Final Report of the SEDAR 74 Ad-hoc Discard Mortality Working Group for Gulf of Mexico Red Snapper (*Lutjanus campechanus*)

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SEDAR74-AP-02

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Discard Mortality Report for SEDAR 74

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 several webinars that were held pre- and post-workshop. Numerous SEDAR panelists, SSC members, researchers, analysts, commercial and recreational fishers and observers participated in discussions that helped shape the recommendations presented herein.

Beverly Sauls chaired the ad-hoc workgroup (chair) and Dominique Lazarre assisted with recording. Kevin McCarthy, Stephanie Martinez Rivera and Steve Smith provided data and analyses for the commercial sector that are summarized in this report. Julie Vecchio conducted a literature review of recent discard mortality studies available since the prior SEDAR and provided data and analyses for the recreational sector that is documented in a separate working paper (SEDAR74-DW-06). Matt Campbell provided documentation and computer code that was helpful for updating the meta-analysis used in prior SEDARs, and Chloe Ramsay developed the new model for SEDAR 74 that is documented in a separate working paper (SEDAR 74-AP-01). Carissa Gervasi, Mandy Karnauskas, and Matthew McPherson provided a summary on depredation for this report.

SEDAR 74 TOR 6: Recommend discard mortality rates

The term of reference related to recommended discard mortality rates for this SEDAR (TOR 6) includes:

- Consider research directed at red snapper as well as similar species from the southeastern United States and other areas.
    - Comment specifically on research detailing the efficacy of descending devices, including their adoption, prevalence of use, and effect on discard mortality
- Review available research and published literature.
- Provide estimates of discard mortality rate by fishery, gear type, depth, and other feasible or appropriate strata.
- Provide estimates of uncertainty around recommended discard mortality rates
- Document the rationale for recommended rates and uncertainties.

Summary of Past Assessments

Prior to the mid-1990's, scant research was available on the vulnerability of Red Snapper to mortality following retrieval from depth and release at the surface first started. A literature review was conducted in 2013 for SEDAR 31, and information derived from eleven studies available at the time was used to conduct a meta-analysis (Campbell et al. 2014). The model derived from the meta-analysis accounted for differences in experimental or observational protocols among various studies so that discard mortality could be modeled as a function of depth and other key factors. At the time the analysis was conducted, most studies measured mortality immediately upon release but did not account for delayed mortality once fish successfully resubmerged. The few lab and cage studies that measured delayed mortality also excluded some contributing factors, such as predation of impaired fish. Nonetheless, the meta-analysis approach was a robust method for incorporating all the discard mortality information that was available at the time. The resulting model revealed a strong positive relationship between depth of capture and point estimates for mortality, and provided a range of discard mortality estimates of 7.4% to 39.1% for the recreational hook-and-line fishery and 43.7-69.5% for the commercial sector at capture depths <10 meters up to 100 meters, respectively. Information provided during SEDAR 31 indicated that a majority of

recreational discarding takes place in shallow depths, based on self-reported data collected through the smart phone app called "iSnapper". Based on the estimated mortality rate for vented and unvented fish caught in shallow depths from the meta-analysis, the SEDAR 31 panel recommended that 21% to 22% mortality be applied to discards from the recreational sector prior to 2008, before anglers in the Gulf were required to vent the swim bladder of discarded Red Snapper to alleviate barotrauma. In later years, a lower rate of 10% to 11% was recommended (SEDAR 2013). The meta-analysis estimated higher mortality rates for the commercial sector, ranging from 43.7% to 86.2% in <10m to 100m, respectively (Campbell et al. 2014).

During the SEDAR 52 data and assessment workshop, one new study (Sauls et al. 2017) that measured immediate and delayed mortality directly within the for-hire recreational fishery in Florida was available. Overall, discard mortality measured within the charter and headboat segments of the fishery was estimated to be >20%, which was higher than what was recommended for SEDAR 31. The assessment panel requested that mortality estimates for each 10 meter depth interval from this new study (Figure 5 in SEDAR52-WP-09) be incorporated into the existing model used for SEDAR 31. The SEDAR 52 panel recommended a new recreational discard mortality of 11.8% for the post 2008 time period (Table 1), which was only a slight increase from 10-11% used for SEDAR 31. A base model sensitivity run using a value of 15.8% was also recommended. The panels for both SEDARs 31 and 52 recommended higher discard mortality values for the commercial sector, which varied pre and post-2008, among open and closed periods (defined as IFQ and non-IFQ trips in later years), and across the eastern and western Gulf regions (Table 1).

