Monterey Bay Aquarium Seafood Watch

Environmental sustainability assessment of wild-caught Goosefish (*Lophius americanus*) from the United States caught using set gillnets and bottom trawls

Species:	Goosefish (*Lophius americanus*)
Location:	United States: Northwest Atlantic
Gear:	Set gillnets, Bottom trawls
Type:	Wild Caught
Author:	Seafood Watch
Published:	September 6, 2022
Report ID:	984

Assessed using Seafood Watch Fisheries Standard v3

Table of Contents

About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard.Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught, farmed or managed.

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report focuses on the goosefish (also called monkfish) (*Lophius americanus*) fishery in U.S. Atlantic waters using bottom trawl and bottom gillnet gear. Two congeners, *L. piscatorius* and *L. budegassa*, are caught in European waters, but because almost all monkfish sold in the U.S. is caught in domestic fisheries, this report only concerns *L. americanus*.

Goosefish has medium inherent vulnerability to fishing pressure and was once classified as overfished, but management actions to reduce overfishing via spatial and temporal efforts, combined with changes to biomass targets, have allowed the management units in both the northern and southern fishery management regions to rise above target levels. Fishing mortality has declined since 2003 and is now projected to be at sustainable levels. But, stock assessments and fishing mortality rates contain a moderate level of uncertainty because there is little information on goosefish stock status before the 1990s and an incomplete understanding of its life history characteristics.

Fisheries for both management units (north and south) have some by-catch, and the species in the table under Criterion 2 have the lowest-scoring by-catch in each fishery, which drives the rankings for that criterion. The lowest-scoring species for the bottom gillnet fishery include Atlantic sturgeon, yellowtail flounder, and North Atlantic right whale. Several groundfish species also limit the score in the monkfish bottom trawl fishery. Most of these species have a high inherent vulnerability, depleted stock status, or overfishing occurring.

Managers follow scientific advice and work is ongoing to minimize by-catch, particularly of species of special concern, such as marine mammals and depleted stocks or those that are in a state of rebuilding. But, monkfish total allowable catches have been frequently exceeded (though the fishery has been improving in this regard in recent years), and there is a good deal of uncertainty in the monkfish stock assessment, leading to a need for increased precaution. Entanglement in fishing gear is the leading cause of mortality for North Atlantic right whale, and the Atlantic Large Whale Take Reduction Plan has failed to curtail mortality to a sustainable level.

Bottom gillnets contact the bottom but have less impact on the seafloor compared to bottom trawls. Trawl gear fishing of northern stocks has moderate mitigation of gear impacts, primarily through the use of area closures and spatial management, while bottom gillnet fisheries in the Mid-Atlantic have only minimal spatial restrictions. Successful ecosystem-based management for goosefish fisheries is currently hindered by an incomplete understanding of goosefish life history characteristics, though efforts are underway to increase knowledge.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Goosefish | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC	3.318	1.000	3.000	2.449	**Good Alternative (2.222)**
Goosefish | Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC	3.318	1.000	1.000	3.000	**Avoid (1.776)**

Summary

This report is on the goosefish (*Lophius americanus*) fishery in U.S. Atlantic waters using bottom trawl and bottom gillnet gear. These gear types account for approximately 95% of the goosefish (also known as monkfish) landings in the U.S. Atlantic. Goosefish caught with bottom trawl are a Good Alternative, while those caught with gillnets are an Avoid. The main concern with the gillnet fishery is the potential impact on the critically endangered North Atlantic right whale and the failure of the Atlantic Large Whale Take Reduction Plan to limit any impact to a sustainable level.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

Best Choice/Green = Final Score >3.2, and no Red Criteria, and no Critical scores

Good Alternative/Yellow = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

This report focuses on the goosefish (also called monkfish; *Lophius americanus*) fishery in U.S. Atlantic waters. Goosefish is targeted using bottom trawl and bottom gillnets. There are two congeners, *L. piscatorius* and *L. budegassa*, caught in European waters; however, because almost all goosefish sold in the U.S. is caught in domestic fisheries, this report only concerns *L. americanus*.

Species Overview

Goosefish is a scaleless, soft-bodied fish that lives near the benthos as a "sit-and-wait" predator (FishWatch 2017). Also known as anglerfish, it has a modified dorsal fin ray that serves as a lure to draw prey items close to its enormous mouth, which can suck prey in whole by creating a vacuum (Richards 2006). Females lay eggs encased in a large gelatinous veil, which is buoyant and can be 6 to 12 m long (Richards 2006). Eggs hatch into juveniles that are pelagic before settling to the benthos (Collette and Klein-Macphee 2002). Studies indicate that the U.S. monkfish population is genetically homogeneous (Chikarme et al. 2000), though patterns of recruitment indicate there might be two biological stocks (NEFSC 2010).

Goosefish occurs from the Canadian Maritimes to Cape Hatteras and is managed as two management units in U.S. waters, due to regional differences in fishing gear. The northern management unit in the Gulf of Maine and northern Georges Bank is caught primarily using trawl gear, while the southern management unit south of Cape Cod is caught primarily using extra-large-mesh gillnets (Figure 1).

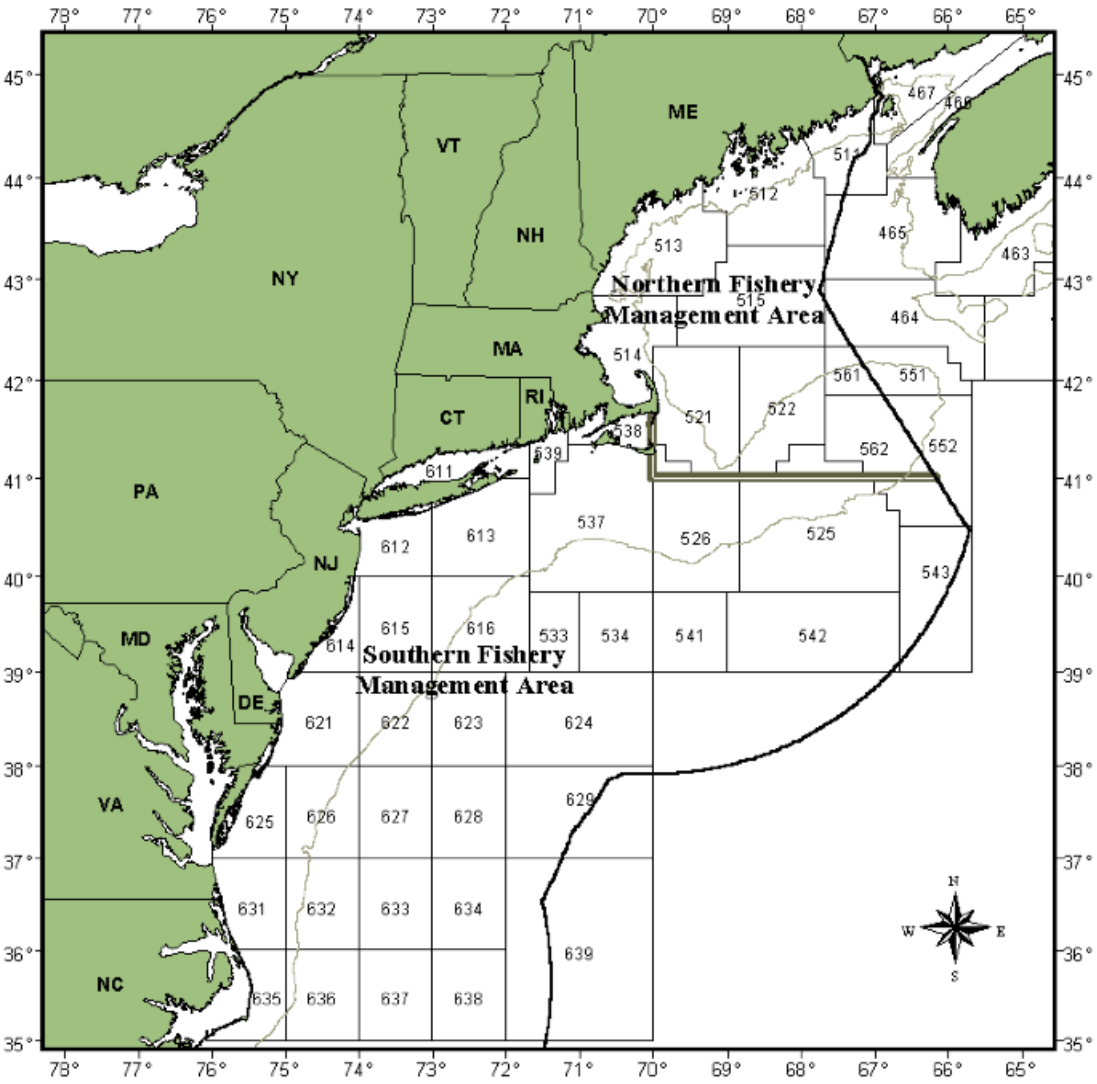

Figure 1: Map of the region where goosefish is caught, showing the northern and southern fishery management areas (figure from NEFMC and MAFMC 2011).

In addition, goosefish is landed in the Northern Fishery Management Area (NMA) primarily as incidental landings, while it is landed in the Southern Fishery Management Area (SMA) primarily as targeted catch (Hermsen 2010). The fishery is managed jointly by the New England Fishery Management Council and the Mid-Atlantic Fishery Management Council (NEFMC and MAFMC 2011).

Before the mid-1970s, goosefish was either discarded as by-catch or sold informally and unreported. From the mid-1970s to the mid-1980s, the price of goosefish tails increased tenfold, leading to a 17-fold increase in trips reporting landings and in landings themselves (Haring and Maguire 2008). Increased demand for goosefish tails in Europe and for livers and whole fish in Japan and South Korea sustained the rising prices for goosefish and expanded fishing effort through the early 1990s. In response to concerns about growing signs of biological stress on the species, fishers urged the NEFMC and MAFMC to draft a goosefish fishery management plan, which was first adopted in 1998 (Haring and Maguire 2008). Goosefish is now an important U.S. commercial fishery.

Production Statistics

Almost all goosefish is caught in U.S. waters, with comparatively small amounts caught in Canadian waters (Figure 2).

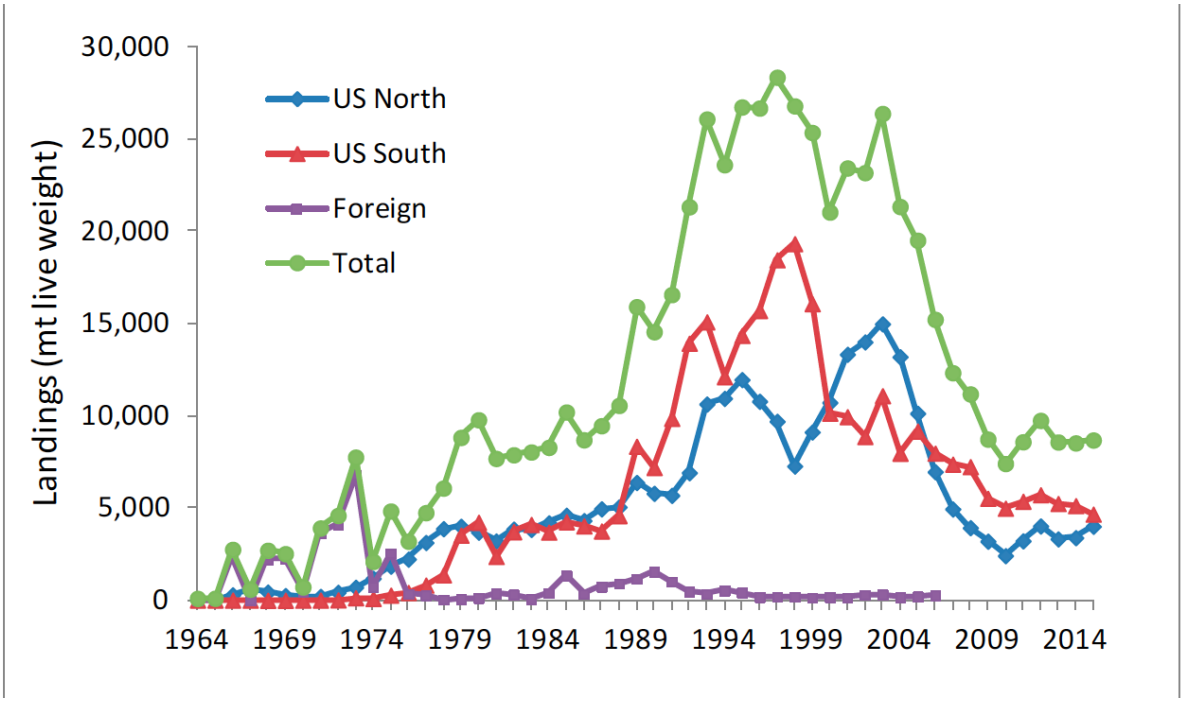

Figure 2: Goosefish landings by management area and combined areas, 1964–2015 (Richards 2016).

Overall production peaked in the 1990s, after which the decreasing size of landed goosefish led to the establishment of the first goosefish fishery management plan (FMP) in 1999 (NEFMC and MAFMC 2011). Production in the Northern Fishery Management Area is dominated by the trawl fishery, which accounts for 75% of all landings in this area, while production in the southern fishery management area is dominated by the gillnet fishery (about 60% of all landings in this area) (Figures 3, 4, 5) (Richards 2016).

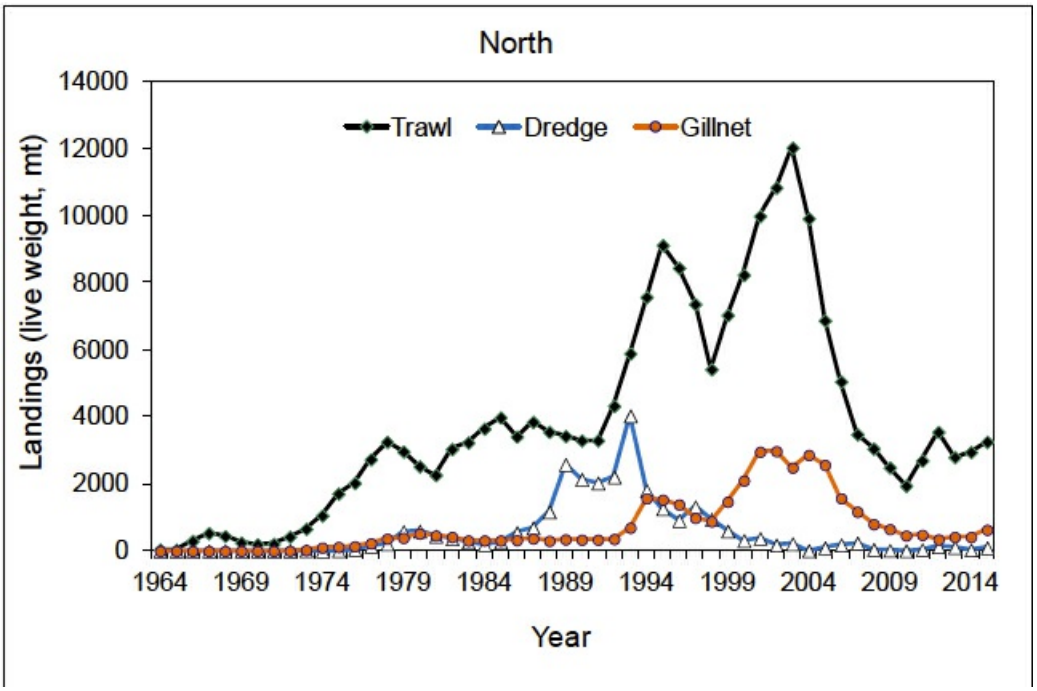

Figure 3: Commercial landings of goosefish by gear type and management area, 1964–2015. Northern management area (Richards 2016).

