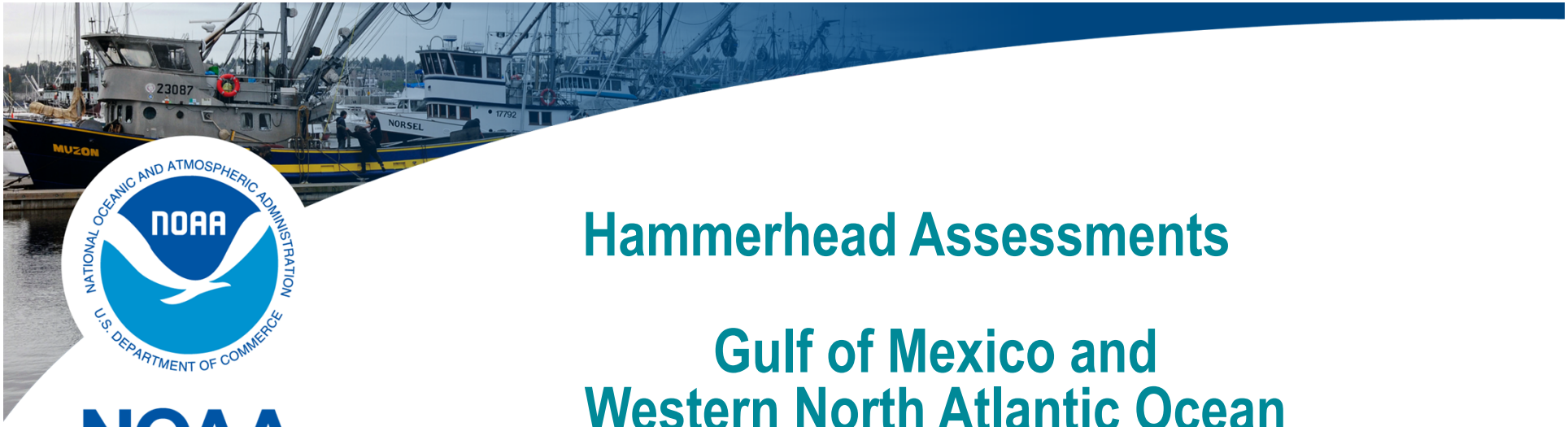


NOAA FISHERIES

SEFSC

Hammerhead Assessments

Gulf of Mexico and Western North Atlantic Ocean

Data Inputs – Post Release Mortality

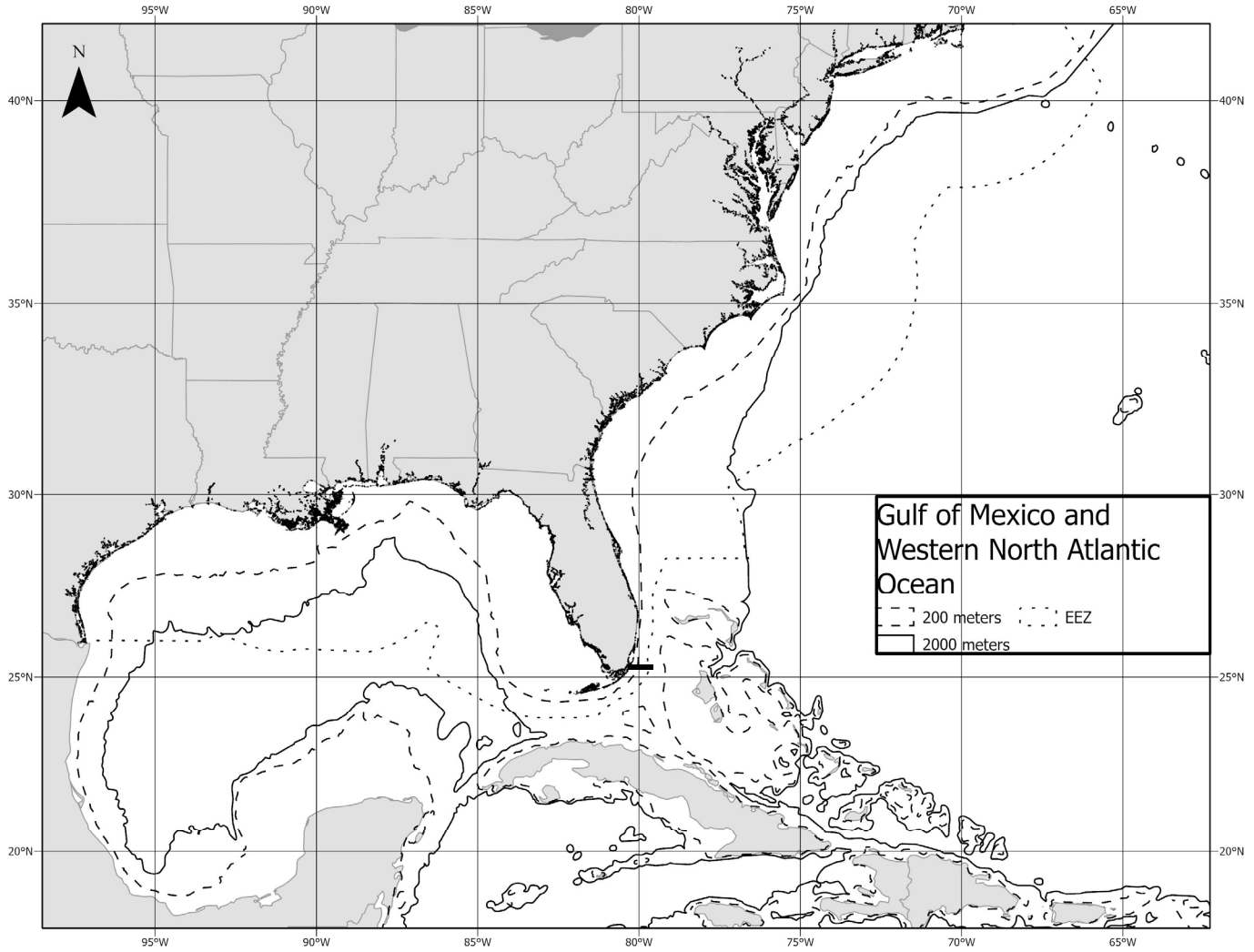
SEDAR 77 (Review Workshop)