New Information Available for SEDAR 74

Estimated Discard Mortality Rates

One new study available for the commercial sector used fishery observer data collected throughout the Gulf of Mexico to evaluate immediate mortality of red snapper caught from bottom longline and vertical line gears (Pulver 2017). Immediate mortality observed at the surface was positively correlated with depth, warmer water temperatures, and external evidence of barotrauma. Higher mortality was also observed for fish released from bottom longline gear. The predicted probability of immediate mortality was significantly decreased when fish were vented. Overall, 24% of Red Snapper observed in the commercial fishery suffered immediate mortality at the surface; however, this should be considered a lower limit since delayed mortality was not measured.

A working paper submitted for SEDAR 74 summarized information available in the Central and Eastern Gulf regions on recreational discarding in the for-hire and private boat fleets (Vecchio et al. 2022). This working paper also provided discard mortality estimates for Red Snapper discards observed in the for-hire fisheries that include additional data collected in Florida since SEDAR 52, as well as new information available from Alabama and Mississippi. For the for-hire charter and headboat fleets, the majority of recreational discards observed in the central and eastern regions (>80% and >60% respectively) were caught in depths <40m, and a higher proportion observed from these depths displayed no visible impairments and resubmerged without the need for venting (particularly in the central region). Private boat fishing parties intercepted in Florida's State Reef Fish Survey reported that the majority of red snapper discarding took place in depths less than 40m (88.3% and 77.7% in central and eastern regions, respectively), which is comparable to what was observed in the for-hire fleets. In the central Gulf (MS, AL and northwest FL), overall estimated mortality across all depths fished ranged between 15.5% and

19.8% for the charter fleet and 11.4% and 24.4% for the headboat fleet. In the eastern Gulf, overall mortality was 26.8% and 27.9% for the charter and headboat fleets, respectively.

Several new published studies that used acoustic tagging to measure delayed mortality after catch-and-release with recreational hook and line gear have become available since SEDAR 52 (summarized in Ramsay et al. 2022). Treatment groups evaluated in these studies include fish released at the surface with no barotrauma mitigation, vented prior to release at the surface, and recompressed at depth with a descender device. In the western Gulf of Mexico, Curtis et al. (2015) reported an overall mortality rate of 23% for fish that were vented or recompressed. Fish that were released without venting or recompression treatment exhibited higher mortality (43% overall), particularly during summer when surface water temperatures are higher and a strong thermocline is present (87% mortality, Table 1). Another study conducted in the western Gulf of Mexico during summer months also reported high mortality rates for recompressed fish retrieved from deeper depths (Tomkins 2017). In the central Gulf of Mexico, Bohaboy et al. (2020) explored the difference in survival between fish that were descended and those that were released at the surface with no treatment. Fishing in depths of 30-55 m, researchers found that average 2-day mortality was 36% (CI = 18-41%) for descended fish and 56% (CI = 72-44%) for fish released at the surface.

During discussions at the SEDAR 74 data workshop, it was recommended that the meta-analysis approach used in prior SEDARs be revisited given the availability of new studies that are more inclusive of all potential sources of mortality. Previous studies that have explicitly tested immediate vs. delayed mortality found that the inclusion of delayed mortality doubles (Curtis et al. 2015) or more than doubles (Campbell and Diamond 2009) discard mortality estimates. Thus, there was concern that many of the studies available at the time the original model was developed only provided a partial measure of mortality and were therefore biased low. It was recommended to exclude studies that did not measure delayed mortality from the updated meta-analysis. The new model includes 84 point estimates from 11 separate studies for recreational hook-and-line gear (detailed methods are presented in the working paper by Ramsay et al. 2022 for the assessment workshop). After excluding studies that only provided a partial measure of discard mortality, the updated model predicted mortality rates that were more than double what was estimated by the prior model. Mortality was significantly higher during the summer season in the western Gulf and did not differ seasonally in the central and eastern regions. Thus, two separate models were run for the western region and the central and eastern regions, combined, to account for higher seasonal mortality in the west (Ramsay et al. 2022).

