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Introduction

The National Marine Fisheries Service's (NMFS) Southeast Fisheries Science Center (SEFSC) implemented a mandatory observer program in July 2006 to characterize the Gulf of Mexico commercial reef fish fishery (Scott-Denton et al., 2011). Currently, there are 821 federally permitted commercial reef fish vessels (SERO[1]). The primary gears used in this fishery include: bottom longline and vertical line (bandit or handline). In recent years, due to regulatory changes in depth restrictions, modified buoy gear was used aboard traditional longline vessels in shallower (~20–35 fm) waters, primarily in the eastern Gulf. The dominant species targeted in the reef fish fishery are groupers, *Epinephelus* spp., and snappers, *Lutjanus* spp.

Based on earlier studies of the Gulf of Mexico reef fish fishery (Scott-Denton and Harper[2]; Scott-Denton[3]; Scott-Denton et al., 2011), longliners off the west coast of Florida typically target red grouper, *Epinephelus morio,* in shallow waters and yellowedge grouper, *E. flavolimbatus*, tilefish (Malacanthidae), and sharks (Carcharhinidae) in deeper waters. Red snapper, *Lutjanus campechanus*, vermilion snapper, *Rhomboplites aurorubens,* shallow-water grouper (e.g. red grouper) and deep-water grouper (e.g. yellowedge grouper) are sought throughout the Gulf of Mexico on vertical line vessels.

Fishing operations in federal waters are restricted or closed in certain areas in the Gulf of Mexico: the Tortugas North and Tortugas South Ecological Reserves in the Florida

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[1] SERO. 2013. Fishery permits and fishery quotas. Southeast Reg. Off., Natl. Mar. Fish. Serv., NOAA, St. Petersburg, Fla. (available at http://sero.nmfs.noaa.gov).

[2] Scott-Denton, E., and D. Harper. 1995. Characterization of the reef fish fishery of the eastern Gulf of Mexico. SEFSC Rep. to Gulf Fish. Manage. Counc. July 17, 1995, Key West, Fla., 45 p.

[3] Scott-Denton, E. 1996. Characterization of the reef fish fishery of the eastern U.S. Gulf of Mexico. MARFIN Grant No. 95MFIH07. Suppl. Rep. to MARFIN Grant No. 94MARFIN17, on file at NOAA Fish., SERO, St. Petersburg, Fla.

Keys National Marine Sanctuary and the Madison Swanson and Steamboat Lumps Marine Reserves off the west central Florida coast (GMFMC[4]). Longline and other buoy gear are prohibited inside the 50-fathom contour west and the 20-fm contour east of Cape San Blas, Fla. (GMFMC[4]). Further restrictions, through Amendment 31 to the Gulf of Mexico Fishery Management Council's (GMFMC) Reef Fish Fishery Management Plan (GMFMC[5]) prohibit bottom longline gear east of Cape San Blas, Fla., shoreward of the 35-fm contour from June through August, limit the number of hooks onboard to 1,000, of which only 750 could be rigged for fishing, and reduced the number of vessels through an endorsement system based on documentation of average annual landings of at least 40,000 lbs from 1999 through 2007.

The continuing goal of the Gulf of Mexico reef fish observer program is to provide quantitative biological, vessel, and gear-selectivity information on the directed reef fish fishery. The specific objectives are designed to: 1) provide general fishery bycatch characterization for finfish species, 2) estimate managed finfish discard and release mortality levels, and 3) estimate protected species bycatch levels. The specific objectives of this report are to: 1) summarize trip, vessel, environmental and gear characteristics, 2) quantify fish and protected species composition and disposition based on surface observations, 3) examine size composition of target species, and 4) estimate catch-per-unit effort (CPUE) trends and spatial distribution for dominant species for the 2010–2011 period.

[4] GMFMC. 2013. Commercial fishing regulations for Gulf of Mexico Federal waters. Gulf Mex. Fish. Manage. Counc., Tampa, Fla. (available at http://www.gulfcouncil.org).

[5] GMFMC. 2005. Amendment 31 to the Reef Fish Management Plan. Gulf Mex. Fish. Manage. Counc., Tampa, Fla. (available at http://www.gulfcouncil.org).

Methods

Protocol sampling modification, randomized vessel selection, and observer deployment through mandatory efforts for the commercial reef fish fishery began in 2006 (Scott-Denton et al., 2011). Observers were placed on reef fish vessels operating throughout the Gulf of Mexico through randomized selection stratified by season, gear, and region. Proportional sampling effort, based on coastal logbook data, among seasons and gears in the eastern and western Gulf of Mexico was used for vessel selection stratification purposes using annual updated effort data. Thus, observer coverage levels (based on sea days, the National metric for percent observer coverage levels) were directed toward regions and gear strata with higher levels of fishing effort, while continuing to sample strata with lower fishing effort.

In 2010, for the longline fishery, eleven trips were not selected through the mandatory process. Instead the trips were based on voluntary cooperation as part of a pilot project to investigate the potential of reducing gear soak times as a method for reducing sea turtle interactions and mortality on reef fish bottom longline vessels. Observers were placed on vessels equipped with hook timers. Hook timers, record the time of interaction with catch, and were deployed on every fifth hook during commercial longline operations. This research is continuing through early 2013. Results will be published upon project completion (D. Foster[6]).

From 2009 through 2011, increased coverage was directed toward the bottom longline fishery in the eastern Gulf to monitor for potential sea turtle interactions. In

[6] Dan Foster. 2012. National Marine Fisheries Service, Pascagoula, MS. pers. commun.

response to the bottom longline closure inside the 50-fm contour in the eastern Gulf in 2009, some traditional longline vessels used modified buoy gear to fish in shallower waters. This gear type was deployed during twenty-six trips from 2010 and 2011 with observers onboard.

Shrimp statistical zones (Patella, 1975) were used to depict area delineations (Fig. 1). Statistical areas 1–9 represent areas off the west coast of Florida, 10–12 delineate Alabama/Mississippi, 13–17 depicted Louisiana, and 18–21 denote Texas. For the reef fish fishery, statistical areas 1–8 represent the eastern Gulf and areas 9–21 the western Gulf. Seasonal categories were: January through March, April through June, July through September, and October through December. Gear types assessed included bottom longline, modified buoy gear, bandit reel, and handline. The latter two were combined to depict the vertical line fishery.

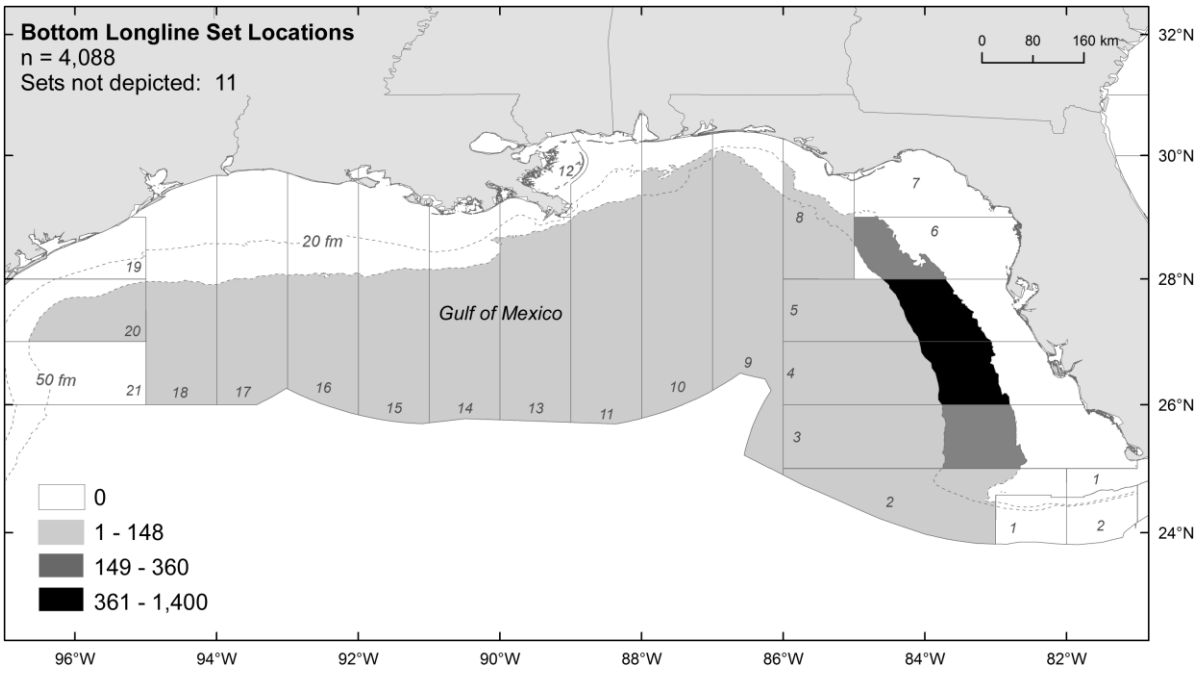

Figure 1— Distribution of sampling effort (sets) based on observer coverage of the U.S. Gulf of Mexico bottom longline reef fish fishery from January 2010 through November 2011.

Detailed vessel requirements for mandatory observer coverage and onboard sampling are described by Scott-Denton et al. (2011). Federal permit holders were required to have a

current Commercial Fishing Vessel Safety Examination decal prior to the selection period for mandatory observer coverage. A minimum sea day requirement by gear type was continued to prevent early trip termination due to observer presence. Reef fish permit holders are required to carry an observer for a minimum of 7 days during a selection period when using longline gear, 3 days for bandit gear, and 2 days for handline.

Once deployed, vessel and gear characteristics were recorded for each vessel. Set-specific information included: 1) location of gear placement at a defined time; 2) type, number, and construction material of the fishing gear; 3) latitude, longitude, depth, and environmental parameters including sea state and bottom type; and 4) total time the gear remained in the water (soak or fishing time).

Fishery data were obtained from each set. The condition of fish when brought onboard was classified into one of the following: 1) live - normal appearance; 2) live - stomach/air bladder protruding; 3) live - eyes protruding; 4) live - combination of 2 and 3; 5) dead on arrival; or 9) not determined. Categories 2 through 4 were combined to depict a stressed condition.

Fate of fish after release was recorded as: 1) discarded alive if it swam down; 2) discarded dead if it swam erratically, floated, or sank; or 3) undetermined. Undersized target and nontarget species were processed first by recording length, weight, condition when brought onboard, and fate after release to provide an estimate of immediate mortality (number discarded dead divided by the number of total discards).

Sea Turtle data were reported on modified Southeast Fisheries Science Center (SEFSC) Sea Turtle Life History Forms (Belskis et al. 2009, revised 2011) and sampled following SEFSC protocols (NMFS, 2008). The Sea Turtle Life History forms were

transmitted to the SEFSC in Miami where data were entered into the Sea Turtle Life History database for the SEFSC's use in annual sea turtle mortality estimates.

On some (16%) vertical line sets, due primarily to time constraints and the extent of the catch, not all reels were sampled for the set. The species total number was extrapolated proportionally based on subsampled reels for that set. Negative sets, or sets where no fish were caught were included in CPUE calculations. No extrapolation procedures were required for longline and modified buoy sets (e.g. all hooks sampled).

Due to data confidentiality guidelines, a minimum of three vessels were required for spatial and temporal stratification purposes. Thus, overall catch rates are presented collectively for all years, areas, seasons, and depths.

Statistical treatment of the data follows methods described by Scott-Denton et al. (2011). Effort was calculated using methods defined by McCarthy and Cass-Calay[7]. The number of hooks used at each location was multiplied by soak time to derive hook-hours. Catch rates were calculated in number of fish per hook-hour. For the vertical line fishery, total soak time was used for one set location using the sum of all hooks used per reel. Average haul in time of drops, when recorded, was used in the effort calculation. If not recorded, total soak time was used. Therefore, effort may not be accurately estimated due to the repeated deployment (e.g. drops) of multiple gear configurations (e.g. hooks) on the same reel at one set location.

[7] McCarthy, K. J., and S. Cass-Calay. 2006. Standardized catch rates for red grouper from the United States Gulf of Mexico handline, longline, and trap fisheries, 1990–2005. SEDAR 12-DW-16. Southeast Data Assessment and Review, South Atl. Fish. Manage. Counc., Charleston, SC (available at www.sefsc.noaa.gov/sedar/).

Ratio estimation was used for analyses of species catch rates. As described by Snedecor and Cochran (1967) and Watson et al. (1999), the ratio estimation (1) below was used as the sample estimate of the mean.

$$(1) \quad R = \frac{\sum Y}{\sum X}$$

Where:

R = ratio estimate,

Y = extrapolated number for species of a particular disposition code for selected strata, and

X = hook-hours for selected strata.

The estimated standard error of the estimate is given in equation 2:

$$(2)\ s(R) = \frac{1}{\bar{x}} \sqrt{\frac{\sum (Y - RX)^2}{n(n-1)}}$$

Where:

$\bar{x}$ = mean of hook-hours for selected strata, and

n = number of sets occurring in selected strata.

Density surface plots of CPUE for dominant species by fishery were calculated as described by Scott-Denton et al. (2011), and based on number of fish kept per 1,000 hook-hours. The plots were created using Fishery Analyst [8,9]; an ArcGIS extension developed to graphically present temporal and spatial trends in fishery statistics (Riolo, 2006). A summary CPUE value for all years combined was calculated for each cell by calculating

[8] Fishery Analyst, Mappamondo GIS, Via Rubens 3, 43100 Parma(PR) – Italy.

[9] Mention of trade names or commercial firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

CPUE values for individual years and dividing by the number of years for which fishing activity occurred in that cell.

To identify CPUE trends for frequently captured species by each gear type, a local spatial statistic, the Getis-Ord Gi* (Gi*), was calculated using the Hot Spot Analysis tool in ArcGIS[10], to locate clusters of features with similarly high or low values (Scott-Denton et al., 2011). The Gi* statistic was also calculated for all discarded and kept species in order to evaluate if geographical regions of particularly high levels of bycatch occurred.

As prescribed in "Evaluating Bycatch" (NMFS, 2004), bycatch (discard) estimates were standardized using the coefficient of variation (CV) as a measure of precision for bycatch estimates. CV estimates were calculated by dividing the estimated standard error by the estimate of the mean CPUE (number per hook-hour) for federally-managed discarded species. Less than 0.08% of the total fish processed had an undetermined fate code and assumed to be discarded in an unknown condition.

Length data are given for the dominant target species by fishery. Fish measurements were recorded in metric units. To be consistent with the current regulatory directives relative to size limits, metric measurements were converted to U.S. system equivalents. Fork to total length conversions for red grouper were based on metric regression (Lombardi-Carlson et al.[11]). Red snapper total lengths were calculated from fork length measurements using equation 3 (SEDAR[12]):

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[10] ArcGIS 10.1 Computer Software. 380 New York Street, Redlands, Calif. 92373.

[11] Lombardi-Carlson, L. A., G. R. Fitzhugh, and J. J. Mikulas. 2002. Red grouper (*Epinephelus morio*) age - length structure and description of growth from the eastern Gulf of Mexico: 1992-2001. U.S. Dep. Commer., NOAA. Natl. Mar. Fish. Serv., Southeast Fish. Sci. Cent., Contrib. Ser. 2002–06, 42 p.

[12] SEDAR. 2005. Stock assessment report of SEDAR 7 Gulf of Mexico Red Snapper. Southeast Data Assessment and Review, South Atl. Fish. Manage. Counc., Charleston, SC (available at www.sefsc.noaa.gov/sedar/).

(3) TL (in) = 0.1729 + FL (in) * 1.059.

Vermilion snapper total lengths were calculated from fork length measurements using equation 4 (Zhao et al., 1997):

(4) TL = 1.12 FL – 0.010

After converting, length values were placed into 1-in intervals. Lengths ranging from 19.000 to 19.999, for example, were categorized as 19 in. Hence, some degree of error is assumed. Only length measurements were considered. Weight data were not recorded for all specimens, and as such not included in the analysis.

Results

Fishing Characteristics

From January 2010 through December 2011, data from 12,541 sets during 389 trips (2,878 sea days) aboard reef fish vessels were collected. Number of trips, sets, sea days and percent coverage levels are given by year and project (Table 1).

Trip, vessel, set, and gear characteristics varied by the primary gear types assessed (longline, vertical line and modified buoy gear; Tables 2-4). Trip length averaged 14.7 days for modified buoy and 7.2 days for vertical line. Vessel length ranged from approximately 40 to 47 ft, with longline vessels typically larger. The majority ($\geq$86%) of vessels were fiberglass construction.

Table 1— Reef fish trips, sets, and sea days by year and project from January 2010 to December 2011.

Trips by Year and Project

Year	Bandit	Handline	Longline	Hook Timer	Buoy Gear	Spear	Other	Total
2010	37.0	19.0	54.4	11.0	23.0	2.0	47.0	193.5
2011	70.0	35.0	82.6		3.0	5.0		195.5
Total	107.0	54.0	134.0	11.0	26.0	7.0	47.0	389.0

Sets by Year and Project

Year	Bandit	Handline	Longline	Hook Timer	Buoy Gear	Spear	Other	Total
2010	2,178.0	181.0	1,462.0	291.0	1,487.0	20.0	288.0	5,907.0
2011	3,339.0	738.0	2,335.0		189.0	33.0		6,634.0
Grand Total	5,517.0	919.0	3,797.0	291.0	1,676.0	53.0	288.0	12,541.0

Sea Days by Year and Project

Year	Bandit	Handline	Longline	Hook Timer	Buoy Gear	Spear	Other	Total	Industry Sea Days	Percent Coverage
2010	240.0	45.0	624.0	119.0	277.0	2.0	68.0	1,375.0	25,715	5.3
2011	438.5	91.0	941.8		29.7	2.0		1,503.0	28,070	5.4
Grand Total	678.5	136.0	1,565.8	119.0	306.7	4.0	68.0	2,878.0	53,785	5.4

Table 2— Trip, vessel, set, gear, and environmental characteristics observed in the longline fishery from January 2010 – November 2011.

Longline				
Trip	Vessel	Set	Gear	Environmental
1684.8 Sea Days 145 trips aboard 50 vessels 4,088 sets	Length: Avg: 47.4 ft Range: 34 to 69 ft (± 8.5 s.d.).	Soak time: Avg: 3.7 hrs (± 1.8 s.d.) Range: 0.9 to 34.3 hours	Mainline material: Cable (89.9%) Monofilament (9.6%) Test: Avg: 1,815.9 lbs (± 922.4 s.d.) Range: 450 to 5,000 lbs	Water Depth: Avg: 48.0 fathoms (± 38.0 s.d.) Eastern: 42.0 Western: 121.2 Range: 19.5 to 212.0
Trip Length: Avg: 12.7 days (± 4.8 s.d.) Range: 2 to 29 days	Hull Construction: Fiberglass: 86.0% Steel: 6% Fiberglass/wood: 8%	Mainline: Avg length: 4.1 nm (± 1.2 s.d.) Range: 0.2 to 10.5 nm	Gangion: Monofilament (99.1%) Other (0.9%) Avg length: 5.9 ft (± 3.0 s.d) Range: 1.5 to 12.5 ft	Sea State: 0 to 2 foot seas: 46% 3 to 5 foot seas: 39% 6 to 8 foot seas: 12% 8+ foot seas: 2%
Crew size: 2 to 5 individuals (excluding captain)	Engine Horsepower: Avg: 289.6 hp (± 196.3 s.d.) Range: 76 to 1250 hp		Hooks: Avg: 964.7 hooks (± 322.4 s.d.) Range: 350 to 3,000 hooks Type: Circle hooks (100%) offset (59.2%) straight (40.8%) Shaft length avg 2.1 in Distance between hooks: Avg: 23.3 ft (± 11.3 s.d.) Range: 5.0 to 60.0 ft Size: 13 aught (51.4%) Range: 11 to 16 aught Brand: Mustad®: 84.7% Eagle Claw®: 15.3%	Bottom type: Rock: 81% Mud: 9% Shell: 6% Coral: 3% Gravel: 2% Unknown, sand, and wreck: <1% each

Table 3— Trip, vessel, set, gear, and environmental characteristics observed in the vertical line fishery from January 2010 – December 2011.

Vertical Line				
Trip	Vessel	Set	Gear	Environmental
814.5 Sea Days 161 trips aboard 130 vessels 6,436 sets	Length: Avg: 39.7 ft Range: 18 to 65 ft (± 9.0 s.d.)	Soak time: Avg: 0.5 hrs (± 0.7 s.d.) Range: 0.01 to 11.0 hours Haul in time: Recorded: 94% Avg: 0.7 min (± 0.6 s.d.) Range: <0.1 to 20.0 min	Reel type: Electric: 62.0% Hydraulic: 16.3% Hand: 21.6% Rod mount: Fixed: 75.2% Portable: 24.8%	Water Depth: Avg: 26.2 fathoms (± 13.8 s.d.) Range: 1.5 to 170.5
Trip Length: Avg: 7.2 days (± 5.8 s.d.) Range: 0 to 29 days	Hull Construction: Fiberglass: 89.2% Wood: 5.4% Fiberglass/wood: 4.6% Steel: <1%	Number of reels/set: Avg: 3.2 (± 1.4 s.d.) Range: 1 to 8	Mainline material: Monofilament (88.9%), Cable (9.3%), Nylon (0.9%), Poly(0.5), Other (0.4%) Test: Avg: 227.5 lbs (± 177.0 s.d.) Range: 10 to 3,000 lbs	Sea State: 0 to 2 foot seas: 53% 3 to 5 foot seas: 37% 6 to 8 foot seas: 10% 8+ foot seas: <1%
Crew size: 0 to 5 individuals (excluding captain)	Engine Horsepower: Avg: 376.5 hp (± 238.8 s.d.) Range: 67 to1342 hp	Hooks: Avg: 14.9 hooks (± 26.1 s.d.) Range: 1 to 240 hooks Hook type: circle (99.2%), J (0.6%), double circle (0.2%) Size(aught): 8 (60.8%), 9 (7.8%), 12 (7.2%), 14 (6.2%), 10 (4.3%), other (13.7%) Range: 1 to 18 aught Brand: Mustad® (95.9%), Eagle Claw® (1.2%)	Subline material: Monofilament: 99.3%, Other(0.7%) Test: Avg: 129.7 lbs (± 52.6 s.d.) Range: 10 to 400 lbs	Bottom type: Rock: 90% Wreck: 2% Gravel: 2% Mud: 2% Sand 2% Shell: 1% Coral: 1% Clay, unknown, and grass: <1%
			Hooks/Reel: Avg: 8.3 hooks (± 11.6 s.d.) Range: 1 to 50 hooks	Fishing State: On anchor: 81% Drifting: 18% Trolling: <1%

Table 4— Trip, vessel, set, gear, and environmental characteristics observed in the modified buoy gear fishery from March 2010 – August 2011.

