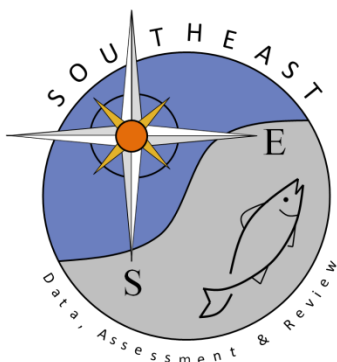


Gulf of America King Mackerel: An investigation of social, economic, and environmental influences on recent fishery dynamics

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SEDAR99-WP-15

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SEDAR99-WP15: Gulf of America King Mackerel: An investigation of social, economic, and environmental influences on recent fishery dynamics

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Abstract

This paper presents the data analyses and discussions of the NOAA Southeast Fisheries Science Center's Coastal Migratory Pelagic Technical Team in response to growing public concern regarding the health of Gulf king mackerel (KMK). Concerns over diminishing landings are supported by multiple indicators showing widespread declines, particularly since 2021. Recreational landings have dropped approximately 65% since the 2001/2002 fishing year, and commercial landings have decreased by about 50% since 2021. Louisiana landings have seen a ~75% decrease since 2020, and the total area fished has been reduced by ~30% in recent years. Standardized SEAMAP catch rates have also declined. Biological data shows that mean length-at-age for older KMK, especially females, has decreased by about 10% since 2001/2002, potentially leading to a greater than 30% reduction in total reproductive output. Concurrently, Northern Gulf sea surface temperatures are increasing, reaching approximately 2°F above the historical average in 2023 and 2024, which may negatively impact larval survival as well as adult growth and migratory dynamics . Observed declines may be attributed to socioeconomic pressures, potential species abundance decline, a population distribution shift (e.g., fish moving offshore due to temperature preferences), or a combination of two or more of those factors. An important consideration for the assessment is whether these patterns are driven heavily by changes in fleet behavior, or if there are environmental factors significantly influencing stock dynamics that need to be accounted for to produce robust management advice.

1. Introduction

The following paper is a compilation of data analyses and discussions undertaken by NOAA Southeast Fisheries Science Center's (SEFSC) Coastal Migratory Pelagic Technical Team (CMP-TT). The CMP-TT was formed in 2024 to provide scientific expertise to address concerns related to CMP trust resources in the Gulf of America (hereafter the Gulf) and U.S. South Atlantic regions. Public comment about Gulf king mackerel (KMK) during recent Fishery

Management Council meetings has raised concerns over diminishing landings and overall stock health. The CMP-TT has been reviewing available data sources and data collection/analytical options to provide recommendations for enhancing SEFSC science advice.

2. Monitoring Challenges

A key challenge in assessing the KMK stock is that Gulf-wide monitoring programs are not specifically geared for effectively sampling KMK, a highly coastal pelagic species. The SEAMAP Summer and Fall Groundfish Surveys use a bottom trawl and therefore do not consistently sample the pelagic environment where juvenile KMK typically occur. Larval data come from the SEAMAP Fall Plankton Survey, which typically occurs only in September. This timing means it is sampling only the latter portion of the KMK spawning season (May-October). As such, indices of abundance for assessing KMK population trends using these surveys have inherent limitations that should be considered when these indices are used in a stock assessment.

3. Fishery Trends

Recent data across both the recreational and commercial sectors indicate large declines in landings and quota usage, particularly in recent years.

3.1 Recreational and Commercial Sectors

Recreational landings of Gulf KMK have seen a substantial decline of approximately 65%, decreasing by roughly 2.6 million pounds since the 2001/2002 fishing year ([Fig. 1](#)). Notably, the recreational sector has not achieved its Annual Catch Limit (ACL) in the past 22 years ([Fig. 1](#)). When the ACL was increased for the 2022/2023 fishing year based on new MRIP-FES numbers, this increase effectively reallocated potential catch to the commercial sector, as the recreational sector continued to under-harvest its quota.

Commercial landings have also significantly decreased, dropping by approximately 50% (about 1.8 million pounds) since the 2015/2016 fishing year ([Fig. 1](#)). The commercial sector has not achieved its ACL since the 2018/2019 fishing year ([Fig. 1](#)). This decline may be indicative of a broader problem, especially as the commercial sector is struggling to meet its quota.

