

Analysis of Alternative Fishing Seasons and Bag limits for Gulf of Mexico Gag
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Background

Gulf of Mexico gag is overfished and the stock is currently in a rebuilding plan. Amendment 32 implemented management measures in 2012 to end overfishing that included reducing the commercial quota and recreational annual catch limit. The recreational gag season was also set from July 1 through October 31 each year. There has been interest in changing when the recreational fishing season is open, primarily from the Florida Fish and Wildlife Conservation Commission and constituents residing in the Big Bend and Southwest Florida. The Gulf of Mexico Fishery Management Council is currently developing a regulatory amendment that considers modifying when the recreational gag season would open and close. The amendment also considers reducing the gag bag limit and eliminating or modifying the shallow-water grouper closed season. Recreational management decision models were developed for the Council, fishermen, and other constituents to evaluate the benefits and tradeoffs of modifying the recreational gag season and bag limit. This report provides an overview of the decision models.

Methods

Baseline removals

As the gag stock rebuilds, yields and dead discards are projected to increase (Figure 1). To evaluate the length of the recreational gag season, estimates of landings and dead discards must be generated for each month. Historically, this information has been readily available because the recreational gag season was open for most of the fishing year. However, in 2011 the recreational gag season was shortened to two months (Sept 15-Nov 15) through emergency action and in 2012 the federal gag recreational season was open only four months (July 1-Oct 31). In order to estimate the amount of landings and dead discards that would occur in 2013, alternative methods had to be developed to determine what would be landed and/or discarded dead if the recreational gag season was open during time periods that are currently closed.

Simple linear regressions were developed to estimate annual landings and dead discards separately. Recreational landings were regressed against exploitable spawning stock biomass (SSB) estimates from the gag stock assessment for 2000-2010 (SEDAR 2009, SEFSC 2010). There was a strong positive linear relationship between landings and exploitable SSB (Figure 2), with 53% of the variability in annual landings explained by exploitable SSB. Baseline 2013 recreational gag landings (in millions of pounds gw (mp gw)) were estimated using Equation 1:

$$2013 \text{ landings (mp gw)} = 0.2077 \times 2013 \text{ exploitable SSB} \quad (1)$$

Exploitable SSB for 2013 was obtained from the gag stock assessment (SEDAR 2009, 2010) and was estimated to equal 17.18 mp gw.

Baseline dead discards for 2013 were also estimated using linear regression. The percentage of total dead discards to total kill was regressed against exploitable SSB. There was a strong negative linear

relationship between the percentage of dead discards to total kill and exploitable SSB, with 72% of the variability explained by exploitable SSB. Recreational dead discards for 2013 were estimated using Equation 2:

$$2013 \text{ lbs discarded dead} = -0.0147 \times \text{exploitable SSB} + 0.4915 \quad (2)$$

Estimated 2013 landings and dead discards were then converted to monthly landings using the proportion of landings and dead discards by month during 2008-2010 (Figures 4 and 5). Because the months of February and March were partially or fully closed during these years, the proportion of landings and dead discards occurring during these months had to be estimated. For February, the proportion of landings and dead discards was set equal to January percentages times the ratio of days in February versus days in January (= 28/31). For March, the proportion of landings and dead discards was set equal to April percentages times the ratio of days in March versus days in April (= 31/30).

Table 1 summarizes estimated 2013 recreational gag landings and dead discards if there was no closed season.

Trip Elimination

Reducing gag fishing mortality requires fishery managers to constrain catch and reduce fishing effort targeted at gag. As a result, extended closed seasons have been implemented in recent years for recreational gag. Closed seasons can eliminate trips directly targeting or harvesting gag. In Amendment 32, decision models were developed that explicitly modeled the effects of closed seasons on landings and dead discards. Target trips were defined as any Marine Recreational Fisheries Statistical Survey (MRFSS) intercept identifying gag as the primary or secondary species targeted during a fishing trip. Directed gag trips were defined as any trip that exceeded 1.5 gag caught per angler. The thresholds for defining directed trips were derived from catch per angler frequency plots (Figure 6).