Modified buoy gear				
Trip	Vessel	Set	Gear	Environmental
306.7 Sea Days 26 trips aboard 16 vessels 1,676 sets	Length: Avg: 43.0 ft Range: 34 to 52 ft (± 4.3 s.d.)	Soak time: Avg: 1.9 hrs (± 1.0 s.d.) Range: 0.33 to 10.0 hours Haul in time: Recorded: 68% Avg: 0.8 min (± 0.6 s.d.) Range: <0.1 to 5.9 min	Mainline material: Cable (44.2%) Poly (26.3%) Cable (21.2%) Other (5.1%) Monofilament (3.2%) Test: Avg: 1,052.0 lbs (± 1,186.2 s.d.) Range: 200 to 5,000 lbs	Water Depth: Avg: 27.1 fathoms (± 19.1 s.d.) Range: 19.2 to 307.0 Eastern: 19.2 to 33.5
Trip Length: Avg: 14.7 days (± 4.2 s.d.) Range: 3 to 23 days	Hull Construction: Fiberglass: 93.8% Fiberglass/wood: 6.3%	Mainline: Avg length: 0.042 nm (± 0.029 s.d.) Range: 0.025 to 0.2 nm	Gangion: Monofilament (100%) Avg length: 1.2 ft (± 1.75 s.d) Range: 0 to 9.5 ft	Sea State: 0 to 2 foot seas: 56% 3 to 5 foot seas: 33% 6 to 8 foot seas: 11% 8+ foot seas: <1%
Crew size: 1 to 2 individuals (excluding captain)	Engine Horsepower: Avg: 284.4 hp (± 214.6 s.d.) Range: 67 to 700 hp		Hooks: Avg: 240.0 hooks (± 197.7 s.d.) Range: 60 to 1,000 hooks Type: Circle hooks (100%) offset (79.7%) straight (20.3%) Shaft length avg 1.8 in Distance between hooks: Avg: 2.2 ft (± 4.2 s.d.) Range: 0 to 25.0 ft	Bottom type: Rock: 100% Mud, shell, and unknown: <1%
			Size: 13 aught (38.3%), 12 aught (32.8%), 14 aught (24.4%) Range: 11 to 15 aught Brand: Mustad®: 94.9% Eagle Claw®: 5.1%	

For longline, in the eastern and western Gulf combined, the distance of mainline set at a location averaged 4.1 nm. Mean gangion length was 5.9 ft. On average, 965 circle hooks were set at a location. Most hooks (51%) were 13 aught in size and ranged from 11 to 16 aught. In the vertical line sector, the number of reels used at a set averaged 3.2. The majority (62%) of reels were electric. The number of hooks used during a set averaged 15 hooks, with circle hooks used most often. The majority (61%) of hooks were smaller hooks (8 aught) as compared to longline. Modified buoy gear was deployed as a series of individual buoys and similar to longline placement (e.g. linear). Mainline length average

0.042 nm, and was composed primarily (44%) of cable construction. The average number of hooks deployed at a set was 240.

Fishing and environmental conditions differed by gear type (Tables 2-4). Average fishing depth for longline sets was 48.0 fm. Fishing depths were shallower for modified buoy gear (27.1 fm) and vertical line (26.2 fm). Average soak time was 3.7 hr for longline, 1.9 hr for modified buoy gear, and 0.5 hr for vertical line. Most sets ($\geq$ 81%) occurred over rock bottom in seas <2 ft during daylight hours for all gear types.

Bottom Longline

Allocation of Sampling Effort

Data from 145 trips aboard 50 bottom longline vessels from January 2010 through November 2011 were analyzed. The capture of 212,835 fish (Table 5) occurred during 4,088 sets deploying longline gear (Fig. 1). For longline, 3,994 sets had associated effort data (14,794 hr; 3,920,981 hooks). Approximately 75% of fishing effort, based on hook-hours, occurred in the eastern Gulf. The greatest concentration of effort (hook-hours) occurred in statistical areas 3 through 5 (Fig. 2), with most (27%) in area 5. By season, 30% of the sets occurred from January through March; 33% April through June; 18% July through September; and 20% October through December for all years combined.[13]

[13] Percentages may not equal 100% due to rounding.

Table 5— Number of fish observed using logline (n = 4,088 sets), vertical line (n = 6,436 sets), and modified buoy gear (n = 1,676 sets) in the Gulf of Mexico from January 2010 to December 2011.

Common name	Scientific name	Longline	Vertical line	Buoy gear	Total
Red grouper	*Epinephelus morio*	141,543	19,081	15,850	176,488
Red snapper	*Lutjanus campechanus*	8,992	16,717	824	26,537
Vermilion snapper	*Rhomboplites aurorubens*	272	23,827	27	24,126
Tilefish	*Lopholatilus chamaeleonticeps*	12,909	24	18	12,951
Yellowedge grouper	*Epinephelus flavolimbatus*	9,861	68	8	9,937
Red porgy	*Pagrus pagrus*	876	7,254	53	8,183
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	5,297	133	20	5,450
Gag	*Mycteroperca microlepis*	2,539	2,367	63	5,002
Scamp	*Mycteroperca phenax*	3,412	534	63	4,011
Blueline tilefish	*Caulolatilus microps*	3,649	45		3,694
King snake eel	*Ophichthus rex*	2,552	1		2,552
Smooth dogfish shark	*Mustelus canis*	1,588	16		1,604
Snowy grouper	*Epinephelus niveatus*	1,525	76		1,601
Yellowtail snapper	*Ocyurus chrysurus*	11	1,481		1,492
Sharks grouped	General sharks	1,179	84	13	1,276
Blacknose shark	*Carcharhinus acronotus*	1,048	32	9	1,089
Dogfish (genus)	*Squalus* sp.	1,043	6	1	1,050
Cuban dogfish	*Squalus cubensis*	1,007	8	2	1,017
King mackerel	*Scomberomorus cavalla*	30	932	3	965
Southern hake	*Urophycis floridana*	887	2		889
Gray triggerfish	*Balistes capriscus*	56	757	4	823
Speckled hind	*Epinephelus drummondhayi*	694	93	16	803
Mutton snapper	*Lutjanus analis*	764	20	1	785
Greater amberjack	*Seriola dumerili*	437	272	2	711
Tomtate	*Haemulon aurolineatum*	4	645	6	655
White grunt	*Haemulon plumieri*	7	624		631
Silk snapper	*Lutjanus vivanus*	284	320		604
Lane snapper	*Lutjanus synagris*	266	288	49	603
Tiger shark	*Galeocerdo cuvier*	524	16	37	577
Gray snapper	*Lutjanus griseus*	219	315	9	564
Spotted hake	*Urophycis regia*	540	1		541
Sharksucker	*Echeneis naucrates*	394	106	16	516
Jolthead porgy	*Calamus bajonado*	454	58	2	514
Blacktail moray	*Gymnothorax kolpos*	509	4		513
Hake (genus)	*Urophycis* sp.	496	0		496
Banded rudderfish	*Seriola zonata*	141	279	4	424
Knobbed porgy	*Calamus nodosus*	49	353	4	406
Almaco jack	*Seriola rivoliana*	85	301	1	387
Leopard toadfish	*Opsanus pardus*	346	10	22	378
Sandbar shark	*Carcharhinus plumbeus*	349	1	1	351
Purplemouth moray	*Gymnothorax vicinus*	320	18	5	343
Sand diver	*Synodus intermedius*	302	20	7	329
Black seabass	*Centropristis striata*	0	308		308
Dolphin	*Coryphaena hippurus*	34	272		306
Clearnose skate	*Raja eglanteria*	296	0	1	297
Sand perch	*Diplectrum formosum*	144	129	9	282
Creole-fish	*Paranthias furcifer*	0	275		275
Spinycheek scorpionfish	*Neomerinthe hemingwayi*	258	2		260
Silky shark	*Carcharhinus falciformis*	172	53	16	241
Bonito	*Euthynnus alletteratus*	190	45	5	240
Jack (genus)	*Seriola* sp.	110	127		237
Great barracuda	*Sphyraena barracuda*	206	8	21	235
Bearded brotula	*Brotula barbata*	218	14		232
Spotted moray	*Gymnothorax moringa*	176	23	14	213

Pale spotted eel	*Ophichthus puncticeps*	203	0		203
Bank seabass	*Centropristis ocyurus*	134	60	2	196
Inshore lizardfish	*Synodus foetens*	173	3	12	188
Snakefish	*Trachinocephalus myops*	173	1	3	177
Blue runner	*Caranx crysos*	5	170		175
Rock seabass	*Centropristis philadelphica*	153	21		174
Blackfin snapper	*Lutjanus buccanella*	56	99		155
Blackedge moray	*Gymnothorax nigromarginatus*	146	5		151
Queen snapper	*Etelis oculatus*	123	10		133
Littlehead porgy	*Calamus proridens*	16	109		125
Pigfish	*Orthopristis chrysoptera*	0	125		125
Moray (genus)	*Gymnothorax* sp.	116	3		119
Gulf hake	*Urophycis cirrata*	113	3		116
Reticulate moray	*Muraena retifera*	102	12		114
Cobia	*Rachycentron canadum*	66	39	1	107
Black grouper	*Mycteroperca bonaci*	95	6	1	102
Hammerhead scalloped shark	*Sphyrna lewini*	101	1		102
Snake eel (family)	Ophichthidae	96	0		96
Hogfish	*Lachnolaimus maximus*	0	0		95
Sixgill shark (genus)	*Hexanchus* sp.	93	1		94
Pinfish	*Lagodon rhomboides*	4	90		94
Shortspine dogfish	*Squalus mitsukurii*	94	0		94
Squirrelfish	*Holocentrus adscensionis*	51	41		92
Night shark	*Carcharhinus signatus*	90	0		90
Seatrout (genus)	*Cynoscion* sp.	14	73		87
Nurse shark	*Ginglymostoma cirratum*	64	17	2	83
Red drum	*Sciaenops ocellatus*	5	77		82
Blacktip shark	*Carcharhinus limbatus*	73	4		77
Warsaw grouper	*Epinephelus nigritus*	40	37		77
Lizardfish (family)	Synodontidae	68	1	2	71
Hammerhead shark (genus)	*Sphyrna* sp.	68	0		68
Chub mackerel	*Scomber japonicus*	1	62		63
Wenchman	*Pristipomoides aquilonaris*	39	18		57
Green moray	*Gymnothorax funebris*	55	1		56
Spinner shark	*Carcharhinus brevipinna*	50	4		54
Barrelfish	*Hyperoglyphe perciferomis*	14	35	5	54
Blackfin tuna	*Thunnus atlanticus*	43	9		52
Lesser amberjack	*Seriola fasciata*	27	22		49
Conger eel	*Conger oceanicus*	43	5		48
Sand tilefish	*Malacanthus plumieri*	35	13		48
Atlantic croaker	*Micropogonias undulatus*	0	46		46
Offshore lizardfish	*Synodus poeyi*	38	6	2	46
Short bigeye	*Pristigenys alta*	6	39		45
Tattler	*Serranus phoebe*	3	38		41
Dusky flounder	*Syacium papillosum*	38	1		39
Sevengill shark	*Heptranchias perlo*	37	0		37
Dogfish shark	*Mustelus* sp.	33	0		33
Porgy (genus)	*Calamus* sp.	21	10		31
Whitebone porgy	*Calamus leucosteus*	16	13		29
Unknown fish	Unknown	22	7		29
Goldface tilefish	*Caulolatilus chrysops*	18	9		27
Chain dogfish	*Scyliorhinus retifer*	26	0		26
Jack (family)	Carangidae	1	24		25
Blackbelly rosefish	*Helicolenus dactylopterus*	23	2		25
Bigeye sixgill shark	*Hexanchus vitulus*	25	0		25
Rock hind	*Epinephelus adscensionis*	20	3		23
Longtail bass	*Hemanthias leptus*	10	12		22

Ballyhoo	*Hemiramphus brasiliensis*	0	22		22
Six gill shark	*Hexanchus griseus*	22	0		22
Roughskin dogfish	*Cirrhigaleus asper*	21	0		21
Bluefish	*Pomatomus saltatrix*	5	16		21
Conger eel (family)	Congridae	19	0		19
Smooth pufferfish	*Lagocephalus laevigatus*	15	4		19
Scorpionfish (genus)	*Scorpaena* sp.	19	0		19
Rainbow runner	*Elagatis bipinnulata*	0	18		18
Goliath grouper (jewfish)	*Epinephelus itajara*	8	9	1	18
Bonnethead shark	*Sphyrna tiburo*	18	0		18
Round scad	*Decapterus punctatus*	0	17		17
Dusky shark	*Carcharhinus obscurus*	16	0		16
Blackbar drum	*Equetus iwamotoi*	0	16		16
Octopus (genus)	*Octopus* sp.	13	2	1	16
Bigeye	*Priacanthus arenatus*	1	15		16
Bigeye scad	*Selar crumenophthalmus*	0	16		16
Saucereye porgy	*Calamus calamus*	10	4	1	15
Common crevalle jack	*Caranx hippos*	11	4		15
Grass porgy	*Calamus arctifrons*	0	14		14
Skate (genus)	*Raja* sp.	14	0		14
Southern flounder	*Paralichthys lethostigma*	7	0		13
Cubbyu drum	*Equetus umbrosus*	0	12		12
Florida smoothhound shark	*Mustelus norrisi*	12	0		12
Grouper (genus)	*Epinephelus* sp.	11	0		11
Spanish flag	*Gonioplectrus hispanus*	0	10		10
Finetooth shark	*Carcharhinus isodon*	9	0		9
Bull shark	*Carcharhinus leucas*	8	1		9
Queen triggerfish	*Balistes vetula*	8	0		8
Seabass (genus)	*Centropristis* sp.	8	0		8
Sand seatrout	*Cynoscion arenarius*	0	8		8
Marbled grouper	*Epinephelus inermis*	0	8		8
Gulf flounder	*Paralichthys albigutta*	8	0		8
Spanish mackerel	*Scomberomorus maculatus*	0	5	1	8
Stingray (genus)	*Dasyatis* sp.	7	0		7
Great hammerhead shark	*Sphyrna mokarran*	7	0		7
Wahoo	*Acanthocybium solandri*	3	3		6
Flounder (family)	Bothidae	4	2		6
Slippery dick	*Halichoeres bivittatus*	0	6		6
Broad flounder	*Paralichthys squamilentus*	5	1		6
Carolina hake	*Urophycis earlli*	6	0		6
Gafftopsail catfish	*Bagre marinus*	3	2		5
Black jack	*Caranx lugubris*	0	5		5
Shortfinmako Shark	*Isurus oxyrinchus*	4	1		5
Bermuda chub	*Kyphosus sectatrix*	0	5		5
Blackpored eel	*Ophichthus melanoporus*	5	0		5
Southern pufferfish	*Sphoeroides nephelus*	0	5		5
Atlantic cutlassfish	*Trichiurus lepturus*	1	4		5
Swordfish	*Xiphias gladius*	4	0	1	5
Graysby	*Cephalopholis cruentata*	0	4		4
Atlantic spadefish	*Chaetodipterus faber*	0	4		4
Bluntnose stingray	*Dasyatis say*	4	0		4
Dwarf sand perch	*Diplectrum bivittatum*	0	4		4
Misty grouper	*Epinephelus mystacinus*	4	0		4
Grunt (genus)	*Haemulon* sp.	0	4		4
Guaguanche	*Sphyraena guachancho*	0	4		4
Bar jack	*Caranx ruber*	0	3		3
Blackline tilefish	*Caulolatilus cyanops*	3	0		3
Snapper (genus)	*Lutjanus* sp.	0	3		3

Blackpored skate	*Raja floridana*	3	0		3
Cownose ray	*Rhinoptera bonasus*	3	0		3
Orangespot Sardine	*Sardinella brasiliensis*	3	0		3
Shortjaw lizardfish	*Saurida normani*	3	0		3
Cero	*Scomberomorus regalis*	0	3		3
Spotted scorpionfish	*Scorpaena plumieri*	3	0		3
Ocellated frogfish	*Antennarius ocellatus*	2	0		2
Bite off	Bite Off	2	0		2
Saddled grenadier	*Caelorinchus caelorhincus*	1	1		2
Shortnose greeneye	*Chlorophthalmus agassizi*	0	2		2
Southern stingray	*Dasyatis americana*	2	0		2
Stingray (family)	Dasyiatidae	2	0		2
Spottail pinfish	*Diplodus holbrooki*	0	2		2
Red Hind	*Epinephelus guttatus*	2	0		2
Honeycomb moray	*Gymnothorax saxicola*	2	0		2
Cubera snapper	*Lutjanus cyanopterus*	2	0		2
Yellowmouth grouper	*Mycteroperca interstitialis*	2	0		2
Lemon shark	*Negaprion brevirostris*	2	0		2
Octopus (order)	Octopoda	2	0		2
Lefteye flounder (genus)	*Paralichthys* sp.	2	0		2
Black drum	*Pogonias cromis*	1	1		2
Beardfish (family)	Polymixiidae	2	0		2
Whitespotted soapfish	*Rypticus maculatus*	0	2		2
Pufferfish (genus)	*Sphoeroides* sp.	1	1		2
Blunthead pufferfish	*Sphoeroides pachygaster*	2	0		2
Angel shark	*Squatina dumeril*	2	0		2
Puffer (family)	Tetraodontidae	2	0		2
Tuna (genus)	*Thunnus* sp.	2	0		2
Florida pompano	*Trachinotus carolinus*	2	0		2
Rough scad	*Trachurus lathami*	0	2		2
Porkfish	*Anisotremus virginicus*	0	1		1
Boarfish (genus)	*Antigonia* sp.	0	1		1
Hardhead catfish	*Arius felis*	0	1		1
Spotfin hogfish	*Bodianus pulchellus*	0	1		1
Spanish hogfish	*Bodianus rufus*	0	1		1
Flounder (genus)	*Bothus* sp.	1	0		1
Ocean triggerfish	*Canthidermis sufflamen*	0	1		1
Spinycheek soldierfish	*Corniger spinosus*	0	1		1
Silver seatrout	*Cynoscion nothus*	1	0		1
Pelagic stingray	*Dasyatis violacea*	1	0		1
Red hogfish	*Decodon puellaris*	0	1		1
Spotted spoonnose eel	*Echiophis intertinctus*	1	0		1
Ladyfish	*Elops saurus*	0	1		1
Red cornetfish	*Fistularia petimba*	1	0		1
Grunt (family)	Haemulidae	1	0		1
Margate	*Haemulon album*	0	1		1
Blue angelfish	*Holacanthus bermudensis*	0	1		1
Deepwater squirrelfish	*Holocentrus bullisi*	1	0		1
Sailfish	*Istiophorus platypterus*	0	0	1	1
Scrawled cowfish	*Lactophrys quadricornis*	0	1		1
Grouper (genus)	*Mycteroperca* sp.	0	1		1
Bullnose ray	*Myliobatis freminvillei*	1	0		1
Spotted snake eel	*Ophichthus ophis*	1	0		1
Bank cusk-eel	*Ophidion holbrooki*	1	0		1
Toadfish (genus)	*Opsanus* sp.	0	1		1
Margintail conger	*Paraconger caudilimbatus*	1	0		1
Cardinal soldierfish	*Plectrypops retrospinus*	0	1		1

Longspine scorpionfish	*Pontinus longispinis*	1	0		1
Blackwing searobin	*Prionotus rubio*	1	0		1
Skate (family)	Rajidae	1	0		1
Skate and ray (Order)	Rajiformes	1	0		1
Atlantic bonito	*Sarda sarda*	0	1		1
Mackerel (family)	Scombridae	0	1		1
Goosehead scorpionfish	*Scorpaena bergii*	0	1		1
Atlantic moonfish	*Selene setapinnis*	0	1		1
Porgie (family)	Sparidae	0	1		1
Barracuda (genus)	*Sphyraena* sp.	1	0		1
Shoal flounder	*Syacium gunteri*	1	0		1
Cottonmouth jack	*Uraspis secunda*	0	1		1
Total		212,835	80,128	17,242	310,388

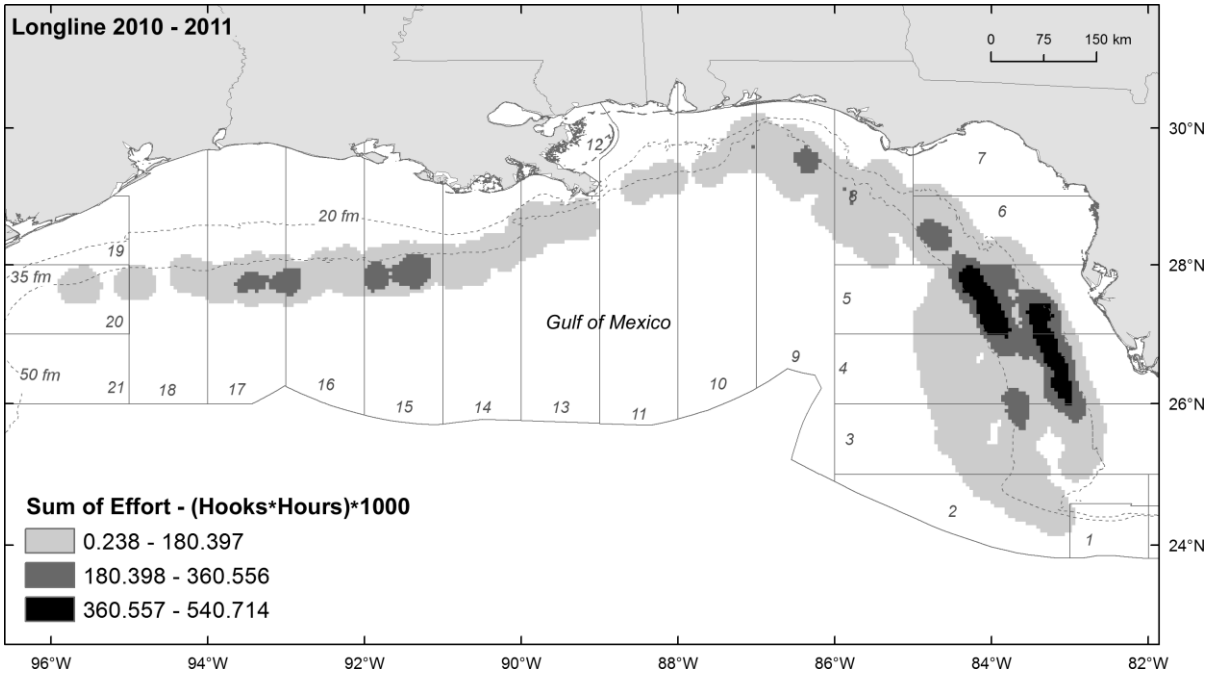

Figure 2— Distribution of sampling effort (hook-hours) based on observer coverage of the U.S. Gulf of Mexico bottom longline reef fish fishery from January 2010 through November 2011.