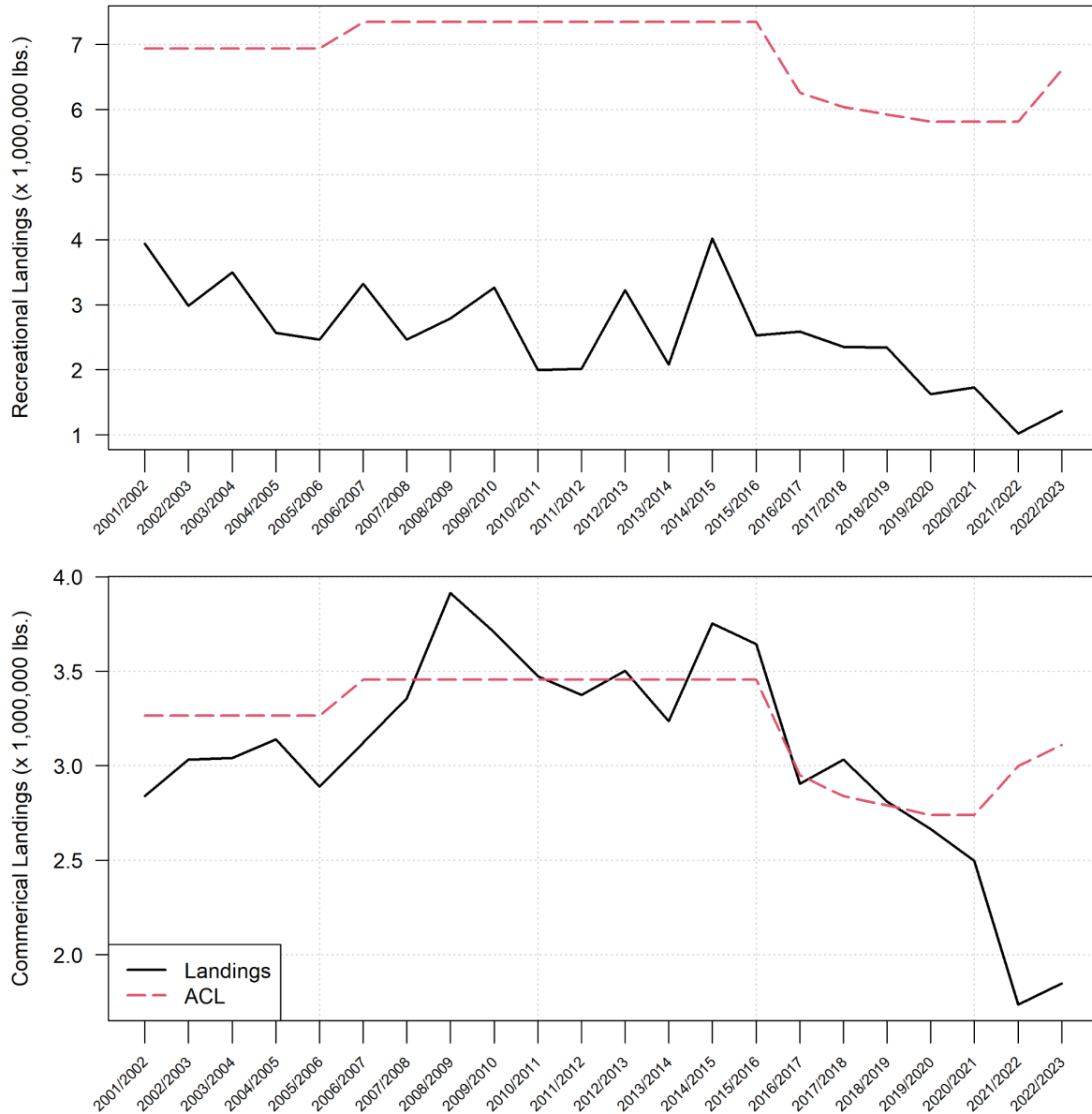


Figure 1. Annual (fishing year) recreational (top) and commercial (bottom) landings (pounds) of king mackerel in the Gulf relative to ACL. Data from SERO ACL website.

3.2 Commercial Zone and State-Specific Declines

Within the [Gulf management zones](#), several areas show pronounced declines in commercial landings since 2021. Specifically, the Western Hook-and-Line (HL) Zone, post-Amendment 26, has decreased by approximately 70% ([Fig. 2](#)), and port agents have suggested that offshore trips may be less economically viable. In the Southern HL Zone, landings had decreased by approximately 50% ([Fig. 2](#)). In both the Northern HL and Southern Gillnet (GN) Zones, catches have been relatively stable.

By state, variable but relatively stable commercial catch trends exist for the four Gulf states with available data (AL, FL, LA, and TX; MS data are confidential); however, specific areas show pronounced declines in commercial landings since 2021 (Fig. 3). Most notable is the large decrease in landings (~75% decrease) from LA beginning in 2020 (Fig. 3), which coincides with port agent reports of a decrease in landings during the COVID-19 shutdown in 2020 that has yet to recover. Decreases in LA represents a sharp drop in one of the historically most productive areas. Summaries of discussions with port agents are found in Appendix, which provides qualitative information on region-specific insights.

