American Fisheries Society Symposium 36:155–166, 2003

Red Snapper Discards in Texas Coastal Waters—a Fishery Dependent Onboard Survey of Recreational Headboat Discards and Landings

BARBARA A. DORF

Texas Parks & Wildlife, Coastal Fisheries Division
702 Navigation Circle, Rockport, Texas 78382-2779, USA

Abstract.—Quantity and characteristics of red snapper *Lutjanus campechanus* recreational headboat discards and landings from three Texas ports (Galveston, Port Aransas, and Port Isabel) were determined in a fishery dependent study using NMFS-trained onboard observers during August and September 1999. Mean fishing depth during 54 trips (199 sets) was 40.2 m (range, 13.4–95.4 m) with 36.5% of reels sampled. Red snapper less than the 1999 federal minimum size of 450-mm (18-in) total length made up 93.4% of the 3,863 snapper collected. Those less than the Texas state minimum size of 375 mm (15 in) made up 64.0% of the catch. When brought on board, 70.2% of snapper appeared normal and 26.1% had protruding stomachs. Of the discarded red snapper, 60.6% were released alive and swam down, 22.8% swam erratically, 15.2% floated, and 1.4% were discarded dead. Fish released either dead or floating were caught at greater depths than fish that swam down or erratically. Galveston had the largest discard:landing ratio (211:1) and smallest mean fish size (0.7 kg, 343 mm). Port Aransas had the lowest discard:landing ratio (5.2:1) and largest mean fish size (0.9 kg, 387 mm).

Introduction

Red snapper *Lutjanus campechanus* is one of the most economically important species in the Gulf of Mexico reef-fish fishery. In order to manage this widely used resource, the Gulf of Mexico Fishery Management Council implemented a Reef Fish Fishery Management Plan in 1984 to rebuild declining reef fish stocks (GMFMC 1981). Recent management measures have been publicly controversial, particularly regarding bycatch in the shrimp fishery, accuracy of stock assessments, and possible underreporting and inaccuracy of commercial and recreational catches. As a result, an independent scientific assessment of red snapper status in the Gulf of Mexico, as well as a peer review of all National Marine Fisheries Service (NMFS) stock assessments and fisheries statistics, was completed in 1997 (MRAG Americas, Inc. 1997). Although supportive of the scientific evaluations, data limitations were noted.

One area of concern was monitoring the number and length frequency of discards. Another was the accurate estimation of discard mortality rates, particularly in relation to depth of capture. In 1999, the NMFS responded to the 1997 peer review and presented a research plan for red snapper in the Gulf of Mexico. The plan addressed all phases of the reef-fish fishery, including the directed commercial fishery, recreational charter boats, and headboats (MRAG Americas, Inc. 1999). Onboard observers were suggested as the best way to estimate discard. To estimate discard mortality rates, a "sink or swim" approach was suggested in which onboard observers would note the short-term fate of discarded red snapper: whether or not the fish swam down out of sight. Another suggested method to determine mortality rate involved releasing snapper into cages, then lowering them to depth. This method has been used previously, although at relatively shallow depths (Gitschlag and Renaud 1994; Render and Wilson 1994).

Discard of red snapper caught in the recreational headboat fishery is usually due to catch during a seasonal closure while fishing for other species, smaller than minimum size, or number in excess of legal bag limits. The amount and characteristics of this recreational bycatch are poorly documented, as is its contribution to bycatch mortality in the Gulf of Mexico. Red snapper from Texas headboats account for 80% of Texas recreational red snapper landings, 85% of Gulf of Mexico headboat red snapper landings, and 25% of gulfwide recreational red snapper landings (Schirripa and Legault 1999). Awareness of the quantity and characteristics of recreational discards from this important sector of the red snapper fishery can promote the development of improved stock assessment and management strategies for the Gulf of Mexico.

The goal of this study was to determine the quantity, characteristics, and fate of red snapper from the directed recreational headboat fishery along the Texas coast from a depth stratified perspective. Specific objectives included placing NMFS trained observers on board recreational headboats from three Texas ports (Galveston, Port Aransas, and Port Isabel) to determine the (1) length, weight, and condition of all snapper brought on board; and (2) condition and short-term fate of all snapper discards.

Methods

Headboats were based in one of three Texas ports: Galveston, Port Aransas, and Port Isabel. Sampling occurred during the months of August and September 1999. Prior to closure of the red snapper fishery in federal waters at the end of August, sampling occurred in federal and state waters, continuing solely in state waters during September. Data were collected following protocols described in MRAG Americas, Inc. (1999), FC.1 Reef fish fishery observer program, and Gitschlag and Renaud (1994). Methodology closely followed already existing NMFS methods to assure data compatibility. Either one or two NMFS-trained observers were placed aboard all available headboat trips departing from each of the three ports.

All red snapper were measured to the nearest millimeter, total length, and the nearest 10 grams, whole weight. Catch per unit effort (CPUE) was calculated as

$$(\text{Fish caught} \cdot \text{Set hours}^{-1}) \cdot \text{Reels sampled}^{-1}$$

When snapper were brought on board, their condition was noted as live with normal appearance, stomach protruding, eyes protruding, combination of stomach and eyes protruding, or dead. Hooking location was recorded as the maxilla, gill, esophagus, or other. For discarded snapper, as the hook was removed, it was noted if the swim bladder had been punctured. After snapper were discarded, their short-term fate was observed as long as possible and recorded as live and swimming down below the surface, erratic swimming near the surface, floating at the surface, or dead.

Because there were often more reels on a headboat than could be sampled effectively by one or two observers, each boat was divided into sections as necessary. A trip-specific random number table was used to determine which boat section to sample during a set. Results represent all reels sampled. Reels were either manual (73% of all reels) or electric (Port Aransas only).

