Gulf of Mexico Fishery Management Council
Standing and Special Reef Fish SSC
Review of SEDAR 33 – Gulf of Mexico Gag
Miami, Florida
June 3-5, 2014

A joint meeting of the Standing, Ecosystem, and Special Reef Fish SSC was held during June 3-5, 2014 in Miami.

SEDAR 33 Gag Benchmark Assessment

Jakob Tetzlaff presented the gag assessment. The previous assessment was conducted using CASAL, a statistical forward projection catch-at-age model. This assessment was conducted using Stock Synthesis, an integrated statistical catch-at-age model, and therefore a benchmark assessment was required. The assessment used data through 2012. As with the previous model, the current assessment model included an episodic mortality event in 2005 to represent the severe red tide event which occurred in that year. The assessment model estimated an episodic mortality rate of 0.35 y^{-1} which translated to a red tide kill of 1.8 million gag in 2005 (23% of the estimated population).

Fishery-dependent inputs included the commercial handline (vertical gear) and longline components and recreational headboat, charter, and private vessel components. Fishery-independent data inputs included the age-0 seagrass survey, the SEAMAP video survey, and the Panama City video survey. Discard mortality data were obtained from observer and coastal logbook data, and stratified by region (panhandle vs. peninsula) and depth zone (inshore, offshore<10 nm, and offshore more than 10nm). The discard mortality rate for each zone ranged from 12% to 25% among zones. Natural mortality (M) was modeled as a function of age based on the Lorenzen model, with a base M = 0.1342 y^{-1} based on a maximum age of 31 years.

Gag are protogynous hermaphrodites, meaning they initially mature as females and transition to males later in life. The age and size at 50% female maturity is 3.5 years and 54 cm (21.2 inches) respectively. The age and size at 50% male transition is 10.7 years and 102 cm (40.2 inches) respectively.

> **By a vote of 19 to 0, the SSC considers the SEDAR 33 gag grouper stock assessment as the best available science and suitable for management advice.**

To determine stock status and develop yield projections, the SSC needed to decide on several factors that affected the output of the assessment.

Total biomass vs. female biomass

Previous assessments evaluated spawning stock biomass in terms of female biomass for the Gulf stock of gag, whereas the South Atlantic assessments have used male and female biomass combined. Although the assessment model predicts a rapid recovery, spawning stock biomass is currently comprised of mainly age 4-8 fish. The remaining age composition has not yet

recovered and male biomass is estimated to be 17% of the age 3+ biomass. With low levels of male biomass, there is a question of whether reproductive success may be sperm-limited. However, there have been strong year-classes in 2006 and 2007. This could indicate that male biomass is not a limiting factor, but it could also reflect a compensatory response to the 2005 red tide mortality event. It was noted that the literature suggests that male biomass should be used to determine spawning stock status if there is an Allee effect (i.e., high population growth rates associated with high population density, and low population growth rates associated with low population density), while female biomass should be used if there is no Allee effect, and both male and female biomass should be used if the Allee effect is unknown. In addition, the literature suggests that female-only SSB provides best estimates of biological reference points if the potential for decreased fertilization is weak, whereas a combined SSB is best when the potential for decreased fertility is moderate or unknown (Brooks et al. 2008). The SSC members felt that there was no evidence of an Allee effect, and the presence of recent strong year-classes is an indication that spawning success is not male biomass limited. In addition, some SSC members noted that the use of total biomass would imply that 1 kg of male biomass is equally important to the likelihood of spawning success as 1 kg of female biomass, which is not likely to be true. For these reasons, the SSC concluded that spawning stock biomass should continue to be based on female SSB.

By a vote of 16 to 0, the SSC moves that, for the gag assessment, the spawning stock biomass metric be female only.

Steepness of the stock-recruit curve

The model estimated steepness near the upper limit of 0.99, implying that, functionally, there is no stock-recruit relationship. However, recruitment estimates were highly variable over a narrow range of spawning biomass estimates, resulting in a poor fit to the Beverton-Holt spawner-recruit function. Sensitivity runs evaluated fixed steepness values of 0.7, 0.85, and 0.98. The SSC felt that a steepness of 0.85 provided a more realistic representation of the spawner-recruit steepness and was consistent with meta-analysis of spawner-recruit steepness in the region.

By a vote of 17 to 1, the SSC moves that, for the gag assessment, the steepness of the spawner recruit function in the base model be set at 0.85.

