CALCULATED RED GROUPER DISCARDS BY VESSELS WITH FEDERAL PERMITS IN THE GULF OF MEXICO

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Introduction

In August 2001, the Southeast Fisheries Science Center (SEFSC) initiated a program to collect information on the numbers of fish that are being discarded in the Gulf of Mexico and South Atlantic fisheries. To collect this information, the SEFSC developed a form that supplements the existing vessel logbooks that are currently mandatory for these fisheries (Poffenberger and McCarthy, 2004).

A 20% sample of the vessels with a Gulf of Mexico, South Atlantic snapper-grouper, king mackerel, Spanish mackerel or shark permit were selected to report. The random selection process is done without replacement, i.e. when a vessel is selected, the same vessel is not selected in subsequent years. To assure that the sample is representative of the total universe of vessels with these Federal permits, the universe of permitted vessels is stratified and a random sample is selected, without replacement, from each stratum. During the first year (8/1/2002 - 7/31/2003), three strata were used. One of the strata was geographical location where the vessel fished during 2000. There are two categories in this stratum - the Gulf of Mexico (Florida Keys to the Texas-Mexican border) and the South Atlantic (which extends from the North Carolina - Virginia border to the Florida Keys). The second stratum was based on the type of gear. There are six categories in this stratum - handline, longline, trolling, trap, diving (speargun and powerhead), and gill nets. The third stratum is based on the fishing activity of the vessels during calendar year 2000 which were divided into two groups: vessels that made between 1 and 10 trips and vessels that made more than 10 trips. In all, there are 20 strata; however, there were too few boats that used gill nets in the Gulf of Mexico, so all of the boats that used gill nets in the Gulf were combined into a single stratum. Consequently, random selections were made in 19 strata.

Inconsistency between the vessel's fishing activity during 2000 and the 8/1/2001 - 7/31/2002 reporting period resulted in the fishing activity strata being dropped from the sample selection for the second year of the survey beginning in 8/1/2002. As a result of this change the data were categorized by only 10 strata after the first year of the survey (Poffenberger and McCarthy, 2004).

The selected fishermen were instructed to complete a supplemental discard form for every fishing trip that they made. If they did not have any discards for the trip, they were instructed to complete a discard form and write "no discards" on the form. If they did not fish during a calendar month and submitted a no-fishing form, then they did not have to submit a discard form.

In addition to the numbers of discards, fishermen are asked to record their best estimate of the condition of the fish when they were released. The fishermen are given 6 options for the condition of released fish. These options are: all animals are dead, majority of the animals are dead, all animals are alive when released, majority of animals are alive, the fish are kept but not sold, and the condition of the animals is unknown. The fishermen are also asked to specify a reason why the fish (animals) were discarded. The choices are that the fish are discarded because of regulations or because the fish are unmarketable or unwanted.

Methods

The objective of this analysis was to calculate the numbers of red grouper discarded by vessels that fish commercially for species other than shrimp or other shellfish. Fishing activity for these analyses did not include the surface longline vessels that typically fish for swordfish, pelagic sharks, tunas, and other highly migratory species. In addition, due to the limited geographic range of the red grouper fishery, the analysis was limited to include only those data reported for NOAA shrimp grids (areas) 1-11 for handline data, areas 1-10 for bottom longline data, and areas 1-8 for trap data (Figure 1).

The data set for calculating red grouper discards included trips from vessels that reported discards between August 1, 2001 and December 31, 2005 in the eastern Gulf of Mexico. During this period, discard information was submitted for 4,562 handline trips in areas 1-11 (Table 1). Of those trips, red grouper discards were reported on 2,459 trips. There were 39,476 handline trips reported to the coastal logbook program with 21,800 landing red grouper (Table 1). Longline logbook reports during the same period in areas 1-10 contained data for 7,611 trips with 5,447 trips reporting red grouper (Table 1). There were 580 longline trips reporting discards with 220 of those trips reporting red grouper discards. A total of 1,863 trap trips reported fishing in areas 1-8 during the August 2001-December 2005 period (Table 1). Red grouper were reported in the landings of 1,624 of those trap trips. Discards of red grouper were reported on 60 of 201 trap trips (Table 1).