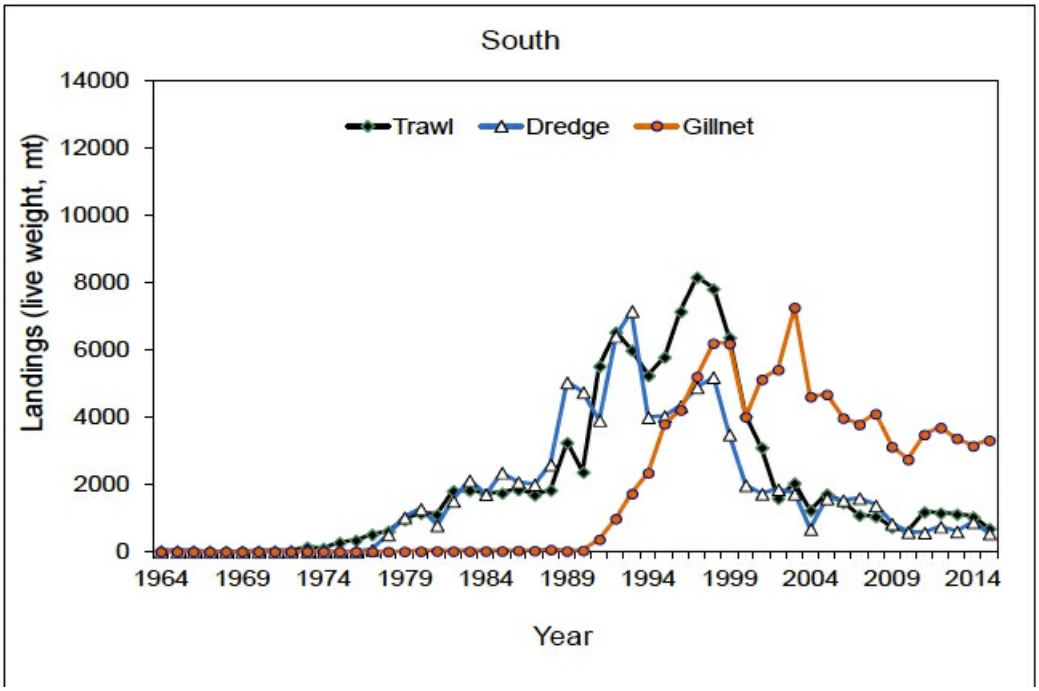

Figure 4: Commercial landings of goosefish by gear type and management area, 1964–2015. Southern management area (Richards 2016).

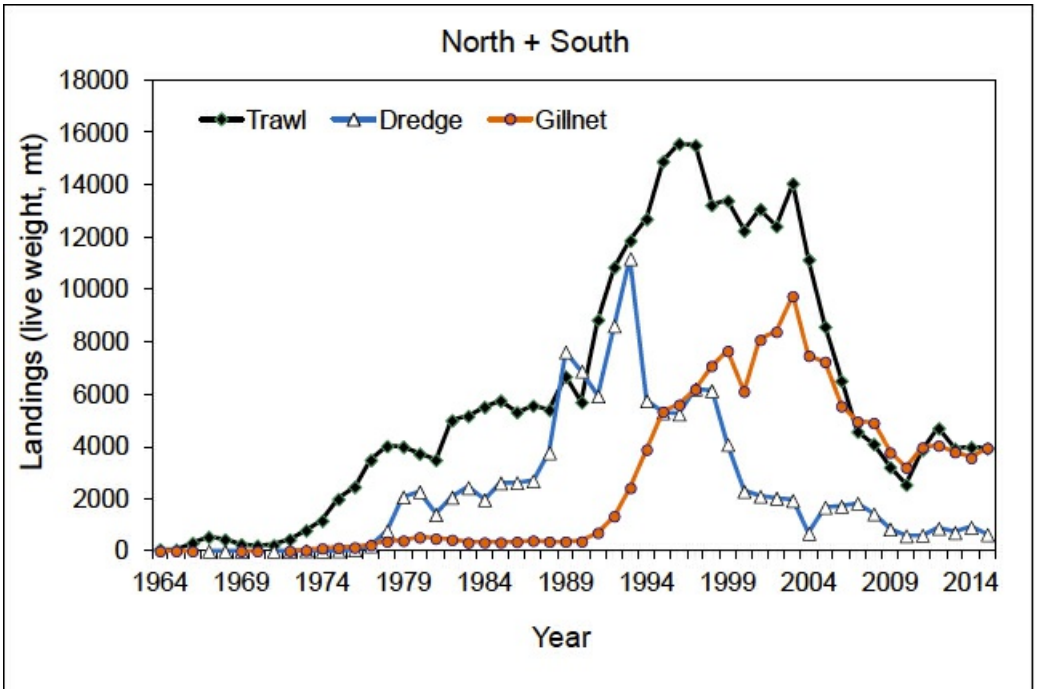

Figure 5: Commercial landings of goosefish by gear type and management area, 1964–2015. Management areas combined (Richards 2016).

Since the last full assessment in 2010, total U.S. landings for goosefish have seen a relatively modest increase and remain fairly stable, averaging 8,826 metric tons (mt) per year {NMFS 2017}. Goosefish landings for all gear types and from both fishery management areas during the 2015 fishing year (May 1, 2014 to April 30, 2015, and the most recent year for which complete data are available) were 8,623 mt {NMFS 2017}.

Importance to the US/North American market.

Almost all goosefish sold in U.S. markets is from domestic fisheries (Figure 2). From 1996 to 2004, goosefish was one of the top five most valuable species in the U.S. northeast and mid-Atlantic, even though price per live weight pound has decreased since the mid-1990s (Orphanides and Magnusson 2007). Goosefish remains one of the highest-valued finfish in the U.S. northeast, and the 2015 goosefish harvest was worth over $19.1 million {NMFS 2017}(FishWatch 2017).

Common and market names.

The market names include both monkfish and goosefish, though the common name is goosefish. Other names include monktails, angler, fishing frog, allmouth, molligut, abbot, sea-devil, and lotte (FishWatch 2017).

Primary product forms

Primary goosefish products are tails, whole fish (head-on gutted), and livers (Richards 2016).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

GOOSEFISH			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance
Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of*

the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.

- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Goosefish

Factor 1.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

According to the most recent operational assessment in 2016, which used survey indices to estimate abundance and biomass, there was a lack of current biological reference points that would allow for stock status determination (Richards 2016)(NMFS 2017a). The 2016 assessment does not include an update to the SAW 50 SCALE model used previously (in 2013) because the method for aging goosefish failed a validation test completed in 2016, thus invalidating the growth model (Richards 2016)(NMFS 2017a). In the 2016 assessment, survey indices were used as proxies for stock abundance, and relative exploitation rates were used as proxies for trends in fishing mortality rates, but neither of these quantities has been used as a basis for proxies for biological reference points (Richards 2016)(NMFS 2017a).

Therefore, the most current abundance estimates are from 2013, which determined that both the northern and southern stock biomass are above targets (NEFSC 2013). But, because it appears that neither the 2013 stock assessment result nor the 2016 stock assessment result is appropriate for determining whether abundance is at a sustainable level, a productivity-susceptibility analysis (PSA) was calculated.

Goosefish has medium inherent vulnerability according to the productivity-susceptibility analysis (PSA = 2.91; see detailed scoring below); and because there are two positive data-limited indicators (NEFSC survey indices are either stable or increasing, landings have decreased substantially, and the size structure is reasonably stable), abundance is scored a low concern.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1. Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2. Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: $S = [(S1 \times S2 \times S3 \times S4) - 1/40] + 1$.

3. Vulnerability score (V) = the Euclidean distance of P and S using the following formula: $V = v(P^2 + S^2)$

Vulnerability (V) = $v(P^2 + S^2)$

V = $v(1.75^2 + 2.325^2)$

V = 2.91 (medium vulnerability)

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)	Reference(s)
Average age at maturity	4.5 years	1	(Steimle et al. 1999)
Average maximum age	10 years	2	(Steimle et al. 1999)
Fecundity	300,000 to 2,780,000 eggs/year	1	(Steimle et al. 1999)
Average maximum size (fish only)	100 cm	2	(Steimle et al. 1999)
Average size at maturity (fish only)	55 cm	2	(Steimle et al. 1999)
Reproductive strategy	Broadcast spawner	1	(Froese and Pauly 2018)
Trophic level	4.4	3	(Choi et al. 2008)
Density dependence (invertebrates only)	-	-	
Habitat quality	Moderately altered	2	SFW default value
Total Productivity (average)		**1.75**	

Susceptibility attribute	Relevant information	Score (1 = low risk, 2 = medium risk, 3 = high risk)	Reference(s)
Areal overlap (considers all fisheries)	The northern goosefish stock is concentrated in the GoM and Georges Bank cod, haddock, and pollock fishing areas.	3	(Richards 2013)
Vertical overlap (considers all fisheries)	Usual depth range of inshore to 900 m; groundfish fishery operates between 10 and 200 m.	3	(Richards 2013)
Selectivity of fishery (specific to fishery under assessment)	Goosefish is incidentally encountered and is not likely to escape the gear, but conditions under "high risk" do not apply.	2	SFW default
Post-capture mortality (specific to fishery under assessment)	Unknown	3	SFW default
Total Susceptibility (multiplicative)		**2.325**	

Factor 1.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

The 50th SAW Assessment Summary Report estimates fishing mortality at F = 0.10 per year in the NMA and F = 0.07 per year in the SMA; F is below $F_{THRESHOLD}$, which is currently set equal to F_{MAX} (F = 0.44 for NMA and F = 0.37 for SMA) (NEFSC 2013). Nevertheless, there is high uncertainty surrounding these estimates, especially because the SCALE model from the 2013 operational assessment has since been rejected due to F BRPs (biological reference points) being considered inappropriate for this species (Richards 2016). And, although the most current assessment in 2016 used relative exploitation rates as proxies to estimate trends in fishing mortality rates, these have not been used as proxies for fishing mortality BRPs (Richards 2016). Because there is uncertainty surrounding these estimates, fishing mortality is considered a moderate concern.

Justification:

The relative exploitation rates cannot be compared with reference points at this stage, but they do indicate, particularly in the north, a clear decrease in recent years.

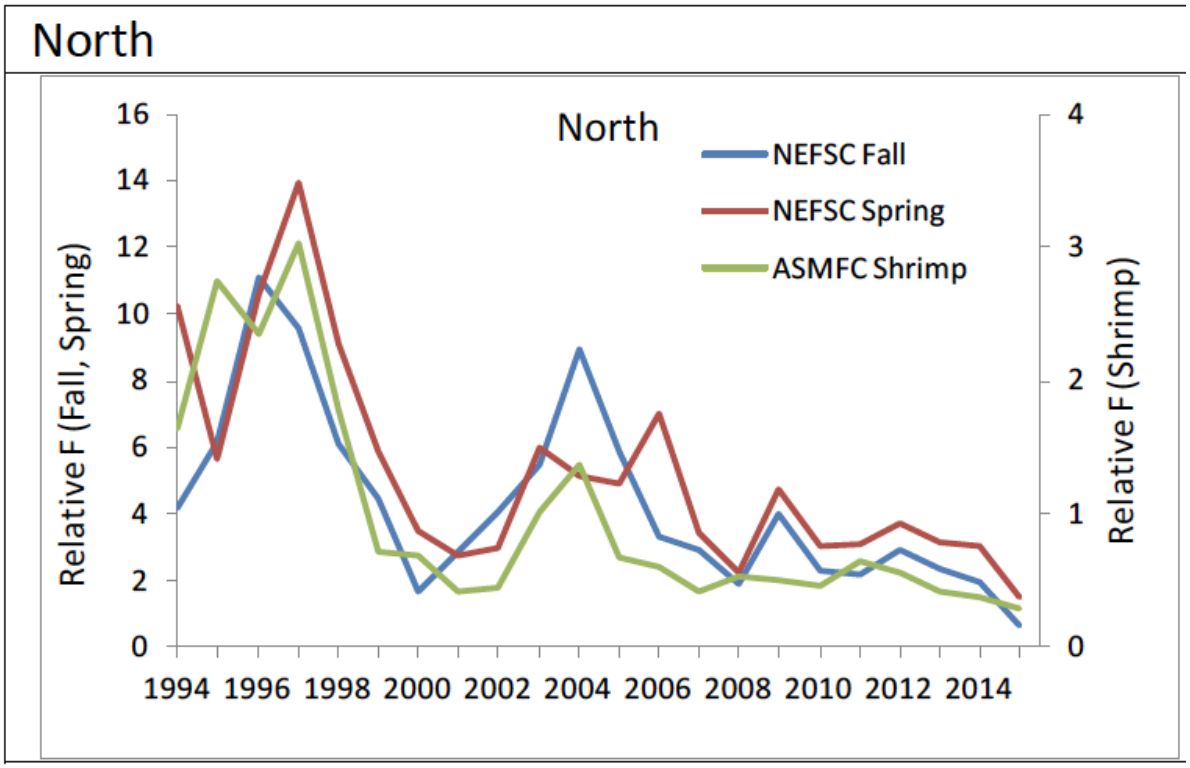

Figure 6: Relative exploitation rates (total catch in numbers/total abundance index) of goosefish in the northern management area (Richards 2016).

