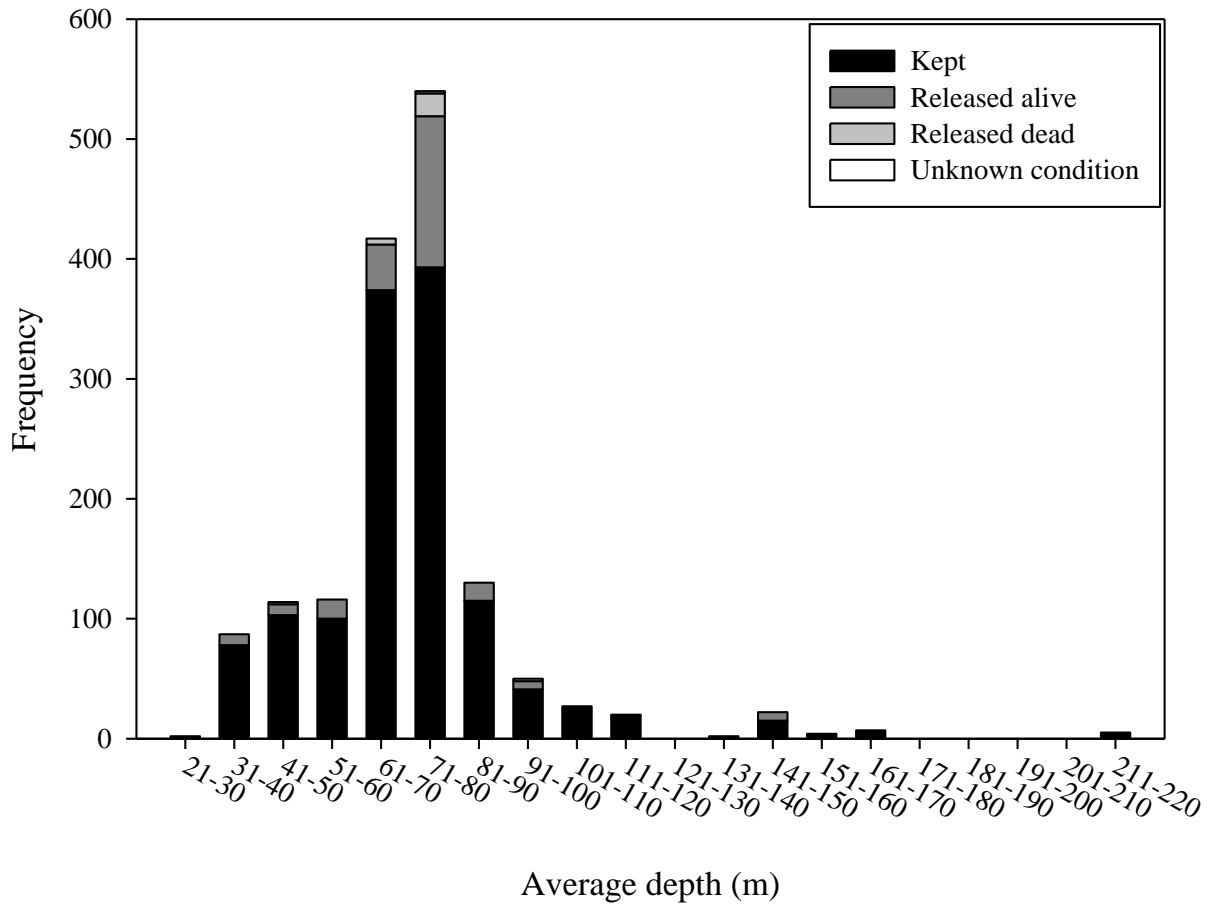


Figure 3. Depth frequency of gag grouper caught in the reef fish-target bottom longline fishery with condition on release.