Red grouper trips were identified from the coastal logbook dataset using the Stephens and MacCall (2004) approach, where trips are subset based upon the reported species composition of the landings. This method is intended to identify trips that fished in locations containing red grouper habitat and, therefore, had the potential of catching red grouper. Once red grouper trips were identified, the data were filtered by eliminating trips with reported data for days at sea, longline length, number of crew, number of lines fished (or longline sets or traps fished), number of hooks per line, or hours fished with values outside the 99.5 percentile of the data as a whole. For example, trips with handline vessels that reported more than 35 hooks per line were eliminated from the dataset. Red grouper trips, identified from the coastal logbook data, were matched to discard data from the same trips (logbook landings data and discard logbook data are separate data sets). Those trips were considered as targeting red grouper. All other trips from the areas and time period of interest were considered as non-red grouper trips (not in the red grouper fishery).

Six variables were considered as possible influences on the reported discards of red grouper in the Gulf of Mexico. Only data for vessels fishing handlines (handline and electric reel gear), longline, and trap were considered. Examination of factors affecting discards of red by vessels fishing other gear types was not possible due to insufficient sample size. Factors examined for handline data were:

Factor	Levels	Value
YEAR	4	2001 – 2004
DAYS	4	1 = 1 day at sea, 2 = 2-3 days at sea, 4=4-6 days at sea, 7=7 or more days at sea
QUARTER	4	1=Jan-Mar, 2=Apr-Jun, 3=Jul-Sep, 4=Oct-Dec
CREW	3	1, 2, or 3 or more crew members
FISHERY	2	0=trips not identified as in the fishery, 1=trips identified as targeting red grouper
AREA	4	1=areas 1-5, 6=area 6, 7=area 7, 8=areas 8-11 (Gulf of Mexico shrimp grids)

For the analysis of longline data, the factors examined with handline data were also considered. Area and crew categories differed, however. Area was defined as 1-4, 5, 6, and 7-10 and crew was categorized as 1-2, 3, 4 or more crew members. In addition, the length of longline was examined as a factor potentially affecting CPUE of longline trips. Longline length was categorized as 5 or fewer miles, 5-10 miles, and greater than 10 miles. Due to small sample size, the only factors considered in the trap discard data analysis were Fishery and Period, where Period=1 was defined as Quarters 1 and 2 and Period=2 was defined as Quarters 3 and 4.

Separate generalized linear models (GLM) analyses of the proportion of successful trips (trips that discarded red grouper) for each gear type were conducted. Parameterization of each model was accomplished using a GLM procedure (GENMOD; Version 8.02 of the SAS System for Windows © 2000. SAS Institute Inc., Cary, NC, USA). In order to properly calculate red grouper discard rates, potential red grouper trips (as identified by the Stephens and MacCall method) that did not report red grouper discards were included in the analyses. Lognormal GLMs model only successful trips, therefore, in order to include trips with no reported red grouper discards, a constant (10% of the mean red grouper CPUE) was added to the red grouper CPUE of each trip. Those data were then used in the GLM analyses.

For each GLM procedure of catch rates on successful trips, a type-3 model assuming lognormal error distribution was employed. The linking function selected was "normal", and the response variable was ln(CPUE). The response variable was calculated as: ln(CPUE) = ln(number of red grouper discarded/hook hours) for handline data. For longline data the response variable was calculated as ln(CPUE) =ln(number of red grouper discarded/number of hooks and for trap data ln(CPUE)=ln(number of red grouper discarded/traps fished) was calculated as the response variable. All 2-way interactions among significant main effects were examined.

A stepwise approach was used to quantify the relative importance of the factors. First a null GLM model was fit. These results reflect the distribution of the nominal data. Next, each potential factor was added to the null model sequentially and the resulting reduction in deviance per degree of freedom was examined. The factor that caused the greatest reduction in deviance per degree of freedom was added to the base model if the factor was significant based upon a Chi-Square test ($p<0.05$), and the reduction in deviance per degree of freedom was $\geq 1\%$. This model then became the base model, and the process was repeated, adding factors and interactions individually until no factor or interaction met the criteria for incorporation into the final model. Higher order interaction terms were not examined.