Results

Forty-eight trips were made aboard four recreational headboats from three Texas fishing ports (Galveston, Port Aransas, and Port Isabel) during August 1999. Six trips were made aboard one recreational headboat (Port Isabel) during September 1999 (Table 1). Data were collected during 32 d and 2 nights of observations. One hundred ninety-nine sets (170 in August and 29 in September) were sampled at the locations shown in Figure 1.

Water depth averaged 40.2 m (20.7 SD) and ranged from 13.4 to 95.4 m (Figure 2). Mean water depth was significantly different between ports in August ($F = 220.132$, $n = 169$, df = 2, $p < 0.0001$)

TABLE 1. Number of trips and sets sampled from Texas recreational headboats in August and September 1999 by fishing port.

	Total	Galveston	Port Aransas	Port Isabel (Aug)	Port Isabel (Sept)
Trips	54	20	13	15	6
Sets	199	74	50	46	29

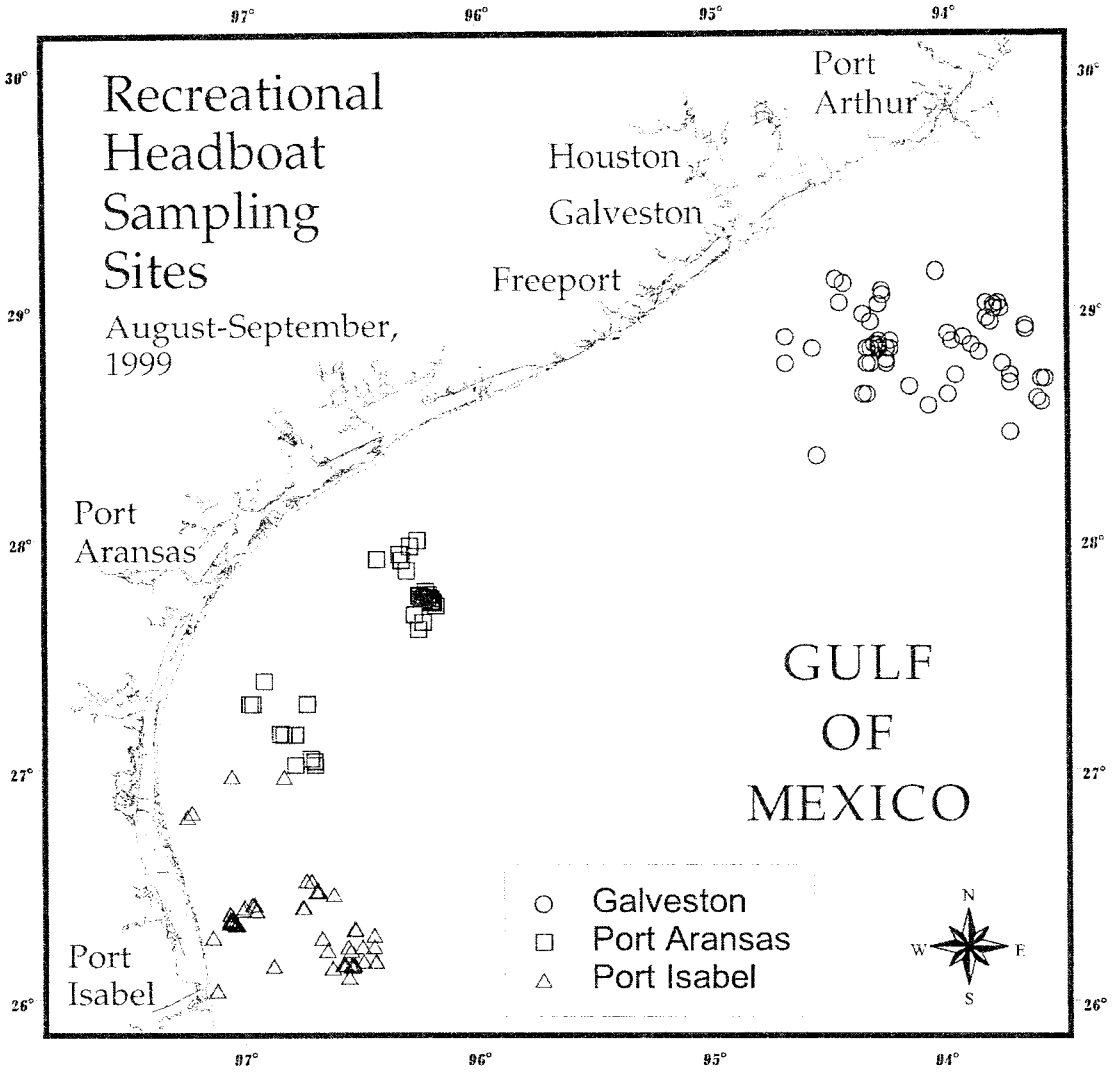

FIGURE 1. Location of Texas recreational headboat sets in August and September 1999.

with the greatest mean depth from Port Aransas (66.0 m, 14.7 SD). Fishing depth was shallowest in Galveston (mean 24.8 m, 6.3 SD), with intermediate August values from Port Isabel (mean 48.6 m, 11.9 SD). In September, the only samples collected were in state waters from Port Isabel (mean 21.5 m, 3.1 SD).

Number of reels sampled per set averaged 9.8 (2.5 SD), with a range of 1–22 reels (36.5% of all reels in use [29.7% SD]). Fishing time per set varied from 0.2 to 4 h with a mean of 0.9 h (0.6 SD). Sets took place over rock bottom (55.6%), mud (14.8%), and coral (1.0%), often adjacent to hydrocarbon production platforms and over submerged structures such as wrecks.

A total of 3,863 red snapper were caught on hook and line during the study period. Of these, 3,828 were measured and ranged from 105-mm to 908-mm (4–36-in) total length (TL) (Table 2). Mean total length was significantly different between ports in August ($F = 139.308$, $n = 2,925$, df = 2, $p < 0.0001$). Overall, snapper 350–375-mm (14–15-in) TL comprised the largest proportion (18.1%) of individuals, although Port Aransas had their largest proportion of snapper (22.8%) in the 375–400-mm (15–16-in) TL size (Table 2).