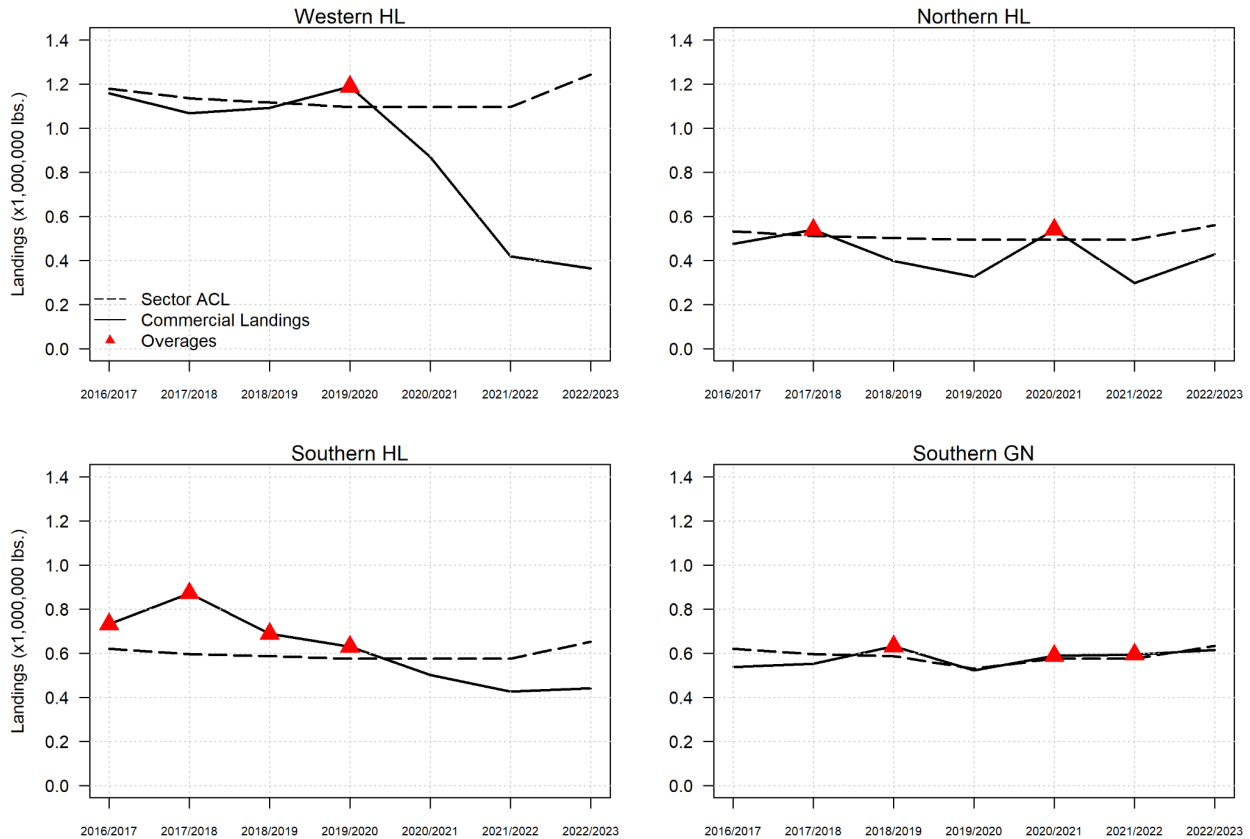


Figure 2. Gulf group KMK Post-Amendment 26 commercial landings by zone fishing years 2016/2017 - 2022/2023. HL = Handline, GN = Gillnet.

Fishermen comments during Gulf Council meetings have pointed out that coastal LA has been repeatedly hit with devastating hurricanes in the past 10 years (Harvey 2017; Laura 2020; Zeta 2020; Ida 2021). Additionally, a “mosquito fleet” that used to travel from the FL Panhandle to fish for KMK off LA no longer exists. The reasons for this development have not been explicitly described; however, it has been implied that part of the reason is the “graying of the fleet.” It is worth noting that the Panhandle was also hit hard in 2018 by Hurricane Michael, which may have had a similar effect in destroying part of the “mosquito fleet.”

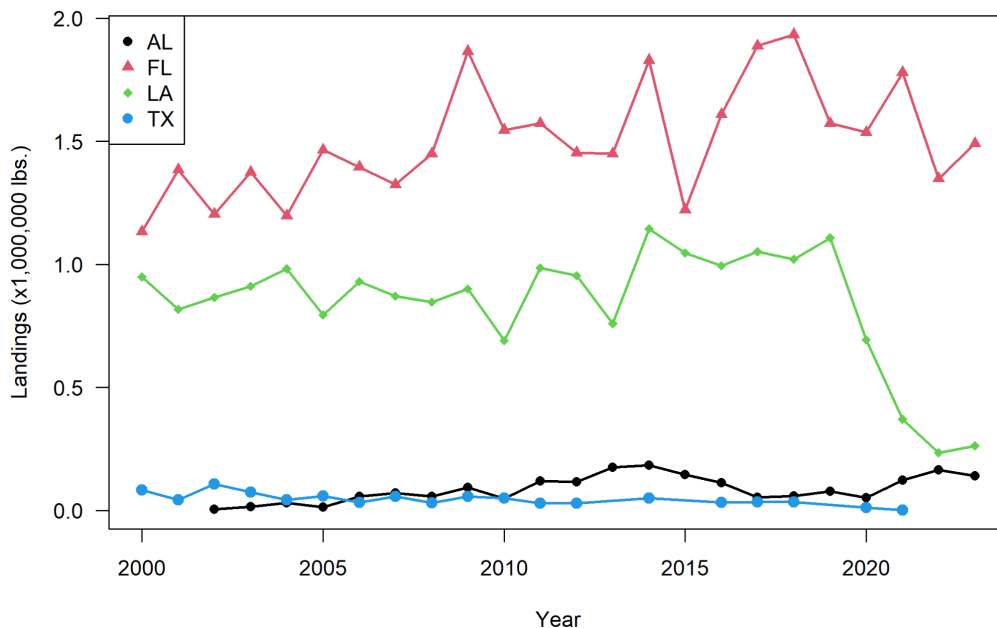


Figure 3. Gulf KMK commercial landings by State. Mississippi landings confidential (not shown). Alabama landings (2000-2001) and Texas landings (2013, 2015, 2019, 2022-2023) confidential (not shown). Data from Gulf States Marine Fisheries Commission - Gulf Fisheries Information Network (GulfFIN) public database.