Proxy for F_{MSY}

Previous gag assessments used F_{MAX} as the proxy for F_{MSY}. In previous analyses, it was found that $F_{30\% SPR}$ exceeded F_{MAX}. This is the reverse of what is usually found, but may be due to the fact that gag is a protogynous hermaphrodite and only female biomass was considered. The current analysis found that $F_{30\% SPR}$ is greater than F_{MAX} when only female SSB is considered, but $F_{30\% SPR}$ is less than F_{MAX} for the combined (male and female) SSB (Table 1).

Table 1. SPR% for each SSB and proxy combination. The highlighted value is the SPR% value for the SSC's accepted base model of F_{MAX}, female SSB, and steepness = 0.85.						
	SSB-female			SSB-combined		
	F(SPR30%)	F(MAX)	F(MSY)	F(SPR30%)	F(MAX)	F(MSY)
Steepness 0.70	0.30	0.40	0.51	0.30	0.15	0.37
Steepness 0.85	0.30	0.40	0.46	0.30	0.16	0.27
Steepness 0.99	0.30	0.41	0.41	0.30	0.17	0.17

At a steepness of 0.85 and using female biomass, F_{MAX} is equal to $F_{40\% SPR}$ (Table 1). The SSC considered recommending a proxy of $F_{40\% SPR}$, but the relationship between F_{MAX} and SPR can change if selectivity changes, if there are changes in the biology of the fish, or if F_{MAX} is calculated on the basis of total removals vs. retained catch. Dr. Tetzlaff noted that F_{MAX} in the gag assessment was based on total removals. A motion to adopt the $F_{40\% SPR}$ proxy failed by a vote of 8 to 11. The SSC then decided to use F_{MAX} because it is closer to the model-generated estimate of F_{MSY}, but more conservative than $F_{30\% SPR}$.

By a vote of 16 to 3, the SSC moves that, for the gag assessment, the proxy for F_{MSY} be F_{MAX}.

Retention and Relative Fishing Pressure

Retention patterns and relative fishing pressure have changed in recent years as a result of changes in regulations and stock abundance. To project future yields, assumptions about future retention patterns were required. Projections for the base model were run assuming that selectivity, discarding, and retention were the same as the three most recent years (2010-2012), and that the catch allocation among fleets used for the projections reflects the average distribution of fishing intensity among fleets during 2010-2012. However, the assessment evaluated several other time periods between 2008 and 2012. A motion was made to use the widest time period for projections, i.e., assume retention is the average of 2008-2012 estimates as is relative fishing pressure among fleets. However, most SSC members felt that there was too much uncertainty about retention and relative fishing pressure to select one scenario. The motion failed by a vote of 4 to 16.

Gag Stock Status as of 2012

Using the SSC's selected model of steepness = 0.85, female only SSB, and and F_{MSY} proxy of F_{MAX}, the ratio of $SSB_{CURRENT}/SSB_{FMAX}$ = 1.280 (Table 2). Because the biomass ratio is above 1.0, the stock biomass is above its B_{MSY} rebuilding target, and the gag stock is not overfished.

Table 2. 2012 Stock Status ($SSB/SSB_{Reference}$)			
Reference	Steepness	SSB-female	SSB-combined
SPR30%	0.7	1.701	0.374
SPR30%	0.85	1.782	0.431
SPR30%	0.98	1.866	0.543
FMAX	0.7	1.120	0.849
FMAX	0.85	1.280	0.925
FMAX	0.98	1.380	0.931

Table 5.1 of the Gag assessment indicates that, with a steepness = 0.85 and female only SSB, the value for F_{MAX} = 0.157 y^{-1} (also equal to the maximum fishing mortality threshold, MFMT). The value for $F_{CURRENT}$ (measured as the geometric mean of 2010-2012) = 0.083 y^{-1}. Therefore, the ratio of $F_{CURRENT}/F_{MAX}$ = 0.529. Because the fishing mortality rate ratio is below 1.0, the current fishing mortality rate is below MFMT, and the gag stock is not undergoing overfishing.

By a vote of 19 to 0, the SSC finds that, based on the gag base model accepted by the SSC (steepness=0.85, female only SSB, and F proxy = F_{MAX}, the SSC estimates the gag stock not to be overfished or undergoing overfishing.

Gag OFL and ABC

The base model accepted by the SSC (steepness=0.85, female only SSB, and F proxy = F_{MAX}, did not have yield projections prepared at this SSC meeting. In addition, a probability density function (PDF) based on the accepted base model has not been constructed. A PDF is needed to apply the ABC control rule. Yield streams and a PDF based on the accepted model will be reviewed at the August SSC meeting, at which time OFL and ABC yield streams will be determined.