Depredation

The potential impacts of depredation (removal of fish from fishing gear by non-target species) on red snapper mortality are currently not considered in estimates of discard mortality. However, from in-depth conversations with charter captains throughout the Gulf of Mexico, depredation was the most common environmental issue identified in the red snapper fishery (Gervasi et al. 2022). Of the 27 captains who participated in conceptual modeling, 12 identified depredation as a major issue in the red snapper fishery, and 7 identified it as a minor issue. The remaining 8 captains either did not mention depredation or said that it was not an issue. Captains generally believed that discards and high-grading are the main reason why depredation (and scavenging) are such a problem, as these practices attract predators to fishing vessels and fishing grounds. All fish captured under the size limit or out of season are discarded, so captains mentioned that short open seasons and restrictive size limits can exacerbate the problem of discarding. Specifically, many captains perceived that depredation increased around 2014, when the red

snapper open season was dramatically decreased to 9 days (from 42 days in 2013), and at which point recreational discard rates would have likely increased substantially. Restrictive bag limits may also lead to recreational anglers throwing back fish above the minimum size limit to retain the largest individuals possible. In addition to potentially increasing levels of discarding and high-grading in the recreational fishery attracting predators, many captains also observed that sharks have become more abundant since fishing pressure on their populations decreased in the early 1990s. Many guides also mentioned that bottlenose dolphins have learned to follow boats, and adults are training their young to follow their boats for easy meals.

Although depredation was mentioned throughout the Gulf, only captains in the Florida Panhandle, Alabama, Mississippi, and Louisiana identified depredation as a major issue. These areas also have the highest estimated density of recreational landings (and thus presumably discards) throughout the GOM (SSC, March 2022, 13i), which could explain why depredation is a pertinent issue in these regions. In Texas and central Florida, several captains noted that depredation does occasionally occur, but it tends to be an issue localized to certain areas or times of the year and therefore has a limited impact on charter businesses. These findings largely align with the preliminary results of a study specifically aimed at characterizing depredation in the Gulf of Mexico reef fish fishery (Drymon et al. 2022). Observer data from the Gulf reef fish fishery, results of an electronic survey, and stakeholders who participated in a depredation workshop all agreed that depredation has increased significantly over time but that incidence varies regionally. While mortality due to scavenging is currently incorporated in calculations of red snapper discard mortality in the Gulf of Mexico to at least some degree (e.g., Sauls et al. 2017), depredation is an additional source of mortality that is not being considered. Additional research into changes in predator abundance throughout the Gulf, as well as linkages between discard rates and depredation incidence would aid in determining impacts on red snapper mortality and better inform stock assessment.

Prevalence of Descender Device Use

It is apparent that anglers in the Gulf of Mexico region are increasingly willing to adopt the use of descender devices to mitigate barotrauma for released fish. A survey in Florida in 2013 indicated less than 10% of anglers had tried descender devices (Adams et al. 2017), followed by another study three years later where 14-27% of anglers reported having used one (Crandall et al. 2018). Another recent study found that most anglers who were given a descender device and asked to use it expressed a willingness to continue doing so at the end of the study (Curtis et al. 2019). However, in the most recent Gulf-wide survey conducted in 2022, roughly two thirds of reef fish anglers still are not familiar with descending devices, and 46% of those that were reported they do not use them (GSMFC 2022). Thus, more outreach and promotions that put descending devices in the hands of anglers are needed to further increase the prevalence of use in the region. A large-scale outreach campaign, branded ‘Return ‘Em Right’, was recently launched in the Gulf region to educate anglers on best release practices and encourage their use of descending devices (https://returnemright.org/). Regulatory requirements may also be effective for increasing awareness and prevalence of use. Following a new requirement in the South Atlantic in 2020 to possess a descender device when fishing for snapper-grouper species, dockside angler interviews conducted in Florida during the federal recreational season for Red Snapper documented an increase in reported use of descender devices from 1% in 2018 to 33% in 2021 (Vecchio et al. 2021). Likewise in the Gulf, federal legislation enacted in 2020 through the Direct Enhancement of Snapper Conservation and the Economy through Novel Devices (DESCEND) Act now requires anglers to possess a venting tool or descending device when fishing for reef fishes in the Gulf of Mexico.

Given that descender device use by anglers in the Gulf of Mexico is expected to continue increasing in the future with the recent regulatory requirement and ongoing outreach efforts, continuous monitoring of catch-and-release practices used in recreational fisheries throughout the region is an important research need in order to account for the impacts in future assessments. In order to evaluate the impact of outreach efforts through the Return 'Em Right program, fishery observer coverage on for-hire vessels was recently expanded west of Florida to include coastal waters of Alabama and Mississippi. In addition, new questions that measure descender device use by private boat anglers have been added to the intercept survey questionnaires used for Florida's State Reef Fish Survey, Alabama's Snapper Check, and Mississippi's Tails 'N Scales. However, there continues to be a critical need for more detailed monitoring of discards and prevalence of venting and descender device use in the western Gulf.

