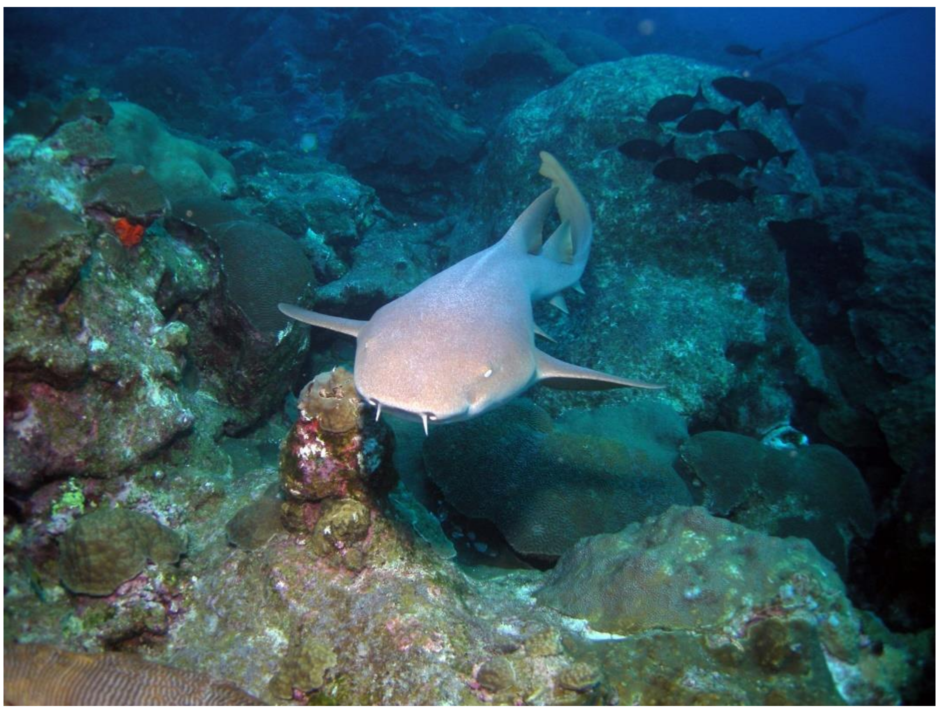
Draft
Atlantic Highly Migratory Species Essential Fish Habitat 5-Year Review



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National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Atlantic Highly Migratory Species Management Division

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List of Acronyms

Acronym	Definition
1999 FMP	1999 Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks
Amendment 1	Amendment 1 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan
Amendment 2	Amendment 2 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan
Amendment 3	Amendment 3 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan
Amendment 5a	Amendment 5a to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan
AOA	Aquaculture Opportunity Area
ASMFC	Atlantic States Marine Fisheries Commission
ATCA	Atlantic Tunas Convention Act
BAYS	bigeye, albacore, yellowfin, and skipjack tunas
BOEM	Bureau of Ocean Energy Management
C	Celsius
CFR	Code of Federal Regulations
CFMC	Caribbean Fishery Management Council
CVA	climate vulnerability assessment
DPS	distinct population segment
EEZ	exclusive economic zone
ESA	Endangered Species Act
EFH	essential fish habitat
FAO	Food and Agriculture Organization
FEIS	Final Environmental Impact Statement
FR	Federal Register
FMP	Fishery Management Plan
GME	Geospatial Modeling Environment
GMFMC	Gulf of Mexico Fishery Management Council
GIS	geographic information system
GULFSPAN	Cooperative Gulf of Mexico Shark Pupping and Nursery Project
HAPC	habitat area of particular concern
HMS	Atlantic highly migratory species

Acronym	Definition
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
LNG	liquefied natural gas
MAFMC	Mid-Atlantic Fishery Management Council
Magnuson-Stevens Act or MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	NOAA's National Marine Fisheries Service
OCS	Outer Continental Shelf
PEIS	Programmatic Environmental Impact Statement
PKD	Plymouth, Kingston, Duxbury bay system
PVC KDE	percent volume contour kernel density estimation
SAFMC	South Atlantic Fishery Management Council
SCRS	Standing Committee on Research and Statistics
SEDAR	Southeast Data, Assessment, and Review
YOY	young-of-year

Executive Summary

Under the current fishery management plan (FMP) as amended, we, NOAA Fisheries, use a two-phase process to review and consider updates to essential fish habitat (EFH) for Atlantic Highly Migratory Species (HMS). Consistent with this process, we initiated Phase 1, which includes the development of this draft 5-year review document, approximately 5 years after publication of the last HMS EFH review and update completed and included in the 2017 Final Amendment 10 to the 2006 Consolidated Atlantic HMS FMP. If no new information is found to warrant updating HMS EFH, then we may choose to retain it in its current composition. However, if updates are warranted, we would initiate Phase 2 of this process which may include an action to implement the recommended updates.

This 5-year review document summarizes the preliminary results of our Phase 1 review. As part of Phase 1, we considered data that was not included in, or that has become available since, the last review and update completed in 2017. We found that new scientific information may warrant updates to the EFH for 40 of 53 HMS. We found no new scientific information that may warrant updates to EFH for skipjack and albacore tuna; longbill spearfish; and bigeye sand tiger, bignose, Caribbean reef, Caribbean sharpnose, Galapagos, narrowtooth, night, sevengill, sixgill, and smalltail sharks. Additionally, we reviewed previously used and alternative methodologies for describing and identifying EFH, and public comments on those methodologies. Based on this review, we found that technical changes to the kernel density estimation methodologies would reduce bias in those descriptions and identifications that results from how multiple, discrete datasets are combined into one composite data structure.

In general, we did not find new information concerning adverse effects of fishing on EFH and therefore make no changes to the evaluation of those effects included in the 2017 EFH review and update. The 2017 EFH review and update did include a spatial analysis of observer data to evaluate bottom longline interactions with coral. This analysis could be updated to incorporate any new information that might be available from the observer program. We also note that, in rare cases, pelagic longline gear can interact with the sea floor when the "deep-set" technique is used. Interest and use of deep-set pelagic longline gear has increased in recent years, and the technique and gear configuration can vary as fishermen determine the best way to use the technique in the Atlantic and Gulf of Mexico. NOAA Fisheries and academic researchers are currently analyzing and characterizing this technique and we will continue to assess its impacts on EFH.

We identified some potential new actions to encourage conservation and enhancement of EFH adversely affected by some non-fishing activities. Decision support tools such as geospatial databases or site suitability analyses could potentially reduce or mitigate effects of marine sand/minerals mining, aquaculture siting, and renewable energy production (i.e., activities associated with all stages of offshore wind energy development and operation). We also recommend, as actions to promote conservation and enhancement of EFH adversely affected by wind energy activities, the development of a robust monitoring and biological sampling framework to collect information on oceanographic conditions and biological comunities; and to conduct project-specific assessments of whether time of year mitigation or minimization strategies are appropriate to reduce adverse effects of lethal or disruptive activities. Additionally, we will continue to monitor ongoing agency initiatives that concern climate change, renewable energy, marine sand and minerals mining, and aquaculture.

The HMS FMP includes habitat areas of particular concern (HAPCs) for bluefin tuna (*Thunnus thynnus*) and for sandbar (*Carcharhinus plumbeus*), lemon (*Negaprion brevirostris*), and sand tiger (*Carcharias taurus)* sharks. We did not find any information that supports changing or removing these HAPCs. However, we will review and, if necessary, update EFH, specifically the geographic boundaries, based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017. HAPCs must be within the boundaries of EFH. Accordingly, if EFH boundaries for species where HAPCs have been identified are changed, we may need to make adjustments to HAPC identifications. We invite public comment on whether a new HAPC is warranted for white sharks in the New York Bight. We also invite the public to submit comments regarding any of the information and/or the preliminary results of the 5-year review presented in this document. The final version of the 5-year review will include a discussion on any Phase 2 action needed to update HMS EFH.

1. Introduction

Atlantic highly migratory species (HMS) fisheries (tunas, billfish, swordfish, and sharks) are managed under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA or Act) (16 U.S.C. 1801 *et seq*.) and the Atlantic Tunas Conventions Act (ATCA) (16 U.S.C. 971 *et seq*.). Because HMS are found throughout the Atlantic Ocean and must be managed both domestically and internationally, NOAA Fisheries manages these species under the 2006 Consolidated HMS Fishery Management Plan (FMP) and its amendments. Under ATCA, the National Marine Fisheries Service (NOAA Fisheries), is authorized to promulgate regulations as may be necessary and appropriate to carry out recommendations by the International Commission for the Conservation of Atlantic Tunas (ICCAT) and its Standing Committee on Research and Statistics (SCRS) for Atlantic tunas and tuna-like species.

The MSA provides for conservation and management of fisheries in the United States exclusive economic zone and requires that FMPs describe and identify essential fish habitat for the fishery based on guidelines. Subpart J of 50 CFR Part 600 provides guidelines for completing this and other MSA requirements that apply to EFH. For purposes of the MSA, EFH means “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” 16 U.S.C. 1801(10). The Act requires that each FMP include an evaluation of the adverse effects on EFH caused by fishing and non-fishing activites and include measures to minimize adverse effects caused by fishing to the extent practicable. FMPs are also required to identify other actions to encourage the conservation and enhancement of EFH, *Id*. at 1853(a)(7), and consulation with NOAA Fisheries on any federal action or proposed action that may adversely affect EFH. *Id*. at 1855(b)(2). Should a state or interstate fishing activity adversely affect EFH, NOAA Fisheries will consider that action to be an adverse effect and will provide

EFH Actions to encourage conservation and enahancements to the appropriate state or interstate fishery management agency on that activity. 50 CFR § 600.815(c).

Subpart J guidelines specify that a complete review of all information available on each of the 10 components of EFH in each FMP must be conducted at least once every five years. Revisions or amendments to these EFH componets should be made as warranted based on a review of available information. The review should include an evaluation of published scientific literature, unpublished scientific reports, information solicited from interested parties, and previously unavailable or inaccessible data.

Table 1.1 provides a summary of how we reviewed new literature and information for each component. The "EFH FMP Component" column also includes an abbreviated title for each component of EFH. Chapters 4-11 of this 5-year review present a summary of new information that we found regarding the 10 components of EFH for Atlantic HMS. An "X" in a cell means that a particular paper was found to be relevant to a component of EFH. Each section features a table using these abbreviations as column headers.

Table 1.1 HMS 5-year review plan for EFH components.

#	EFH FMP Component	Review Plan
1	Description and identification of EFH ("Describe & ID EFH")	Identify and evaluate new scientific literature and information from other relevant sources to see whether species-specific EFH description and identification, as written in the FMP, is correct. Suggest edits to the FMP text as appropriate. Identify new scientific information that could be used to update species life history review, including but not limited to topics such as distribution, migration, local movement, habitat associations, habitat useage, biological information, stock identification, prey, and other relevant life history information.
2	Fishing activities that may adversely affect EFH ("MSA Fishing Activities")	Review whether there have been changes in, or newly available information on, federal fishing activities managed under the Magnuson-Stevens Act that may adversely affect EFH. Identify sources of information that may influence analysis of the impact of these fishing activities.
3	Non-Magnuson-Stevens Act fishing activities that may adversely affect EFH ("Non-MSA Fishing Activities")	Review whether there have been changes in current non-Magnuson-Stevens Act fishing (e.g., state water fisheries), compared to the EFH analysis. Identify sources of information that may influence analysis of the impact of these fishing activities.
4	Non-fishing related activities that may adversely affect EFH ("Non-Fishing Activities")	Review whether there have been changes to, or newly available information on, non-fishing activities affecting habitat since the EFH analysis. Identify sources of information that may influence analysis of the impact of these fishing activities.
5	Cumulative impacts analysis ("Cumul. Impacts")	Review cumulative impacts discussion in FMPs and evaluate against new information.
6	Conservation and enhancement ("Cons. & Enhance.")	Review actions identified to promote conservation and enhancement of EFH adversely affected by fishing and non-fishing activities, and evaluate against new information to see whether updates to the identified actions are warranted. Applicable actions identified in earlier EFH actions which are deemed to still be scientifically valid are incorporated by reference.
7	Prey species ("Prey")	Review prey species information and determine if updates are warranted.

#	EFH FMP Component	Review Plan
8	Identification of HAPC (“HAPC”)	As appropriate, based on species-specific review of EFH, suggest revisions to existing or new candidate HAPCs if warranted.
9	Research and information needs (“Research & Info Needs”)	Based on review of new information in Component 1, review research and information needs, and determine whether updates to EFH research needs identified in the FMP are warranted.
10	Review and revision of EFH components of FMPs (“Review & Update”)	The final HMS EFH 5-Year Review completes Phase 1 of the process to review and update EFH. This may refer to the overall process used to update HMS EFH.

The current HMS FMP employs a two-phase process to update HMS EFH. This document refers to each phase as Phase 1 or Phase 2, as approporate. Phase 1 includes the development of a draft 5-year review, the public comment process, and publication of a final 5-year review. Phase 1 is initiated approximately five years after publication of the most recent EFH action. If there is no new information that warrants updating EFH, then we may choose to retain the previously designated HMS EFH. However, if new information warrants updates, we would initiate Phase 2 of this process, which may include a follow-up action that implements the recommended updates to HMS EFH. The type of follow-up action depends on the outcomes of the 5-year review (i.e., whether it is a simple update, or if it requires an FMP amendment or rulemaking). Although Phase 2 is discussed in this document as part of a description of the overall process of updating EFH, this document only provides a foundation of decision-making for Phase 2. This draft 5-year review should not be interpreted as a step in Phase 2.

In total, there have been nine EFH actions resulting in either the generation of new or updated EFH descriptions and identifications for HMS (Table 1.2). The first comprehensive of EFH for Atlantic tunas, swordfish, and sharks were included in the 1999 FMP for Atlantic Tunas, Swordfish, and Sharks (1999 FMP) (64 FR 29090, May 28, 1999). Habitat Areas of Particular Concern (HAPC) were also identified for sandbar sharks. EFH for billfishes was first described and identified in Amendment 1 to the Billfish FMP (64 FR 29090, May 28, 1999). In Amendment 1 to the 1999 FMP, EFH was updated for five shark species due to changes in stock status and the availability of new information that could inform EFH (68 FR 74746, December 24, 2003). No new HAPCs were identified at that time, and NOAA Fisheries did not update EFH for any of the other species in the HMS management unit.

NOAA Fisheries first completed a comprehensive 5-year review of HMS EFH using a two-phase approach between 2006 and 2009. Phase 1 was completed in the 2006 Consolidated HMS FMP (71 FR 40096, July 14, 2006). All EFH text descriptions and maps previously provided in separate documents (e.g., the 1999 FMP, Amendment 1 to the Billfish FMP, and Amendment 1 to the 1999 FMP) were combined in the 2006 Consolidated HMS FMP. NOAA Fisheries presented new EFH information and data collected since 1999, a new evaluation of fishing gear impacts, and requested public comment on any additional data or information that needed to be included in the review. Based on this evaluation, NOAA Fisheries determined that modification to existing EFH for some species and/or life stages was warranted, and that any changes to EFH, including identification of new HAPCs and options to minimize the adverse effects of fishing, should be considered in a separate amendment (Phase 2). NOAA Fisheries also conducted a comprehensive review of all federally and non-federally managed fishing gears that formed the basis for further analysis on gear impacts. In 2009, NOAA Fisheries completed Phase 2 of the EFH update process via Amendment 1 to the 2006 Consolidated HMS FMP (Amendment 1) (74 FR 28018, June 12, 2009). In Amendment 1, NOAA Fisheries updated and revised existing descriptions and identifications of HMS EFH, identified a HAPC for bluefin tuna (*Thunnus thynnus*) in the Gulf of Mexico, and analyzed fishing and non-fishing effects on HMS EFH pursuant to section 305(b) of the Magnuson-Stevens Act.[1]

Two rulemakings were completed in 2010 that added new HMS to the management unit. Amendment 3 to the 2006 Consolidated HMS FMP (Amendment 3) (75 FR 30484, June 1, 2010) added the smoothhound shark management group to the HMS management unit and defined EFH for the group. An interpretive rule and final action (75 FR 57698, September 22, 2010) added roundscale spearfish (*Tetrapturus georgii*) to the HMS management unit and defined its EFH.

The next comprehensive review and update of HMS EFH occurred between 2014 and 2017. Phase 1 was completed through the publication of a Final HMS EFH 5-Year Review on July 1, 2015 (80 FR 37598). In general, that document considered the body of available scientific literature, technical information, and new data made available through December 31, 2014. However, literature that was published after 2014 was identified through internal review and the public comment process as relevant. The Phase 2 follow up action therefore included some scientific information, on a topic-specific basis, that reflected this feedback. NOAA Fisheries determined that updates to HMS EFH was warranted (Phase 1) and that Amendment 10 to the 2006 Consolidated HMS FMP (Amendment 10) should be developed in order to implement these updates (Phase 2). In 2017, NOAA Fisheries completed Phase 2 and updated EFH in Amendment 10 (82 FR 42329, September 7, 2017). With Amendment 10, NOAA Fisheries updated and revised existing EFH for HMS, modified current HAPCs for bluefin tuna and sandbar shark, identified new HAPCs for sand tiger and lemon shark, and analyzed fishing and non-fishing effects on EFH. [2]

The EFH and analyses of adverse effects of fishing and non-fishing activites on that EFH presented in Amendment 10 will apply until and unless updated in a future action (i.e., Phase 2 of this 5-year review cycle). Maps depicting current HMS EFH boundaries are available in the Final Environmental Assessment for Amendment 10.[3] HMS EFH shapefiles are presented online

[1] Original text descriptions of HMS life history, behavior, and EFH can be found in Chapter 5 of Amendment 1: https://media.fisheries.noaa.gov/dam-migration/a1-hms-feis.pdf.
[2] The most recent updates to HMS life history, behavior, and EFH may be found in Chapter 6 of Amendment 10: https://media.fisheries.noaa.gov/dam-migration/final_a10_ea_signed_fonsi_092017.pdf.
[3] https://www.fisheries.noaa.gov/action/amendment-10-2006-consolidated-hms-fishery-management-plan-essential-fish-habitat

in NOAA Fisheries' EFH Mapper.[4] These shapefiles can also be downloaded from the EFH Data Inventory.[5]

This Draft HMS EFH 5-Year Review should be considered Phase 1 of the new EFH review and update cycle. On April 5, 2022, NOAA Fisheries published a notice of initiation of a 5-year EFH review and a public request for information (87 FR 19667). NOAA Fisheries compiled these public submissions with information and data that was not previously included in recent updates to HMS EFH, or has become available since publication of the previous 5-year review in 2015 and/or Amendment 10 in 2017. Published and unpublished scientific reports, fishery-dependent and independent datasets, and expert and anecdotal information detailing the habitats used by HMS were evaluated and synthesized with existing species and habitat descriptions into this document.

Each section of this draft includes recommendations to either update or not update relevant components of HMS EFH, i.e., EFH defintions, an evaluation of adverse effects, measures to minimize adverse effects of fishing on EFH, and actions that should be considered to ensure the conservation and enhancement of EFH. This draft review provides an additional opportunity for public review and input, which will be considered in the development of a final 5-year review (Phase 1). The recommendations and conclusions of the final 5-year review (Phase 1) would be used to determine whether it is appropriate to update HMS EFH in a subsequent action (Phase 2).

Table 1.2. Management history for HMS EFH.

Year and FMP or Amendment	EFH and Species
1999 FMP for Atlantic Tunas, Swordfish, and Sharks	EFH first identified and described for Atlantic tunas, swordfish and sharks; HAPCs designated sandbar sharks
1999 Amendment 1 to the Billfish FMP	EFH first identified and described for Atlantic billfish
2003 Amendment 1 to the FMP for Atlantic Tunas, Swordfish, and Sharks	EFH updated for five shark species (blacktip, sandbar, finetooth, dusky, and nurse sharks)
2006 Consolidated HMS FMP	EFH for all HMS consolidated into one FMP; comprehensive 5-year review of EFH for all HMS (Phase 1)
2009 Amendment 1 to the 2006 Consolidated HMS FMP	EFH updated for all federally managed HMS (Phase 2); HAPC for bluefin tuna spawning area designated in the Gulf of Mexico
2010 Amendment 3 to the 2006 Consolidated HMS FMP	EFH was first defined for smoothhound sharks
2010 White Marlin/Roundscale Spearfish Interpretive Rule and Final Action	EFH was first defined for roundscale spearfish (same as white marlin EFH designation in Amendment 1)
2015 5-Year Review of HMS EFH	Comprehensive 5-year review of EFH (Phase 1)
2017 Amendment 10 to the 2006 Consolidated HMS FMP	EFH updated for all federally managed HMS (Phase 2); new HAPCs for sand tiger and lemon shark, and minor adjustments to HAPCs for bluefin tuna and sandbar shark
2022 Initiation of 5-Year Review of HMS EFH	Comprehensive 5-year review of EFH (Phase 1); final document expected in 2023

[4] https://www.habitat.noaa.gov/apps/efhmapper/
[5] https://www.habitat.noaa.gov/protection/efh/newInv/index.html

2. Approach

The results of the Draft HMS EFH 5-Year Review, Phase 1, are documented in this report. The draft review evaluates new information on HMS EFH, provides recommendations for revisions to HMS EFH, and identifies information gaps and research needs. This review considers information on the biology, distribution, habitat requirements, life history characteristics, migratory patterns, spawning, pupping, and nursery areas of HMS along with a summary of fishing and non-fishing activities that may adversely affect EFH. A summary of notable management changes implemented since Amendment 10 are also provided on a species-by-species basis for contextual purposes; however, this should not be considered a comprehensive review or history of all rulemakings affecting the management unit. If warranted, the recommendations and conclusions from this review would be used in a Phase 2 action to update EFH ranges and text descriptions.

2.1. Steps Used to Complete and Document the Essential Fish Habitat Review

This section outlines the major steps used in conducting the Draft HMS EFH 5-Year Review (Phase 1). For all steps, HMS Management Division staff were the lead evaluators and drafters. Additionally, NOAA Fisheries Office of Habitat Conservation staff, Regional Office staff, Science Center staff, and other qualified individuals, such as Advisory Panel members, provided assistance by reviewing documents when appropriate and identifying data gaps and new information.

- *Evaluation of new information*: We reviewed each of the mandatory 10 EFH components (as enumerated at § 600.815(a)(1)-(10)) for new data and other information available since Amendment 1 in 2009; Amendment 3 in 2010; the interpretive rule and final action that defined EFH for roundscale spearfish in 2010; and the previous 5-year review in 2015 and/or Amendment 10 in 2017. Generally, a Phase 1 EFH 5-year review document should consider the body of available scientific literature, technical information and new data that has come available since the previous EFH action. However, it may not be an exhaustive list. It is possible that scientific information published during or prior to the previous action was not included, or was not adequately addressed. It is also possible that a paper could be published after this time window that is critically important for EFH discussions or addresses an issue raised by the public during the comment process. The 5-year review process allows for multiple opportunities to iteratively review, identify and incorporate the best scientific information available into EFH designations regardless of when it was published. For this draft document, the initial literature search was focused on scientific literature that was either not previously considered in past EFH actions or was published between January 1, 2015 and June 30, 2022. Particularly relevant papers published after June 30, 2022 could be included in the Final HMS EFH 5-Year Review (Phase 1) or in Phase 2 analyses for a subsequent follow up action to update EFH.

- *Request for information/scoping*: NOAA Fisheries published a notice to initiate the EFH 5-year review process and a public request for information (87 FR 19667, April 5, 2022).

During the 60-day comment period from this initial request for information, NOAA Fisheries received metadata and information on one new dataset from the Maryland Department of Natural Resources and two public comment submissions with suggestions for the 5-year review. The new dataset compiles 16 years of vessel logbook information collected by a charter captain, and reflects a study conducted by Maryland Department of Natural Resources to evaluate the ability of dependent shark records from a charter boat to answer biological questions. One of the public submissions provided information on spiny dogfish (*Squalus acanthias*). Since this species is not in the HMS management unit and is instead managed jointly by the New England and Mid-Atlantic Fishery Management Councils, this information was not included in this Draft HMS EFH 5-Year Review. The other public submission included suggestions on many of the 10 components of EFH, such as the process used to review and update EFH, fishing and non-fishing impacts analysis, and the role of prey as EFH. We considered these comments in the development of this draft 5-year review.

- *Preparation of the Draft HMS EFH 5-Year Review*: Contents of the review include:

  a. Review of 10 EFH components, documentation of how the review was conducted, and identification of new information available that relates to each component.
  b. Recommendations by section regarding future analyses or updates to HMS EFH. Identification of any recommended changes to the 10 EFH components in the draft 5-year review, and public comment, will be considered in decision-making regarding a follow up action. The final 5-year review will include recommendations on whether a follow up action is needed and the type of follow-up action that could be used. The type of follow up action depends, in part, on whether the change is a substantive change (e.g., a change in EFH description), or a non-substantive or minor technical one (e.g., minor changes to life history information).
  c. Intra-agency scientific and legal review.

- *Comments on the Draft HMS EFH 5-Year Review*: This draft 5-year review is being made available to the public and the HMS Advisory Panel for comment. Each section of the 5-year review provides topic-specific guidance on feedback that would be helpful from the public to complete this 5-year review, however, the public is encouraged to submit feedback on any aspect of this 5-year review. Other requests for comment or instructions may be specified in the *Federal Register* notice accompanying this draft 5-year review. Comments are specifically requested on:

  a. Whether the individual species reviews are accurate and complete;
  b. Whether the available new information warrants revision to any of the 10 components of EFH presented in the 2006 Consolidated HMS FMP;
  c. New data or information that should be incorporated into future analyses to redefine EFH boundaries for HMS;

d. Appropriate methodologies for delineation of HMS EFH boundaries;
e. Identification and delineation (or modification) of HAPCs for HMS EFH;
f. The role of prey for EFH;
g. Adverse effects of fishing and non-fishing activities on EFH;
h. The potential use of decision support tools to mitigate potential adverse effects of certain non-fishing activities on HMS EFH; and
i. Other issues or information relevant to HMS EFH.

- *Final HMS EFH 5-Year Review*: We will address public comments and HMS Advisory Panel comments on the Draft HMS EFH 5-Year Review, and make final recommendations on: (1) whether revisions to HMS EFH are warranted, and (2) the type of Phase 2 follow up action, if warranted, that will be initiated to update EFH. We will publish a notice of availability in the *Federal Register* when the Final HMS EFH 5-Year Review is complete. This review will also be made available on the HMS website.

2.2. Role of Prey in Essential Fish Habitat Designations

Over the years, NOAA Fisheries has had questions from constituents regarding the role of prey species in EFH designations. This question is particularly relevant to HMS as many HMS are high level predators. NOAA Fisheries Procedure 03-201-15 specifically addresses the treatment of prey species in EFH designations.[6] As noted in this procedure, "including prey in EFH identifications and descriptions has considerable implications for the overall scope of EFH when those prey are considered during the EFH consultation process. It is important that prey do not become a vehicle for overly expansive interpretations of EFH descriptions." In order to avoid overly expansive interpretations of EFH, the procedure recommends that prey species alone not be described as EFH; that any EFH designations focus on how prey makes waters or substrate function as a feeding habitat; and that prey habitat should not be included in FMPs unless the prey habitat is also EFH for a managed species.

NOAA Fisheries identified predator-prey relationships as part of the HMS life history reviews in Amendment 10 by including known, scientific information on prey species.[7] Table 2.1 provides a list of specific prey taxa identified in Amendment 10 life history profiles; it should not be considered a comprehensive list of all predator-prey associations for this species. Many HMS are prey generalists (meaning they feed on a variety of prey species), and in general we have not found explicit enough associations for specific habitats and prey species that they could be defined as part of the EFH text descriptions. However, Amendment 10 did not present prey information for HMS in the same manner for all HMS. For example, species profiles for teleost fish (tunas, swordfish and billfish) had a separate subsection that explicly discussed predator/prey relationships, whereas this information was consolidated with other life history information in shark sections. To remedy this, we recommend a reorganization of life history

[6] https://media.fisheries.noaa.gov/dam-migration/03-201-15.pdf
[7] https://media.fisheries.noaa.gov/dam-migration/final_a10_ea_signed_fonsi_092017.pdf

information in Phase 2, which would include a subsection in each species profile that contains new information or information not previously considered on the role of prey species in EFH designations.