3.3 Commercial Effort and Catch Indicators

The Coastal Fisheries Logbook Program dataset was used to examine spatially explicit catch per unit effort (CPUE) and landings. Coastal logbook data began 1x1 degree reporting in 2013, which was previously reported in Shrimp StatZones, limiting our analysis to the most recent 11 years of data available (2013-2023). Spatially explicit KMK landings demonstrate a reduction off LA similar to aggregated data from GSMFC. The methods applied by Walter & McCarthy (2014; 1993-2013SEDAR38-DW-10) were adapted to select the KMK-targeting fleet and calculate CPUE. While there are no discernible trends in CPUE, there was a 30% reduction in the number of areas fished from 2021 to 2023 (Fig. 4 top), primarily for coastal and offshore waters off TX and LA (Fig. 4 bottom).

Data from the KMK Gill Net Quota Monitoring program were examined for trends in that Southern zone fishery. The vessel landings per trip have decreased in recent years (Fig. 5), suggesting that the fleet has become less efficient and is taking more effort to reach the quota. Port samplers from the Florida Keys noted the perception that the size of schools has decreased (see Appendix), which could be a cause for the reduced vessel landings per trip (Fig. 5). With only 13 years of data, there are no clear trends in season length for the KMK Southern Gillnet fishery (Fig. 5); however, it is noteworthy that in the past two years, the fishery did not reach its

quota and was thus never closed. Overall, the number of vessels has stayed fairly consistent, except for 2024 having the lowest number (Fig. 5). The number of days fished has increased and the distribution of vessel landings is trending downward from 2022 to 2024 (Fig. 5). Given that the vessel trip limit was increased in 2016 from 25,000 lbs to 45,000 lbs, it is notable that vessel landings rarely reach the new limit.

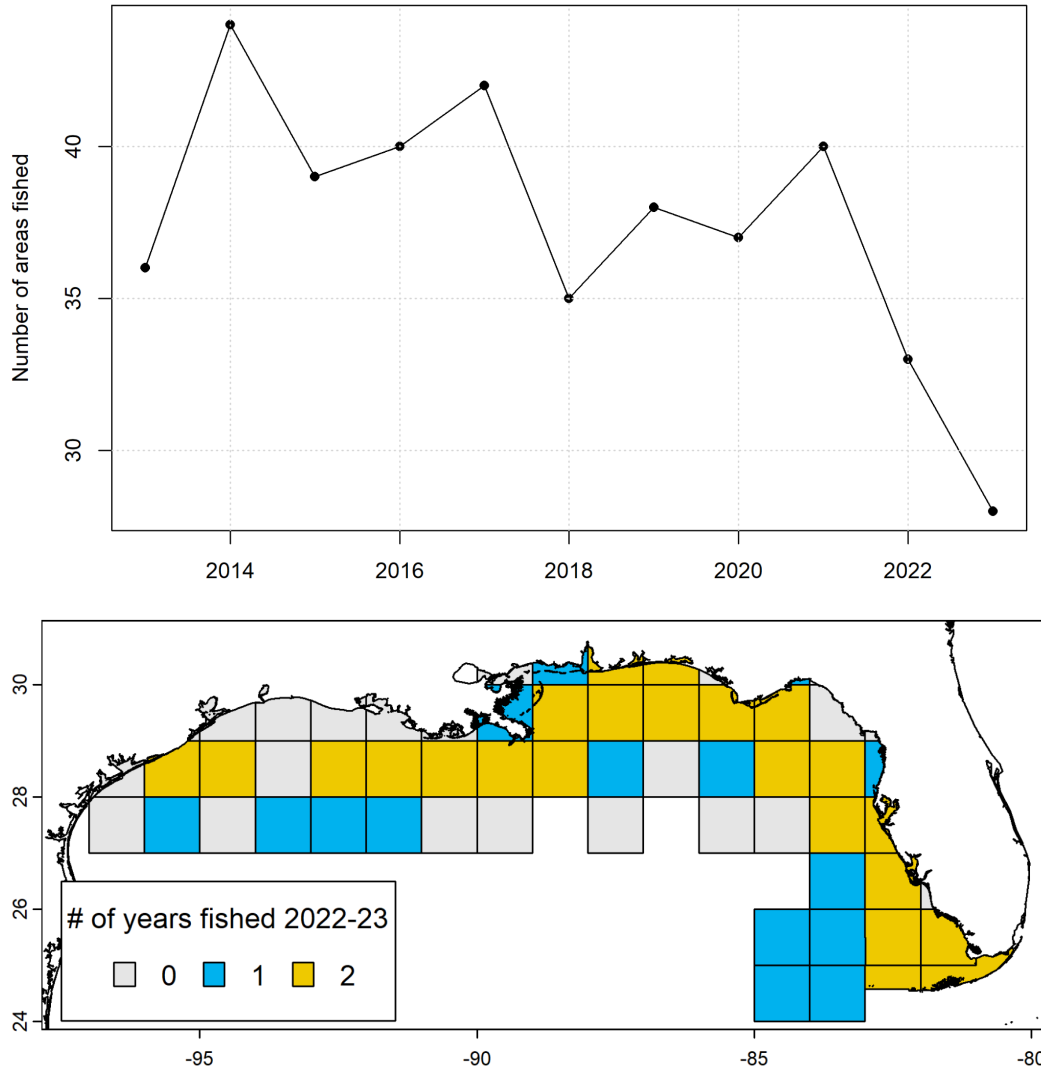


Figure 4. (Top) Number of areas fished for Gulf KMK from 1x1 degree Coastal Fisheries Logbook Program. (Bottom) Spatial histogram of number of years each area was fished for Gulf KMK in the years 2022-23 from the Coastal Fisheries Logbook Program.

