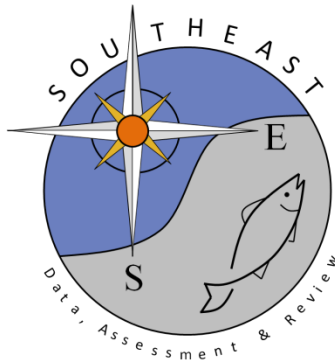


# Gray Triggerfish Post-Release Mortality (SEDAR 100)

S100 Ad Hoc Discard Mortality Working Group

SEDAR100-AP-01

23 April 2026



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Please cite this document as:

S100 Ad Hoc Discard Mortality Working Group. 2026. Gray Triggerfish Post-Release Mortality (SEDAR 100). SEDAR100-AP-01. SEDAR, North Charleston, SC. 12 pp.

## Gray Triggerfish Post-Release Mortality (SEDAR 100)

### 1. Executive Summary

An ad-hoc discard mortality plenary discussion was held in support of the SEDAR 100 Gulf gray triggerfish assessment to address Assessment Terms of Reference #2: Consider recent discard mortality studies and analytical results and incorporate updated discard mortality rate(s) as appropriate. The plenary consisted of a presentation of recently completed research conducted by Hyman et al. (SEDAR 100-DW17), a discussion of the results of recently published studies, and a round table focused on synthesizing the existing information into stock assessment model recommendations. Additional analyses looking at weighting the estimates from Hyman et al. (2025) by recreational discards by wave were prepared and presented at the post-DW webinar.

This report summarizes findings and panel discussions regarding gray triggerfish post-release (discard) mortality for the SEDAR 100 stock assessment, based on recent tagging and acoustic telemetry research. Utilizing long-term observer data and fully Bayesian discrete-time survival modeling, researchers demonstrated that capture depth, sea surface temperature, and seasonal timing significantly decrease post-release survival, resulting in substantially higher mortality estimates than previously assumed. Higher estimates were also supported by other recent studies using acoustic telemetry. As a result, the panel reached a consensus to update the discard mortality rates for the current stock assessment model. The final recommendations for the SEDAR 100 stock assessment were:

- Utilize the SEDAR 100 consensus point estimate of 40% for the SEDAR 100 base model with sensitivity analyses ranging from a low of 26% to a high of 60%. Rates should be applied consistently across all fleets, spatial areas, and time blocks. Given the paucity of data for the commercial fishery, assume commercial hook-and-line rates are the same as recreational hook-and-line rates.
- For continuity model runs, utilize the 5% and 25% rates which had previously been used in SEDAR 43 and SEDAR 62, respectively. Rates should be applied consistently across all fleets, spatial areas, and time blocks.

### 2. Contributors

This report is a summary of the available research and discussions that came from an ad-hoc session held during the in-person workshop and a post-workshop webinar. Numerous SEDAR panelists, SSC members, researchers, analysts, commercial and recreational fishers and observers participated in discussions that helped shape the recommendations presented herein. A. Challen Hyman presented a novel analysis utilizing long-term observer data and fully Bayesian discrete-time survival modeling to estimate discard mortality over varying environmental conditions and depth. Skyler Sagarese presented a summary of previous studies and guided the discussion. This report of the SEDAR 100 Discard Mortality Ad-Hoc Working Group was drafted by Matt Smith and Skyler Sagarese.

### 3. Summary of Past Assessments

The SEDAR 43 standard stock assessment utilized a 5% discard mortality rate for both recreational and commercial fisheries and tested a discard mortality rate of 10% in a sensitivity run. These recommendations were based on a review of best available (but limited) information during the SEDAR 43 Data Workshop in 2015. The standard SEDAR 62 assessment, while never completed, would have used a 25% discard mortality rate in the base model and 66% in a sensitivity run. The SEDAR 62 Data/Assessment Panel had reviewed estimates for discard mortality from the recreational for-hire fishery collected by the state of Florida and Runde et al. (2019). While the results from these studies indicated that discard mortality could be as high as 66%, the Panel concluded this estimate was likely too high given the specific fishing tactics used in the Gulf recreational fishery.