Red snapper less than 450-mm (18-in, federal minimum size at the time of this study) TL made up 93.4% of snapper caught. Those less than 400 mm

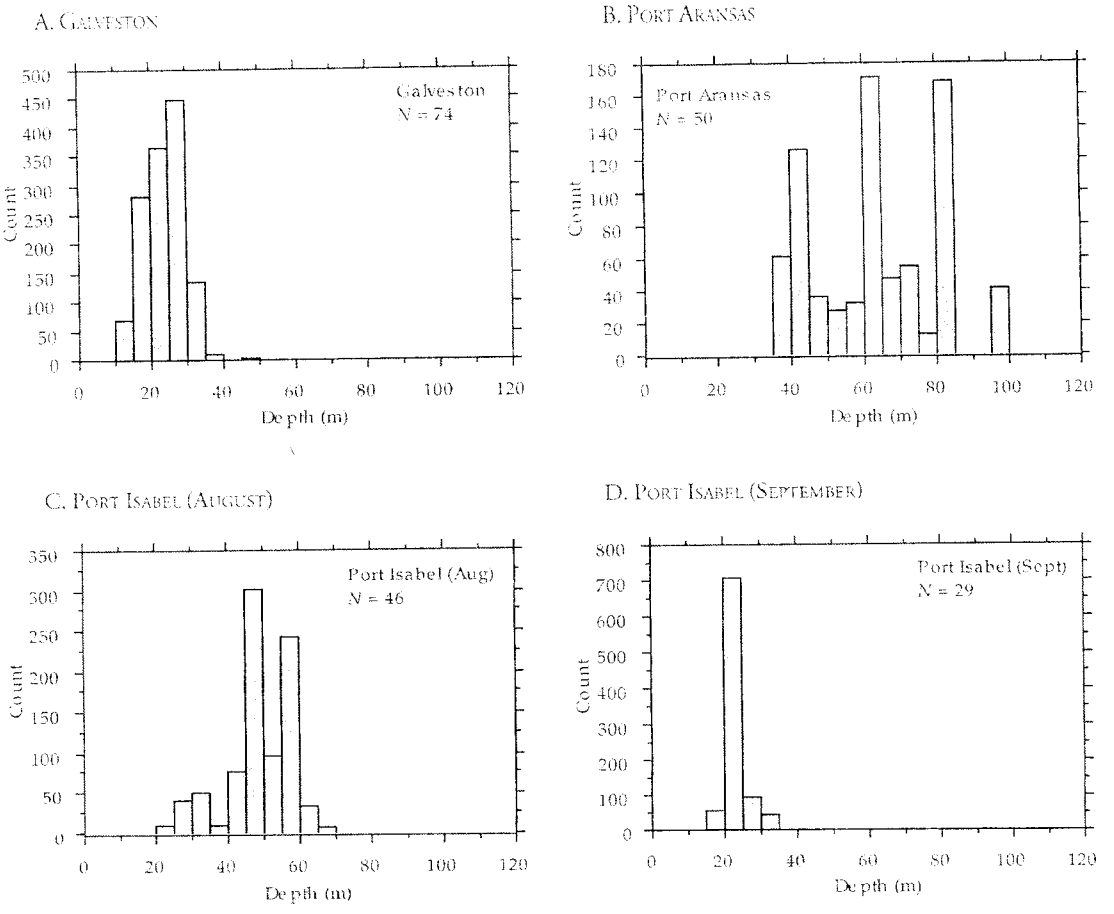

FIGURE 2. Fishing depth by port for recreational headboat sets in August and September 1999. A. Galveston; B. Port Aransas; C. Port Isabel (August); D. Port Isabel (September).

(16 in, current federal minimum size) made up 78.1% of snapper caught. Snapper less than 375 mm (15 in, current state minimum size) constituted 64.0% of fish collected (Table 2). Port Isabel had the greatest proportion of snapper larger than 425 mm (17+ inches) in August samples, although Port Aransas had the largest proportion of 375-mm to less than 425-mm (15-in to less than 17-in) snapper (Table 3). There was no significant statistical relationship between depth and total length of snapper caught in this survey for any port or all ports combined ($r^2 = 0.092$).

Hooking location was determined for 3,849 snapper: 91.8% were hooked in the maxilla, 6.2% in the esophagus, 0.8% in the gill, and 1.3% in some other area of the body. Condition when brought on board was determined for 3,844 snapper: 70.2% were normal in appearance, 26.1% had their stomach protruding from their mouths, 2.8% had protruding eyes, 0.6% had both eyes and stomach protruding, and 0.3% were brought on board dead. There were significant differences in mean depth between conditions ($F = 109.056$, $n = 3,840$, df = 4, $p < 0.0001$), although there was no clear trend evident (Figure 3; Table 4). Percent of snapper brought to the surface with stomach protrusion was variable with depth and port, possibly a reflection of variable fish retrieval rates (manual versus electric reels) by headboat fishers.

When snapper were discarded, 62.8% were released by removing the hook without puncturing the swim bladder. The swim bladder was punctured along with hook removal for 36.2% of released snapper. Discard fate was determined for 3,851 fish (12.9% of the catch was kept and landed). Of those that were discarded, 60.6% were released alive and swam down, 22.8% swam erratically, 15.2% floated, and 1.4%

TABLE 2. Size-frequency distribution (A. Total; B. Cumulative) of red snapper measured during Texas recreational headboat sets in August and September 1999.

