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

Kevin McCarthy
Sustainable Fisheries Division
Southeast Fisheries Science Center
75 Virginia Beach Drive, Miami, FL

Sustainable Fisheries Division Contribution SFD-2006-007

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 data set for this analysis includes trips from vessels that reported discards between August 1, 2001 and December 31, 2004. During this period, discard information was submitted for 6,785 trips. Of those trips, discards were reported on 5,374 trips (Table 1) and no discards were reported on the remaining 1,411 trips. Discards of gag grouper were reported on 1,211 trips or 22.5% of the trips where discards were reported. There was concern that some gag grouper may have been mistakenly reported to the coastal fisheries logbook program as black grouper. The proportion of gag grouper to black grouper reported to the coastal logbook program differed considerably from that reported in the Trip Interview Program (TIP). Area specific percentages of gag to black grouper, determined from the TIP, were used to estimate the total gag grouper discards by multiplying the black grouper discards reported from an area by the appropriate gag to black grouper percentage and adding that product to the number of gag grouper discards reported. Discards of either gag or black grouper (assuming that some gag were misidentified as black grouper) were reported on 1,783 trips or 33.2% of trips reporting discards (Table 1).

There were 60,203 Gulf of Mexico trips reported by vessels to the coastal logbook program during the period for which the discard program has been conducted (Table 1). Gag grouper catches were reported for 19,572 (32.5%) of the trips. When gag and black grouper trips were examined, again assuming some misidentification, there were 28,650 trips landing gag or black grouper (Table 1). This was 47.6% of all Gulf of Mexico trips reported to the coastal logbook program during the period when discards were reported.

The objective of this analysis was to estimate the numbers of gag grouper discarded by vessels that fish commercially for species other than shrimp or other shellfish. Fishing activity for these analyses does 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 gag grouper fishery, the analysis was also limited to include only those data reported for areas 1-13 (Figure 1).

Seven variables were considered as possible influences on the reported discards of gag grouper in the Gulf of Mexico. Five of the variables were similar to those used in developing indices of abundance from the handline fishery for gag grouper (SEDAR10-DW10). Only data for vessels fishing handlines (handline and electric reel gear) were considered. Examination of factors affecting discards of gag by vessels fishing other gear types was not possible due to insufficient sample size. Factors examined were:

Factor	Levels	Value
YEAR	4	2001 – 2004
DAYS	3	1 = <6 days at sea, 2 = 6-10 days at sea, 3=11-15 days at sea
MONTH	12	Month of the year
CREW	4	1-4 crew members
DIS_PERIOD	7	1, 3, 5, 7 = August – December of 2001-2004 respectively; 2, 4, 6 = January-July of 2002-2004 respectively
GAGSEASON	2	Open, Closed = all periods with prohibition of gag landings
AREA1	5	1=areas 1-5, 2=areas 6-8, 3=areas 9-13 of the Gulf of Mexico shrimp grids

The subsample of vessels required to report discards changes yearly, asynchronously with the calendar year. The factor DIS_PERIOD was constructed to examine any effect that change in vessels reporting discards may have had on discard CPUE relative to annual CPUE variation.

Separate generalized linear model (GLM) analyses of the proportion of successful trips (trips that discarded gag grouper) and the catch rates on successful trips 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).

For each GLM procedure of proportion positive handline trips, a type-3 model was fit, a binomial error distribution was assumed, and the logit link was selected. The response variable was proportion

successful trips. During the analysis 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 gag grouper discarded/hook hours). 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 GLM model was fit on year. 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 ≥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.

Results and Discussion

The final models for the binomial on proportion positive trips and the lognormal on CPUE of successful trips were:

Proportion positive trips = YEAR + AREA1

LN(CPUE) = YEAR AREA1 + DAYS + CREW1 + AREA1*DAYS + YEAR*AREA1 + YEAR*CREW1

Final model linear regression statistics are provided in Table 2.

