Gulf of Mexico King Mackerel

SEDAR 38 Update Executive Summary

October 2020

This document serves as a summary of the full SEDAR 38 Update Stock Assessment Report (SAR), which can be found at *http://sedarweb.org/sedar-38*.

Stock

This assessment documents the status of the King Mackerel (*Scomberomorus cavalla*) resource in the Gulf of Mexico (Gulf) through 2017 and projects the quotas starting in 2021. The Gulf King Mackerel stock ranges from Texas to Florida including Monroe County north of the Florida Keys during all months of the year.

Stock Status

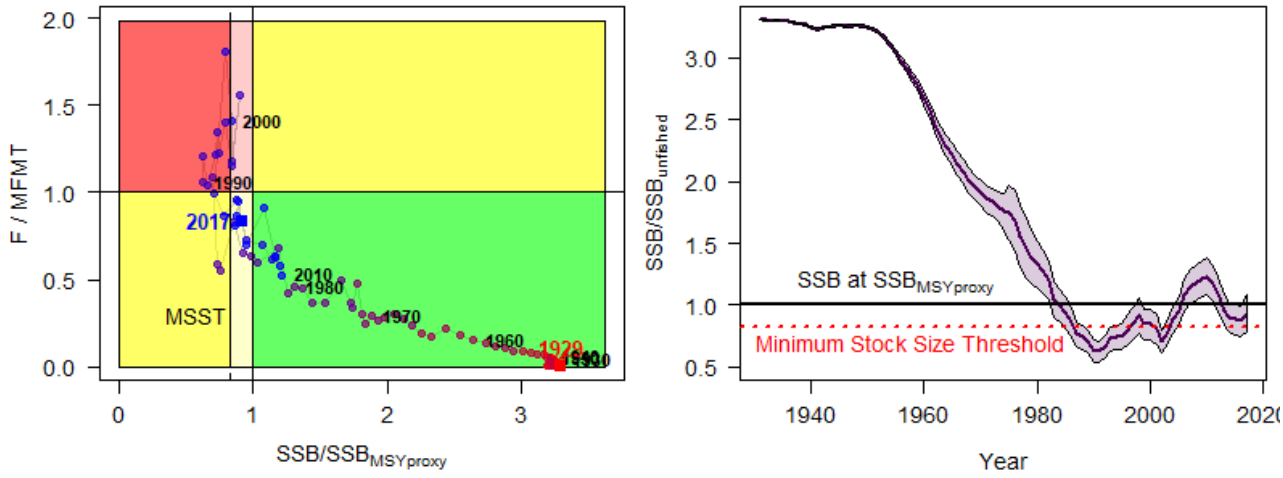

Figure 1: Kobe plot [left panel] showing the progression of exploitation status for Gulf King Mackerel from 1929 to 2017, with the Minimum Stock Size Threshold (MSST) denoted. Each point reflects a single year, labels are specified every 10 years, and colors gradually change from red (1929) through purple and ultimately blue (2017). Ratio of Spawning Stock Biomass (SSB) to unfished SSB relative to the MSY$_{Proxy}$ with 95% asymptotic confidence intervals (shaded region) [right panel].

Projections were to be completed by forecasting fishing mortality (F) at maximum sustainable yield (F_{MSY}) using the base assessment model configuration. However, it was not possible to calculate MSY and its associated reference points (F_{MSY} and biomass at MSY; B_{MSY}) since the spawner-recruit relationship was deemed unreliable; therefore, a proxy for F_{MSY} was required. Using an MSY_{Proxy} of 30% spawning potential ratio (SPR) as the benchmark in defining the minimum stock size threshold (MSST) and maximum fishing mortality threshold (MFMT) in Table 1, the

assessment found that in 2017 Gulf King Mackerel is neither undergoing overfishing ($F_{Current}$/MFMT = 0.84) nor overfished ($SSB_{Current}$/MSST = 1.12). The Kobe plot illustrates that over the course of the years included in the assessment (i.e., 1929 in red through 2017 in blue), the stock has experienced overfishing between 1989 and 2001 and been overfished between 1987 and 2003 (Figure 1). However, the terminal year estimate of SSB_{2017} divided by the estimated virgin SSB (SSB_0) of 28% remains just below the SPR of 30% at the $SSB_{MSYproxy}$ (Figure 1).

Table 1: Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for SEDAR 38 Update. SSB is in billions of eggs, whereas F is a harvest rate (total biomass killed / total exploitable biomass), and $F_{Current}$ is the geometric mean of F from 2015 – 2017.