August 28 – September 1, 2023

Outline

- Hammerhead Assessments – Data Process
  - Gulf of Mexico and Western North Atlantic Ocean
- Data Process Presentations
  - Post-Release Mortality Rates
- Data Process Final Report
  - Discussion and decisions

Gulf of Mexico and Western North Atlantic Ocean



Data Process Final Report Discussion and Decisions

3.1.2 Commercial Datasets and Decisions

SEDAR

Southeast Data, Assessment, and Review

SEDAR 77

HMS Hammerhead Sharks

Data Workshop Final Report

April 2022

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - The Post-release delayed mortality (PRLDM) Ad-hoc Working Group discussed SEDAR77-DW09 and SEDAR77-DW10 (Prohaska et al. 2021a, 2021b), which provided evidence from the evaluation of blood biochemical indicators and capture condition that scalloped and great hammerheads captured with bottom longlines and on the hook for longer than about 3 hr are likely to be in either poor condition or dead at release.
  - The PRLDM Ad-hoc Working Group discussed SEDAR77-RD35 (Gulak et al. 2015; Simon Gulak, Pers. Comm. December 14, 2022), which provided evidence from fisheries research conducted employing hook timers on contracted commercial bottom-longline vessels in the U.S. Highly Migratory Species Shark Research Fishery to determine that the proportion of total number captured by hour for scalloped and great hammerheads on the hook <= 3 hr was 33.54 and 33.80%, respectively (**Tables 27 and 28**).

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - The PRLDM Ad-hoc Working Group discussed SEDAR77-RD20 (Drymon and Wells 2017), SEDAR77-RD42 (Gallagher et al. 2014), SEDAR77-DW34 (Hoffmayer et al. 2021), and SEDAR77-DW35 (Whitney et al. 2021), which provided evidence from electronically tagged sharks to estimate PRLDM of great hammerheads captured on drumline and bottom longline gear soaked for between about 1 – 3 hr that ranged from 0 % (N tagged = 3, n dead post-release = 0) to 56% (N tagged = 9, n dead post-release = 5) with a pooled estimate of 45% (N tagged = 60, n dead post-release = 27; **Table 29**). The PRLDM Ad-hoc Working Group also discussed that SEDAR77-DW35 (Whitney et al. 2021) provided evidence from electronically tagged sharks to estimate PRLDM of scalloped hammerheads captured on bottom longline gear soaked for between about 1 – 3 hr (post-release mortality = 8% obtained from N tagged = 25 and n dead post-release = 2; **Table 29**).