Species Composition

Of the 212,835 fish (184 taxa) caught on longline gear, 51% of the individuals were kept, 33% were released alive, 12% were discarded dead, 3% were retained for bait, and 2%

were discarded with an unknown condition (Tables 6-8). By number, red grouper dominated the catch composition at 67%. Tilefish, *Lopholatilus chamaeleonticep,* comprised 6% of the catch followed by yellowedge grouper at 5%, red snapper at 4%, and Atlantic sharpnose shark, *Rhizoprionodon terraenovae,* blueline tilefish, *Caulolatilus microps*, and scamp *Mycteroperca phenax,* each at 2%. All other species combined constituted 13% of the catch.

By category, red grouper, tilefish, yellowedge grouper, red snapper and scamp comprised the majority (91%) of the 107,552 individuals kept by longliners (Table 6). Three species (red grouper, red snapper, and Atlantic sharpnose shark) accounted for 85% of the released alive category. Of the 69,320 individuals released alive, 61% exhibited visual signs of stress, while 38% exhibited a normal appearance. Of the 6,040 individuals used for bait, the species caught and used most often for bait were king snake eel, *Ophichthus rex* (31%), southern hake, *Urophycis floridana* (8%), and blacktail moray, *Gymnothorax kolpos* (6%). Red grouper, tilefish, blueline tilefish, and Atlantic sharpnose shark comprised the majority (83%) of 26,310 individuals in the discarded dead category. Minimum assumed mortality was estimated for: red grouper (25%), tilefish (87%), blueline tilefish (69%), and Atlantic sharpnose shark (22%). The fate of 3,612 individuals was undetermined. Of these, approximately 64% were red grouper.

Table 6— Species composition and disposition by gear type observed from January 2010 to December 2011.

Longline			Vertical line			Modified buoy gear		
212,835 fish of 184 taxa			80,128 fish of 164 taxa			17,242 fish of 52 taxa		
Kept:	50.53%		Kept:	74.82%		Kept:	54.71%	
	Red grouper	66.34%		Vermilion snapper	37.53%		Red grouper	95.09%
	Tilefish	9.72%		Red snapper	20.61%		Red snapper	2.37%
	Yellowedge grouper	9.05%		Red grouper	17.60%		Scamp	0.64%
	Red snapper	3.13%		Red porgy	11.49%		Gag	0.51%
	Scamp	3.07%						
Released alive:	32.57%		Released alive:	18.51%		Released alive:	35.03%	
(61.33% stressed: air bladder expansion and/or eyes protruding; 38.07% normal; 0.60% unknown)			(48.44% stressed: air bladder expansion and/or eyes protruding; 49.51% normal; 2.05% unknown)			(85.68% stressed: air bladder expansion and/or eyes protruding; 14.14% normal; 0.18% unknown)		
	Red grouper	72.67%		Red grouper	50.63%		Red grouper	89.02%
	Red snapper	6.39%		Red snapper	20.34%		Red snapper	8.10%
	Atlantic sharpnose shark	5.79%		Gag	9.04%		Tiger shark	0.56%
				Vermilion snapper	4.45%			
Discarded dead:	12.36%		Discarded dead:	3.93%		Discarded dead:	9.07%	
	Red grouper	66.49%		Red snapper	37.71%		Red grouper	89.38%
	Tilefish	7.91%		Red grouper	31.02%		Red snapper	7.10%
	Blueline tilefish	4.63%		Vermilion snapper	15.05%			
	Atlantic sharpnose shark	4.36%						
Unknown:	1.70%		Unknown:	0.42%		Unknown:	0.66%	
	Red grouper	64.23%		Red snapper	46.29%		Red grouper	93.81%
	Sharks grouped	7.39%		Tomtate	14.24%		Speckled hind	1.77%
	Red snapper	7.25%		Red grouper	11.87%		Silky shark	1.77%
				Vermilion snapper	10.68%			
Kept for bait:	2.84%		Kept for bait:	2.32%		Kept for bait:	0.54%	
	King snake eel	30.79%		Tomtate	22.16%		Great barracuda	15.05%
	Southern hake	7.76%		White grunt	8.84%		Leopard toadfish	9.68%
	Blacktail moray	5.99%		Vermilion snapper	8.25%		Inshore lizardfish	9.68%
				Pigfish	6.74%			
				Sand perch	6.36%			
Total CPUE			Total CPUE			Total CPUE		
All		0.013	All		1.189	All		0.017
Kept		0.007	Kept		0.953	Kept		0.009
	Red grouper	0.005		Vermilion snapper	0.421		Red grouper	0.009
				Red grouper	0.101			
				Red snapper	0.245			
Sea Turtles		11	Sea Turtles		0	Sea Turtles		0
						Bottlenose dolphin		1

Table 7—Number, condition (when brought onboard), and fate of fish species with n>25 caught based on observer coverage of the U.S. Gulf of Mexico bottom longline reef fish fishery from January 2010 through November 2011.

Fate upon release		Kept					Released alive				Kept for bait					Discarded dead					Unknown				
Condition upon capture			Live					Live				Live					Live					Live			
Common name	Total	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Dead	Unknown
Red grouper	141,543	71,355	12,470	52,533	169	6,183	50,375	11,586	38,590	199						17,493	3,049	13,296	1,022	126	2,320	501	1,291	1	527
Tilefish	12,909	10,455	3,832	6,505	20	98	256	105	149	2	74	9	53	12		2,082	300	1,592	181	9	42	27	9		6
Yellowedge grouper	9,861	9,736	331	8,661	680	64	3	1	2							120	2	57	60	1	2	1			1
Red snapper	8,992	3,370	1,221	1,952	39	158	4,433	1,840	2,526	67	1			1		926	346	453	118	9	262	64	72		126
Atlantic sharpnose shark	5,297						4,011	4,010	1		17	10		7		1,148	564	2	531	51	121	115			6
Blueline tilefish	3,649	1,870	776	1,061	30	3	383	175	206	2	8	2	6			1,217	316	847	42	12	171	91	57		23
Scamp	3,412	3,304	1,539	1,491	62	212	39	23	16		2	1		1		57	16	20	20	1	10	6	4		
King snake eel	2,552						326	288	3	35	1,860	1,704	150	4	2	306	290	1	9	6	60	57			3
Gag	2,539	1,367	388	887	23	69	995	315	674	6						128	20	98	8	2	49	16	25		8
Smooth dogfish shark	1,588	2			2		1,392	1,392			9	9				126	61		35	30	59	58			1
Snowy grouper	1,525	1,495	78	1,217	189	11	4		4							24	1	23			2	1	1		
Sharks grouped	1,179						876	840		36	4	4				32	19		13		267	233			34
Blacknose shark	1,048	1			1		929	929			3	2		1		96	73		22	1	19	18			1
Dogfish (genus)	1,043	5	5				957	956	1							67	15		29	23	14	14			
Cuban dogfish	1,007	1			1		825	825			17	17				152	94		58		12	11			1
Southern hake	887	30	3	27			21	8	13		469	13	432	24		357	8	314	28	7	10		9		1
Red porgy	876	581	449	123	7	2	119	85	34		77	58	15	4		90	41	16	30	3	9	8	1		
Mutton snapper	764	759	581	168	2	8										5		1	4						
Speckled hind	694	407	88	310	1	8	178	52	126							101	15	84	2		8	2	5		1
Spotted hake	540	18	1	16	1		24	8	16		159	27	125	7		339	15	237	87						
Tiger shark	524						468	460		8						31	23		7	1	25	11			14
Blacktail moray	509						55	55			362	334		27	1	57	32	3	20	2	35	33			2
Hake (genus)	496	144	113	7	24		7	4	3		189	87	84	18		154	9	129	16		2		1		1
Jolthead porgy	454	422	389	10		23	11	10	1		3	3				16	5		11		2	2			
Greater amberjack	437	110	107	1	2		273	269	4		5	5				47	33	1	12	1	2	1			1
Sharksucker	394	1	1				305	304	1		63	63				19	16		3		6	5			1
Sandbar shark	349						346	324	1	21						3	1		2						
Leopard toadfish	346	2	1	1			105	48	56	1	131	53	78			98	30	60	7	1	10	1	7		2
Purplemouth moray	320						10	10			269	257		12		41	35		6						
Sand diver	302						27	26		1	248	217	7	20	4	20	12		8		7	6			1
Clearnose skate	296						72	72			218	216			2	3	2		1		3	1			2
Silk snapper	284	284	143	136	1	4																			
Vermilion snapper	272	172	113	49	5	5	35	22	13		26	22	2	2		37	19	10	8		2	2			
Lane snapper	266	214	61	130	1	22	31	10	21		1			1		19	5	9	5		1	1			
Spinycheek scorpionfish	258	228	64	152	11	1	2		2		12	2	10			16	5	7	3	1					
Gray snapper	219	204	80	101		23	8	4	4							7	3	1	3						
Bearded brotula	218	208	123	75	7	3	3	3			2	2				5	1	3	1						
Great barracuda	206						20	19		1	156	149		7		29	22		7		1	1			
Pale spotted eel	203						28	28			162	155	3	3	1	11	10		1		2	2			
Bonito	190	6	3		3		1	1			163	35		128		20	2		18						
Spotted moray	176	3	3				15	15			92	80	1	9	2	66	59		7						
Inshore lizardfish	173						11	11			151	143		8		11	10		1						
Snakefish	173						9	9			152	132	9	11		11	10		1		1	1			
Silky shark	172						124	124			3	1		2		41	8		33		4	4			
Rock seabass	153						24	14	10		109	51	49	3	6	17	8	5	3	1	3	3			
Blackedge moray	146						34	33	1		61	55		6		50	30		20		1	1			
Sand perch	144						7	5	2		124	67	54	3		12	4	5	3		1	1			
Banded rudderfish	141	2	2				75	75			42	40		2		17	7	2	8		5	5			
Bank seabass	134						12	9	3		94	54	35	5		25	10	11	4		3	1		1	1
Queen snapper	123	120	72	45		3	1	1			2		2												
Moray (genus)	116						2	2			32	28		3	1	80			3	77	2				2
Gulf hake	113						2		2		74	2	72			37		36	1						
Jack (genus)	110	51	50	1			37	37								18	3		9	6	4				4

Reticulate moray	102						4	4			96	82		9	5	2			2								
Hammerhead scalloped shark	101						82	61		21						13	4		9		6	5			1		
Snake eel (family)	96						1	1			5			5		90	18			72							
Black grouper	95	92	40	48	1	3	3	1	2																		
Shortspine dogfish	94						93	93								1	1										
Sixgill shark (genus)	93						64	64								29	2		27								
Night shark	90						67	66		1						23	2		21								
Almaco jack	85	44	43		1		31	30	1		1	1				8	4	1	3		1	1					
Blacktip shark	73						58	53		5						9	4		5		6	4			2		
Hammerhead shark (genus)	68						58	56		2						3	1		2		7	4			3		
Lizardfish (family)	68						6	6			48	47		1		13	8	1	4		1	1					
Cobia	66	38	35	2		1	26	26								2	1		1								
Nurse shark	64						64	64																			
Gray triggerfish	56	51	41	8	1	1	3	2	1							2	1	1									
Blackfin snapper	56	56	36	18	2																						
Green moray	55						4	4			45	39		3	3	5	5				1	1					
Squirrelfish	51	8	6	2			23	21	2							18	11	4	3		2	2					
Spinner shark	50						33	33								12	3		9		5	5					
Knobbed porgy	49	42	39	2	1		2	1	1							5	4		1								
Conger eel	43	2	2				7	7			29	29				2	2				3	1			2		
Blackfin tuna	43	35	20		15		1	1								7	1		6								
Warsaw grouper	40	39	9	29		1	1		1																		
Wenchman	39	13	2	8	3		1		1		7	4	2	1		18	3	13	2								
Dusky flounder	38						14	14			19	17		2		4	2		2		1	1					
Offshore lizardfish	38						2	2			27	27				9	8		1								
Sevengill shark	37						30	30								6	3		3		1	1					
Sand tilefish	35	4	4				10	5	5		9	3	6			11	7		4		1		1				
Dolphin	34	23	10		13		1	1			1			1		9	3		6								
Dogfish shark	33						32	32								1			1								
King mackerel	30	2	2				4	4			8	5		3		16	5		11								
Lesser amberjack	27						12	12			14	13		1							1	1					
Chain dogfish	26						19	19								6	6				1	1					
Bigeye sixgill shark	25						16	16			6	5		1		1			1		2	2					
Total (all species)	212,835	107,552	23,494	75,821	1,328	6,909	69,320	26,390	42,515	415	6,040	4,440	1,205	368	27	26,310	5,808	17,369	2,689	444	3,612	1,341	1,485	2	784		
No catch	7																										

Table 8— Number, condition (when brought onboard), and fate of fish species with n>25 caught based on observer coverage of the U.S. Gulf of Mexico vertical line reef fish fishery from January 2010 through December 2011.

Fate upon release		Kept					Released alive				Kept for bait					Discarded dead					Unknown			
Condition upon capture			Live					Live				Live					Live					Live		
Common name	Total	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Unknown
Vermilion snapper	23,827	22,504	21,135	1,335	15	19	660	552	59	49	153	129	6	3	15	474	428	26	12	8	36	31	2	3
Red grouper	19,081	10,552	2,389	8,124	1	38	7,509	2,397	5,042	70	3	1	2			977	235	736	2	4	40	11	24	5
Red snapper	16,717	12,355	5,891	6,393	31	40	3,016	1,484	1,476	56	2	1	1			1,188	418	755	11	4	156	60	77	19
Red porgy	7,254	6,890	6,393	490	5	2	202	193	8	1	83	47	36			58	42	7	8	1	21	21		
Gag	2,367	1,002	525	464	1	12	1,341	924	406	11						21	8	12		1	3		1	2
Yellowtail snapper	1,481	1,358	1,351	7			96	93	3		11	11				15	8		7		1	1		
King mackerel	932	860	860				69	69			1	1				2	1		1					
Gray triggerfish	757	491	362	127		2	232	184	45	3						31	11	20			3	1	2	
Tomtate	645	5	5				147	146	1		411	363			48	34	30	3	1		48	48		
White grunt	624	428	376	52			31	24	6	1	164	124	12		28	1	1							
Scamp	534	425	260	164		1	58	48	10							49	23	24	1	1	2	1		1
Knobbed porgy	353	313	302	11			13	7		6	24	23	1			2				2	1	1		
Silk snapper	320	315	81	233		1	1			1	4		3	1										
Gray snapper	315	304	186	117		1	11	8	3															
Black seabass	308	191	139	52			92	56	11	25	22	16	2		4	3	3							
Almaco jack	301	264	243	21			18	17		1	17	14	3			2	2							
Lane snapper	288	273	75	197		1	9	8	1		5	2	2		1	1		1						
Banded rudderfish	279	31	31				143	142		1	94	91	1		2	11	10		1					
Creole-fish	275	151	39	112			10	3	7		82	65	9		8	32	18	12		2				
Dolphin	272	259	259								12	12				1	1							
Greater amberjack	272	66	66				191	183		8	2	2				11	8		2	1	2	2		
Blue runner	170	61	61				22	22			78	78				3	3				6	6		
Atlantic sharpnose shark	133						123	115		8	1	1				8	7			1	1	1		
Sand perch	129						5	3	2		118	58	16		44	6	3	3						
Jack (genus)	127						90	90			37	37												
Pigfish	125										125	12			113									
Littlehead porgy	109	90	86	4			14	14			3	2	1			2	2							
Sharksucker	106	2	2				86	82		4	13	13				3	3				2	1		1
Blackfin snapper	99	89	30	59			2		2		7	2	3		2	1			1					
Speckled hind	93	19	6	13			44	4	39	1	1	1				29	1	28						
Pinfish	90	3	3				11	11			74	65			9	2	2							
Sharks grouped	84						83	59		24						1				1				
Red drum	77						73	48	24	1						4	1	3						
Snowy grouper	76	55	3	48	4		9	3	6							12	1	9	1	1				
Seatrout (genus)	73	68	35	33												5			5					
Yellowedge grouper	68	68	1	67																				
Chub mackerel	62	2	2				1	1			59	57			2									
Bank seabass	60						15	14	1		35	19	8		8	10	6	4						
Jolthead porgy	58	55	53	1		1					2	2				1	1							
Silky shark	53						49	44		5						3	1			2	1			1
Atlantic croaker	46	46	29	17																				
Blueline tilefish	45	13	5	8			20	15	5							11	3	8			1	1		
Bonito	45	4	4				4	4			36	34		2		1	1							
Squirrelfish	41	17	16	1			10	10								12	12				2	2		
Short bigeye	39	5	4	1			27	26	1							7	5			2				
Cobia	39	16	16				22	21		1											1	1		
Tattler	38						4	3	1		23	2	20	1		11	2	9						
Warsaw grouper	37	32	6	26			1	1								4		2		2				
Barrelfish	35	34	26	8												1			1					
Blacknose shark	32	2	2				29	28		1						1	1							
Total (all species)	80,128	59,955	41,511	18,268	57	119	14,830	7,343	7,183	304	1,855	1,412	136	10	297	3,150	1,345	1,702	56	47	337	199	106	32
No catch	6,663																							

Table 9— Number, condition (when brought onboard), and fate of fish species with n>25 caught based on observer coverage of the U.S. Gulf of Mexico modified buoy gear reef fish fishery from March 2010 through August 2011.

Fate upon release		Kept						Released alive				Kept for bait					Discarded dead					Unknown		
Condition upon capture			Live						Live				Live					Live						Live	
Common name	Total	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed	Dead	Unknown	Total	Normal	Stressed
Red grouper	15,850	8,970	649	8,087	231	3	5,377	622	4,752	3						1,397	124	1,196	69	8	106	3	103
Red snapper	824	224	111	94	19		489	88	399	2						111	24	78	9				
Gag	63	48	20	25	3		11	4	7							3	2	1			1		1
Scamp	63	60	20	38	2		1		1							2		1	1				
Red porgy	53	32	29	3			14	13	1							7	5	1	1				
Lane snapper	49	39	11	28			3	1	2		1			1		6		4	1	1			
Tiger shark	37						34	33		1						3	2			1			
Vermilion snapper	27	10	9		1		7	2	1	4	7	6			1	3	1	2					
Total (all species)	17,242	9,433	864	8,307	259	3	6,040	854	5,175	11	93	71	10	9	3	1,563	174	1,291	88	10	113	8	105
No catch	98																						

Red Grouper Disposition and Size Composition

All of the 141,543 red grouper caught using longline were in the eastern Gulf of Mexico. Based on visual observations, the majority (50%) of the fish were kept, 36% released alive, 12% were discarded dead, and 2% were of unknown condition.

A total of 138,038 red grouper were measured and ranged from 8 to 37 in TL with the mode of 15,986 individuals at 17 in TL (Fig. 3). Of these, 39% of the fish caught were <18 in TL, the legal minimum size (18 in TL), with 74% released alive, 23% discarded dead, and 3% discarded in an unknown condition. Of the 61% of red grouper ≥ 18 in TL, 83% were kept, 11% were released alive, 5% were discarded dead, and <1% were of unknown condition.

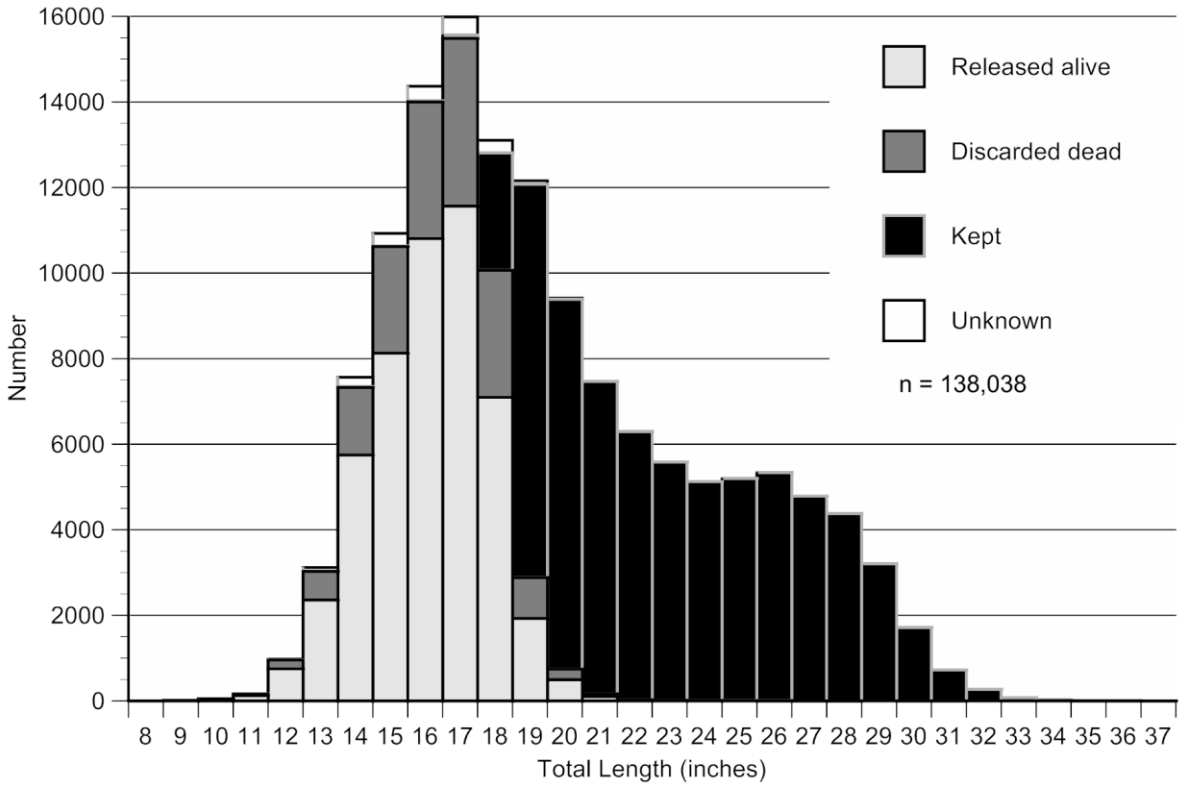

Figure 3— Size and fate of red grouper caught on bottom longline gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

Depths of red grouper captures ranged from 20 to 68 fm. Most (40%) red grouper were caught between 20 – 25 fm, followed by 26 – 30 fm (24%), 36 – 40 fm (13%) and 31 – 35 fm and 41-45 fm zones (11%). Catch was ≤ 2% for the remaining zones (Fig. 4).