#### **4. New Information Available for SEDAR 100**

##### **4.1. Hyman et al. 2025 (SEDAR 100-DW17)**

###### ***4.1.1 Methodology and Data Sources***

The research utilized data from a long-term large-scale mark–recapture program to estimate post-release (discard) mortality for gray triggerfish. The primary data source was the Florida Fish and Wildlife Conservation Commission (FWC) Cooperative Observer Program, a collaborative initiative where trained biologists monitor the for-hire fishing sector, including charter vessels and party boats. Observers document species caught, tag and release the fish, and record specific variables such as capture location, time, and fish length. The analysis heavily focused on the Florida Panhandle region, which accounts for the vast majority of triggerfish tagged and released in this program. To incorporate environmental conditions, the high-resolution location and time data from the observer program were matched with the Hybrid Coordinate Ocean Model (HYCOM), an oceanographic model providing estimates of sea surface temperature. Following an expansion of the tagging program in 2022 funded by the Return 'Em Right initiative, the study focused on data from 2022 through the end of 2024. During this period, researchers evaluated a total of 3,767 tagged triggerfish, of which 397 (approximately 10.5%) were recaptured and reported.

###### ***4.1.2 Statistical Modeling***

A fully Bayesian discrete-time survival model was developed to estimate post-release survival of gray triggerfish using tag–recapture data. The foundational logic of the model established that the probability of recapturing a tagged fish at a given time step is the product of three factors: the probability of it surviving the initial post-release period, the probability that it remained "at risk" (alive and not yet recaptured or dead from natural causes), and the probability of it being recaptured by an angler. To isolate the specific discard mortality, the model accounted for a constant baseline natural mortality rate and a tag shedding rate over time, recognizing that some tags are lost naturally and not reported. Furthermore, the model incorporated recreational fishing effort using data from the FWC State Reef Fish Survey. This served as a spatial and temporal proxy to adjust for the varying probability of a tagged fish being encountered and reported based on localized fishing pressure. To evaluate the specific impacts of depth and sea surface temperature, researchers utilized a modified "soft-plus" function. This functional form was

deliberately chosen because the researchers expected a threshold effect; they anticipated that post-release survival would remain stable at shallower depths and cooler temperatures, but would begin to decline linearly only after surpassing specific physiological thresholds, such as the onset of barotrauma.

#### ***4.1.3 Discard Mortality Results***

Results showed that both capture depth and sea surface temperature have significant negative effects on the post-release survival of gray triggerfish. For example, survival in 15°C waters at 20 meters of depth resulted in low mortality (median posterior probability of 0.08; 0.06-0.18), whereas mortality spiked to 0.80 (0.72-0.87) in 30°C waters at 60 meters of depth. The negative impact of sea surface temperature was surprisingly strong, demonstrating a steep decline in post-release survival as temperatures increased. Capture depth also exhibited a substantial negative effect with increasing depth. By applying the actual observer data to these modeled posterior distributions, the study calculated considerable annual post-release mortality rates. Assuming a highly conservative baseline survival of 100% for fish caught safely below the depth and temperature thresholds, the estimated annual post-release mortality was approximately 40% to 41% for 2022 and 2023, and 36% for 2024. However, the study noted that these overall estimates are highly sensitive to the assumed baseline survival rate. If the baseline survival is assumed to be lower—for instance, 85% instead of 100%—the overall discard mortality estimates increase to around 45% to 49%. Ultimately, the findings suggest a much higher discard mortality rate for gray triggerfish than previous stock assessments. Overall, Hyman et al. estimated overall annual mortality rates between 26% and 60% based on the long-term conventional tagging data, which are much higher than the estimates used in previous stock assessments (see **Section 3**). Further, this study identified a strong trend in post-release mortality across months, with the highest estimates in the summer months (~0.65) and lower estimates in cooler months (~0.2).