We encourage the public to submit information that may be relevant in refining the role of prey in EFH desigation (e.g., spatially explicit predator-prey associations for specific habitats, the overall effects of removing prey from habitats designated as HMS EFH).

Table 2.1. Amendment 10 predator-prey associations noted by species.

Amendment 10 Section	HMS Predator	Prey Species Noted
2.3.2	White shark	Gray seals
4.2; Alternative 6b	Sand tiger shark	Menhaden, crabs
6.2.1	Albacore tuna	Fish (e.g., anchovy), cephalopods,
6.2.2	Bigeye tuna	Fish, cephalopods, crustaceans
6.2.3	Bluefin tuna	, Cephalodpods, benthic invertebrates, fish (e.g., silver hake, atlantic mackerel, herring, krill, sand lance, menhaden)
6.2.4	Skipjack tuna	Fish, cephalopods, crustaceans
6.2.5	Yellowfin tuna	Fish and invertebrates, sargassum-associated fauna, larval stomatopods, crabs, squirrelfish
6.3	Swordfish	Fish (e.g., small tunas, dolphinfishes, lancetfish, snake mackerel, flyingfishes, barracudas and squids, mackerels, herrings, anchovies, sardines, sauries, and needlefishes, hakes, pomfrets, snake mackerels, cutlass fish, lightfishes, hatchet fishes, redfish, lanternfishes, and cuttlefishes)
6.4.1	Blue marlin	Tuna-like fishes, squid, deep sea fish (e.g., chiasmodontids), dolphinfish, octopods, copepods
6.4.2	White marlin	Squid, fish (e..g, dolphinfishes, blue runner, mackerels, flyingfishes, and bonitos, cutlass fishes, puffers, herrings, barracudas, moonfishes, triggerfishes, remoras, round herring), crabs
6.4.4	Atlantic sailfish	Fish (e.g., little thunny, halfbeaks, cutlassfish, rudderfish, jacks, pinfish, sea robin), cephalodpods, gastropods, and shrimp
6.4.5	Longbill spearfish	Fish, squid
6.5.6	Sandbar	Fish
6.5.7	Scalloped hammerhead	Fish, shrimp
6.5.10	Spinner shark	Fish (e.g., clupeids)
6.6.2	Bonnethead	Crustaceans (e.g., blue crab), molluscs
6.6.4	Atlantic sharpnose shark	Fish
6.7.3	Porbeagle	Fish, cephalopods
6.7.4	Shortfin mako shark	Fish (e.g., swordfish, tuna, bluefish, clupeids, needlefishes), sharks, crustaceans and cephalopods
6.7.5	Common thresher shark	Squid, pelagic crabs, fish (e.g., anchovy, sardines, hakes, and small mackerels)
6.8.1	Smooth dogfish	Crustaceans (e.g., crabs, lobsters), fish (e.g., menhaden, stickleback, wrasses, porgies, sculpins, and puffers)
6.9.1	Angel shark	Squid, crustaceans, portunid crabs, fish

Amendment 10 Section	**HMS Predator**	**Prey Species Noted**
6.9.2	Basking shark	Zooplankton
6.9.5	Bigeye thresher	Squid, fish
6.9.7	Caribbean reef shark	Fish
6.9.11	Longfin mako shark	Fish (e.g., porcupine fish), squid
6.9.14	Sand tiger shark	Fish, elasmobranchs
6.9.15	Sevengill shark	Fish, cephalopods, batoids, benthic invertebrates
6.9.16	Sixgill shark	Fish (e.g., dolphinfish, billfish, flounder, cod), Agnathans (e.g., hagfish, lampreys), chimaeras, rays, sharks (e.g., spiny dogfish, longnose dogfish, shortnose dogfish, prickly sharks), gastropods, crustaceans, cephalopods, carrion
6.9.18	Whale shark	Plankton, including fish eggs and small fishes
6.9.19	White shark	Fish, marine mammals

3. Recent Environment and Management Changes

3.1. Environmental and Habitat Changes Since 2017

Since 2017, large-scale environmental and habitat changes have occurred that may have impacted HMS EFH. These include ongoing response to the Deepwater Horizon Oil Spill, increased public attention towards the impacts of climate change, and development and planning of lease sites for offshore wind energy facilities. Some of these changes are covered in greater detail in Chapter 13.

3.1.1. Deepwater Horizon

On April 20, 2010, an explosion and subsequent fire damaged the Deepwater Horizon MC252 oil rig, which capsized and sank approximately 50 miles southeast of Venice, Louisiana. Oil flowed for 86 days into the Gulf of Mexico from a damaged wellhead on the seafloor. In response to the Deepwater Horizon MC252 oil spill, NOAA Fisheries issued a series of emergency rules (75 FR 24822, May 6, 2010; 75 FR 26679, May 12, 2010; 75 FR 27217, May 14, 2010) closing a portion of the Gulf of Mexico exclusive economic zone (EEZ) to all fishing and analyzed the environmental impacts of these closures in an environmental assessment. Between May and November 2010, NOAA Fisheries closed additional portions of the Gulf of Mexico to fishing. The maximum closure was implemented on June 2, 2010, when fishing was prohibited in approximately 37 percent of the Gulf of Mexico EEZ. Significant portions of state territorial waters in Alabama (40 percent), Florida (2 percent), Louisiana (55 percent), and Mississippi (95 percent) were closed to fishing (Upton 2011). After November 15, 2010, approximately 0.4 percent (1,041 square miles) of the federal fishing area was kept closed immediately around the Deepwater Horizon wellhead through April 19, 2011, when the final oil spill closure area was lifted (NOAA 2011).

The largest environmental damage settlement in U.S. history ($20.8 billion) was approved on April 4, 2016. As part of this settlement, BP PLC will pay up to $8.8 billion to restore the Gulf of Mexico. The settlement included $1 billion allocated for early restoration activities, and $7.1 billion for an additional 15 years of restoration (starting in 2017). Up to an additional $700 million is also included to account for damages unknown at the time of settlement and for adaptive management. In 2016, the Deepwater Horizon Natural Resource Damage Assessment Trustee Council (Trustees) released its Final Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PEIS) that describes how restoration funding is allocated across geographic areas and different types of restoration activities, i.e., 13 different “restoration types.” These included the following:

- Wetlands, coastal, and nearshore habitats;
- Habitat projects on federally managed lands;
- Nutrient reduction;
- Water quality;
- Fish (including HMS) and water column invertebrates;
- Sturgeon;

- Submerged aquatic vegetation;
- Oysters;
- Sea turtles;
- Marine mammals;
- Birds;
- Mesophotic and deep benthic communities; and
- Provide and enhance recreational opportunities.

Early restoration efforts included projects intended to: reduce bycatch of pelagic fish across the Gulf of Mexico; enhance bird nesting habitat; improve nearshore and reef habitats; enhance recreational opportunities on federal lands; and reduce sea turtle mortality. Recently, the Open Ocean Trustees, charged with restoring fish and column invertebrates injured by the oil spill, released a first strategic plan for restoration work.[8] This strategic plan identified and prioritized fish and water column invertebrate species for restoration, identified threats and restoration opportunities for these species, and identified specific restoration objectives for fish and water column invertebrates. As of 2022, approximately $320 million of the $400 million allocation remains for future fish and water column invertebrate restoration planning and implementation. NOAA Fisheries will consider the impacts of Deepwater Horizon restoration work on HMS EFH as new information comes available.

NOAA continues to study and assess the impacts of the oil spill. For more information about Deepwater Horizon oil spill and restoration efforts, please visit the Gulf Coastal Ecosystem Restoration Council website and Gulf Spill Restoration Natural Resource Damage Assessment website.

3.1.2. Climate Change

Climate change has been included in previous analyses on adverse effects of non-fishing activities on HMS EFH. However, there has been an increasing amount of research on the impacts of climate change on HMS. Therefore, in Section 13.2.2.9 of this EFH review, NOAA Fisheries re-examines the effects of climate change on HMS EFH.

We will be conducting a climate vulnerability assessment (CVA) for HMS in 2023. Results from this assessment, which include species narratives providing a summary of climate change impacts to species, could be incorporated into life history reviews of HMS and other aspects of EFH, if appropriate. Relevant outcomes of this CVA might also help identify information gaps, research needs, and actions to encourage conservation and enhancement of HMS EFH.

3.1.3. Renewable Energy Projects / Wind Energy

The Bureau of Ocean Energy Management (BOEM) Office of Renewable Energy Programs facilitates the responsible development of renewable energy resources on the Outer

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[8] https://www.gulfspillrestoration.noaa.gov/2022/04/open-ocean-trustees-release-restoration-strategy-fish-water-column-invertebrates

Continental Shelf (OCS). In 2009, the Department of the Interior announced the final regulations for the OCS Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. These regulations provide a framework for issuing leases, easements and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. Executive Order (E.O.) 14008, "Tackling the Climate Crisis at Home and Abroad" addresses numerous aspects of renewable energy management and calls for an increase in renewable energy production.[9] Specifically, this E.O. calls for doubling offshore wind by 2030. On January 12, 2022, BOEM and NOAA announced a new interagency collaboration to advance offshore wind energy development.[10] On December 5, 2022, BOEM and NOAA advanced this collaboration with a Federal Mitigation Strategy to address anticipated impacts of offshore energy development on NOAA Fisheries' scientific surveys.[11] Offshore wind development can adversely affect NOAA Fisheries' surveys by precluding access to sampling areas, impacting statistical design, altering habitats, and interfering with survey operations. The joint strategy aims to avoid such impacts.

Wind energy has been included in previous analyses on the effects of "renewable energy projects" on HMS EFH. However, there has been a large increase in the amount of wind energy research and public attention on the development of wind farm leases off the east coast of the United States. Therefore, in this EFH review, NOAA Fisheries re-examines the impacts of offshore wind energy on HMS EFH. See Section 13.2.2.8 for more information on the effects of wind energy on HMS EFH.

3.2. EFH or Habitat Conservation-Related Actions Since 2017

The following sections provide a summary of state, territorial, Fishery Management Council, HMS, and other federal government initiatives that might be relevant to HMS EFH. Some of these initiatives are ongoing, and some were finalized after the publication of Amendment 10.

States and Territories

Many individual states and territories in the Atlantic, Gulf of Mexico, and U.S. Caribbean take EFH into consideration when developing fishery management measures. Through the Atlantic States Marine Fisheries Commission (ASMFC), Atlantic states consider habitat impact under all Interstate FMPs. The ASMFC has a Habitat Committee that works to identify, enhance, and cooperatively manage vital fish habitat.[12] Recent work by the Habitat Committee includes,

[9] https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/
[10] https://www.fisheries.noaa.gov/feature-story/noaa-and-bureau-ocean-energy-management-sign-new-interagency-agreement-wind-energy
[11] https://www.fisheries.noaa.gov/feature-story/efforts-mitigate-impacts-offshore-wind-energy-development-noaa-fisheries-surveys
[12] http://www.asmfc.org/habitat/program-overview

among other things, the development of a coastal shark fact sheet detailing life history and habitat needs.[13]

At this time, the only coordinated HMS management under the ASMFC is for coastal sharks. In August 2018, the ASMFC finalized Addendum V to the Coastal Sharks Interstate FMP to adjust regulations through Coastal Shark Management Board ("Board") action instead of addendum. This provided flexibility to respond to changes in stock status of coastal shark populations and ensure greater consistency between state and federal regulations. In April 2019, the Board approved changes to the recreational size limits for shortfin mako shark, bringing the interstate FMP into consistency with ICCAT Recommendations. In October 2019, the Board approved changes to gear requirements for recreational shark fishing.

The Gulf States Marine Fisheries Commission provides recommendations to states along the Gulf of Mexico to help coordinate state fisheries management. At this time, the Gulf States Marine Fisheries Commission has not recommended specific action to address HMS EFH.

Fishery Management Council EFH Actions

Five Fishery Management Councils have jurisdiction overlapping with HMS: the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), the South Atlantic Fishery Management Council (SAFMC), the Gulf of Mexico Fishery Management Council (GMFMC), and the Caribbean Fishery Management Council (CFMC). These Councils manage federal non-HMS fisheries and sometimes develop habitat protection measures that can impact HMS EFH.

In April 2018, the NEFMC implemented Omnibus Habitat Amendment 2. This amendment included updated EFH designations for all Council-managed species, designated new HAPCs, and revised current habitat and groundfish management areas. NEFMC also developed a habitat clam dredge exemption framework adjustment and an Omnibus Deep-Sea Coral Amendment, which were finalized 2020 and 2021, respectively.

In 2017, the MAFMC finalized Amendment 16 to the Atlantic Mackerel, Squid, and Butterfish FMP to protect deep sea corals and sponges from fishing gears that interact with benthic habitat. The Atlantic mackerel, squid, and butterfish fisheries sometimes use gear types that are also used when targeting HMS (e.g., gillnet), thus, the amendment could impact some HMS fisheries. Additional MAFMC habitat initiatives include the Northeast Regional Marine Fish Habitat Assessment (2019-2022) and the development of an Ecosystem Approaches to Fisheries Management Guidance Document (2016).

In 2020, NOAA Fisheries announced a final rule implementing Amendment 9 to the FMP for Coral and Coral Reef Resources in the Gulf of Mexico, which established 13 new HAPCs with fishing regulations, 8 areas without fishing regulations, and modified regulations in 3 existing areas (85 FR 65740, October 16, 2020).

[13] http://www.asmfc.org/files/Habitat/SpeciesFactsheets/CoastalSharks.pdf

The most recent SAFMC, GMFMC and CFMC amendments concerning EFH were published prior to 2017, and are not included here. Please see relevant Council websites for more information.

HMS Management Division EFH Actions

Since finalizing Amendment 10 in 2017, NOAA Fisheries has not undertaken additional regulatory action to either designate new EFH or to implement regulations intended to address fishing effects on HMS EFH. However, Amendment 12 (86 FR 46836, August 20, 2021) implemented revisions to Magnuson-Stevens Act National Standard Guidelines that were finalized in 2016, a rulemaking regarding standardized bycatch reporting methodology, and other NOAA Fisheries policy directives.[14] We revised some FMP objectives in the 2006 Consolidated HMS FMP, including those relevant to HMS EFH (Table 3.1). Other ongoing projects that could be informative to HMS EFH include HMS PRiSM, and a future HMS CVA.[15,16] The HMS CVA is discussed in greater detail in Section 13.49.

Table 3.1. Amendment 12 objectives related to EFH.

Objective	2006 Consolidated HMS FMP Objective	Final Revised FMP Objective	Rationale
10	Promote conservation and enhancement of areas identified as EFH for HMS, particularly for critical life stages.	Promote, identify, conserve, enhance, and analyze impacts on areas identified as EFH for HMS, particularly for critical life stages.	Adds “identify” to better reflect NOAA Fisheries work to identify HMS EFH. Maintains the concepts of conservation and enhancement, but in active voice. Adds the concept of “analyzing impacts” to EFH.
18	N/A - new objective.	Consistent with the other objectives of this FMP, consider ecosystem-based effects and seek to understand the impacts of shifts in the environment, including climate change, on HMS fisheries to support and enhance effective HMS fishery management.	Adds an objective to consider ecosystem-based effects and shifts in the environment, including climate change, in HMS fishery management.

Related Federal Actions

A variety of actions, initiatives, and programs have been undertaken by NOAA, other agencies, and Congress, and even through presidential proclamations, which affect the regulatory landscape within which EFH is managed. Some of these include:

[14] https://www.fisheries.noaa.gov/action/amendment-12-2006-consolidated-hms-fishery-management-plan-msa-guidelines-and-national
[15] https://www.fisheries.noaa.gov/atlantic-highly-migratory-species/new-scientific-paper-published-noaas-highly-migratory-species
[16] https://media.fisheries.noaa.gov/2022-08/Fall%202022%20HMS%20AP%20Meeting%20CVA_508.pdf

- Hudson Canyon National Marine Sanctuary designation - NOAA's Office of National Marine Sanctuaries is in the early stages of the process to designate a new national marine sanctuary around the Hudson Canyon, approximately 100 miles southeast of New York City.[17]
- Flower Garden Banks National Marine Sanctuary expansion - NOAA issued a final rule for expanding this sanctuary on January 19, 2021 (86 FR 4937) to protect 14 additional reefs and banks, and to adjust boundaries of the sanctuary's original three banks. This rule expanded the sanctuary from 56 square miles to a total of 160 square miles.[18]
- Florida Keys National Marine Sanctuary Restoration Blueprint - NOAA conducted a comprehensive review of the management plan, zoning plan, and regulations for this sanctuary and accepted public comments on a proposed rule in 2022 (87 FR 42800, July 18, 2022).[19]
- Northeast Canyons and Seamounts Marine National Monument - Prohibitions concerning this area have been revised three times between 2016 and 2021. An omnibus amendment is currently under development to incorporate the national monument into FMPs (87 FR 67677, November 9, 2022).[20,21]
- E.O. 14008, the America the Beautiful Initiative ("30 x 30") - directs the Department of the Interior, in consultation with the Department of Commerce and other agencies, to produce a report to the National Climate Task Force that recommends steps for conserving at least 30 percent of U.S. lands and waters by 2030.[22,23,24]

3.3. Conclusions

Environmental and management changes implemented or initiated since 2017 have not required HMS EFH to be re-evaluated outside of the normal 5-year review and update process. However, we encourage public comment on any environment and management changes that could affect HMS EFH. Any new information about impacts from the Deepwater Horizon oil spill, wind energy, or other ongoing ocean use activities will need to be monitored for information relevant to HMS and the EFH analyses included in the 2006 Consolidated HMS FMP and its amendments. Similarly, management measures affecting HMS EFH will also need to be considered during any subsequent HMS EFH actions.

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[17] https://sanctuaries.noaa.gov/hudson-canyon/
[18] https://flowergarden.noaa.gov/management/sanctuaryexpansion.html
[19] https://floridakeys.noaa.gov/blueprint/
[20] https://bit.ly/31X190d
[21] https://bit.ly/3KfDrFc
[22] https://bit.ly/3xwWEKZ
[23] https://www.doi.gov/priorities/america-the-beautiful
[24] https://bit.ly/3IxoU6u

3.4. Literature Cited

NOAA. 2011. NOAA: All federal waters of the Gulf of Mexico once closed to fishing due to spill now open. Press Release. Available at: http://www.noaanews.noaa.gov/stories2011/20110419_gulfreopening.html.

Upton HF. 2011. The Deepwater Horizon oil spill and the Gulf of Mexico fishing industry. Congressional Research Service (Rf1640; February 17, 2011)

4. Atlantic Tunas

The following sections review and itemize new information on life history, behavior, distribution, and habitat for Atlantic tunas managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and EFH presented in Amendment 10; and 2) itemize possible new sources of data that could be incorporated into EFH updates for the species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

4.1. Atlantic Bigeye Tuna (*Thunnus obesus*)

4.1.1. Management

Atlantic bigeye tuna have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for Atlantic bigeye tuna was completed by ICCAT in 2021. As of 2022, the stock status is overfished and overfishing is not occurring.

4.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic bigeye tuna:

Table 4.1. Literature search summary for Atlantic bigeye tuna, *Thunnus obesus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Andrade (2015)		X				X				
Cornic and Rooker (2021)*	X				X					
Cornic et al. (2018)	X									
Duffy et al. (2017)	X						X			
Erauskin-Extramiana et al. (2019)*	X					X			X	
Hsu et al. (2015)	X	X								
Lynch et al. (2018)*	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Monllor-Hurtado et al. (2017)	X			X	X					
Orbesen et al. (2017)	X	X								
Schirripa (2016)		X				X				

*While all literature in Table 4.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

4.1.3. Recommendations

Recent studies may support updating EFH for Atlantic bigeye tuna. Papers were found that provide new information on life history. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

4.2. West Atlantic Skipjack Tuna (*Katsuwonus pelamis*)

4.2.1. Management

West Atlantic skipjack tuna have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for West Atlantic skipjack tuna was completed by ICCAT in 2022. As of 2022, the stock status is not overfished and overfishing is not occurring.

4.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for West Atlantic skipjack tuna:

Table 4.2. Literature search summary for West Atlantic skipjack tuna, *Katsuwonus pelamis.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review & Update
Erauskin-Extramiana et al. (2019)*	X					X			X	

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review & Update
Lucena-Frédou et al. (2021)			X						X	
Muhling et al. (2015)	X									
Orbesen et al. (2017)	X	X								

*While all literature in Table 4.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

4.2.3. Recommendations

Although some updates to the life history for juvenile and adult West Atlantic skipjack tuna were found, they were minor and do not support any further review of EFH boundaries for any life stages for this species. We will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

4.3. North Atlantic Albacore Tuna (*Thunnus alalunga*)

4.3.1. Management

North Atlantic albacore tuna have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for North Atlantic albacore tuna was completed by ICCAT in 2016. As of 2022, the stock status is not overfished and overfishing is not occurring.

4.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for North Atlantic albacore tuna:

Table 4.3. Literature search summary for North Atlantic albacore tuna, *Thunnus alalunga.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Dragon et al. (2015)	X									
Duffy et al. (2017)	X						X			

EFH Component / Author, Year	1 Describe & ID EFH	2 MSA Fishing Activity	3 Non-MSA Fishing Activity	4 Non-Fishing Activity	5 Cumul. Impacts	6 Cons. & Enhance.	7 Prey	8 HAPC	9 Research & Info Needs	10 Review& Update
Erauskin-Extramiana et al. (2019)	X					X			X	
Hsu et al. (2015)	X	X								
Nikolic et al. (2017)	X								X	

4.3.3. Recommendations

Although some updates to the life history for juvenile North Atlantic albacore tuna were found, they were minor and do not support any further review of EFH boundaries for any life stages for this species. We will review, and, if necessary, update EFH boundaries based on new observer, survey, and tag/recapture data since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

4.4. Atlantic Yellowfin Tuna (*Thunnus albacares*)

4.4.1. Management

Atlantic yellowfin tuna have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for Atlantic yellowfin tuna was completed by ICCAT in 2019. As of 2022, stock status is not overfished and overfishing is not occurring. The next ICCAT yellowfin tuna stock assessment is expected to be conducted in 2023.

4.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for yellowfin tuna:

Table 4.4. Literature search summary for Atlantic yellowfin tuna, *Thunnus albacares*.

EFH Component / Author, Year	1 Describe & ID EFH	2 MSA Fishing Activity	3 Non-MSA Fishing Activity	4 Non-Fishing Activity	5 Cumul. Impacts	6 Cons. & Enhance.	7 Prey	8 HAPC	9 Research & Info Needs	10 Review& Update
Andrews et al. (2020)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Cornic and Rooker (2021)*					X					
Cornic et al. (2018)	X									
Duffy et al. (2017)	X						X			
Erauskin-Extramiana et al. (2019)*	X					X			X	
Hsu et al. (2015)*	X	X								
Kitchens (2017)	X									
Kitchens et al. (2018)	X									
Lang et al. (2017)*									X	
Monllor-Hurtado et al. (2017)	X			X	X					
Orbesen et al. (2017)	X	X								
Ortiz (2017)*	X									
Pacicco et al. (2021)				X		X				
Poland et al. (2019)							X			
Price et al. (2022)	X			X						

*While all literature in Table 4.4 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

4.4.3. Recommendations

Recent studies may support updating EFH for yellowfin tuna. Papers were found that provided new information on stock structure, population connectivity, life history, distribution, environmental associations, and potential fishing and non-fishing effects on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

4.5. Western Atlantic Bluefin Tuna (*Thunnus thynnus*)

4.5.1. Management

Western Atlantic bluefin tuna have had changes to their management structure since the publication of Amendment 10.

In 2020, NOAA Fisheries published a final rule that created two monitoring areas, removed a gear restricted area, and changed the timeframe when weak hooks were required in the Gulf of Mexico for the pelagic longline fishery (85 FR 18812, April 2, 2020).[25] In 2022, NOAA Fisheries published Amendment 13 to the 2006 Consolidated HMS FMP (87 FR 59966, October 3, 2022), effective January 1, 2023.[26] Amendment 13 refined the Individual Bluefin Quota Program; reassessed share distribution of bluefin tuna quotas, including the potential elimination or phasing out of the Purse Seine category, and revised a number of regulations for the directed and incidental bluefin tuna fisheries.

The most recent stock assessment for West Atlantic bluefin tuna was completed by ICCAT in 2021. As of 2022, overfishing is not occurring.

4.5.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bluefin tuna:

Table 4.5. Literature search summary for West Atlantic bluefin tuna, *Thunnus thynnus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Aalto et al. (2023)*	X									
Arai et al. (2020)*	X					X				
Butler et al. (2015)	X						X			
Cruz-Castán et al. (2019)	X									
Druon et al. (2016)	X									

[25] https://www.fisheries.noaa.gov/action/pelagic-longline-bluefin-tuna-area-based-and-weak-hook-management-measures
[26] https://www.fisheries.noaa.gov/action/amendment-13-2006-consolidated-hms-fishery-management-plan-bluefin-management-measures

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Goldsmith (2018)		X				X				
Hansell et al. (2022)	X	X								
Hazen et al. (2016)				X	X				X	
Hernandez et al. (2022)*	X									
Marcek et al. (2016)*	X									
Orbesen et al. (2018)*	X									
Rodríguez-Ezpeleta et al. (2019)	X					X			X	
Rypina et al. (2019)*	X									
Rypina et al. (2021)*	X									

*While all literature in Table 4.5 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

4.5.3. Recommendations

Recent studies may support updating EFH for bluefin tuna. Papers were found that provided new information on life history, range, distribution, environmental associations, and potential fishing and non-fishing effects on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

NOAA Fisheries did not identify literature suggesting that the existing bluefin tuna HAPCs should be changed or removed. If changes are made to the EFH of speices with HAPCs, such as bluefin, we may need to adjust boundaries of existing HAPCs. HAPC boundaries must fall within designated EFH. NOAA Fisheries encourages comments on whether the current HAPCs should be modified or removed from the HMS FMP.

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5. Atlantic Swordfish

The following sections review and itemize new information on life history, behavior, distribution, and habitat for Atlantic swordfish managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and EFH presented in Amendment 10; and 2) itemize possible new sources of data that could be incorporated into EFH updates for the species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

5.1. Atlantic Swordfish (*Xiphias gladius*)

5.1.1. Management

Atlantic swordfish have had changes to their management structure since the publication of Amendment 10.

In 2021, NOAA Fisheries published a final rule (86 FR 22882, April 30, 2021) that modified retention limits for swordfish and sharks in the U.S. Atlantic and Caribbean waters. This action provided increased retention limits of swordfish and consistency between the three open access swordfish handgear permits, which resulted in increased fishing opportunities for sustainably managed swordfish in the Atlantic and U.S. Caribbean and sharks in the U.S. Caribbean.

The most recent stock assessment for North Atlantic swordfish was completed by ICCAT in 2022. As of 2022, the stock status is not overfished and overfishing is not occurring.

5.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic swordfish:

Table 5.1. Literature seach summary for Atlantic swordfish, *Xiphias gladius*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Abascal et al. (2015)*	X								X	
Braun et al. (2019)*	X								X	
Coelho et al. (2022)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Erauskin-Extramiana, et al. (2020)				X	X				X	
Forrestal and Schirripa (2020)*	X								X	
Goodyear and Forrestal (2017)*	X								X	
Heemsoth et al. (2020)	X									
Kerstetter et al. (2017)		X								
Lerner et al. (2017)		X								
Logan et al. (2021)		X								
Lynch et al. (2018)		X							X	
Ortiz and Kimoto (2022)	X									
Schirripa et al. (2017)	X									
Suca et al. (2018)	X									

*While all literature in Table 5.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

5.1.3. Recommendations

Recent studies may support updating EFH for Atlantic swordfish. Papers were found that provided new information on life history, range, distribution, environmental associations, and fishing and non-fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

5.2. Literature Cited

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6. Billfish

The following sections review and itemize new information on life history, behavior, distribution, and habitat for Atlantic billfish managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and EFH presented in Amendment 10; and 2) itemize possible new sources of data that could be incorporated into EFH updates for the species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

6.1. Atlantic Blue Marlin (*Makaira nigricans*)

6.1.1. Management

Atlantic blue marlin have had changes to their management structure since the publication of Amendment 10.