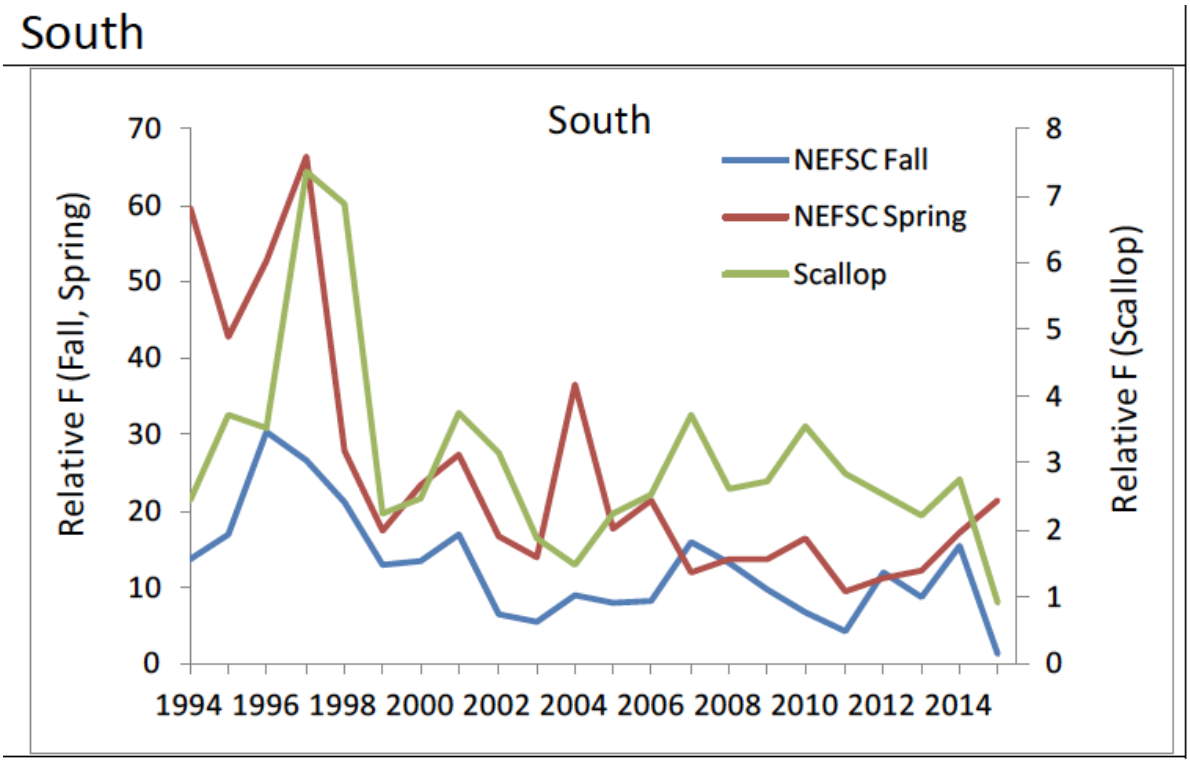

Figure 7: Relative exploitation rates (total catch in numbers/total abundance index) of goosefish in the southern management areas (Richards 2016).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

GOOSEFISH			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC	1.000	1.000: < 100%	Red (1.000)
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC	1.000	1.000: < 100%	Red (1.000)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

ATLANTIC AND ADJACENT AREAS | ATLANTIC, NORTHWEST | BOTTOM TRAWLS | UNITED STATES | NEFMC			
SUB SCORE: 1.000	DISCARD RATE: 1.000	**SCORE: 1.000**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Yellowtail flounder	1.000: High Concern	1.000: High Concern	Red (1.000)
Atlantic cod	1.000: High Concern	1.000: High Concern	Red (1.000)
Atlantic cod	1.000: High Concern	1.000: High Concern	Red (1.000)
Yellowtail flounder	1.000: High Concern	1.000: High Concern	Red (1.000)
Atlantic halibut	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Witch flounder	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Windowpane flounder	1.000: High Concern	3.000: Low Concern	Red (1.732)
Blackback	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Spiny dogfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Ocean pout	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Thorny skate	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Goosefish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
White hake	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Short-beaked common dolphin	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)

Long-finned pilot whale	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Harbor porpoise	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Atlantic white-sided dolphin	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Blackback	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Blackback	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Winter skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Barndoor skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Windowpane flounder	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Little skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Summer flounder	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Smooth skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Rosette skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Clearnose skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
American plaice	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Haddock	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Scup	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Pollock	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Haddock	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

ATLANTIC AND ADJACENT AREAS | ATLANTIC, NORTHWEST | SET GILLNETS | UNITED STATES | MAFMC			
SUB SCORE: 1.000	DISCARD RATE: 1.000		**SCORE: 1.000**
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Yellowtail flounder	1.000: High Concern	1.000: High Concern	Red (1.000)
North Atlantic right whale	1.000: High Concern	1.000: High Concern	Red (1.000)
Atlantic halibut	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Atlantic sturgeon	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Spiny dogfish	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Witch flounder	1.000: High Concern	3.000: Moderate Concern	Red (1.732)
Thorny skate	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Loggerhead turtle	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Goosefish	3.670: Low Concern	3.000: Moderate Concern	Green (3.318)
Atlantic white-sided dolphin	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
White hake	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Harbor porpoise	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Little skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Clearnose skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Rosette skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Smooth skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Barndoor skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Winter skate	3.670: Low Concern	5.000: Low Concern	Green (4.284)
American plaice	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Pollock	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

All species listed in this section are caught as by-catch in the monkfish fishery. But monkfish, especially in the northeast bottom trawl fishery, is landed as incidental catch (i.e., not landed on a monkfish day-at-sea), so it is extremely difficult to determine which of these species are most likely to be caught as by-catch while fishing for monkfish. The majority of the monkfish trawl fishery occurs in conjunction with the northeast multispecies fishery in the Northern Fishery Management Area (NMA), which comprises mostly the Gulf of Maine and Georges Bank. Therefore, species assessed here for trawl gear are most likely to interact with the monkfish fishery, given the gear type and fishing area. Efforts are currently underway to gain a better understanding of which by-catch species are generally landed while targeting monkfish, which will likely streamline this list in the future. Monkfish is commonly a targeted fishery in the Mid-Atlantic region.

The lowest-scoring species—thus limiting the final score—for the bottom gillnet fishery include Atlantic

sturgeon, yellowtail flounder, and North Atlantic right whale. Several groundfish species also limit the score for the bottom trawl fishery. Most of these species have high inherent vulnerability, depleted stock statuses, overfishing occurring, or all three of these issues. Finally, the bottom trawl fishery is known to interact with pilot whale, but all these interactions have occurred in areas where only the long-finned pilot whale is found north of latitude 40° N. Thus, short-finned pilot whale is not considered a main species in the bottom trawl fishery.

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

American plaice

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

Based on the 2017 American plaice stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 13,351 mt, which is 99% of the biomass target for this stock (SSB_{MSY} proxy = 13,503; see Figure 8) {Terceiro 2017}. According to the NMFS first quarter 2018 update, Georges Bank American plaice is not overfished and is in year 4 of a 10-year rebuilding plan (NMFS 2018c). Because the stock is not overfished, and abundance is more than 75% above the biomass target, abundance is considered a low concern.

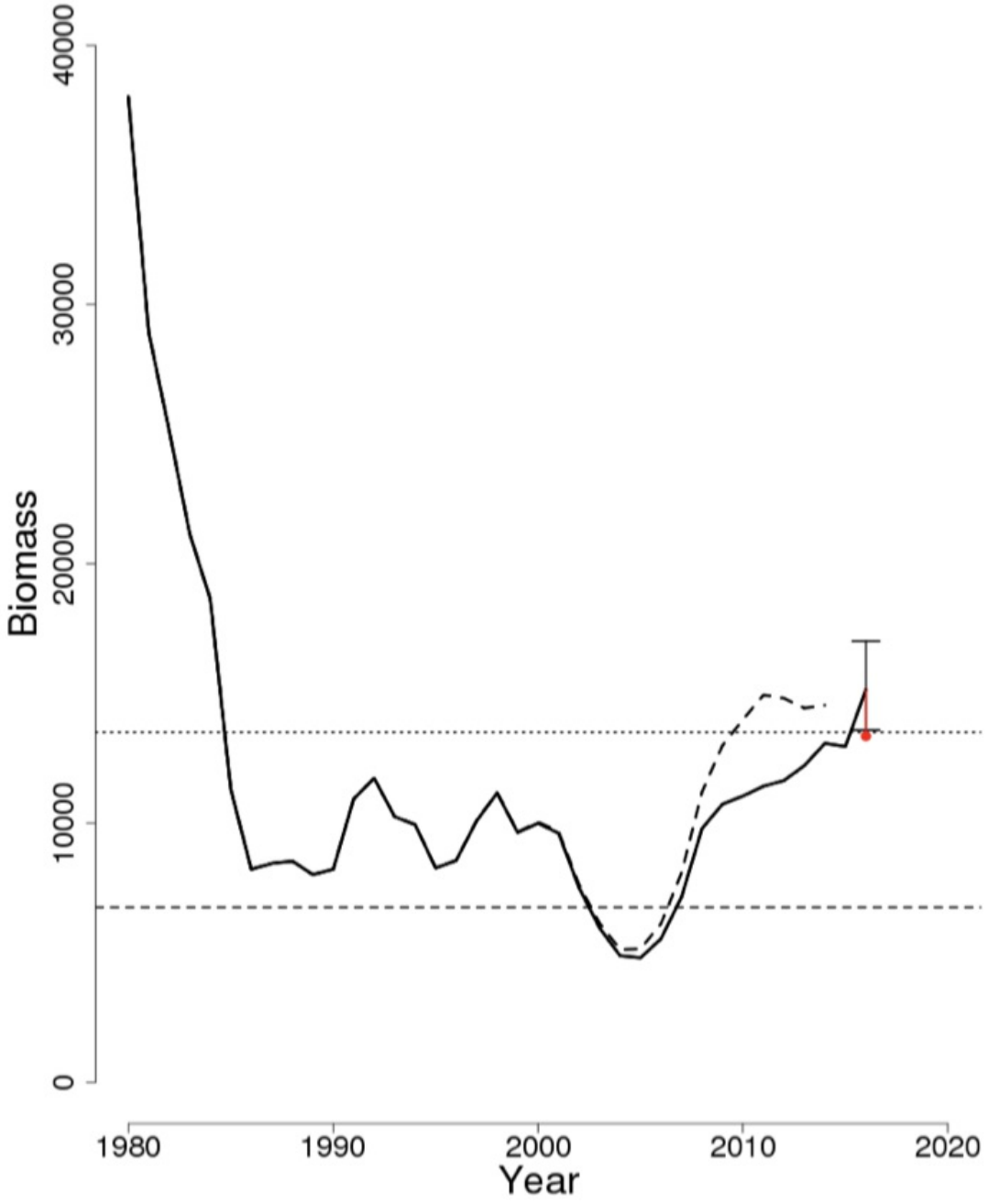

Figure 8: Trends in SSB of Gulf of Maine–Georges Bank American plaice between 1980 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment (Terceiro 2017).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

Based on the 2017 American plaice stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.111, which is 51% of the overfishing threshold proxy (F_{MSY} proxy = 0.216; see Figure 9) {Terceiro 2017}. Therefore, the stock is not undergoing overfishing and fishing mortality is considered a low concern.

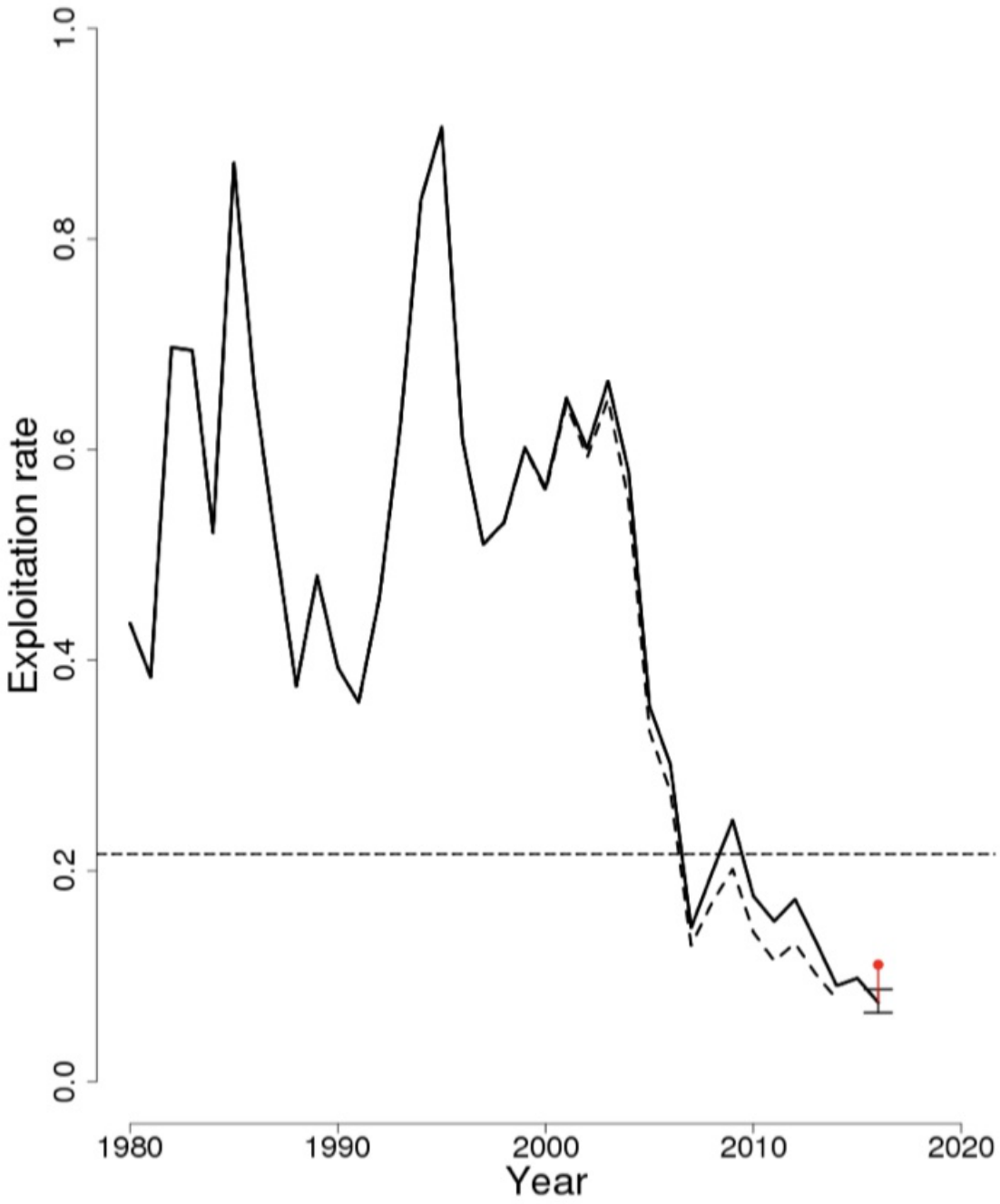

Figure 9: Trends in the fully selected fishing mortality (F_{FULL}) of Gulf of Maine–Georges Bank American plaice between 1980 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.216; horizontal dashed line) (Terceiro 2017).