#### ***4.1.4 Updated modeling framework and results presented in Hyman et al. 2026***

The analysis discussed above was updated using a more defensible discrete-time relative-risk model within a modified Cormack-Jolly-Seber framework. In addition to modifying the modeling structure, this updated modeling framework also accounted for size-selectivity by scaling the hazard of re-encounter for a given fish by selectivity based on the general circle hook selectivity curve presented in Garner et al. (2017). Overall, the general trends in results were similar to those discussed above, with discard mortality estimates dependent upon both SST and capture depth and seasonal patterns in discard mortality estimates evident. Estimates of discard mortality rates from the updated analysis were a bit lower, with estimated overall annual mortality rates between 25% and 51%. Table 1 includes a comparison of discard mortality estimates by wave estimated from the model presented in SEDAR 100-DW17 and the newer approach utilized in Hyman et al. (2026).

## **4.2 Other Research Studies Discussed**

Following the presentation of the Bayesian survival model during the Data Workshop, the panel reviewed several research studies regarding gray triggerfish post-release mortality.

#### **4.2.1 Runde et al. (2019; SEDAR 100-RD05)**

Runde et al. (2019; SEDAR 100-RD05) reported a highly elevated discard mortality rate of 66% (41-92%) for the recreational hook-and-line fishery in Florida (Atlantic), noting that the unique morphology of gray triggerfish may make them prone to death and lack of recovery after capture. Their study accounted for delayed mortality by using a mark-recapture approach and used a robust control group through the use of SCUBA divers. The authors suggested that the unique biology and physiology of gray triggerfish may contribute to their lower discard survival, with cryptic injuries potentially behind lower survival. Necropsies identified about 69% of fish caught with hook-and-line had intestinal prolapse into the buccal cavity, which could cause permanent damage to the gastrointestinal tract and adjacent organs.

#### **4.2.2 Bohaboy et al. (2020; SEDAR 100-RD01)**

Bohaboy et al. (2020; SEDAR 100-RD01) utilized 3D acoustic telemetry to estimate discard mortality of gray triggerfish. Results were relatively limited in terms of sample sizes ( $N = 26$ ), with the majority of individuals collected in spring 2016 in 30 meters. This study found that point estimates of discard mortality were actually higher for descender-released fish (60.0%;  $SE = 15.5\%$ ) than for surface-released fish (26.7%;  $SE = 11.4\%$ ), although the effects of descender devices on discard mortality was not statistically significant (largely due to small sample size). Only 10 gray triggerfish were returned to depth with a descender device. Predation by large pelagic predators was estimated to account for 100% of gray triggerfish discard mortality.

#### **4.2.3 Patterson et al. 2020 (SEDAR 100-RD02)**

Through a Cooperative Research Program funded project, Patterson et al. 2020 (SEDAR 100-RD02) tracked 120 gray triggerfish around artificial reefs at approximately 30 meters depth using 3D acoustic telemetry. Discard mortality was estimated after 48 hours and after 14 days to capture acute and chronic patterns, respectively. After 48 hours, winter discard mortality estimates were much lower ( $5.8\% \pm 5.2$  (95% confidence interval)) compared to summer ( $34.7\% \pm 11.8$ ). A similar pattern was also found for longer-term chronic estimates after 14 days (winter:  $7.1\% \pm 6.2$ ; summer:  $41.1\% (\pm 12.2)$ ). Similar to the Bohaboy et al. (2020) results, nearly all the mortality suffered by acoustically tagged fish was due to predators (i.e., sharks and dolphins) according to direct observation or examination of acoustically tracked movement dynamics of released fish versus positive (live) or negative (dead) controls tagged on the seafloor.