Recommendations for SEDAR 74

Assessment analysts requested that discard mortality recommendations be provided for each of the three stock boundaries as defined for SEDAR 74. Within each region, separate estimates were requested for three recreational fleets (private boat, charter, headboat) and two commercial fleets (vertical line and longline). For each fleet, recommendations were also requested separately for open and closed seasons. Seasons were defined by time periods when harvest is permitted. Post IFQ, seasons for commercial fleets were considered open for trips with an IFQ available to legally harvest fish and closed otherwise.

The time blocks used in previous SEDARs to account for decreased mortality rates following the widespread adoption of venting in the fishery after 2008 were not used for SEDAR 74. This decision was based on discussions at the workshop by scientists and fishermen indicating that predation has increased in recent decades, which potentially negates any reduced discard mortality as a result of increased venting practices.

Recreational Sector Recommendations

To make objective recommendations for SEDAR 74, two approaches were used:

1. Direct measurement: If an available study provided a direct measure of discard mortality for a particular fleet in a region, then that estimate was recommended. Direct measures were only available in the central and eastern regions (Vecchio et al. 2022) and, since the meta-analysis did not detect seasonal differences in these two regions, a single value was recommended for both the open and closed seasons (Table 2).

    a. For the eastern region charter and head boat fleets, direct estimates were available (Vecchio et al. 2022, values labeled as southwest Florida in the working paper).
    b. For the central region headboat fleet, a direct estimate was available (Vecchio et al. 2022). Since only one headboat was sampled in MS and no estimate was available from AL, the value provided in the working paper for northwest Florida was recommended.
    c. For the central region charter fleet, separate estimates for the Florida panhandle, Alabama and Mississippi were provided in Vecchio et al. (2022). The estimate that was recommended for the central region (Table 2) used the highest and lowest confidence limit values from the three reported estimates as the upper and lower recommended values, and the point estimate is the central point between the two values.

2. If a direct measure was not available, the median fishing depth for a given fleet was determined using available data from the region, and this value was used to select an appropriate proportional

mortality rate from the model outputs of the updated meta-analysis conducted for SEDAR 74 (Ramsay et al. 2022). In the western region, higher mortality rates estimated during summer months were applied to the "open" season, and lower rates estimated outside of the summer were applied to the "closed" season. Since the meta-analysis did not detect seasonal differences in the central and eastern regions, a single value was recommended for both open and closed seasons (Table 2).

a. For the headboat fleet in the western region:
The median depth that red snapper discards were caught from for the headboat fleet in the western region was 35m, which was calculated using data from the Southeast Headboat survey (provided by Rob Cheshire).

b. For the charter and private boat fleets in the western region:
Median depths where charter and private boats release red snapper in the western region were provided separately for Texas and Louisiana. In Texas, self-reported data collected through iSnapper from 2015-2021 indicated a median fishing depth of 25m for charter and private boat modes (data provided by Judd Curtis). Data collected through the LA Creel survey indicate that red snapper discarding in Louisiana occurs in deeper depths: 34m for private boats and 45m for charter (data provided by Jason Adriance, LDWF). Therefore, the highest confidence limit value from Louisiana was used as the upper estimate for the western region, the lower confidence limit value from Texas was used as the lower estimate for the region, and the point estimate was the central point between this error range (Table 2).

c. For the private boat fleet in the central region:
The median depth of 27m was provided in Vecchio et al. (2022)

d. For the private boat fleet in the eastern region:
The median depth of 33m was provided in Vecchio et al. (2022)

Commercial Sector Recommendations

The only two data sets that were available for the commercial fishery did not measure delayed mortality and thus could not be included in the meta-analysis. Therefore, an alternative approach was used to recommend discard mortality rates for the commercial sector. Data to inform discard mortality in the commercial Red Snapper fishery were available from the commercial discard logbook program (2002-2019) and the reef fish observer program (2007-2019). The discard logbook program includes commercial fisher reported data while data in the reef fish observer program are collected by fisheries observers onboard commercial fishing vessels. Observer reported data were assumed to be more complete than discard logbook data due to frequent underreporting in the discard logbook program (McCarthy 2012), thus only observer data were used.

Observer data included information on the number of fish that were dead when brought onboard the commercial fishing vessel and the number of fish with indications of barotrauma (Table 3). The recommendation of the discard working group was to estimate Red Snapper discard mortality in the commercial fishery as the midpoint between the observed percentage of Red Snapper reported as dead when brought onboard and the percentage of dead Red Snapper plus those with indications of barotrauma

(Table 4). The range of discard mortalities were the percentage dead when brought onboard (minimum estimate) and the combined percentage of dead plus those with indicates of barotrauma (maximum estimate). Those estimates were provided by gear (vertical line [handline, electric/hydraulic reels] and bottom longline) and region (east, central, west). Sample sizes were insufficient to provide separate estimated mortalities during the open and closed seasons by gear and region.