Reference Point Criteria		**Current Benchmarks**	
SPR at $SSB_{MSYproxy}$	30%	SSB_{2017}	1,580
Base natural mortality (M)	0.174	$F_{Current\ (geom.\ mean:\ 2015\text{-}2017)}$	0.14
Steepness	0.99	SSB_{2017} / SSB_0 (SPR_{2017})	0.28
Generation Time	7.77	SSB_{2017} / $SSB_{MSYproxy}$	0.92
SSB_0 (Unfished)	5,644	SSB_{2017} / MSST	1.12
$SSB_{MSYproxy}$	1,714	--MSST Overfished?	No
MSST = (1-M)*$SSB_{MSYproxy}$	1,416	$F_{Current}$ / MFMT	0.84
MFMT = $F_{MSYproxy}$	0.167	--Overfishing?	No
F_{OY} (F at optimum yield)	0.142		

Scientific and Statistical Committee (SSC) Recommendations

The SEDAR 38 Update stock assessment and projections were reviewed by the Gulf SSC on September 14, 2020. The SSC determined that the SEDAR 38 Update represents the best scientific information available and, based on assessment results, the stock status is estimated to be not overfished and not undergoing overfishing. SSC members discussed discomfort with the narrow buffers produced using the probability density functions (PDFs) in the projections. The SEFSC also noted that the uncertainty in the SEDAR 38 Update base model is larger than that produced by the PDFs, and that a percentage of the MSY proxy may be more appropriate. Thus, the SSC estimated the overfishing limit (OFL) to be 10.89, 11.05, and 11.18 million pounds whole weight (mp ww) for the Gulf King Mackerel stock during fishing years 2021-2023, respectively, based on results of the SEDAR 38 Update assessment and projections. The SSC set the acceptable biological catch (ABC) for the same years to be 9.37, 9.72, and 9.99 mp ww, respectively, with the annual ABC being the projected yield at F_{OY} (0.85*$F_{SPR30\%}$).

Socioeconomic and Ecosystem Considerations

Although no socioeconomic or ecosystem considerations were incorporated into the SEDAR 38 Update, information on Gulf King Mackerel was collected from recreational and commercial fishermen via the Gulf of Mexico Fishery Management Council's Something's Fishy tool. This tool facilitates input from stakeholders into the stock assessment process by inquiring those stakeholders about a particular species ahead of its assessment. Stakeholders could identify as private recreational, federal for-hire, commercial, or a combination thereof. A total of 47 responses were gathered from September 6, 2020, to October 6, 2020, with a majority being private angler

respondents. Responses were analyzed manually (reader-validated) and using automated sentiment analysis (performed using the R tidytext package and a Bing lexicon library) to determine if responses indicated positive, negative, or neutral trends in the Gulf King Mackerel stock. The manual classification of responses indicated a negative trend in stock health, while the automated sentiment analysis indicated a minor trend towards a positive sentiment of the stock. Responses were also categorized by location; those from the west coast of Florida were much more positive than those collected from Alabama to Louisiana. The automated analysis also indicated a decline or negative perception of abundance when sorted by location. Many of the negative comments specified that a lack of bait as prey for Gulf King Mackerel was driving the observed decline in abundance. Positive comments indicated Gulf King Mackerel were observed to be larger than normal.

Projections

The retained yield and associated ratio of SSB to unfished SSB were projected under the assumption that all recent fishery dynamics would continue indefinitely (e.g., relative fishing effort, selectivity, retention and shrimp fishery bycatch) at the 2017 estimated values and that recruitment would remain constant at the unfished level of 7.68 million fish per year. Forecasts begin in 2021, because the 2018, 2019 and 2020 fishing years are already completed or underway. Catches in 2018-2020 were arrived at by exploiting the 2018-2020 projected stock size by the 2017 estimated exploitation rate. Forecasts were carried out at the $F_{MSYproxy}$ with a P* of 0.5 in order to determine the OFLs (Figure 2). The stock is currently (2017) below the $SSB_{MSYproxy}$ (Table 1), and forecasts indicate maintaining yields at or below the 2021 acceptable biological catch (ABC) of 10.89 mp ww in the near-term will allow the stock to build towards the $SSB_{MSYproxy}$ (Figure 2). An optimum yield (yield resulting from fishing at 85% of $F_{MSYproxy}$) projection was also completed. The trends obtained from the optimum yield projection are similar to the OFL run, but result in a relatively higher SPR (35%) with slightly lower annual yield (Figure 2).