On October 1, 2020 (85 FR 57783), NOAA Fisheries required catch-and-release fishing only for Atlantic blue marlin, white marlin, and roundscale spearfish in all areas of the Atlantic Ocean through December 31, 2020 to avoid exceeding the 250-marlin landings limit during the 2020 fishing year. The switch to catch-and-release fishing was based on the best available information possessed by NOAA Fisheries which showed a low margin between the latest landings estimate and the 250-marlin landings limit.

The most recent stock assessment for Atlantic blue marlin stock was completed by ICCAT in 2018. As of 2022, the stock status is overfished and overfishing is occurring.

6.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic blue marlin:

Table 6.1. Literature search summary for Atlantic blue marlin, *Makaira nigricans*.

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Dale et al. (2022)*	X								X	
Goodyear (2016)*	X									
Lynch, Shertzer et al. (2018)						X			X	

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Mourato et al. (2018)*		X								
Orbesen et al. (2017)	X	X							X	
Pons et al. (2017)		X				X				

*While all literature in Table 6.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

6.1.3. Recommendations

Recent studies may support updating EFH for Atlantic blue marlin. Papers were found that provided new information on life history, range, distribution, environmental associations, and the effects of fishing on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

6.2. Atlantic White Marlin (*Kajikia albidus*)

6.2.1. Management

Atlantic white marlin have had changes to their management structure since the publication of Amendment 10.

On October 1, 2020 (85 FR 57783), NOAA Fisheries required catch-and-release fishing only for Atlantic blue marlin, white marlin, and roundscale spearfish in all areas of the Atlantic Ocean through December 31, 2020 to avoid exceeding the 250-marlin landings limit during the 2020 fishing year. The switch to catch-and-release fishing was based on the best available information possessed by NOAA Fisheries which showed a low margin between the latest landings estimate and the 250-marlin landings limit.

The most recent stock assessment for Atlantic white marlin stock was completed by ICCAT in 2019. As of 2022, the stock status is overfished and overfishing is not occurring.

6.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic white marlin:

Table 6.2. Literature search summary for Atlantic white marlin, *Kajikia albidus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Graves et al. (2016)*	X					X				
Lynch et al. (2018)						X			X	
Mamoozadeh et al. (2018)	X									
Musyl and Gilman (2019)*	X					X			X	
Pons et al. (2017)						X				
Orbesen et al. (2017)	X	X							X	
Schlenker et al. (2016)*	X									
Vaudo et al. (2018)*	X									

*While all literature in Table 6.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

6.2.3. Recommendations

Recent studies may support updating EFH for Atlantic white marlin. Papers were found that provided new information on range, distribution, biology, and fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

6.3. Roundscale Spearfish (*Tetrapturus georgii*)

6.3.1. Management

Roundscale spearfish have had changes to their management structure since the publication of Amendment 10.

On October 1, 2020 (85 FR 57783), NOAA Fisheries required catch-and-release fishing only for Atlantic blue marlin, white marlin, and roundscale spearfish in all areas of the Atlantic Ocean through December 31, 2020 to avoid exceeding the 250-marlin landings limit during the 2020 fishing year. The switch to catch-and-release fishing was based on the best available information possessed by NOAA Fisheries which showed a low margin between the latest landings estimate and the 250-marlin landings limit.

The most recent stock assessment for roundscale spearfish was completed by ICCAT in 2019 (as part of the white marlin stock assessment). As of 2022, the stock status is overfished and overfishing is not occurring.

6.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for roundscale spearfish:

Table 6.3. Literature search summary for roundscale spearfish, *Tetrapturus georgii*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Lynch et al. (2018)						X			X	

6.3.3. Recommendations

Recent studies that highlight data on roundscale spearfish do not support updating EFH boundaries for roundscale spearfish. However, this is a cryptic species often confused with white marlin, and the stock is assessed collectively with white marlin. Therefore, we will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

6.4. Longbill Spearfish (*Tetrapturus pfluegeri*)

6.4.1. Management

Longbill spearfish have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

6.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for longbill spearfish:

Table 6.4. Literature search summary for longbill spearfish, *Tetrapturus pfuegeri.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Lynch et al. (2018)						X			X	

6.4.3. Recommendations

Recent studies do not support updating EFH boundaries for longbill spearfish. However, we will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

6.5. Sailfish (*Istiophorus platypterus*)

6.5.1. Management

Sailfish have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for western Atlantic sailfish stock was completed by ICCAT in 2016; however the next ICCAT assessment is scheduled for 2023 and relevant information from that assessment could be incorporated into future EFH update products. As of 2022, the stock status is not likely overfished and overfishing is not likely occurring.

6.5.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for western Atlantic sailfish:

Table 6.5. Literature search summary for sailfish, *Istiophorus platypterus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bubley et al. (2020)*	X									
Lynch et al. (2018)									X	
Lam et al., 2016*	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Pons et al. (2017)						X				

*While all literature in Table 6.5 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

6.5.3. Recommendations

Recent studies may support updating EFH for western Atlantic sailfish. Papers were found that provided new information on life history, range, distribution, and environmental associations. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

6.6. Literature Cited

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Lam, C.H., Galuardi, B., Mendillo, A., Chandler, E., & Lutcavage, M.E. (2016) Sailfish migrations connect productive coastal areas in the West Atlantic Ocean. Scientific Reports 6, 38163. https://doi.org/10.1038/srep38163

Lynch, P. D., et al. (2018). Abundance trends of highly migratory species in the Atlantic Ocean: accounting for water temperature profiles. ICES Journal of Marine Science 75(4): 1427-1438.

Mamoozadeh, N. R., et al. (2018). Genetic evaluation of population structure in white marlin (Kajikia albida): the importance of statistical power. ICES Journal of Marine Science 75(2): 892-902.

Mourato, B., et al. (2018). Stock assessment of Atlantic blue marlin (*Makaira nigricans*) using a Bayesian state-space surplus production model JABBA. Collective Volume of Scientific Papers, ICCAT 75(5): 1003-1025.

Musyl, M. K. and E. L. Gilman (2019). Meta-analysis of post-release fishing mortality in apex predatory pelagic sharks and white marlin. Fish and Fisheries 20(3): 466-500.

Orbesen, E. S., et al. (2017). Diurnal patterns in Gulf of Mexico epipelagic predator interactions with pelagic longline gear: implications for target species catch rates and bycatch mitigation. Bulletin of Marine Science 93(2): 573-589.

Pons, M., et al. (2017). Effects of biological, economic and management factors on tuna and billfish stock status. Fish and Fisheries 18(1): 1-21.

Schlenker, L. S., et al. (2016). Physiological stress and post-release mortality of white marlin (Kajikia albida) caught in the United States recreational fishery. Conservation Physiology 4(1): cov066.

Vaudo, J.J., et al. (2018). Horiztontal and vertical movements of white marlin, *Kajikia albida*, tagged off the Yucatan Peninsula. ICES Journal of Marine Science 75(2):844-857. doi:10.1093/icesjms/fsx176.

7. Large Coastal Sharks

The following sections review and itemize all new literature on life history, behavior, distribution, and habitat for large coastal sharks managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and essential fish habitat presented in Amendment 1; and 2) itemize possible new sources of data that could be incorporated into EFH updates for these species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

7.1. Blacktip Shark (*Carcharhinus limbatus*)

7.1.1. Management

Blacktip sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for the Gulf of Mexico blacktip shark stock was completed under the Southeast Data, Assessment, and Review (SEDAR) process in 2018 (SEDAR 29). As of 2022, the Gulf of Mexico blacktip shark stock status is not overfished and overfishing is not occurring. The most recent stock assessment for the Atlantic blacktip shark stock was completed by SEDAR in 2020 (SEDAR 65). As of 2022, the Atlantic blacktip shark stock status is not overfished and overfishing is not occurring.

7.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for blacktip shark:

Table 7.1. Literature search summary for blacktip sharks, *Carcharhinus limbatus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)	X		X							
Bangley and Rulifson (2017)*	X									X
Bangley et al. (2018)*	X									X
Benavides et al. (2021)	X									
Bethea et al. (2015)*	X									X
Diaz-Carballido et al. (2022)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Doan and Kajiura (2020)	X									
Drymon et al. (2020)*	X									X
Gallagher et al. (2017)		X								
Gallagher et al. (2017)	X									
Gibson et al. (2019)	X									
Gledhill et al. (2015)	X									
Gulak and Carlson (2021)		X								
Hamilton et al. (2022)*	X									X
Haulsee et al. (2020)*	X			X						X
Jerome et al. (2018)		X								
Kajiura and Tellman (2016)*	X									X
Kohler and Turner (2019)*	X									X
Lear et al. (2021)	X									
Legare et al. (2018)*	X									X
Legare et al. (2020)*	X									X
Livernois et al. (2021)	X									
Lynch et al. (2018)		X								
Matich et al. (2017)	X									
Martin et al. (2019)	X									
Matich et al. (2021)							X			
Matich et al. (2021)	X									
Matich et al. (2022)*	X									X
Mohan et al. (2020)		X								

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Morgan et al. (2020)	X									
Mullins et al. (2021)*	X									X
Peterson et al. (2017)	X	X								
Peterson et al. (2020)*	X									
Pickens et al. (2022)*	X									X
Peterson and Grubbs (2020)	X									
Plumlee and Wells (2016)				X			X			
Plumlee et al. (2018)*	X									X
Postaire et al. (2020)	X									
Roskar et al. (2020)	X									
SEDAR (2020)	X	X							X	
Shiffman et al. (2019)	X									
Ward-Paige et al. (2015)*	X									X
Whitney et al. (2017)		X								
Whitney et al. (2021)		X								
Williams et al. (2019)*	X									X

*While all literature in Table 7.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.1.3. Recommendations

Recent studies may support updating EFH for blacktip sharks. Papers were found that provided new information on life history, distribution, environmental associations, prey species, fishing effects, and non-fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.2. Bull Shark (*Carcharhinus leucas*)

7.2.1. Management

Bull sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed. A research track stock assessment, which will be conducted under the SEDAR process, is scheduled for this species beginning in 2024.

7.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bull sharks:

Table 7.2. Literature search summary for bull sharks, *Carcharhinus leucas.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review & Update
Ajemian et al. (2016)			X							
Altobelli and Szedlmayer (2020)*	X									X
Bangley et al. (2018)*	X									X
Bangley et al. (2018)*	X									X
Bethea et al. (2015)	X									
Calich et al. (2018)*	X									X
Calich et al. (2021)*	X									X
Dawdy et al. (2022)	X									
Diaz-Carballido et al. (2022)	X									
Edwards et al. (2022)*	X							X		X
Gallagher et al. (2017)	X									
Graham et al. (2016)*	X			X						X

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review & Update
Gausmann (2021)*	X									X
Gibson et al. (2019)	X									
Griffin et al. (2022)	X									
Gulak and Carlson (2021)		X								
Hammerschlag et al. (2022)*	X									X
Haulsee et al. (2020)*	X			X						X
Jerome et al. (2018)		X								
Kohler and Turner (2019)*	X									X
Laurrabaquio-A et al. (2019)	X									
Lear et al. (2021)	X									
Livernois et al. (2021)	X									
Matich and Heithaus (2015)	X									
Matich et al. (2017)	X									
Matich et al. (2020)	X									
Matich et al. (2021)	X									
Mitchell et al. (2021)*	X									X
Plumlee et al. (2018)*	X									X
Roskar et al. (2020)	X							X		
Shiffman et al. (2019)	X									
Strickland et al. (2020)	X									
TinHan et al. (2020)	X									
TinHan and Wells (2021)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review & Update
Whitney et al. (2021)		X								
Williams et al. (2019)*	X									X

*While all literature in Table 7.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.2.3. Recommendations

Recent studies may support updating EFH for bull sharks. Papers were found that provided new information on life history, range, distribution, environmental associations, fishing effects, and non-fishing effects. Some scientific literature on bull sharks in the Indian River lagoon was identified that could support a discussion on a potential HAPC (see Chapter 14). We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.3. Great Hammerhead (*Sphyrna mokarran*)

7.3.1. Management

Great hammerheads have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed. A research track stock assessment for hammerhead sharks is currently being conducted under the SEDAR process (SEDAR 77), with an operational assessment scheduled to begin after completion.

7.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for great hammerheads:

Table 7.3. Literature search summary for great hammerhead sharks, *Sphyrna mokarran.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)*	X		X						X	
Barker et al. (2017)*	X								X	

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Benavides (2020)*	X									
Bethea et al. (2015)*	X									
Calich et al. (2018)*	X	X								
Calich et al. (2021)*	X									
Chi Chan et al. (2021)*	X									
Doan and Kajiura (2020)	X									
Drymon and Wells (2017)*	X									
Graham et al. (2016)*	X									
Griffin et al. (2022)*	X									
Gulak et al. (2015)						X				
Gulak et al. (2017)	X									
Guttridge et al. (2017)*	X								X	X
Hamilton et al. (2022)	X									
Hammerschlag, Gutowsky, et al. (2022)*	X									
Hansell et al. (2018)*	X									
Heim et al. (2021)	X			X						
Kohler and Turner (2019)*										
Lear et al. (2021)*	X									
Macdonald et al. (2021)*	X					X				
Mullins et al. (2021)*	X									
Queiroz et al. (2016)*	X									
Rider et al. (2021)				X						
Roemer et al. (2016)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
. Tinari and Hammerschlag (2021)*	X									
Williams et al. (2019)*	X									

*While all literature in Table 7.3 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.3.3. Recommendations

Recent studies may support updating EFH for great hammerheads. Papers were found that provided new information on life history, range, distribution, environmental associations, fishing effects, and non-fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.4. Lemon Shark (*Negaprion brevirostris*)

7.4.1. Management

Lemon sharks have had no changes to their management structure since the publication of Amendment 10. NOAA Fisheries has not made a stock status determination for lemon shark (i.e., it is currently considered "unknown" for management purposes); however, a recent assessment conducted by Hansell et al. (2021) is being evaluated for use in determining stock status under National Standard 2 of the Magnuson-Stevens Act.

7.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for lemon sharks:

Table 7.4. Literature search summary for lemon sharks, *Negaprion brevirostris.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)*	X								X	
Brooks et al. (2016)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bruns and Henderson (2020)	X									
Casselberry et al. (2020)*	X									
Gallagher, Shiffman, et al. (2017)*	X									
Garla et al. (2017)	X		X							
Griffin et al. (2021)*	X									X
Hamilton et al. (2022)*	X									
Harborne et al. (2016)	X					X				
Kessel et al. (2016)*	X									
Kohler and Turner (2019)*	X									
Legare et al. (2015)*						X				
Legare et al. (2020)*	X									
Leurs et al. (2018)*	X									
Pickard et al. (2016)*	X									
Plumlee et al. (2018)*	X									
Ruiz-Abierno et al. (2020)	X									
Shiffman et al. (2019)	X									
Shipley et al. (2019)	X									
Tavares (2020)*	X									
Tavares et al. (2021)*	X									
Tinari and Hammerschlag (2021)*	X									
Williams et al. (2019)*	X									

*While all literature in Table 7.4 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.4.3. Recommendations

Recent studies may support updating EFH for lemon sharks. Papers were found that provided new information on life history, range, distribution, environmental associations, and fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

NOAA Fisheries did not identify literature suggesting that the existing lemon shark HAPCs should be changed or removed. If changes are made to the EFH of speices with HAPCs, such as lemon shark, we may need to adjust boundaries of existing HAPCs. HAPC boundaries must fall within designated EFH. NOAA Fisheries encourages comments on whether the current HAPCs should be modified or removed from the HMS FMP.

7.5. Nurse Shark (*Ginglymostoma cirratum*)

7.5.1. Management

Nurse sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

7.5.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for nurse sharks:

Table 7.5. Literature search summary for nurse sharks, *Ginglymostoma cirratum*.

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Altobelli and Szedlmayer (2020)*	X									
Bruns and Henderson (2020)	X									
Casselberry et al. (2020)*	X									
de Sousa Rangel et al. (2021)	X			X						
Garzon et al. (2021)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Griffin et al. (2021)*	X									X
Hammerschlag, Gutowsky, et al. (2022)*	X			X						
Hansell et al. (2018)*	X									
Kohler and Turner (2019)*	X									
Mullins et al. (2021)*	X									
Pratt et al. (2018)*	X									
Rider et al. (2021)*				X						
Shiffman et al. (2019)	X									
Shipley et al. (2019)	X									
Tinari and Hammerschlag (2021)*	X									

*While all literature in Table 7.5 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.5.3. Recommendations

Recent studies may support updating EFH for nurse sharks. Papers were found that provided new information on life history, range, distribution, environmental associations, and non-fishing effects on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.6. Sandbar Shark (*Carcharhinus plumbeus*)

7.6.1. Management

Sandbar sharks have had no changes to their management structure since the publication of Amendment 10. Sandbar sharks can only be retained by vessels selected to participate in the shark research fishery. The most recent stock assessment for sandbar sharks was completed by SEDAR in 2017 (SEDAR 54). As of 2022, the stock status is overfished and overfishing is not occurring.

7.6.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for sandbar sharks:

Table 7.6. Literature search summary for sandbar sharks, *Carcharhinus plumbeus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Matthew J. Ajemian et al. (2016)	X									
Altobelli and Szedlmayer (2020)*	X									X
C. W. Bangley et al. (2018)*	X									X
Benavides et al. (2021)	X									
Collatos et al. (2020)*	X									X
Crear et al. (2020)*	X									X
Crear et al. (2021)	X									
Drymon et al. (2020)*	X									X
Haulsee et al. (2020)*	X			X						X
Kohler and Turner (2019)*	X									X
Gibson et al. (2019)	X									
Gulak and Carlson (2021)		X								
Jerome et al. (2018)		X								
Latour et al. (2022)*	X									X
Lear et al. (2021)	X									
Marshall et al. (2015)		X								
Morgan et al. (2020)	X									
Natanson and Deacy (2019)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Peterson et al. (2020)*	X									
Piercy et al. (2016)	X									
Roskar et al. (2020)	X									
Rulifson et al. (2020)	X									
SEDAR (2017)	X								X	
Shaw et al. (2016)	X									
Shiffman et al. (2019)	X									
Whitney et al. (2021)	X									
Williams et al. (2019)*	X									X

*While all literature in Table 7.6 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.6.3. Recommendations

Recent studies may support updating EFH for sandbar sharks. Papers were found that provided new information on life history, distribution, environmental associations, and fishing effects. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

NOAA Fisheries did not identify literature suggesting that the existing sandbar shark HAPCs should be changed or removed. If changes are made to the EFH of speices with HAPCs, such as sandbar shark, we may need to adjust boundaries of existing HAPCs. HAPC boundaries must fall within designated EFH. NOAA Fisheries encourages comments on whether the current HAPCs should be modified or removed from the HMS FMP.

7.7. Scalloped Hammerhead (*Sphyrna lewini*)

7.7.1. Management

Scalloped hammerheads have had no changes to their management structure since the publication of Amendment 10.

In 2020, NOAA Fisheries released two Biological Opinions under section 7(a)(2) of the ESA. These Biological Opinions concluded consultation over the HMS pelagic longline and non-pelagic longline fisheries, as managed under the 2006 Consolidated HMS FMP and its amendments. Conservation recommendations in both Biological Opinions strongly encouraged the inclusion of the Central and Southwest Atlantic Distinct Population Segment (DPS) of scalloped hammerheads on the HMS list of prohibited shark species for recreational and/or commercial HMS fisheries. NOAA Fisheries recently published a proposed rule that considers prohibiting retention of scalloped hammerhead in the U.S. Caribbean region (88 FR 17171; March 22, 2023).

The stock status for this species is unknown as it has not been assessed. A research track stock assessment for hammerheads is currently being conducted under the SEDAR process (SEDAR 77), with an operational assessment scheduled to begin after completion.

7.7.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for scalloped hammerheads:

Table 7.7. Literature search summary for scalloped hammerheads, *Sphyrna lewini.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)			X							
Anderson et al. (2022)*	X									X
Barker et al. (2021)*	X									X
Bethea et al. (2015)	X									
Carlson et al. (2021)		X								
Chi Chan et al. (2021)*	X									X
Cuevas-Gomez et al. (2020)*	X									X
Drymon et al. (2020)*	X									X
Frazier et al. (2021)	X									
Gallagher and Klimley (2018)	X	X								
Gulak et al. (2015)		X								
Kohler and Turner (2019)*	X									X
Lear et al. (2021)	X									
Lyons et al. (2020)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Plumlee et al. (2018)*	X									X
Pinhal et al. (2020)										
Portnoy et al. (2021)	X									
Rooker et al. (2019)*	X									X
Shiffman et al. (2019)	X									
Sulikowski and Hammerschlag (2023)*	X									
SEDAR (2022)*	X	X							X	X
Ward-Paige et al. (2015)*	X									X
Wargat (2021)*	X									X
Wells et al. (2018)*	X									X

*While all literature in Table 7.7 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.7.3. Recommendations

Recent studies may support updating EFH for scalloped hammerheads. Papers were found that provided new information on life history, distribution, environmental associations, and the effects of fishing on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.8. Silky Shark (*Carcharhinus falciformis*)

7.8.1. Management

Silky sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

7.8.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for silky sharks:

Table 7.8. Literature search summary for silky sharks, *Carcharhinus falciformis*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)*	X								X	
Benavides (2020)*	X									
Benavides et al. (2021)*	X									
Hutchinson et al. (2019)	X					X				
Grant et al. (2019)	X									
Kohler and Turner (2019)*	X									
Lezama-Ochoa et al. (2016)*	X									
Lopez et al. (2020)*	X									
Orbesen et al. (2017)	X	X								
Santander-Neto et al. (2021)	X									
Tagliafico et al. (2021)	X									

*While all literature in Table 7.8 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.8.3. Recommendations

Recent studies may support updating EFH for silky sharks. Papers were found that provided new information on life history, range, distribution, and environmental associations. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.9. Smooth Hammerhead (*Sphyrna zygaena*)

7.9.1. Management

Smooth hammerheads have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed. A research track stock assessment for hammerhead sharks is currently being conducted under the SEDAR process (SEDAR 77), with an operational assessment scheduled to begin after completion.

7.9.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for smooth hammerheads:

Table 7.9. Literature search summary for smooth hammerheads, *Sphyrna zygaena.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Deacy et al. (2020)*	X	X								X
Fernandez-Carvalho et al. (2015)			X							
Gallagher and Klimley (2018)	X	X								
Kohler & Turner (2019)*	X									X
Logan et al. (2020)*	X	X								X
Lopes da Silva Ferrette et al. (2021)	X									
Miller (2016)		X								
Mucientes et al. (2022)			X							
Santos and Coelho (2018)*	X	X								X
Santos and Coelho (2019)*	X		X							X
SEDAR (2022)*	X	X							X	X

*While all literature in Table 7.9 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.9.3. Recommendations

Recent studies may support updating EFH for smooth hammerheads. Papers were found that provided new information on life history, range, distribution, environmental associations, and the effects of fishing on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.10. Spinner Shark (*Carcharhinus brevipinna*)

7.10.1. Management

Spinner sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed. A research track stock assessment, which will be conducted under the SEDAR process, is scheduled for this species beginning in 2024.

7.10.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for spinner sharks:

Table 7.10. Literature search summary for spinner shark, *Carcharhinus brevipinna.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)*	X									
Bangley (2016)*	X									
Benavides (2020)*	X									
Benavides et al. (2021)*	X									
Bethea et al. (2015)	X									
Haulsee et al. (2020)*	X			X						
Kohler and Turner (2019)*	X									
Livernois et al. (2021)	X									
Peterson et al. (2020)*	X									
Pickens et al. (2022)	X								X	X
Plumlee et al. (2018)*	X									
Swift and Portnoy (2020)*	X									
Tagliafico et al. (2021)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ward-Paige et al. (2015)*	X									

*While all literature in Table 7.10 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.10.3. Recommendations

Recent studies may support updating EFH for spinner sharks. Papers were found that provided new information on life history, range, distribution, and environmental associations. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

7.11. Tiger Shark (*Galeocerdo cuvier*)

7.11.1. Management

Tiger sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed. A research track stock assessment, which will be conducted under the SEDAR process, is scheduled for this species beginning in 2024.

7.11.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for tiger sharks:

Table 7.11. Literature search summary for tiger sharks, *Galeocerdo cuvier*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Afonso and Hazin (2015)	X									
Aines et al. (2017)	X									
Ajemian et al. (2016)*	X								X	
Ajemian et al. (2020)*	X			X					X	

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bègue et al. (2020)	X									
Benavides (2020)*	X									
Benavides et al. (2021)*	X									
Binstock et al. (2023)	X		X							
Calich et al. (2018)*	X	X								
Calich et al. (2021)*	X									
Casselberry et al. (2020)*	X									
Castro et al. (2016)	X									
Domingo et al. (2016)*	X									
Drymon et al. (2019)	X									
Gallagher et al. (2021)*	X									
Graham et al. (2016)*	X									
Griffin et al. (2021)*	X									X
Hamilton et al. (2022)*	X									
Hammerschlag et al. (2015)*	X			X						
Hammerschlag et al. (2017)*	X									
Hammerschlag, McDonnell, et al. (2022)*	X									
Hansell et al. (2018)*	X									
Holland et al. (2019)									X	
Kohler and Turner (2019)*	X									
Lea et al. (2015)*	X									
Lea et al. (2018)*	X					X				
Lear et al. (2021)*	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Mullins et al. (2021)*	X									
Orbesen et al. (2017)	X	X								
Payne et al. (2018)	X									
Peterson et al. (2020)*	X									
Pickard et al. (2016)*	X									
Queiroz et al. (2016)*	X									
Shiffman et al. (2019)*	X									
Shipley et al. (2019)*	X									
Smukall et al. (2022)*	X									
Sulikowski et al. (2016)*	X									
Sulikowski and Hammerschlag (2023)*	X									
Tagliafico et al. (2021)	X									
Tinari and Hammerschlag (2021)*	X									
Williams et al. (2019)*	X									

*While all literature in Table 7.11 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

7.11.3. Recommendations

Recent studies may support updating EFH for tiger sharks. Papers were found that provided new information on life history, range, distribution, environmental associations, and the effects of fishing and non-fishing activities on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

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8. Small Coastal Sharks

The following sections review and itemize all new literature on life history, behavior, distribution, and habitat for small coastal sharks managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and essential fish habitat presented in Amendment 1; and 2) itemize possible new sources of data that could be incorporated into EFH updates for these species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

8.1. Atlantic Sharpnose Shark (*Rhizoprionodon terraenovae*)

8.1.1. Management

Atlantic sharpnose sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for Atlantic sharpnose sharks was completed by SEDAR in 2013 (SEDAR 34). As of 2022, the stock status is not overfished and overfishing is not occurring.

8.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic sharpnose sharks:

Table 8.1. Literature search summary for Atlantic sharpnose sharks, *Rhizoprionodon terraenovae.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)	X								X	
Altobelli and Szedlmayer (2020)*	X									
Bangley (2016)*	X									
Bangley et al. (2018)	X									
Bethea et al. (2015)	X									
Davis (2018)	X									
Driggers et al. (2020)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Drymon et al. (2020)	X									
Kohler and Turner (2019)*	X									
Peterson et al. (2017)	X									
Pickens et al. (2022)	X	X								
Roskar et al. (2020)	X									
Shiffman et al. (2019)	X									
Tinari and Hammerschlag (2021)*	X									
Ward-Paige et al. (2015)	X									
Williams et al. (2019)	X									

*While all literature in Table 8.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

8.1.3. Recommendations

Recent studies may support updating EFH for Atlantic sharpnose sharks. Papers were found that provided new information on life history, range, distribution, biology, environmental associations, and the effects of fishing on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

8.2. Blacknose Shark (*Carcharhinus acronotus*)

8.2.1. Management

Blacknose sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for blacknose sharks was completed by SEDAR in 2011 (SEDAR 21). As of 2022, the stock status for Atlantic blacknose shark is overfished and overfishing is occurring and for Gulf of Mexico blacknose shark is unknown.