The following is from the August 2014 Gulf SSC meeting.

Gag OFLs and ABCs

Jake Tetzlaff gave a presentation summarizing OFL and ABC projections for gag based on the assessment model run accepted by the SSC at its June meeting (female-only based spawning stock biomass, F_{MAX} proxy for F_{MSY}, and spawner-recruit steepness value = 0.85). In order to run projections, several assumptions need to be made. In particular, assumptions about future selectivity and retention patterns and relative fishing pressure among fleets affect both the reference points and projected yield streams. It is usually assumed that these parameters in the future will be similar to recent past years, but in the case of gag the most recent past years were atypical due to the oil spill, implementation of the commercial grouper IFQ in 2010, and management regulations to rebuild the stock in 2011 and 2012. Thus, it is possible that

fishermen behavior in future years may be different than in recent years. To account for this, projections were made under three assumptions regarding future retention and two assumptions regarding relative fishing pressure. Four combinations of these assumptions were modeled (Figure 6).

Benchmark and projection reference years

Retention assumption

- Option 1: assume retention is average of 5 most recent years
- Option 2: assume retention is average of 2 most recent years
- Option 3: assume retention of legal fish will not be inhibited by reduced quotas/closed seasons

Relative fishing pressures among fleets

- Option 1: assume relative F is similar to 5 most recent years (2008-2012)
- Option 2: assume relative F similar to 2 most recent years (2011-2012)

Scenario	Notation	Selectivity	Retention	Relative fishing pressure
1	R0812_F0812	2008-2012	2008-2012	2008-2012
2	R112_F1112	2008-2012	2011-2012	2011-2012
3	R13_F0812	2008-2012	2013*	2008-2012
4	R13_F1112	2008-2012	2013*	2011-2012

*2013 retention not estimated - assumes 100% retention of fish above the current size limit

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Figure 1. Assumptions used for four gag OFL/ABC projection scenarios.

All of the OFL yield projections start out high, and then decrease as the female biomass is fished down to equilibrium levels (Figure 7). The resulting OFLs and ABCs for 2015 through 2018, plus the equilibrium values, are shown in Figure 8. OFL is the yield at F_{MAX}, and ABC is the yield at a P* = 0.40. Three of the scenarios (A, C, and D) produce similar results, but scenario B produces much lower OFLs and ABCs. This is because this scenario assumes that both retention and relative fishing pressure would be similar to 2011-2012. This is a period when a large amount of discarding occurred in both the commercial and recreational fisheries.

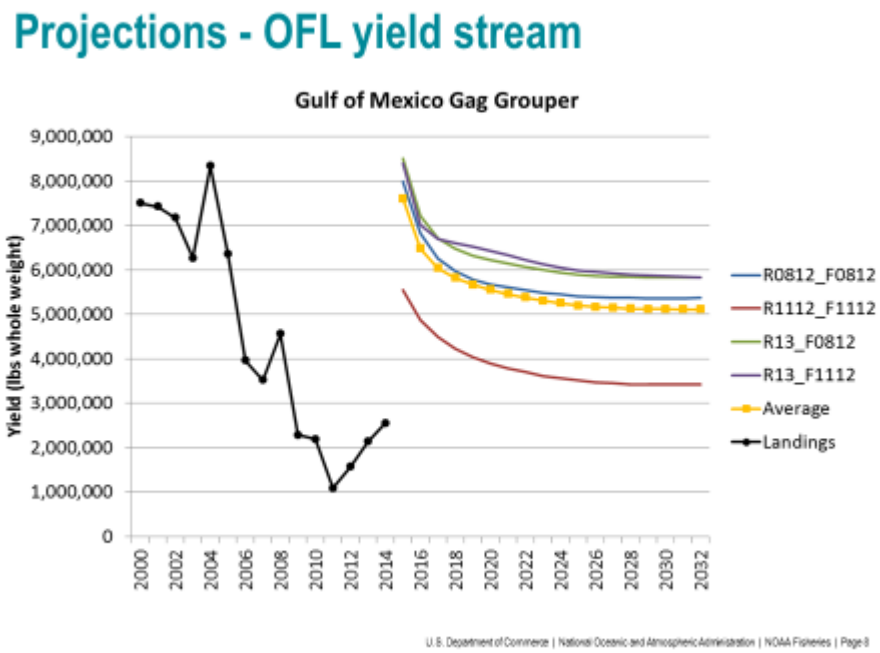

Figure 2. Gag OFL projections under four retention and relative fishing pressure scenarios.