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - The PRLDM Ad-hoc Working Group discussed using the proportion of total number captured by hour for scalloped hammerheads on bottom longline hook-timers for <=3 hr and > 3 hr to compute the PRLDM rate for scalloped hammerheads captured in commercial bottom longline gear.
  - The estimate of PRLDM rate obtained from electronically tagged scalloped hammerheads captured on bottom longlines with hook or soak times about 1 – 3 hr (8%; **Table 29**) was applied to the proportion of scalloped hammerheads on hook-timers for <=3 hr (33.54%, n = 55; **Tables 27 and 30**).
  - The PRLDM Ad-hoc Working Group discussed that the PRLDM rate of scalloped hammerheads on hook timers > 3hr (66.46%, n = 109; **Tables 27 and 30**) was assumed to be 100% because live scalloped hammerheads were likely to be in poor condition at release and unlikely to survive post-release.
  - The PRLDM mortality rate calculated for scalloped hammerheads released from commercial bottom longline gear using this approach was 69.15% (**Table 30**).

Data Process Final Report Recommendations
Commercial Post Release Mortality

- *Discussion and decisions*
  - A binomial confidence interval was used to calculate a range of uncertainty for PRLDM in a recent SEDAR blacktip shark stock assessment (NMFS 2020).
  - Consequently, the PRLDM Ad-hoc Working Group also discussed using a binomial 95% confidence interval (CI, 0.0098 – 0.2603) calculated in R version 4.0.5 (R Development Core Team, 2021) with the library “binom” (Dorai-Raj 2014): binom.confint(x = 2, n = 25, method = "exact") as the minimum and maximum estimate of PRLDM obtained from electronic tag data for scalloped hammerheads captured on bottom longline gear soaked for between about 1 – 3 hr.
  - Applying this range of uncertainty obtained from the binomial CI to the equations in **Table 30** resulted in a 95% CI of 66.79 – 75.19% PRLDM for scalloped hammerheads captured on bottom longline gear.

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - Similarly, the PRLDM Ad-hoc Working Group discussed using proportions of great hammerheads on bottom longline hook-timers for <=3 hr and > 3hr to compute the PRLDM for great hammerheads captured in commercial bottom longline gear.
  - The estimate of PRLDM rate obtained from electronically tagged great hammerheads captured on drumlines and bottom longlines with soak times about 1 – 3 hr (45%; **Table 29**) was applied to the proportion of great hammerheads on hook-timers for <=3 hr (33.80%, n = 24; **Tables 28 and 31**).
  - The PRLDM Ad-hoc Working Group discussed that the PRLDM rate of great hammerheads on hook timers > 3hr (66.20%, n = 47; **Tables 28 and 31**) was assumed to be 100% because live great hammerheads were likely to be in poor condition at release and unlikely to survive post-release.
  - The PRLDM rate calculated for great hammerheads released from commercial bottom longline gear using this approach was 81.41% (**Table 31**).

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - Similarly, the PRLDM Ad-hoc Working Group discussed using a binomial 95% confidence interval (CI, 0.3212 – 0.5839) calculated in R version 4.0.5 (R Development Core Team, 2021) with the library “binom” (Dorai-Raj 2014): binom.confint(x = 27, n = 60, method = "exact") as the minimum and maximum estimate of PRLDM obtained from electronic tag data for great hammerheads captured on bottom longline gear soaked for between about 1 – 3 hr.
  - Applying this range of uncertainty obtained from the binomial CI to the equations in **Table 31** resulted in a 95% CI of 77.05 – 85.93% PRLDM for great hammerheads captured on bottom longline gear.

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - Other methods have also been used to obtain a 95% confidence interval for post-release mortality estimates for demersal longlines (Whitney 2019 citing methods in Goodyear 2002), however these methods were not reviewed by the PRLDM Ad-hoc Working Group during the data process workshops.
  - The PRLDM Ad-hoc Working Group discussed that PRLDM rates obtained for hammerheads captured with bottom longline gear may also be the best available estimates of PRLDM for hammerheads captured in commercial gillnet gear.

Data Process Final Report Recommendations Commercial Post Release Mortality

- *Discussion and decisions*
  - The PRLDM Ad-hoc Working Group discussed that smooth and scalloped hammerheads are physiologically more similar than smooth and great hammerheads.
  - Consequently, the PRLDM Ad-hoc Working Group discussed that PRLDM rates obtained for scalloped hammerheads captured with bottom longline gear may be the best available estimates of PRLDM for smooth hammerheads captured with both bottom longline gear and commercial gillnet gear.