A. Total

Total length (mm)		Total		Galveston		Port Aransas		Port Isabel, August		Port Isabel, September	
From (≥)	To (<)	Count	%	Count	%	Count	%	Count	%	Count	%
75	100	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
100	125	1	0.03	0	0.00	0	0.00	1	0.11	0	0.00
125	150	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
150	175	1	0.03	1	0.08	0	0.00	0	0.00	0	0.00
175	200	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
200	225	13	0.34	4	0.31	2	0.26	2	0.23	5	0.56
225	250	85	2.22	36	2.83	0	0.00	13	1.49	36	4.00
250	275	196	5.12	64	5.02	4	0.51	52	5.98	76	8.44
275	300	262	6.84	103	8.08	19	2.42	45	5.17	95	10.56
300	325	510	13.32	205	16.09	49	6.25	103	11.84	153	17.00
325	350	688	17.97	256	20.09	110	14.03	136	15.63	186	20.67
350	375	693	18.10	269	21.11	163	20.79	150	17.24	111	12.33
375	400	539	14.08	184	14.44	179	22.83	101	11.61	75	8.33
400	425	374	9.77	105	8.24	119	15.18	68	7.82	82	9.11
425	450	212	5.54	33	2.59	62	7.91	62	7.13	55	6.11
450	475	96	2.51	12	0.94	32	4.08	37	4.25	15	1.67
475	500	65	1.70	1	0.08	18	2.30	40	4.60	6	0.67
500	525	24	0.63	0	0.00	7	0.89	14	1.61	3	0.33
525	550	18	0.47	1	0.08	3	0.38	13	1.49	1	0.11
550	575	6	0.16	0	0.00	1	0.13	5	0.57	0	0.00
575	600	19	0.50	0	0.00	5	0.64	14	1.61	0	0.00
600	625	5	0.13	0	0.00	1	0.13	4	0.46	0	0.00
625	650	5	0.13	0	0.00	2	0.26	2	0.23	1	0.11
650	675	6	0.16	0	0.00	4	0.51	2	0.23	0	0.00
675	700	3	0.08	0	0.00	1	0.13	2	0.23	0	0.00
700	725	3	0.08	0	0.00	0	0.00	3	0.34	0	0.00
725	750	1	0.03	0	0.00	1	0.13	0	0.00	0	0.00
750	775	1	0.03	0	0.00	0	0.00	1	0.11	0	0.00
775	800	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
800	825	1	0.03	0	0.00	1	0.13	0	0.00	0	0.00
825	850	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
850	875	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
875	900	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
900	925	1	0.03	0	0.00	1	0.13	0	0.00	0	0.00
925	950	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	Total	3,828	100.00	1,274	100.00	784	100.00	870	100.00	900	100.00

TABLE 2. Continued.

B. Cummulative

Total length (mm)		Total		Galveston		Port Aransas		Port Isabel, August		Port Isabel, September	
From (≥)	To (<)	Count	%	Count	%	Count	%	Count	%	Count	%
75	100	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
100	125	1	0.03	0	0.00	0	0.00	1	0.11	0	0.00
125	150	1	0.03	0	0.00	0	0.00	1	0.11	0	0.00
150	175	2	0.05	1	0.08	0	0.00	1	0.11	0	0.00
175	200	2	0.05	1	0.08	0	0.00	1	0.11	0	0.00
200	225	15	0.39	5	0.39	2	0.26	3	0.34	5	0.56
225	250	100	2.61	41	3.22	2	0.26	16	1.84	41	4.56
250	275	296	7.73	105	8.24	6	0.77	68	7.82	117	13.00
275	300	558	14.58	208	16.33	25	3.19	113	12.99	212	23.56
300	325	1,068	27.90	413	32.42	74	9.44	216	24.83	365	40.56
325	350	1,756	45.87	669	52.51	184	23.47	352	40.46	551	61.22
350	375	2,449	63.98	938	73.63	347	44.26	502	57.70	662	73.56
375	400	2,988	78.06	1122	88.07	526	67.09	603	69.31	737	81.89
400	425	3,362	87.83	1227	96.31	645	82.27	671	77.13	819	91.00
425	450	3,574	93.36	1260	98.90	707	90.18	733	84.25	874	97.11
450	475	3,670	95.87	1272	99.84	739	94.26	770	88.51	889	98.78
475	500	3,735	97.57	1273	99.92	757	96.56	810	93.10	895	99.44
500	525	3,759	98.20	1273	99.92	764	97.45	824	94.71	898	99.78
525	550	3,777	98.67	1274	100.00	767	97.83	837	96.21	899	99.89
550	575	3,783	98.82	1274	100.00	768	97.96	842	96.78	899	99.89
575	600	3,802	99.32	1274	100.00	773	98.60	856	98.39	899	99.89
600	625	3,807	99.45	1274	100.00	774	98.72	860	98.85	899	99.89
625	650	3,812	99.58	1274	100.00	776	98.98	862	99.08	900	100.00
650	675	3,818	99.74	1274	100.00	780	99.49	864	99.31	900	100.00
675	700	3,821	99.82	1274	100.00	781	99.62	866	99.54	900	100.00
700	725	3,824	99.90	1274	100.00	781	99.62	869	99.89	900	100.00
725	750	3,825	99.92	1274	100.00	782	99.74	869	99.89	900	100.00
750	775	3,826	99.95	1274	100.00	782	99.74	870	100.00	900	100.00
775	800	3,826	99.95	1274	100.00	782	99.74	870	100.00	900	100.00
800	825	3,827	99.97	1274	100.00	783	99.87	870	100.00	900	100.00
825	850	3,827	99.97	1274	100.00	783	99.87	870	100.00	900	100.00
850	875	3,827	99.97	1274	100.00	783	99.87	870	100.00	900	100.00
875	900	3,827	99.97	1274	100.00	783	99.87	870	100.00	900	100.00
900	925	3,828	100.00	1274	100.00	784	100.00	870	100.00	900	100.00
925	950	3,828	100.00	1274	100.00	784	100.00	870	100.00	900	100.00
	Total	3,828	100.00	1274	100.00	784	100.00	870	100.00	900	100.00

TABLE 5. Percentage of red snapper measured greater than equal to 450-, 425-, 400-, and 375-mm (18-, 17-, 16-, and 15-in) total length caught during Texas recreational headboat sets in August and September 1999.