### **4.3 Additional Analyses Conducted post-DW (presented on post-DW Webinar)**

#### ***4.3.1 Methodology and Data Sources***

To account for the seasonal differences in discard mortality identified in the studies above, the wave-specific discard mortality rates estimated by Hyman et al. (Table 1) were used to develop weighted discard mortality rates which took into account recreational discards by wave. Annual estimates of recreational discards by wave were obtained from the general recreational data (MRIP-FES, LA Creel, and TPWD) submitted 9/18/2025 for SEDAR 100 (reported in SEDAR

100-WP02) for the entire Gulf (Gulf-wide), the eastern Gulf, and the western Gulf (Figure 1). Headboat discards submitted by the Southeast Regional Headboat Survey were not provided by wave, but only accounted for 3% of total discards Gulf-wide (0.2% West and 4% East) and therefore would have minimal impacts on the results presented here. To explore how weighted discard mortality rates varied over time due to recreational regulations implemented, five time periods were identified:

- 1981-1998: no size limit or recreational gray triggerfish bag limit
- 1999-2008: 12 in Total Length size limit and no recreational gray triggerfish bag limit
- 2009-2012: 14 in Fork Length size limit and no recreational gray triggerfish bag limit
- 2013-2018: 14 in Fork Length size limit and 2 recreational gray triggerfish bag limit
- 2019-2024: 15 in Fork Length size limit and 1 recreational gray triggerfish bag limit

This analysis was conducted using the discard mortality rates reviewed during the SEDAR 100 Data Workshop (SEDAR 100-DW17) and later using updated results presented in Hyman et al. (2026). These updated results were reviewed by the Gulf Council's Scientific and Statistical Committee at their February 2026 meeting.

#### ***4.3.2 Discard Mortality Results - Weighted by Wave-specific Discards***

Combined across years, recreational discards were most prevalent in the late spring (May-June) and summer (July-August) months for each region explored (Figure 2). The Eastern Gulf trends were nearly identical to the Gulf-wide trends because the overwhelming majority of data come from the East (~94%). Weighted-discard mortality rates across the three baseline survival assumptions were very similar among regions (Figure 3). Assuming a baseline survival of 1.0 (100%) for fish released in optimal conditions, the weighted discard mortality estimate was approximately 45% across all years (up to ~0.55 if baseline survival was 0.85 or 85%). Weighted-discard mortality rates across different regulatory time blocks revealed some small differences in estimates, which were not large enough to warrant including time-varying discard mortality estimates within the stock assessment model. After updating the analyses presented at the post-DW Webinar using results from Hyman et al. (2026), the weighted discard mortality estimates were reduced and more in line with the recommended value of 40% made by the SEDAR 100 panel (Figure 4).

### **5. Discard Mortality Recommendations for the SEDAR 100 Stock Assessment**

Collectively, the studies and analyses discussed above led to considerable discussion by the ad-hoc discard mortality panel regarding the most appropriate discard mortality rates to recommend for the SEDAR 100 stock assessment. Acknowledging the new empirical evidence demonstrating substantial depth and temperature-driven mortality as well as the specific fishing tactics in the Gulf, the panel reached a consensus to recommend a 40% discard mortality rate for all hook-and-line fleets, encompassing both the commercial and recreational sectors. This 40% value aligns closely with the central estimates of both the conventional tagging and acoustic telemetry studies. While the discard mortality rates weighted by recreational discards by wave were closer to 45% under a 1.0 baseline survival assumption (the most optimistic assumption) based on the results of Hyman et al. 2025 (SEDAR 100-DW17), the 40% recommendation was

maintained on the post-DW Webinar because it represented a synthesis across the multiple acoustic and tagging studies reviewed. Additionally, updated results from Hyman et al. (2026), which accounted for selectivity and a more defensible modeling approach, led to slightly lower weighted discard mortality rates more in line with the SEDAR 100 recommendation. To capture the uncertainty, the panel recommended sensitivity runs of 26% and 60%, reflecting the lower bounds of the literature and the upper end of the confidence intervals. The panel also advised setting commercial discard rates equal to the recreational rates given the lack of information available for the commercial fishery.