Atlantic cod

Factor 2.1 - Abundance

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Georges Bank Atlantic cod stock assessment, stock status cannot be quantitatively determined due to a lack of biological reference points associated with the "Plan B smooth" approach {Legault 2017}. But, it is considered to be overfished due to poor stock condition {Legault 2017}. The survey biomass in 2017 (the arithmetic average of the 2017 NEFSC spring and 2016 NEFSC fall surveys smoothed using a loess) was estimated to be 7.237 kg/tow (see Figure 10) {Legault 2017}. According to the NMFS first quarter 2018 update, Georges Bank Atlantic cod is overfished and in year 14 of a 23-year rebuilding plan (NMFS 2018). Because the stock is overfished, abundance is scored a high concern.

Justification:

NMFS first quarter 2018 update stock status determinations are a holdover according to NOAA's policy, where the agency decided after the 2015 assessment that the Georges Bank Atlantic cod stock status would remain as overfishing occurring and overfished based on an earlier benchmark assessment (the SAW 55 benchmark assessment in 2011) {O'Brien 2015}.

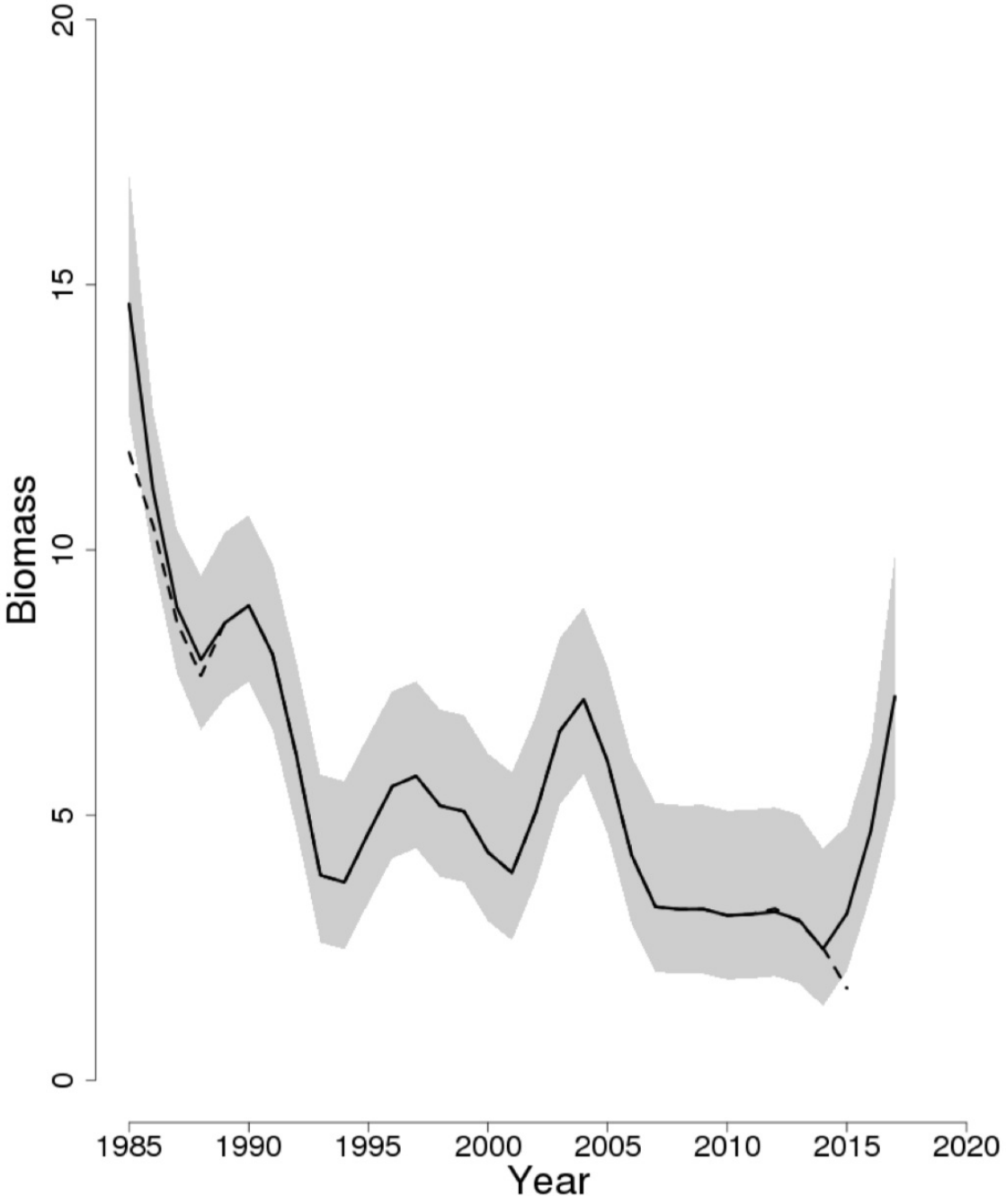

Figure 10: Trends in smoothed survey biomass (kg/tow) of Georges Bank Atlantic cod between 1985 and 2017 from the current (solid line) and previous (dashed line) assessment based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {Legault 2017}.

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Gulf of Maine Atlantic cod stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 3,046 mt under the M = 0.2 model and 3,262 mt under the M-ramp model scenario, which is 8% and 5%, respectively, of the biomass target, SSB_{MSY} proxy (40,604 mt and 59,714 mt) (see Figure 11) (Palmer 2017a). According to the NMFS first quarter 2018 update, Gulf of Maine Atlantic cod is overfished and in year 4 of a 10-year rebuilding plan (NMFS 2018c). Because the stock is overfished, abundance is considered a high concern.

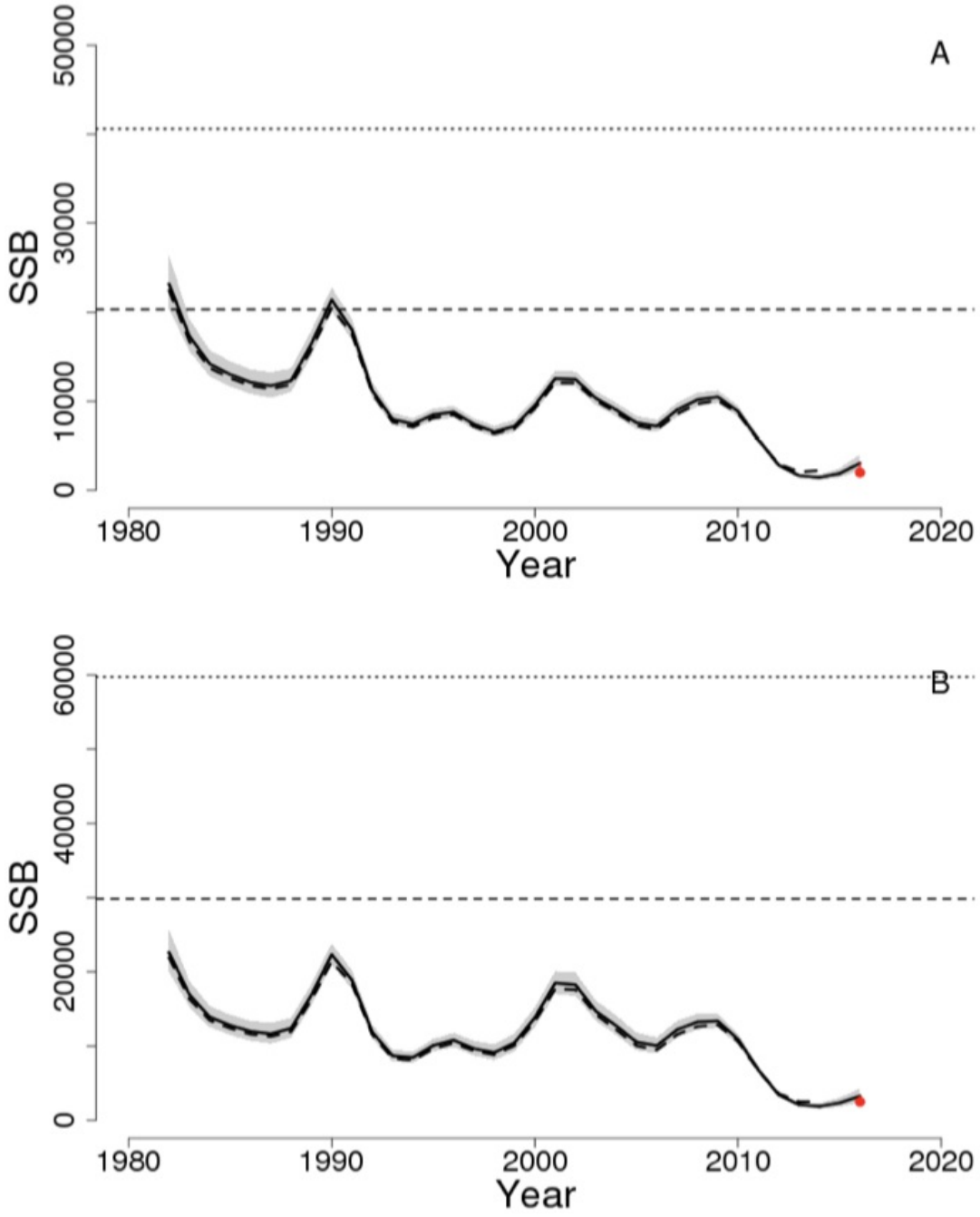

Figure 11: Estimated trends in the spawning stock biomass (SSB) of Gulf of Maine Atlantic cod between 1982 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY}; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY}; horizontal dotted line) based on the 2017 M = 0.2 (A) and M-ramp (B) assessment models {Palmer 2017}.

Factor 2.2 - Fishing Mortality

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Georges Bank Atlantic cod stock assessment, the 2016 relative exploitation rate (2016 catch divided by 2016 smoothed survey biomass) was estimated to be 0.174 (see Figure 12) {Legault 2017}. But, the recommended overfishing status is unknown. According to the NMFS first quarter 2018 update, Georges Bank Atlantic cod is undergoing overfishing and in year 14 of a 23-year rebuilding plan, where the management action is focusing on reducing mortality (NMFS 2018). For these reasons, fishing mortality is scored a high concern.

Justification:

NMFS first quarter 2018 update stock status determinations are a holdover according to NOAA's policy, where the agency decided after the 2015 assessment that the Georges Bank Atlantic cod stock status would remain as overfishing occurring and overfished based on an earlier benchmark assessment (the SAW 55 benchmark assessment in 2011) {O'Brien 2015}.

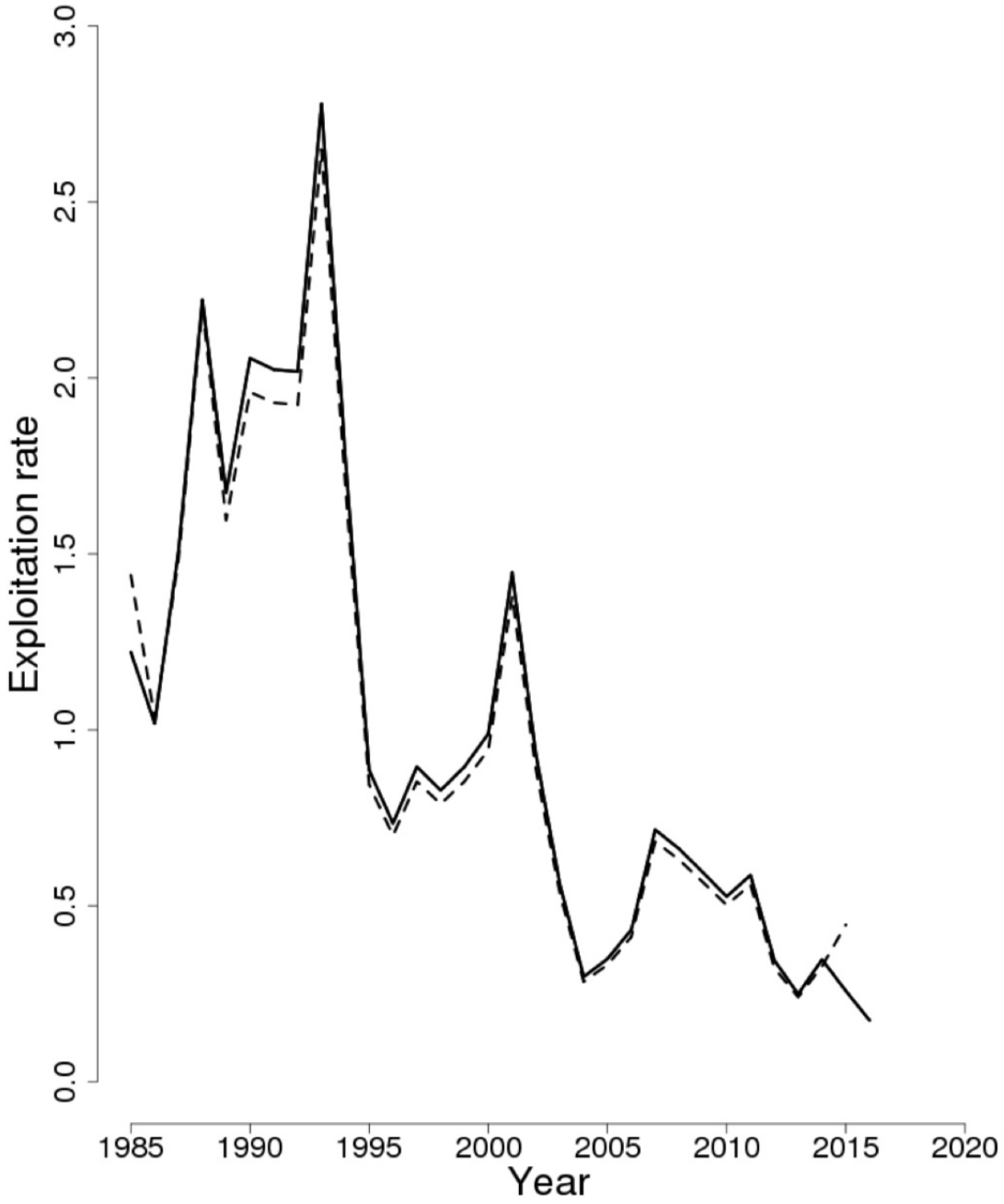

Figure 12: Trends in the relative exploitation rate (catch/smoothed survey) of Georges Bank Atlantic cod between 1985 and 2017 from the current (solid line) and previous (dashed line) assessment based on the 2017 assessment {Legault 2017}.

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Gulf of Maine Atlantic cod stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.228 and 0.237, which is 131% and 134% of the F_{MSY} proxy ($F_{40\%}$; 0.174 and 0.177) under the M = 0.2 model and the M-ramp model scenarios, respectively (see Figure 13) (Palmer 2017a). Because the stock is undergoing overfishing, fishing mortality is considered a high concern.