To evaluate the sensitivity of eliminating trips during seasonal closures, two scenarios were considered for this analysis. Scenario 1 did not eliminate any target or directed trips for gag; therefore, gag landings and discards were assumed to occur at the same rate as if the season remained open. Scenario 2 re-estimated landings and discards after eliminating any trips identified as targeting or directed at gag. For scenario 2, gag landings and discards were re-estimated using MRFSS estimation procedures. Intercepts were dropped if a trip was identified as a target trip and/or if a trip exceeded the threshold(s) for directed catch. MRFSS landings and discards were also post-stratified, consistent with the gag stock assessment, to remove catch from the Florida Keys. Reductions in headboat landings and discards associated with various trip elimination scenarios were assumed to be the same as reductions observed for charter vessels, since headboat logbooks do not identify target trips or include reported discards. No trips were eliminated from Texas as few gag are reported to be harvested off Texas each year.

Table 1 summarizes estimated monthly landings and dead discards for 2013 if directed and target trips are eliminated. Scenario 2 would result in a 45% reduction in landed catch (that would have to be discarded) if all months are closed that were previously open. Similarly, Scenario 2 would result in a 64% reduction in dead discards if months are closed that were previously open.

Bag Limit

In addition to changing when the gag season is open and closed, the Council was also interested in exploring reductions to the bag limit. The current bag limit for gag is 2 fish. MRFSS and Headboat

intercept data for 2009-2011 were used to estimate monthly reductions in landings associated with a 1 fish bag limit.

The MRFSS system classifies recreational catch into three categories:

- Type A - Fish that were caught, landed whole, and available for identification and enumeration by the interviewers.
- Type B - Fish that were caught but were either not kept or kept but not available for identification.
 - Type B1 - Fish that were caught and filleted, released dead, given away, or disposed of in some way other than Types A or B2.
 - Type B2 - Fish that were caught and released alive.

Type A and B1 catches were used for bag limit analyses. Type A catch represents the total catch of all anglers on a fishing trip. However, some or all of the anglers contributing to the A catch are also interviewed to report type B1 catch, and those may be recorded on an individual basis. If the number of people contributing to the A catch was greater than the number of people interviewed to report B1 catch, Equation 3 was used to account for possible under reporting of the B1 catch:

$$B1 = B1_{interviewed} \times (\# \text{ people in fishing party} / \# \text{ people interviewed to report B1 catch}) \quad (3)$$

The total catch per angler was then determined by summing the total Type A and Type B1 catch (AB1) for each trip and then dividing it by the number of anglers in the fishing party. Percent reductions in harvest were estimated for a 1 gag per person bag limit. If AB1 catch per angler was greater than the bag limit being analyzed, the value was re-set to the new bag limit ($AB1_{bag \text{ limit}}$), otherwise no changes to the catch were made.

Formulas 4 and 5 were used to estimate reductions in harvest resulting from bag limits:

$$\text{If } AB1 \text{ catch} \leq \text{bag limit, then harvest} = A + B1 \quad (4)$$

$$\text{If } AB1 \text{ catch} > \text{bag limit, then harvest} = AB1_{bag \text{ limit}} \quad (5)$$

Reductions for Headboat bag limits were calculated in a similar manner as described above, except no B1 catch data were available. If the catch per angler was greater than the bag limit being analyzed, the value was re-set to the bag limit, as described above. If the catch per angler was less than the bag limit being analyzed, then no change to the catch was made. Percent reductions associated with bag limits were estimated relative to the status quo 2 gag bag limit, by mode of fishing. If a monthly sample size of 30 gag was not achieved then the samples were pooled with the nearest months until a sample size of 30 was achieved. The impact of bag limits varied by mode: the largest reductions were observed in the private and charter modes while the smallest reductions were observed in the Headboat mode. Figure 7 shows the frequency distribution of MRFSS and headboat landings per angler. Figure 8 provides the monthly percent reductions for a 1 gag bag limit. More than 94% of anglers landed less than one gag per trip on average. Reductions from bag limits were highest during winter and fall when gag are aggregating or closer to shore.