Projections - OFL and ABC advice

A) Projection scenario: R0812_F0812

Year	OFL	ABC	OY
2015	7,990,000	7,830,000	6,160,000
2016	6,820,000	6,700,000	5,570,000
2017	6,260,000	6,170,000	5,350,000
2018	5,970,000	5,890,000	5,280,000
Equilibrium	5,400,000	5,360,000	5,370,000

C) Projection scenario: R13_F0812

Year	OFL	ABC	OY
2015	8,510,000	8,340,000	6,570,000
2016	7,220,000	7,100,000	5,900,000
2017	6,720,000	6,620,000	5,730,000
2018	6,470,000	6,390,000	5,710,000
Equilibrium	5,840,000	5,800,000	5,800,000

B) Projection scenario: R1112_F1112

Year	OFL	ABC	OY
2015	5,550,000	5,280,000	4,260,000
2016	4,870,000	4,650,000	3,930,000
2017	4,490,000	4,300,000	3,790,000
2018	4,230,000	4,040,000	3,730,000
Equilibrium	3,500,000	3,330,000	3,560,000

D) Projection scenario: R13_F1112

Year	OFL	ABC	OY
2015	8,400,000	8,160,000	6,500,000
2016	7,010,000	6,830,000	5,720,000
2017	6,700,000	6,560,000	5,680,000
2018	6,600,000	6,500,000	5,790,000
Equilibrium	5,780,000	5,740,000	5,800,000

E) Equally weight all four scenarios:

Year	OFL	ABC	OY
2015	7,610,000	7,240,000	5,870,000
2016	6,480,000	6,190,000	5,280,000
2017	6,040,000	5,770,000	5,140,000
2018	5,820,000	5,550,000	5,130,000
Equilibrium	5,130,000	4,870,000	5,130,000

ABC determination used a P of 0.40

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Figure 3. Gag OFL, ABC, and OY projections under four retention and relative fishing pressure scenarios. ABC projections use a P* = 0.40. For comparison, in 2014 the gag OFL = 2.82 mp, and the ABC = 2.91 mp.

It was observed that some of the OY equilibrium yields in the projections were higher than the equilibrium OFL, thus questions arose as to why this could occur. Dr. Tetzlaff responded that if fished at 75% of F_{MSY}, at some point biomass levels would increase to a point where OY would become higher than OFL. Another reason for this result was that this resulted from the relative selectivities and allocation of gag between the commercial and recreational sectors. Dr. Calay added that at equilibrium OY the spawning stock biomass is much higher than at equilibrium OFL, so it is possible for the yield at F_{OY} to exceed the yield at F_{MAX}.

The SSC discussed which of the projection scenarios to use for management advice. Dr. Patterson noted that the National Standard 1 guidelines allow the SSC to "recommend an ABC that differs from the result of the ABC control rule calculation, based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors, but must explain why." SSC members stated that the greatest uncertainty was the effect of the red tide event. The red tide of 2005 caused substantial gag mortality, and the impact of the ongoing event is currently unknown. This uncertainty could not be accounted for in the ABC control rule tier 1 spreadsheet, and the SSC therefore concluded that an ABC derived from a P* calculated by the tier 1 control rule would not adequately account for the red tide uncertainty.

As an alternative to setting an annual ABC based on the control rule, the SSC considered setting ABC at the equilibrium OY from one of the projection scenarios. The equilibrium OYs are below the annual ABCs for each of the scenarios, and would provide an additional buffer against the red tide uncertainty, but would still allow an increase from the recent yields.

A question was raised regarding the impact of the 2005 red tide event. Dr. Tetzlaff responded that the 2005 event was estimated to have removed about half the adult gag populations. Mr. Atran added that according to the SEDAR assessment report about 3.4 million gag were removed, with a mortality rate of 0.708 y^{-1}. The effect of the 2005 red tide event has been incorporated into the projections, but the current red tide event has not been incorporated.

SSC members felt that without additional analysis to evaluate the probable impact of the red tide event they did not have enough information to make an ABC recommendation. A suggestion was made to request additional projections that incorporate the current red tide event as an episodic mortality event in 2014. Questions would be which base scenarios to use and how large a mortality rate to apply to the episodic event. Dr. Tetzlaff responded that such projections could be run, but he had not done such a projection previously and could not have it done in time for the current SSC meeting. Dr. Barbieri stated that he would not have information on the magnitude of the red tide event until mid-2015.