## 6. Research Recommendations

To address remaining uncertainties and strengthen future stock assessments, the panel outlined several key research recommendations. First, researchers emphasized the need for a targeted investigation into the effects of handling time and deck exposure, aiming to determine whether the heightened summer mortality is solely driven by water temperature or exacerbated by prolonged handling stress during the warmer months. Second, the panel recommended expanding the spatial scope of future tagging and observer efforts to other regions in the Gulf of America, such as Texas, to verify if the mortality rates observed in the Florida Panhandle are representative of the entire stock. Additionally, researchers suggested pulling in length data from the broader, untagged observer datasets to better analyze potential size-selective discard mortality. Finally, because gray triggerfish are currently released at the surface and are notoriously difficult to descend, the panel recommended formal studies to evaluate whether specialized descending devices could be effectively utilized to mitigate post-release mortality for this species. Because studies showed that descending devices either had no significant effect or resulted in higher mortality for gray triggerfish, further research is needed to determine the safest discard practices for this specific species given its unique morphology.

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Table 1. Discard mortality estimates (median values with 80% confidence intervals) provided by wave for the Data Workshop (based on analyses in SEDAR 100-DW17) and after the Data Workshop (based on analyses in Hyman et al. 2026). Note that estimates are provided for three different baseline survival assumptions (1.0, 0.92, and 0.85; following Sauls 2014) required for fish released in the best condition at shallow depths and cool waters.

Wave	Baseline Survival	DW Results (SEDAR 100-DW17)			post-DW Results (Hyman et al. 2026)		
		0.1	0.5	0.9	0.1	0.5	0.9
1	1	0.37	0.23	0.16	0.15	0.19	0.23
2	1	0.43	0.29	0.19	0.07	0.12	0.2
3	1	0.58	0.46	0.36	0.17	0.23	0.32
4	1	0.72	0.62	0.53	0.48	0.56	0.64
5	1	0.66	0.55	0.46	0.55	0.62	0.68
6	1	0.43	0.3	0.21	0.15	0.21	0.31
1	0.92	0.42	0.29	0.22	0.22	0.25	0.29
2	0.92	0.48	0.34	0.25	0.14	0.19	0.26
3	0.92	0.61	0.5	0.41	0.23	0.29	0.37
4	0.92	0.74	0.65	0.57	0.52	0.59	0.66
5	0.92	0.68	0.59	0.5	0.59	0.65	0.71
6	0.92	0.47	0.35	0.27	0.21	0.27	0.36
1	0.85	0.46	0.35	0.28	0.28	0.31	0.35
2	0.85	0.52	0.39	0.31	0.21	0.25	0.32
3	0.85	0.64	0.54	0.46	0.29	0.34	0.42
4	0.85	0.76	0.68	0.6	0.56	0.63	0.69
5	0.85	0.71	0.62	0.54	0.62	0.68	0.73
6	0.85	0.52	0.41	0.33	0.28	0.33	0.41

Figure 1. Annual proportions of recreational discards by wave for gray triggerfish for the entire Gulf (Gulf-wide), the eastern Gulf, and the western Gulf. The implementation of recreational size limits (inches Total Length [in TL] or inches Fork Length [in FL]) and bag limits (1 or 2 Bag) are shown with vertical black lines to separate time periods.