The fishing activity of vessels deploying handlines, including electric reels (bandit rigs) for gag grouper are provided for each of the significant main effects determined from the GLMs. The analyses were limited to areas 1-13 due to sample size limitations, therefore total trips may not match those in Table 1. The numbers of trips and reported gag grouper landings and discards by year are shown in Table 3. Trips and gag grouper landings and discards reported to the coastal logbook program by area1 are provided in Table 4. Tables 5 and 6 provide the number of gag grouper trips, landings, and discards by days at sea (days) and number of crew (crew1), respectively.

Reported gag grouper discards was highest in 2003, the data for 2001 are for only the last five months of that year. The highest numbers of discards were reported from Area1=2. Not surprisingly, the majority of the landings are reported from that location. Single day trips and trips of six or more days had the highest reported numbers of gag grouper. The number gag grouper discards also varied with the number of crew on a vessel. Boats with two or three crew members reported many more discards than did boats with fewer (single crew) or more (four or more) crew members.

Calculations of total discards for each strata (year, area1, days, crew1) could not be accomplished due to small sample sizes. With the data set stratified to such an extent, many of the strata contained no observations of discards. Only year and area1 could be used to stratify these data and allow for calculation of mean discards per strata. Discard calculations were made by multiplying the total number of trips in a year-area1 strata by the mean number of discards reported from trips in the same strata. Calculations of discards during the period 8/1/01-12/31/04 (the period when discards were reported to the coastal logbook program) are provided in Table 7.

Numbers of gag discarded were also calculated for the years prior to the beginning of the discard program. The mean number of discards for the entire period, 8/1/01-12/31/04, was determined for each level of area1. Those mean discards were multiplied by the number of handline trips per year in the appropriate corresponding area1 (Table 8). Total yearly numbers of gag grouper discarded were calculated by summing all the area1 calculated totals for each year (Table 9).

Approximately 57% of all gag grouper discards were reported as "all alive" when released. An additional 21% were reported as "majority alive" at release. Mortality estimates of 12.7% (all dead when discarded), 2% (majority dead), and 0.9% (kept but not sold) were reported. The survival of a further 6.2% of discards was reported as unknown or was not reported. The reason reported for discarding gag grouper was overwhelmingly "discarded due to regulations" (98.4%).

Literature Cited

McCarthy, K. 2006. Standardized catch rates for gag grouper from the United States Gulf of Mexico handline fishery during 1993-2004. SEDAR 10-DW10.

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, 8/1/01-12/31/04. *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	Logbook Landings Data		Discard Data	
	All Trips	Gag Grouper	All Trips	Gag Grouper
Handline*	45,740	22,006	5,396	1,677
Longline	7,129	4,366	691	70
Trolling	3,663	129	329	4
Trap	1,426	863	184	18
Diving	1,583	1,234	169	13
Other	662	50	16	1

Table 2. Linear regression statistics for the final GLM models on proportion positive trips (a) and catch rates on positive trips (b) for gag grouper discards in the Gulf of Mexico.

a.

source	df	% reduction dev/df	chi square	p>chi square
year	3		16.29	0.0001
area1	2	21.34	1206.83	<0.0001

b.

source	df	% reduction dev/df	chi square	p>chi square
year	3		5.71	0.1264
area1	2	16.71	190.68	<0.0001
days	4	23.70	272.61	<0.0001
crew1	3	6.35	69.13	<0.0001
days*area1	8	2.51	41.47	<0.0001
year*area1	6	1.89	43.97	<0.0001
year*crew1	9	1.56	34.82	<0.0001

Table 3. Numbers of handline (includes electric reel gear) trips and reported landings from logbooks and number of discards of gag grouper by year in areas 1-13 of the Gulf of Mexico, 8/1/2001-12/31/2004. *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		Gag Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
2001*	4,339	472	753,825	4,962
2002	11,420	979	2,290,437	8,179
2003	11,382	1,466	1,678,777	17,414
2004	10,489	1,259	1,988,492	11,128
Total	37,630	4,176	6,711,531	41,683

Table 4. Numbers of handline (includes electric reel gear) trips and reported landings from logbooks and number of discards of gag grouper by area1 in areas 1-13 of the Gulf of Mexico, 8/1/2001-12/31/2004. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Area1	Number of Trips		Gag Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
1 (1-5)	13,452	1,300	1,503,385	2,441
2 (6-8)	14,361	1,715	4,867,101	36,495
3 (9-13)	9,817	1,161	341,045	2,747
Total	37,630	4,176	6,711,531	41,683

Table 5. Numbers of handline (includes electric reel gear) trips and reported landings from logbooks and number of discards of gag grouper by days at sea class in areas 1-13 of the Gulf of Mexico, 8/1/2001-12/31/2004. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen.