Research Recommendations

- Long-term monitoring that provides a statistically valid measure of the annual magnitude of recreational discards in state and federal waters adjacent to Texas.
- Long-term studies in the western Gulf that monitor the size and condition of discards and release methods used within recreational fisheries in the western Gulf.
- Studies that quantify delayed mortality of discards caught from commercial fishing gears.

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Table 1. Proportional discard mortality recommendations provided for SEDAR 52.

			Eastern Gulf		Western Gulf	
Sector	Time period	Venting assumed	Closed	Open	Closed	Open
Recreational	Pre-2008	No	0.21	0.21	0.22	0.22
	Post-2008	Yes	0.118	0.118	0.118	0.118
Vertical line	Pre-2008	No	0.74	0.75	0.87	0.78
	Post-2008	Yes	0.55	0.56	0.74	0.60
Longline	Pre-2008	No	0.74	0.81	0.87	0.91
	Post-2008	Yes	0.55	0.64	0.74	0.81

Table 2. Discard mortality recommendations for SEDAR74, expressed as percentages with +/- standard error, for the recreational directed fleets.

	Western Gulf		*Central Gulf*		*Eastern Gulf*	
Fleet	Open	Closed	Open	Closed	Open	Closed
Private boat	35.5 +/- 10	21.1 +/- 7	29.7 +/- 10	29.7 +/- 10	31.5 +/- 10	31.5 +/- 10
Charter	41.2 +/- 16	26.2 +/- 8	16.9 +/- 9	16.9 +/- 9	26.8 +/- 5	26.8 +/- 5
Headboat	40.6 +/- 6	24.6 +/- 5	24.4 +/- 5	24.4 +/- 5	27.9 +/- 5	27.9 +/- 5

Table 3. Commercial Observer Program Red Snapper Disposition-Condition, 2007-2019. Zone = Gulf of Mexico areas as defined for SEDAR 74; N fish = number of observed fish; Kept = fish were landed and sold; Released = fish were discarded; Kept as bait = fish were used as bait; Unknown = disposition unknown/unreported; Alive, Good = fish had no signs of barotrauma; Alive, Barotrauma = fish were alive when brought onboard, but had signs of barotrauma; Dead = fish were dead when brought onboard the vessel; Not Recorded = condition was not recorded by the observer.

Vertical Line									
		Disposition %				Further Breakdown of Released Fish: Condition % Upon Arrival to Vessel			
Zone	N fish	Kept	Released	Kept as Bait	Unknown	Alive, Good	Alive, Barotrauma	Dead	Not Recorded
Central	77,238	85.48	14.49	0.00	0.02	60.83	36.83	0.78	1.56
East	23,151	61.87	38.12	0.00	0.00	49.43	48.95	0.22	1.40
West	82,934	89.84	9.43	0.00	0.73	57.13	39.80	1.28	1.79
Bottom Longline									
Zone	N fish	Kept	Released	Kept as Bait	Unknown	Alive, Good	Alive, Barotrauma	Dead	Not Recorded
Central	574	23.52	76.48	0.00	0.00	17.77	78.59	1.37	2.28
East	25,331	43.38	56.52	0.00	0.10	48.16	45.68	3.51	2.65
West	2,911	69.12	30.88	0.00	0.00	62.07	30.70	6.79	0.44

Table 4. Commercial discard mortality recommendations by fleet (vertical line, bottom longline) for SEDAR 74. Zone = Gulf of Mexico areas as defined for SEDAR 74; N fish = number of observed fish;

Dead = observed percentage of fish observed dead when brought onboard the vessel (the recommended lower limit for discard mortality); Barotrauma+Dead = observed percentage of dead Red Snapper plus those with indications of barotrauma (the recommended upper limit for discard mortality); Midpoint/Estimated discard mortality = midpoint the dead percentage and Barotrauma+Dead percentage (the recommended discard estimate).

Vertical Line				
Zone	N fish	Dead	Barotrauma+Dead	Midpoint/Estimated discard mortality
Central	574	0.78	37.61	19.2
East	25,331	0.22	49.17	24.7
West	2,911	1.28	41.08	21.2
Bottom Longline				
Zone	N fish	Dead	Barotrauma+Dead	Midpoint/Estimated discard mortality
Central	574	1.37	79.96	40.7
East	25,331	3.51	49.19	26.4
West	2,911	6.79	37.49	22.1