Decision Tools

Decision tools were developed to analyze the effects of gag closed seasons and bag limits. Percent reductions calculated from changes in management measures were applied to 2013 monthly projected

landings and dead discards to determine how much mortality would be reduced by management measures. These results were incorporated into two recreational decision tools: a low discard and a high discard decision model. For both models, if month (m) was 100% closed, landings were set to zero pounds for all sectors. For both the low and high discard decision models, if a month was partially or fully open, the projected monthly recreational landings (RL) were computed using Formula 6:

$$RL = PRL_m * O_m * \beta_{sector,m} \quad (6)$$

where PRL: projected 2013 recreational landings, O: percent of month open to fishing, and β : percent bag limit reduction.

For the low discard decision model, dead discards were computed using Formula 7:

$$DD = PDD_m * O_m * \zeta_{sector,m} + PDD_m * C_m * \zeta_{sector,m} \quad (7)$$

where PDD: projected 2013 recreational dead discards, O: percent of month open to fishing, C: percent of month closed to fishing, and ζ : percent reduction from eliminating target and directed trips.

For the high discard decision model, dead discards were computed using Formula 8:

$$DD = PDD_m * O_m * \zeta_{sector,m} + PDD_m * C_m * \zeta_{sector,m} + PRL_m * C_m * \zeta_{sector,m} * r \quad (8)$$

where PDD: projected 2013 recreational dead discards, O: percent of month open to fishing, C: percent of month closed to fishing, ζ : percent reduction from eliminating target and directed trips, PRL: projected recreational landings that would previously be landed but now will be discarded due to closures, and r : release mortality rate. The release mortality rate was based on the 2006-2009 average recreational release mortality rate and equals 18.9% for all areas combined.

The projected monthly recreational landings and dead discards were calculated based on various management measures imposed. Estimates were totaled for each month and across all months and compared to projected target removals for 2013. Table 2 summarizes 2013 projected landings, dead discards, and total removals. If estimated removals (RL + DD) exceeded total ACL or ACT removals, then management measures were modified (closed seasons, bag limits) until estimated total removals fell below total projected ACL or ACT removals.

Results

A myriad of gag recreational season lengths can be generated using the decision models. In general, season lengths are longer when trips are assumed to be eliminated due to closures and when previously landed catch is not factored into discard estimates (i.e., low discard model). Longer seasons occur during late summer and fall, when landings and dead discards are lower. Shorter seasons occur during winter and fall when landings and dead discards are higher. Imposing a one fish bag limit resulted in little change to the season length because most anglers do not land more than one gag per trip. Additional results are summarized in Table 2.1.2 of GMFMC (2012).

Discussion

The reliability of the decision model results are dependent upon the accuracy of their underlying data and input assumptions. This analysis used historical data and projected spawning biomasses to create a baseline for comparing the effects of various management measures, under the assumption that projected 2013 landings will accurately reflect actual 2013 landings. Uncertainty exists in this projection, as economic conditions, weather events, changes in catch-per-unit effort (CPUE), fisher response to management regulations, stock rebuilding, and a variety of other factors may cause departures from this assumption. The bounds of this uncertainty are not captured by the model as currently configured; as such, landing rates may be higher or lower than projected. In addition to the aforementioned sources of uncertainty, the modeled reductions associated with management measures assume that past performance in the fishery is a good predictor of future dynamics. We have attempted to constrain the range of data considered to recent years to reduce the unreliability of this assumption.

The models do not account for effort shifting that may take place during a seasonal closure. Effort shifting may lead to increased removal rates before and after a closure that partially offset the reductions expected from the closure. As a result, model results may overestimate expected reductions. Additionally, the models attempt to account for the elimination of directed and target fishing trips during closures. Such estimates may over- or underestimate the true reductions associated with fishery closures.