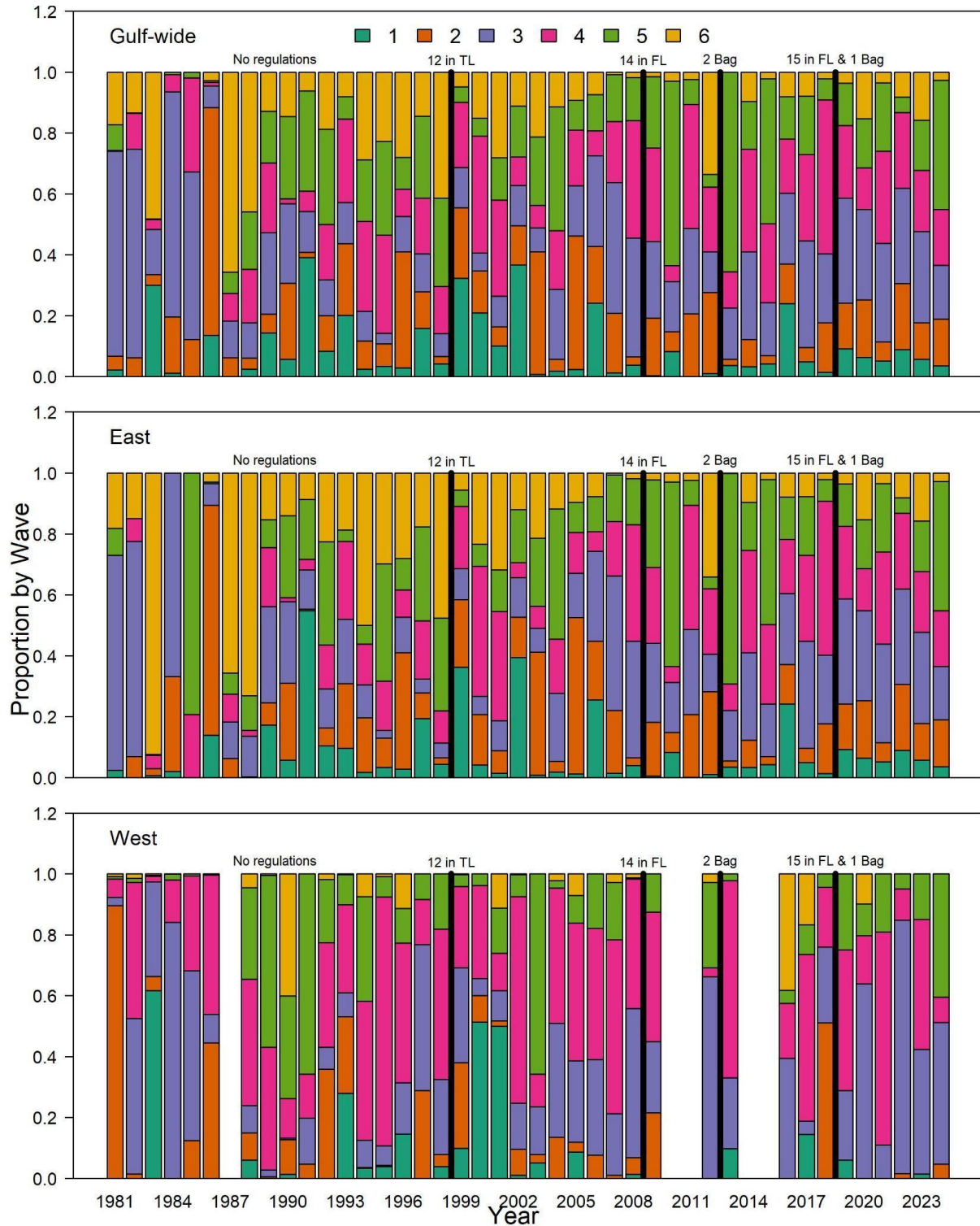


Figure 2. Overall proportion of recreational discards by wave for the entire Gulf (Gulf-wide), the eastern Gulf, and the western Gulf.