Total length (mm)	Summary	Galveston %	Port Aransas %	Port Isabel (Aug) %	Port Isabel (Sept) %
450+	6.6	1.1	9.8	15.8	2.9
425+	12.2	3.7	17.7	22.9	9.0
400+	21.9	11.9	32.9	30.7	18.1
375+	36.0	26.4	55.7	42.3	26.4
N	3,828	1,274	784	870	900

were discarded dead (Figure 4). There were significant differences in mean depth between discard fates (F = 66.594, n = 3,353, df = 3, p < 0.0001). Fish released either dead or floating were caught at greater depths than fish that swam down or swam erratically on release (Figure 5; Table 5).

There were no significant differences in mean total length between discard fates, excluding those kept and landed (F = 1.361, n = 3,324, df = 3, p = 0.2527). The only clear trend was that all discard fates had similar total length distributions except for fish greater than 450 mm, which were legally kept (Table 6; Figure 6).

Snapper landings from Port Isabel in September reflected the smaller minimum size requirement for snapper caught in Texas territorial waters (380 mm, 15 in) rather than the 450-mm (18-in) federal minimum size. As a result, Port Isabel kept a larger proportion of fish than other locations (Table 6).

Overall, 87.1% of the red snapper catch was discarded (Table 7). By weight, discarded snapper made up 75.2% of the catch (Table 8). Galveston had the largest discard:landing ratio (211:1), the smallest mean weight per fish sampled (0.7 kg, 0.3 SD), and the smallest mean fish total length (343 mm, 47.3 SD; 13.5 in, 1.9 SD; Table 9). Port Aransas had the lowest discard:landing ratio (5.2:1) along with the largest weight per fish (0.9 kg, 0.7 SD) and total length per fish (387 mm, 62.7 SD; 15.3 in, 2.5 SD).

Mean CPUE for red snapper was 2.8 fish per angler-hour (2.19 SD). There were no significant differences in CPUE between ports (p > 0.0258).

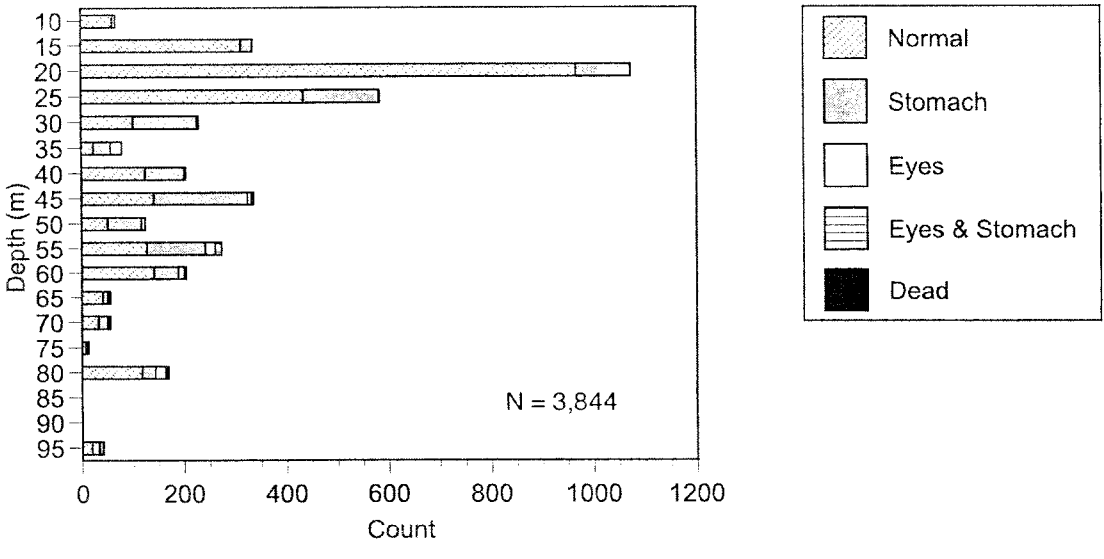

FIGURE 3. Depth and condition (when brought on board) of red snapper caught and measured during Texas recreational headboat sets in August and September.

TABLE 4. Mean depth (m) and frequency for condition (when brought on board) of red snapper measured during Texas recreational headboat sets in August and September 1999.

	Mean depth (m) [% of catch]				
Condition	Summary (n = 3,844)	Galveston (n = 1,306)	Port Aransas (n = 781)	Port Isabel Aug (n = 872)	Port Isabel Sept (n = 901)
Normal	33.8 [70.2]	22.4 [71.1]	64.0 [64.0]	47.0 [46.4]	22.4 [97.1]
Stomach protruding	43.1 [26.1]	26.9 [28.5]	59.8 [25.3]	50.5 [47.5]	29.1 [2.8]
Eyes protruding	61.8 [2.8]	–	65.7 [9.3]	54.6 [3.9]	25.6 [0.1]
Eyes and stomach	58.3 [0.6]	34.7 [0.1]	71.3 [0.6]	56.0 [2.1]	–
Dead	57.3 [0.3]	27.4 [0.3]	75.6 [0.8]	67.6 [0.1]	–

Discussion

Previous discard mortality studies have been carried out in waters shallower than those commonly fished by Texas headboats (up to 95 m). Render and Wilson (1994) carried out their study on a Louisiana gas production platform in 21 m of water. Surface release studies by Gitschlag and Renaud (1994) used fish collected at 21–40-m depths. Although these depths are representative of the eastern Texas coast, they are less representative of central and southern coastal snapper fishing areas presented in this study.

