

Notes on Golden Crab Literature & MSY

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1996 Original Golden Crab FMP

- Very rough estimates of MSY and biomass were done based on what is known about golden crabs in the Eastern Gulf of Mexico and what was currently known about habitats in the South Atlantic. **This resulted in various MSY estimates ranging from 69,658 lbs to 1,648,611 lbs.**
- The large range in estimates comes from using variable crab densities and habitat area in calculations.
- The SSC reviewed all the different MSY calculations but concluded that **there is simply not enough information on golden crab to reliably set an OY or MSY or TAC.** The Golden Crab AP also reviewed the data and came to the same conclusion.
- The Council reviewed all the data and comments from the SSC and AP and decided that, based upon the best available information, **not to specify an MSY in the FMP.**
- TURF and Coop management options were considered but rejected.

1999 Amendment 2

- Was part of the Council's Comprehensive Amendment addressing Sustainable Fishery Act (SFA) definitions.
- Amended the FMP as required to make definitions of MSY, OY, overfishing and overfished consistent with "National Standard Guidelines"; identified and defined fishing communities and addressed bycatch management measures.
- The description of fisheries and communities was approved, as was bycatch reporting. The remaining items for golden crab were disapproved because the stock status determination criteria were incomplete and did not totally fulfill the new requirements of the MSA and national standard guidelines.

2000 analysis (Harper et al)

This analysis was done by request of the SAFMC in 2000, and is Appendix 3 in the 2004 SAFE Report.

- Monthly catches, number of traps hauled by fishing zone per month, and number of vessels reporting catches per year have been updated through September 2003 in the SAFE report.
- Because of a lack of data, catch and estimated effort have been fit to a non-equilibrium production model to analyze and estimate stock status relative to MSY levels.
- They summarized logbook program and TIP sampling info available through March 2000, and updated the fishery production model analysis. **They concluded that as of 2000 GC was neither overfished nor undergoing overfishing.**
- For a quarterly run of the model, they assumed that initial biomass levels in 1986 were at carrying capacity.
- They found that current biomass was slightly less than B_{MSY} (after having increased from lower levels in the recent past) but above MSST; and that F was nearly equal to F_{MSY} and MFMT.
- Under this model, the approximate 80% confidence range for quarterly MSY is about 144,000 to 186,000 lbs per quarter, with a median estimate of 171,000 lbs per quarter for the fishery as it has historically operated. This yield would be expected from a quarterly effort level of about 4,800 trap hauls within the fishing grounds where the fishery has historically taken place.
- These quarterly estimates translate into an **annual median estimate for MSY of approximately 684,000 lbs** and an **annual median estimate for f_{MSY} of approximately 19,000 trap hauls per year** within the areas and manner historically fished.
- For a run of the model that used the 5 annual catch and effort observations, results were similar, but provide more uncertain estimates of stock status. This run resulted in a current biomass

- estimate that is slightly above B_{MSY} after having increased from a low in 1998, while fishing mortality is slightly below F_{MSY} .
- Under this run, the approximate 80% confidence interval range for annual MSY resulting from this fit to the fishery data is about 212, 00 to 799,000 lbs per year with a **median estimate of 673,000 lbs per year** for the fishery as it has historically operated. This yield would be expected from an annual effort level of **about 22,100 trap hauls** within the fishing grounds and in the manner the fishery has historically operated.
 - There is concern that the low amount of data put in the production model isn't quite enough to be statistically sound. However, the study was run by the NOAA SEFMC so would therefore probably be considered the best available science.
 - This analysis needs to be run again with more recent data.
 - The quarterly estimates translated into annual estimates are more precisely determined and fall well within the confidence ranges for estimates of parameters based on annual data.

2000 Amendment 3

- Established MSY and adopted definitions of Minimum Stock Size Threshold (MSST) and Maximum Fishing Mortality Threshold (MFMT).
- MFMT is the rate that if exceeded constitutes overfishing. This is a fishing mortality rate that is in excess of the fishing mortality rate that produces MSY.
- MSST is the stock size below which golden crab are considered overfished. This would be either a ratio of current biomass to biomass at MSY (B_{MSY}) or one minus the natural mortality rate ($1 - M$) times B_{MSY} (where $1 - M$ should never be less than 0.5). Golden crab would be considered to be overfished if current Biomass was less than MSST, and would be considered recovered when current biomass was equal or greater than the biomass at MSY.
- Based on the Harper et al paper, this document concluded that the stock is not overfished and overfishing is not occurring.
- The SSC still expressed concern about the limited amount of data and if it was applicable to use the data from a limited area to generate MSY for the entire area or even a limited area.
- **The AP also expressed the same concerns, but said that if an MSY number is necessary, a range of 4 to 18 million pounds be used.** This number was arrived at by taking the MSY estimate of 5.5 million pounds and the amount of area known for red crab, and scaling it up to account for the larger area yielding golden crabs.
- **An updated NMFS assessment (Harper et al) estimated an annual MSY of 673,000 lbs based on annual landings, and an estimate of 171,000 lbs based on quarterly catches.** The Council discussed these estimates but **rejected** them because they were based on catches from only a small portion of the fishery. In addition, using these numbers would have resulted in a limit on landings that would have prevented proper development of the fishery and achievement of OY and the fishery management goals. The AP also commented that using such a low estimate of MSY would prevent further development in the fishery.
- In the end, **the full Council approved an MSY of 4 to 12 million pounds**, reduced from the AP's upper limit of 18 million lbs in order to be more risk averse while still allowing full development of a sustainable and viable fishery. At that time, they stated that they are not relying on MSY to manage the fishery, and that the biological measures (no harvest of females, escape gaps, escape panels, etc) provide adequate protection to prevent overfishing. They are only specifying this number because they have to in order to comply with MSA.