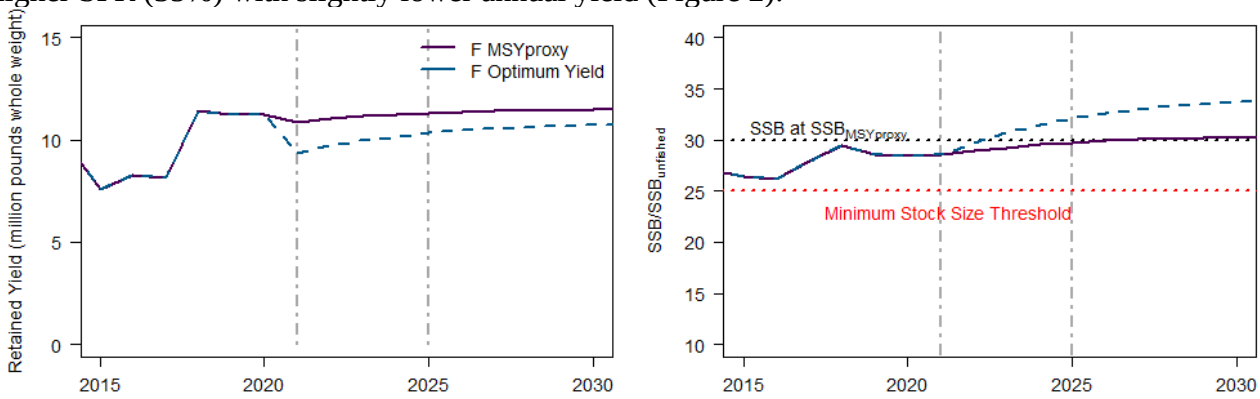

Figure 2: Retained Yield [left panel] and resulting ratio of SSB to unfished SSB [right panel, expressed as a percentage] for projections fishing at $F_{MSYproxy}$ (Base Model) and at 85% of this level (Optimum Yield). All scenarios assume recruitment equivalent to unfished levels, and reference points (defined in Table 1) are marked with horizontal dotted lines. Vertical dashed lines identify the first five years of projected yields: 2021 through 2025.

Data and Assessment

The assessment model used was Stock Synthesis (version 3.24P). Removal data used in the model include landings and/or discards for two commercial fishing fleets (vertical line and gillnet) and two recreational fishing fleets (headboat and charter/private). Bycatch dead discards from the Gulf

shrimp fleet were also included. Fishery-dependent indices of relative abundance were included for the commercial vertical line fishery and the recreational headboat fishery (Figure 3). The SEAMAP fall groundfish trawl survey was included as a fishery-independent index of relative abundance (Figure 3). A larval survey was included and modeled as an index of SSB (Figure 3).

Relative abundance trends were highly variable for most indices, particularly in recent years. Length composition data were used to estimate selectivity for each fishery, and the SEAMAP groundfish trawl survey and the shrimp bycatch were assumed to catch age-0 fish. Age composition was modeled as a set of conditional ages at length. No composition data were available for discards, so retention functions were assumed to be knife-edged at the fleet and regulation-specific minimum size limits.