8.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to

Table 8.2. Literature search summary for blacknose sharks, *Charcharhinus acronotus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bangley (2016)*	X								X	
Bangley and Rulifson (2017)	X									
Benavides et al. (2021)		X								
Bethea et al. (2015)	X									
Binstock et al. (2023)*	X		X							
Drymon, Dedman et al. (2020)	X								X	
Fuller and Parsons (2019)	X									
Gulak and Carlson (2021)		X								
Knotek et al. (2022)	X									
Kohler and Turner (2019)*	X									
Latour et al. (2020)	X									
Mullins et al. 2021)	X									
Peterson et al. (2017)		X								
Peterson et al. (2017)	X									
Peterson and Grubbs (2020)	X									
Roskar, McCallister et al. (2020)	X									
Shiffman, Kaufman et al. (2019)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Tinari and Hammerschlag (2021)*	X									
Williams, Roberson et al. (2019)*	X									

*While all literature in Table 8.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

8.2.3. Recommendations

Recent studies may support updating EFH for blacknose sharks. Papers were found that provided new information on life history, range, distribution, biology, environmental associations, and the effects of fishing on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

8.3. Bonnethead (*Sphyrna tiburo*)

8.3.1. Management

Bonnetheads have had no changes to their management structure since the publication of Amendment 10P. The most recent stock assessment for bonnethead sharks was completed by SEDAR in 2013 (SEDAR 34). As of 2022, the stock status is unknown.

8.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bonnetheads:

Table 8.3. Literature search summary for bonnetheads, *Sphyrna tiburo*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al. (2016)	X								X	
Bangley et al. (2018)*	X									
Bethea et al. (2015)	X									
Byers et al. (2017)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Branham et al. (2022)	X									
Dawdy et al. (2022)*	X								X	
Frazier et al. (2020)	X									
Gonzalez et al. (2020)	X									
Kohler and Turner (2019)*	X									
Kroetz and Powers (2015)	X			X						
Kroetz et al. (2015)*	X									
Kroetz et al. (2017)	X									
Mullins et al. (2021)	X									
Roskar et al. (2020)*	X									
Plumlee and Wells (2016)	X									
Ward-Paige, et al. (2015)	X									
Williams et al. (2019)*	X									

*While all literature in Table 8.3 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

8.3.3. Recommendations

Recent studies may support updating EFH for bonnetheads. Papers were found that provided new information on life history, range, distribution, biology, environmental associations, and the effects of non-fishing activities on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

8.4. Finetooth Shark (*Carcharhinus isodon*)

8.4.1. Management

Finetooth sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for finetooth sharks was completed by

SEDAR in 2013 (SEDAR 34). As of 2022, the stock status is not overfished and overfishing is not occuring. A research track stock assessment, which will be conducted under the SEDAR process, is scheduled for this species beginning in 2024.

8.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for finetooth sharks:

Table 8.4. Literature search summary for finetooth sharks, *Carcharhinus isodon*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Ajemian et al., 2016	X								X	
Bangley (2016)	X									
Bangley et al. (2018)*	X									
Bethea et al. (2015)	X									
Brown et al. (2020)	X					X				
Byers, Holmes et al. (2017)	X									
Higgs et al. (2016)	X						X			
Higgs et al. (2020)	X									
Kohler and Turner (2019)*	X									
Portnoy et al. (2016)	X					X				
Roskar et al. (2020)	X					X				
Vinyard, Frazier et al. (2019)	X									
Ward-Paige, Britten et al. (2015)	X									

*While all literature in Table 8.4 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

8.4.3. Recommendations

Recent studies may support updating EFH for finetooth sharks. Papers were found that provided new information on life history, range, distribution, biology, and environmental associations. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

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9. Pelagic Sharks

The following sections review and itemize all new literature on life history, behavior, distribution, and habitat for pelagic sharks managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and essential fish habitat presented in Amendment 1; and 2) itemize possible new sources of data that could be incorporated into EFH updates for these species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

9.1. Blue Shark (*Prionace glauca*)

9.1.1. Management

Blue sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for North Atlantic blue shark was completed by ICCAT in 2015. As of 2022, the stock status is likely not overfished and overfishing is not likely occurring. The next ICCAT blue shark stock assessment is expected to be conducted in 2023.

9.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for blue sharks:

Table 9.1. Literature search summary for blue sharks, *Prionace glauca.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Braun et al. (2019)*	X									X
Campana et al. (2016)	X									X
Coelho et al. (2017)	X									
Doyle et al. (2015)*	X									
Howey et al. (2017)*	X									X
Kohler and Turner (2019)*	X									X

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Lynch et al. (2018)	X								X	X
Natanson et al. (2018)	X									
Pacoureau et al. (2021)	X									
Queiroz et al. (2016)*	X									
Queiroz et al. (2017)*	X									X
Viducic et al. (2022)	X									
Yokoi et al. (2017)	X									

*While all literature in Table 9.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

9.1.3. Recommendations

Recent studies may support updating EFH for blue sharks. Papers were found that provided new information on range, distribution, environmental associations, and biology. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

9.2. Oceanic Whitetip Shark (*Carcharhinus longimanus*)

9.2.1. Management

Oceanic whitetip sharks have had no changes to their management structure since the publication of Amendment 10.

In 2018, NOAA Fisheries published a final rule, in response to a petition from Defenders of Wildlife, which determined that oceanic whitetip sharks warrant listing as a threatened species under the Endangered Species Act (ESA) throughout its range (83 FR 4153, January 30, 2018). In 2020, NOAA Fisheries released two Biological Opinions under section 7(a)(2) of the ESA. These Biological Opinions concluded consultation over the HMS pelagic longline and non-pelagic longline fisheries, as managed under the 2006 Consolidated HMS FMP and its amendments. Conservation recommendations in both Biological Opinions strongly encouraged the inclusion of oceanic whitetip sharks on the HMS list of prohibited shark species for recreational and/or commercial HMS fisheries. NOAA Fisheries recently published a proposed rule that considers adding oceanic whitetip sharks to the prohibited shark species group (88 FR 17171; May 22, 2023).

The stock status for this species is unknown as it has not been assessed.

9.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for oceanic whitetip sharks:

Table 9.2. Literature search summary for oceanic whitetip sharks, *Carcharhinus longimanus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Andrzejaczek et al. (2018)	X									
Camargo et al. (2016)*	X									X
Howey et al. (2016)*	X									X
Kohler and Turner (2019)*	X									
Madigan et al. (2015)*	X					X				X
Papastamatiou et al. (2018)	X									
Tolotti et al. (2017)	X									
Young et al. (2017)	X					X				
Young and Carlson (2020)	X								X	

*While all literature in Table 9.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

9.2.3. Recommendations

Recent studies may support updating EFH for oceanic whitetip sharks. Papers were found that provided new information on life history, migration, and distribution. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

9.3. Porbeagle (*Lamna nasus*)

9.3.1. Management

Porbeagleshave had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for northwest Atlantic porbeagle shark stock was completed by ICCAT in 2020. As of 2022, the stock status is overfished and overfishing is not occurring.

9.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for porbeagles:

Table 9.3. Literature search summary for porbeagles, *Lamna nasus*.

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Anderson et al. (2021)*										X
Andrzejaczek et al. (2022)*	X									
Biais et al. (2017)*	X								X	X
Bowlby et al. (2020)*	X									
Bowlby et al. (2021)*	X									
Curtis et al. (2016)*	X									X
SCRS (2020)	X								X	
Kohler and Turner (2019)*	X									X
Lynch et al. (2018)*	X									X
Natanson et al. (2018)	X									
Natanson et al. (2019)	X									
Skomal et al. (2021)*	X								X	X

*While all literature in Table 9.3 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

9.3.3. Recommendations

Recent studies may support updating EFH for porbeagles. Papers were found that provided new information on migration, distribution, and life history. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

9.4. Shortfin Mako (*Isurus oxyrinchus*)

9.4.1. Management

Shortfin makos have had several changes to their management structure since the publication of Amendment 10.

The North Atlantic shortfin mako stock was last assessed by ICCAT in 2017, and that assessment found that the North Atlantic shortfin mako stock is overfished and overfishing is occurring. As a result, in 2019, NOAA Fisheries published Amendment 11 to address overfishing and rebuild the overfished North Atlantic shortfin mako stock (84 FR 5358, February 21, 2019). Amendment 11 implemented management measures to reduce fishing mortality on shortfin makos and established the foundation for rebuilding the shortfin mako population consistent with legal requirements. Commercial measures included only allowing retention in certain circumstances. Recreational measures included increasing the minimum size limits and gear modifications to maximize live release.

However, in May 2019, the SCRS completed a North Atlantic shortfin mako stock assessment update and provided additional rebuilding information. As a result, in 2021, ICCAT adopted Recommendation 21-09, which prohibits retention of North Atlantic shortfin makos caught in association with ICCAT fisheries in 2022 and 2023. Limited retention of shortfin mako sharks may be allowed in 2023 and future years if ICCAT determines that fishing mortality is at a low enough level North Atlantic-wide to allow retention consistent with the conservation objectives of the recommendation. In order to meet domestic management objectives, implement Recommendation 21-09, and acknowledge the possibility of future retention, NOAA Fisheries implemented a flexible shortfin mako retention limit with a default limit of zero in commercial and recreational HMS fisheries. The shortfin mako retention limit per trip of zero will remain in place unless changed after consideration of regulatory criteria and the amount of retention allowed by ICCAT.

9.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for shortfin makos:

Table 9.4. Literature search summary for shortfin makos, *Isurus oxyrinchus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Byrne et al. (2017)	X	X							X	X
Campana et al. (2016)	X	X								X
Crear et al. (2021)	X	X								X
Gibson et al. (2021)*	X									X
Kohler and Turner (2019)*	X									X
Lynch et al. (2018)	X									
Lyons et al. (2015)	X									
Manz (2021)	X									X
Natanson et al. (2018)	X									
Natanson et al. (2020)	X									X
Queiroz et al. (2016)*	X									X
Rooker et al. (2019)	X									X
Vaudo et al. (2017)	X								X	X
Yokoi et al. (2017)	X									

*While all literature in Table 9.4 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

9.4.3. Recommendations

Recent studies may support updating EFH for shortfin makos. Papers were found that provided new information on range, distribution, environmental associations, biology, predatory/prey, relationships, and the effects of fishing activity on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

9.5. Thresher Shark (*Alopias vulpinus*)

9.5.1. Management

Thresher sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

9.5.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for thresher sharks:

Table 9.5. Literature search summary for thresher sharks, *Alopias vulpinus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bangley (2016)	X									
Haulsee et al. (2020)	X				X					
Kneebone et al. (2020)*	X									X
Kohler and Turner (2019)*	X									
Lynch et al. (2018)	X	X								
Natanson et al. (2018)	X									
Orbesen et al. (2017)	X	X								
Young et al. (2016)	X								X	

*While all literature in Table 9.5 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

9.5.3. Recommendations

Recent studies may support updating EFH for thresher sharks. Papers were found that provided new information on life history, movement, distribution, and fishing activities. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

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10. Prohibited Sharks

The following sections review and itemize all new literature on life history, behavior, distribution, and habitat for prohibited sharks managed by the HMS Management Division that could be used to update EFH boundaries and text descriptions. Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and essential fish habitat presented in Amendment 1; and 2) itemize possible new sources of data that could be incorporated into EFH updates for these species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

10.1. Atlantic Angel Shark (*Squantina dumeril*)

10.1.1. Management

Angel sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Atlantic angel sharks:

Table 10.1. Literature search summary for Atlantic angel sharks, *Squantina dumeril.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Driggers III et al. (2018)*	X								X	
Haulsee et al. (2020)				X					X	
Kohler and Turner (2019)*	X									
Tagliafico, Rangel and Broadhurst (2017)	X									
Tagliafico, Rangel and Rago (2017)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Zea-de la Cruz et al. (2021)			X			X			X	

*While all literature in Table 10.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.1.3. Recommendations

Recent studies may support updating EFH for Atlantic angel sharks. Papers were found that provided new information on life history, range, distribution, environmental associations, and effects of fishing and non-fishing activities on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.2. Basking Shark (*Cetorhinus maximus*)

10.2.1. Management

Basking sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.2.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for basking sharks:

Table 10.2. Literature search summary for basking sharks, *Cetorhinus maximus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Braun et al. (2018)*	X								X	
Crowe et al. (2018)	X									
Doherty et al. (2019)	X									
Gore et al. (2018)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Hoogenboom et al. (2015)*	X									
Johnston et al. (2019)	X									
Kohler and Turner (2019)*	X									
Miller et al. (2015)	X									
Queiroz et al. (2017)	X									

*While all literature in Table 10.2 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.2.3. Recommendations

Recent studies may support updating EFH for basking sharks. Papers were found that provided new information on life history, migratory patterns, vertical habitat use within the water column, environmental associations, and stock structure. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.3. Bigeye Sand Tiger (*Odontaspis noronhai*)

10.3.1. Management

Bigeye sand tigers have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.3.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bigeye sand tigers:

Table 10.3. Literature search summary for bigeye sand tigers, *Odontaspis noronhai*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update

Kerstetter and Taylor (2008)	X									

10.3.3. Recommendations

EFH boundaries were not previously delineated for bigeye sand tigers. No new information has been found which supports updating EFH for bigeye sand tigers. However, a paper by Kerstetter and Taylor (2008) was identified which was not previously included in the life history description of bigeye sand tigers. This section could be updated with this information. We will also review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.4. Bigeye Sixgill Shark (*Hexanchus nakamurai*)

10.4.1. Management

Bigeye sixgill sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.4.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bigeye sixgill sharks:

Table 10.4. Literature search summary for bigeye sixgill sharks, *Hexanchus nakamurai.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Daly-Engel et al. (2018)	X									
González-Acosta (2017)	X									
Pulver et al. (2016)*	X									

*While all literature in Table 10.4 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.4.3. Recommendations

EFH boundaries were not previously delineated for bigeye sixgill sharks. Recent studies may support updating EFH for bigeye sixgill sharks. Papers were found that provided new information on life history, stock descriptions, distribution, and population structure. We recommend updating EFH based on this new information. We will also review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.5. Bigeye Thresher (*Alopias superciliosus*)

10.5.1. Management

Bigeye thresher sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.5.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for bigeye threshers:

Table 10.5. Literature search summary for bigeye threshers, *Alopias superciliosus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Aalbers et al. (2021)	X									
Anderson et al. (2022)	X									
Coelho et al. (2015)*	X									
Del Moral-Flores et al. (2021)	X									
Fernandez-Carvalho et al. (2015)*	X									
Fernandez-Carvalho et al. (2015)	X									
Kohler and Turner (2019)*	X									
Morales et al. (2018)	X									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Sepulveda et al. (2019)	X									
Young et al. (2016)*	X									

*While all literature in Table 10.5 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.5.3. Recommendations

Recent studies may support updating EFH for bigeye threshers. Papers were found that provided new information on life history, range, distribution, environmental associations and stock delineation. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.6. Bignose Shark (*Carcharhinus altimus*)

10.6.1. Management

Bignose sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.6.2. New Literature and Information

No new literature, data, or information specifically and solely pertaining to EFH for bignose sharks has been identified. Literature was found which documented historical datasets that contained small numbers of bignose shark (e.g., Lynch et al. (2018), Kohler and Turner (2019), Latour and Gartland (2020)); these datasets may have already been included in previous EFH exercises. Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed.

10.6.3. Recommendations

EFH boundaries were not previously delineated for bignose sharks. Due to the small number of records found in some literature, recent studies likely do not support updating EFH for bignose sharks. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.7. Caribbean Reef Shark (*Carcharhinus perezi*)

10.7.1. Management

Caribbean reef sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.7.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for Caribbean reef sharks:

Table 10.6. Literature search summary for Caribbean reef sharks, *Carcharhinus perezi*.

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Casselberry et al. (2020)	X									
Gallagher et al. (2021)	X									
Kohler and Turner (2019)*	X									
Shipley et al. (2017)	X									
Shipley et al. (2017)	X									
Stoffers et al. (2021)	X									
Talwar et al. (2022)	X									

*While all literature in Table 10.6 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.7.3. Recommendations

Most of the recent new research on Caribbean reef sharks has been conducted in regions outside of the U.S. Caribbean. We found one new study completed in the U.S. Caribbean on these sharks by Casselberry et al. (2020); however, the area studied is already included in current EFH for Caribbean reef sharks. Therefore, recent studies do not support updating EFH for Caribbean reef sharks. However, we will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.8. Caribbean Sharpnose Shark (*Rhizoprionodon porosus*)

10.8.1. Management

Caribbean sharpnose sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.8.2. New Literature and Information

No new literature, data, or information pertaining to EFH for Caribbean sharpnose sharks has been identified.

10.8.3. Recommendations

EFH boundaries were not previously delineated for Caribbean sharpnose sharks. Two papers concerning stock structure of sharpnose sharks in the northwest Atlantic were found, and information in the life history section of the HMS FMP should be updated to reflect this information (Mendonça et al. (2011); Davis et al. (2019)). However, no new information has been found which supports updating EFH boundaries. Therefore, we do not recommend updating EFH at this time. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.9. Dusky Shark (*Carcharhinus obscurus*)

10.9.1. Management

Dusky sharks have had no changes to their management structure since the publication of Amendment 10. Since Amendment 10, management changes for dusky sharks described in Amendment 5b have been fully implemented. The most recent stock assessment for dusky sharks was completed by SEDAR in 2016 (SEDAR 21 Update). As of 2022, the stock status is overfished and overfishing is occurring.

10.9.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for dusky sharks:

Table 10.7. Literature search summary for dusky sharks, *Carcharhinus obscurus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bangley 2016	X									
Bangley et al. 2020	X									
Haulsee et al 2020*	X			X						
Kohler and Turner. 2019*	X									
Kroetz et al. 2021*	X									
Lynch et al. 2018*	X									
Marshall et al. 2015*	X									
Natanson et al. 2018	X									
Rossouw et al. 2016	X									
Sulikowski et al. 2020	X									

*While all literature in Table 10.7 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

10.9.3. Recommendations

Recent studies may support updating EFH for dusky sharks. Papers were found that provided new information on life history, habitat associations, migration, distribution, and the effects of non-fishing activities on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.10. Galapagos Shark (*Carcharhinus galapagensis*)

10.10.1. Management

Galapagos sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.10.2. New Literature and Information

In general, little new literature, data, or information pertaining to EFH for Galapagos shark has been identified. There may be a limited amount of new information available in the datasets referenced by Kohler and Turner (2019). We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017. However, the life history information could be updated to reflect new population genetic studies differentiating Galapagos sharks from dusky sharks (Corrigan et al. (2017).

10.10.3. Recommendations

EFH boundaries were not previously delineated for Galapagos sharks. Recent studies do not support updating EFH for Galapagos sharks. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.11. Longfin Mako (*Isurus paucus*)

10.11.1. Management

Longfin makos have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.11.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for longfin makos:

Table 10.8. Literature search summary for longfin makos, *Isurus paucus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Hueter et al. (2017)	x		x							
Kohler and Turner (2019)*	x									
Lynch et al. (2018)	x									
Ruiz-Abierno et al. (2020)	x		x							

10.11.3. Recommendations

Recent studies may support updating EFH for longfin makos. Papers were found that provided new information on life history, range, distribution, and fishing effects on EFH. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.12. Narrowtooth Shark (*Carcharhinus brachyurus*)

10.12.1. Management

Narrowtooth sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.12.2. New Literature and Information

There was no new literature found pertaining to EFH for narrowtooth sharks in the U.S. Atlantic EEZ.

10.12.3. Recommendations

EFH boundaries were not previously delineated for narrowtooth sharks. Recent studies do not support updating EFH for narrowtooth sharks. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.13. Night Shark (*Carcharhinus signatus*)

10.13.1. Management

Night sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.13.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for night sharks:

Table 10.9. Literature search summary for night sharks, *Carcharhinus signatus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Baremore et al., 2019	x									
Domingues et al. (2019)	x					x				
Kohler and Turner (2019)*	x									
Lynch et al. (2018)	x									

10.13.3. Recommendations

Recent studies do not support updating EFH for night sharks. However, we will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.14. Sand Tiger (*Carcharias taurus*)

10.14.1. Management

Sand tigers have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.14.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to

Table 10.10. Literature search summary for sand tigers, *Carcharias taurus*.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Haulsee et al. (2015)	x									
Haulsee et al. (2016)*	x									
Haulsee et al. (2018)*	x									

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Haulsee et al. (2020)	x			x						
Kilfoil et al. (2017)*	x	x								
Klein et al. (2019)	x					x				
Kneebone et al. (2018)*	x					x				
Kohler and Turner (2019)*	x									
Paxton et al. (2019)	x									
Teter et al. (2015)	x	x								
Williams et al. (2019)	x									
NMFS (2020)	x	x						x		

10.14.3. Recommendations

Recent studies may support updating EFH for sand tigers. Papers were found that provide new information on migration and distribution patterns, habitat associations, and life history. We recommend updating EFH based on this new information. We also will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

NOAA Fisheries did not identify literature suggesting that the existing sand tiger HAPCs should be changed or removed. If changes are made to the EFH of speices with HAPCs, such as the sand tiger, we may need to adjust boundaries of existing HAPCs. HAPC boundaries must fall within designated EFH. NOAA Fisheries encourages comments on whether the current HAPCs should be modified or removed from the HMS FMP.

10.15. Sevengill Shark (*Heptranchias perlo*)

10.15.1. Management

Sevengill sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.15.2. New Literature and Information

There was no new literature found pertaining to EFH for sevengill sharks in the U.S. Atlantic EEZ.

10.15.3. Recommendations

EFH boundaries were not previously delineated for sevengill sharks. Recent studies do not support updating EFH for sevengill sharks. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.16. Sixgill Shark (*Heptranchias griseus*)

10.16.1. Management

Sixgill sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.16.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for sixgill sharks:

Table 10.11. Literature search summary for sixgill sharks, *Hexanchus griseus.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Daly-Engel et al. (2019)	x									x
Kasana et al., 2022	x									

10.16.3. Recommendations

EFH boundaries were not previously delineated for sixgill sharks. Although some updates to the life history for sixgill shark were found, they were minor and do not support any further review of EFH boundaries for any life stages for this species. A paper was found which supports updating the life history profile with new information on population structure of the species. We will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.17. Smalltail Shark (*Carcharhinus porosus*)

10.17.1. Management

Smalltail sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.17.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for smalltail sharks:

Table 10.12. Literature search summary for smalltail sharks, *Carcharhinus porosus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Feitosa et al. (2020)	x		x							
Kohler and Turner (2019)	x									
Swift and Portnoy (2021)	x									

10.17.3. Recommendations

EFH boundaries were not previously delineated for smalltail shark. Although some updates to the life history for the smalltail shark were found, they were minor and do not support any further review of EFH boundaries for any life stages for this species. However, we will review and, if necessary, delineate EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.18. Whale Shark (*Rhincodon typus*)

10.18.1. Management

Whale sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.18.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for whale sharks:

Table 10.13. Literature search summary for whale sharks, *Rhincodon typus.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Dove (2015)							x			
Hacohen-Domené et al. (2015)	x									
Hoffmayer et al. (2021)	x									
McKinney et al. (2017)	x									
Norman et al. (2017)	x									
Ong et al. (2020)	x									
Ramirez-Macias et al. (2017)	x									
Rohner et al. (2015)							x			
Rooker et al. (2019)	x									
Sequeira et al. (2016)	x									
Trujillo-Córdova et al. (2020)	x									
Tyminski et al. (2015)	x					x			x	
Womersley et al. (2022)				x						

10.18.3. Recommendations

Recent studies may support updating EFH for whale sharks. Papers were found that provided new information on life history, range, distribution, and non-fishing effects. We recommend updating EFH based on this new information. We also will review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

10.19. White Shark (*Carcharodon carcharias*)

10.19.1. Management

White sharks have had no changes to their management structure since the publication of Amendment 10. The stock status for this species is unknown as it has not been assessed.

10.19.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for white sharks:

Table 10.14. Literature search summary for white sharks, *Carcharodon carcharias.*

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bastien et al. (2020)	x									
Curtis et al. (2018)*	x								x	
Franks et al. (2021)*	x								x	
Gaube et al. (2018)	x						x			
Haulsee et al. (2020)*	x			x						
Huveneers et al. (2018)*									x	
James et al. (2022)	x									
Jewell et al. (2019)	x									
Kanive et al. (2021)	x									
Kohler and Turner (2019)*	x									
Lynch et al. (2018)	x									
Natanson and Skomal (2015)	x									
Natanson et al. (2018)	x									
O'Connell et al. (2021)	x			x						

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Semmens et al. (2019)							x			
Shaw et al. (2021)*	x							x		x
Skomal et al. (2017)*	x									
Watanabe et al. (2019b)	x						x			
Watanabe et al. (2019a)							x			
White et al. (2019)	x									
Williams et al. (2019)	x									
Winton et al. (2021)	x			x						

10.19.3. Recommendations

Recent studies may support updating EFH for white sharks. Papers were found that provided new information on life history, range, distribution, and non-fishing effects. We recommend updating EFH based on this new information. Some scientific literature on white sharks in the northern Mid-Atlantic Bight was identified that could support a discussion on a potential HAPC (see Chapter 14). We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

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11. Smoothhound Sharks

The following section reviews and itemizes all new literature on life history, behavior, distribution and habitat for smoothhound sharks managed by the Atlantic HMS Management Division that could be used to update EFH boundaries and text descriptions.[27] Unless otherwise noted, this information is intended to: 1) supplement the text descriptions of life history, behavior, and EFH presented in Amendment 10; and 2) itemize possible new sources of data that could be incorporated into EFH updates for these species. Please see Table 1.1 for a description of each component, which is abbreviated in the row headers.

11.1. Smooth Dogfish (*Mustelus canis*), Florida Smoothhound (*Mustelus norrisi*), and Gulf of Mexico Smoothhound (*Mustelus sinusmexicanus*)

11.1.1. Management

The smoothhound sharks have had no changes to their management structure since the publication of Amendment 10. The most recent stock assessment for smoothhound sharks was completed by SEDAR in 2015. As of 2022, the stock status for Atlantic smooth dogfish and the Gulf of Mexico smoothhound shark complex is not overfished and overfishing is not occurring.

11.1.2. New Literature and Information

Existing EFH datasets (e.g., observer, survey, exempted fishing permit, tagging) may have seven or more years of new scientific information (2015 through 2022) that can be reviewed. Additionally, the following new information has been found which may be relevant to EFH for smooth dogfish, Florida smoothhound and Gulf of Mexico smoothhound:

Table 11.1. Literature search summary for smooth dogfish, *Mustelus canis;* Florida smoothhound, *Mustelus norrisi;* and Gulf of Mexico smoothhound, *Mustelus sinusmexicanus.*

EFH Component	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
(Bangley, 2016)	X									

[27] While life history and other known scientific information on smoothhound sharks in HMS EFH is described for each species, actual EFH designations are made on the regional smoothhound shark complex stocks. We do not delineate separate EFH for all three species. The smoothhound shark complex consists in the Atlantic region of smooth dogfish. In the Gulf of Mexico region, the smoothhound shark complex consists of three species - smooth dogfish, Florida smoothhound, and Gulf of Mexico smoothhound.

EFH Component	1	2	3	4	5	6	7	8	9	10
Author, Year	Describe & ID EFH	MSA Fishing Activity	Non-MSA Fishing Activity	Non-Fishing Activity	Cumul. Impacts	Cons. & Enhance.	Prey	HAPC	Research & Info Needs	Review& Update
Bangley and Rulifson (2017)	X									
Bangley et al. (2018)*	X								X	X
Bethea et al. (2015)*	X									X
Bockus et al. (2020)*	X									X
Dell'Apa et al. (2018)*	X									X
Drymon et al. (2020)*	X									X
Giresi et al. (2015)*	X									X
Haulsee et al. (2020)*	X									X
Kohler and Turner (2019)*	X									X
Montemarano et al. (2016)	X									

*While all literature in Table 11.1 can be incorporated into future analyses related to the 10 components of EFH, the starred scientific papers have datasets that could be used to update EFH boundaries.