Once the significant factors were identified, the lsmeans (corrected for log transform bias and with the constant removed) produced from the GLM constructed on the final model were used to calculate red grouper discards. Significant factors identified in the GLM procedure were used to stratify the coastal logbook trips. For example, area and fishery were significant factors affecting handline CPUE, all handline trips in the coastal logbook dataset were stratified by area and fishery (targeting or not targeting red grouper). Total effort of trips in each stratum was multiplied by the appropriate lsmean of red grouper discards to calculate total red grouper discards for each gear type.

Results and Discussion

Yearly totals of trips reported to the coastal logbook program are included in Table 2 for handline trips in areas 1-11 from 2001-2005 (data for 2001 includes trips with landing dates beginning in August, the inception of the discard logbook program). Also included are the number of discard trips, red grouper landings in pounds whole weight reported to the logbook program, and number of red grouper discards reported to the discard logbook program from handline trips. Total logbook trips, discard trips, red grouper landings, and red grouper discards reported by vessels fishing longlines are provided for 2001-2005 in Table 3. Total trips, discard trips, red grouper landings, and number of red grouper discards from trap trips are listed in Table 4.

The species targeted (trips identified as red grouper trips versus other trips) and Area fished had significant effects on red grouper discard rates. The final models for the lognormal on CPUE of successful trips were:

Handline	**LN(CPUE) = AREA + FISHERY**
Longline	**LN(CPUE) = FISHERY + AREA**
Trap	**LN(CPUE) = FISHERY**

No two-way interaction terms were significant for any of the GLM procedures.

The mean number of discards per hook-hour fished by handline vessels reporting discards is presented in Table 5 by area and fishery (targeting red grouper and all other handline trips) strata. Discard estimates for some individual trips appeared to be erroneous, e.g. handline trips with more than 400 discarded red grouper. Trips with discards exceeding those calculated for the 95th percentile were excluded from calculation of total discards. Year was not a significant factor, therefore, handline trips were calculated for the period 1990-2005 (the time series of the coastal logbook data) were included in these calculations. The total effort in hook-hours of handline vessels and the calculated discards are also provided in Table 5. Calculated yearly handline red grouper discards and total handline hook-hours fished are provided in Table 6.

Table 7 contains mean number of discards per hook fished by longline vessels reporting discards by area and fishery. The mean number of discards calculated by longline hooks (Table 7) and were similar to the red grouper discards per hook calculated from the NMFS bottom longline survey (0.0037367 fish per hook). Trips with red grouper discards greater than the 95th percentile of calculated discards were excluded from the total discard calculations. Total longline effort in each stratum in hooks fished and the total calculated number of red grouper discards is also provided in Table 7. Yearly discards, calculated for longline vessels, and total longline effort in number of hooks fished are provided in Table 8.

Calculated trap discards are presented in Tables 9 and 10. Again, trips with red grouper discards greater than the 95th percentile of calculated discards were excluded from the total discard calculations. The mean number of discards per trap fished and the total effort reported from each Fishery group (trap trips targeting red grouper and other trap trips) are provided in Table 9. Yearly total traps fished and calculated trap discards are included in Table 10.

Calculated red grouper discards were highest for handline trips where 5,114,537 discards were calculated for the period 1990-2005 in areas in areas 1-11. The highest number of discards was calculated for vessels targeting species other than red grouper in areas 8-11, however in all other areas discards were highest for vessels targeting red grouper. Calculation of yearly discards for 1990-1992 required using an expansion factor of five because only a 20% sample of commercial vessels in Florida were required to report to the coastal logbook program during those years. The highest number of discards was calculated for 1999 and calculated discards declined steadily from 2001-2005. Calculated longline discards totaled 974,476 for the period in areas 1-10. Longline trips targeting red grouper had much higher calculated discards than did other longline trips. Calculated discards were relatively constant over all years except for the 1993, 1995, and 2005 calculations that were lower than the discards calculated for other years. Discard calculations for 1990-1992 used an expansion factor of five as was done for the handline calculations. Many fewer discards were calculated for trap trips than for the other gears. Most red grouper discards from traps were from trips that targeted red grouper. The highest number of calculated discards was for 1993. Calculated discards have decreased each year since 2002.

On handline trips reporting to the logbook discard program, more than 90% of all red grouper discards were reported as “all alive” or “majority alive” when released (Table 11). Mortality estimates of 0.9% (all dead when discarded), 6.1% (majority dead), and 0.9% (kept but not sold) were also reported. The survival of a further 1.8% of discards was reported as unknown or was not reported. The reason reported for discarding red grouper was overwhelmingly “discarded due to regulations” (98%, Table 11).