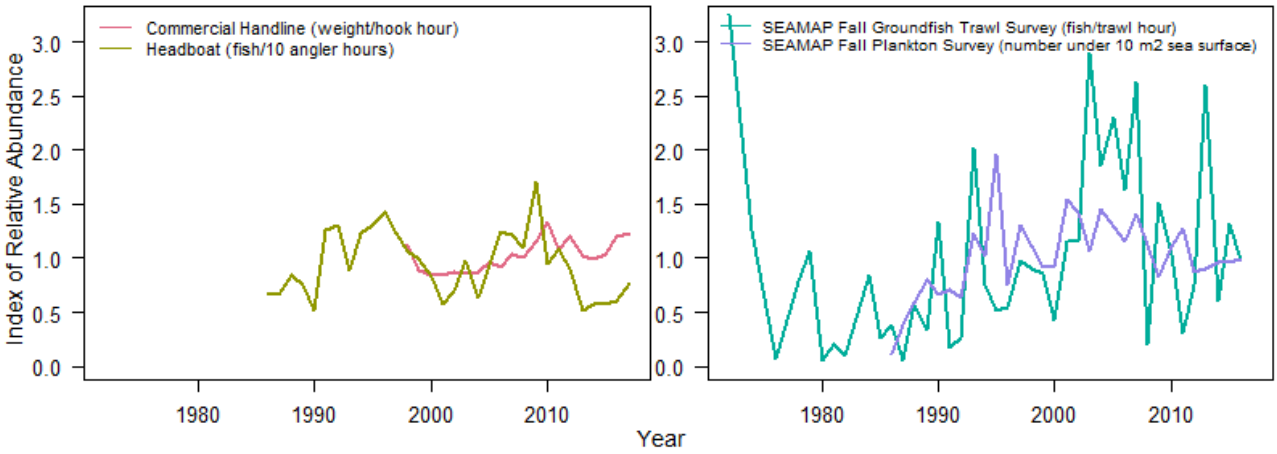

Figure 3: Gulf King Mackerel observed indices from SEDAR 38 Update by fishery (left panel) and survey (right panel), 1972-2017.

Life history equations and parameters used in SEDAR 38 Update are reported in Table 2. The assessment model was set-up with 2 genders to account for sexually dimorphic growth. A fixed length-weight relationship was used to convert body length (cm) to body weight (kg) with no differences between sex. Sex-specific growth curves were estimated within the model using starting parameters estimated during SEDAR 38 (Table 2). An age-specific vector of natural mortality was obtained using the Lorenzen estimator and a target M of 0.174 per year. Fecundity was modeled as a function of proportion mature and batch fecundity, with SSB defined in billions of eggs. The Beverton-Holt stock-recruitment model was used in this assessment, and adhering to the accepted methodology of SEDAR 38, steepness was fixed at 0.99.

Table 2: Overview of life history equations and recommended parameters used in SEDAR 38 Update. All lengths and weights were reported in fork length (FL) and whole weight (ww), respectively.

Definition	Equation	Parameters
Total to Fork	FL = a + b * TL	a= -4.28 cm , b= 0.963
Length to Weight	$W(t) = a * L(t)^b$	a= 7.31E-06 kg*cm^{-b} , b= 3.008
Age to Length	Starting parameters from SEDAR38 estimates	Female: L_{inf}= 107.21 cm , K= 0.3845 yr^{-1} Male: L_{inf}= 92.57 cm , K= 0.3515 yr^{-1}

Definition	Equation	Parameters
Base M	$M=\exp[1.46 - 1.01 * \ln(t_{max})]$	t_{max}= 24 yr , M= 0.174
Maturity	$P_{mat}= 1/(1+e^{slope*[Length-Length50\%]})$	slope= -0.3689 , L50%= 58.113 cm
Annual Fecundity	$BF(t) = a * L(t)^b$	a= 6.08E-07 eggs*cm^{-3*b} , b= 3.05
Recruitment	$R_{yr}=[4hR_0SSB_{yr}]*[SSB_0(1-h)+SSB_{yr}(5h-1)]^{-1}$	h= 0.99 , R_0= 7.68 million recruits

Recruitment

With steepness fixed at 0.99, the recruit variance term was estimated at 0.679 and virgin recruitment was estimated at 7.68 million fish per year. Starting in the early 1970s, when recruitment deviations were first estimated, recruitment remained below average until the 1990s (Figure 4). Recruitment remained above average until 2004 then declined to below average values. The lowest recruitment estimate occurred in 1983, with only 1.73 million recruits in comparison to the 15.41 million recruits estimated in 1995.

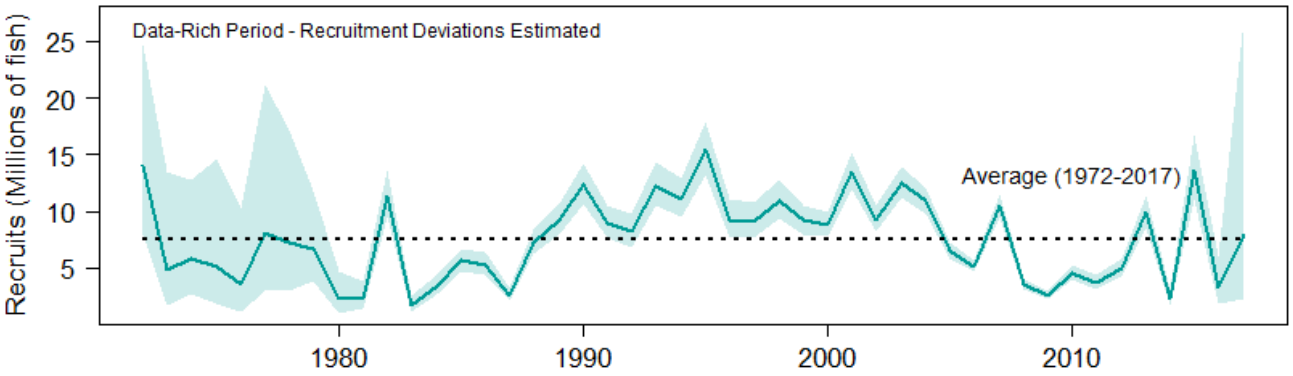

Figure 4: Estimated recruitment (millions of fish) for Gulf King Mackerel with 95% asymptotic confidence intervals (shaded region). Thin dashed lines represent average recruitment during the time series where recruitment was estimated (upper black line).