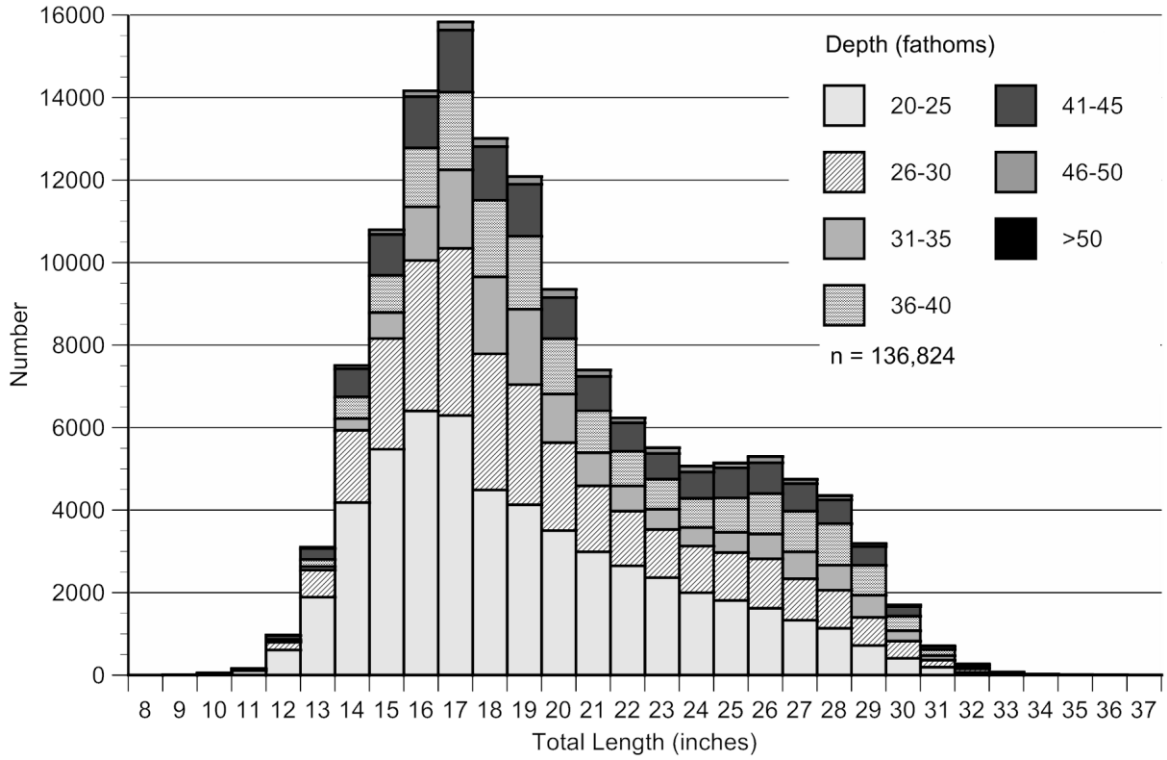

Figure 4— Number of red grouper by size and depth zone caught on bottom longline gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

CPUE and Discard CV

Mean CPUE for all species and dispositions combined was 0.013 fish per hook-hour (± 0.0002 SE; Table 6). The catch rate estimate for red grouper was 0.005 fish kept per hook-hour (± 0.0001 SE). Spatial CPUE density (numbers of fish kept per 1,000 hook-hour) for dominant species for all years combined is depicted (Fig. 5 – 9). Red grouper were caught and retained primarily in statistical areas 2 through 8, with highest density CPUE observed in statistical area 5.

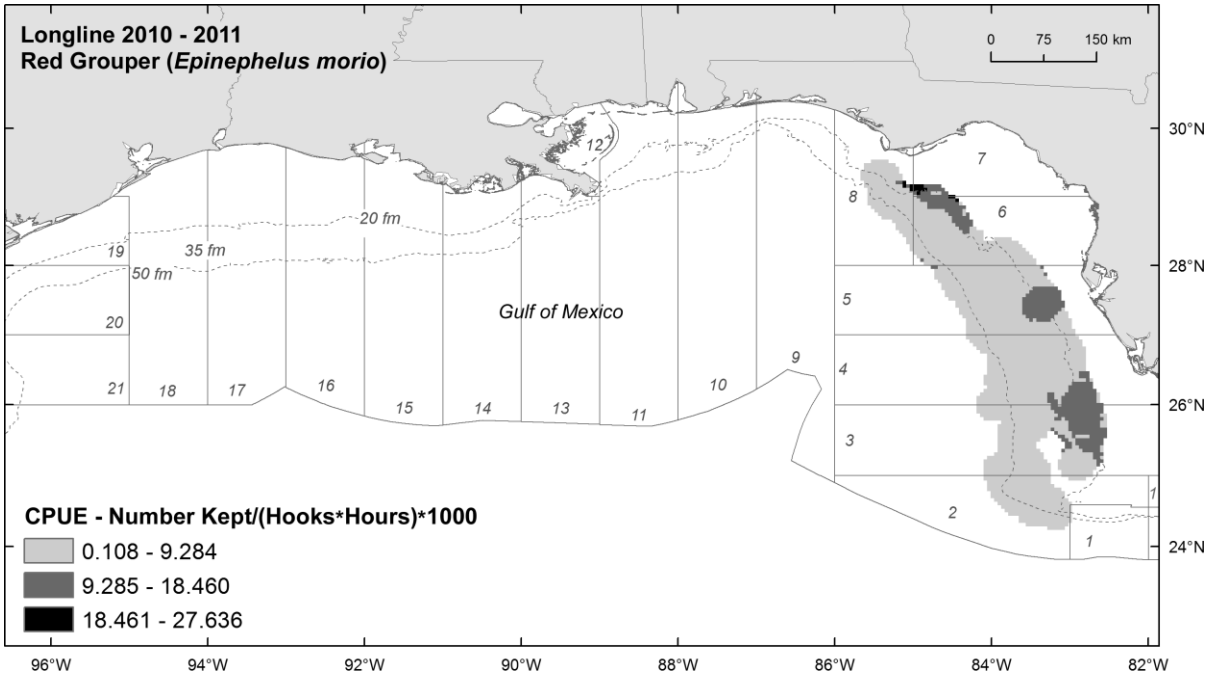

Figure 5— CPUE density surface for red grouper kept in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

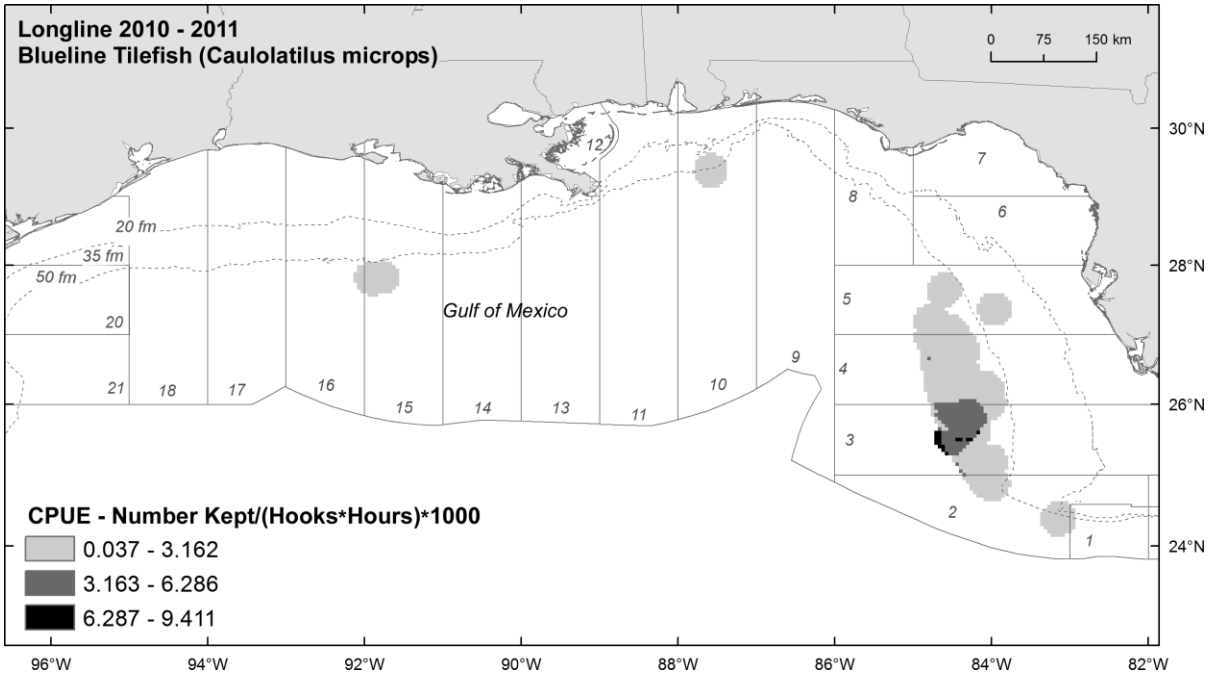

Figure 6— CPUE density surface for blueline tilefish kept in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

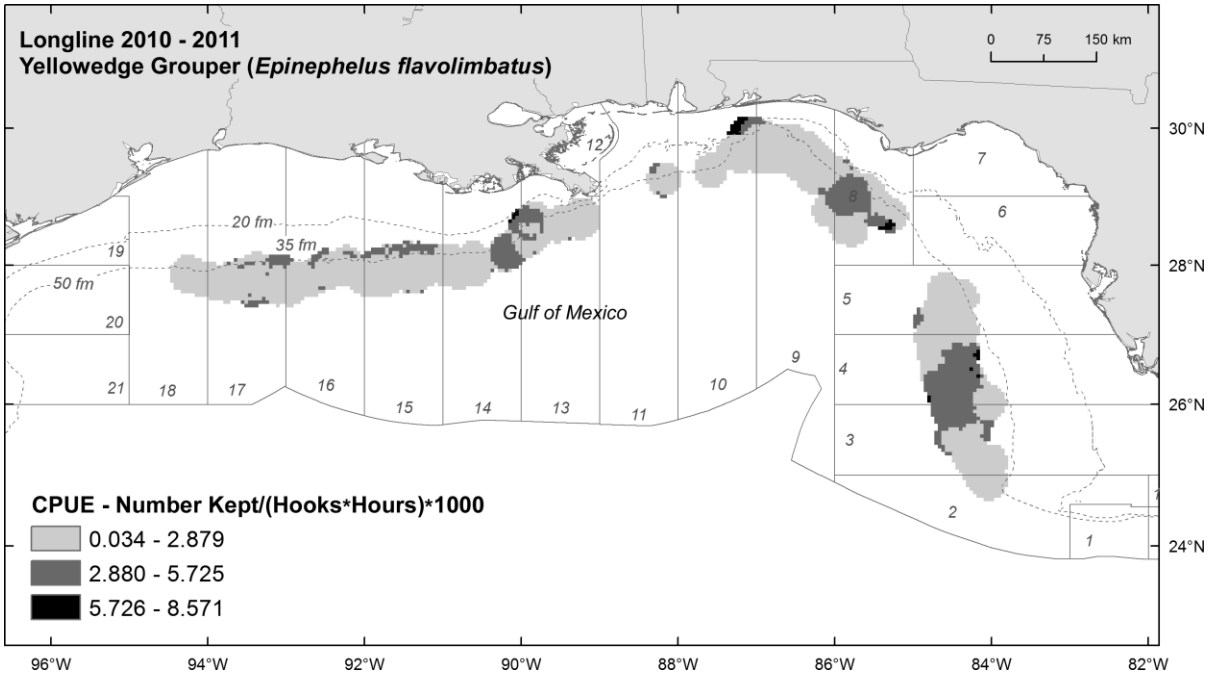

Figure 7— CPUE density surface for yellowedge grouper kept in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

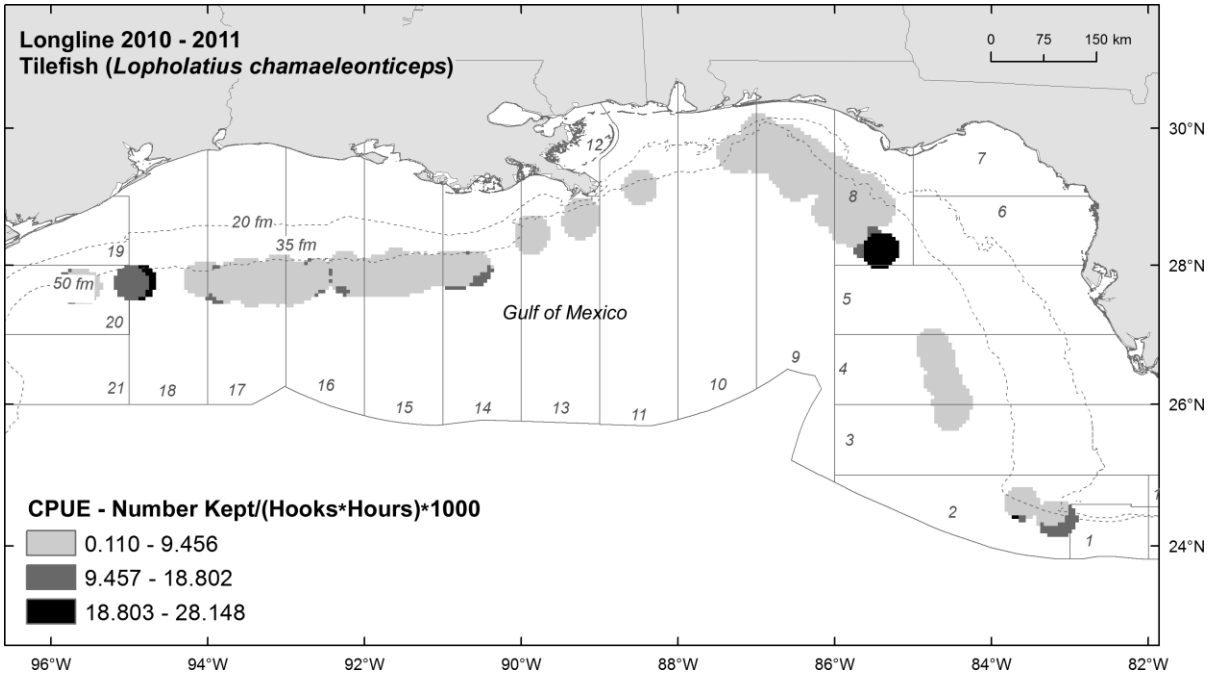

Figure 8— CPUE density surface for tilefish kept in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

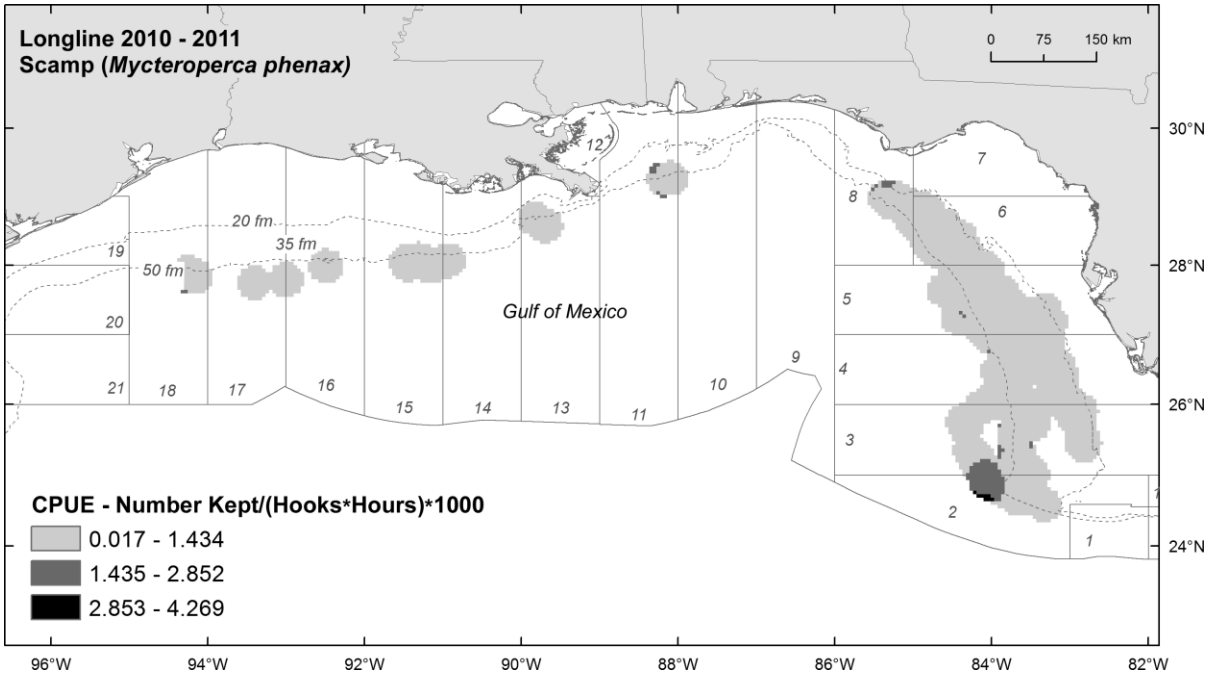

Figure 9— CPUE density surface for scamp kept in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

A similar pattern was detected for blueline tilefish with highest density CPUE in the eastern Gulf of Mexico in statistical area 3. Yellowedge grouper, tilefish, and scamp were distributed throughout the Gulf with substantial CPUE observed in deeper waters of the western Gulf. Statistically significant clusters of high CPUE for red grouper were located in statistical areas 3 through 8 (Fig. 10). For all kept species, statistically significant clusters of high CPUE were detected in the same areas (Fig. 11). Cluster of high discard CPUE was evident in statistical areas 3 through 6 (Fig. 12).

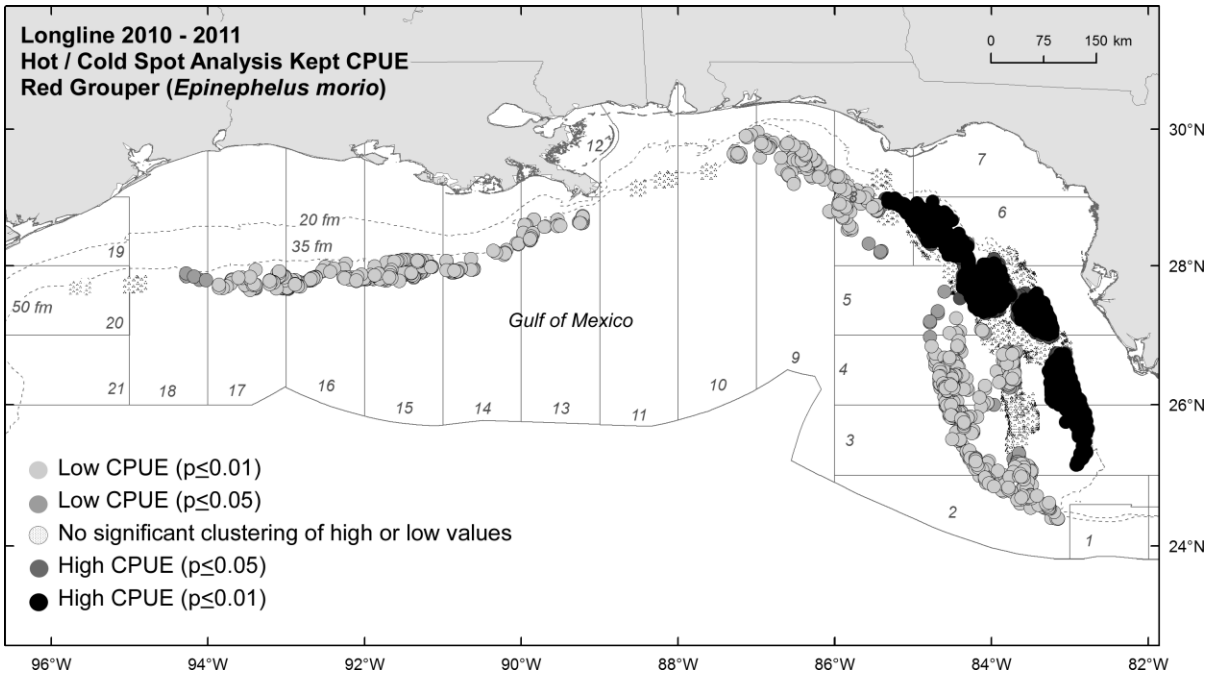

Figure 10— Hot Spot Analysis for all kept red grouper in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

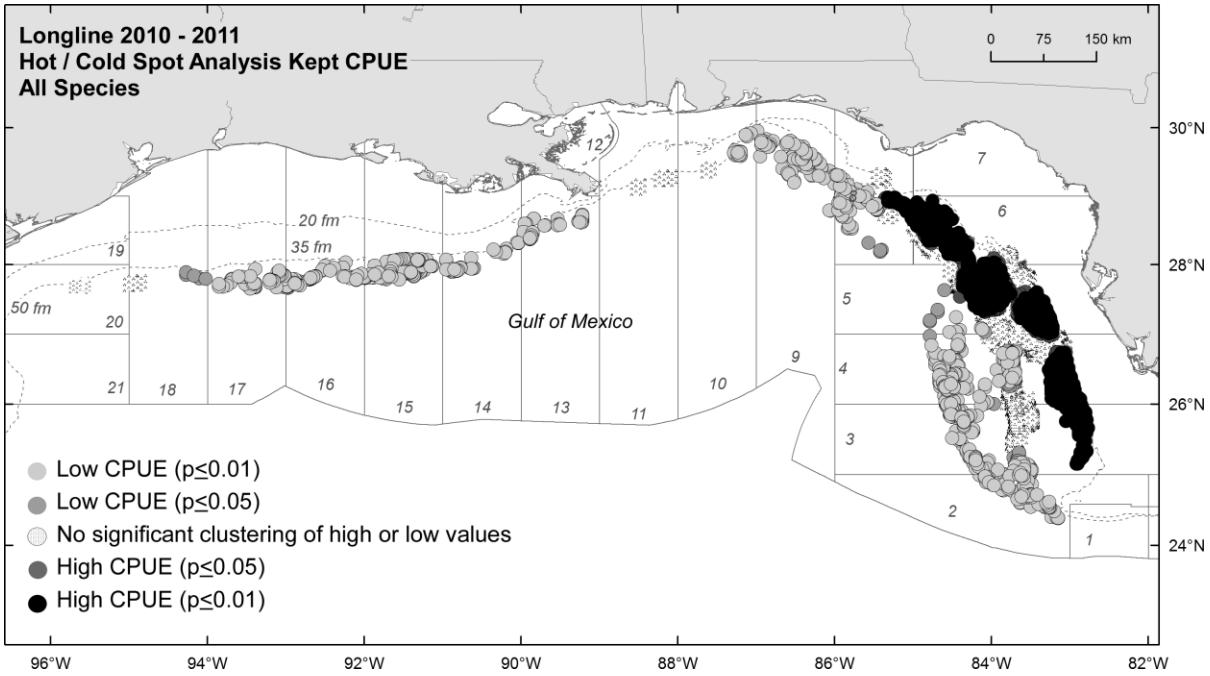

Figure 11— Hot Spot Analysis for all kept species in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