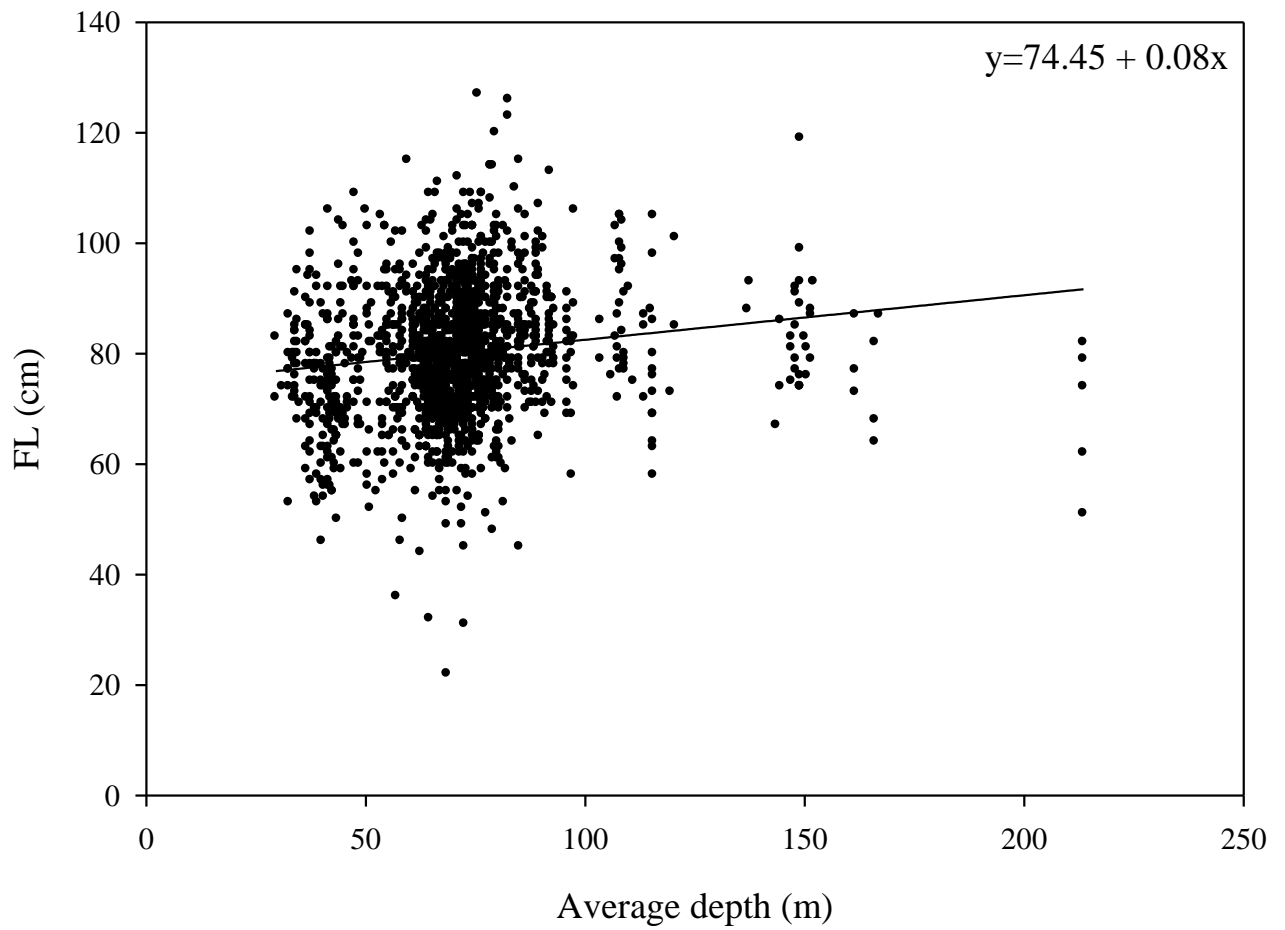


Figure 4. Fork length (cm) versus depth (m) of gag grouper caught in the reef fish-target bottom longline fishery. A linear regression is plotted with the equation given ($r^2 = 0.02$, $p < 0.0001$).