11.1.3. Recommendations

Recent studies may support updating EFH for smooth dogfish, Florida smoothhound, and Gulf of Mexico smoothhound. Papers were found that provide new information on habitat preferences, thermal ranges, relationships between catch data and environmental factors, genomics techniques for the analysis of Mustelus lineages, and distribution information. We recommend updating EFH based on this new information. We will also review and, if necessary, update EFH boundaries based on data added to existing EFH datasets since publication of the previous 5-year review in 2015 and/or Final Amendment 10 in 2017.

11.2. Literature Cited

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Giresi, M. M., Grubbs, R. D., Portnoy, D. S., Driggers III, W. B., Jones, L., & Gold, J. R. (2015). Identification and Distribution of Morphologically Conserved Smoothhound Sharks in the Northern Gulf of Mexico. Transactions of the American Fisheries Society, 144(6), 1301-1310. https://doi.org/10.1080/00028487.2015.1069212

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12. Adverse Fishing Effects on Essential Fish Habitat

The HMS FMP must contain an evaluation of the potential adverse effects of fishing on EFH designated under the FMP, including effects of each fishing activity regulated under the HMS FMP or other federal FMPs. This evaluation should consider the effects of each fishing activity on each type of habitat found within EFH. FMPs must describe each fishing activity, review and discuss all available relevant information (such as information regarding the intensity, extent, and frequency of any adverse effect on EFH; the type of habitat within EFH that may be affected adversely; and the habitat functions that may be disturbed), and provide conclusions regarding whether and how each fishing activity adversely affects EFH.

2.3. Background

Several HMS (tunas, swordfish, billfish and some sharks) reside in the upper part of the water column and their habitat preferences are likely influenced by oceanic factors (e.g., current confluences, temperature edges, and surface structure), many of the HMS commercial and recreational fisheries are fished in these areas and do not pose any adverse impacts to these species' EFH. While mobile trawls and dredges physically disturb the sea floor, most gears in HMS fisheries, with the exception of shark bottom longline and gillnets, are suspended in the water column and do not affect water column or benthic habitat characteristics. The EFH of coastal and bottom-dwelling shark species are more likely to be affected by these gear types.

NOAA Fisheries previously reviewed fishing gear impacts in the 1999 HMS FMP, the 2006 Consolidated HMS FMP, and Amendments 1 and 10 to the 2006 Consolidated HMS FMP. In Amendment 1, NOAA Fisheries identified adverse effects of fishing on EFH and actions to minimize adverse effects. In Amendment 10, NOAA Fisheries re-analyzed the impacts of bottom longline gear and noted that the following minimization measures were still valid:

- Vessels fishing with bottom longline gear should avoid or reduce bottom longline effort on corals, gorgonians, or sponge habitat in order to minimize risk of habitat damage to these areas.
- Vessels fishing with bottom longline gear should take appropriate measures to identify bottom obstructions and avoid setting gear in areas where it may become entangled.
- "Ghost fishing" is part of the global marine debris issue that impacts marine organisms, leading to undesirable mortality of marine life.[28] ICCAT adopted Recommendation 19-11 on abandoned, lost or otherwise discarded fishing gear in 2019.[29] While NOAA Fisheries determined that most HMS fishing gears (i.e., authorized gears other than longline) covered under this recommendation do not pose a significant risk of ghost fishing, if gear is lost, diligent efforts should still be undertaken to recover the lost gear.

[28] https://marinedebris.noaa.gov/sites/default/files/publications-files/Ghostfishing_DFG.pdf
[29] https://www.iccat.int/Documents/Recs/compendiopdf-e/2019-11-e.pdf

Additionally, the shark bottom longline fishery is prohibited from operating in the marine protected areas, HAPCs, and time/area closures that were established by the SAFMC to protect vulnerable deep water coral habitats. There are other existing time/area closures for both HMS and non-HMS managed fisheries that protect habitats within HMS EFH and HMS HAPCs.[30] For example, in 2020, NOAA Fisheries announced a final rule implementing Amendment 9 to the FMP for Coral and Coral Reef Resources in the Gulf of Mexico, which established 13 new HAPCs with fishing regulations, 8 areas without fishing regulations, and modified regulations in 3 existing areas (85 FR 65740, October 16, 2020). On November 9, 2022, NOAA Fisheries published a notice seeking comments on an omnibus amendment for the Greater Atlantic Region's FMPs that would incorporate Northeast Canyons and Seamounts Marine National Monument's area and commercial fishing prohibition into FMPs. These and any other new or ongoing actions could be considered in an analysis of fishing effects, cumulative effects or other sections of future EFH documents.

In Amendment 10, NOAA Fisheries conducted a literature review to investigate additional impacts of HMS fishing gears on HMS. During this review, NOAA Fisheries did not find any significant changes in expected impacts to HMS EFH from HMS and non-HMS fishing gears (including gillnet and bottom longline) since the gear analysis was conducted for Amendment 1. Amendment 10 also contained an analysis of ESA listed and non-ESA listed coral habitat and shark bottom longline interactions that was conducted by NOAA Fisheries. The analysis found that long-term negative effects could occur on coral habitats from shark bottom longline gear, but the impacts are expected to be minimal due to infrequent interactions. EFH for Council-managed fish species (i.e., not HMS) was also considered in this analysis and shark bottom longline gear was determined to not have negative effects on those species EFH. Since this analysis was completed, seven additional years of data have come available through these data streams. The analysis presented in Amendment 10 could be reviewed, and if necessary updated, to reflect new and relevant information.

12.1. Summary of New Literature and Information

Deep-Set Pelagic Longline Gear

We have previously analyzed potential adverse effects of pelagic longline fishing on EFH. As previously noted, when fished in a traditional manner, this gear typically does not come into contact with the sea floor and therefore would not have adverse effects on EFH. However, in rare cases, pelagic longline gear can sometimes interact with the sea floor when the "deep-set" technique is used. Users of deep-set pelagic longline gear deploy hooks deeper in the water column, usually just below the thermocline, in an effort to increase the amount and quality of target catch of pelagic species such as swordfish while decreasing bycatch. On deep sets, floats on the mainline are spaced further apart and more hooks are deployed between floats. This creates more of a sag in the mainline, allowing the set to fish deeper than with a shallow set.

[30] See the most recent version of the Atlantic HMS Commercial Compliance Guide for more details: https://bit.ly/3IcFkA4

Deep-set pelagic longline gear is well-studied in Hawaiian longline fisheries (Beverly and Robinson 2004); however there is little scientific information available on the use of this fishing technique by U.S. vessels in the Atlantic Ocean and Gulf of Mexico. Interest in and use of the deep-set configuration of pelagic longline gear by the U.S. vessels has increased in recent years, and the technique and gear configuration can vary as fishermen determine the best way to use the technique in the Atlantic Ocean and Gulf of Mexico. Since deep-set pelagic longline is used to target pelagic species such as swordfish, it is unlikely that fishermen intentionally set the gear deep enough to interact with the sea floor. However, pelagic observer program data shows that sea floor interaction does occasionally occur as indicated by bycatch of benthic species such as golden tilefish, black bellied rosefish, cusk, sea anemones, sea stars, and lobster. Such reports are rare, though, and since target catch is likely reduced when the gear is at or near the sea floor, contact with the sea floor is likely undesirable to fishermen. As the deep-set technique further develops and fishermen become more skilled at it, such interactions with the sea floor will likely decrease, thus, it is unlikely that the deep-set pelagic longline technique would present any concerns regarding EFH impact. NOAA Fisheries and academic researchers are currently analyzing and characterizing the technique. We will continue to monitor impacts to EFH as more information becomes available (including through the pelagic longline observer program).

2.4. Recommendations

NOAA Fisheries identified no new information to warrant changes to the potential adverse effects from fishing on HMS EFH, and therefore recommends that the conservation measures outlined in Amendment 1, Amendment 3, the interpretive rule for white marlin and roundscale spearfish, and Amendment 10 remain in effect. However, we recommends revisiting the analysis of ESA listed and non-ESA listed coral habitat and shark bottom longline interactions that was conducted in Amendment 10 with updated data collected through 2022 (or the most recent available).

NOAA Fisheries will continue to work with Regional Fishery Management Councils and Interstate Marine Fisheries Commissions to minimize gear impacts in areas where HMS EFH is delineated.

12.2. Literature Cited

Beverly S, Robinson E. 2004. New deep setting longline technique for bycatch mitigation. AFMA report number RO3/1398. Secretariat of the Pacific Community, Noumea, New Caledonia. 30 p.

13. Adverse Effects of Non-Fishing Activities on Essential Fish Habitat

The EFH regulations (50 CFR 600.815(a)(3)) require that the HMS FMP identify activities other than fishing that may adversely affect EFH. Broad categories of such activities include, but are not limited to: dredging, filling, excavation, mining, impoundment, discharge, water diversions, thermal additions, actions that contribute to non-point source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH. For each activity, the HMS FMP should describe known and potential adverse effects to EFH.

13.1. Background

NOAA Fisheries conducted thorough reviews of the adverse effects of non-fishing activities in previous EFH documents. The HMS FMP currently includes an analysis of 13 non-fishing activities with adverse effects on EFH (Table 13.1). Unless otherwise mentioned or expanded upon, the information and synthesis provided in these analyses are still considered valid, and are not repeated in great detail here. The intent of the current analysis of adverse effects analysis is to consider those activities that are most likely to have an adverse effect on HMS EFH and for which new information may be available.

Table 13.1. Non-fishing activities previously analyzed in the HMS FMP.

Year and FMP or Amendment	New Non-Fishing Activity Reviewed*
1999 FMP (pages 269 through 286)	Marine sand and minerals mining; offshore oil and gas operations; coastal development; dredging and disposal of dredge material; agriculture and silviculture; aquaculture and mariculture; navigation; marinas and boating; ocean dumping
2003 Amendment 1 to the 1999 FMP (pages 10-21 through 10-35)	No new non-fishing effects presented
2006 Consolidated HMS FMP (pages 10-48 through 10-51)	Liquid natural gas (LNG)
2009 Amendment 1 to the 2006 Consolidated HMS FMP (pages 275 through 293)	Renewable energy projects (e.g., wind, wave, solar, underwater current, hydrogen)
2017 Amendment 10 to the 2006 Consolidated HMS FMP (pages 84 through 94)	Seismic surveys, climate change

*Non-fishing impact analyses include previously defined non-fishing effects. For example, Amendment 10 and its HMS EFH 5-Year Review considered all non-fishing impact analyses from the previous four EFH actions identified in the table.

13.2. Review Approach and Summary of Findings

The review of habitat use for HMS identified both benthic and water column habitats in coastal, estuarine, and offshore areas as HMS EFH; although in many cases the particular habitat characteristics that influence species habitat use are not clearly understood or identified. Many of these habitat characteristics appear to be related to water quality (e.g., temperature, salinity, dissolved oxygen); therefore, water quality degradation is a key discussion point in many parts of this section. When analyzing the impacts that water quality changes can have on HMS EFH, it is important to examine all habitats, including offshore areas which can be affected by actions that originate in coastal habitats (both terrestrial and aquatic) and adjacent estuaries. Many HMS aggregate over submarine canyons or along river plumes; these physiographic features can serve as conduits for currents moving from inshore out across the continental shelf and slope, while carrying and redistributing contaminants from nearshore to offshore habitats.

13.2.1. Land-Based Activities That May Impact Essential Fish Habitat

NOAA Fisheries conducted thorough reviews of land-based activities that may impact HMS EFH in the 1999 HMS FMP, 2006 Consolidated HMS FMP, Amendments 1 in 2009, and Amendment 10 in 2017. These documents found coastal development and agriculture to be the main sources of land-based impacts through water run-off.

Coastal development activities include urban, suburban, commercial, and industrial construction, along with development of corresponding infrastructure. These activities may result in:

- Erosion and sedimentation;
- Dredging and filling;
- Point and nonpoint source discharges of nutrients, chemicals, and cooling water into streams, rivers, estuaries and ocean waters; and,
- Destruction of coastal wetlands that filter sediments, nutrients, and contaminants.

In addition, hydrological modifications associated with coastal development alter freshwater inflow to coastal waters, resulting in changes in salinity, temperature, and nutrient regimes, and thereby contributing to further degradation of estuarine and nearshore marine habitats. Coastal development also includes seabed mining, beach replenishment, land reclamation, and port development. Subsequently, the high demand for port development raises concern for aquatic life because of the increased interactions between coastal fisheries and port locations. Potential threats to fish and fisheries caused by coastal development continue to be assessed in research, but the current data does not support if the negative outcomes outweigh the positive impacts.

Agricultural and silvicultural practices can affect estuarine, coastal, and marine water quality through nutrient enrichment and chemical contamination from animal wastes, fertilizers, pesticides and other chemicals via non-point source runoff or via drainage systems that serve as conduits for contaminant discharge into natural waterways. Major impacts also include nutrient over-enrichment with subsequent deoxygenation of marine or aquatic habitats (e.g., the "dead zone" in the northern Gulf of Mexico, Rabalais et al. (2002)). Agricultural activities also increase soil erosion and associated sediment transport in adjacent water bodies, resulting in high turbidity. Many of these same concerns may apply to silviculture as well.

NOAA Fisheries has concluded that based on its review of recent literature, updates to previously identified actions to encourage conservation and enhancement for agriculture and silviculture are not warranted. However, NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of agriculture and silviculture (or other land-based activities) on HMS EFH.

13.2.2. Coastal and Offshore Activities That May Adversely Affect Essential Fish Habitat

NOAA Fisheries conducted thorough reviews of coastal and offshore activities that may impact HMS EFH in the previous HMS EFH documents. These documents found 10 broad activity categories that impact HMS EFH:

- Dredging and disposal of dredging material;
- Oil and gas exploration and operations (including seismic surveys);
- Navigation;
- Marinas and recreational boating;
- Marine sand and minerals mining;
- Ocean dumping;
- LNG;
- Renewable energy projects (including wind energy);
- Climate change; and
- Aquaculture.

13.2.2.1. Dredging and Disposal of Dredging Material

Dredging and disposal of dredging material can result in the temporary degradation of water quality due to the resuspension of bottom materials, resulting in water column turbidity, potential contamination due to the release of toxic substances (metals and organics), and reduced oxygen levels due to the release of oxygen-consuming substances (e.g., nutrients, sulfides) (Myszewski, 2015). The Dredged Material Management Plans for federal navigation projects are in place to establish disposal capabilities, potential benefits, sufficient disposal facilities for the next 20 years, mitigate environmental harm, and conduct maintenance procedures (Myszewski, 2015). This includes the implementation to mitigate the loss of fish and wildlife unless a specific finding is made that would result in "adverse impacts to fish and wildlife" (33 U.S.C. § 2283(d)(1)). According to the literature, the preferred method for disposing material from navigation is to place it in confined disposal facilities. Some benefits of making use of dredge material or a placement site incorporate beach nourishment, creating parks and recreation, shoreline stabilization, and improving soil surfaces in agriculture and aquaculture. Accelerated shipping activity and coastal implementation will cause dredging operations to intensify and may create potential impacts on fish.

NOAA Fisheries has concluded that based on its review of recent literature, updates to previously identified actions that encourage conservation and enhancement concerning marine sand and minerals mining are not warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of dredging and disposal of dredge material on HMS EFH.

13.2.2.2. Oil and Gas Exploration and Operations / Seismic Surveys

The adverse effects of the oil and gas industry on HMS EFH were first described in the 1999 FMP for Atlantic Tunas, Swordfish, and Sharks. While these analyses are not repeated here, there is a growing body of scientific literature concerning the decommissioning of oil and gas platforms, and the viability of retaining infrastructure as habitat through “Rigs-to-Reef” programs. Numerous studies have analyzed the ecological communities, behavior, and habitat utilization of marine organisms in the vicinity of Gulf of Mexico oil platforms and offshore energy infrastructure (e.g., Ajemian et al. (2015), Johnston et al. (2022)). Ajemian et al. (2015) observed sandbar and silky sharks in association with offshore oil infrastructure. Other studies have analyzed changes in biological community composition and potential impacts on marine organisms (e.g., Meyer-Gutbrod et al. (2020), Johnston et al. (2022)), and the ecological role of oil and gas platforms as novel ecosystems (van Elden et al. (2019)). Sommer et al. (2019) ecosystem function and services increase with the age of the structure, and may need to be considered prior to a decommissioning operation.

The oil and gas industry uses seismic surveys to investigate subterranean structure and search for petroleum and natural gas. Seismic surveys have been increasingly pervasive in natural soundscapes and ocean ambient sounds for decades (Wang (2022)). Marine seismic survey vessels use intense pulses of sound to search for hydrocarbon deposits, research geophysical features, and claim resources found in the sea under the United Nations Convention (Nowacek 2015). Amendment 10 analyzed the adverse effects of seismic surveys on HMS EFH. Since Amendment 10 was finalized, some new information concerning the adverse effects of seismic surveys (and ocean noise in general) on marine organisms have come available.[31]

Popper (2019) has provided a thorough overview of fish bioacoustics and the impacts of anthropogenic sound on fishes. Efforts to reduce the impact of ocean noise on marine species has

[31] Seismic surveys are not the only source of sound in the ocean. Military exercises, production, shipping/boating, construction, pile driving, pipe laying, and offshore oil developments all can produce intense sounds that may affect the behavior of marine organisms. The information summarized above can apply to many different sources of anthropogenic noise, and might be broadly applicable to other sections of this chapter (e.g., marine traffic, dredging, and the construction of wind turbines also can produce noise).

been recognized and implemented both internationally (e.g., Canada) (Williams 2014) and domestically (Popper 2019). Sound or acoustic disturbances can temporarily render a habitat unsuitable to marine life, potentially causes marine organisms to leave habitats that may be important for feeding or breeding (Popper 2019). Anthropogenic disturbances may also interfere with behaviors (such as sound production) that are vital for fish communication, mating, detecting prey and predators, and migration. Thus, the interaction between fish anthropogenic sounds is a disturbance to the community. While there is a growing body of research on the effcts of underwater sound on marine organisms, additional research is needed to understand the extent of this effect on HMS EFH.

In Amendment 10, NOAA Fisheries concluded that seismic surveys associated with oil and gas exploration and operations had the potential to generate detrimental non-fishing effects on HMS EFH. Due to insufficient information available, NOAA Fisheries did not previously identify specific actions to promote conservation and enhancement of HMS EFH adversely affected by seismic surveys. While the HMS FMP does identify actions to promote conservation and enhancement of HMS EFH affected by oil and gas production and development activities, these recommendations do not consider new scientific literature on decommissioning activities.

NOAA Fisheries has concluded that based on its review of recent literature that an update to previous analyses on the effects of decommissioning activities may be warranted.In addition, results of the recent literature search suggest that an update to the analysis of seismic surveys as a non-fishing impact to HMS EFH is warranted. While seismic testing and airguns are known to have detrimental effects on many species of fish (e.g., sciaenids, clupeids) and mammals, and may render pelagic habitats in the immediate area of surveys or testing temporarily unsuitable for many species, NOAA Fisheries has not previously identified conclusive empirical evidence in the literature specifically on the effects of seismic surveys on HMS EFH. Including this information into previous analyses will likely help determine if additional actions to promote conservation and enhancement of HMS EFH adversely affected by decommisioning activity and seismic surveys is warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding adverse impacts of oil and gas exploration and operations, including decommisioning activities and seismic surveys, on HMS EFH.

13.2.2.3. Navigation

Navigation-related threats to HMS EFH include navigation support activities such as excavation and maintenance of channels (including disposal of excavated sediments), which result in the elevation of turbidity and resuspension of contaminants; construction and operation of ports, mooring, and cargo facilities; construction of ship repair facilities; and construction of channel stabilization structures such as jetties and revetments. Threats to both nearshore and offshore waters are posed by vessel operation activities such as the discharge and spillage of oil, other hazardous materials, trash, waste water, and cargo, all of which may result in localized water quality degradation and have adverse effects on HMS. Navigation also results in the dispersal of non-native marine life, impacting the aquatic ecosystem (Gabel, 2017). Generating ship-induced waves and currents are also a direct physical adverse effect (Gabel, 2017). Wakes from vessel operation may also exacerbate shoreline erosion, affecting habitat modification and potential degradation. Ship induced wakes were shown to influence fish at all growing stages of life including displacement and stranding, lowered foraging, and abundance and community composition (Gabel, 2017).

Based on our review of recent literature, we conclude that minor updates to the analysis of the adverse effects of navigation to HMS EFH are warranted. However, updates to the previously identified actions to encourage conservation and enhancement of EFH affected by navigation are not warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding adverse effects of navigation on HMS EFH.

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13.2.2.4. Marinas and Recreational Boating

Marinas and recreational boating are increasingly popular uses of coastal areas. Impacts caused by pollutants associated with marinas include lowered dissolved oxygen, increased temperatures, bioaccumulation of pollutants by organisms, toxic contamination of water and sediments, resuspension of sediments and toxins during construction, eutrophication, change in circulation patterns, shoaling, and shoreline erosion. Pollutants that result from marina activities include nutrients, metals including copper released from antifouling paints, petroleum hydrocarbons, pathogens, and polychlorinated biphenyls. Also, chemicals commonly used to treat timber used for piers and bulkheads (e.g., creosote, copper, chromium, and arsenic salts) are introduced into the water. Other potential impacts associated with recreational boating are the result of improper sewage disposal, fuel and oil spillage, cleaning operations, and disposal of fish waste. Propellers from boats can also cause direct damage to all life stages of organisms, including eggs, larvae/neonates, juveniles and adults; destratification; elevated temperatures, and increased turbidity and contaminants by resuspending bottom materials. Recreational boating activities often are conducted in or near vegetated habitat areas that are vital for fish recruitment (Hansen (2018)).

NOAA Fisheries has concluded that, based on its review of recent literature, updates to previous analysis of adverse effects of marinas and recreational boating on HMS EFH are not warranted. Additionally, this review of the recent literature suggests that updates to the previously identified actions to encourage conservation and enahancements of HMS EFH adversely affected by marinas and recreational boating are not warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of marinas and recreational boating on HMS EFH.

13.2.2.5. Marine Sand and Minerals Mining

Mining for sand (e.g., for beach nourishment projects), gravel, and shell stock in estuarine and coastal waters can result in water column effects by changing circulation patterns, increasing turbidity, and decreasing oxygen concentrations at deeply excavated sites where flushing is minimal. Deep borrow pits created by mining may become seasonally or permanently anaerobic. BOEM recently conducted an assessment of Frying Pan Shoals as a source of sand for beach nourishment projects off the coast of North Carolina (Pickens, 2021).[32] This study identified numerous mitigation measures that could be implemented to reduce risk from dredging related impacts, including spatial zoning, appropriate selection of dredge technique, timing the dredge activities to avoid peak recruitment and nursery use periods of fish species to minimize adverse ecological effects, to dredge at night to reduce physical impact to fish, to mine shoals in rotation, to mine shoals with specific physical features less prone to serve as important habitat, and other best practices that could reduce any temporary adverse effects to water column habitat. Additionally, mitigation measures were identified to protect the geomorphic integrity of shoals. NOAA and BOEM finalized a decision support tool in 2020 called "ShoalMATE" to reduce dredging impacts to EFH.[33] ShoalMATE provides BOEM with a consistent, science-based framework to streamline EFH consultations. The tool generates a report that evaluates impacts of proposed dredging activities on EFH. Data mapped in ShoalMATE includes predicted locations of shoal features in the Gulf and Atlantic Coasts based on physical characteristics, as well as modeled fish species distributions based on habitat characteristics, already designated EFH, past dredging activities, and a range of environmental factors. ShoalMATE allows BOEM to overlay these data in customizable maps and analyze relative value of habitats in the project area into a concise assessment report. HMS EFH information has been integrated into ShoalMATE and is currently being used for EFH consultations.

NOAA Fisheries has concluded that, based on its review of recent literature, updates to previous analysis of adverse effects of marine sand and minerals mining on HMS EFH are warranted. Additionally, NOAA Fisheries recommend including one new action to encourage conservation and enahancement to HMS EFH adversely affected by marine sand and minerals mining. Where feasible, NOAA Fisheries supports the use of decision support tools such as ShoalMATE to reduce or mitigate the effects of marine sand and minerals mining on EFH. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of marine sand and minerals mining on HMS EFH

13.2.2.6. Ocean Dumping

Ocean dumping of hazardous and/or toxic materials (e.g., industrial wastes) containing concentrations of heavy metals, pesticides, plastics, petroleum products, radioactive wastes, and pathogens, in the ocean degrades water quality and benthic habitats. Deep ocean dumping of hazardous waste, industrial, military, or nuclear disposal was a global practice in the 20th century (Kivenson, 2019). In the United States alone records display that 50-97 tons of industrial waste were dumped at sea (Kivenson, 2019). One of the growing concerns of ocean dumping results from microplastics, which have created a rise in concern as they poses major risks to the environment and animals. Around 8 million metric tons of plastic have entered the world's oceans each year, overloading the waste management infrastructures that are in place (Tullo, 2018). The increase of microplastics result from commercial product development and the

[32] https://espis.boem.gov/final%20reports/BOEM_2021-028.pdf
[33] https://coastalscience.noaa.gov/news/noaa-boem-develop-new-tool-to-reduce-dredging-impacts-to-essential-fish-habitat/

degeneration of larger plastics. Marine life often is directly affected by this pollution through consumption. Fish are impacted due to the reduction in food intake, delayed growth, oxidative damage, and abnormal behaviors that stem from these plastics. Justino et al. (2023) found a high frequency of microplastic occurrence in bigeye and yellowfin tuna harvested in the southwestern Tropical Atlantic Ocean, mainly as a result of trophic transfer (i.e, larger tunas consumed smaller prey that had injested microplastics).

NOAA Fisheries has concluded that based on its review of recent literature, updates to the previous analysis of the adverse effects of ocean dumping on HMS EFH are warranted (specifically, to include a discussion on microplastics). However, based on this review of recent literature, updates tothe previously identified actions to encourage conservation and enahancements for HMS EFH adversely affected by ocean dumping are not warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of ocean dumping on HMS EFH.

13.2.2.7. Liquid Natural Gas

For LNG facilities, a major concern is the saltwater intake system used to heat LNG and regasify it before piping to shore; which could subject multiple life stages of marine species to entrainment, impingement, thermal shock, and water chemistry changes.

NOAA Fisheries did not identify new literature on the adverse effects of LNG production or facilities on HMS EFH. Therefore, updates to the previous analysis of the adverse effects of LNG production or facilities operation are not warranted. Additionally, updates to the previously identified actions to encourage conservation and enhancement of HMS EFH adversely affected by for LNG production or facilities operation are not warranted. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of LNG production or facilities operation on HMS EFH.

13.2.2.8. Renewable Energy Projects / Wind Energy

Alternative energy includes, but is not limited to wind, wave, solar, underwater current and generation of hydrogen fuel. Construction, maintenance, and operation for these installations can disturb water quality in HMS EFH. BOEM maintains a list of activities by region and by state.[34,35,36]

Wind energy is a process in which wind is used to produce renewable energy. Wind energy has been included in previous "renewable energy projects" non-fishing effects analyses for HMS EFH (Table 13-1). However, there has been a large increase in the amount of wind energy research and public attention on the development of wind farm leases off the east coast of the United States. Therefore, in this EFH review, NOAA Fisheries re-examines the impacts of

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[34] https://www.boem.gov/renewable-energy/state-activities/gulf-mexico-activities
[35] https://www.boem.gov/renewable-energy/state-activities/central-atlantic
[36] https://www.boem.gov/renewable-energy/state-activities

offshore wind energy on HMS EFH. Offshore wind energy development has the potential to play an important role in U.S. efforts to combat the climate crisis and build a clean energy economy, and NOAA supports the Administration's goals of rapidly and responsibly advancing offshore wind energy in U.S. waters to mitigate climate change and bolster the blue economy.

Offshore wind turbines placed in large bodies of water or at sea harness the force of wind to turn propeller-like blades, which in turn spins a generator, creating electricity.[37] Wind energy structure could potentially act as an artificial reef, although corresponding benefits to biota may not be evenly distributed among all species and fisheries geographically (Gill, 2020). Adverse ecological consequences may include as wind wakes, environmental sensory adjustments related to sound, or electromagnetic fields (Gill, 2020).