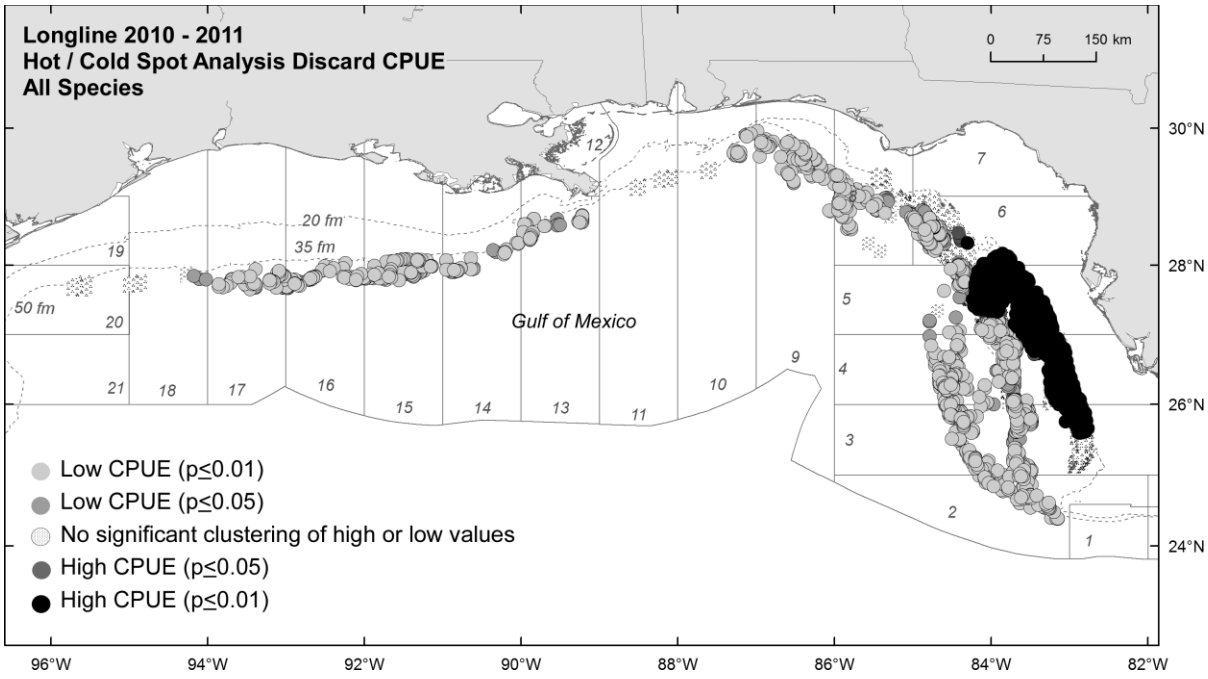

Figure 12— Hot Spot Analysis for all discarded species in the bottom longline fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through November 2011.

CV estimates (Table 10) for discarded red grouper and red snapper were low ($\leq$0.1). Several other species of grouper, jacks (Carangidae), tilefish, snapper, king mackerel, *Scomberomorus cavalla*, and cobia, *Rachycentron canadum*, had values $\leq$ 0.3.

Table 10— Coefficient of variation (CV) for Federally-managed discarded species caught aboard longline vessels in the Gulf of Mexico from January 2010 to November 2011.

Common name	Scientific name	*n*	CV
Red grouper	*Epinephelus morio*	69,521	<0.1
Red snapper	*Lutjanus campechanus*	5,504	<0.1
Gag	*Mycteroperca microlepis*	1,154	0.1
Greater amberjack	*Seriola dumerili*	324	0.1
Speckled hind	*Epinephelus drummondhayi*	268	0.1
Tilefish	*Lopholatilus chamaeleonticeps*	2,079	0.1
Vermilion snapper	*Rhomboplites aurorubens*	94	0.1
Scamp	*Mycteroperca phenax*	108	0.1
Blueline tilefish	*Caulolatilus microps*	1,779	0.1
Banded rudderfish	*Seriola zonata*	139	0.1
Yellowedge grouper	*Epinephelus flavolimbatus*	125	0.1
Lane snapper	*Lutjanus synagris*	52	0.2
King mackerel	*Scomberomorus cavalla*	28	0.2
Ling cobia	*Rachycentron canadum*	28	0.2
Lesser amberjack	*Seriola fasciata*	27	0.3
Gray snapper	*Lutjanus griseus*	15	0.3
Snowy grouper	*Epinephelus niveatus*	30	0.3
Wenchman	*Pristipomoides aquilonaris*	26	0.4
Goliath grouper	*Epinephelus itajara*	8	0.4
Rock hind	*Epinephelus adscensionis*	12	0.4
Mutton snapper	*Lutjanus analis*	5	0.4
Gray triggerfish	*Balistes capriscus*	5	0.4
Red drum	*Sciaenops ocellatus*	5	0.5
Black grouper	*Mycteroperca bonaci*	3	0.6
Queen snapper	*Etelis oculatus*	3	0.7
Red hind	*Epinephelus guttatus*	1	1.0
Yellowtail snapper	*Ocyurus chrysurus*	1	1.0
Warsaw grouper	*Epinephelus nigritus*	1	1.0

Vertical Line

Allocation of Sampling Effort

Data from 161 trips were collected aboard 130 vertical line vessels from July 2010 through December 2011, with a total of 80,128 fish processed (Table 5). Locations for 6,436 vertical line sets are depicted (Fig. 13). Effort data (3,305 hr; 166,740 hooks) were available for 6,348 sets. The majority (79%) of sets were in the eastern Gulf of Mexico. However, the

highest concentrated effort (75%), based on hook-hours, occurred in the western Gulf of Mexico (Fig. 14). By season, 29% of the effort occurred from October through December; 27% April through June; 25% July through September; and 19% January through March for all years combined.

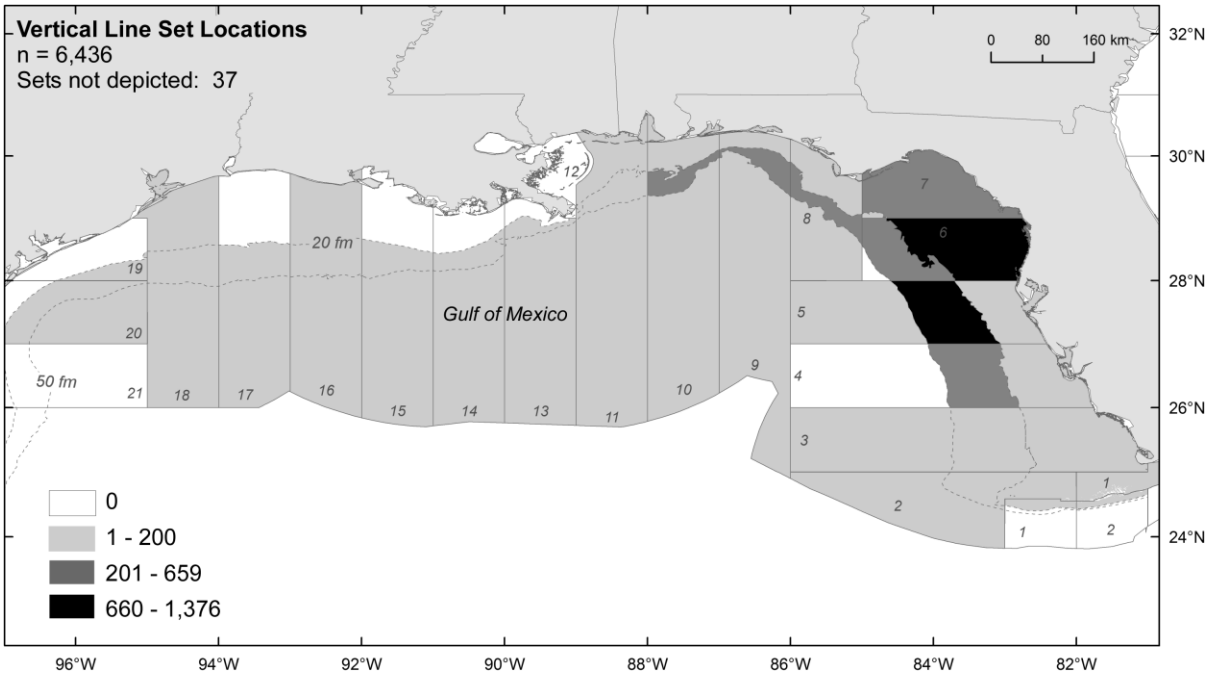

Figure 13 — Distribution of sampling effort (sets) based on observer coverage of the U.S. Gulf of Mexico vertical line reef fish fishery from January 2010 through December 2011.

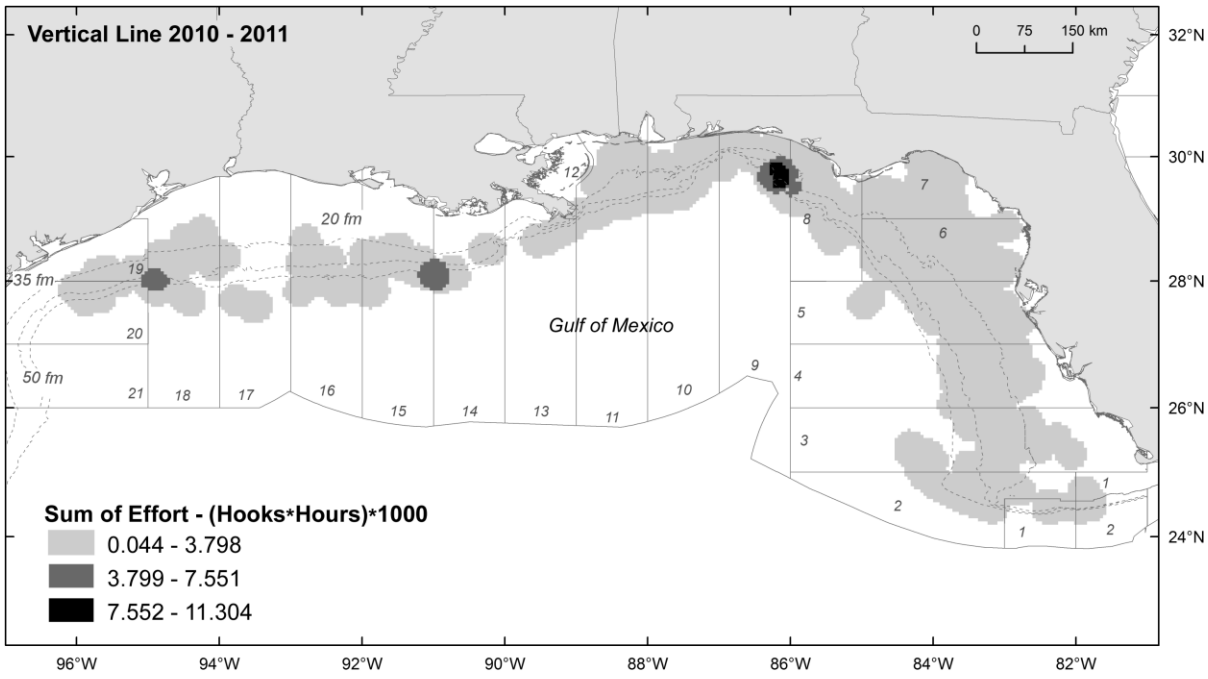

Figure 14— Distribution of sampling effort (hook-hours) based on observer coverage of the U.S. Gulf of Mexico vertical line reef fish fishery from January 2010 through December 2011.

Species Composition

Of the 80,128 fish (164 taxa) sampled, 75% of the individuals were kept, 19% were released alive, 4% were discarded dead, 2% were retained for bait, and < 1% were discarded in an unknown condition (Tables 5, 6 and 8). By number, vermilion snapper ranked highest in the catch composition at 30%. Red grouper comprised 24% of the catch, followed by red snapper (21%), red porgy, *Pagrus pagrus* (9%), gag, *Mycteroperca microlepis* (3%) and the remaining species combined (14%).

Vermilion snapper, red snapper, red grouper, and red porgy comprised 87% of the 59,955 individuals in the kept category. Four species (red grouper, red snapper, gag, and vermilion snapper) accounted for 84% of the released alive category. Of the 14,830 individuals released alive, 48% exhibited visual signs of stress, while 50% exhibited a normal appearance.

Red snapper, red grouper, and vermilion snapper accounted for 84% of 3,150 individuals in the discarded dead category. Minimum assumed mortality for these species was approximately: red snapper (27%), red grouper (11%), and vermilion snapper (41%).

Of the 1.855 individuals used for bait, the species caught and used most often were tomtate, *Haemulon aurolineatum*, white grunt, *Haemulon plumieri*, vermilion snapper, pigfish, *Orthopristis chrysoptera*, and sand perch, *Diplectrum formosum*. These five species comprised 52% of the bait category. The fate of 337 individuals was not determined.

Vermilion Snapper Disposition and Size Composition

A total of 23,827 vermilion snapper were sampled on vertical line gear. Statistical areas of capture ranged from 2 to 20, with the exception of statistical area 17 with no reported takes. Most (78%) of the vermilion snapper were captured in the western Gulf of Mexico. The majority (94%) of the fish were kept. Based on visual observations, 3% were released alive, 2% were discarded dead, and 1% used for bait.

A total of 23,674 vermilion snapper were measured and ranged from 5 to 23 in TL, with the mode of 5,154 individuals at 11 in TL (Fig. 15**).** Of these, 96% were $\geq$10 in TL, the legal minimum size. Approximately 4% were <10 in TL length, with 30% of the individuals discarded dead.

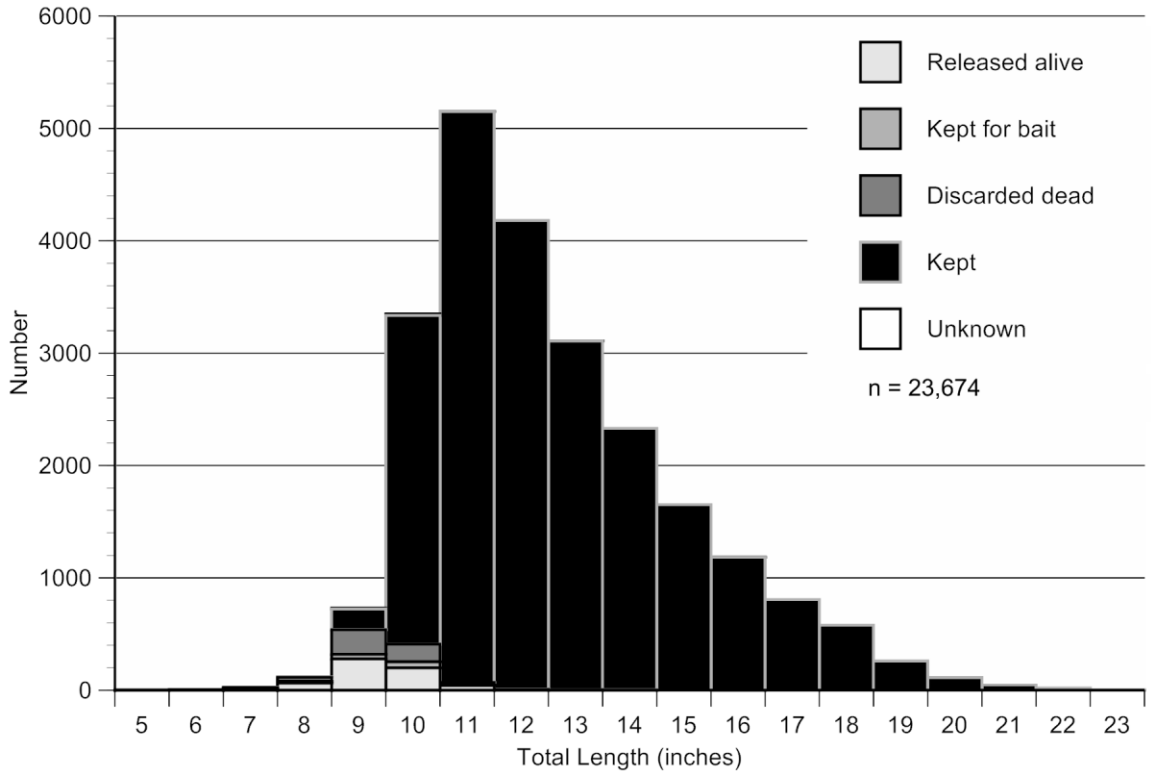

Figure 15— Size and fate of vermilion snapper caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Depths of vermilion snapper capture ranged from 13 to 107 fm. Most (29%) vermilion snapper were caught in waters between 20-25 fm, followed by 31 – 35 fm (27%) and 26 – 30 (10%; Fig. 16). The remaining depth zones comprised 34%. No depth values were recorded for 69 vermilion snapper.

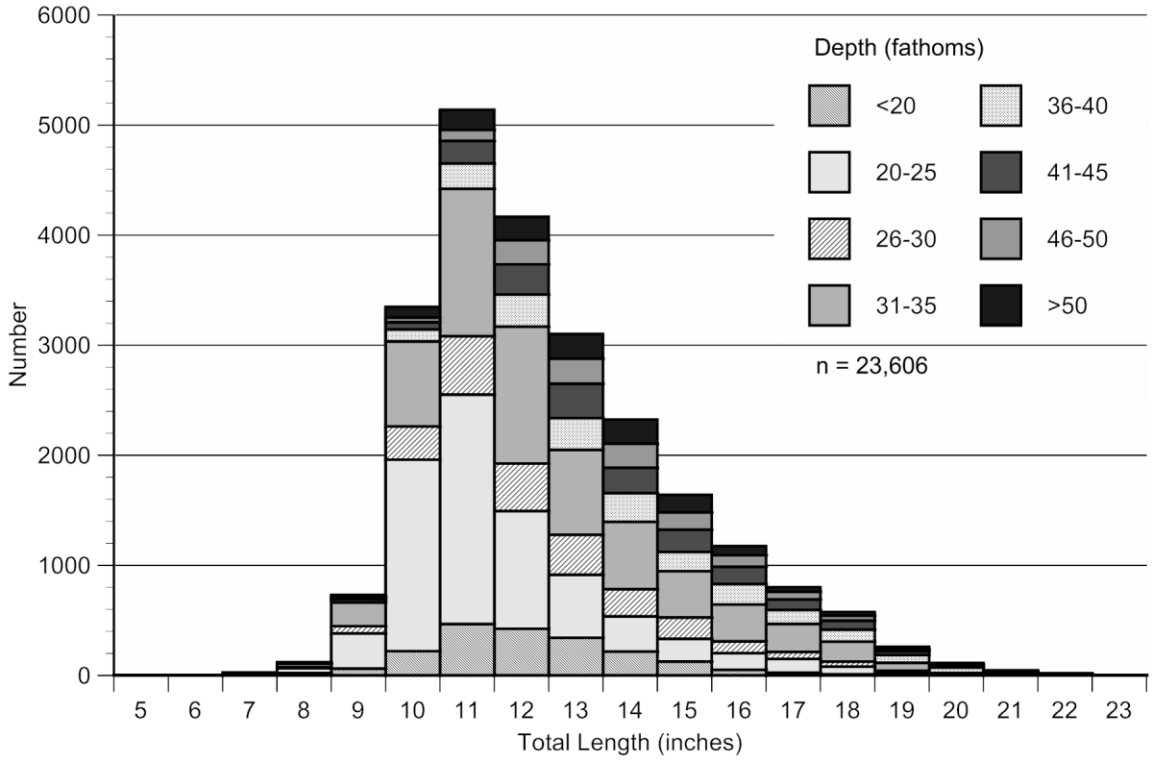

Figure 16— Number of vermilion snapper by size and depth zone caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Red Grouper Disposition and Size Composition

A total of 19,081 red grouper were caught using vertical line gear. Based on visual observations, the majority (55%) of the fish were kept, 39% released alive, 5% were discarded dead and <0.1% were of an unknown condition. Three red grouper were used for bait.

A total of 18,901 red grouper were measured and ranged from 9 to 35 in TL with the mode of 2,532 individuals at 17 in TL (Fig. 17). Of these, 36% of the fish caught were <18 in TL, with 88% released alive, 11% discarded dead, and 1% kept. Of the 64% of red grouper ≥ 18 in TL, 86% were kept, 12% were released alive, and 2% were discarded dead.