Mr. Atran noted that if the SSC did not make any ABC recommendation for 2015, there is a scheduled increase already on the books that will raise the 2015 ABC from 2.82 mp to 3.12 mp. He added that if the SSC could evaluate the additional analysis and make an ABC recommendation in October, and the Council was able take final action on a framework action in January 2015, the action, if approved by NMFS, would be implemented sometime around the middle of the year. However, the recreational sector might not get the full benefit of the change if it included a change in the July 1 starting date. If the Council was unable to take final action

until its April meeting, then it was unlikely that management changes could be implemented in time for the 2015 fishing year.

A suggestion was made to set an ABC for just 2015, and reevaluate the gag projections for subsequent years in 2015 after the impact of the red tide event was known. However, all but one of the projection scenarios presented would more than double the ABC for 2015, which seems inappropriate given the uncertainty about the red tide event. One SSC member suggested setting the 2015 ABC at the equilibrium OY value for scenario B (3.56 mp). This was the most conservative catch level in the projections, but it was still higher than the catch level for 2014, and slightly higher than the ABC will be in 2015 if no action is taken (3.12 mp). However, other SSC members felt that the SSC should select the most likely scenario for retention and relative F rather than the most conservative output, and then reduce that value to account for the red tide. Other SSC members felt that all of the scenarios presented are based on the ABC control rule with P* = 0.40, and given that the SSC previously determined that the tier 1 control rule would not adequately account for the red tide uncertainty, none of the scenarios should be used.

Options considered by the SSC are summarized as follows:

- Do not make an ABC recommendation until more information is available on the red tide event. Without this information, some of the SSC members had no confidence that any of the scenarios analyzed were realistic. If no action is taken, existing regulations will automatically increase the ABC to 3.12 million pounds in 2015.

- Select the ABC for the most reasonable scenario for 2015 and reduce it by approximately 2 million pounds, which represents the reduction in landings from 2005 to 2006 during the previous major red tide event (the actual reduction was 2.4 mp). This would result in a 2015 ABC of 3.2 mp to 6.3 mp depending upon which scenario is selected. An SSC member suggested that the reduction should be based on a percentage of the spawning stock biomass that was removed by the 2005 red tide event, which would need to be modeled. Since the biomass is higher today than in 2006, this would likely result in a greater number of pounds to reduce the ABC.

- Set the 2015 ABC at the equilibrium ABC of the selected scenario (3.3 mp to 5.8 mp), or the average equilibrium ABC from all four scenarios (4.9 mp). Any of these options would result in an ABC below the projected 2015 value, and would set ABC at the eventual long-term level.

Regardless of the approach used, the 2015 ABC would be considered a placeholder until more information is available about the red tide event.

Dr. Tetzlaff stated that he expected to be able to provide additional analysis in October, but it depended how difficult it would be to add an episodic event to the projection analysis. Dr. Calay added that there would not be enough information by October to have scientific evidence on the impact of the red tide event, so some assumptions will need to be made.

The SSC discussed what scenarios to request analyses for. The SSC decided that the scenarios on which to base the analysis should be scenarios A and B (Figure 5) in order to capture a full range of possibilities. Scenario A was selected because both retention and relative fishing pressure were based on the longest time series (2008-2012). This time series includes 2010, which is often excluded from analyses due to the impacts from the oil spill. However, the projection analysis requires a continuous time-series and is unable to exclude a year in the middle of a series. Scenario B was selected because retention and relative fishing pressure were based on the short time series (2011-2012) when there was a short recreational season and high commercial discards. It was also a period when the commercial sector was under an IFQ for the entire time series. Although SSC members considered scenario B implausible, when combined with Scenario A it provided a wide range of possible outcomes. The SSC also felt that the analyses should consider a range of possible red tide impacts. After discussion on how to configure the analysis request, the following motion was passed:

> **By a vote of 11 to 2, the Committee recommends that projections of gag grouper be developed using an episodic natural mortality rate in 2014 due to the observed red tide on the West Florida shelf. The natural mortality rate should be modeled using a multiplier of the 2005 red tide mortality ranging from 0.5-1.5. Projections should be developed using the assumptions of scenarios A (R0812_F0812) and B (R1112_F1112).**

Scenario	Notation	Selectivity	Retention	Relative Fishing Pressure
A	R0812_F0812	2008-2012	2008-2012	2008-2012
B	R1112_F1112	2008-2012	2011-2012	2011-2012

The following is from the October 2014 Gulf SSC meeting.

The Committee recommends that the 2015 Gag grouper ABC be 3.07mp and that the OFL be 3.31mp. (BG)

Motion passed 10-1.