Snapper collected in this study represent a greater size range than those of most previous work, reflecting size distribution differences among locations along the Texas Gulf coast. In the surface release study by Gitschlag and Renaud (1994), southeast of Galveston, Texas, 91% of their snapper were less than 300-mm FL (324-mm TL; Parrack 1986). For their cage studies, tested snapper were less than or equal to 430-mm FL (463-mm TL), with 35% of their snapper less than 300-mm FL (324-mm TL), similar to the present study where 32.4% of Galveston snapper were under 325-mm TL. Mortality tests by Render and Wil-

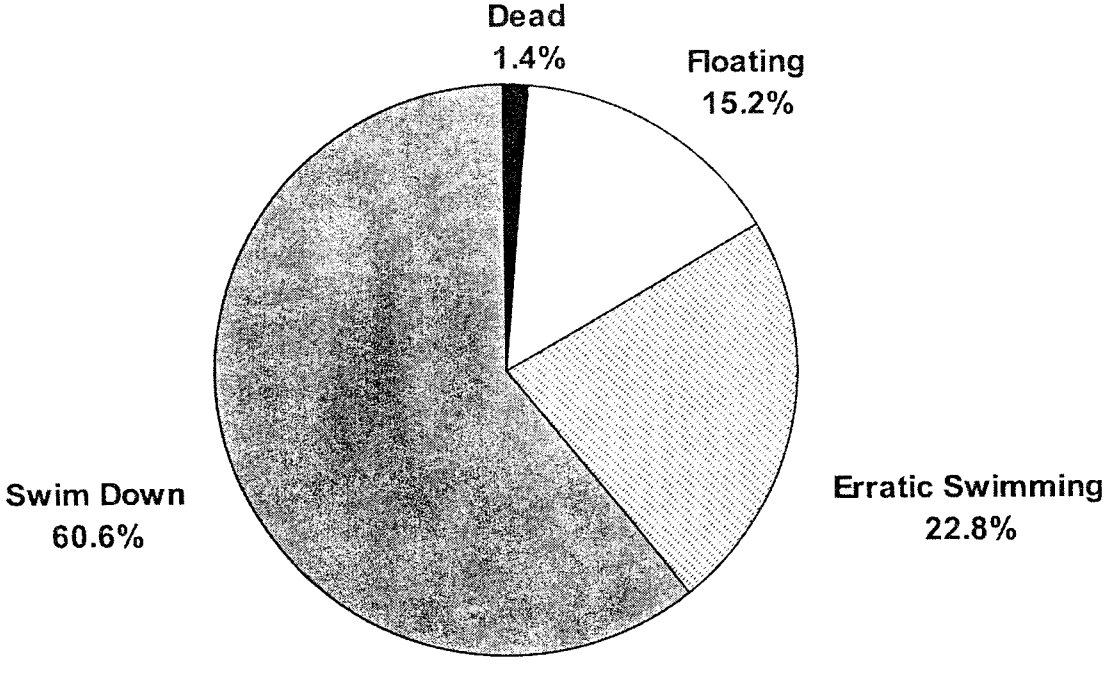

FIGURE 4. Fate of red snapper caught and measured during Texas recreational headboat sets in August and September 1999.

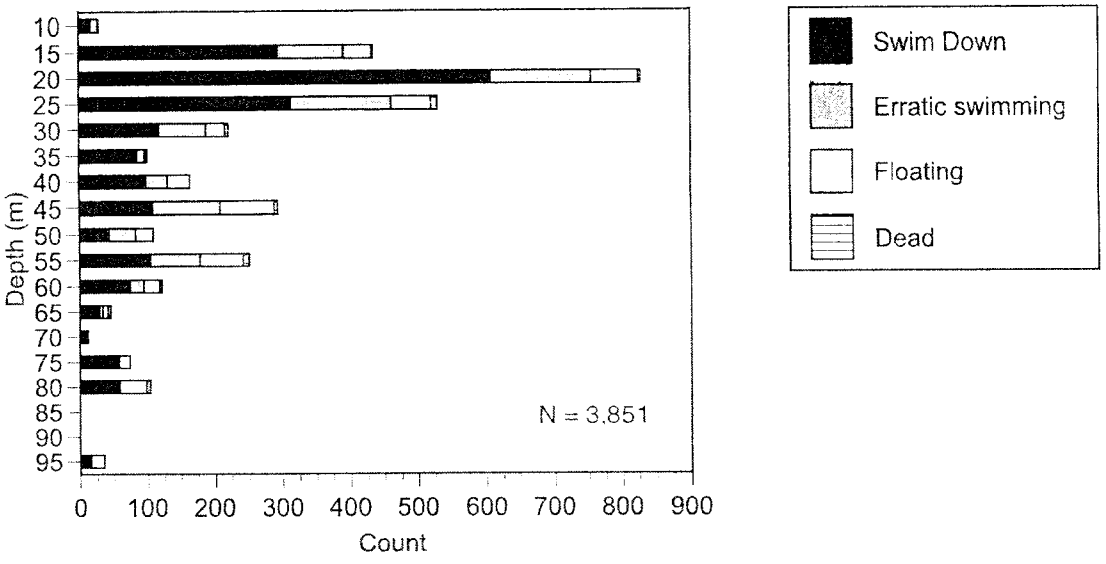

FIGURE 5. Depth and fate of red snapper caught and measured during Texas recreational headboat sets in August and September.

son (1996) were conducted south of Cameron, Louisiana on fish less than 360-mm FL (388-mm TL). In the present study, Port Aransas and Port Isabel (August) snapper greater than or equal to 375+ mm TL accounted for 55.7% and 42.3% of the catch, respectively.

Based on a cage study of snapper collected during three single day headboat trips, Gitschlag and Renaud (1994) found that 33% of snapper were brought on board with everted stomachs, with 51% showing some sign of capture-related stress. These results are similar to results presented from the present study. For their surface release study, stomach protrusion from the mouth was noted in 1% of fish collected at 21–24-m depth, 56% at 27–30-m, and 59% at 37–40-m depths. They also found that higher proportions of snapper swam down (99% at 21–24 m, 90% at 27–30 m, and 56% at 37–40 m) than reported for the present study. Researchers, rather than headboat patrons, caught snapper in their study, and onboard handling procedures and fish retrieval rates (manual versus electric reels) may account for differences in swim down proportion on release. Render and Wilson (1996) noted a general trend of increasing mortality due to physiological stress of unvented snapper collected at depths up to 56 m. As in the present study where there was no significant difference in discard fate with size, Gitschlag and Renaud (1994) found that survival of caged fish was also unrelated to size.