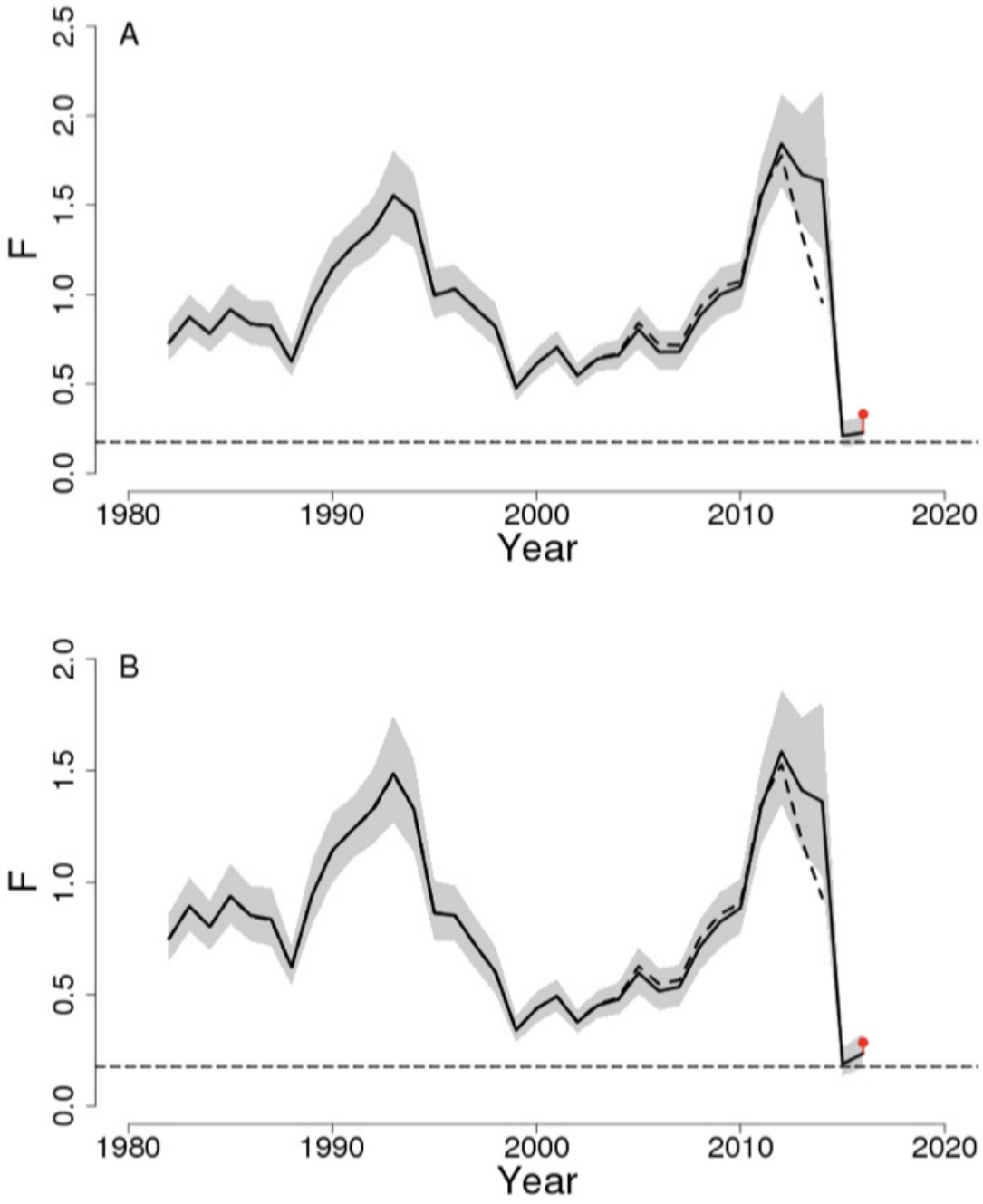

Figure 13: Estimated trends in the fully selected fishing mortality (F) of Gulf of Maine Atlantic cod between 1982 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (0.174 (M = 0.2), 0.177 (M-ramp); dashed line) based on the 2017 M = 0.2 (A) and M-ramp (B) assessment models. The 90% lognormal confidence intervals are shown {Palmer 2017}.

Atlantic halibut

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern
Based on the 2015 Atlantic halibut stock assessment, spawning stock biomass (SSB) in 2014 was estimated to be 96,464 mt, which is 199% of the biomass target (SSB_{MSY} proxy = 48,509; see Figure 14) (NEFSC 2015a). But, the assessment indicated that the model used was highly uncertain due to the high sensitivity to initial biomass, and that the survey data used were "noisy" due to the low number of animals caught in the surveys (NEFSC 2015a). Therefore, stock status for this species cannot be determined based on the current assessment and is unknown (NEFSC 2015a). According to the NMFS first quarter 2018 update, Atlantic halibut is overfished and in year 14 of a 52-year rebuilding plan (NMFS 2018c). This factor is considered a high concern, because Atlantic halibut is also listed as a species of concern under the Endangered Species Act (ESA) (NMFS 2017a).

Justification:
Catch has been very low for at least 100 years relative to landings reported early in the time series, despite a strong market and high value relative to other groundfish {NEFSC 2015}. The low catch throughout the century implies that the Atlantic halibut stock is very likely depleted relative to its unfished condition and is therefore likely to be overfished, even if its current biomass is unknown {NEFSC 2015}.

NMFS fourth quarter 2017 update stock determinations are from the GARMIII benchmark assessment and the 2012 updated assessment, which concluded that the stock was overfished but overfishing was not occurring; information available in the updated assessment indicates that stock size has not substantially increased. Hence, it was concluded that the stock is still overfished, and the overfishing status is unknown.

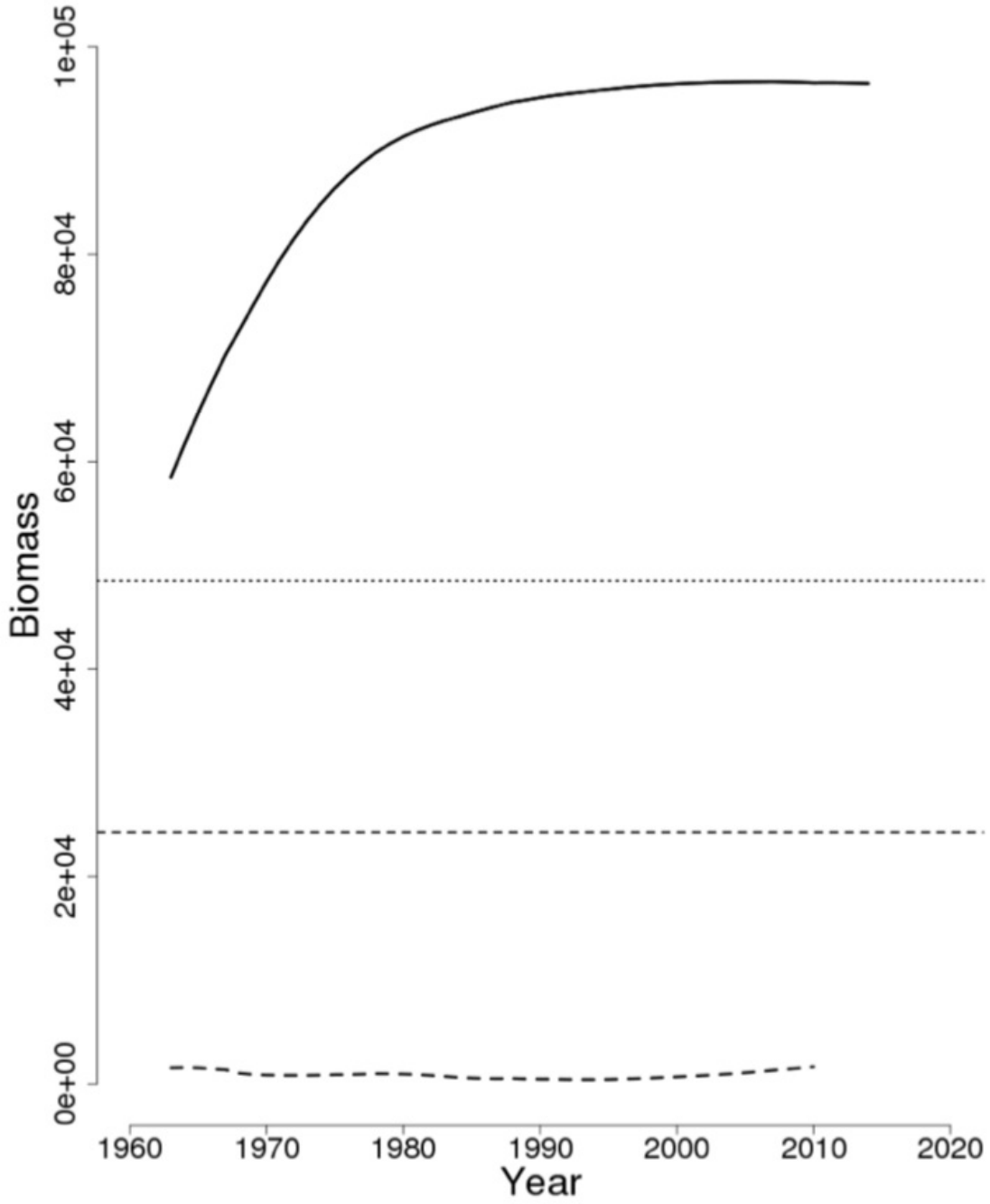

Figure 14: Estimated trends in the biomass of Atlantic halibut between 1963 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $B_{THRESHOLD}$ = 1/2 B_{MSY} proxy (horizontal dashed line) as well as B_{TARGET} (B_{MSY} proxy; horizontal dotted line) based on the 2015 assessment {NEFSC 2015}.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

Based on the 2015 Atlantic halibut stock assessment, the 2014 fully selected fishing mortality was estimated to be 0.001, which is 1% of the overfishing threshold proxy (F_{MSY} proxy = 0.073; see Figure 15) (NEFSC 2015a). According to the NMFS first quarter 2018 update, Atlantic halibut is not undergoing overfishing (NMFS 2018c). Because there is no 2017/2018 stock assessment update to support the NMFS FSSI listing, the Atlantic halibut stock is likely severely depleted, and the model used in the 2015 stock assessment has been deemed unreliable, this factor is scored a moderate concern.

Justification:

NMFS fourth quarter 2017 update stock determinations are from the GARMIII benchmark assessment and the 2012 updated assessment, which concluded that the stock was overfished but overfishing was not occurring; information available in the updated assessment indicates that stock size has not substantially increased. Hence, it was concluded that the stock is still overfished, and the overfishing status is unknown.

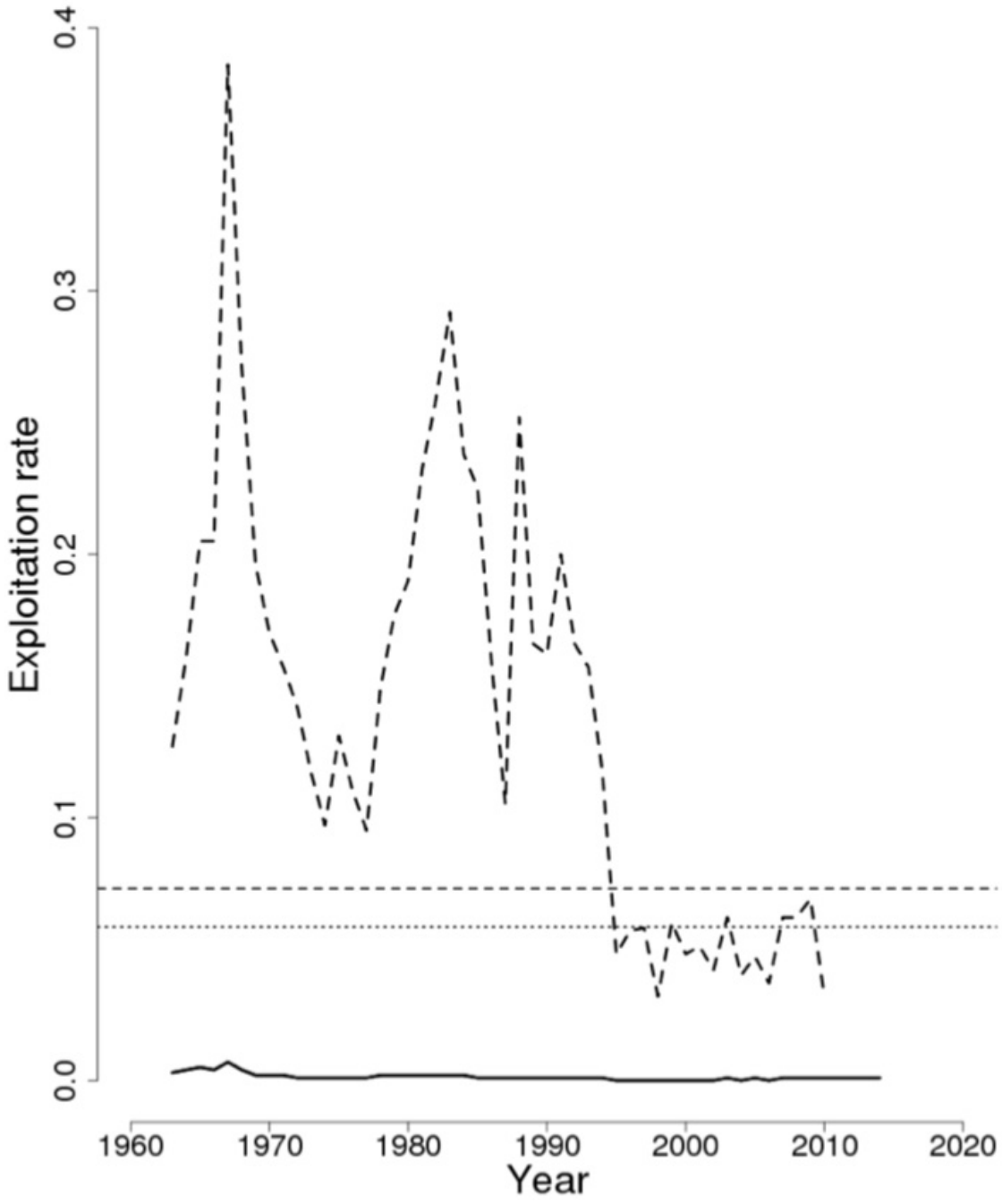

Figure 15: Estimated trends in the fully selected fishing mortality (F_{FULL}) of Atlantic halibut between 1963 and 2014 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (0.073; horizontal dashed line) as well as F_{TARGET} (0.8 × F_{MSY} proxy; dotted line) based on the 2015 assessment {NEFSC 2015}.