Landings

Commercial landings of Gulf King Mackerel were obtained from a variety of sources: National Marine Fisheries Service's Office of Science and Technology (1927-1962); the Accumulated Landings System (1963-2017); Florida Fish and Wildlife Conservation Commission Trip Tickets (1985-2013); and the Gulf of Mexico Fisheries Information Network (2000-2017). From 1930 to 2017, estimated commercial landings for the vertical line fishery averaged 1.1 million pounds (mp) whole weight (ww), with a low of 0.02 mp ww in 1933, and a peak of 2.63 mp ww in 2017. Since 1986, estimates have averaged 1.68 mp ww, with a low of 0.57 mp ww in 1987, and a peak of 2.63 mp ww in 2017 (Figure 5). From 1950 to 2017, estimated commercial landings for the gillnet fishery averaged 0.82 mp ww, with a low of 0 mp ww in 1952 and 1958, and a peak of 4.94 mp ww in 1973. Since 1986, estimates have averaged 0.44 mp ww, with a low of 0.01 mp ww in 1987, and a peak of 0.95 mp ww in 1998 (Figure 5). [See Tables 3.3-3.4 of the full SEDAR 38 Update document for commercial landings used in the assessment.]

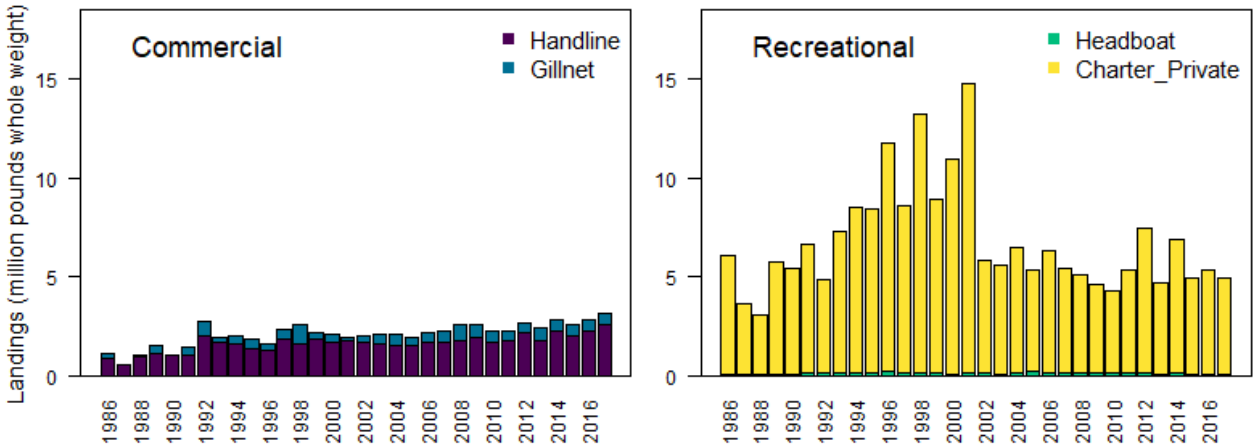

Figure 5: Final Gulf King Mackerel landings estimates from SEDAR 38 Update for commercial and recreational fisheries in millions of pounds whole weight, 1986-2017.