2003 Status of Stocks Report (NMFS)

- There are *no* stocks subject to overfishing in the golden crab FMP.
- There are *no* overfished stocks in the FMP.
- There are *no* stocks approaching an overfished condition in the FMP.

2004 SAFE report

- It appears that the latest data can be found in the 2004 SAFE Report. A rough stock analysis was done by request of the SAFMC in 2000, and is Appendix 3 in the 2004 SAFE Report (Harper et al).
- Monthly catches, number of traps hauled by fishing zone per month, and number of vessels reporting catches per year have been updated through September 2003 in the SAFE report.
- Monthly measurements of individual crab carapace widths were also updated through September 2003. This info came from the Trip Interview Program Database (TIP).
- The trend since the mid-1990's has been a reduction in number of permits issued, as well as a reduction of permits that are actually fished.
- Up until 2003 catches occurred primarily in the middle zone. Landings in this zone fell 40% from 2000 to 2003. In general there is a trend of decreasing catch from January to July, then an increase beginning in August.
- It appears that through 2000, catches came primarily from the middle zone. In some years, the southern zone wasn't even fished. More recently it seems that there are now more fishermen in the southern zone than in the middle zone.
- Up until 2003 catches in the southern zone made up about 30% of the total across all zones. In general CPUE in the southern zone is lower and more variable than the middle zone.
- CPUE trends demonstrate variable seasonal patterns with peak CPUE occurring in winter-spring (December through May) and lower CPUE during summer-fall (June through November).
- Based on the Harper et al paper, plus the 2003 Status of Stocks report, **this SAFE report did not argue the fact that golden crab have been determined to not be overfished or experiencing overfishing.**

2008 Status of Stocks Report (NMFS)

- It is unknown if stocks are undergoing overfishing.
- It is unknown if the stock is overfished.
- It is unknown if stocks are approaching an overfished condition.

MSY discussion from Amendment 3

Amendment 3 proposed an MSY range of 4 to 12 million lb (1.8 to 5.4 million kg). NMFS disapproved the estimate because the best scientific information available indicated that the range was too high. NMFS believed that the proposed MSY estimate, if implemented, could have led to overfishing of the golden crab resource. NMFS and the Council said they would continue to monitor landings and other biological information on this fishery and as soon as sufficient information becomes available, an improved MSY estimate will be implemented (as far as I can tell, this has not been done yet).

Two fishermen supported the proposed MSY estimate and were disappointed that NMFS had disapproved that measure. However, at the time when Amendment 3 was published, the fishery was conducted only in the southern and middle zones. NMFS stated that the best scientific information available for these zones indicated that this area could support an annual harvest of somewhat less than 700,000 pounds (317,515 kg). The northern zone, which is equivalent in size to the combined southern and middle zones, lacked catch data to derive an MSY proxy. Nonetheless, information in the original FMP indicated that the MSY proxy for the northern zone could be between 0.54 and 1.65 million pounds (0.25 and 0.75 million kg). Adding the two sets of estimates together indicates an MSY proxy of between 1.25 and 2.35 million pounds (0.57 and 1.07 million kg). NMFS said that this information constitutes the best scientific information available and indicates that the true MSY for the combined areas most likely is between 1.5 and 2.5

million pounds (0.68 and 1.13 million kg). Since one large vessel has the capability of landing up to 3 million pounds annually, one or two larger vessels together with existing participants could have overfished the golden crab resource if the proposed MSY proxy of 4 to 12 million pounds (1.8 to 5.4 million kg) had been approved. Consequently, NMFS disapproved the proposed MSY proxy to minimize the possibility of overfishing this resource.

In summary:

SSC recommends an MSY of 4 – 8 million lbs to the Council

The full Council votes in favor of an MSY of 4 – 12 million lbs, this amount is sent to NMFS for approval in Amendment 3

NMFS disapproves of this MSY and determined it is too high.

NMFS suggests that a more accurate MSY for all areas combined would be closer to 1.5 and 2.5 million pounds.

No MSY was accepted, and there remains no MSY today. (I will be contacting Kate Michie with NMFS to make sure this is true)