In conclusion, managers will need to weigh the social, economic, and biological benefits and tradeoffs of changing the recreational fishing season. Seasons starting in summer or early fall can be longer than seasons starting in late fall or winter. Reducing the bag limit has little effect on extending the season. Managers will need to determine if it is more desirable to allow harvest during shorter seasons when catch rates are higher or maximize the length of the season when catch rates are lower.

Table 1. Estimated 2013 recreational gag landings and dead discards with and without trip elimination by month. Results

Month	2013 Estimated Landings		2013 Estimated Dead Discards	
	No trips elim	Trips elim	No trips elim	Trips elim
Jan	340,001	203,993	132,880	48,301
Feb	321,107	195,951	121,808	44,276
Mar	314,854	170,023	99,174	42,491
Apr	324,559	172,995	95,975	41,120
May	480,367	238,068	115,640	39,359
Jun	462,924	227,991	111,910	38,089
Jul	180,218	94,154	64,253	15,317
Aug	176,660	92,692	64,253	15,317
Sep	123,015	40,828	59,518	12,325
Oct	133,052	44,638	61,502	12,736
Nov	353,470	241,625	96,010	45,547
Dec	358,575	244,925	99,211	47,065
Total	3,568,801	1,967,885	1,122,133	401,941

Table 2. Projected 2013 recreational gag annual catch limit and annual catch target landings, dead discards, and total removals.

	ACL	ACT
2013 Est Landings	1,495,000	1,287,000
2013 Dead discards	446,528	364,748
Total removals	1,941,528	1,651,748

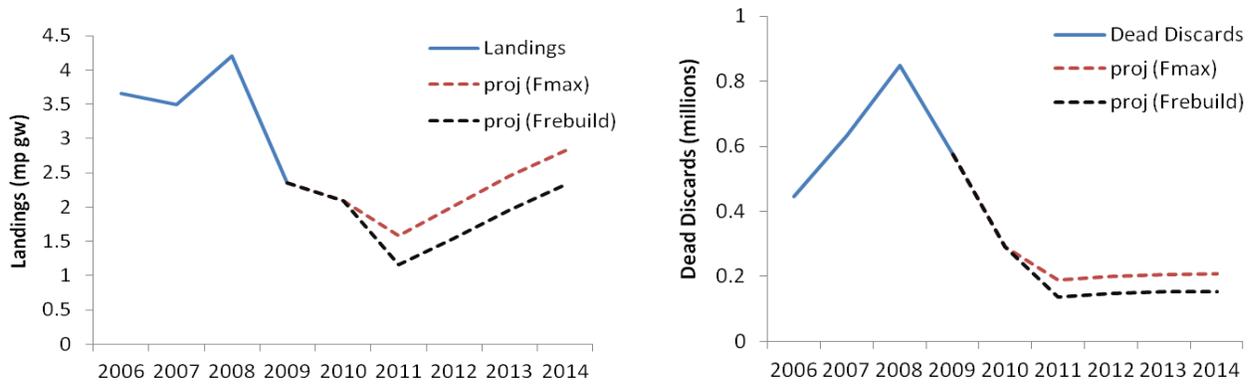


Figure 1. Projected gag landings and dead discards through 2014.

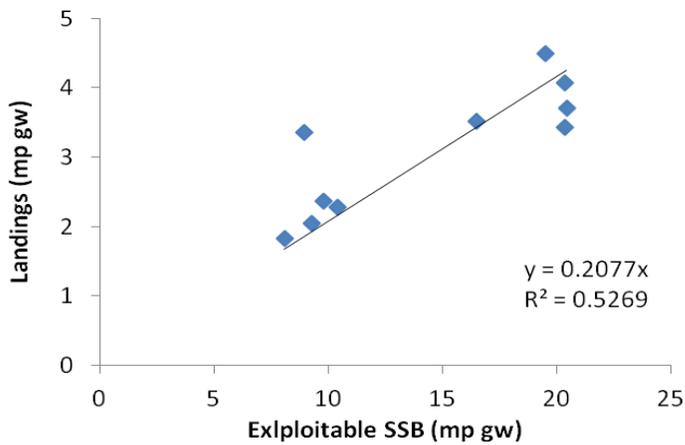


Figure 2. Linear relationship between gag recreational landings and exploitable spawning stock biomass, 2000-2010.