It is likely that large proportions of the snapper that were brought on board showing signs of physiological stress, or floated or swam erratically on release, died or were subject to predation soon after release. In

TABLE 5. Mean depth (m) and frequency for discard fate of red snapper measured during Texas recreational headboat sets in August and September 1999.

	Mean depth (m) [% of catch]				
Discard fate	Summary (n = 3,353)	Galveston (n = 1,298)	Port Aransas (n = 655)	Port Isabel Aug (n = 731)	Port Isabel Sept (n = 669)
Swim down	34.3 [60.6]	23.3 [57.9]	59.0 [72.8]	47.2 [33.9]	22.1 [83.0]
Erratic swimming	34.8 [22.8]	24.1 [30.0]	60.8 [5.2]	49.4 [37.8]	23.0 [9.7]
Floating	46.3 [15.2]	24.4 [10.6]	72.4 [20.3]	49.9 [26.0]	23.1 [7.3]
Dead	47.9 [1.4]	26.1 [1.5]	73.0 [1.7]	57.3 [2.3]	–

TABLE 6. Mean total length (mm) and frequency for discard fate of red snapper measured during Texas recreational headboat sets in August and September 1999.

	Mean total length (mm) [% of catch]				
Discard fate	Summary (n = 3,828)	Galveston (n = 1,274)	Port Aransas (n = 784)	Port Isabel Aug (n = 870)	Port Isabel Sept (n = 900)
Swim down	343 [52.6]	342 [57.7]	374 [61.1]	351 [28.4]	316 [61.6]
Erratic swimming	344 [19.8]	345 [30.0]	366 [4.5]	349 [31.7]	305 [7.2]
Floating	348 [13.2]	339 [10.4]	364 [17.0]	352 [21.9]	314 [5.4]
Dead	339 [1.2]	330 [1.5]	350 [1.4]	342 [2.0]	–
Kept	459 [12.9]	478 [0.5]	468 [16.1]	518 [15.3]	419 [25.4]

addition, some of the snapper that swam down on release probably died later as a result of gas bladder rupture or other physiological damage, as summarized in Render and Wilson (1996). It is beyond the scope of this study to draw this conclusion, as no specific data were available on the long-term fate of the released snapper. In addition, survival rates from forced submergence cage studies must be interpreted carefully when compared to rates derived from surface release studies. Cage studies eliminate predation risk and, by forcing submergence, may enhance the survival of fish that would have otherwise remained at the surface either floating or swimming erratically.

CPUE from the present study was higher than all values reported in Schirripa and Legault (1999) for the Gulf of Mexico recreational fishery. Their CPUE measure and Texas recreational harvest estimates are derived exclusively from the Marine Recreational Fishery Statistics Survey (MRFSS) and Texas Parks and Wildlife (TPWD) Harvest Survey data. However, headboat sampling was discontinued by the MRFSS in 1985, and TPWD does not sample headboat landings. The Texas coast and the greater depths (up to 95 m) where recreational snapper fishing occurs there are currently underrepresented in management data collection efforts. The NMFS Headboat Survey, begun in 1985, includes Gulf of Mexico ports and estimates headboat landings but not discards. Currently, there is no direct measure of discards included in red snapper stock assessment.

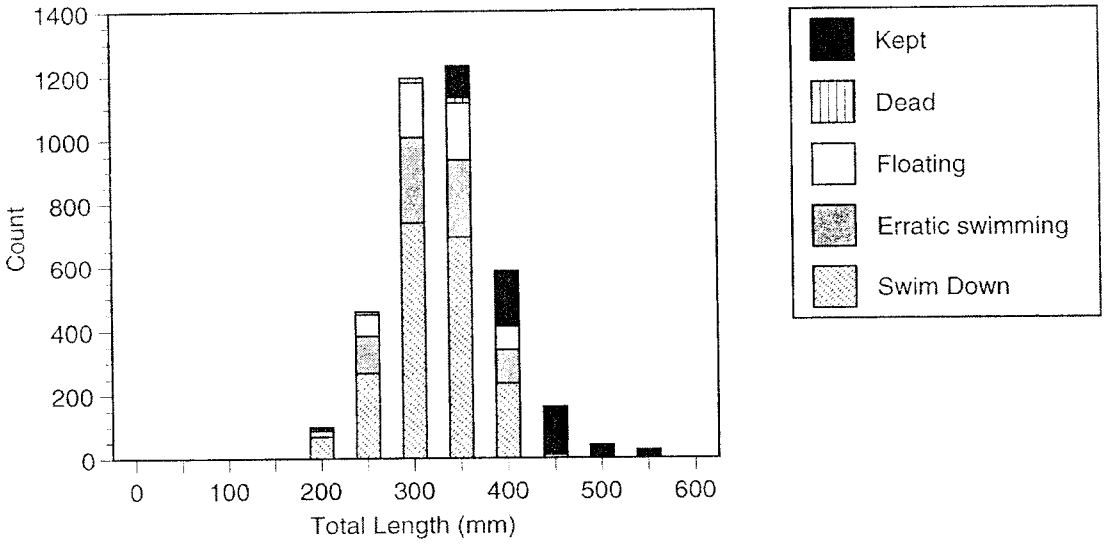

FIGURE 6. Size and fate of red snapper caught and measured during Texas recreational headboat sets in August and September.

TABLE 7. Discards and landings (numbers) of red snapper measured from Texas recreational headboat sets in August and September 1999 by fishing port.

