Calculated discards of red grouper from commercial vertical line fishing vessels in the US South Atlantic

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Introduction

In August 2001, the Southeast Fisheries Science Center (SEFSC) initiated a program to collect commercial fishing vessel discard data from Gulf of Mexico and US South Atlantic fisheries. A reporting form was developed that supplements the existing vessel coastal logbook forms that are currently mandatory for those fisheries (Poffenberger and McCarthy, 2004). Discard data from the SEFSC coastal fisheries logbook program were used to calculate the number of red grouper that were discarded during the period January 1, 2002 through December 31, 2008.

Data collection for the discard logbook program involves, each year, a 20% random sample of the vessels with South Atlantic snapper-grouper, Gulf of Mexico reef-fish, king mackerel, Spanish mackerel or shark permits selected to report the number of animals discarded by species. To assure that the sample was representative of vessels with those Federal permits, the universe of permitted vessels was stratified by region and gear fished. A random sample was selected, without replacement, from each stratum. Region was defined as the Gulf of Mexico (Gulf-side of the Florida Keys-Dry Tortugas to the Texas-Mexico border) and the South Atlantic (which extends from the North Carolina-Virginia border to the southern/eastern side of the Florida Keys-Dry Tortugas). Fishing gear strata included handline, electric reel (bandit rig), trolling, longline, trap, gillnet, and diving. The selected fishers were instructed to complete a supplemental discard form for every fishing trip that they made. Trips with no discards were reported as such.

Reported data included the numbers of discards by species, estimated condition of the fish when released, reason for release (due to regulations or unmarketable/unwanted), and the fishing area where the animal was discarded. There are six options for the condition of released fish: 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. To calculate species specific discard rates, discard data were matched to the landings and effort data reported (for the appropriate trip) to the coastal logbook program.

Methods

The data set for these analyses included all trips from vertical line (handline and electric reel/bandit rig) vessels that reported discards between January 1, 2002 and December 31, 2008 in the US South Atlantic, defined as the area south and east of the Florida Keys-Dry Tortugas to 37^{o} N. During those years, discard forms were submitted for 14,887 South Atlantic vertical line trips with discards reported on 43.4% of those trips. Discards of red grouper were reported on 752 trips (5.1%). There were187,510 South Atlantic trips (all fishing gears) reported during 2002-2008 to the coastal logbook program, of those 17,696 (9.4%) reported red grouper landings. Ninety percent of the positive red grouper trips were reported as vertical line trips. Only trips that could be unambiguously categorized to a single gear and area fished were used to calculate the above counts and percentages.

The objective of this analysis was to calculate the numbers of red grouper discarded by commercial vessels that fished for species other than shrimp or other shellfish. Fishing activity for these analyses included only vertical line gear (handlines and electric reels). Electric reel (bandit rig) was reported as handline until 2002 and the proper reporting of those gears required several years of transition once separate reporting of those two gear types was begun, therefore electric reel gear was combined with handline gear for these analyses

Five factors were considered as possible influences on the red grouper discard rate. In order to develop a well balanced sample design it was necessary to define categories within some of the factors examined:

Factor	Levels	Value
Year	7	2002-2008
Subregion	3	Statistical areas 2400-2500, 2500-3400, 3400-3700; see Figure 1.
Days at sea	4	1, 2-3, 4+
Crew	3	1, 2, or 3+ crew members
Month	12	January - December

General linear model (GLM) analyses were used to identify any significant effects the above factors may have had on the red grouper discard rate of vertical line commercial fishing trips. 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 the GLM analysis of proportion positive 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 examined. The linking function selected was "normal", and the response variable was log(CPUE) calculated as log(CPUE) = log(number of red grouper discards/hook hour). Only main effects were examined.

A forward stepwise regression procedure was used to determine the set of main effects that explained a significant portion of the observed variability. 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 individually until no factor met the criteria for incorporation into the final model.