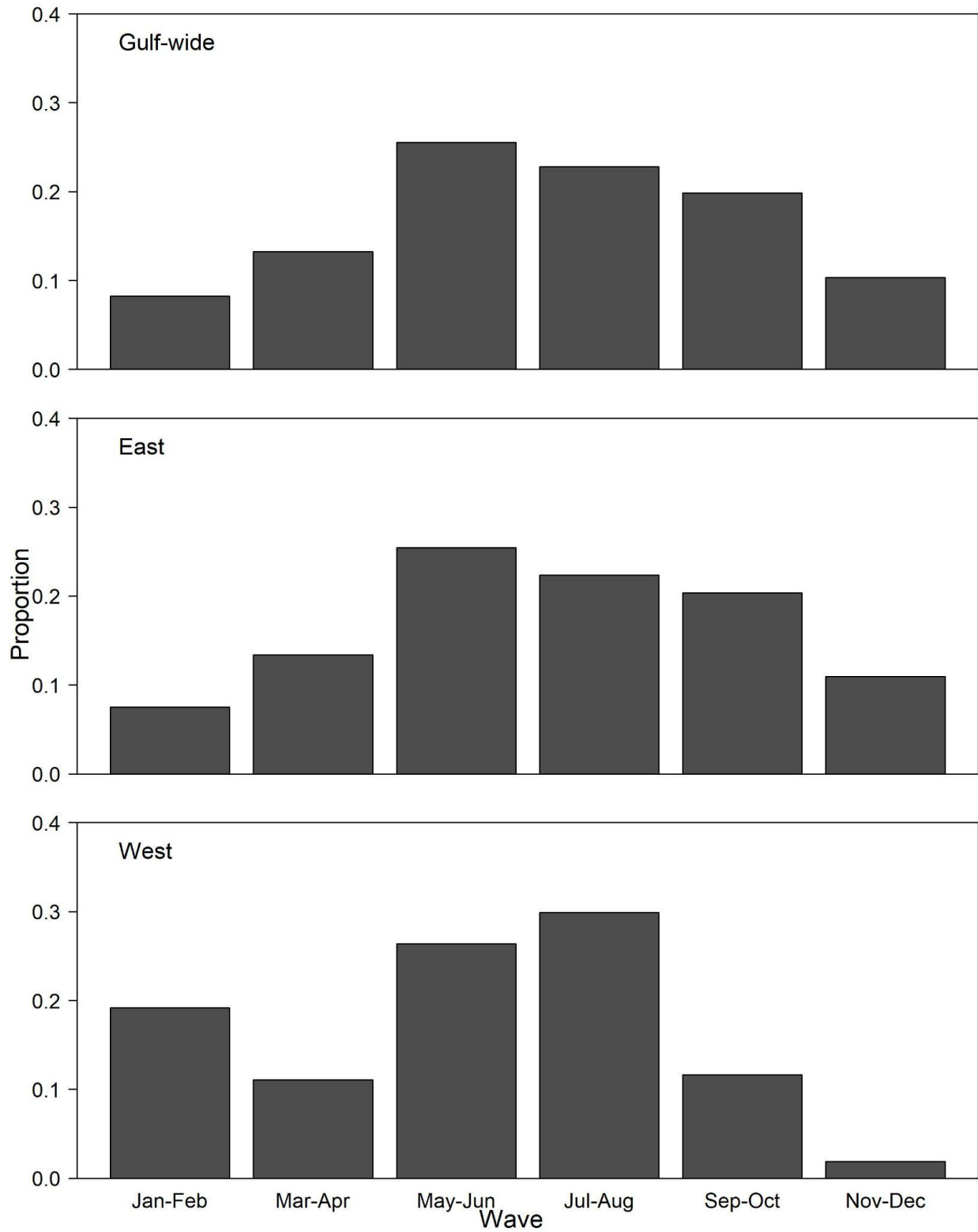


Figure 3. Discard mortality rates weighted by recreational discards by wave for the entire Gulf, Eastern Gulf, and Western Gulf based on results presented in SEDAR 100-DW17. Time periods explored include all years (1981-2024) and time periods based on regulations (shown in Figure 1). Additional details on discard mortality rates and baseline survival assumptions are provided in Table 1.