Atlantic sturgeon

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

All U.S. populations of Atlantic sturgeon are listed as "Endangered" or "Threatened" by the Endangered Species Act (ESA) (NMFS 2012a). U.S. populations of Atlantic sturgeon are divided into five distinct population segments (DPS) for management purposes (NOAA Fisheries 2012b). The Gulf of Maine DPS is currently listed as "Threatened" by the ESA, while the four DPS south of Cape Cod are currently listed as "Endangered" (NOAA Fisheries 2012b). Little is known about stock status: reliable data are difficult to collect because many river systems have few fish and are difficult to sample (ASFMC 2017). Although accurate stock assessments are difficult to conduct, some states conduct long-term monitoring of Atlantic sturgeon via fishery-independent surveys (see Figure 16) (ASFMC 2017). The figure comprises data from NJ and NC surveys that provide an example of local conditions, with both surveys indicating an increase in the number of sturgeon in these areas (ASFMC 2017). Because all populations of Atlantic sturgeon are threatened or endangered, Seafood Watch deems this factor a high concern.

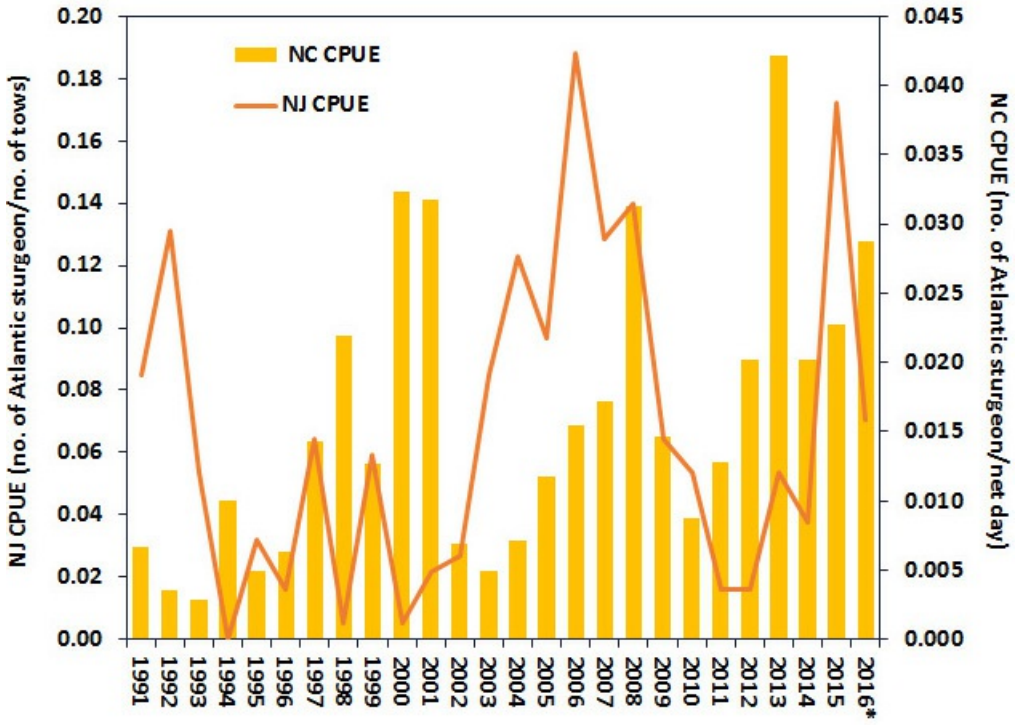

Figure 16: Atlantic sturgeon fishery-independent catch per unit effort in New Jersey's coastal waters and North Carolina's Albemarle Sound {NJDEP 2016}{NCDMF 2016}.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

The most recent stock assessment for Atlantic sturgeon predicted overall take for both bottom trawl gear and gillnets. From 2000 to 2015, total by-catch from bottom trawls ranged from 624 to 1,518 fish, with an average of 4% recorded as dead {ASMFC 2017b}. Total by-catch from sink and drift gill nets ranged from 253 to 2,715 fish, with an average of 30% resulting in annual dead discards. Little change in dead discard numbers has been noted since 2000 {ASMFC 2017b}. Statistical uncertainty surrounds these estimates regarding whether or not they exceed the determined threshold for total mortality {ASMFC 2017b}; therefore, a score of moderate concern was awarded.

Atlantic white-sided dolphin

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern
According to the most current marine mammal stock assessment report, the best estimate of abundance for the North Atlantic white-sided dolphin stock was 93,233 (CV = 0.71), with a minimum population size of 54,443 (Hayes et al. 2020). The status of this population relative to the optimum sustainable population (OSP) in the U.S. Atlantic EEZ is unknown, and a trend analysis has not been conducted for this species (Hayes et al. 2020). The International Union for the Conservation of Nature (IUCN) considers this species as "Least Concern" (Hammond et al. 2008a), and because status and trend analysis are unknown, abundance is considered a moderate concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern
The total annual estimated average fishery-related mortality or serious injury to the western North Atlantic white-sided dolphin stock during 2013 to 2017 was 26 individuals (CV = 0.20), with a potential biological removal (PBR) of 544 (Hayes et al. 2020). The Northeast bottom trawl is by far the primary contributor, accounting for 81% (21/26 individuals) of the total by-catch across all fisheries, with the Northeast sink gillnet fishery accounting for 11% (2.8/26 individuals) (Hayes et al. 2020). Because PBR is not exceeded, and the bottom trawl fishery takes less than 50% of the PBR, fishing mortality is considered a low concern.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern
The total annual estimated average fishery-related mortality or serious injury to the western North Atlantic white-sided dolphin stock during 2013 to 2017 was 26 individuals (CV = 0.20), with a potential biological removal (PBR) of 544 (Hayes et al. 2020). The Northeast bottom trawl is by far the primary contributor, accounting for 81% (21/26 individuals) of the total by-catch across all fisheries, with the Northeast sink gillnet fishery accounting for 11% (2.8/26 individuals) (Hayes et al. 2020). Because mortality or serious injury is only 5% of the PBR, and the sink gillnet fishery takes less than 50% of the PBR, fishing mortality is considered a low concern.

Barndoor skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For barndoor skate, the 2017 to 2019 NEFSC autumn average survey biomass index of 2.02 kg/tow is above the biomass threshold reference point (0.78 kg/tow) and 102% above the B_{MSY} proxy (1.57 kg/tow; see Figure 17) (Sosebee 2020). Because the stock is not overfished, but there is uncertainty associated with using the survey index as a proxy for abundance, a score of low concern is given (rather than a score of very low concern).

Justification:

For barndoor skate, the B_{MSY} proxy is defined as the average of 1963 to 1966 autumn survey biomass indices, because the survey did not catch barndoor skate for a protracted period (Sosebee 2020).

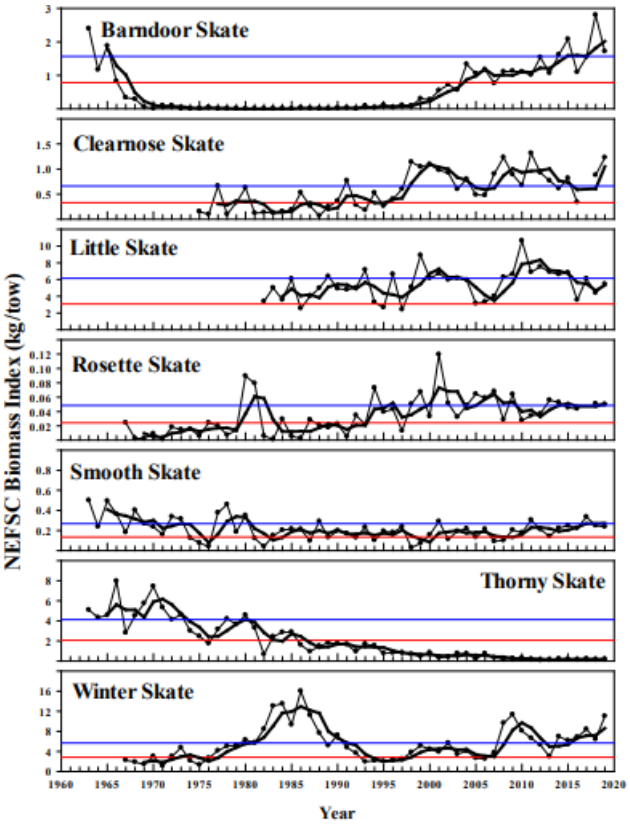

Figure 17: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For barndoor skate, the 2017 to 2019 average index is above the 2016 to 2018 index by 11.4% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is considered a low concern.

Justification:

The fishing mortality reference points are based on changes in the 3-year survey biomass indices. If there is a decline in the 3-year moving average of the survey biomass index that is greater than the

average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY}, and overfishing is occurring for that skate species (Sosebee 2020).

Blackback

Factor 2.1 - Abundance

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

Based on the 2017 Georges Bank blackback/winter flounder stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 3,946 mt, which is 52% of the biomass target for an overfished stock (SSB_{MSY} = 7,600 with a threshold of 50% of SSB_{MSY}; see Figure 18) (Hendrickson 2017). According to the NMFS first quarter 2018 update, Georges Bank blackback/winter flounder is not overfished and is in year 8 of a 7-year rebuilding plan (NMFS 2018c). Because the stock is not overfished, and biomass is less than 75% of the target biomass, abundance is scored a moderate concern.

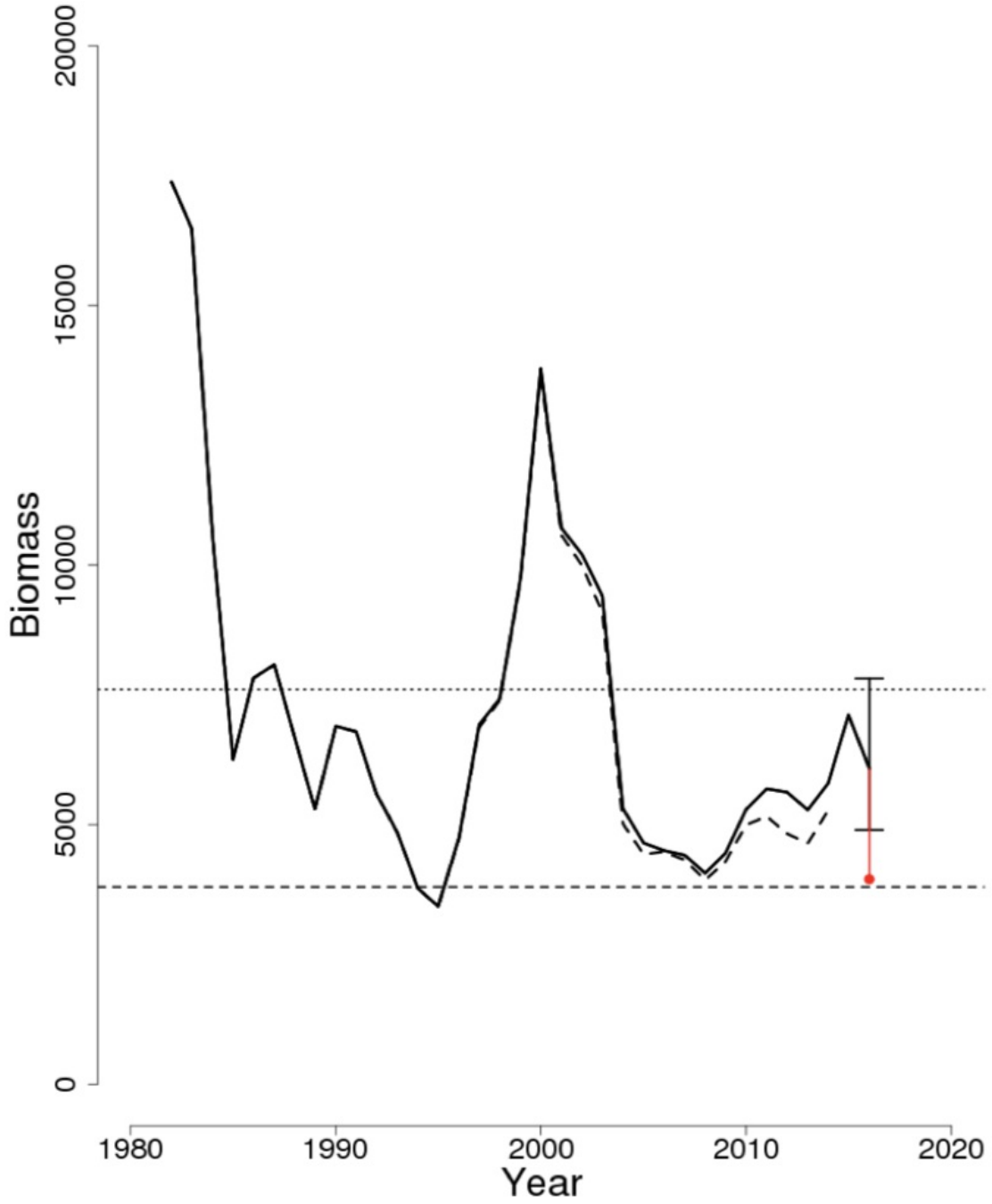

Figure 18: Trends in spawning stock biomass (mt) of Georges Bank blackback/winter flounder between 1982 and 2016 from the current (solid line) and previous (dashed line) assessments and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY}; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY}; horizontal dotted line) based on the 2017 assessment. The 90% normal confidence interval is shown for 2016 (Hendrickson 2017).

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

Based on the 2020 Gulf of Maine blackback/winter flounder stock assessment update, biomass (30+ cm mt) in 2019 was estimated to be 2,862 mt (see Figure 19), and biomass status is unknown (NOAA 2020c). Biomass is estimated from survey area-swept for nonoverlapping strata from three different fall trawl surveys: Maine New Hampshire (MENH), Massachusetts Division of Marine Fisheries (MDMF), and Northeast Fisheries Science Center (NEFSC), using an updated survey gear catchability (q) estimate of 0.87 (on the wing spread) from the sweep study (Miller et al. 2017) (Nitschke 2017), but biomass-based reference points cannot be determined from this method. According to the NMFS first quarter 2022 update, Gulf of Maine blackback/winter flounder overfishing status is also unknown (NMFS 2022).

A productivity-susceptibility analysis (PSA) was calculated to determine the inherent vulnerability of blackback, because biomass relative to a reference point is unknown. The PSA score = 2.84 (detailed scoring of each PSA attribute is shown below), and blackback is deemed to have medium vulnerability. Because of the medium vulnerability of blackback, Seafood Watch considers abundance a moderate concern.

Justification:

Productivity-Susceptibility Analysis:

Scoring Guidelines

1. Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2. Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: S = [(S1 × S2 × S3 × S4) – 1 ÷ 40] + 1.