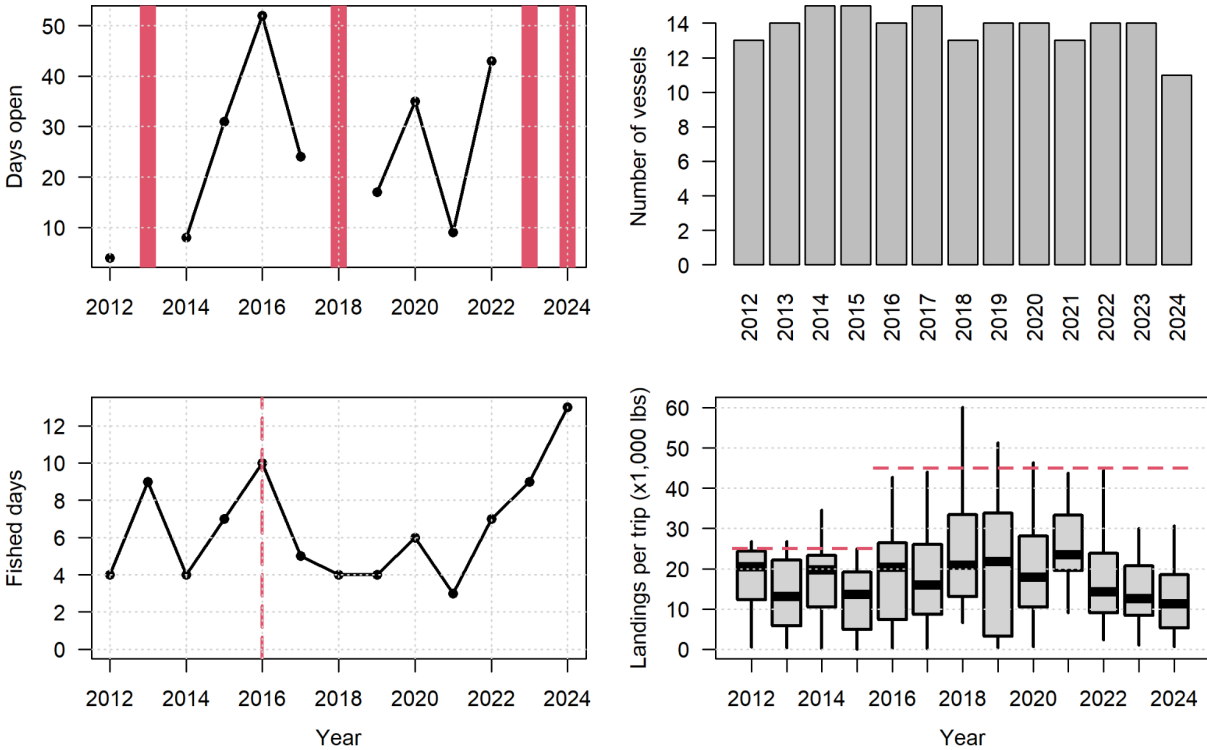


Figure 5. (Topleft) Number of days Southern gillnet fishery was open. (Topright) Number of vessels with landings in the Southern gillnet fishery. (Bottomleft) Number of days with landings in the Southern gillnet fishery. (Bottomright) Landings of KMK per trip in the Southern gillnet fishery.

Public comment received during the January 2025 Gulf Council meeting (where some of these trends were presented), added important context to the patterns in the data. The Southern GN fishery is unique in that it is highly cooperative; captains frequently collaborate by sharing spotter plane observations of KMK school locations. Captains have also frequently assisted each other in hauling overloaded nets so that a single vessel does not go over its trip limit. Fishermen stated that in recent years they agreed to harvest less per trip to fetch a better ex-vessel price. This change in behavior could explain smaller landings per trip and increased days fished per season. Additionally, fishermen stated that red tide blooms north of the FL Keys in the winter can frequently delay the fishery and push KMK schools further offshore.

Starting in 2016, the CMP FMP was amended to include a payback provision for the Southern GN fishery. If in a given year the fishery catches more than the allotted quota, that overage amount is subtracted from the following fishing year's quota. In 2019, 2021, and 2022, the fishery exceeded the quota requiring decreases in quota for 2020, 2022, and 2023.

4. Biological and Environmental Anomalies

4.1 Lengths at Age

Analyses of Gulf KMK lengths at age (Shropshire et al. under review) show declines in mean lengths at age, primarily observed in older age classes and females (Fig. 6; similar trends were evident in males). While a slight rebound was noted around 2009, the overall reduction in length persists for the full time series evaluated (Fig. 6). Although trends in growth began to rebound after 2010, the time series ends in 2016, and it remains unknown if the trend continues up to the terminal year for SEDAR99. This pattern, where older fish are smaller and potentially less fecund, may suggest an issue related to food availability or growth conditions. A 10% reduction in length translates to an approximate 30% reduction in weight, which in turn potentially leads to a greater than 30% reduction in total reproductive output. This analysis (Shropshire et al. under review) quantified changes in growth over time based on data used in SEDAR38 and SEDAR38 Update. The study also found that annual mean length was associated with total biomass from SEDAR38U, annual, summer and fall chlorophyll (these models also included total biomass), and just sea surface temperatures (SSTs) in the summer (GAM deviance explained 0.77, 0.53, 0.72, 0.76, and 0.13, respectively).