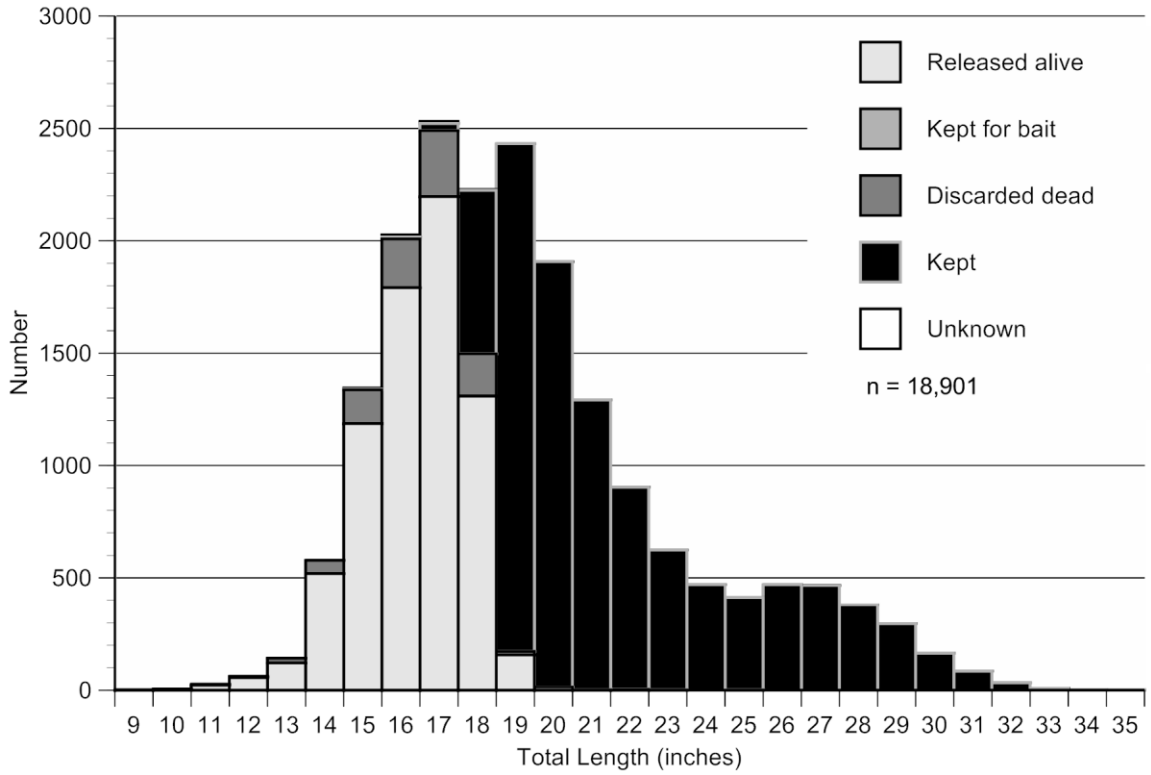

Figure 17— Size and fate of red grouper caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Depths of red grouper captures ranged from 7 to 45 fm. Most (55%) red grouper were caught in waters less than 20 fm, followed by 26 – 30 fm (23%), and 20 – 35 fm (11%). Catch was 11% for the remaining zones (Fig. 18).

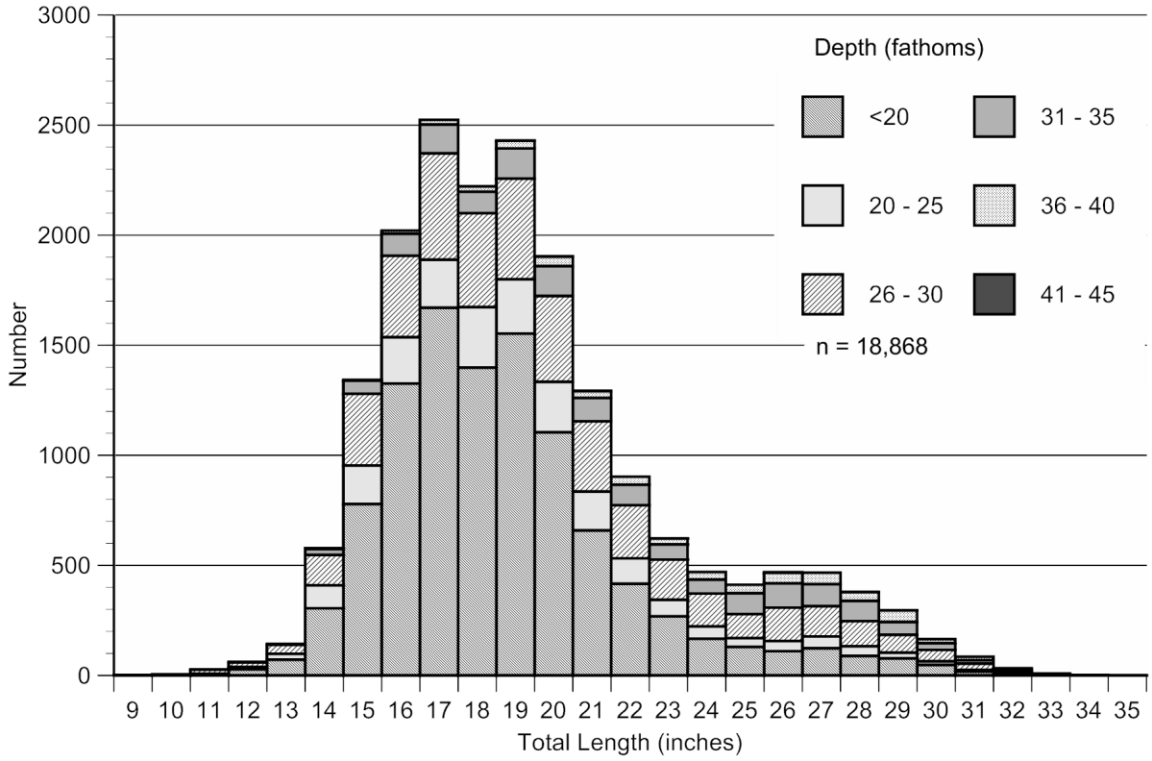

Figure 18— Number of red grouper by size and depth zone caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Red Snapper Disposition and Size Composition

A total of 16,717 red snapper were sampled on vertical line gear. Statistical areas of capture ranged from 2 to 20. Approximately 81% of the red snapper were captured in the western Gulf of Mexico, with the remaining 19% captured in the eastern Gulf. The majority (74%) of the fish were kept. Based on visual observations, 18% were released alive, 7% were discarded dead, and 1% discarded in an unknown condition. Two red snapper were used for bait.

A total of 16,382 red snapper were measured and ranged from 8 to 37 in TL, with the mode of 1,694 individuals at 18 in TL (Fig. 19). Of these, 96% were $\geq$13 in TL, the legal minimum size. Approximately 4% were <13 in TL length, with 46% of the individuals discarded dead.

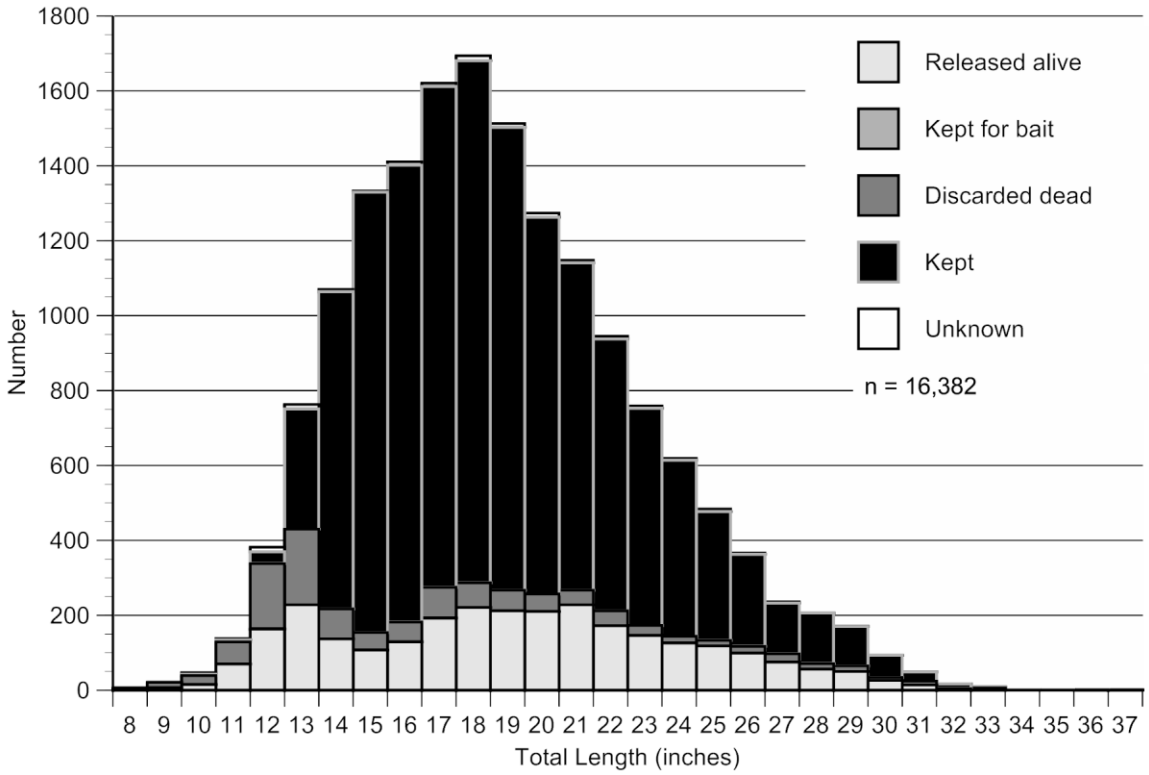

Figure 19— Size and fate of red snapper caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Depths of red snapper capture ranged from 7 to 76 fm. Most (27%) red snapper were caught in waters between 20-25 fm, followed by 26 – 30 fm (21%) and 31 – 35 and <20 fm (18% each; Fig. 20). The remaining depth zones comprised 16%. No depth values were recorded for 20 red snapper.

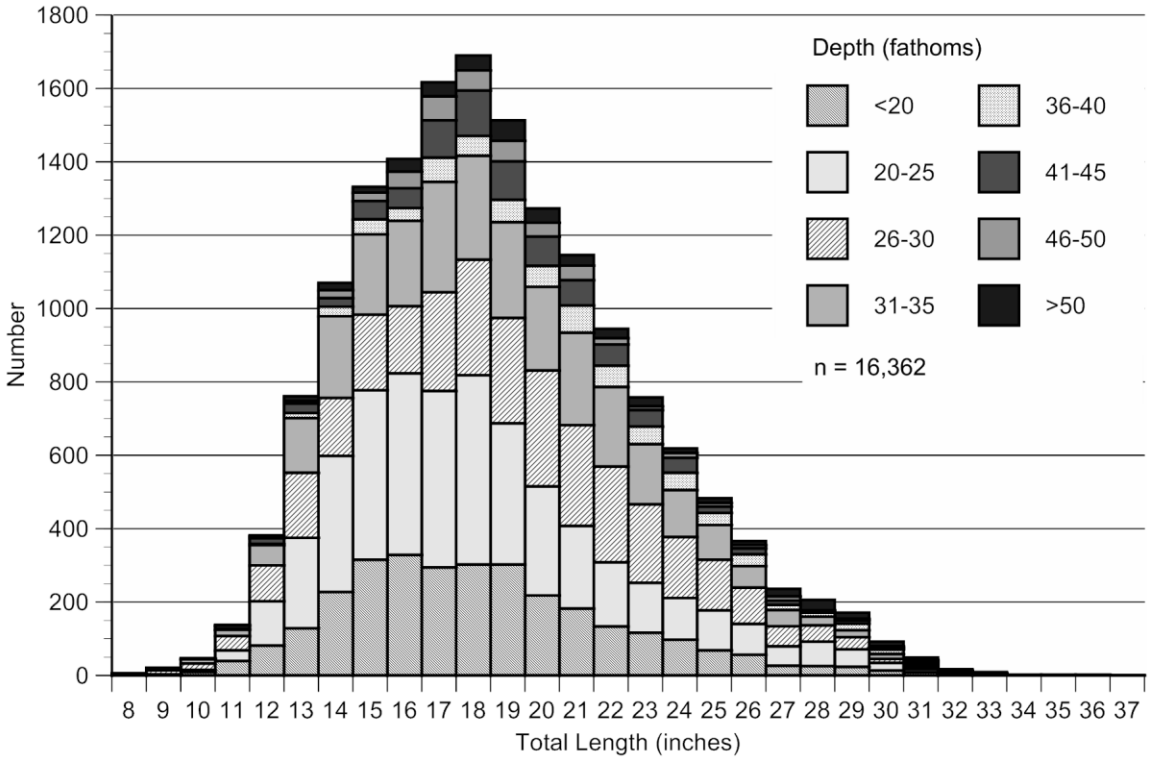

Figure 20— Number of red snapper by size and depth zone caught on vertical line gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

CPUE and Discard CV

Mean CPUE for all species and dispositions was 1.189 fish per hook-hour (± 0.041 SE; Table 6). Vermilion snapper catch rate was 0.421 fish kept per hook-hour (± 0.0195 SE). Red grouper mean catch rate was 0.101 fish kept per hook-hour (± 0.0055 SE). Red snapper mean catch rate was 0.245 fish kept per hook-hour (± 0.0206 SE). Spatial CPUE density (numbers of fish kept per 1,000 hook-hours) for dominant species caught in the vertical line fishery is depicted in Figures 21 through 25. Vermilion snapper were caught and retained throughout the Gulf, with highest density CPUE observed in statistical area 9. Red grouper were concentrated in the eastern Gulf, with the highest CPUE density observed in statistical area 4. Red snapper occurred in both Gulf regions with a high spatial density in statistical

areas and 18, 11 and 14. High density CPUE for red porgy was found primarily in the eastern Gulf. Gag were caught and retained primarily off Florida, predominantly in statistical areas 4–7.

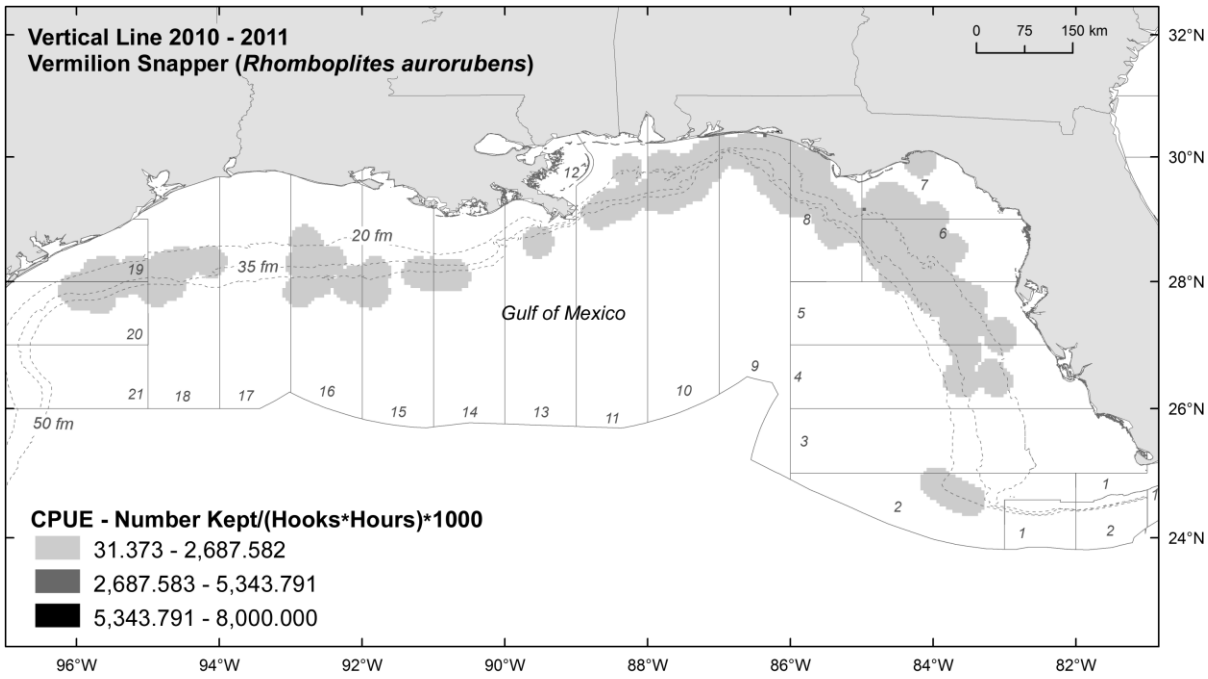

Figure 21— CPUE density surface for vermilion snapper kept in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

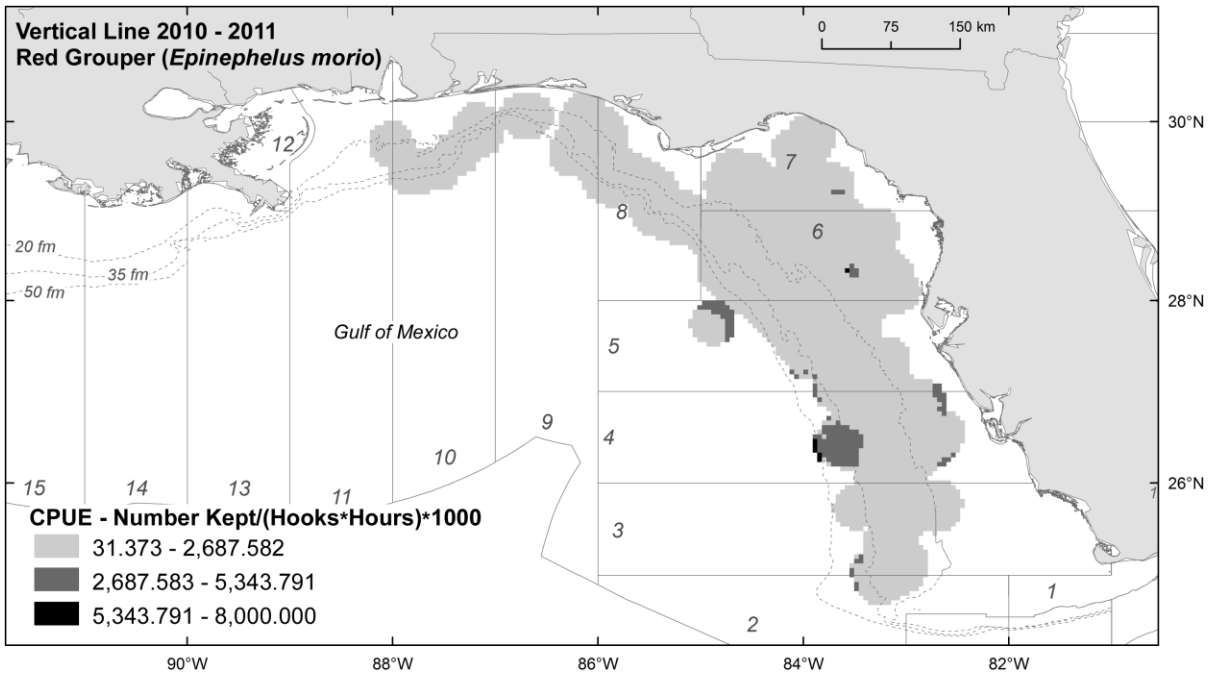

Figure 22— CPUE density surface for red grouper kept in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

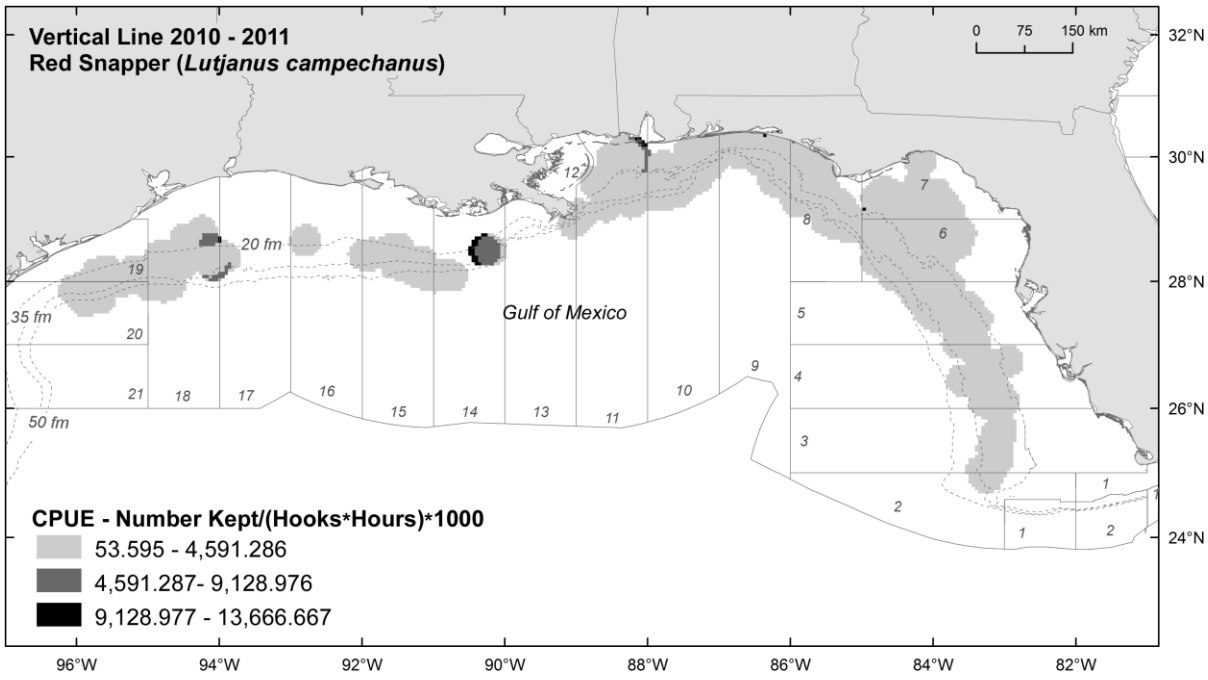

Figure 23— CPUE density surface for red snapper kept in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

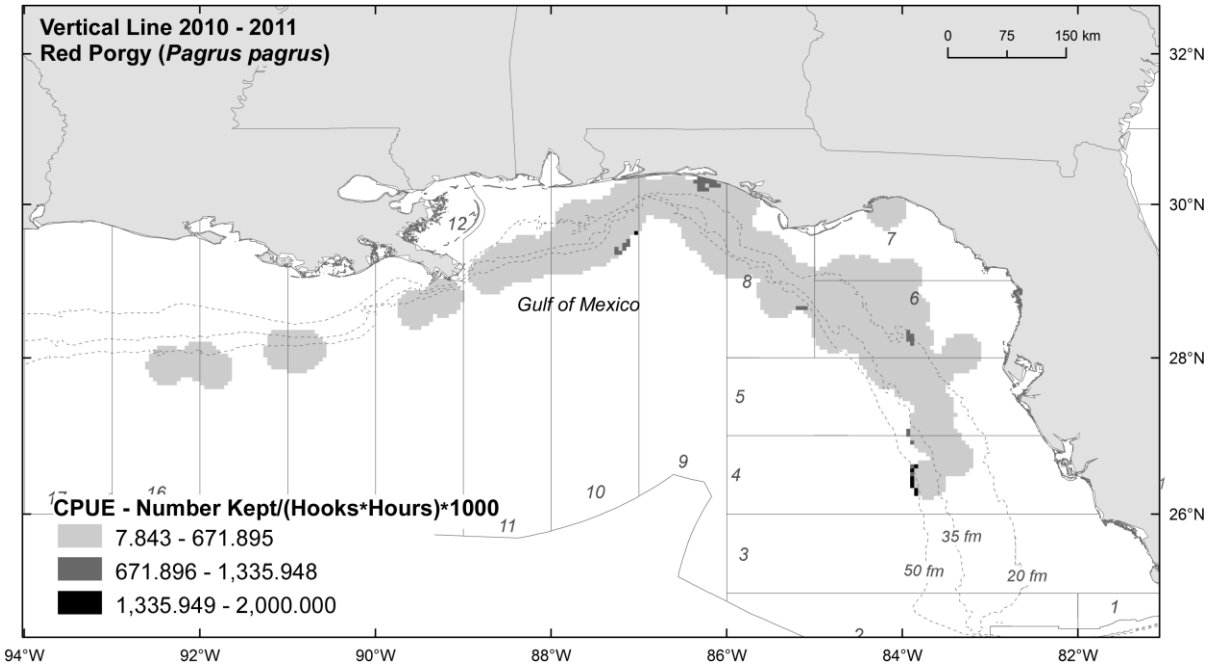

Figure 24— CPUE density surface for red porgy kept in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