Recreational landings of Gulf King Mackerel were obtained from the Marine Recreational Information Program (MRIP-Fishing Effort Survey [FES]-adjusted), the Southeast Region Headboat Survey (SRHS), and Texas Parks and Wildlife Department (TPWD). Following the three-year transition period for MRIP, estimates of fishing effort for the private and shore modes were obtained from the FES and the 2013 design change in the Access Point Angler Intercept Survey was accounted for during the transition. A charter calibration analysis was conducted by the Southeast Fisheries Science Center on the newly released MRIP data to correct for the change from the Coastal Household Telephone Survey to the For-Hire Telephone Survey. Recreational landings derived from MRIP were comprised of Gulf King Mackerel landed whole and observed by interviewers ("Type A") and Gulf King Mackerel reported as killed by the fishers ("Type B1"). From 1936 to 2017, estimated headboat landings averaged 0.25 mp ww, with a low of 0.02 mp ww in 1936, and a peak of 0.51 mp ww in 1983. Since 1986, estimates have averaged 0.17 mp ww, with a low of 0.1 mp ww in 2017 and a peak of 0.24 mp ww in 1996 (Figure 5). From 1946 to 2017, estimated charter/private landings averaged 4.18 mp ww, with a low of 0.05 mp ww in 1946, and a peak of 14.61 mp ww in 2001. Since 1986, estimates have averaged 6.61 mp ww, with a low of 3.02 mp ww in 1988 and a peak of 14.61 mp ww in 2001 (Figure 5). [See Tables 3.5-3.6 of the full SEDAR 38 Update document for recreational landings used in the assessment.]

Discards

Commercial discards of Gulf King Mackerel for the vertical line fleet were estimated from the Coastal Fisheries Logbook Program (CFLP) from 1998 through 2017 using methodologies described in SEDAR16. A discard mortality rate of 25% for the commercial vertical line fleet was applied following the SEDAR 38 recommendation. Gulf King Mackerel commercial dead discards were not estimated prior to 1998 because no census of total effort was available. Commercial vertical line fleet dead discards averaged 0.04 mp ww from 1998-2017, with a low of 0.03 mp ww in 2010 and a peak of 0.06 mp ww in 1999 (Figure 6).

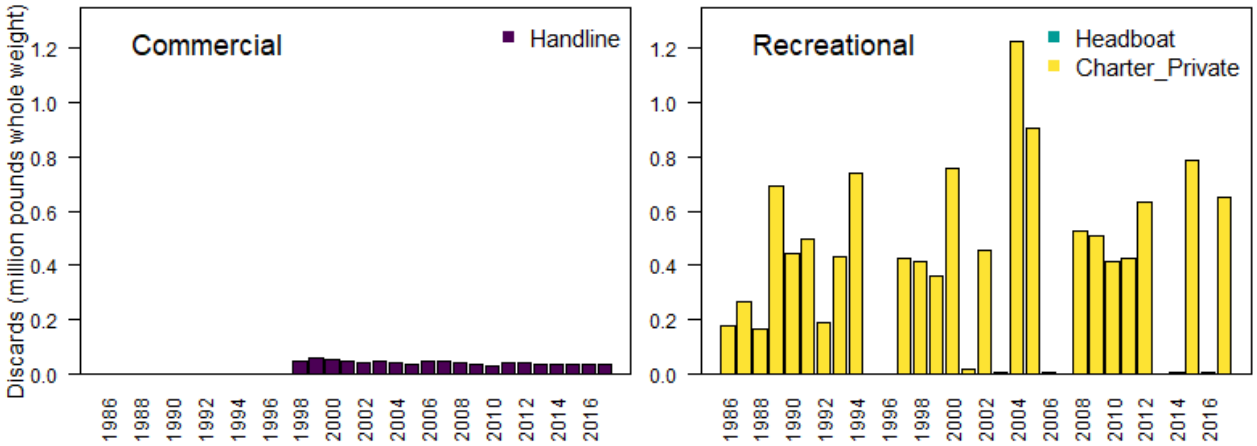

Figure 6: Final Gulf King Mackerel discard estimates from SEDAR 38 Update assessment for commercial (left panel, by fleet) and recreational (right panel, by fleet) fisheries in millions of pounds whole weight, 1986-2017.

Gulf King Mackerel recreational discards were derived from MRIP estimates of live released fish (B2) between 1986 and 2017 and self-reported discards in the SRHS logbook since 2004. Gulf King Mackerel discards from headboats prior to 2004 were estimated using the MRIP charter for-hire discard ratio as a proxy. Since the TPWD survey does not record discards, a Gulf-wide (Florida West - Louisiana) MRIP charter for-hire discard ratio was used as a proxy to estimate headboat discards in Texas. Discard mortality rates of 22% and 20% for the headboat and charter/private fleets, respectively, were adhered to following SEDAR 38 methods. Dead discard estimates from headboats averaged 0.001 mp ww from 1986-2017, with a low of 0 mp ww in 1986 and a peak of 0.004 mp ww in 2000 (Figure 5). Dead discard estimates for the charter/private fleet averaged 0.38 mp ww from 1986-2017, with a low of 0.001 mp ww in 1995 and a peak of 1.22 mp ww in 2004 (Figure 6).