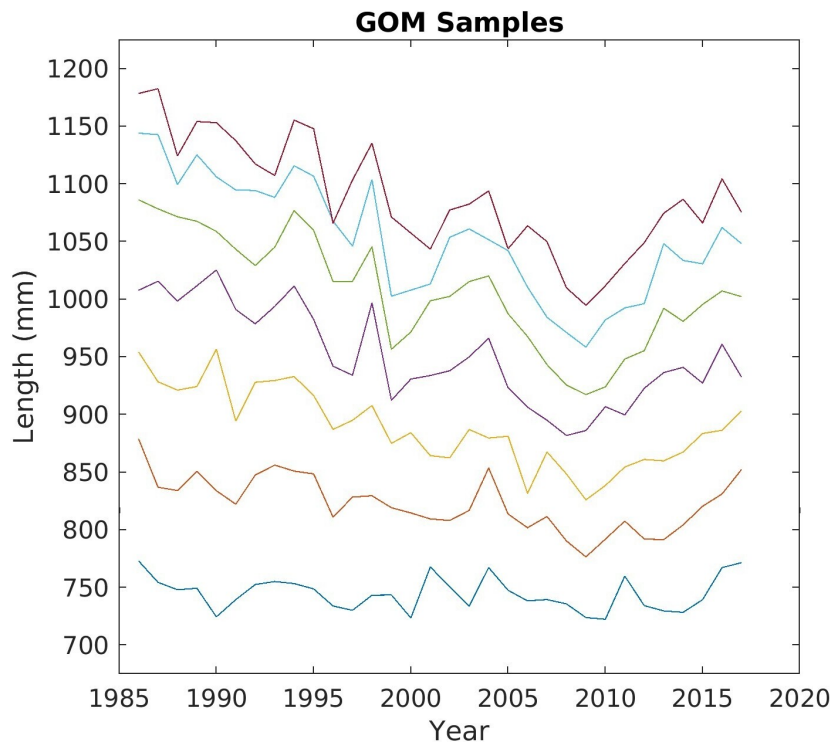


Figure 6. Female Gulf KMK mean length-at-age for ages 2 through 8. From an analysis by Shropshire et al (under revision).

4.2 Baitfish Abundance

A potential contributing factor is the status of key prey species. Currently, there are no standardized or Gulf-wide monitoring programs for accurately estimating the abundance of Gulf menhaden (or other pelagic bait species) in the Gulf, for either adults or juveniles. State-specific monitoring programs do however provide locally-specific fishery-independent data for Gulf menhaden stock assessments. Based on the most recent assessment update (GSMFC, 2024), adult Gulf menhaden abundance, from LA inshore GN data, illustrate an overall increase in relative abundance over the whole time series (Fig. 7). No discernable trends are evident for juvenile abundance, as derived from LA, MS, and AL inshore seine data, although interannual variability has been more pronounced in the 15 most recent years for the index (Fig. 7). Additionally, the biomass and spawning stock biomass trends from the recent assessment have been increasing since the early 1990s (Fig. 7). Overall, these data support an increasing population trend for Gulf menhaden, and the most recent assessment indicates that the Gulf stock is not experiencing overfishing and is not overfished. There is an important caveat that the spatial extent of those index data are limited when considering potential implications for the broader geographic range of the Gulf KMK stock.