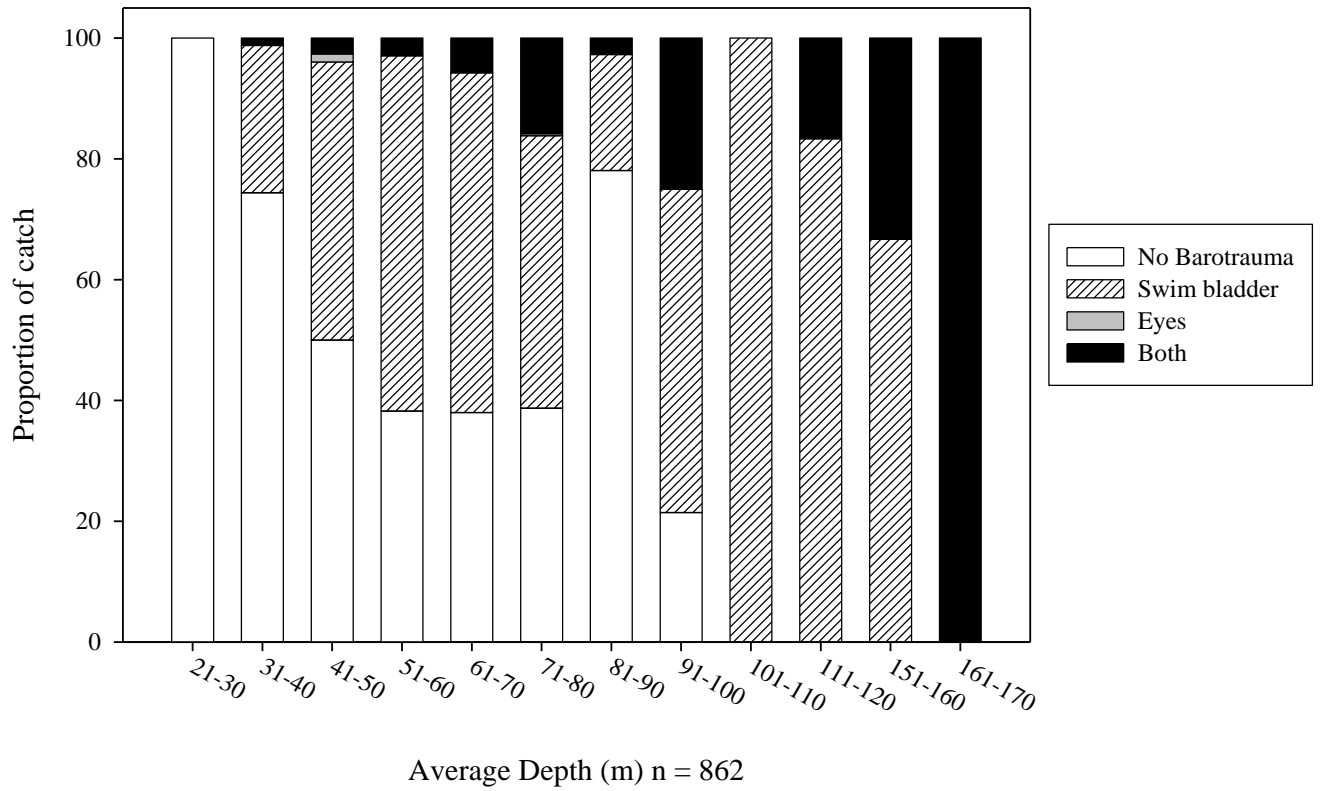


Figure 5. Condition on capture of gag groupers captured in the bottom longline fishery versus average depth.

Table 6. Condition on release (in number) of gag grouper captured in the bottom longline fishery by soak duration (hrs) for shark-target sets (SHX) and reef fish-target sets (REF). Cut for bait is included with Released dead and unknown condition is excluded.