3. Vulnerability score (V) = the Euclidean distance of P and S using the following formula: V = v(P^2 + S^2)

Productivity Attribute	Relevant Information	Risk (1 = low risk, 2 = medium risk, 3 = high risk)
Average age at maturity	1.9–3.5 (Froese and Pauly 2018)	1
Average maximum age	14 years (Lux 1973)	2
Fecundity	200,000–1,400,100 (Buckley et al. 1991)	1
Average maximum size	64 cm (Froese and Pauly 2018)	1
Average size at maturity	27.4 cm (Buckley et al. 1991)	1
Reproductive strategy	Demersal {Scotten et al. 1973}	2
Habitat quality	Moderately altered (default)	2
Productivity Score = 1.625		

Susceptibility Attribute	Relevant Information	Risk (1 = low risk, 2 = medium risk, 3 = high risk)
Areal overlap	>30% overlap (default)	3
Vertical overlap	High overlap with demersal fishing gears	3
Selectivity of fishery	Species is targeted and is not likely to escape gear, but conditions under "high risk" do not apply	2
Post-capture mortality	Retained species (default)	3
Susceptibility Score = 2.325		
Vulnerability Score = 2.84		

The PSA score for blackback in GoM bottom trawl fisheries is calculated as follows:

Vulnerability (V) = $\sqrt{}(P^2 + S^2)$

V = $\sqrt{}(1.625^2 + 2.325^2)$

V = 2.84

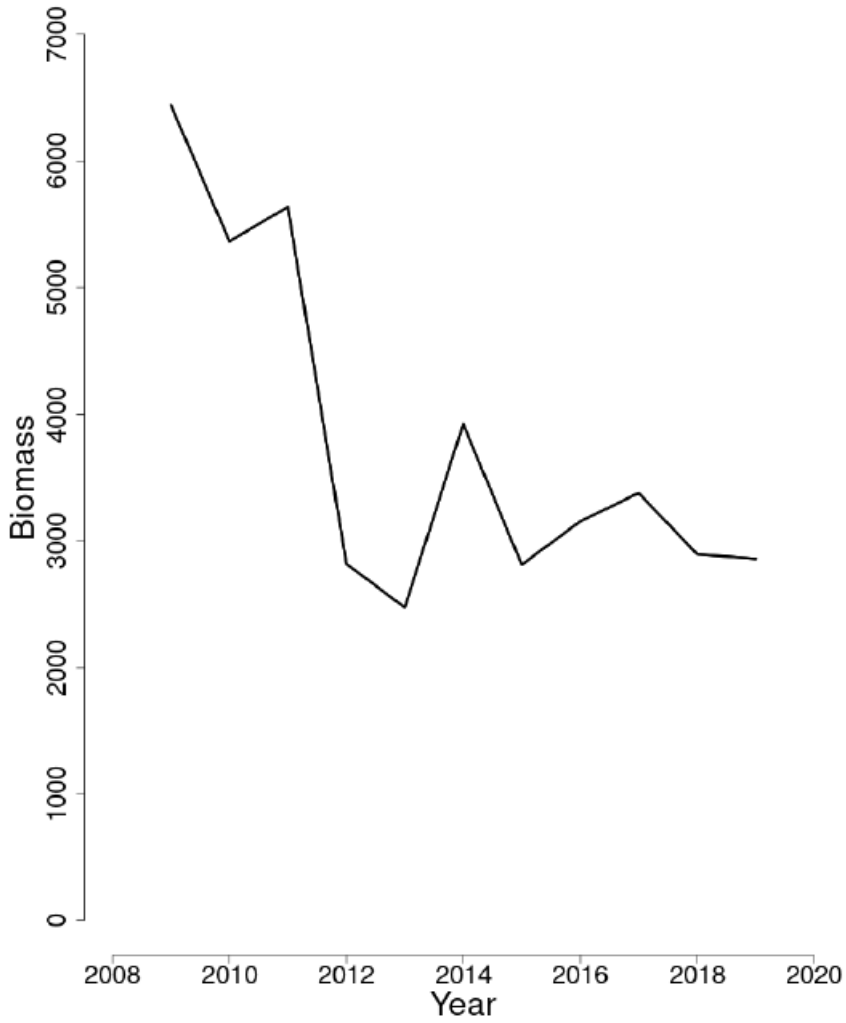

Figure 19: Trends in 30+ cm area-swept biomass of Gulf of Maine blackback/winter flounder between 2009 and 2019 from the current assessment based on the fall (MENH, MDMF, NEFSC) surveys. From (NOAA 2020c).

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

The 2017 Southern New England/Mid-Atlantic blackback/winter flounder stock assessment spawning stock biomass (SSB) for 2016 was 4,360 mt, which was 18% of the biomass target of 24,687 mt, as well as 36% of the biomass threshold of an overfished stock ($SSB_{THRESHOLD}$ = 12,343.5 mt; see Figure 20) (NEFSC 2017f). Because this stock is overfished, this factor is considered a high concern.

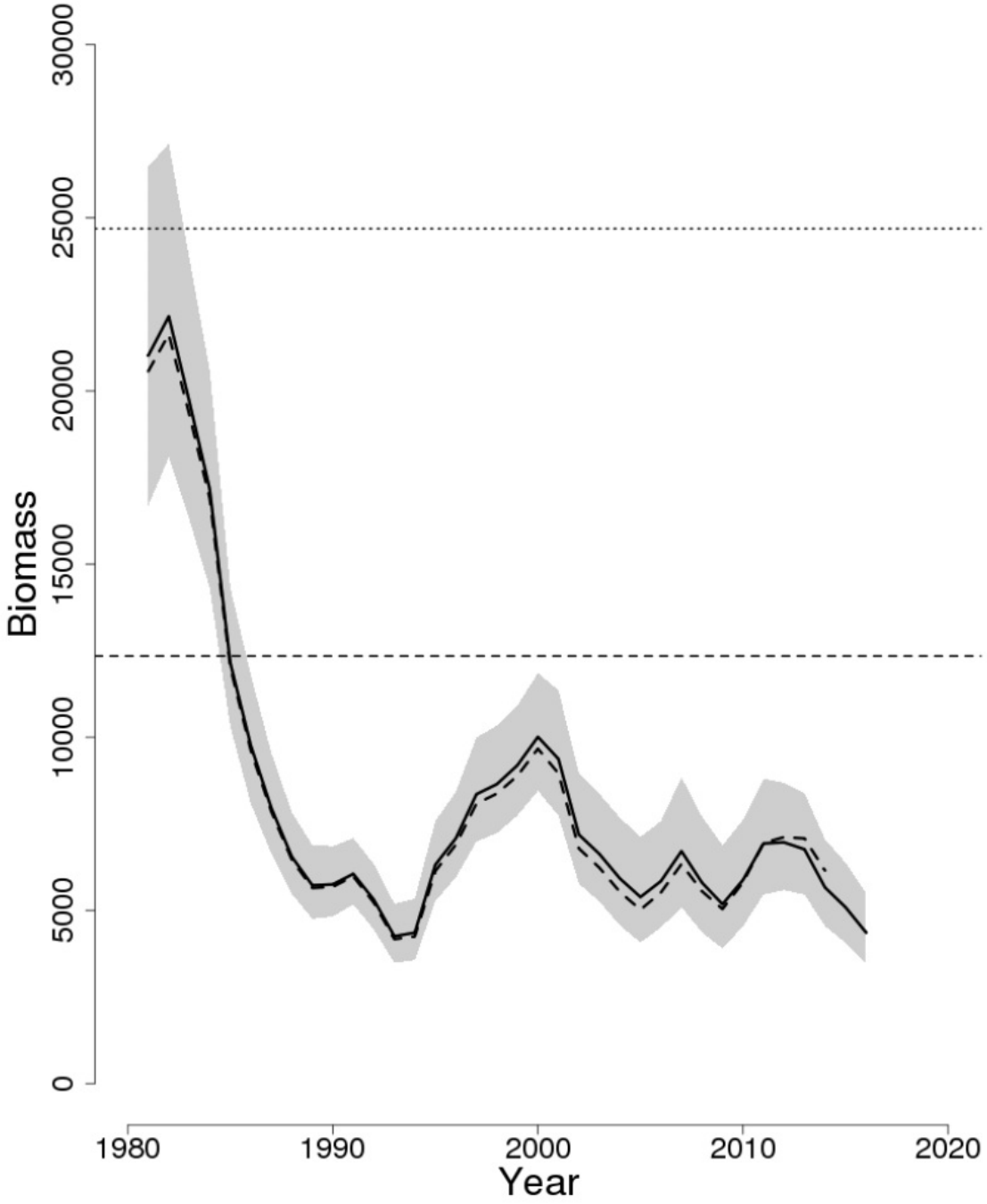

Figure 20: Trends in spawning stock biomass of Southern New England Mid-Atlantic blackback/winter flounder between 1981 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {NEFSC 2017}.

Factor 2.2 - Fishing Mortality

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 Georges Bank blackback/winter flounder stock assessment, the 2016 fully selected fishing mortality (F) was estimated to be 0.117, which is 22% of the overfishing threshold (F_{MSY} = 0.522; see Figure 21) (Hendrickson 2017). According to the NMFS first quarter 2018 update, Georges Bank blackback/winter flounder is in year 8 of a 7-year rebuilding plan (NMFS 2018c). Because blackback/winter flounder is not undergoing overfishing, fishing mortality is scored a low concern.

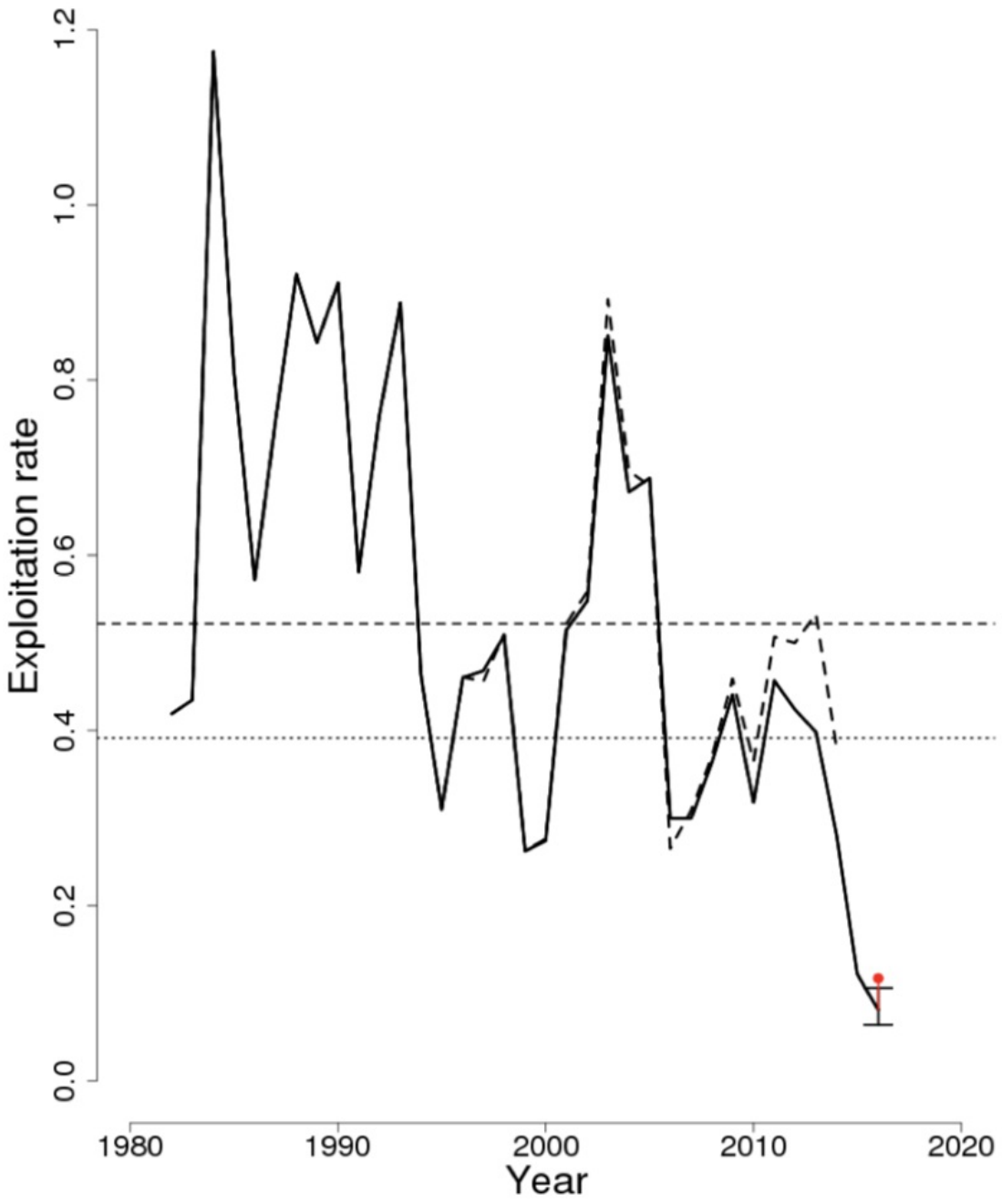

Figure 21: Trends in fully selected fishing mortality (F_{FULL}) of Georges Bank blackback/winter flounder between 1982 and 2016 from the current (solid line) and previous (dashed line) assessments and the corresponding $F_{THRESHOLD}$ (F_{MSY} = 0.522; horizontal dashed line) as well as F_{TARGET} (75% of F_{MSY} = 0.392; horizontal dotted line). The 90% normal confidence interval is shown for 2016 (Hendrickson 2017).

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2020 Gulf of Maine blackback/winter flounder stock assessment update, the 2019 30+ cm exploitation rate was estimated to be 0.052, which is 23% of the overfishing exploitation threshold proxy (E_{MSY} proxy = 0.23; see Figure 22) (NOAA 2020c). Therefore, fishing mortality is scored a low concern.