	Summary	Galveston	Port Aransas	Port Isabel (Aug)	Port Isabel (Sept)
Discards	3,324	1,268	658	730	668
Landings	494	6	126	133	229
Total	3,818	1,274	784	863	897
D:L	6.7:1	211.3:1	5.2:1	5.5:1	2.9:1

TABLE 8. Discards and landings (whole weight, kg) of red snapper measured from Texas recreational headboat sets in August and September 1999 by fishing port. Number in parentheses is the mean weight per fish sampled.

	Summary	Galveston	Port Aransas	Port Isabel (Aug)	Port Isabel (Sept)
Discards	2,259 (0.68)	879 (0.69)	525 (0.80)	511 (0.69)	344 (0.51)
Landings	746 (1.51)	10 (1.69)	207 (1.64)	275 (2.07)	254 (1.11)
Total	3,005 (0.79)	889 (0.70)	732 (0.93)	786 (0.90)	598 (0.67)

TABLE 9. Discards and landings (mean total length, mm) of red snapper measured from Texas recreational headboat sets in August and September 1999 by fishing port. Number in parentheses is the standard deviation of total length.

	Summary	Galveston	Port Aransas	Port Isabel (Aug)	Port Isabel (Sept)
Discards	344 (48.4)	342 (46.5)	371 (39.6)	351 (52.4)	314.6 (37.1)
Landings	459 (74.2)	478 (23.8)	468 (91.9)	518 (66.6)	419 (31.6)
Total	359 (65.1)	343 (47.3)	387 (62.7)	376 (81.5)	341 (57.9)

This study is the first time that observers have been placed on board recreational headboats to directly document the quantity and characteristics of red snapper discards and landings on the Texas coast. The proportion of discards in relation to landings was much larger than expected (87% of the catch; 75% by weight). Total discard estimates per port are conservative because of the need to subdivide the boat when the number of fishers was too large for two observers to manage efficiently.

Texas accounts for 85% of Gulf of Mexico headboat red snapper landings and 25% of gulfwide recreational red snapper landings (Schirripa and Legault 1999). If current minimum size limits had been in effect during the time of this study (400-mm [16-in] minimum size in federal and 375-mm [15-in] minimum size in Texas territorial waters), the discard rate would still have been 78% of the catch in federal waters and 64% of the catch in Texas territorial waters. These figures are much higher than discards reported from a commercial fishery observer program in 1995 that targeted several red snapper trips on handline vessels located off of Louisiana and east Texas. That study took place at similar depths to the present study (mean 40 m, range 33–62 m) and discards constituted 41% of the catch, 19% by weight at 375-mm (15-in) minimum retention size (Schirripa and Legault 1999). Comparable amounts of red snapper were discarded dead (1.6%), and most discards were said to have either stomachs or eyes protruding.

If up to 38% of recreational headboat discards (erratic swimming and floating, this study) are at risk of short-term mortality, in addition to a currently unknown number of snapper that swim down and may be subject to delayed mortality, a very significant number of snapper are currently underrepresented in Texas and Gulf of Mexico recreational snapper stock assessments. Although limited in duration, this study demonstrates the importance of discards to the Texas red snapper fishery as well as to fair geographic representation of all areas for red snapper stock assessment in the Gulf of Mexico. The proportion of discards is so large that accurate discard estimates must be taken

into account to achieve credible red snapper stock assessment. It would be beneficial to continue, optimize, and expand this type of study to cover the entire red snapper season in all areas of the Gulf of Mexico where headboat sampling occurs.

Acknowledgments

I thank Russell O'Brien for his work in coordinating fishery observers in the field, as well as the fishery observers, themselves. Headboat captains, crews, and recreational fishers in Galveston, Port Aransas, and Port Isabel were essential and voluntary participants in the study, providing willing access to fish brought on board. Paul Choucair prepared the sampling site map. Joan Holt provided valuable suggestions at early project stages. The University of Texas Marine Science Institute provided institutional support. This study was made possible by the financial support of the Gulf & South Atlantic Fisheries Foundation, Inc., Tampa, Florida.

References

Gitschlag, G. R., and M. L. Renaud. 1994. Field experiments on survival rates of caged and released red snapper. North American Journal of Fisheries Management 14:131–136.

GMFMC (Gulf of Mexico Fishery Management Council). 1981. Environmental impact statement and fishery management plan for the reef fish resources of the Gulf of Mexico. Florida Sea Grant College Gulf of Mexico Fishery Management Council, Tampa, Florida.

MRAG Americas, Inc. 1997. Consolidated report on the peer review of red snapper (*Lutjanus campechanus*) research and management in the Gulf of Mexico. The Office of Science and Technology, National Marine Fisheries Service, Tampa, Florida.

MRAG Americas, Inc. 1999. NMFS response to the 1997 peer review of red snapper (*Lutjanus campechanus*) research and management in the Gulf of Mexico. National Marine Fisheries Service, St. Petersburg, Florida.

Parrack, N. C. 1986. Review and update of Gulf of Mexico red snapper biometrics: 1. Length-weight relations, 2. Length-length conversions. NMFS, SEFC, Miami Laboratory, Miami.

Render, J. H., and C. A. Wilson. 1994. Hook-and-line mortality of caught and released red snapper around oil and gas platform structural habitat. Bulletin of Marine Science 55: 1106–1111, Manila, Phillipines.

Render, J. H., and C. A. Wilson. 1996. The effect of gas bladder deflation on mortality of hook-and-line caught and released red snappers: implications for management. Pages 244–253 *in* F. Arreguin-Sanchez, J. L. Munro, M. C. Balgo, and D. Pauly, editors. Biology, fisheries, and culture of tropical groupers and snappers. ICLARM Conference Proceedings 48.

Schirripa, M. J., and C. M. Legault. 1999. Status of the red snapper in U.S. waters of the Gulf of Mexico: updated through 1998. SE Fisheries Science Center, Sustainable Fisheries Division, Miami.