SHX n	SHX Kept	SHX Released Alive	SHX Released Dead	Soak Duration Bins (hr)	REF n	REF Kept	REF Released Alive	REF Released Dead
0	0	0	0	0-1	971	796	159	14
1	0	0	0	1-2	433	357	62	14
0	0	0	0	2-3	53	46	7	0
3	2	0	1	3-4	29	29	0	0
0	0	0	0	4-5	10	10	0	0
0	0	0	0	5-6	6	6	0	0
0	0	0	0	6-7	6	6	0	0
0	0	0	0	7-8	6	6	0	0
1	0	0	1	8-9	6	6	0	0
6	4	1	1	9-10	4	4	0	0
2	1	0	1	10-11	1	1	0	0
2	2	0	0	11-12	1	1	0	0
0	0	0	0	12-13	1	1	0	0
2	2	0	0	13-14	0	0	0	0
1	1	0	0	14-15	5	5	0	0
0	0	0	0	15-16	0	0	0	0
0	0	0	0	16-17	10	10	0	0
2	2	0	0	17-18	0	0	0	0
				//				
0	0	0	0	23-24	1	1	0	0
				//				
1	1	0	0	32-33	0	0	0	0

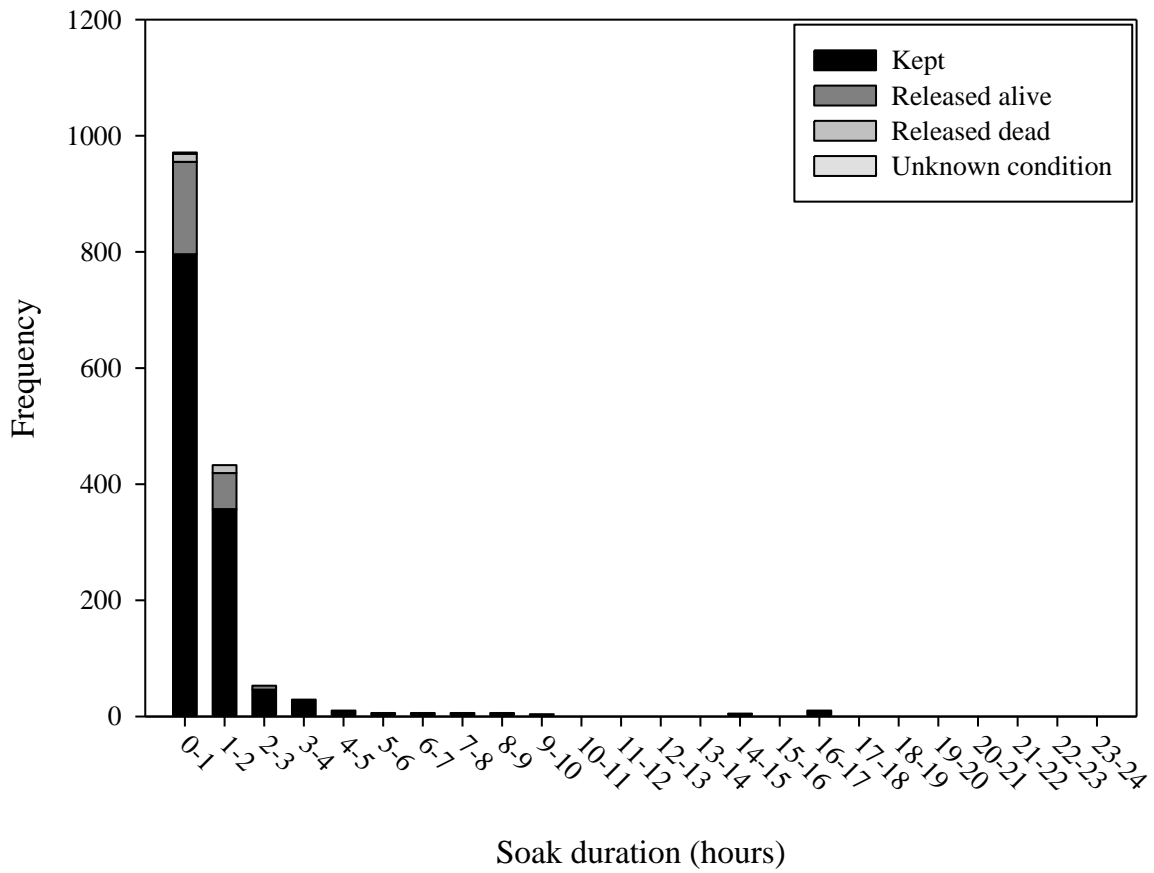


Figure 6. Soak frequency of gag grouper caught in the reef fish-target bottom longline fishery with condition on release.