Once the significant main effects were identified, the data were stratified by those factors and a mean discard rate was calculated for each stratum. Those mean rate calculations included all vertical line discard trips within each stratum, i.e. trips with no red grouper discards were included in the discard rate calculations to produce a mean nominal discard rate. Total vertical line effort (hook hours) was calculated from the coastal logbook data set for each stratum. Total discards for each stratum were then calculated as: stratum mean discard rate*stratum total effort. Coastal logbook total effort data were available to 1993. For the years prior to 2002 (the beginning of the discard logbook program), the overall mean discard rate was applied to the yearly total effort reported to the coastal logbook program.

Results and Discussion

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

PPT = Days at Sea + Year + Crew Number + Subregion

LOG(CPUE) = Days at Sea + Crew Number + Year + Subregion

When the discard logbook data set was stratified by all significant factors, some of the strata were unpopulated with a discard rate due to the small size of the data set. Discards were assumed to be zero for those strata.

Calculated total South Atlantic red grouper yearly discard totals are included in Table 1. Including stratum specific discard totals resulted in a large matrix that was not included here, however those totals are available upon request. In all years the number of red grouper discards were low, never exceeding 22,000 discarded fish. The percentage of trips reporting "no discards" increased since the inception of the discard logbook program; nearly doubling from 33.5% to 66%. The generally decreasing trend in number of discards per year since 2002 may be due to lack of reporting. In comparison, the percentage of vertical line Gulf of Mexico reports of "no discards" increased from 17 to 34% from 2002 to 2008.

The release condition of discarded red grouper is reported in Table 2. In all years except 2005 over 90% of red grouper discards were reported as "alive" or "majority alive" when released. In 2005, 89% of discards were reported as "alive" or "majority alive". The category "kept" also accounted for a low percentage of red grouper in the discard reports. The number of red grouper reported in the "all alive" or "majority alive" are generally higher than the number reported in either of the "dead" categories or as "kept".

The reason "due to regulatory restrictions" accounted for approximately 90% of reported red grouper discards over all years. Beginning in 2008, the regulatory restriction reporting category was expanded to differentiate between fish discarded due to size restriction and those discarded due to fishery closures. Approximately 85% red grouper discards were reported as discarded due to size restrictions with another 11% discarded due to unspecified regulatory restrictions.

The number of vertical line trips reporting red grouper discards in the US South Atlantic varied from 73 to 149 per year. The number of yearly vertical line trips with discard reports ranged from 1,187 to 4,651 each year, although many of those reports were for no discards during a trip. Given the increasing number of "no discards" reporting trips, red grouper discards from South Atlantic vertical line vessels may be underreported.

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. Calculated yearly commercial vertical line vessel red grouper discards. Discards are reported in number of fish.

Year	Yearly Total
1993	8,575
1994	14,397
1995	10,489
1996	11,582
1997	14,709
1998	10,461
1999	12,956
2000	10,869
2001	8,423
2002	21,608
2003	11,354
2004	10,850
2005	9,992
2006	4,933
2007	8,571
2008	1,993

Table 2. Percent red grouper discards by estimated condition at release from commercial vertical line vessels reported by region.

Year	All Dead	Majority Dead	All Alive	Majority Alive	Kept	Unknown	N Fish
2002	0.00%	0.00%	87.06%	9.41%	3.53%	0.00%	**468**
2003	0.91%	5.45%	76.36%	16.36%	0.91%	0.00%	**473**
2004	1.90%	0.00%	94.29%	2.86%	0.95%	0.00%	**662**
2005	1.60%	0.80%	80.80%	8.00%	0.00%	8.80%	**628**
2006	0.00%	0.00%	82.19%	16.44%	1.37%	0.00%	**521**
2007	0.00%	0.00%	93.29%	6.04%	0.67%	0.00%	**889**
2008	0.00%	3.81%	86.67%	9.52%	0.00%	0.00%	**525**
N Trips	**10**	**142**	**3,447**	**466**	**14**	**87**	**4,166**

Figure 1. Coastal Logbook defined fishing areas.