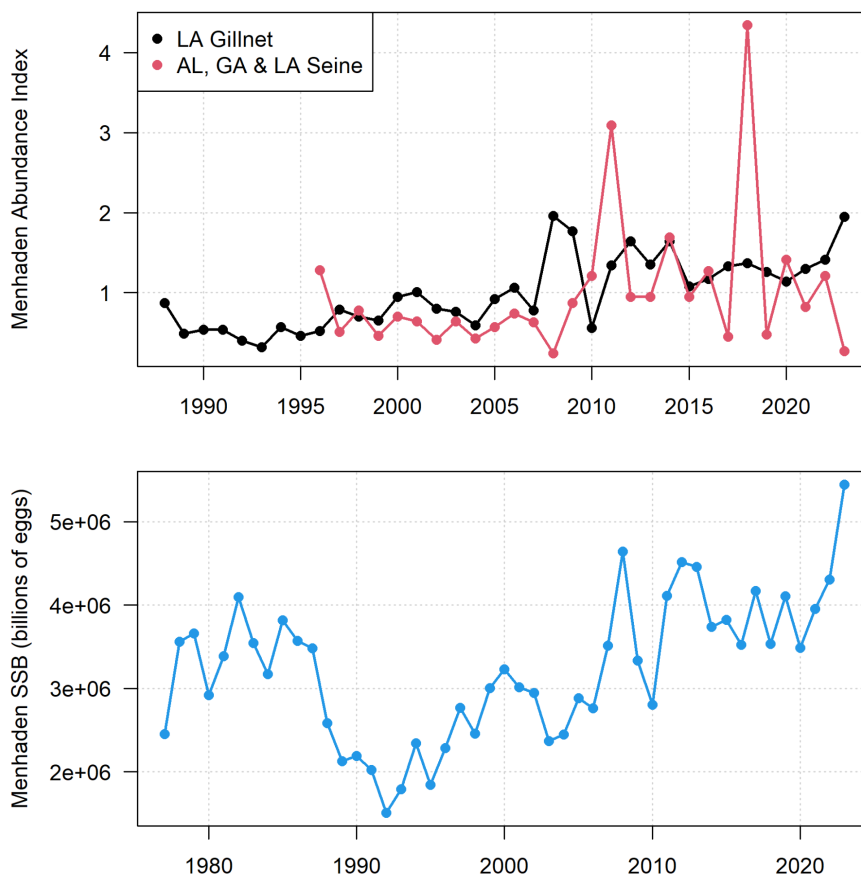


Figure 7. (Top) Menhaden indices of abundance from LA Gillnet and AL, GA & LA Seine surveys used in GDAR 04/SEDAR 97 Gulf Menhaden Stock Assessment 2024 Update. (Bottom) Menhaden SSB (Billions of eggs) from GDAR 04/SEDAR 97 Gulf Menhaden Stock Assessment 2024 Update. Note different x-axes between plots.

4.3 Environmental Considerations

KMK larvae are fast-growing with high metabolism and short development stages, requiring temperatures between 78.8 – 87.8 °F (Denson 2021). Temperatures in the Northern Gulf (north of 26N latitude) have been increasing over time, particularly for the last decade (Fig 8). Both 2023 and 2024 were particularly warm, with sea surface temperatures (SSTs) well above average for the entire year, reaching approximately 2°F above the historical (1982-2014) average (Fig 8). Spawning for KMK occurs from May to September, peaking in June through August. In recent years, broad areas of the Gulf have experienced SSTs above 31° C during typical timing and location of spawning activities (Fig 8). Taken together, increased temperatures may cause adults to move to deeper waters to find suitable spawning temperatures. Critically, increased larval metabolism due to higher temperatures may also lead to larvae facing starvation if food resources are insufficient.

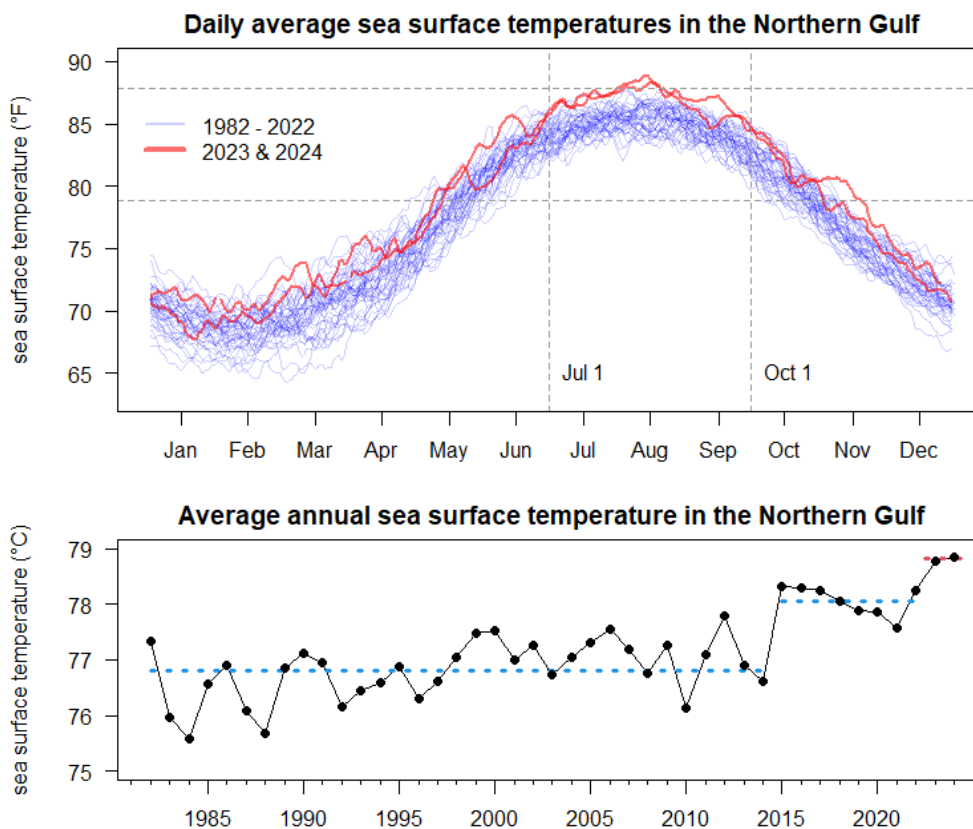


Figure 8. (Top) Daily Sea Surface Temperature in the North Gulf of America. Horizontal dashed lines are the temperature thresholds in which larval KMK have been found. The vertical dashed lines are the approximate start and stop dates for KMK spawning in the Northern Gulf.