Generalized effects of wind energy production on the marine environment have been identified. Altered currents and bottom shear from water moving around the combined submerged vertical profile of the piles, foundations, and scour protection may result in changes to the hydrodynamic patterns near the wind farm that degrade natural bottom habitat features downstream (e.g., sediment texture distribution and micro-topography). Vertical mixing of the water column is increased during the summer when the water column is stratified as is the transport of nutrients into the surface layer. Modeling studies have found that wind farms can alter vertical mixing and seasonal stratification in areas outside the footprint of individual wind farms (Broström (2008); Carpenter et al. (2016); Cazenave et al. (2016)). However, direct observation of hydrodynamic effects in two wind farms in the North Sea have indicated that vertical mixing is increased during the summer when the water column is stratified as is the transport of nutrients into the surface layer (Floeter et al. (2017)). The changed hydrodynamic forces will create turbine wakes and sediment plumes in EFH with finer sediments and may reduce the productivity and efficacy of visual predation. Altered bottom shear stress may degrade natural bottom habitat features downstream (e.g., sediment texture distribution and micro-topography). Increased suspended sediment has been observed in the wakes of monopile foundations with direction of wakes changing based on tides and extending up to 1 or more km downstream (Vanhellemont and Ruddick (2014)). Adverse effects on EFH from these sediment plumes may affect the light field which could have implications for primary productivity and visual predation (Vanhellemont and Ruddick (2014)). The severity of any sediment plumes to depend on local conditions, particularly sediment type and any local scour at the site.

Our literature review identified new research projects on wind lease areas that have included HMS (e.g., Haulsee et al. (2020); Normandeau Associates and Ltd (2020); Friedland et al. (2021)), or evaluated the overlap of habitat associations and seasonal distribution of HMS with wind lease areas (e.g., Bangley et al., 2020). Hogan et al. (2023) synthesized the science associated with fisheries and offshore wind interactions, a summary of which is provided herein.[38] This technical memo compiles contributions from a workshop and related efforts by NOAA, BOEM, and the Responsible Offshore Development Alliance (RODA), and addresses the following topics:

- Benthic habitat modification;

[37] https://www.energy.gov/eere/wind/how-do-wind-turbines-work
[38] https://repository.library.noaa.gov/view/noaa/49151

- Physical habitat modification;
- Interactions of offshore wind on oceanographic processes;
- Effects on phytoplankton and zooplankton;
- Effects on demsersal finfish;
- Effects on medium pelagic, large pelagic, and highly migratory finfish species;
- Effects on small pelagic finfish;
- Effects on shellfish;
- Effects on interactions within the biotic community (e.g., the effect of converting habitat on predator-prey relationships);
- Fisheries sociocultural effects;
- Effect on fishery-dependent data collection;
- Effect on fishery-independent data collection;
- Impacts on fisheries management;
- Cumulative impacts;
- Incorporating offshore wind into the Integrated Ecosystem Assessment process;
- Innovations in monitoring approaches and technology;
- Regional science planning; and
- Fishing industry identification of research priorities.

Hogan et al. (2023) provides a synthesis of available information on the effects and impacts of offshore wind on HMS (Section 1.4.4, pg 83-91 of their report). Offshore wind development is likely to affect the distribution, localized abundance, ecology and behavior of HMS. The effects of offshore wind activities on HMS may vary by project stage (e.g.,pre-construction seismic site surveys, construction, operation and decommissioning), but could result in localized impacts on HMS throughout their natural range, particularly if constructed within EFH (e.g., nursery areas, feeding areas, and mating or pupping areas). Noise from offshore wind construction activities were linked to short-term (Perez-Arjona et al. 2014) and long-term (Mooney et al 2020) behavioral modifications of HMS, and are inferred to occur based on applicable research on the impacts of ocean noise (see Section 13.2.2.2). Trophic interactions may be affected by altered hydrodynamics and by the tendency of some marine taxa to aggregate around artificial structures. Wind turbines produce electromagentic field (EMF) emissions from high voltage cables. While the effects of EMF emissions are largely unknown, it is speculated that marine organisms sensitive to EMF (such as sharks) could modify their behavior in response to EMF emissions associated with offshore wind facilities.

Some research has been completed on how to mitigate adverse ecological effects associated with the development of wind energy infrastructure. In a comparative study of benthic mapping and offshore development (LaFrance, 2014), benthic habitats were examined for potential impact from the construction of the wind energy infrastructure. Mapping benthic habitats has been used to examine and potentially mitigate the effects of the abiotic-biotic relationships between the structures and the life it directly affects (LaFrance, 2014). Mapping activities undertaken by BOEM include a feedback process to obtain input from the public, which is then used to narrow down the areas under consideration.[39] Van Parijs et al. (2021)

[39] https://www.boem.gov/renewable-energy/state-activities/maine/gulf-maine

identifies minimum recommendations for passive acoustic telemetry systems that can be used to support monitoring and mitigation programs. While this study is focused on protected species mitigation and monitoring, the techniques included could be considered best practices to characterize soundscapes, monitor ambient noise, and provide information on soniferous fishes.

NOAA Fisheries has concluded, from an analysis of recent literature, that updates to the previous analysis of adverse effects of renewable energy projects (including offshore wind energy) on HMS EFH are warranted. Additionally, NOAA Fisheries recommends including new actions to encourage conservation and enhancement of HMS EFH adversely affected renewable energy projects:

- Where feasible, NOAA Fisheries supports the use of decision support tools, mapping to enhance site selection, and/or participation in site analyses intended to reduce or mitigate the effects of wind farms on EFH.
- Develop and maintain continuous, well-developed monitoring and biological sampling frameworks to collect information on oceanographic conditions and the biological community (including HMS) through all stages of offshore wind development and operation.This can include surveys, laboratory research, long-term monitoring (e.g., biologging, passive and active acoustic telemetry, PSAT deployment, video, and other approaches to identify, track and model HMS behavior), socio-economic surveys, biological sampling, field measurements of acoustic and EMF emissions and captive mesocosms.
- Where feasible and appropriate, conduct project-specific assessments of whether time-of-year mitigations or minimization strategies are appropriate to reduce adverse effects of lethal or disruptive wind energy development, production, or decommisioning activities on HMS or HMS EFH.

NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of renewable energy projects, including offshore wind energy, on HMS EFH.

13.2.2.9. Climate Change

Climate change has a known impact on HMS and HMS EFH. Literature on climate change published through 2014 was thoroughly reviewed in Amendment 10 (see pages 87-92) and the previous 5-year review (see pages 101-105) and is not repeated here. NOAA Fisheries has found new literature related to the impacts of climate change on HMS (e.g., changing distributions of species) and recommends updating HMS EFH with new information. A large volume of new scientific literature is available regarding the impacts of climate change; an excerpt of sampled literature is provided in Table 13.2.

NOAA Fisheries will be conducting a CVA for HMS in 2023. Results from this assessment should be incorporated into HMS EFH, where appropriate. The outcomes of this CVA can also be used, if appropriate, to identify actions to encourage conservation and enahancements that mitigate the effects of climate change on HMS EFH. We have not identified actions to enhance or conserve HMS EFH adversely affected by climate change. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the adverse effects of climate change, and activities linked to climate change, on HMS EFH.

Table 13.2. Some recent studies investigating the effects of climate change on HMS.

Study	Region	HMS
Brodie et al. (2021)	Pacific / California current	Swordfish
Crear et al. (2020)	Chesapeake Bay	Sandbar shark
Diaz-Carballido et al. (2022)	Pacific, Atlantic coasts of Mexico	Sharks
Dell'Apa et al. (2018)	Gulf of Mexico	Tunas, billfish
Erauskin-Extramiana et al. (2020)	Global	Swordfish
Evans et al. (2020)	Global	Tunas, billfish
Faillettaz et al. (2019)	North Atlantic	Bluefin tuna
Muhling et al. (2015)	North Atlantic	Tunas, billfish
Muhling et al. (2017)	Global	Pelagic species
Muhling et al. (2017)	North Atlantic	Bluefin tuna
Robinson et al. (2015)	Southwest Pacific	Tunas, billfish, sharks
Rosa et al. (2017)	Southwest Pacific	Sharks
Schirripa et al. (2017)	North Atlantic	Swordfish
Wu et al. (2020)	Global	Yellowfin tuna

13.2.2.10. Aquaculture

Management of Aquaculture

NOAA Fisheries consults with state, federal and private entities to support aquaculture development in the U.S. EEZ. NOAA Fisheries and the GMFMC finalized an Aquaculture FMP in 2009.[40] On January 13, 2016, NOAA Fisheries published a final rule to implement the FMP for regulating offshore aquaculture in the Gulf of Mexico, as prepared by the GMFMC (81 FR 1761). However, a court ruling determined that the Department of Commerce did not have the authority to permit or regulate aquaculture under existing federal fisheries management law in the Gulf of Mexico.[41] Therefore, recent activities undertaken by the agency regarding aquaculture have been intended to complete necessary consultations (e.g., ESA, Marine Mammal Protection Act, and EFH consultations) and use the best scientific information available to help inform siting of aquaculture facilities.

[40] https://gulfcouncil.org/wp-content/uploads/Aquaculture-FMP-PEIS-Final-02-24-09.pdf
[41] https://gulfcouncil.org/wp-content/uploads/Gulf-AQ_Fifth_Circuit_Opinion-8-3-20.pdf

Aquaculture Opportunity Areas

On May 7, 2020, the White House issued an E.O. on Promoting American Seafood Competitiveness and Economic Growth (E.O. 13921), which requires the Secretary of Commerce to identify geographic areas containing locations suitable for commercial aquaculture and develop programmatic environmental impact statements to assess the impacts of siting aquaculture in those locations.[42] The goal of identifying Aquaculture Opportunity Areas (AOA) was to promote American seafood competitiveness, food security, economic growth, and support the facilitation of the development of domestic commercial aquaculture, consistent with sustaining and conserving marine resources and applicable laws, regulations and policies. E.O. 13921 instructed NOAA to lead a multi-agency, public planning effort to identify 10 AOAs over the course of 7 years. In order to select the first two geographic regions in which AOAs would be identified, NOAA Fisheries, on behalf of NOAA, took into consideration existing aquaculture industry interest; existing foundational work (siting analyses and environmental reviews) that could support AOA development; the maturity of the existing interagency communication and collaboration structure; and the history of engagement with stakeholders on aquaculture in regions throughout the United States. As a result of these considerations, NOAA Fisheries selected Federal waters off the coast of southern California and Federal waters in the Gulf of Mexico as the first two geographic regions in which to identify AOAs.

The National Centers for Coastal Ocean Science initiated a marine spatial planning process to assist agency decision makers in identifying areas that may be suitable for locating AOAs as mandated by E.O. 13921. This process was based on spatial suitability modeling that included over 200 different data layers relevant to administrative boundaries, national security (i.e., military), navigation and transportation, energy and industry infrastructure, commercial and recreational fishing, natural and cultural resources, and oceanography (i.e., non-living resources). This spatial modeling approach was specific to the planning goal of identifying discrete areas that are 500-2,000 acres (202-809 hectares) that met the industry and engineering requirements of depth (between 50 m (164 ft) and 150 m (492 ft)) and distance from shore and that may be suitable for all types of aquaculture development including the cultivation of finfish, macroalgae, shellfish, or a combination of species.[43] These spatial planning goals were informed by a series of public engagement approaches including a Request for Information published in the Federal Register (85 FR 67519, October 23, 2020) and one-on-one meetings with stakeholders.[44]

This work resulted in an “Aquaculture Opportunity Atlas for the U.S. Gulf of Mexico” (Riley et al. (2021)). The Atlas used a precision-siting, scoring, and ranking process to narrow the suitability analysis results to nine, 500-2,000-acre (202-809 hectares) “AOA options” that have

[42] https://www.federalregister.gov/documents/2020/05/12/2020-10315/promoting-american-seafood-competitiveness-and-economic-growth
[43]https://www.federalregister.gov/documents/2022/06/01/2022-11564/notice-of-intent-to-prepare-a-programmatic-environmental-impact-statement-for-identification-of
[44]https://coastalscience.noaa.gov/data_reports/an-aquaculture-opportunity-area-atlas-for-the-u-s-gulf-of-mexico/

high potential suitability for an AOA in the Gulf of Mexico: Three off the coast of Texas, three off the coast of Louisiana, and three off the west coast of Florida. The Atlas is considered the most comprehensive marine spatial modeling in the U.S. Gulf of Mexico to date and includes peer-reviewed technical information that may be used to assist agency decision makers in identifying areas that may be suitable for locating AOAs.

Following release of the AOA Atlas for the Gulf of Mexico, NOAA Fisheries published a Notice of Intent to prepare a PEIS for identification of AOAs in federal waters of the Gulf and to conduct public scoping meetings (87 FR 33124, June 1, 2022). The PEIS will assess the environmental impacts related to the potential siting of aquaculture facilities in potential AOA locations in Federal waters in the Gulf of Mexico. Formal public scoping for this effort concluded on August 1, 2022. NOAA Fisheries along with its cooperating and participating agencies are currently preparing the draft PEIS for publication. This effort is ongoing at time of preparation of this draft 5-year review, and any new relevant information made available to the public will be incorporated into the final 5-year review and follow up action (if deemed necessary).

New Literature and Information

Much of the new information regarding aquaculture impacts on HMS either refers to species that are being raised in aquaculture facilities, or species affected by aquaculture facilities.

Recent HMS aquaculture research has focused on bluefin tuna outside of the US EEZ (e.g., Zohar et al. (2016); Blanco et al. (2017). While there are currently no commercial aquaculture facilities in the U.S. EEZ that include HMS, HMS are the focus of some experimental facilities (e.g., the University of Rhode Island has a facility experimenting with yellowfin tuna in a land-based containment system).[45] Additionally, HMS could be included in the PEIS as a potential species of interest pursued by aquaculture operations sited within AOAs. Where applicable, the actions to encourage conservation and enahancements previously identified for HMS still apply.

Fujita et al. (2023) reviewed ecological risks of the offshore aquaculture industry in the U.S. EEZ, and provided numerous actions to encourage conservation and enahancements that could supplement those already in the HMS FMP, including:

- Use appropriate site selection methods to address ocean use concerns and reduce risk of harmful interactions with endangered, threatened and protected species. Good siting also reduces disease risk and can address water quality concerns.
- Offshore aquaculture infrastructure and equipment must withstand or be resilient to storms, strong offshore waves, winds, and currents as well as resist corrosion and fouling.
- Conduct regular surveillance of offshore aquaculture systems to monitor for predator interactions and damaged equipment, and to explore non-lethal means of deterring

[45] https://web.uri.edu/quadangles/050-big-fish/

predators as needed. Husbandry practices such as removing dead fish from pens and avoiding over-feeding can reduce shark interactions with aquaculture cages or pens (Huveneers et al. (2022)).
- Consider rotating and fallowing (i.e., leaving sites empty for certain time periods) to reduce instances of disease outbreaks by removing potential hosts.

Additional recommendations concerning stocking, feed, metabolic waste, disease, escapement, and antibiotic use are provided and could be considered.

NOAA Fisheries has concluded that, based on recent literature, updates to the analysis of adverse effects of aquaculture on HMS EFH are warranted. In addition, the identification of new actions to encourage conservation and enahancements (such as those identified in Fujita et al. (2023)) are also warranted. Where feasible, NOAA Fisheries supports the use of decision support tools such as the AOA analysis process to reduce or mitigate aquaculture effects to HMS EFH. NOAA Fisheries encourages the public to submit new information or information not previously considered regarding adverse effects of aquaculture on HMS EFH.

13.3. Conclusions and Recommendations

13.3.1. Non-Fishing Effects Analysis Updates

At this time, NOAA Fisheries has not identified any new activities with potential to generate detrimental non-fishing impact to HMS EFH. However, NOAA Fisheries encourages public comment on any new non-fishing effects not previously analyzed.

NOAA Fisheries has identified new literature that can be incorporated into the analysis of the effects of several non-fishing activities on HMS EFH. These updates could incorporate new literature on navigation, oil and gas exploration and operations (e.g., decommissioning activities and seismic surveys), marine sand and minerals mining, ocean dumping, renewable energy projects/wind energy, climate change, and aquaculture. In some cases, this new information is generalized with respect to impacts on marine life, and is included to better define or describe the topic. However, literature including HMS or some HMS-specific information were found for some topics. HMS data were included into decision support tools (i.e., marine sand and minerals mining, aquaculture) or HMS were included as study targets or from survey data (i.e., wind energy, climate change). The discussion of these non-fishing effects can be updated in the HMS FMP with this literature.

There are many ongoing initiatives concerning climate change (i.e., HMS CVAs), renewable energy (i.e., wind energy), and aquaculture (i.e., AOAs) that should continue to be monitored. New information relevant to EFH for HMS should be incorporated into the HMS FMP. NOAA Fisheries encourages additional research on any previously identified non-fishing impact, with special focus on the aforementioned activities. NOAA Fisheries also encourages public comments, new research, or other scientific information not previously discussed on any previously analyzed non-fishing effects on HMS EFH.

13.3.2. Actions to Encourage Conservation and Enhancement of HMS EFH

Actions to encourage conservation and enahancements to prevent or mitigate non-fishing effects of previously analyzed activities on EFH are included in the 1999 HMS FMP, and the 2006 Consolidated HMS FMP and relevant amendments (i.e., Amendments 1 and 10). NOAA Fisheries did not find literature that suggests any previous actions to encourage conservation and enahancements should be changed; therefore they are not repeated here. However, NOAA Fisheries recommends the inclusion of additional actions to encourage conservation and enahancements to the HMS FMP. NOAA Fisheries encourages the public to submit new information on the topics included, to assist in considering all possible EFH non-fishing effects from these activities.

Renewable Energy Project / Wind Energy: We have identified several new actions to encourage conservation and enhancement of HMS EFH adversely affected renewable energy projects. Where feasible, NOAA Fisheries supports: (1) the use of decision support tools, mapping to enhance site selection, and/or participation in site analyses intended to reduce or mitigate the effects of wind farms on EFH; (2) the development and maintenance of continuous, well-developed monitoring and biological sampling frameworks to collect information on oceanographic conditions and the biological community (including HMS) through all stages of offshore wind development and operation; (3) project-specific assessments of whether time-of-year mitigations or minimization strategies are appropriate to reduce adverse effects of lethal or disruptive wind energy development, production, or decommisioning activities on HMS or HMS EFH.

Marine Sand and Minerals Mining: Where feasible, NOAA Fisheries supports the use of decision support tools such as ShoalMATE to reduce or mitigate the effects of marine sand and minerals mining on EFH.

Aquaculture: Consistent with the new procedures identified through the AOA site-selection process and recommendations identified in the recent literature (e.g., Fujita et al., 2023), NOAA Fisheries recommends updating actions to encourage conservation and enahancements for aquaculture. At minimum, actions to encourage conservation and enahancements should be consistent with those identified in the ongoing development of the PEIS for Gulf of Mexico AOAs, and include undertaking appropriate site-suitability analyses to balance ecological, stakeholder use, and economic needs associated with these activities.

Climate Change: While no specific actions to encourage conservation and enahancements have been identified, NOAA Fisheries will be completing a CVA that will include a comprehensive analysis of known information and expert opinion on the effects of climate change on HMS. NOAA Fisheries recommends evaluating the final CVA products when they are available (in fall 2023 or in 2024), in a future stage of the EFH update process. New information should be incorporated into the non-fishing effects analysis and, if appropriate, new actions to encourage conservation and enahancements can be identified.

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14. Habitat Areas of Particular Concern

14.1. Regulations and Processes

To further the conservation and enhancement of EFH, the EFH guidelines (§ 600.815(a)(8)) encourage FMPs to identify HAPCs. HAPCs are areas within EFH that should be identified based on one or more of the following considerations:

1) The importance of the ecological function provided by the habitat;
2) The extent to which the habitat is sensitive to human-induced environmental degradation;
3) Whether, and to what extent, development activities are, or will be, stressing the habitat type; and
4) The rarity of the habitat type.

A HAPC designation does not automatically result in time/area closures or other management measures designed to reduce or eliminate fishing effort. Rather, a HAPC designation identifies an area as particularly important or rare ecologically, and may take into account the degree to which the habitat is sensitive to human-induced environmental degradation. If NOAA Fisheries determines that human activities are having an effect on HAPCs, then NOAA Fisheries could propose measures to minimize impacts fishing activities or develop actions to encourage conservation and enahancements for non-fishing activities. NOAA Fisheries has identified the impacts of fishing and non-fishing effects on HMS EFH in Chapter 12 and 13, respectively.

Designation of a HAPC does not change the fishery regulations of any species that inhabit that area. NOAA Fisheries will provide the public and Regional Fishery Management Councils a chance to comment on any new HMS HAPC designations resulting from this 5-year review of HMS EFH. HAPCs can also be used to target areas for additional scientific research. Measures intended to reduce impacts on habitat would need to be proposed and analyzed in an additional rulemaking and could include gear restrictions, time/area closures, or other measures that minimize impacts to the habitat as necessary to protect the habitat.

14.2. Current Habitat Areas of Particular Concern

Currently, HAPCs have been designated for four HMS: sandbar sharks, bluefin tuna, lemon sharks, and sand tigers. In the 1999 FMP, areas off of North Carolina, Virginia (Chesapeake Bay), Delaware (Delaware Bay), and New Jersey (Great Bay) have been identified as HAPCs for sandbar sharks (Figure 14.1). A HAPC for bluefin tuna was designated in Amendment 1 (Figure 14.2) and is located across the western, northern, and central Gulf of Mexico. A HAPC for lemon sharks was designated in Amendment 10 (Figure 14.3) between Jupiter Inlet and Cape Canaveral, Florida. HAPCs for sand tigers were also designated in Amendment 10 in Delaware Bay (Figure 14.4) and in the PKD (Plymouth, Kingston, and Duxbury) bay system of coastal Massachusetts (Figure 14.5).

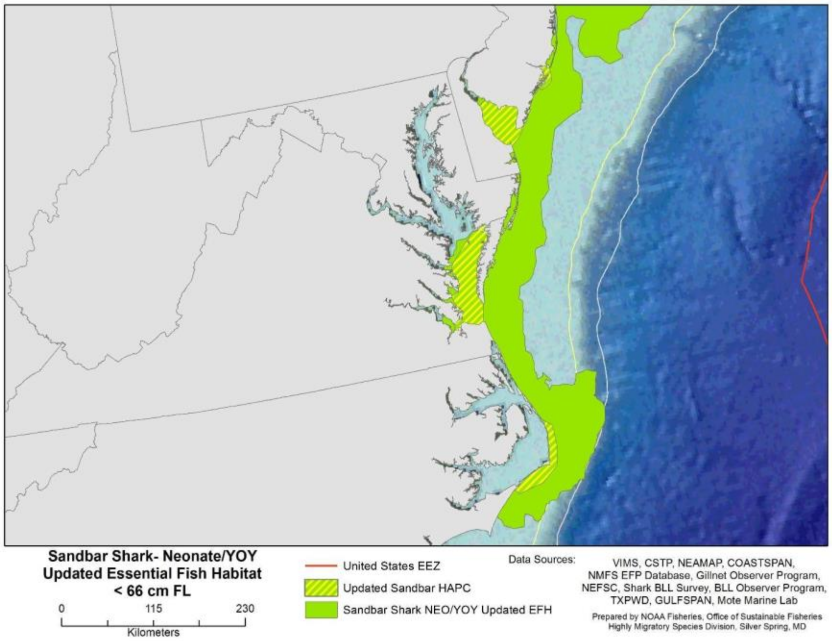

Figure 14-1. Sandbar shark HAPC designated off New Jersey, Delaware, Virginia (Chesapeake Bay), and the Outer Banks of North Carolina.
Source: Amendment 10 to the 2006 Consolidated HMS FMP.

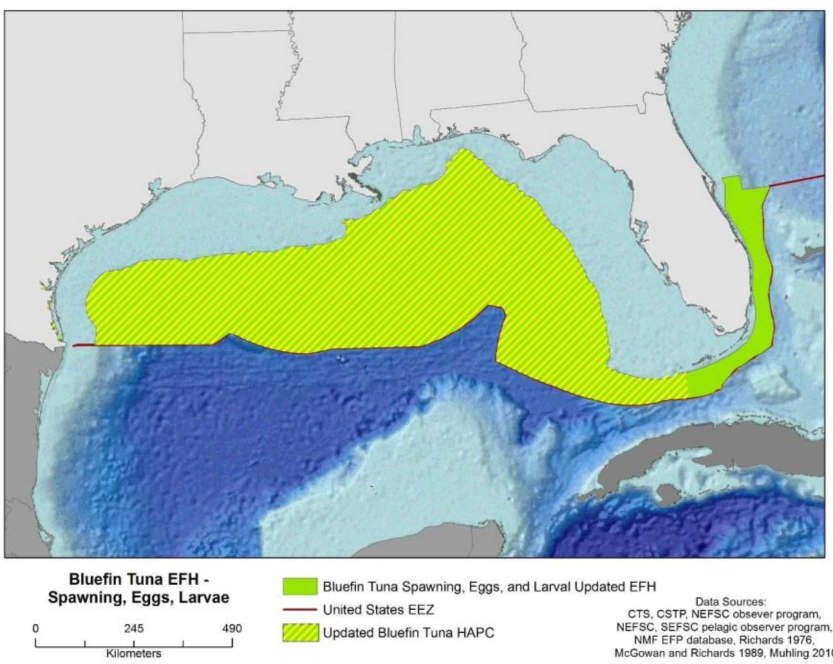

Figure 14-2. Bluefin tuna HAPC in the Gulf of Mexico.
Source: Amendment 10 to the 2006 Consolidated HMS FMP.

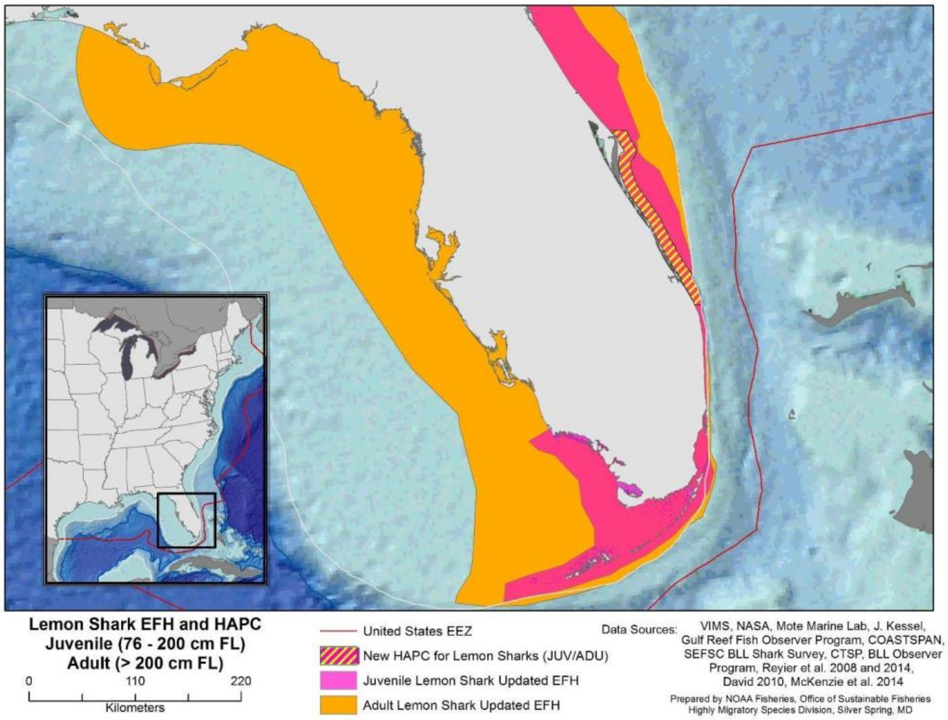

Figure 14-3. Lemon shark HAPC off the east coast of Florida.
Source: Amendment 10 to the 2006 Consolidated HMS FMP.