Data Process Final Report Recommendations Commercial Post Release Mortality

- Scalloped Hammerhead Assessment – Data Process
- Gulf of Mexico and Western North Atlantic Ocean
- *Decisions*
  - ***Decision:* Use a PRLDM mortality rate of 69.15% as the best estimate of PRLDM for scalloped hammerheads released alive from commercial bottom longline gear.**
  - ***Decision:* Use a 95% CI of 66.79 – 75.19% PRLDM as the minimum and maximum estimate of PRLDM for scalloped hammerheads released alive from commercial bottom longline gear.**
  - ***Decision:* Use PRLDM rates obtained for hammerheads captured with bottom longline gear as the best available estimates of PRLDM for hammerheads captured in commercial gillnet gear.**

Data Process Final Report Recommendations Commercial Post Release Mortality

- Great Hammerhead Assessment – Data Process
- Gulf of Mexico and Western North Atlantic Ocean
- *Decisions*
  - ***Decision:*** ***Use a PRLDM rate of 81.41% for great hammerheads released alive from commercial bottom longline gear.***
  - ***Decision:*** ***Use a 95% CI of 77.05 – 85.93% PRLDM as the minimum and maximum estimate of PRLDM for great hammerheads released alive from commercial bottom longline gear.***

Data Process Final Report Recommendations Commercial Post Release Mortality

- Smooth Hammerhead Assessment – Data Process
- Gulf of Mexico and Western North Atlantic Ocean
- *Decisions*
  - ***Decision:* Use PRLDM rates obtained for scalloped hammerheads captured with bottom longline gear as the best available estimates of PRLDM for smooth hammerheads captured with both bottom longline gear and commercial gillnet gear.**

Data Process Final Report Discussion and Decisions

3.1.3 Recreational Catch Datasets and Decisions

SEDAR

Southeast Data, Assessment, and Review

SEDAR 77

HMS Hammerhead Sharks

Data Workshop Final Report

April 2022

SEDAR
4055 Faber Place Drive, Suite 201
North Charleston, SC 29405

Data Process Final Report Recommendations
Recreational Post Release Mortality

- Recreational post-release live discard mortality (PRLDM)
- *Discussion and decisions*
  - A PRLDM Ad-hoc Working Group discussed that direct estimates of PRLDM were not available for hammerheads from a review of the scientific literature reviewed in SEDAR77-DW25 (Courtney et al. 2021, their Tables A.1 and A.2).
  - Consequently, a minimum estimate of recreational PRLDM for hammerheads was developed by the PRLDM Ad-hoc Working Group from great hammerheads captured and released alive in three directed electronic tagging studies of recreational fishing gear reported and reviewed during the SEDAR 77 Data Workshop (SEDAR77-DW07, SEDAR77-DW22, and a SEDAR 77 Data Workshop presentation).

Data Process Final Report Recommendations
Recreational Post Release Mortality

- Recreational post-release live discard mortality (PRLDM)
- *Discussion and decisions*
  - The [minimum] PRLDM rate estimate was obtained primarily from great hammerheads captured and released alive by experienced recreational anglers targeting sharks.
  - As a result, the PRLDM estimate obtained from these studies was assumed to represent a plausible minimum estimate of the PRLDM of all hammerheads released alive from recreational gear, which are primarily captured incidentally.
  - The [minimum] PRLDM estimate discussion and decisions are provided in more detail within Data Process Final Report.

Data Process Final Report Recommendations
Recreational Post Release Mortality

- Recreational post-release live discard mortality (PRLDM)
- *Discussion and decisions*
  - In contrast, a best estimate of hammerhead shark recreational PRLDM was obtained during the SEDAR 77 Data Workshop from a previously published meta-analysis of pelagic shark PRLDM rates captured and released alive from multiple gear types (Musyl and Gilman 2019).
  - It was noted during the SEDAR 77 Data Workshop that meta-analysis may provide a relatively more robust (stable) PRLDM estimate than those obtained from individual directed studies, which can fluctuate based on individual study design and sample size, as discussed below.
  - Similarly, a maximum estimate of hammerhead shark recreational PRLDM was obtained during the SEDAR 77 Data Workshop as the 95% upper confidence interval (UCI) of pelagic shark PRLDM (Musyl and Gilman 2019).

Data Process Final Report Recommendations Recreational Catches RPM

- Hammerhead Assessment – Data Process
- Gulf of Mexico and Western North Atlantic Ocean
- *Decisions*
  - ***Decision:* Use the pooled PRLDM rate of 11.8% obtained from three directed electronic tagging studies of great hammerheads released alive from recreational gear as a minimum estimate of the PRLDM rate for hammerheads captured and released alive with recreational gear.**
  - ***Decision:* Use the PRLDM obtained from meta-analysis for pelagic sharks (26.8%, Musyl and Gilman 2019) as the best estimate of the PRLDM rate for hammerheads captured and released alive with recreational gear.**
  - ***Decision:* Use the 95% upper confidence interval (UCI) of PRLDM obtained from meta-analysis for pelagic sharks (36.0%, Musyl and Gilman 2019) as the maximum estimate of the PRLDM rate for hammerheads captured and released alive with recreational gear.**