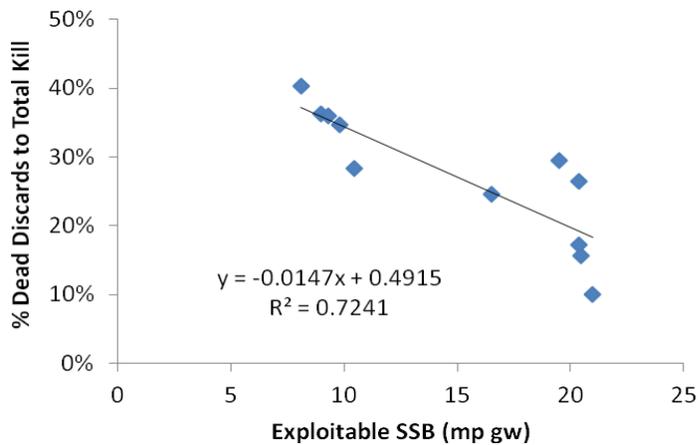


Figure 3. Linear relationship between the percentage of total dead discards to total kill versus exploitable spawning stock biomass, 2000-2010.

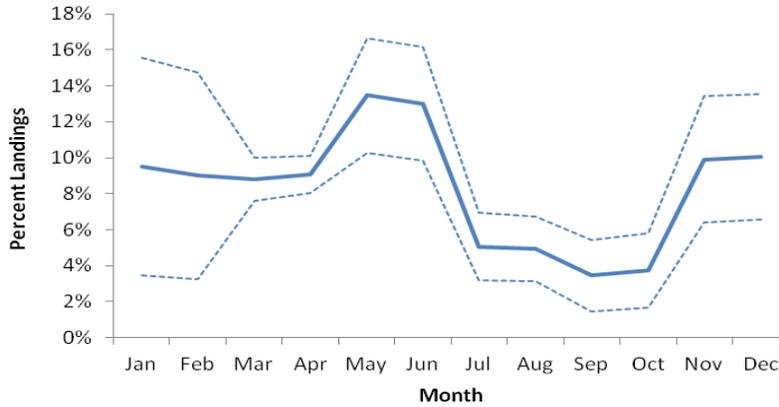


Figure 4. Percentage of annual landings by month, 2008-2010. Dashed lines represent 95% confidence limits.

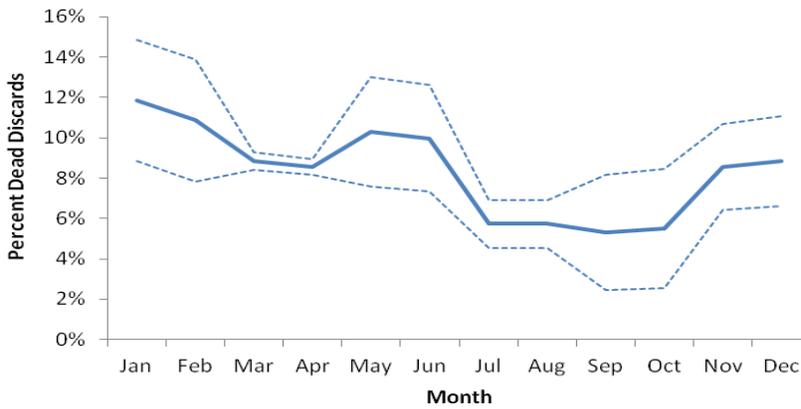


Figure 5. Percentage of annual dead discards by month, 2008-2010. Dashed lines represent 95% confidence limits.