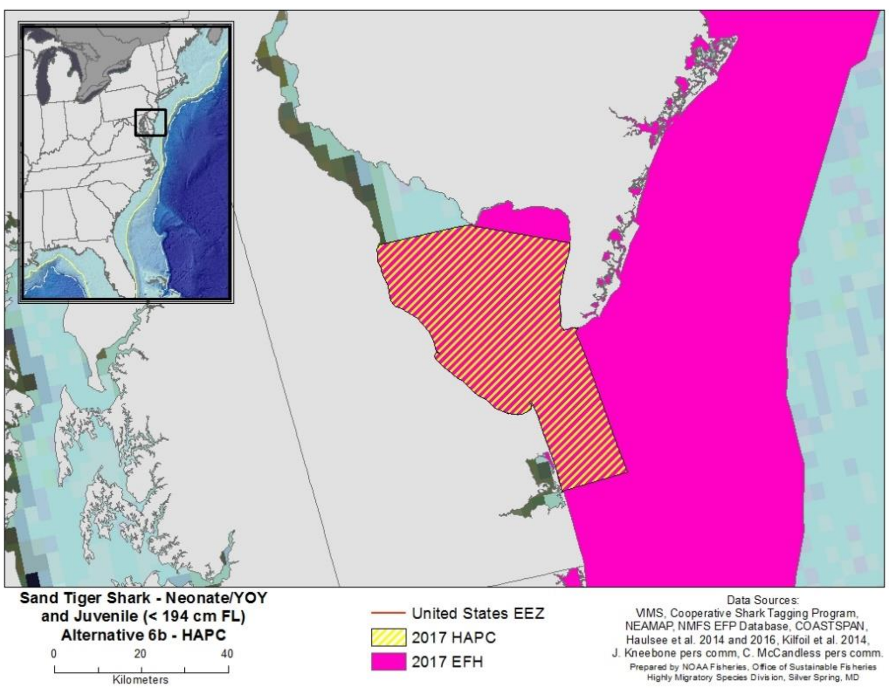

Figure 14-4. Sand tiger HAPC in Delaware Bay.
Source: Amendment 10 to the 2006 Consolidated HMS FMP.

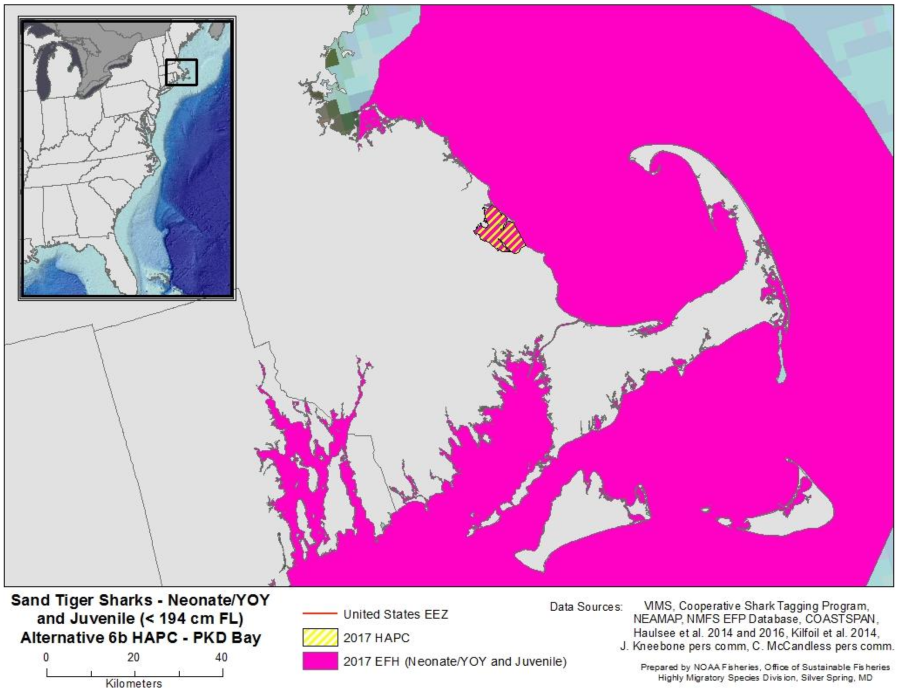

Figure 14-5. Sand tiger HAPC in the PKD bay system of coastal Massachusetts.
Source: Amendment 10 to the 2006 Consolidated HMS FMP

NOAA Fisheries did not identify literature suggesting that existing HAPCs should be changed or removed. However, it is likely that EFH boundaries for these species will be re-evaluated based on the availability of seven more years of published literature, data and other information. Existing boundaries of HAPCs may also need to be evaluated and changed to ensure they fall within any adjustments of HMS EFH. NOAA Fisheries encourages comments on whether the current HAPCs should be modified or removed from the HMS FMP.

14.3. New Habitat Areas of Particular Concern

We published a notice to initiate the 5-year review process and to request information that could be considered in the development of the HMS EFH 5-Year Review (87 FR 19667, April 5, 2022). We did not receive any comments with specific HAPC suggestions. However, a comment was submitted suggesting that the agency "identify and designate HAPCs for stocks that are not achieving good biological outcomes, including designation of HAPCs for known breeding and pupping habitats as well as for seasonal or persistent prey species aggregations."

HAPCs must be designated following the criteria outlined in Section 14.1. Stock status is not one of those criteria. Many of the HAPCs previously identified were breeding and pupping habitats (i.e., the bluefin HAPC is for the "spawning, eggs, and larval" life stage and the sandbar HAPC was designated for habitats used by neonate and YOY sandbar sharks). Much of the scientific literature and evidence supporting EFH and HAPC designations for sharks pertains to the identification of shark nursery habitats. However, the scientific literature often lacks clear, consistently used definitions for shark nursery habitats (see Heupel et al. (2007) for a thorough discussion). Bass (1978) identifies nursery habitats as "those where the young sharks are actually born and spend the first part of their lives" and secondary nursery habitats as "those inhabited by slightly older but not yet adolescent or mature sharks." Beck et al. (2001) noted that areas may be identified as nursery habitats without empirical testing of the nursery-role concept simply because of the presence of appropriately-aged individuals. Many areas identified as nursery habitats contain adolescent or mature sharks, therefore not strictly meeting the definition of these habitats from Bass (1978) (Heupel et al. (2007); Heupel et al. (2019); J. Carlson pers comm; C. McCandless pers comm).

We encourage the application of the shark nursery habitat definition identified in Heupel et al. (2007) as habitats in which: "1) sharks are more commonly encountered in these areas versus other areas; 2) sharks remain or return to these areas for extended periods of time (i.e., site fidelity that is greater than mean fidelity to all sites across years); 3) the habitat is repeatedly used across all years, whereas others are not". These criteria have been widely used in elasmobranch research to delineate nursery areas in the scientific literature (Heupel et al. (2019)). We have considered this definition in ground truthing shark EFH model results against the body of known scientific information and literature, and in application of the HAPC criteria to shark nursery habitats identified in alternatives which consider the creation or modification of HAPCs. Heupel et al. (2019) provides numerous examples of how to test the criteria using a combination of field techniques.

In this 5-year review and any follow up action, NOAA Fisheries will evaluate literature and other known information against these criteria in deciding whether to add, modify, or remove HAPCs from the 2006 Consolidated HMS FMP.

Scientific information that was deemed potentially relatable to the HAPC criteria were found on the areas identified below. We encourage public comment on whether it is appropriate to delineate a HAPC in these areas.

New York Bight - Nursery Habitat for White Sharks

In recent years there has been a growing body of research indicating that the New York Bight (i.e., continental shelf waters between Montauk, New York and Cape May, New Jersey) serves as a nursery area for white sharks, building on previous studies such as Casey and Pratt Jr. (1985) and Curtis et al. (2014). These previous studies supported two of the three criteria needed to be considered a shark nursery area, as described by Heupel et al. (2007): YOY sharks are more frequently encountered in the area compared to other areas and YOY sharks use the area repeatedly across years. The third criteria, that YOY sharks demonstrate residency within the area for extended periods, had not been addressed until Curtis et al. (2018) described the movements and seasonal migrations of YOY white sharks tagged in the North Atlantic Ocean. The results of Curtis et al. (2018) showed that the summer/fall (August through October) distribution of YOY white sharks was generally limited to the New York Bight, with focus areas along the southeastern shores of Long Island. This pattern of residency, along with previously documented occurrences of YOY white sharks in the area, confirms that the New York Bight functions as a nursery area under the above criteria.

Building on the results of Curtis et al. (2018), Shaw et al. (2021) compiled four years of white shark tagging data to examine distribution and selection for a range of oceanographic variables during the summer/fall (August through October) residence in the New York Bight. The results of this study suggest that young white sharks exhibit connectivity between the immediate shoreline and mid-continental shelf region, where they play important ecological roles as predators on a variety of species. Furthermore, results from Shaw et al. (2021) provide valuable insights into the unique combination of habitat characteristics that make the New York Bight vital to YOY and juvenile white sharks. Those insights are detailed below.

The young white shark summer/fall residency and consistent selection of continental shelf habitat in the New York Bight, combined with the relative scarcity of large white sharks in the nursery area, provides young sharks a refuge from natural mortality and risk effects associated with predation, and permits them to play a role as apex predators. This can lead to direct and indirect effects on ecosystem structure and nutrient pathways from the coastal zone to offshore habitats.

Young white sharks in the New York Bight selected areas with relatively high levels of productivity (i.e., mesotrophic waters) as reflected by salinity and chlorophyll-a concentration. Tagged white sharks selected sea surface salinities that were slightly less saline than oceanic waters (shallow areas close to land tend to have lower salinities). High levels of chlorophyll-a concentrations in the area are attributed to freshwater inputs, longshore currents, groundwater upwelling along Long Island's southern shoreline, and nutrient runoff from several rivers.

Additionally, evidence suggests that young white sharks may be exploiting more abundant food resources on the edge of the mid-Atlantic Cold Pool (a "cold pool" of water that commonly develops along the bottom of the mid-shelf region through the summer), which facilitates oceanographic conditions that support high levels of prey productivity.

Lastly, summer/fall water temperature in the New York Bight may span the optimal physiological temperatures for young white sharks (which is a narrower range than for adult white sharks), making the New York Bight ideal habitat from a thermal perspective. This has important implications for future young white shark habitats, given the effects of climate change and variability. Particularly because the mid-Atlantic Bight is warming at a faster rate than most of the global ocean (Shaw et al. (2021), Saba et al. (2016), Huveneers et al. (2018)).

In Amendment 10, NOAA Fisheries considered whether a potential HAPC was warranted in the northern Mid-Atlantic and southern New England area for neonate/YOY and juvenile white sharks. Although some information was available (Curtis et al. (2014)), there was insufficient information at that time to support designation of a HAPC based on the HAPC criteria outlined at § 600.815(a)(8). NOAA Fisheries was also unable to identify a discrete area that could be delineated and compared against the HAPC criteria. Therefore, NOAA Fisheries did not move forward with the evaluation of an alternative in Amendment 10 to delineate a white shark HAPC.

However, since Amendment 10 was finalized, scientific information has come available that both meets the criteria and refines a discrete location where a HAPC could be considered. Specifically, tagging data and habitat analysis from Curtis et al. (2018) and Shaw et al. (2021) suggest that the New York Bight white shark nursery grounds serve important ecological functions and host a rare combination of features to support young white sharks. NOAA Fisheries encourages the public to submit comments, scientific information, and data that could inform a recommendation on whether areas within the New York Bight should be considered a HAPC based on the HAPC criteria identified at § 600.815(a)(8).

Cape Cod - Aggregation Site for White Sharks

To gain a deeper understanding of spatio-temporal variability and movement ecology during residency and migration phases of white sharks in the western North Atlantic, Franks et al. (2021) tracked 48 large juvenile to adult white sharks between 2012 and 2020. Results from the study included, but were not limited to, identifying summer residency areas off the coast of Massachusetts and portions of Canada, with individuals showing fidelity to specific regions over multiple years.

While tagged white sharks were tracked over a wide latitudinal and longitudinal range, Franks et al. (2021) identified the waters off Massachusetts as a focal area for residency in summer/fall (July 1 through October 15). Additional tagging and tracking studies were completed by Skomal et al. (2017) and Winton et al. (2021). Individual white sharks showed fidelity to the waters off Massachusetts for a number of years, with white sharks revisiting the same general areas of residency over a multi-year period. It is possible that white sharks may aggregate in these waters due to the presence of pinniped colonies at the same time. This overlap is likely a critical time for energy acquisition, with enhanced feeding opportunities playing a key role in the balance of annual energy budgets Franks et al. (2021). Therefore, individual white sharks may establish specific areas off Massachusetts to revisit each year and minimize intraspecific, competitive interactions.

NOAA Fisheries previously considered whether a HAPC encompassing feeding grounds off Cape Cod for white sharks was warranted in Amendment 10. NOAA Fisheries previously considered whether the uniqueness of the feeding site might warrant HAPC designation if it supports an important ecological function for white sharks; however, the presence of gray seals and white sharks was noted to be seasonal. The migratory nature and abundance of gray seal colonies may also fluctuate annually, which would alter the area's significance as a feeding ground for white sharks from one year to the next. Finally, we noted that Cape Cod was already a designated National Seashore, and pinnipeds were protected from human interaction (take) under the Marine Mammal Protection Act; therefore, NOAA Fisheries found that the additional designation of HAPC under the Magnuson-Stevens Act was not necessary in Amendment 10. Based on the review of recent literature and policy directives, these previous conclusions still stand. However, NOAA Fisheries encourages the public to submit new information or information not previously considered regarding potential aggregation sites off Cape Cod and in New England as EFH. NOAA Fisheries also encourages the public to submit comments that could inform a review of previous decisions concerning a white shark HAPC off Cape Cod.

Indian River Lagoon – Nursery Habitat for Bull Sharks

New information identified in the literature search for this 5-year review concerning bull shark nursery areas should be considered in conjunction with literature found for the previous 5-year review and Amendment 10. As noted in Curtis et al. (2011) and others, the Indian River Lagoon is a shallow estuarine barrier island system that spans portions of the central Atlantic coast of Florida. Curtis et al. (2011) divided the Indian River Lagoon into multiple areas that could be referenced across the body of literature, including Mosquito Lagoon, the Northern Indian River and Banana River Lagoons, the Melbourne-Sebastian area, and the Southern Indian River Lagoon. The body of literature analyzed for the previous 5-year review noted that northern regions of the Indian River were commonly used by immature bull sharks, function as an important nursery area, and meet the criteria for a shark nursery area per Heupel et al. (2007) (Curtis et al. 2011). At the time of publication, immature bull sharks were considered uncommon in other Atlantic estuaries and coastal regions (Castro 1993; McCandless et al. 2007). The Indian River Lagoon was therefore deemed the most significant Atlantic nursery habitat for bull sharks (Curtis et al. 2011). Curtis et al. (2011) noted that sharks were frequently found in altered habitats; therefore a follow-up paper analyzed the use of altered habitats in northern portions of the Indian River Lagoon (Curtis et al. 2013). Tagged sharks exhibited high levels of area reuse and small activity spaces. Short term movements were tied to habitats that had either been altered or degraded by human activity, and a little over half of the tracking positions were in “altered habitats.” Furthermore, reliance and fidelity of bull sharks to Indian River Lagoon habitats prolonged exposure to degraded habitat conditions and bioaccumulation of contaminants.

Scientific research on bull sharks in the Indian River Lagoon that was found for this 5-year review analyzed distribution, habitat use, and the importance of the southern Indian River lagoon as a nursery area. Roskar et al. (2020) conducted a fishery-independent survey with longline and gillnet gear to characterize the elasmobranch community and understand distribution patterns and habitat in southern portions. This study provided the first in-depth analysis of the elasmobranch community in the southern Indian River Lagoon. Bull sharks (specifically, YOY and juvenile life stages) were the most abundant species caught during the study year round. Furthermore, the Vero Beach and St. Lucie River regions of the southern Indian River Lagoon were hypothesized to serve as nurseries for bull sharks based on criteria established by Heupel et al. (2007). However, Roskar et al. (2020) noted a need for supplemental movement and habitat use data collection to understand how bull sharks use this region. Edwards et al. (2022) expanded on this research, using acoustic telemetry to confirm that the southern Indian River Lagoon was a nursery habitat per the Heupel et al. (2007) criteria. Year-round habitat use was observed, along with ontogenetic changes in activity space and use of coastal habitats.

Bull sharks are currently managed as a single stock across the Gulf of Mexico and Atlantic regions. While the significance of the Indian River Lagoon has been commented upon in these and other scientific papers, numerous bull shark nursery areas have also been identified in the Gulf of Mexico (Simpfendorfer et al. 2005; Blackburn et al. 2007; Heuter and Tyminski 2007; Froeschke et al. 2010). Furthermore, bull sharks are ubiquitously distributed and neonate/YOY nursery habitats have been noted in the literature in other areas of the Atlantic, e.g., North Carolina, and Georgia (Gausmann et al. 2021). Therefore, while this area is undoubtedly important for bull sharks, the current body of scientific literature suggests the Indian River Lagoon does not meet the HAPC criteria of "rarity" as a nursery habitat. Should future stock assessments identify a more complicated population structure for bull sharks (e.g., separate Atlantic and Gulf of Mexico stocks), both the rarity of the habitat and the importance of the Indian River Lagoon nursery to a sub-population could be analyzed (HAPC criteria #1 and #4).

In all of the papers analyzed, the authors commented extensively on the degraded condition of the Indian River Lagoon, and collectively cited exposure of young bull sharks to degraded habitat, heavy use of the Indian River Lagoon in transportation, coastal development, contamination, pollutants, cultural eutrophication, and harmful algae blooms. Therefore the body of literature analyzed herein could be considered to meet the HAPC criteria related to the extent the habitat is sensitive to human-induced degradation and the extent (and whether) development activities are or will be stressing the habitat type (HAPC criteria #2 and #3).

At this time, we do not believe that the current body of scientific knowledge supports further consideration of the Indian River Lagoon as a HAPC without additional information on the population structure of bull sharks. A research track stock assessment, which will be conducted under the SEDAR process, is scheduled for this species beginning in 2024. We recommend reconsideration of the Indian River Lagoon as a HAPC after the stock assessment process (research track plus operational assessment) has been completed. However, NOAA Fisheries encourages the public to submit new information or information not previously considered regarding the Indian River Lagoon (specifically the Vero Beach and St. Lucie River regions) as EFH and potentially as a HAPC for neonate/YOY bull shark. NOAA Fisheries also encourages the public to submit comments, scientific information, and data that could inform a recommendation on whether the Indian River Lagoon should be considered a HAPC based on the HAPC criteria identified at § 600.815(a)(8).

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15. Research and Information Needs

Amendments 1 and 10 outlined a number of research and information needs to improve HMS EFH designation. These amendments noted that, in many cases, movements of HMS are still not well understood or have only been defined in broad terms. Furthermore, although the habitats through which HMS transit may be well studied, and the physical and biological processes fairly well understood in broad terms, there is little understanding of the particular characteristics that influence the distribution of tunas, swordfish, sharks, and billfish within those systems. Unlike many estuarine or coral reef species that can be easily observed, collected or cultured, the extensive mobility and elusiveness of HMS, combined with the rarity of some species, has delayed the generation of much of the basic biological and ecological information needed to analyze their habitat affinities.

While this section mainly focuses on a recent document detailing HMS Management-Based Research Needs and Priorities developed by the HMS Management Division, additional information on research needs of HMS can and should be cross referenced from other documents or ongoing management or research initiatives. NOAA Fisheries encourages those interested in EFH research to continue to monitor these projects or programs for future guidance on research needs and priorities. NOAA Fisheries will incorporate relevant information into the Final EFH 5-Year Review and upcoming action, if warranted:

- Stock assessments identifying research needs (e.g., SEDAR shark assessments and ICCAT shark, swordfish, billfish, and tuna assessments).[46]
- Climate Science Strategy Regional Action Plans.[47]
- Deepwater Horizon Strategic Plans and future Restoration Plans (e.g., the Fish and Water Column Invertebrate Strategic Plan).[48]
- HMS CVA (scheduled for 2023-2024; see this HMS Advisory Panel presentation for more information).[49]
- Regional Climate Vulnerability Assessments.[50]
- Regional Integrated Ecosystem Status Reports.[51]
- HMS Ecosystem-Based Fishery Road Map Implementation Plan.[52]
- Programmatic Environmental Impact Statements, EFH consultations, and other relevant documents.

[46] https://sedarweb.org/ and https://www.iccat.int/en/assess.html
[47] https://www.fisheries.noaa.gov/national/climate/climate-science-strategy-regional-action-plans
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[51] https://www.integratedecosystemassessment.noaa.gov/ecosystem-status-reports
[52] https://media.fisheries.noaa.gov/dam-migration/final_hms_ebfm_implementation_plan_041519.pdf

- NOAA Technical Memoranda, NOAA Fisheries Policies and Procedures, and other documents conveying policy and procedural advice or scientific information.[53]
- Other relevant strategic planning, resource prioritization, rulemaking, policy or procedure documents, agency-wide prioritization (NOAA or DOC), or congressional action.[54]

15.1. Highly Migratory Species Management-Based Research Needs and Priorities

Since publication of Amendment 10, NOAA Fisheries has published an updated version of the "Atlantic HMS Management-Based Research Needs and Priorities" document.[55] The document contains a list of near- and long-term research needs and priorities that can be used by individuals and groups interested in HMS to identify key research needs, improve management, reduce duplication, prioritize limited funding, and form a potential basis for future funding. "Near-term" priorities are generally those that are needed to address a more pressing management need. "Long-term" priorities would provide for more effective HMS management, despite lacking an immediate need.

The following list includes some, but not all, stated research priorities that are considered relevant to EFH.

15.1.1. Priorities for All Highly Migratory Species Essential Fish Habitat

Near-Term Priorities

- Assess the ecological and socioeconomic impacts of HMS spatial management and closed areas.

Long-Term Priorities

- Enhance routine biological sampling of HMS for studies of age, growth, maturity, longevity, population genetics, stock composition, and total reproductive contribution by size and age.
- Expand the use of species distribution and habitat modeling to address spatial management priorities, and examine the feasibility of dynamic area management based on oceanographic conditions (hindcasts as well as short- and long-term forecasts).
- Continue conventional and electronic tagging studies across HMS stocks, regions, and life stages with an emphasis on filling gaps on movements, seasonal migration and residency patterns, habitat use, stock identification and mixing rates, fisheries exposure, bycatch susceptibility, age validation, and survival rates.

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[53] https://repository.library.noaa.gov/view/noaa/49151
[54] As part of the FY2019 Appropriations Bill for NOAA, Congress directed Sea Grant to spend up to $2 million to initiate an HMS research initiative focused on HMS in the Gulf of Mexico and Atlantic Ocean. The first version (2014) of the Atlantic HMS Management-Based Research Needs and Priorities document was used by Sea Grant, along with phrasing in the appropriations bill, to establish research priorities for this funding opportunity.
[55] https://www.fisheries.noaa.gov/resource/document/atlantic-highly-migratory-species-management-based-research-needs-and-priorities

- Advance the implementation of Ecosystem Based Fishery Management (EBFM) and consideration of integrated ecosystem assessments for HMS, in line with the 2018 Stock Assessment Improvement Plan update and HMS EBFM Implementation Plan, with an emphasis on forage fish distribution and abundance and improved diet studies on HMS.
- Collect data that would allow for all HMS EFH boundary designations to be based on more than presence/absence data (e.g., electronic tagging data, including spatial, depth and thermal habitat use; catch density correlated with remote sensing data; habitat models).
- Examine the influence of climate change and variability in oceanographic conditions on stock productivity, range, seasonal distribution, migration, spawning or nursery habitat, prey species, and availability to fisheries for HMS.
- Assess long-term socioeconomic and ecological impacts of the Deepwater Horizon oil spill, including beyond the Gulf of Mexico.
- Evaluate the impacts of offshore energy development activities (including construction and post-installation monitoring) on HMS and associated fisheries.

15.1.2. Priorities for Bluefin Tuna Essential Fish Habitat

Near-Term Priorities

- Evaluate impacts of oceanographic and climate dynamics on stock mixing, migration, availability to fisheries, trophic dynamics, productivity, and stock recruitment.
- Investigate potential Slope Sea spawning questions, such as stock of origin of these fish, temporal and spatial stationarity of spawning in this region, and associated population-level implications.

Long-Term Priorities

- Enhance information on larval distribution to support stock assessments.
- Determine predator/prey relationships and forage availability.

15.1.3. Priorities for BAYS Tunas Essential Fish Habitat

Long-Term Priorities

- Determine larval distribution and dynamics.

15.1.4. Priorities for Billfish Essential Fish Habitat

Long-Term Priorities

- Determine larval distribution and dynamics.
- Determine spawning areas and spawning seasonality, seasonal migration and localized abundance, distribution, and stock structure.

15.1.5. Priorities for Swordfish Essential Fish Habitat

Long-Term Priorities

- Identify spawning areas.
- Determine larval distribution and dynamics.

15.1.6. Priorities for Shark Essential Fish Habitat

Near-Term Priorities

- Develop a comparison and standardization of regional shark surveys, and ensure surveys effectively sample the geographic range of stocks.

Long-Term Priorities

- Identify and characterize use of key habitats (e.g., nursery areas, pupping grounds, mating grounds, feeding aggregation sites) to improve spatial management.
- Determine if species life history characteristics (growth, maturity, fecundity, reproductive periodicity, etc.) have changed over time.

15.2. Essential Fish Habitat 5-Year Review Research Priorities

Research recommendations are sometimes provided in scientific literature by authors. Table 15.1 summarizes some of the research recommendations identified by authors of scientific literature reviewed in this 5-year review. It is not necessarily an exhaustive list of all recommendations from the papers identified in this 5-year review. This list can be used in tandem with the research needs identified in Section 15.1 to characterize potential information gaps and research needs for HMS EFH.

Table 15.1. Research and information needs identified by authors of scientific papers reviewed for this document.

Topic	Citation	Research/Information Need
BAYS tunas	Erauskin-Extramiana et al. (2019); Lucena-Frédou et al. (2021); Nikolic et al. (2016); Lang et al. (2017)	Predicting species behavior in response to climate change; stock structure and extent, ICCAT research needs; albacore spatial dynamics, stock extent, and reproductive biology.
Bluefin tuna	Hazen et al. (2016); Rodríguez-Ezpeleta et al. (2019)	Effects of Deepwater Horizon oil spill on bluefin tuna, feasibility of dynamic closures for bluefin; stock spatial dynamics.
Swordfish	Abascal et al. (2015); Goodyear and Forrestal (2017); Lynch et al. (2018); Camrin D Braun et al. (2019); Forrestal and Schirripa	Stock structure and spatial dynamics; more tagging data to validate environmental associations and allow for more robust analyses; evaluate habitat-specific catch rates; use of habitat association information in identifying areas of high target catch with low bycatch; predicting species behavior in response to climate change.

Topic	Citation	Research/Information Need
	(2020); Erauskin-Extramiana et al. (2020)	
Billfish	Lynch et al. (2018); Dale et al. (2022); Orbesen et al. (2017); Musyl and Gilman (2019)	Evaluate habitat-specific catch rates; additional tagging of blue marlin, incorporating predator-prey dynamics and vertical habitat metrics into habitat suitability modeling; day and night vulnerability to longline fishing; consistency in research design.
Large Coastal Sharks	Martin et al. (2019); SEDAR (2020); SEDAR (2017); SEDAR (2022); Ajemian et al. (2016); Barker et al. (2017); Guttridge et al. (2017); Pickens et al. (2022); Ajemian et al. (2020); Holland et al. (2019)	Association with fishing piers and foraging ecology; Research needs identified in SEDAR stock assessments; importance of coastal Texas habitats as shark nursery grounds; great hammerhead nursery grounds in the South Atlantic; great hammerhead site fidelity to parturition sites and presence north of Florida; effect of coastal wetlands and their productivity on sharks; role of shelf-edge habitats in reproductive life history of tiger sharks (i.e., Flower Garden Banks National Marine Sanctuary); identification of pupping grounds, sexual and ontogenetic segregation, behavioral tagging studies, and the impacts of climate change.
Small Coastal Sharks	Ajemian et al. (2016); Bangley (2016); Drymon et al. (2020); Dawdy et al. (2022)	Importance of coastal Texas (and Gulf of Mexico) habitats as shark nursery grounds; use of coastal and inshore North Carolina habitats; long-term monitoring to quantify sex-based differences in habitat use; define fine-scale movement behaviors in ecologically significant areas.
Prohibited sharks	Zea-de la Cruz et al. (2021); Haulsee et al. (2020); Driggers Iii et al. (2018); Braun et al. (2018); Swift and Portnoy (2020); Hoffmayer et al. (2021); Tyminski et al. (2015); Curtis et al. (2018); Franks et al. (2021)	Identify the temporality and distribution of angel shark aggregations; ongoing monitoring of HMS in wind lease areas; stock structure of angel sharks; drivers of basking shark migration; range expansion of smalltail shark; importance of Ewing Bank habitats to whale sharks; purpose of deep diving behavior for whale sharks; white shark feeding, nursery, and mating grounds..
Smoothhound sharks	Bangley et al. (2018)	Inclusion of eastern Pamlico Sound as EFH for smooth dogfish, role of seagrass habitats, distribution of prey species across seagrass habitats.
All HMS	Hogan et al. 2023	Evaluate and monitor the impacts of offshore wind facility construction and production on HMS fisheries, on the ecology and behavior of HMS, on trophic interactions, on the larger biological community, oceanographic conditions, EMF emmisisions, and potentially adverse effects on HMS EFH.