Discards from longline trips were reported as “all alive” or “majority alive” for more than 83% of discarded red grouper (Table 12). Approximately 12% of red grouper were reported as “all dead” or “majority dead” when discarded. More than 99% of red grouper discarded on longline trips were reportedly discarded due to regulations (Table 12).

Over 98% of red grouper discarded from trap trips were reported to have been “all alive” or “majority alive” when discarded (Table 13). The condition of the remaining 1.7% of discarded red grouper was reported as “unknown”. All trap discarded red grouper were reported as “due to regulations”.

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Literature Cited

Poffenberger, J. and K. McCarthy. 2004. Estimates of red snapper discards by vessels with Federal permits in the Gulf of Mexico. SEDAR 7-DW-22.

Table 1. Number of Gulf of Mexico trips reported to the coastal logbook program by type of gear fished, 8/1/01-12/31/05. *Handline includes trips made by handline and electric reel (bandit rig) vessels. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Gear Type	Coastal Logbook Data		Discard Data	
	All Trips	Red Grouper	All Trips	Red Grouper
Handline*	39,476	21,800	4,562	2,459
Longline	7,611	5,447	580	220
Trolling	2,730	81	150	2
Trap	1,863	1,624	201	60
Diving	2,399	975	185	8
Other	364	44	9	0

Table 2. Numbers of handline (includes electric reel gear) trips and reported landings from logbooks and number of discards of red grouper by year in areas 1-11 of the Gulf of Mexico, 8/1/2001-12/31/2005. *Totals for 2001 are for a partial year. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Year	Number of Trips		Red Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
2001*	3,878	474	854,825	12,874
2002	9,797	958	2,145,041	27,411
2003	9,484	1,399	1,337,395	57,362
2004	8,908	1,083	1,618,580	31,705
2005	7,409	648	1,678,181	16,034
Total	39,476	4,562	7,634,022	145,386

Table 3. Numbers of longline trips and reported landings from logbooks and number of discards of red grouper by year in areas 1-10 of the Gulf of Mexico, 8/1/2001-12/31/2005. *Totals for 2001 are for a partial year. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Year	Number of Trips		Red Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
2001*	655	41	1,708,707	3,299
2002	1,713	118	3,857,174	13,680
2003	1,882	188	3,620,252	11,001
2004	1,765	152	4,023,130	30,491
2005	1,596	81	3,629,712	10,833
Total	7,611	580	16,838,975	69,304

Table 4. Numbers of trap trips and reported landings from logbooks and number of discards of red grouper by year in areas 1-8 of the Gulf of Mexico, 8/1/2001-12/31/2005. *Totals for 2001 are for a partial year. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Year	Number of Trips		Red Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
2001*	225	21	389,119	730
2002	592	57	1,185,247	3,168
2003	451	54	843,406	55,187
2004	343	51	824,673	10,230
2005	252	18	686,472	1,976
Total	1,863	201	3,928,917	71,291

Table 5. Calculated numbers of red grouper total discards for the Gulf of Mexico handline fishery by Area and Fishery for the period June 19, 2000-December 31, 2005. Fishery denotes trips that were classified as red grouper (Y) or not red grouper (N) trips.

Area	Fishery	Discards/Hook Hour	Handline Hook-hours	Calculated Discards
1-5	N	0.256661	2,751,676	220,784
1-5	Y	0.080236	3,735,880	958,856
6	N	0.525731	649,907	198,998
6	Y	0.306194	2,240,109	1,177,695
7	N	0.463118	519,955	147,510
7	Y	0.283697	1,702,371	788,399
8-11	N	0.194375	14,156,989	1,192,217
8-11	Y	0.084214	2,212,620	430,077
Total			27,969,508	5,114,537

Includes calculated discards from 1990-2002 based upon an expansion factor of 5

Table 6. Calculated numbers of red grouper total discards for the Gulf of Mexico handline fishery by year.