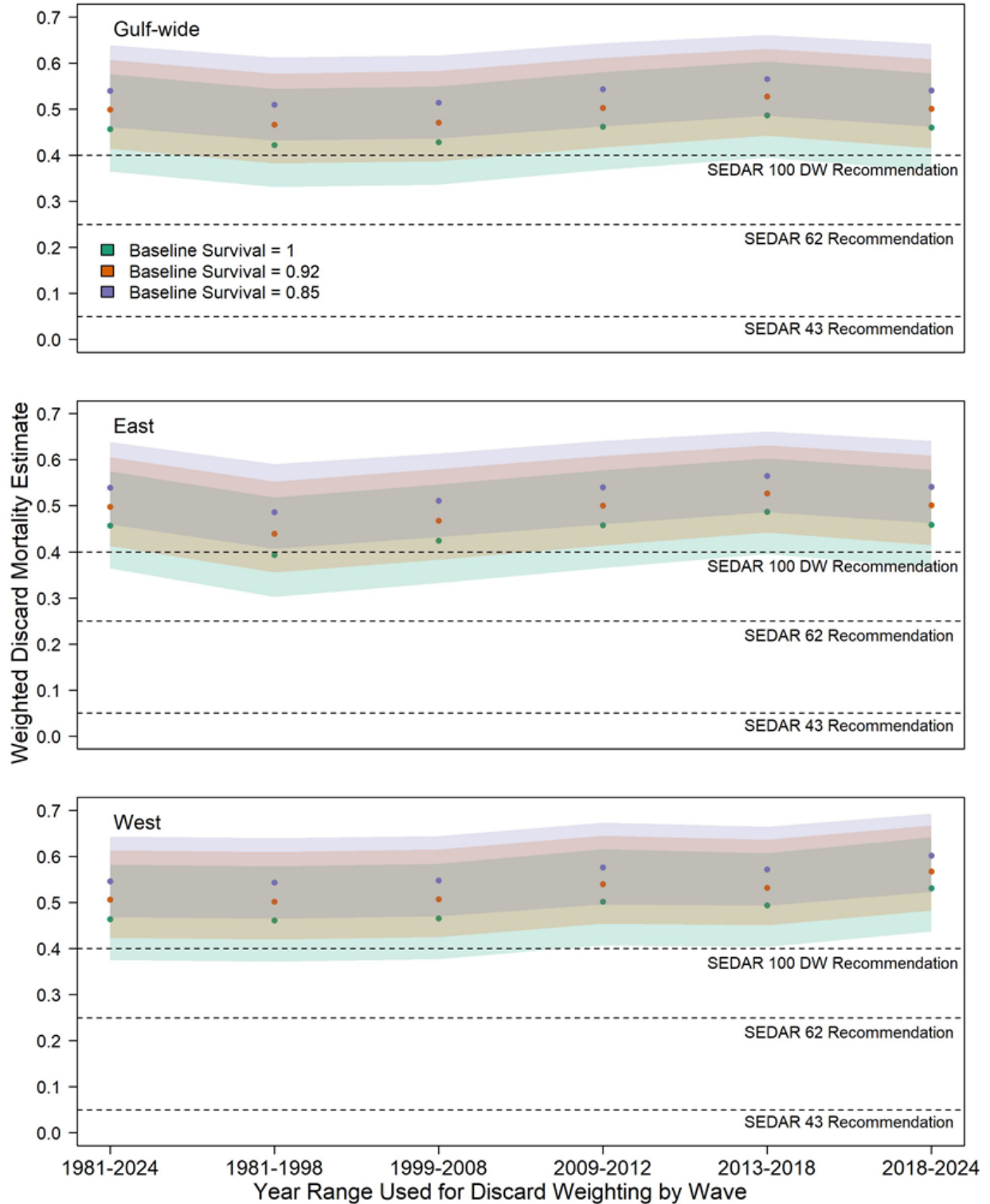


Figure 4. Discard mortality rates weighted by recreational discards by wave for the entire Gulf, Eastern Gulf, and Western Gulf based on results presented in Hyman et al. 2026. Time periods explored include all years (1981-2024) and time periods based on regulations (shown in Figure 1). Additional details on discard mortality rates and baseline survival assumptions are provided in Table 1.