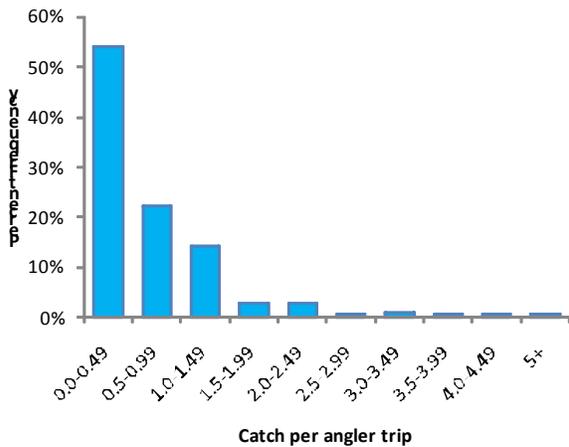


Figure 3. Frequency plot of gag catch per angler (Source: MRFSS). Trips exceeding 1.5 gag caught per angler were defined as directed trips.

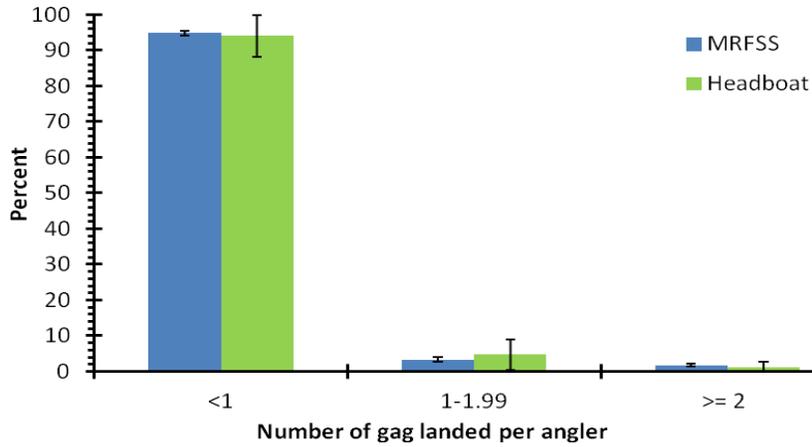


Figure 7. Percent frequency of the number of gag landing per angler by mode, 2009-2011.

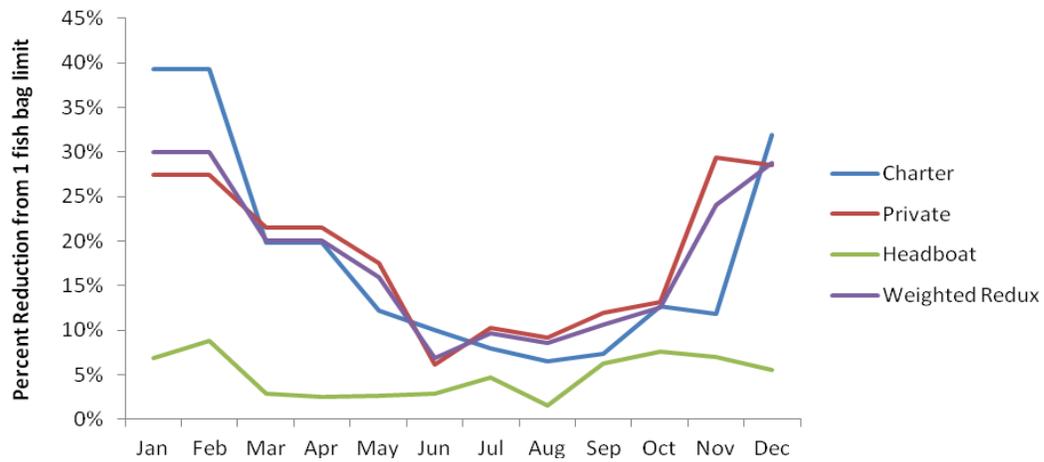


Figure 8. Percent reduction from a one fish gag bag limit by month and mode, 2009-2011.

References

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