Year	Handline Hook-Hours	Calculated Discards
1990	1,291,153	253,082
1991	2,216,730	403,453
1992	2,534,915	495,706
1993	1,247,868	222,057
1994	1,496,248	263,099
1995	1,232,466	244,543
1996	1,788,615	316,766
1997	1,672,711	305,480
1998	1,661,657	301,903
1999	2,089,282	377,218
2000	1,809,033	343,245
2001	1,952,560	361,651
2002	2,009,180	351,833
2003	1,921,667	327,169
2004	1,653,992	290,903
2005	1,391,433	256,428
Total	27,969,508	5,114,537

Highlighted years include calculated discards based upon an expansion factor of 5

Table 7. Calculated numbers of red grouper total discards for the Gulf of Mexico longline fishery by Area and Fishery for the period June 19, 2000-December 31, 2005. Fishery denotes trips that were classified as red grouper (Y) or not red grouper (N) trips.

Area	Fishery	Discards/Hook	Longline Hooks Fished	Calculated Discards
1-4	N	0.001531	45,507,068	23,328
1-4	Y	0.002269	183,258,987	280,484
5	N	0.000513	30,356,479	22,434
5	Y	0.000538	147,110,299	409,289
6	N	0.002782	15,388,529	8,277
6	Y	0.00322	57,328,442	130,075
7-10	N	0.000739	37,716,006	23,350
7-10	Y	0.000619	23,987,859	77,240
Total			540,653,669	974,476

Includes calculated discards from 1990-2002 based upon an expansion factor of 5

Table 8. Calculated numbers of red grouper total discards for the Gulf of Mexico longline fishery by year.

Year	Longline Hooks Fished	Calculated Discards
1990	34,912,585	52,489
1991	60,327,355	87,446
1992	34,392,610	60,841
1993	27,193,873	49,764
1994	34,124,151	60,492
1995	30,466,739	46,246
1996	32,928,479	61,743
1997	37,498,471	69,474
1998	33,117,476	62,706
1999	33,625,178	65,944
2000	33,568,068	61,665
2001	32,260,977	61,994
2002	29,539,584	60,521
2003	32,750,065	64,865
2004	31,083,199	62,178
2005	22,864,859	46,110
Total	540,653,669	974,476

Highlighted years include calculated discards based upon an expansion factor of 5

Table 9. Calculated numbers of red grouper total discards for the Gulf of Mexico trap fishery by Area and Fishery for the period June 19, 2000-December 31, 2005. Fishery denotes trips that were classified as red grouper (Y) or not red grouper (N) trips.

Fishery	Discards/Trap	Traps Fished	Calculated Discards
Y	0.271145488	695,050	188,460
N	0.093068132	298,890	27,817
Total		993,940	216,277

Includes calculated discards from 1990-2002 based upon an expansion factor of 5

Table 10. Calculated numbers of red grouper total discards for the Gulf of Mexico trap fishery by year.

Year	Traps Fished	Calculated Discards
1990	71,030	12,818
1991	137,305	26,097
1992	228,335	52,678
1993	63,565	14,230
1994	64,149	13,452
1995	62,093	12,564
1996	56,156	11,990
1997	41,746	9,846
1998	33,587	6,982
1999	38,843	8,446
2000	37,469	8,953
2001	42,018	9,134
2002	41,500	10,027
2003	32,555	8,017
2004	24,856	6,228
2005	18,733	4,815
Total	993,940	216,277

Highlighted years include calculated discards based upon an expansion factor of 5

Table 11. Red grouper discard condition and reason for discards reported from handline discard trips.

Discard Condition		Reason For Discard	
Category	Percent	Category	Percent
All Dead	0.9	Regulations	98.0
Majority Dead	6.1	Market Conditions	0.8
All Alive	53.2	Unreported	1.2
Majority Alive	37.0		
Kept Not Sold	0.9		
Unknown	1.8		

Table 12. Red grouper discard condition and reason for discards reported from longline discard trips.

Discard Condition		Reason For Discard	
Category	Percent	Category	Percent
All Dead	3.4	Regulations	99.2
Majority Dead	8.4	Market Conditions	0.4
All Alive	18.5	Unreported	0.4
Majority Alive	65.4		
Unknown	4.2		

Table 13. Red grouper discard condition and reason for discards reported from trap discard trips.

Discard Condition		Reason For Discard	
Category	Percent	Category	Percent
All Alive	79.3	Regulations	100
Majority Alive	19.0		
Unknown	1.7		

Figure 1. Commercial Logbook defined fishing areas.