Days at Sea	Number of Trips		Gag Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
1	18,793	2,200	807,529	13,103
2	5,200	505	865,908	6,107
3	3,258	359	813,769	4,054
4 (4-5)	4,957	538	1,693,559	6,555
5 (>5)	5,422	574	2,530,767	11,863
Total	37,630	4,176	6,711,532	41,682

Table 6. Numbers of handline (includes electric reel gear) trips and reported landings from logbooks and number of discards of gag grouper by crew1 in areas 1-13 of the Gulf of Mexico, 8/1/2001-12/31/2004. All vessels with a reef fish permit are required to submit logbooks while discards reports are obtained from a sample of permitted fishermen

Number of Crew	Number of Trips		Gag Grouper	
	Logbook	Discards	Logbook (lbs)	Discards (number)
1	7,621	777	863,453	5,720
2	18,368	2,084	3,249,633	22,390
3	8,955	1,082	2,154,166	10,979
4 (>4)	2,686	269	444,279	2,594
Total	37,630	4,176	6,711,531	41,683

Table 7. Calculated numbers of gag grouper total discards for the Gulf of Mexico handline fishery by Year and Area1.

Year	Area1	Mean Gag Discards	Handline Trips	Calculated Discards
2001	1	9.6599	4,431	42,803
2001	2	19.6674	4,172	82,052
2001	3	3.0978	2,585	8,008
2002	1	3.3023	4,181	13,807
2002	2	26.1473	4,236	110,760
2002	3	9.2160	3,003	27,676
2003	1	22.8528	4,219	96,416
2003	2	35.5262	4,124	146,510
2003	3	7.5655	3,039	22,992
2004	1	6.6006	3,548	23,419
2004	2	17.9381	4,152	74,479
2004	3	9.7462	2,789	27,182

Table 8. Calculated numbers of gag grouper total discards for the Gulf of Mexico handline fishery by Year and Area1.

Year	Area1	Mean Gag Discards	Handline Trips	Calculated Discards
1993	1	13.0434	4,886	63,730
1993	2	25.1963	2,398	60,421
1993	3	8.5731	2,006	17,198
1994	1	13.0434	5,406	70,513
1994	2	25.1963	3,095	77,983
1994	3	8.5731	2,096	17,969
1995	1	13.0434	5,606	73,121
1995	2	25.1963	3,069	77,328
1995	3	8.5731	1,969	16,880
1996	1	13.0434	4,514	58,878
1996	2	25.1963	2,738	68,988
1996	3	8.5731	2,167	18,578
1997	1	13.0434	4,596	59,948
1997	2	25.1963	3,032	76,395
1997	3	8.5731	2,090	17,918
1998	1	13.0434	3,871	50,491
1998	2	25.1963	3,841	96,779
1998	3	8.5731	2,405	20,618
1999	1	13.0434	4,211	54,926
1999	2	25.1963	4,222	106,379
1999	3	8.5731	2,634	22,582
2000	1	13.0434	4,456	58,122
2000	2	25.1963	4,200	105,825
2000	3	8.5731	2,774	23,782

Table 9. Calculated numbers of gag grouper total discards for the Gulf of Mexico handline fishery by year.

Year	Calculated Discards
1993	141,349
1994	166,465
1995	167,330
1996	146,444
1997	154,261
1998	167,889
1999	183,886
2000	187,728
2001	132,863
2002	152,243
2003	265,917
2004	125,080

Figure 1. Gulf of Mexico Commercial Logbook defined fishing areas.