(Bottom) Average annual SSTs in the Northern Gulf. The horizontal dashed lines denote jumps in mean temperatures at 2016 and 2023. Data source: Huang et al. (2020) NOAA 0.25-degree Daily Optimum Interpolation Sea Surface Temperature (OISST), Version 2.1. NOAA National

5. Summary of Recent Anomalies

A number of anomalous patterns have been observed, with a cluster of indicators showing declines since 2021:

Indicator	Observed Changes
Recreational Landings	↓ 65% (since 2001/2002)
Commercial Landings	↓ ~50% (since 2021)
Western HL Landings	↓ ~70% (since 2021)
Louisiana Landings	↓ ~75% (since 2020)
Total Area Fished (Logbook)	↓ ~30% (since 2021)
Gillnet Landings per Trip	Decreased (since 2021)
Mean Length at Age (Older/Females)	↓ ~10% (since 2001/2002)
Sea Surface Temperatures (SST)	Increasing trend (overall); above average (since 2021)

6. Possible Explanations

The observed declines in fishery performance metrics could be attributed to several factors, either individually or in combination. There are some potential socioeconomic causes for apparent declines. Market forces such as rise in more profitable species and increased fuel cost could drive changes in species landed. The recent history of devastating hurricanes making landfall in coastal LA combined with the ‘graying of the fleet’ may have contributed to the steep decline in KMK landings in the Western HL Zone. There could also be a decline in species abundance potentially due to undetected overfishing not captured in the current assessment models. From an ecological perspective, abundance declines could be driven by a temperature-induced recruitment failure impacting the survival of larvae and juveniles. The Gulf KMK group could also be undergoing a population distribution shift with fish moving farther offshore in the Gulf, potentially due to depletion nearshore, changes in the distribution of baitfish, or temperature preferences. Alternatively, a regional shift could be occurring with migration rates

favoring different regions, such as movement of Gulf KMK into U.S. South Atlantic waters. Unfortunately, none of the explanations are mutually exclusive, and few data exist to robustly test these hypotheses.

7. Conclusion and Recommendation

Our investigations uncovered a number of social and economic changes in the KMK fishery that could be responsible for observed recent patterns in landings, but also suggested evidence of environmentally-driven changes in stock dynamics. Of these changing stock dynamics, likely the most significant from an assessment model perspective is the observed changes in length-at-age; a 10% decline in length over time would equate to a 30% decrease in biomass and an even larger decrease in reproductive potential for the stock. Failing to account for changes in growth and reproductive potential in instances where it has significantly declined over time can result in biased estimates of reference points, and it is generally recommended time-varying growth is considered in the model, at least in a sensitivity analysis (Lorenzen 2016). Specifications of the assessment projections should also be carefully evaluated, as recent average dynamics may not be a good assumption for future predictions.

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Appendix

1. Port Agent insights

The following qualitative data were summarized from conversations with SEFSC Port Agents assigned to the Gulf. The Port Agents were asked about changes to infrastructure, abundance, and distribution as these topics pertain to KMK. The agents were also asked general questions about the economics of the KMK fishery and demand for KMK.

Area	Infrastructure	Abundance / distribution	Economics / demand
Florida Keys	<p>Hurricanes have not had major impacts on fish houses; they quickly open after passing of storm (e.g., fish houses reopened quickly following Irma)</p> <p>Land development and gentrification is a major issue, (e.g., 20 years ago there were 13-15 fish houses, but now there are only 2)</p> <p>Troll fishery used to be bigger; reasons for decline are unclear</p>	<p>20-30 years ago KMK caught off Marquesas Keys, but fish have since moved north; fleet has had to travel further</p> <p>Size of KMK schools has decreased over time; no longer see large schools</p> <p>KMK are still around but harder to find in smaller schools</p>	
Manatee	<p>Fish houses in Cortez were badly damaged in Hurricane Milton (2024); note they typically purchase 100K-150K lbs of KMK from gillnetters</p>		
Pinellas through Big Bend		<p>KMK aggregating off Pasco very limited</p> <p>Northern zone season length could affect the effort</p>	<p>The graying of the fleet may affect KMK landings</p>
Panama City	<p>No major changes, boats and infrastructure have not been impacted recently</p>	<p>In recent years has been difficult to find KMK in this area</p> <p>Many fishermen feel that the KMK stock abundance has</p>	<p>Fishermen would catch KMK if they could because price is high (\$5/lb)</p>

		decreased significantly and attribute the trend to lack of baitfish	
AL / MS / Eastern LA	<p>Hurricane Ida (2021) destroyed a lot of infrastructure, but it has since been mostly rebuilt</p> <p>Few fish houses land KMK</p> <p>5-10 years ago, more FL boats used to fish for KMK, but now there are only one or two</p>	<p>KMK are still around but have moved; bait is a concern from all fishermen; headboats report bait balls are hard to find</p> <p>Shark population affects fishing behavior off the mouth of the river; fleet has moved west to avoid high shark abundance areas</p> <p>Decrease in KMK landings has been attributed to removal of rigs (used to fish around them) and shark and dolphin depredation</p> <p>There were consistent KMK landings in region but a significant drop-off occurred in 2018; after the pandemic landings have been very low</p> <p>Before the pandemic, the KMK quota was reached by Oct/Nov, but recently the quota has not been reached</p>	<p>Not landing KMK due to economic reasons; hook and line fleet has to go too far out for trips to be economically viable</p> <p>High price of speckled trout in LA (\$5/lb) has contributed to reduced offshore effort</p> <p>In New Orleans there is high demand for a variety of seafood products; not a big market for KMK, demand for Spanish Mackerel is higher</p> <p>Some concern that Mexico was catching all the fish; however, fish house owner notes that price is very high and that if there was high supply coming from Mexico then price would be lower</p>
Western LA and TX	<p>Before Hurricane Rita and Ike, there were more KMK landings; unclear if number of fish houses has changed</p> <p>Some vessels with KMK permits expired, sold, or switched to red snapper</p>	<p>Western Gulf has not seen a lot of KMK landings</p> <p>Western Gulf season length may affect the effort</p>	