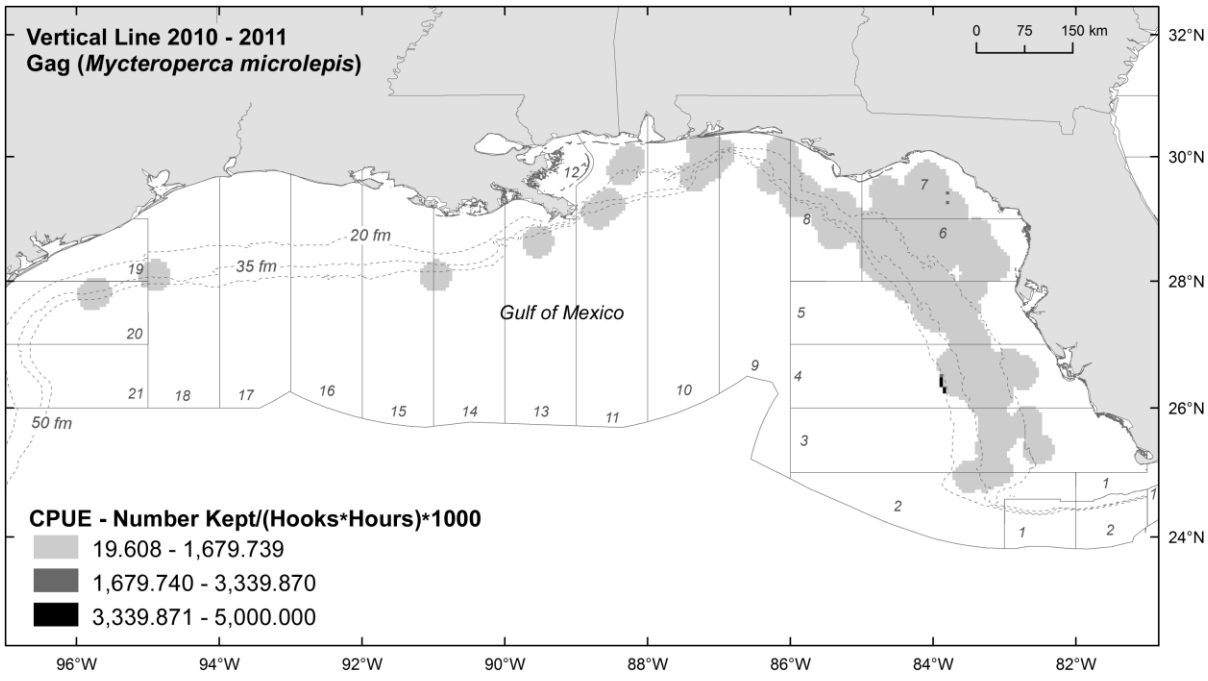

Figure 25— CPUE density surface for gag kept in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Statistically significant clusters of high CPUE for retained vermilion snapper were most pronounced in statistical areas 7 through 10 (Fig. 26), in statistical area 6 for red grouper (Fig. 27), and in several areas throughout the Gulf for red snapper (Fig. 28). For all retained species, significant clusters of high CPUE were detected primarily in the eastern Gulf (Fig. 29). Similarly, clusters of high discard CPUE values were observed in the eastern Gulf predominately in statistical areas 5 through 7 (Fig. 30).

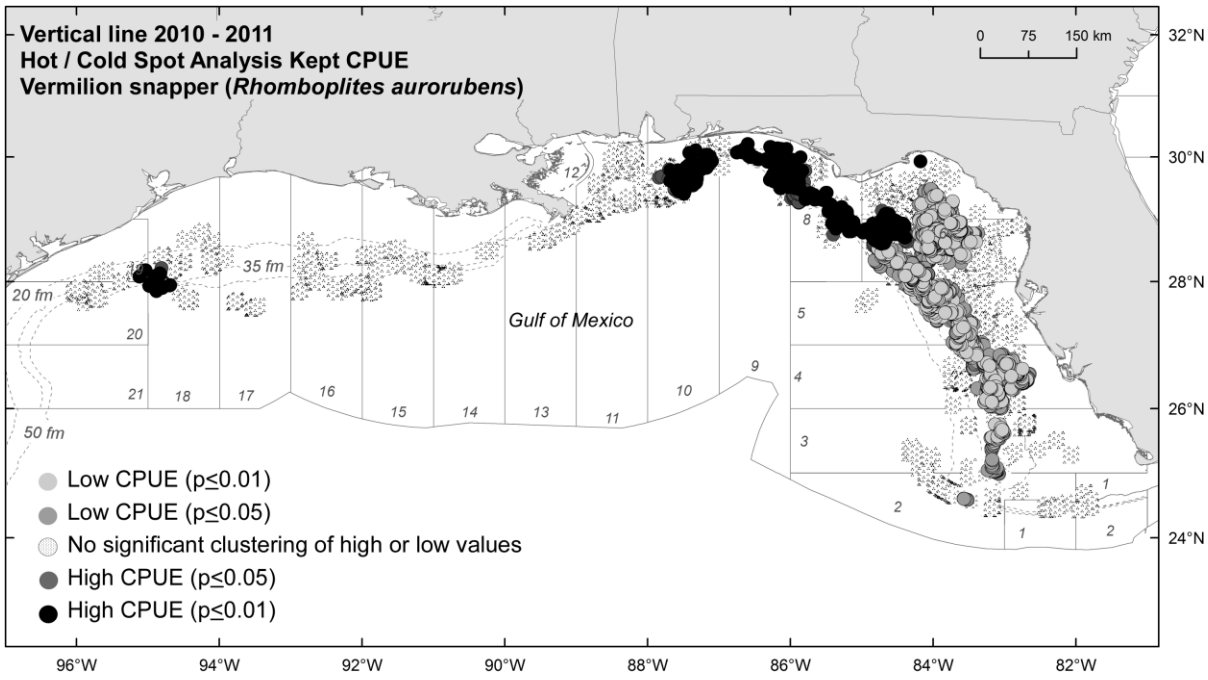

Figure 26— Hot Spot Analysis for all kept vermilion snapper in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

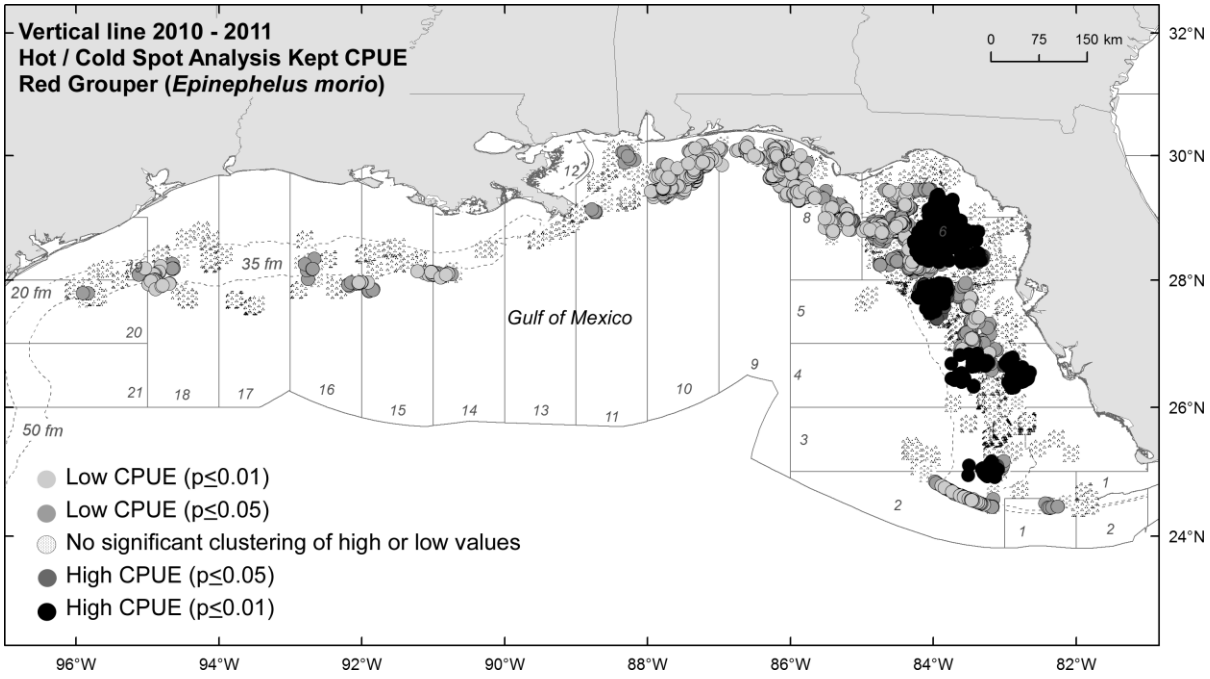

Figure 27— Hot Spot Analysis for all kept red grouper in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

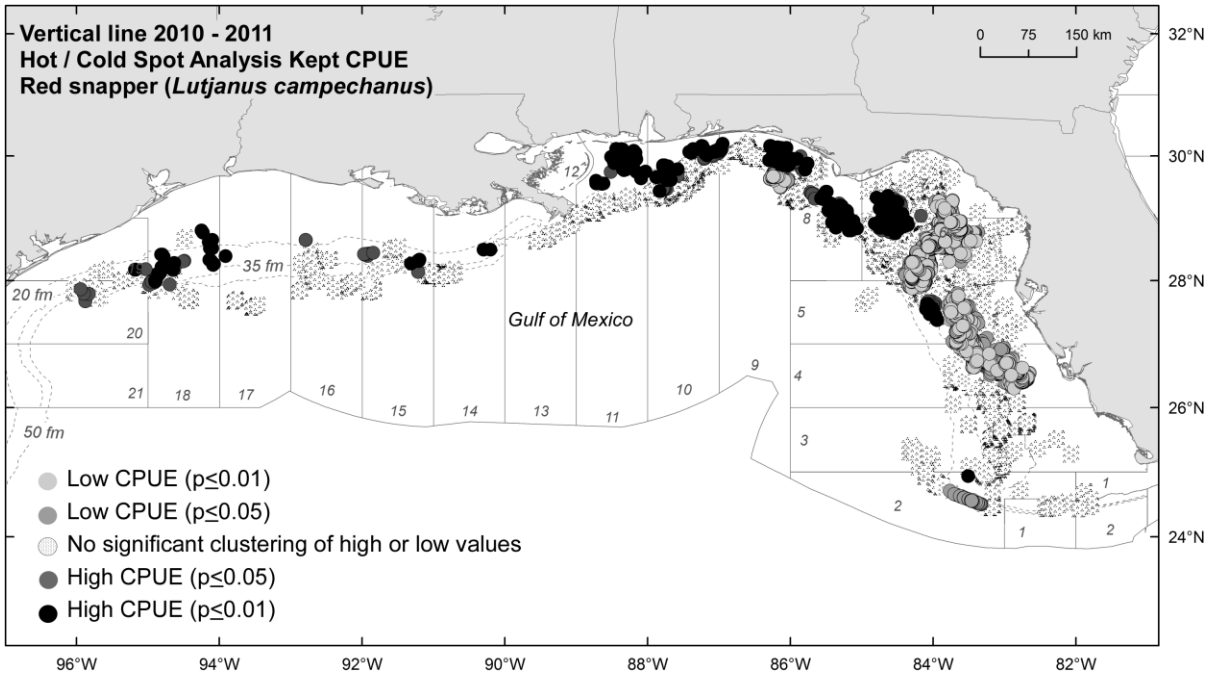

Figure 28— Hot Spot Analysis for all kept red snapper in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

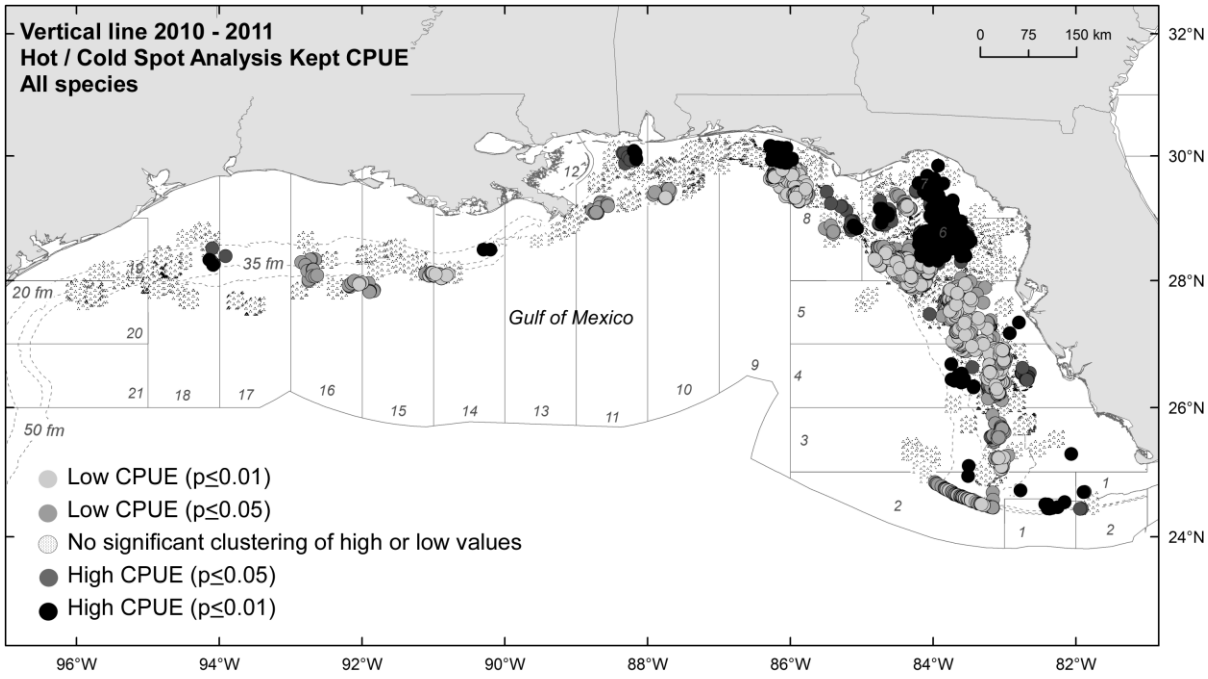

Figure 29— Hot Spot Analysis for all kept species in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

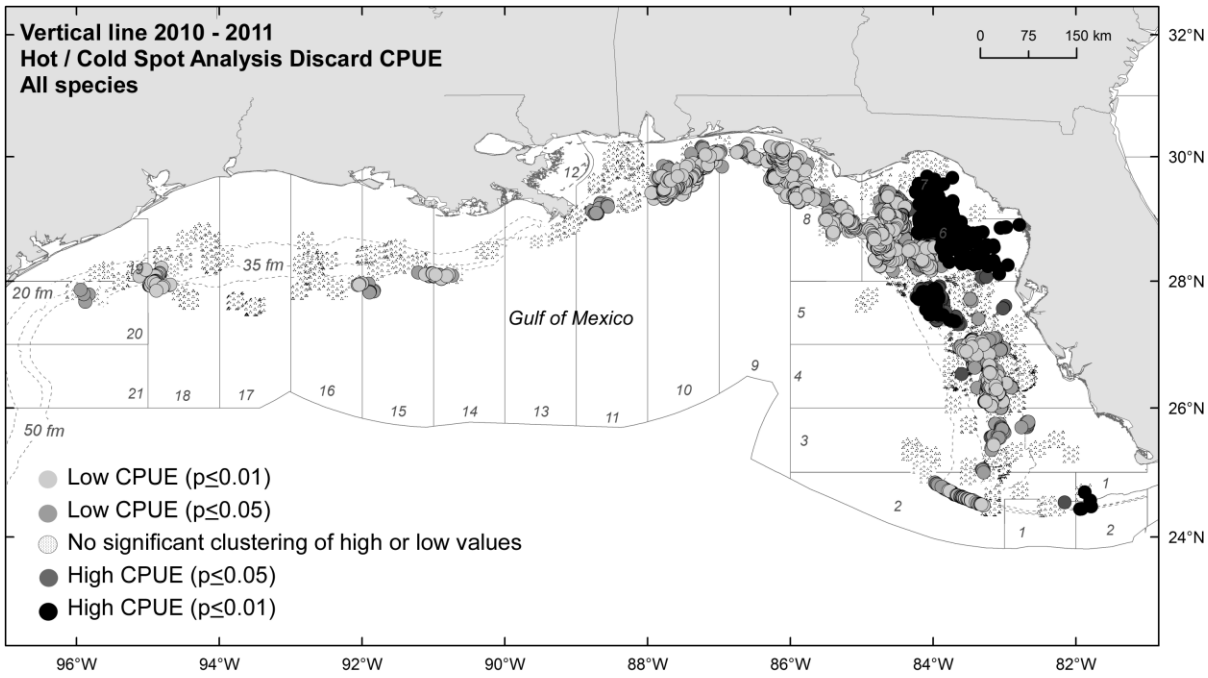

Figure 30— Hot Spot Analysis for all discarded species in the vertical line fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from January 2010 through December 2011.

Based on number discarded, CV estimates for Federally managed species caught in the vertical line fishery (Table 11) were low for red grouper, red snapper, gag, vermilion snapper, gray triggerfish, *Balistes capriscus*, and scamp (≤0.1). Several other species had values less than or equal to 0.5 such as jacks, grouper and snapper.

Table 11— Coefficient of variation (CV) for Federally-managed discarded species caught aboard vertical line vessels in the Gulf of Mexico from January 2010 to December 2011.

Common name	Scientific name	*n*	CV
Red grouper	*Epinephelus morio*	8,914	0.1
Red snapper	*Lutjanus campechanus*	6,986	0.1
Gag	*Mycteroperca microlepis*	1,455	0.1
Vermilion snapper	*Rhomboplites aurorubens*	2,494	0.1
Gray triggerfish	*Balistes capriscus*	603	0.1
Scamp	*Mycteroperca phenax*	142	0.1
Banded rudderfish	*Seriola zonata*	276	0.2
Greater amberjack	*Seriola dumerili*	345	0.2
Speckled hind	*Epinephelus drummondhayi*	74	0.3
Blueline tilefish	*Caulolatilus microps*	32	0.3
Cobia	*Rachycentron canadum*	25	0.3
Yellowtail snapper	*Ocyurus chrysurus*	55	0.3
Red drum	*Sciaenops ocellatus*	122	0.3
Goliath grouper	*Epinephelus itajara*	9	0.3
Lane snapper	*Lutjanus synagris*	12	0.3
Snowy grouper	*Epinephelus niveatus*	24	0.4
Gray snapper	*Lutjanus griseus*	11	0.4
Blackfin snapper	*Lutjanus buccanella*	10	0.4
Silk snapper	*Lutjanus vivanus*	5	0.5
Warsaw grouper	*Epinephelus nigritus*	5	0.5
Lesser amberjack	*Seriola fasciata*	108	0.6
King mackerel	*Scomberomorus cavalla*	73	0.7
Rock hind	*Epinephelus adscensionis*	2	0.7
Black grouper	*Mycteroperca bonaci*	2	0.7
Wenchman	*Pristipomoides aquilonaris*	37	0.8

Modified Buoy Gear

Allocation of Sampling Effort

Data from 26 trips aboard 16 vessels from March 2010 through August 2011 were analyzed. The capture of 17,242 fish (Table 5) occurred during 1,676 sets aboard vessels deploying modified buoy gear (Fig. 31). Effort data (3,166 hr; 491,286 hooks) were available for 1,663 sets. Approximately 96% of fishing effort, based on hook-hours, occurred in the eastern Gulf. The greatest concentration of effort (61%) occurred in statistical area 4. By season, 59% of the sets occurred from April through June; 25% July through September; and 17% January through March for all years combined.

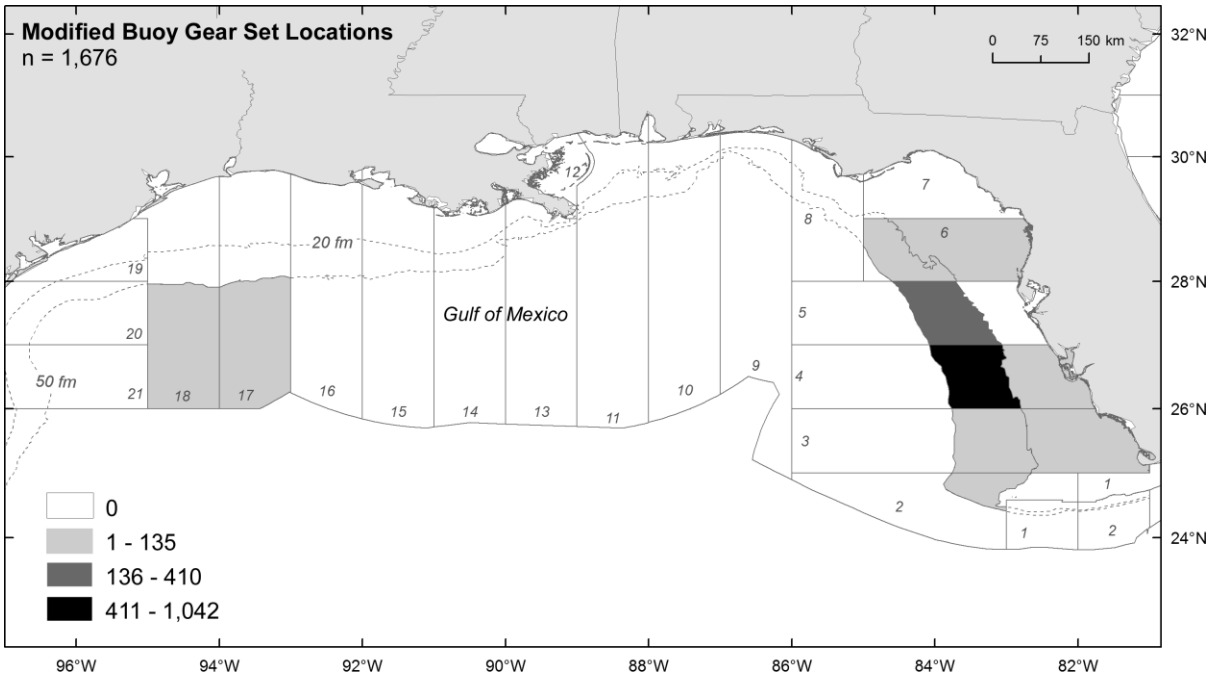

Figure 31— Distribution of sampling effort (sets) based on observer coverage of the U.S. Gulf of Mexico modified buoy gear fish fishery from March 2010 through August 2011.