We have also noted specific research needs based on the results of this 5-year review. This should not be considered an exhaustive list of research recommendations. NOAA Fisheries encourages the collection and analysis of scientific information on any data or information poor species:

- Additional research is needed on the effects of fishing gear (both HMS and non-HMS) on EFH (both HMS and Council-managed species). For example, research on the extent, if any, that deep-set pelagic longline gear adversely affects EFH compared to previous determinations that pelagic longline gear does not affect EFH.

- Additional research is needed on the effects of all previously analyzed non-fishing activities on EFH (especially wind energy (all activity stages), oil and gas exploration/seismic surveys, ocean noise, aquaculture, marine sand and minerals mining, dredging, and climate change).
- Additional research that evaluates whether existing HAPCs for sandbar sharks, lemon sharks, sand tigers, and bluefin tuna need to be modified or removed.
- Additional research to refine or better describe EFH and determine whether the following areas should be considered as HAPCs in the future. Such research should refer back to the HAPC criteria identified at § 600.815(a)(8). If HAPCs are being considered for young life stages, NOAA Fisheries encourages reference to the definition of nursery habitat outlined in Heupel et al. 2007 and 2019 in addition to the HAPC criteria.

15.3. Conclusions and Recommendations

Since the publication of Amendment 10, NOAA Fisheries has undertaken numerous new projects, programs and initiatives, strategic planning or resource prioritization exercises, and published other documents that highlight research and information needs. Additionally, the review of recent scientific literature has identified several information gaps. We recommend that the research and information needs pertaining to HMS EFH be updated to reflect this new information.

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16. Essential Fish Habitat Delineation

The purpose of this chapter is to evaluate whether the current method of delineating EFH is still the most appropriate. In order to evaluate the most appropriate methodology, this chapter: 1) reviews all previous methodologies considered in delineating EFH; 2) discusses the most recent approach to delineate HMS EFH as a "status quo" method; 3) provides a review of other approaches that have been used to evaluate EFH in the scientific literature and by other entities (i.e., Regional Fishery Management Councils); 4) reviews recent public comment that NOAA Fisheries has received concerning EFH delineation methodology; and 5) provides an analysis of options and a recommendation on appropriate methodologies for use in future HMS EFH reviews.

16.1. Review of Approaches Previously Considered

Most recently, we used a kernel density estimation approach to delineate EFH boundaries. This methodology was first explored in Amendment 1 to the HMS FMP (2009). New EFH boundaries were created based on the 95 percent probability boundary estimated with a Percent Volume Contour/Kernel Density Estimator (PVC KDE) tool using ESRI ArcGIS and Hawth's Analysis Tools. The PVC KDE used all the data points and the distance between points to calculate an area of probability across the entire U.S. EEZ. The 95-percent area of probability would therefore on average contain 95 percent of the points that were used to generate the kernel density estimate. This process also included the use of an isopleth tool that generated a polyline representing the 95-percent volume contour that represented the probability boundary.

We selected this approach as the preferred alternative in Amendment 1 because it was based on empirical data, provided a standardized and transparent method for delineating EFH, was reproducible, and the 95 percent probability boundaries were easily calculated in ArcGIS using Hawth's Analysis Tools. This approach was also noted to be appropriate for the type of information that was readily available for use in EFH analyses. We used the same methodology to designate EFH for smoothhound in Amendment 3 to the HMS FMP and for roundscale spearfish in 2010 (75 FR 57698, September 22, 2010).

Methodology established in Amendment 1 continued to be employed to update all HMS EFH designations as part of Amendment 10. However, new software was used to calculate the PVC KDE. Hawth's Analysis Tools was updated through ArcGIS version 9.3 (roughly, through early 2010). Afterwards, the Hawth's Analysis Tools programmers transitioned to a new software program called "Geospatial Modeling Environment" (GME), which integrated with ArcGIS and was compatible with later versions of ArcGIS.

At the time Amendment 10 was published, we used ArcGIS versions 10.2 and 10.3, which are incompatible with Hawth's Analysis tools. Because Hawth's Analysis Tools were no longer available, the GME software was used to delineate EFH.

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16.2. Current Methodology to Delineate Highly Migratory Species Essential Fish Habitat

For the analyses used to generate the maps in Amendment 10, new data collected since Amendment 1 to the 2006 Consolidated HMS FMP, as well as previously existing data used to identify previous EFH boundaries, were analyzed using the GIS software GME. Geospatial analyses then consisted of a two-step process whereby we generated kernel density estimates for point data, and then derived probability boundaries depicting the locations containing 95 percent of the data points.

In the first step, point data were imported into a KDE modeling tool in GME to establish density surface as the basis for establishing new EFH boundaries. The KDE tool creates a raster (gridded surface) as output which estimates the density of point data across a surface (i.e., each grid cell is assigned a density value). The second step in the geospatial analysis was to input the raster files into the GME Isopleth tool, which calculated probability boundaries. The probability boundary represents the boundary of the area that contains a certain percent of the volume of a probability density distribution. The 95-percent volume contour would therefore, on average, contain 95 percent of the points that were used to generate the 95-percent probability boundary. This methodology is commonly used in the scientific literature to delineate EFH, habitat utilization, and home range.

The GME software is no longer being developed or maintained and is not available for distribution. Additionally, NOAA Fisheries is transitioning toward Esri products that are incompatible with GME (i.e., ArcPro as opposed to desktop software). In the event that we determine EFH must be redrawn for any HMS, and we determine that the status quo methodology is appropriate for continued use, we would need to use other tools to delineate the 95-percent probability contours for EFH. Due to the need for a consistent HMS EFH delineation methodology less dependent on third-party extensions to ArcGIS software, we are considering other options that may provide a more flexible modeling framework and be compatible with a wide variety of GIS software.

16.3. Current Methodology for Species' Habitat Preference

The 95-percent volume contour process identified above provides EFH shapefiles reflecting the maximum geographic extent of areas that are identified as HMS EFH. However, as noted in NMFS Procedure 03-201-15, there is a need to refine the identification of EFH so that it is not considered overly expansive.[56] For some data poor species such as HMS, the patchy nature of available information and the modeling techniques used could delineate an extremely large

[56] https://media.fisheries.noaa.gov/dam-migration/03-201-15.pdf

area as EFH. Text descriptions provide additional clarity and refinement on which habitat types or characteristics are deemed essential for species and lifestage.

Text descriptions of HMS habitat preferences and EFH have historically been evaluated and updated qualitatively through literature review and scientific consultations. Where possible, specific habitat associations validated from multiple years' research or identified in the literature are referenced. For example, the NOAA Cooperative Gulf of Mexico Shark Pupping and Nursery Project (GULFSPAN) survey is conducted annually to sample shark nursery habitat in the Gulf of Mexico. Annual reports provide a repeated analysis of habitat associates and preferences in specific locations. These associations are included in text descriptions as defined shark EFH for specific locations where it is appropriate to include them. However, for some species there is an inconsistent amount of information on habitat preference in the literature and available through expert consultation across HMS. What is available is often not specific enough, spatially or temporally, to formulate actions to encourage conservation and enahancements that would be used in habitat consultations to mitigate fishing and non-fishing effects to EFH. In addition, it may be difficult to select species associations when multiple studies measure habitat variables in different areas or using different techniques, and arrive at different conclusions. There is no effective way to measure the validity of one paper's conclusions against another without redoing all analyses in a consistent manner.

NOAA Fisheries encourages comment from the public on effective EFH refinement strategies, and provides a recommended approach below.

16.4. Other Methodologies Used to Delineate Essential Fish Habitat

Many alternative methodologies were considered in the previous HMS EFH actions. Most recently, a detailed comparison of other methods can be found in Chapter 16 of the Final 5-Year Review that analyzed new information used in Amendment 10 to the HMS FMP.[57] Additional methods that could be considered for use in delineating EFH are discussed in this section. If a different methodology is selected, NOAA Fisheries would have to redraw EFH boundaries for all HMS.

Methods explored, but not previously considered in previous HMS EFH actions generally fall into the category of spatially explicit statistical models which attempt to explain variation in species presence/absence or abundance as a function of environmental drivers. These methods provide excellent insight into species distributions, habitat associations, and offer predictive capabilities that would allow NOAA Fisheries to extrapolate EFH bounds beyond where data are collected.

However, the drawbacks that have prevented NOAA Fisheries from employing these types of models in HMS EFH delineation persist. These models generally require high-resolution catch per unit effort or density data, or concurrent ecological data, which is not, in all cases, available for HMS. Additionally, distribution information and habitat parameters were often not collected in a consistent and statistically robust manner, and/or were not comparable across

[57] https://media.fisheries.noaa.gov/dam-migration/hms_efh_5_year_review_final.pdf

datasets. NOAA Fisheries has not identified a more appropriate mechanism to evaluate HMS EFH, or has located information that would suggest the conclusions previously drawn about these methodologies has changed.

NOAA Fisheries encourages comments on additional methodologies to delineate HMS EFH.

16.5. Public Comment on Essential Fish Habitat Methodology

NOAA Fisheries has solicited public comments on HMS EFH, including comments regarding the approach NOAA Fisheries should use to delineate EFH. NOAA Fisheries published a notice that announced the intention to initiate an EFH 5-year review (87 FR 19667, April 5, 2022) and that solicited comments and information from the public regarding HMS EFH. NOAA Fisheries did not receive any comments that specifically addressed EFH delineation techniques. One comment did address additional considerations that should be included in defining EFH, but did not recommend a specific delineation approach.

Comments received during the development of Amendment 1 to the 2006 Consolidated HMS FMP that addressed EFH designations can be found in Appendix 1 of the Amendment 1 Final Environmental Impact Statement (FEIS). Comments that addressed EFH delineation approaches focused on how, under the current approach, data-poor species may result in smaller, discontinuous areas of EFH when compared to data-rich species and if statistical analyses were done to determine whether there were sufficient points or adequate sample size to determine EFH based on presence/absence data. These comments were addressed by NOAA Fisheries in the Amendment 1 FEIS, but should still be considered when determining if the current EFH delineation approach is still appropriate.

Comments were also solicited during the development of Amendment 10. One comment focused on how methods used in Amendment 10 may bias results when sampling intensity is imbalanced across species or life stages, noting that EFH becomes a function of data availability instead of animal behavior. NOAA Fisheries acknowledged that data for HMS are often clustered based on the extent of sampling, and that alternative approaches that mitigate bias in EFH delineations will be considered in the future. Another commenter recommended designating EFH by depth where appropriate if there is scientific information that supports such as designation. NOAA Fisheries agrees, and includes reference to depth where possible based on the best scientific information available.

16.6. Recommendation on Essential Fish Habitat Delineation Methods

After review of the previously used methodologies, alternatives methodologies in the literature, methodologies employed by Councils to identify and delineate EFH, and public comments on EFH methodologies, NOAA Fisheries has concluded that simple changes to methodologies used to delineate EFH for HMS could be implemented to reduce bias resulting from the combination of multiple, discrete datasets into one composite data structure that would be used to delineate EFH. While the general methodology does not change (i.e., NOAA Fisheries could continue to use the KDE PVC approach), weights could be assigned to point location data to better account for differences in sampling intensity across the geographic range of all datasets.

For example, for each species and life stage, data sources identified and collected through the literature review and public comment would be combined. Inevitably, many of these composite datasets will contain imbalances in number of individual observations, survey effort, or sampling time period and intensity. Some of the individual datasets making up the composite will originate in discrete spatial locations (e.g., an embayment or specific state waters) while others may span the entire U.S. EEZ. By applying weights to the points prior to performing the calculation of the KDE PVC, more relevance is provided to the dataset with fewer observations. NOAA Fisheries acknowledges that this method does not entirely eliminate bias attributed to sampling intensity (e.g., places with no sampling are still underrepresented); however, it does reduce the likelihood of any one survey or dataset to wash out other datasets in the maps being created.

To implement this method, NOAA Fisheries recommends using a different software than has been used in the past as tools used previously (i.e., Hawth's Tools and GME) are no longer available. NOAA Fisheries reviewed several options looking for a tool that met some basic criteria:

- Readily available software;
- Incorporate weights into KDE PVC calculations; and
- Easily specify input and output parameters (cell size, kernel, bandwidth, etc.).

As pointed out previously, GME has been discontinued, and that has precluded the use of that software to implement the recommended methods to delineate EFH. Esri products are able to generate weighted KDE surfaces, but there is no built in tool to calculate the PVC which leads to EFH shapefiles. There are several implementations for spatial statistics in various R packages, but many failed to meet all the criteria listed above. One R package, spatialEco (Evans and Murphy (2021)) includes all of the above functionality and allows end to end data processing within a single software framework.

Where applicable, other modeling parameters used to delineate EFH previously will be carried over to largely replicate the KDE/PVC method used previously, but with the inclusion of weights. A detailed description of the process used to generate EFH maps is available in Appendix F of Amendment 10.[58]

NOAA Fisheries requests comments on how to best incorporate weights, or other alternatives to better reduce bias in EFH delineation, such as down sampling more numerous data.

16.7. Recommendation on Species' Habitat Preference

The methods proposed below constitute recommendations to refine EFH text descriptions for species that have insufficient information across part or all of their range to provide detailed text descriptions for specific habitats. NOAA Fisheries would retain sufficiently detailed EFH

[58] https://media.fisheries.noaa.gov/dam-migration/final_a10_ea_signed_fonsi_092017.pdf

text description for certain areas and species (e.g., large and small coastal sharks that have habitat associations identified through shark nursery area surveys coordinated by NOAA Fisheries). These methods are expected to be helpful in refining EFH in pelagic habitats that might otherwise be coarsely discussed in text descriptions.

One way to determine species' habitat preference is to use oceanographic products that provide modeled ocean conditions based on satellite and observed data. These products provide estimates of ocean conditions at a daily temporal resolution and a spatial resolution ranging from 1/60 to 1/12°. These ocean conditions can be assigned to each data point using the position and date of the data point.

This method assigns ocean conditions to each data point regardless of whether in situ measurements were made when the data point was collected. In addition, this method provides an opportunity to understand a species preference for environmental variables that are important for HMS and not measured in the field when a data point is collected, such as chlorophyll-a and sea surface height.

Environmental data can be extracted from multiple publicly available ocean products. Two static environmental variables are considered to influence HMS distribution, bathymetry and rugosity. Bathymetry data would be downloaded from ETOPO1 at a 1/60° resolution.[59] Rugosity, which represents the measure of variations in amplitude of the ocean bottom, would be calculated as the standard deviation of bathymetry over a 0.25º square. The remaining variables are dynamic variables, meaning the data change over some temporal period. Most dynamic environmental covariates would be extracted as daily fields from HYCOM + NCODA Global 1/12 Analysis at a 1/12º resolution (Ferris 2019). Environmental variables extracted from HYCOM would be sea surface temperature, sea surface salinity, sea surface height, bottom temperature, and bottom salinity. Mixed layer depth or the depth where surface water becomes more stratified is often where prey congregate and in turn where HMS inhabit. Mixed layer depth would be extracted as daily fields from a Copernicus Marine Environmental Monitoring Service (CMEMS) Global Ocean Physics Reanalysis product at a 1/12º resolution. Turbidity or the clarity of the water, in the units of Secchi disk depth (m) would be extracted from a CMEMS product at a 4 km resolution. Lastly chlorophyll-a would be extracted from the ERDDAP ESA CCI Ocean Colour Product at a spatial resolution of 0.04º and at an eight-day mean instead of daily to reduce contamination by cloud cover/weather conditions. Each environmental variable will be matched to each data point for each species based on the latitude, longitude, and date of the data point regardless of data type (e.g., survey, fishery, telemetry).

After all data points are assigned environmental conditions, a series of habitat metrics will be calculated for each species and each environmental variable. These habitat metrics include mean, median, standard deviation, and interquartile range. There will also be opportunities to calculate these habitat metrics on a seasonal basis instead of annual due to the difference in seasonal habitat use for many HMS.

[59] https://www.ncei.noaa.gov/products/etopo-global-relief-model

NOAA Fisheries requests comments on how to best determine habitat preferences as well as what habitat metrics may be the most useful in describing a species' habitat.

16.8. Literature Cited

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17. Conclusions

17.1. Summary of 5-Year Review Recommendations

The Draft HMS EFH 5-Year Review has been completed and is documented in this summary report. At this stage, NOAA Fisheries' primary decision point is to determine, based on the new information available in the last five years and on public comment on the draft, whether changes to the HMS EFH designations are warranted. Any such changes may require initiation of an FMP amendment and associated analysis.

The recommendations contained within the review are summarized in Table 17.1. During the review process, NOAA Fisheries considered the following questions:

- Do the EFH descriptions and geographical distributions for individual species warrant revision? Should the FMP be revised to reflect new information on their life history, biological/habitat/predator-prey associations, or fishery?
- Is a new evaluation of the adverse effects of fishing on EFH needed?
- Should any new conservation measures be considered to mitigate adverse effects of fishing?
- Should the actions that promote conservation and enhancement of HMS EFH adversely affected by non-fishing activities be revised?
- Is there a need to identify new HAPCs?
- Does NOAA Fisheries want to identify new directions for EFH research for the next 5 years?

We summarize the potential for change to a species' EFH:

- **Not Likely** – little to no new information is available, or the information that is available does not appear to warrant updates to the life history review, EFH text description, EFH boundaries, HAPCs or other aspects of EFH.
- **Likely** – some new scientific papers, technical information or new datasets are available and could, with further consideration, warrant updates to the life history review, EFH text description, EFH boundaries, HAPCs or other aspects of EFH.

- **Highly Likely** –several new scientific papers, technical information or new datasets containing relevant point data are available and warrants updates to the life history review, EFH text description, EFH boundaries, HAPCs or other aspects of EFH.

Table 17.1. Preliminary species-specific recommendations for the HMS EFH 5-Year Review.

Species	**Potential For Change Based On Literature Reviews**
Tunas	
Atlantic Bigeye Tuna, *Thunnus obesus*	**Likely**
Atlantic Skipjack Tuna, *Katsuwonus pelamis*	Not Likely
Atlantic Albacore Tuna, *Thunnus alalunga*	Not Likely
Atlantic Yellowfin Tuna, *Thunnus albacares*	**Highly Likely**
Atlantic Bluefin Tuna, *Thunnus thynnus*	**Likely**
Swordfish	
Atlantic Swordfish, *Xiphias gladius*	**Likely**
Billfishes	
Atlantic Blue Marlin, *Makaira nigricans*	**Likely**
Atlantic White Marlin, *Kajikia albidus*	**Likely**
Roundscale Spearfish, *Tetrapturus georgii*	**Likely**
Longbill Spearfish, *Tetrapturus pfluegeri*	Not Likely
Sailfish, *Istiophorus platypterus*	**Likely**
Large Coastal Sharks	
Atlantic and Gulf of Mexico blacktip, *Carcharhinus limbatus*	**Highly Likely**
Bull, *Carcharhinus leucas*	**Highly Likely**
Great hammerhead, *Sphyrna mokarran*	**Highly Likely**
Lemon, *Negaprion brevirostris*	**Highly Likely**
Nurse, *Ginglymostoma cirratum*	**Highly Likely**
Sandbar, *Carcharhinus plumbeus*	**Highly Likely**
Scalloped hammerhead, *Sphyrna lewini**	**Highly Likely**
Silky, *Carcharhinus falciformis*	**Likely**
Smooth hammerhead, *Sphyrna zygaena*	**Highly Likely**
Spinner, *Carcharhinus brevipinna*	**Highly Likely**
Tiger, *Galeocerdo cuvier*	**Highly Likely**
Small Coastal Sharks	
Atlantic sharpnose, *Rhizoprionodon terraenovae*	**Highly Likely**
Atlantic and Gulf of Mexico blacknose, *Carcharhinus acronotus*	**Highly Likely**
Bonnethead, *Sphyrna tiburo*	**Highly Likely**
Finetoth, *Carcharhinus isodon*	**Highly Likely**
Pelagic Sharks	
Blue, *Prionace glauca*	**Highly Likely**
Oceanic whitetip, *Carcharhinus longimanus*	**Highly Likely**
Porbeagle, *Lamna nasus*	**Highly Likely**
Shortfin mako, *Isurus oxyrinchus*	**Highly Likely**
Thresher, *Alopias vulpinus*	**Likely**
Prohibited Sharks	
Atlantic angel, *Squatina dumeril*	**Highly Likely**

Species	**Potential For Change Based On Literature Reviews**
Basking, *Cetorhinus maximus*	**Likely**
Bigeye sand tiger, *Odontaspis noronhai*	Not Likely
Bigeye sixgill, *Hexanchus nakamurai*	**Likely**
Bigeye thresher, *Alopias superciliosus*	**Highly Likely**
Bignose, *Carcharhinus altimus*	Not Likely
Caribbean reef, *Carcharhinus perezi*	Not Likely
Caribbean sharpnose, *Rhizoprionodon porosus*	Not Likely
Dusky, *Carcharhinus obscurus*	**Likely**
Galapagos, *Carcharhinus galapagensis*	Not Likely
Longfin mako, *Isurus paucus*	**Likely**
Narrowtooth, *Carcharhinus brachyurus*	Not Likely
Night, *Carcharhinus signatus*	Not Likely
Sand tiger, *Carcharias taurus*	**Likely**
Sevengill, *Heptranchias perlo*	Not Likely
Sixgill, *Hexanchus griseus*	Not Likely
Smalltail, *Carcharhinus porosus*	Not Likely
Whale, *Rhincodon typus*	**Likely**
White, *Carcharodon carcharias*	**Highly Likely**
Smoothhound Sharks	
Smooth dogfish, *Mustelus canis*	**Highly Likely**
Florida smoothhound, *Mustelus norrisi*	**Likely**
Gulf of Mexico smoothhound, *Mustelus sinusmexicanus*	**Likely**

*Should NOAA Fisheries determine that it is appropriate to add Carolina hammerhead to the HMS FMP as a separate managed species, per the outcomes of the SEDAR 77 stock assessment, then the potential for change for Carolina hammerhead and its cryptic conspecific (scalloped hammerhead) should be considered "Likely."

Table 17.2. Preliminary recommendations on other EFH components based on the draft HMS EFH 5-Year Review.

#	EFH Component Description	Species	Recommendation for Change
2, 3	Fishing activities that may adversely affect EFH	All HMS	No substantial changes in fishing effects were found for this review. Therefore, the conservation measures outlined in Amendment 1, Amendment 3, the interpretive rule for white marlin and roundscale spearfish, and Amendment 10 are still valid. However, NOAA Fisheries recommends revisiting the analysis of ESA listed and non-ESA listed coral habitat and shark bottom longline interactions that was conducted in Amendment 10 with data collected through 2022.
4	Non-fishing activities that may adversely affect EFH	All HMS	NOAA Fisheries has not identified any new activities with potential to generate detrimental non-fishing impact to HMS EFH. NOAA Fisheries has identified new literature that can be incorporated into the analysis of the effects of several non-fishing activities on HMS EFH. Ongoing initiatives concerning climate change, renewable energy, marine sand and minerals mining, and aquaculture should continue to be monitored. New information relevant to HMS EFH should be incorporated into the HMS FMP.

#	EFH Component Description	Species	Recommendation for Change
5	Cumulative Impacts Analysis	All HMS	FMPs must analyze how the cumulative impacts of fishing and non-fishing activities influence the function of EFH. Sufficient new information has been found in species literature reviews and on the adverse effects of non-fishing impacts to EFH that an update to this is warranted in the HMS FMP.
6	Conservation & Enhancement of EFH	All HMS	NOAA Fisheries recommends the analyses of the adverse effects of non-fishing activities be updated. In addition, we recommend that actions to encourage conservation and enahancements be updated. We recommend adding new actions which encourage the use of decision support tools for reducing/mitigating effects of marine sand/minerals mining, aquaculture siting, and renewable energy production. We also recommend additional actions for renewable energy production, including the development of a robust monitoring and biological sampling framework to collect information on oceanographic conditions and biological comunities; and to conduct project-specific assessments of whether time of year mitigation or minimization strategies are appropriate to reduce adverse effects of lethal or disruptive activities.
7	Prey	All HMS	NOAA Fisheries recommends a reorganization of life history information presented in species-specific sections of the FMP.
8	HAPCs (existing)	Bluefin tuna, lemon shark, sand tiger shark, and sandbar shark	NOAA Fisheries did not identify literature suggesting that existing HAPCs should be changed or removed. However, it is likely that EFH boundaries for these species will be re-evaluated based on the availability of seven more years of published literature, data and other information. Existing boundaries of HAPCs may also need to be evaluated and changed to ensure they fall within any adjustments of HMS EFH.
8	HAPCs (new)	White shark	To protect a nursery area for white sharks in the New York Bight
9	Research and information needs	All HMS	NOAA Fisheries recently published the Atlantic HMS Management-Based Research Needs and Priorities document, which contains a list of near- and long-term research needs and priorities for all HMS, and include priorities that would support HMS EFH designation and protection (see Section 15.1). Species-specific research priorities (see Section 15.2) have been identified by the HMS Management Division.
10	EFH Delineation Methodologies	All HMS	NOAA Fisheries did not identify literature suggesting that the currnet kernel density estimation / 95 percent volumer contour method to delineate HMS EFH should be changed. However, minor updates to the methodology would address changing technology needs and would better address bias associated with different types of data. Additionally, text descriptions of EFH for species that have insufficient information across part or all of their range could be improved with statistical modeling.

17.2. Next Steps

The purpose of this 5-year review is to determine whether new information warrants the initiation of a follow-up action to revise EFH components found in Amendment 1, Amendment 3, the 2010 White Marlin/Roundscale Spearfish Interpretive Rule and Final Action, and Amendment 10. We will apply any new and appropriate information including, but not limited to, observer data, survey data, logbook information, and tag/recapture data that are available for all HMS. We will consider delineating new EFH if new data warrants any changes. During this process, we will conduct supporting analyses, consistent with all statutes and other requirements, and provide for public comment on the draft amendment. If any changes to the regulations are also needed, NOAA Fisheries will issue proposed and final rules with public comment.

As indicated in Section 17.1, a preliminary review of the 10 components of EFH suggests that an update to HMS EFH may be warranted. We encourage the public to provide public comment, scientific information, and data that either supports or refutes the preliminary recommendations provided in this draft 5-year review.

18. List of Preparers

The development of this document involved input from many NOAA Fisheries employees and contractors, the public, constituent groups, and the HMS Advisory Panel. Staff and contractors from the HMS Management Division, in alphabetical order, who reviewed the literature and drafted this document include:

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Many individuals contributed literature and reviewed this draft 5-year review document, including staff from the Office of Habitat Conservation, the Southeast Regional Office, the Southeast and Northeast Fisheries Science Centers, the Greater Atlantic Regional Office, the Office of Science & Technology, the Office of Aquaculture, and other entities within NOAA. We also appreciate and acknowledge the datasets and suggestions submitted by the public and from the HMS Advisory Panel members.