Species Composition

Of the 17,242 fish (52 taxa) caught on modified buoy gear, 55% of the individuals were kept, 35% were released alive, 9% were discarded dead, <1% each were discarded with an unknown condition, or retained for bait (Tables 5, 6 and 9). By number, red grouper dominated the catch composition at 92%. Red snapper comprised 5% of the catch. All other species combined constituted 3% of the catch.

By category, red grouper, red snapper, scamp and gag grouper comprised the majority (99%) of the 9,433 individuals kept by buoy gear vessels (Table 6). Three species (red grouper, red snapper, and tiger shark, *Galeocerdo cuvier*, accounted for 98% of the released alive category. Of the 6,040 individuals released alive, 86% exhibited visual signs of stress, while 14% exhibited a normal appearance. Of the 93 individuals used for bait, the species caught and used most often for bait were great barracuda, *Sphyraena barracuda* (15%), leopard toadfish, *Opsanus pardus* (10%), and inshore lizardfish, *Synodus foetens* (10%). Red grouper and red snapper comprised the majority (96%) of 1,563 individuals in the discarded dead category. Minimum assumed mortality was estimated at 20% for red grouper and 19% for red snapper. The fate of 113 individuals was undetermined. Of these, approximately 94% were red grouper.

Red Grouper Disposition and Size Composition

All of the 15,850 red grouper caught using modified buoy gear were in the eastern Gulf of Mexico. Based on visual observations, the majority (57%) of the fish were kept, 34% released alive, 9% were discarded dead, and 1% were of unknown condition.

A total of 15,738 red grouper were measured and ranged from 9 to 34 in TL with the mode of 1,651 individuals at 16 in TL (Fig. 32). Of these, 39% of the fish caught were <18 in TL, with 79% released alive, 19% were discarded dead, 1% discarded in an unknown condition, and 1% kept. Of the 61% of red grouper ≥ 18 in TL, 93% were kept, 5% were released alive, and 2% were discarded dead.

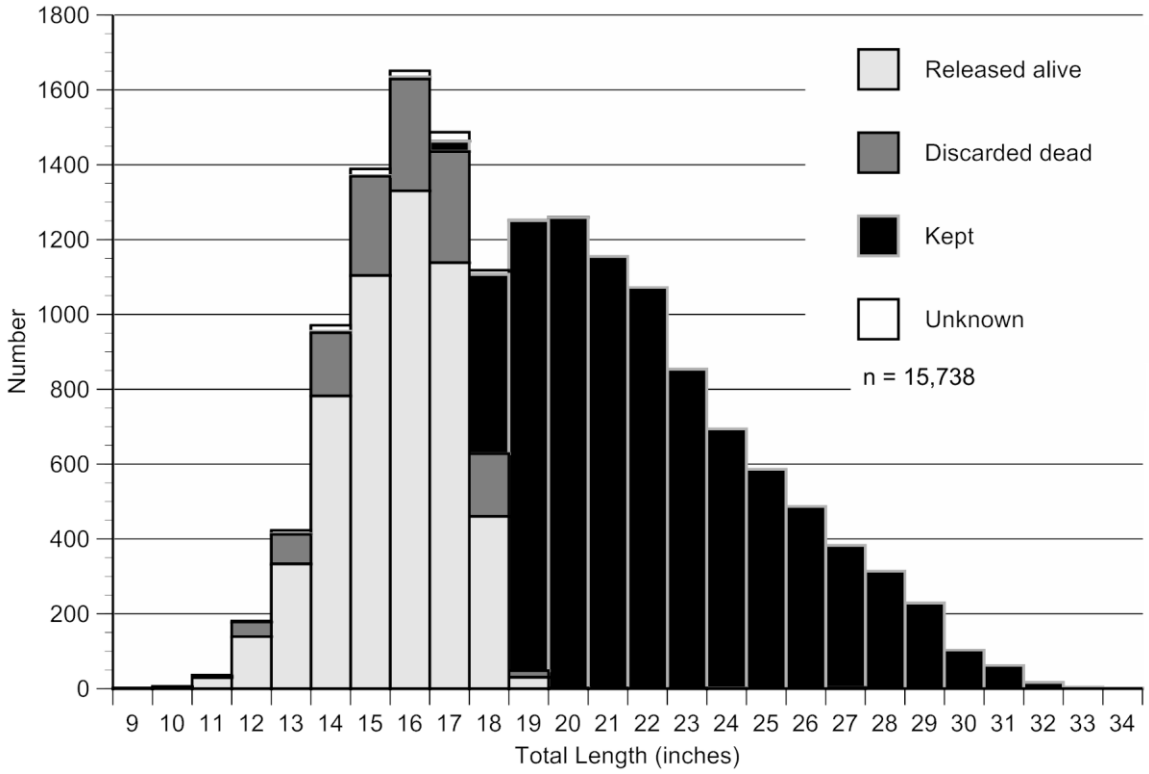

Figure 32— Size and fate of red grouper caught on modified buoy gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from March 2010 through August 2011.

Depths of red grouper captures ranged from 19 to 34 fm. Most (54%) red grouper were caught between 20 – 25 fm, followed by 26 – 30 fm (44%). Catch was 2% for the remaining zones (Fig. 33).

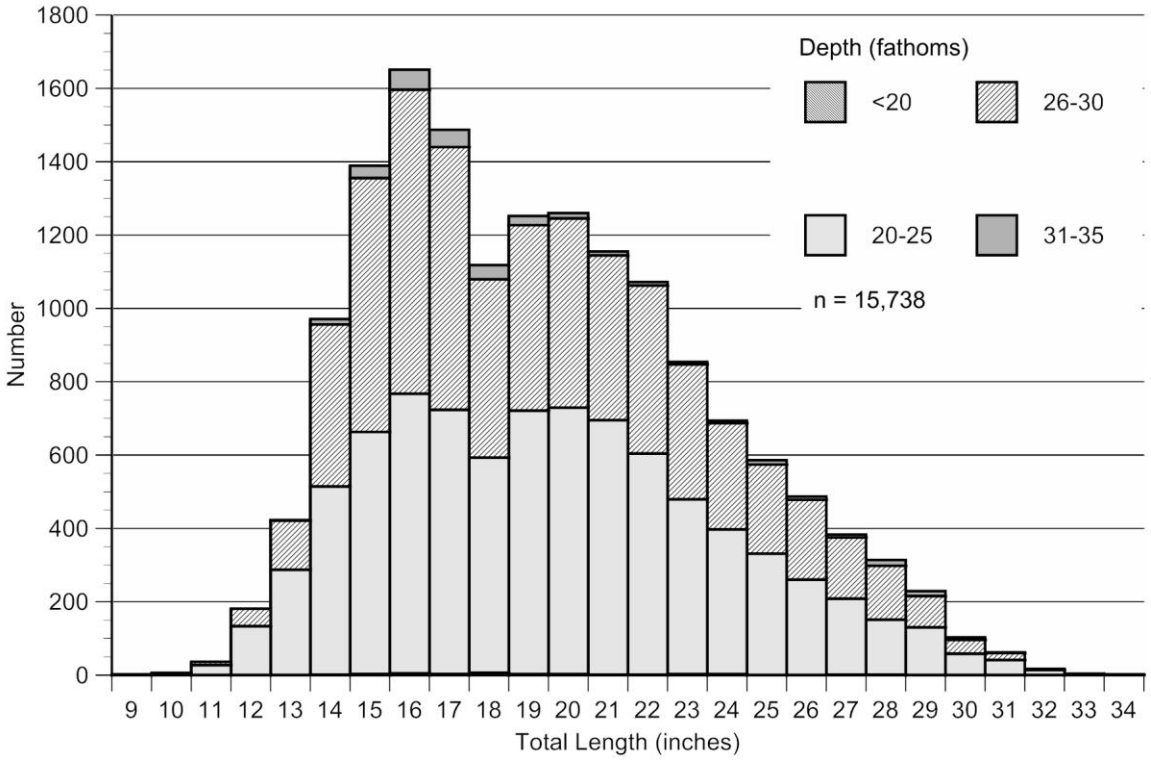

Figure 33— Number of red grouper by size and depth zone caught on modified buoy gear based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from March 2010 through August 2011.

CPUE and Discard CV

Mean CPUE for all species and dispositions combined was 0.017 fish per hook-hour (± 0.0004 SE; Table 6) for modified buoy gear. The catch rate estimate for red grouper was 0.009 fish kept per hook-hour (± 0.0003 SE). Spatial CPUE density (numbers of fish kept per 1,000 hook-hour) for red grouper for all years combined is depicted (Fig. 34). Red grouper were caught and retained primarily in statistical areas 3 through 5. Depiction of significant clusters locations high CPUE for kept and discarded species was not given due to data confidentially concerns.

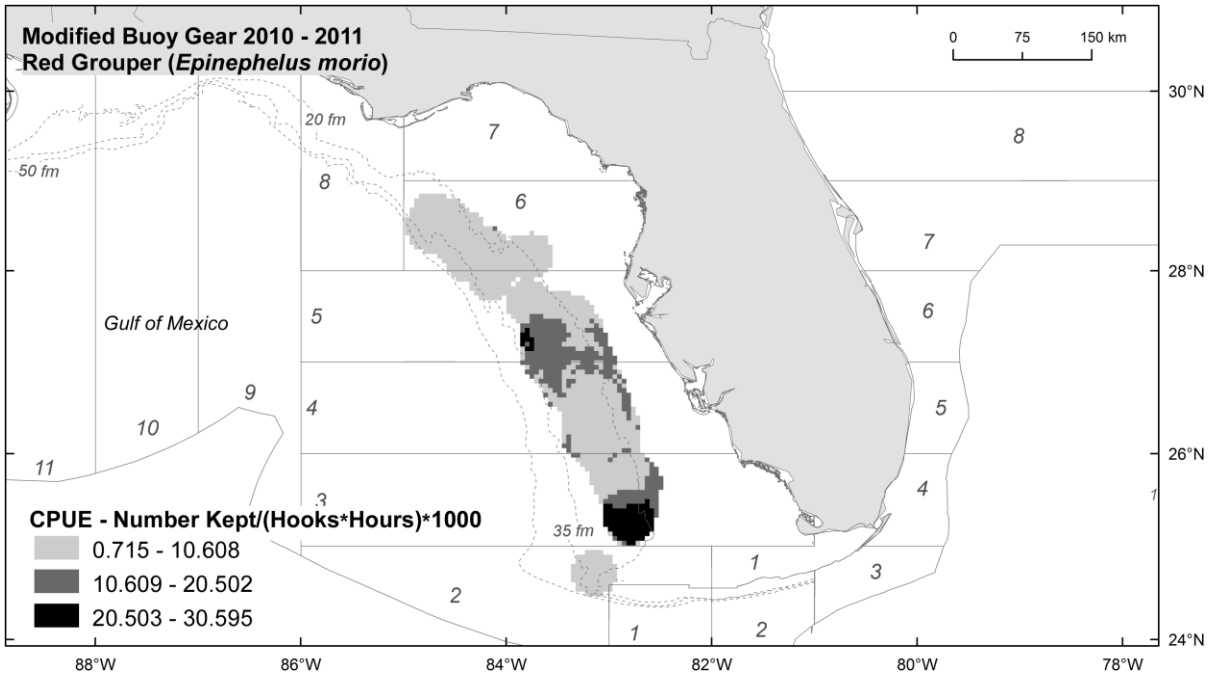

Figure 34— CPUE density surface for red grouper kept in the modified buoy gear fishery based on observer coverage of the U.S. Gulf of Mexico reef fish fishery from March 2010 through August 2011.

CV estimates (Table 12) for discarded red grouper and red snapper were low (≤0.1). Other species of grouper and snapper had values ≤ 0.3.

Table 12— Coefficient of variation (CV) for Federally-managed discarded species caught aboard modified buoy gear vessels in the Gulf of Mexico from March 2010 to August 2011

Common name	Scientific name	*n*	CV
Red grouper	*Epinephelus morio*	6,841	<0.1
Red snapper	*Lutjanus campechanus*	596	0.1
Vermilion snapper	*Rhomboplites aurorubens*	17	0.2
Gag	*Mycteroperca microlepis*	15	0.3
Speckled hind	*Epinephelus drummondhayi*	14	0.3
Lane snapper	*Lutjanus synagris*	10	0.3
Banded rudderfish	*Seriola zonata*	4	0.5
King mackerel	*Scomberomorus cavalla*	3	0.6
Scamp	*Mycteroperca phenax*	3	0.6
Greater amberjack	*Seriola dumerili*	2	0.7
Gray triggerfish	*Balistes capriscus*	2	0.7
Gray snapper	*Lutjanus griseus*	1	1.0
Spanish mackerel	*Scomberomorus maculatus*	1	1.0
Goliath grouper	*Epinephelus itajara*	1	1.0
Yellowedge grouper	*Epinephelus flavolimbatus*	0	
Tilefish	*Lopholatilus chamaeleonticeps*	0	
Mutton snapper	*Lutjanus analis*	0	
Black grouper	*Mycteroperca bonaci*	0	
Ling	*Rachycentron canadum*	0	

Interactions with Protected Species in the Reef Fish Fishery

Eleven sea turtles were captured on observed trips utilizing longline gear from 2010 to 2011; four occurred during the hook-timer pilot project. One bottlenose dolphin, *Tursiops truncatus* was hooked in the snout during modified buoy operations. All protected species were released alive. Sea turtle mortality and projected take estimates by gear type were reported by SEFSC[14].

[14] SEFSC. 2009. Estimated takes of sea turtles in the bottom longline portion of the Gulf of Mexico reef fish fishery July 2006 through December 2008 based on observer data. U. S. Dep. Commer., NOAA, NMFS

Discussion

To further our knowledge of catch rates, bycatch composition and discard mortality associated the commercial U.S. Gulf of Mexico reef fish fishery, a mandatory observer program was established in 2006 based on a proportional randomized sampling design stratified by season, gear and region (Scott-Denton et al., 2011). Observer data continue to be critical for population assessments and provide a time series over a range of geographic areas for federally-managed species.

Data from 2010 through 2011 from this observer program revealed relatively high species richness from the two primary gears (longline n = 184 taxa; and vertical line n = 164 taxa). This is similar to those reported by Scott-Denton et al. (2011) from earlier years of the program (longline n = 183 taxa; and vertical line n = 178 taxa). While diversity was high, red grouper, tilefish, and yellowedge grouper (in longline), and vermilion snapper, red grouper and red snapper (in vertical line), comprised more than 74% by number of the species caught. Hale et al. (2010) examined species composition and disposition of fish captured from commercial bottom longline sets targeting reef fish in the Gulf of Mexico and reported, in order of abundance, that red grouper, blueline tilefish, tilefish, and yellowedge grouper comprised 76% of catch. These findings are similar to those described by Stephen and Harris (2010) from the South Carolina snapper-grouper vertical line fishery. They reported high overall diversity; however, a small number of species (17) accounted for 90% of catch.

In our current study, 51% of the individuals, predominately red grouper, were kept in the longline fishery. In vertical line, a larger percentage (75%) was kept and comprised primarily vermilion snapper, red grouper and red snapper. These are similar percentages as those reported by Scott-Denton et al. (2011) for longline at 46% and vertical line at 71%. Similarly, Rudershausen et al. (2007), Stephen and Harris (2010), and Scott-Denton[3] reported low discard proportions for the vertical line trips. It should be noted, however, that low discard proportions may still have the potential to affect long-lived species populations.

From review of the literature (Scott-Denton et al., 2011) discard mortality estimates are extremely variable and influenced by an array of factors, including species-specific life history characteristics (Coleman et al., 2000; Patterson et al., 2002; Nieland et al., 2007), season (Render and Wilson, 1994) depth, and method of capture and release (Gitschlag and Renaud, 1994; Collins et al., 1999, Dorf, 2003; Rummer, 2007; Burns et al.[15]). Bartholomew and Bohnsack (2005), using the Marine Recreational Fishery Statistic Survey data from 1981–1999 and findings from 53 release mortality studies, reported significant mortality factors related to hook location, bait removal, hook type, capture depth, water temperature, and handling time.

From a Texas headboat survey, Dorf (2003) reported that red snapper (<18 in TL) constituted 93% of the released fish, of which, 60.6% were released alive, 22.8% swam erratically, 15.2% floated, and 1.4% were discarded dead. From a study conducted off of three South Texas petroleum production platforms**,** Diamond and Campbell (2009) examined red snapper caught on hook and line and found immediate mortality at 17%. Through the use of an injury status condition index, however, delayed mortality was estimated to be 64%.

[15] Burns, K. M., N. F. Parnell, and R. R. Wilson, Jr. 2004. Partitioning release mortality in the undersized bycatch: Comparison of depth vs. hooking effects. MARFIN Grant No. NA97FF0349, 36 p., on file at NOAA Fish., SERO, St. Petersburg, Fla.

Patterson et al. (2002) estimated discard mortality of 13.5% for red snapper and <1% for gray triggerfish, based on surface release observations and recapture rates of fish caught with recreational gear off Alabama.

Variable minimum assumed mortality rates and discard proportions may also be affected due to regulatory mandates in minimum size limit requirements and through implementation of individual fishing quota (IFQ) programs, notably, for red snapper, red grouper and tilefish. In this study, immediate mortality for red grouper was 25% in longline and 11 % in vertical line, with minimum assumed mortality for red snapper of 27% and 41% for vermilion snapper in vertical line. For modified buoy gear immediate mortality was estimated at 20% for red grouper and 19% for red snapper.

Rudershausen et al. (2007) reported low (<10%) immediate release morality for vermilion snapper, gag, and red grouper; moderate (14%) mortality for red porgy; and high (23%) immediate mortality for scamp in the North Carolina commercial snapper-grouper fishery.

For vertical line trips targeting vermilion snapper off South Carolina, Stephen and Harris (2010) estimated minimum assumed mortality from a range of 33–100%, with >90% mortality observed for gray triggerfish, greater amberjack, scamp and red snapper. Nieland et al. (2007) assessed the fate of red snapper regulatory discards aboard commercial vertical line vessels operating primarily off Louisiana using four release condition categories similar, but more in depth than that of this study. The authors estimated 69% of discarded red snapper were either dying or dead when released.

In our study, red snapper ranged from 8–37 in TL with a mode of 18 in TL in the vertical line fishery. This is larger than 15 in TL reported by Scott-Denton et al. (2011) and

by Nieland et al. (2007) who reported a commercial red snapper landings mode of 400 mm (15.7 in) TL. In this study, the mode for red grouper was 17 in TL for both the longline and vertical sectors. This is similar to values collected from fishery independent longline surveys conducted by NMFS in the Gulf of Mexico from 2000 through 2005 that depict a of mode 18 in TL (Ingram et al.[16]), and from the commercial fishery as reported by Scott-Denton et al. (2011).

Highest density CPUE (numbers of fish kept per 1,000 hook-hours) occurred in the eastern Gulf for red grouper and blueline tilefish in the longline sector, a similar distribution as reported by Ingram et al.[16] and Scott-Denton et al. (2011). In deeper waters of the western Gulf, yellowedge grouper, tilefish, and scamp had substantial CPUE density values. For vertical line, highest CPUE for red snapper occurred in the western Gulf, consistent with SEDAR[12] and Scott-Denton et al. (2011). Density CPUE values were higher and more dispersed in vertical line for other dominant species (vermilion snapper, red grouper, red porgy, and gag).

As recommended by NMFS' National Bycatch Strategy addressing fishery bycatch on a national level, precision goals for bycatch estimates are defined in terms of CV estimates (NMFS, 2004). In this study, CV estimates were low (0.1) for undersize target species, notably red grouper and red snapper. CV estimates for other species of commercial, recreational and ecological importance, including several species of grouper and snapper, were relatively high and in some cases equal to 1.0.

[16] Ingram, W., M. Grace, L. Lombardi-Carlson, and T. Henwood. 2006. Catch rates, distribution and size/age composition of red grouper, *Epinephelus morio,* collected during NOAA Fisheries Bottom Longline Surveys from the U.S. Gulf of Mexico. SEDAR-12-DW-05. Southeast Data Assessment and Review, South Atl. Fish. Manage. Counc., Charleston, SC. (available at www.sefsc.noaa.gov/sedar/).

Concerns over fishing areas of high bycatch, bring about the need for management measures designed to reduce bycatch and address options that include:
(1) changes in fishing behaviors, (2) modifications of gear, and (3) management alternative to close areas. As illustrated by Hot/Cold Spot Analysis[10], areas of significant clusters of high discard rates were identified. In the longline fishery, significant clusters of high discard CPUE were located in statistical areas 3 through 6. For vertical line, significant cluster of high discard catch rates were concentrated in the eastern Gulf in statistical areas 5 through 7.

Prior to mandatory observer coverage, self-reporting through logbook and discard supplementary data submission were used prior to estimate sea turtle take in the reef fish fishery and provided the foundation for biological opinions pursuant to formal consultation under Section 7 of the ESA (NMFS[17]). Observers documented 11 sea turtle interactions in the bottom longline fishery during the study period.

Observer programs remain the most reliable and accurate means for monitoring fishery characteristics by providing insight on protected species interactions, and for assessing quota and size restrictions, IFQ programs, CPUE, discard levels, gear effectiveness, and numerous other variables of interest to fishery managers, the fishing industry, academia, and the public.

[17] NMFS. 2005. Endangered Species Act – Section 7 consultation on the continued authorization of reef fish fishing under the Gulf of Mexico Reef Fish Fishery Management Plan and Proposed Amendment 23. Biol. Opinion, Feb. 15, 115 p. NOAA Fish., SERO, St. Petersburg, Fla. (available at http://sero.nmfs.gov/pr/pdf/Final_RFFMP23.pdf).

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