Justification:

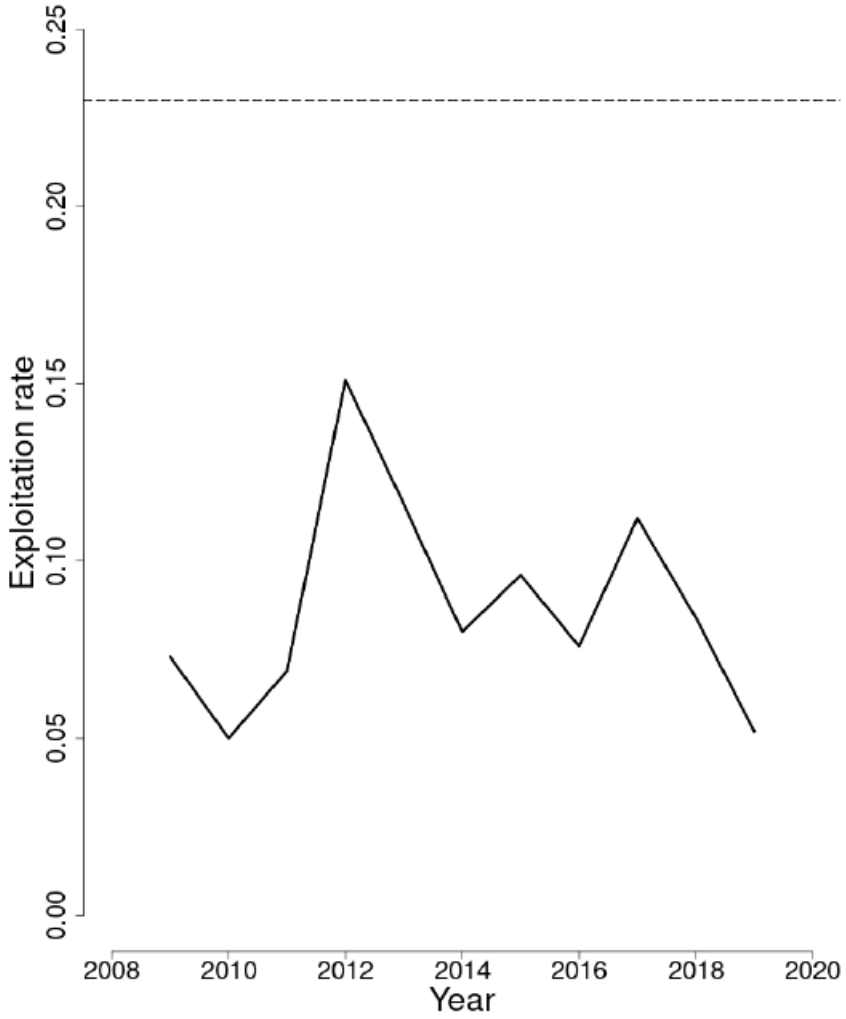

Figure 22: Trends in the exploitation rates (E_{FULL}) of Gulf of Maine blackback/winter flounder between 2009 and 2019 from the current assessment and the corresponding $F_{THRESHOLD}$ (E_{MSY} proxy = 0.23; horizontal dashed line). From (NOAA 2020c).

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

The 2017 Southern New England/Mid-Atlantic blackback/winter flounder stock assessment indicated that the 2016 fully selected fishing mortality (F_{FULL}) on fully selected ages 4 and 5 was 0.21, which

was 62% of the overfishing threshold (F_{MSY} = 0.34; see Figure 23) (NEFSC 2017f). The SNE/MA blackback stock shows an overall declining trend in SSB over the time series (1981 to 2016), with current estimates near the time series low (NEFSC 2017f).

The stock was in a 10-year rebuilding plan, but did not meet its rebuilding target in 2014, partly because of low recruitment {NEFSC 2015}. In 2014, NOAA Fisheries partly implemented Framework Adjustment 50 to revise the rebuilding end date to 2023. It is possible that, although fishing mortality is below MSY, it may be above the level that will allow recovery under current environmental conditions. The stock remains vulnerable to heavy fishing pressure and habitat degradation, and has low genetic variability that hinders its recovery {NEFSC 2015}. But, estimates of fishing mortality have remained steady since 2012, and recruitment has been increasing since an all-time low in 2013 and is currently above the 10-year average (and the highest since 2008) (NEFSC 2017f). Because overfishing is not occurring, but recovery of the stock has not yet been achieved, we consider fishing mortality a moderate concern.

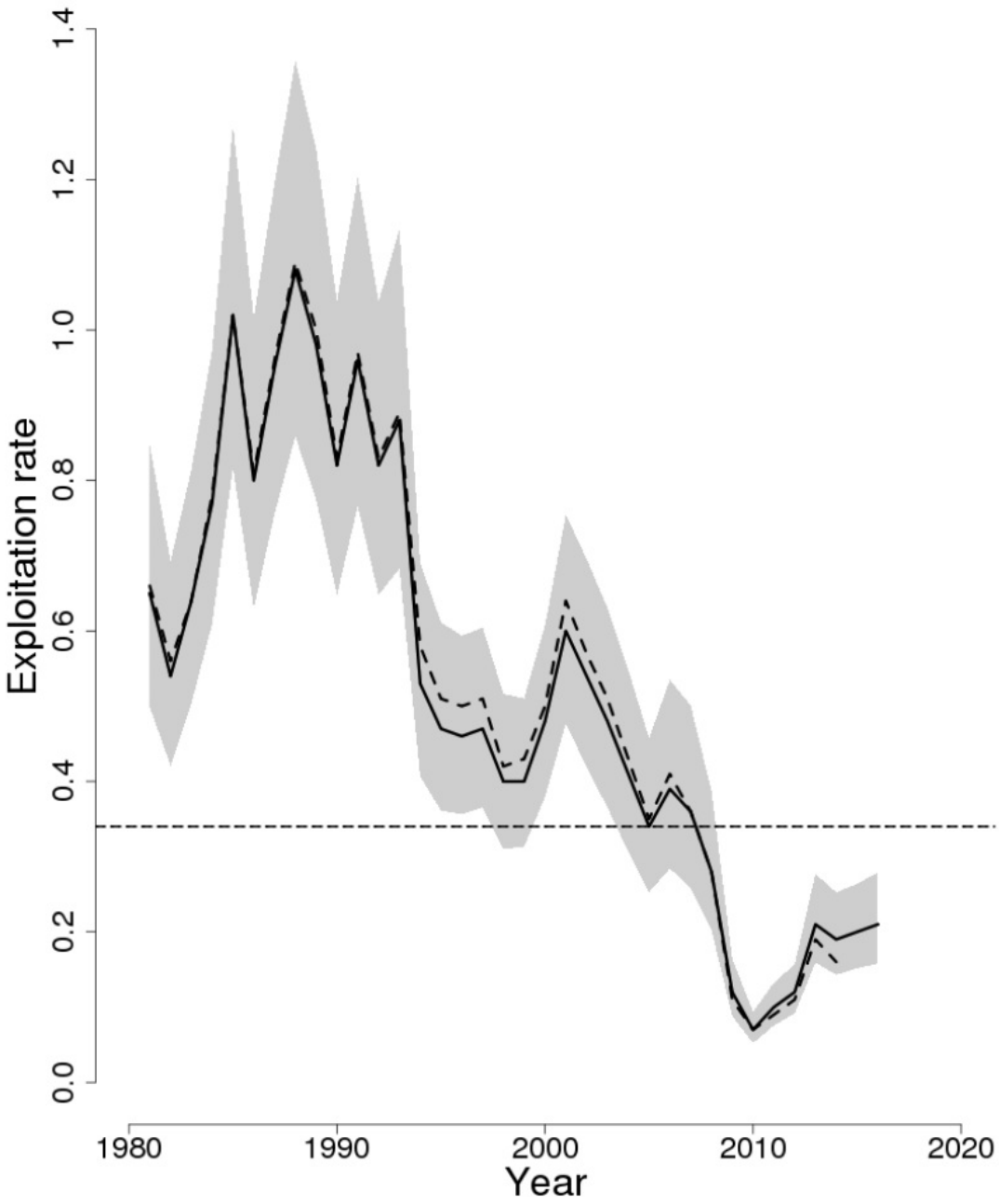

Figure 23: Trends in the fully selected fishing mortality (F_{FULL}) of Southern New England Mid-Atlantic blackback/winter flounder between 1981 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} = 0.34; horizontal dashed line) based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {NEFSC 2017}.

Clearnose skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For clearnose skate, the 2017 to 2019 NEFSC autumn average biomass index of 1.05 kg/tow is above the biomass threshold reference point (0.33 kg/tow) and the B_{MSY} proxy (0.66 kg/tow; see Figure 24) (Sosebee 2020). Because the stock is not overfished, but there is uncertainty in using a survey index as a proxy for biomass relative to MSY, abundance is scored a low concern (rather than very low concern).

Justification:

For clearnose skate, the B_{MSY} proxy is defined as the 75th percentile of the appropriate survey biomass index time series for that species (Sosebee 2020).

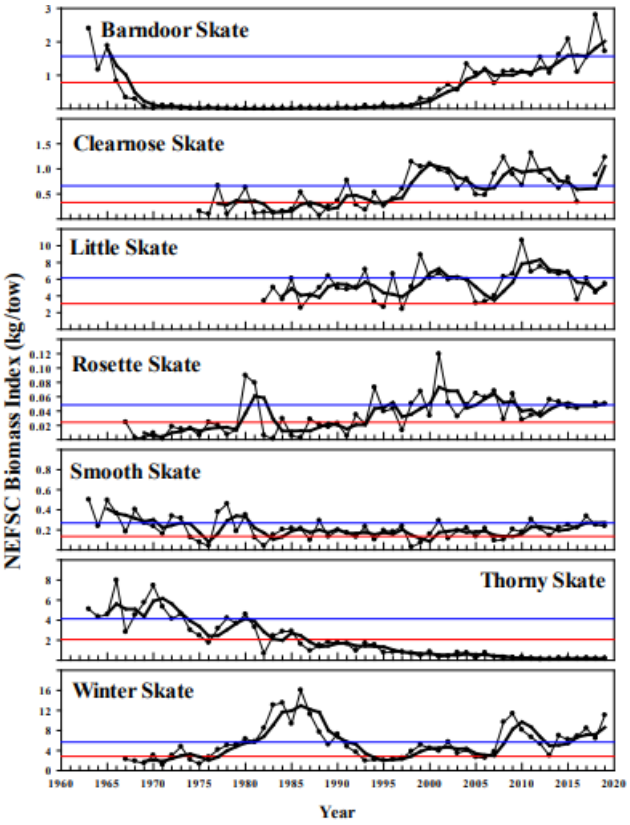

Figure 24: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For clearnose skate, the 2017 to 2019 index is above the 2016 to 2018 index by 73.1% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is scored a low concern.

Justification:

The fishing mortality reference points are based on changes in the 3-year survey biomass indices. If there is a decline in the 3-year moving average of the survey biomass index that is greater than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY}, and overfishing is occurring for that skate species (Sosebee 2020).

Haddock

Factor 2.1 - Abundance

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Very Low Concern

Based on the 2017 Georges Bank haddock stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 290,324 mt, which is 278% of the biomass target (SSB_{MSY} proxy = 104,312; see Figure 25) (Brooks 2017). Because the stock is not overfished and SSB is above the biomass target, abundance is scored a very low concern.

Justification:

A retrospective adjustment was made for both the determination of stock status and projections of catch in 2018, which changed the 2016 SSB from 549,938 to 290,324 (Brooks 2017).

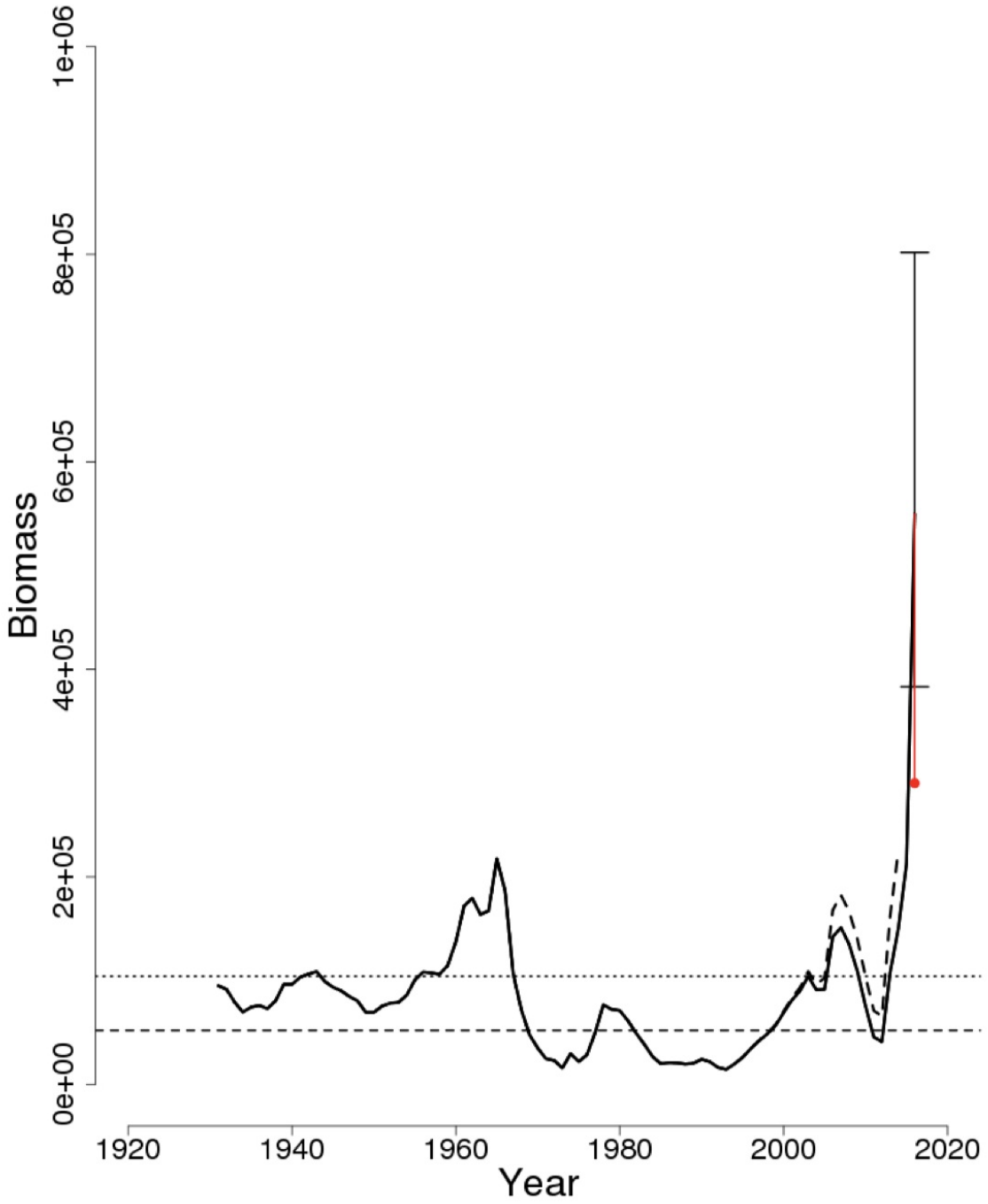

Figure 25: Trends in spawning stock biomass of Georges Bank haddock between 1931 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2015 assessment (Brooks 2017).

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Very Low Concern

Based on the 2017 Gulf of Maine haddock stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 47,821 mt, which is 706% of the biomass target (SSB_{MSY} proxy = 6,769; see Figure 26) (Palmer 2017b). Because the stock is not overfished and SSB is above the biomass target, abundance is scored a very low concern.

Justification:

The M = 0.2 model has a major retrospective pattern (7-year Mohn's rho SSB = 0.53, F = –0.31) and the M-ramp model has a minor retrospective pattern (7-year Mohn's rho SSB = 0.30, F = –0.17) (Palmer 2017b). But, following the recommendations of the SARC 55 and 2014 assessment review panels, no retrospective adjustments were made to the terminal model results or in the base catch projections (NEFSC 2013a)(Palmer 2014)(Palmer 2017b). The 2015 assessment review panel (NEFSC 2015b) supported this decision, noting that an adjustment using the 7-year average may not be appropriate.

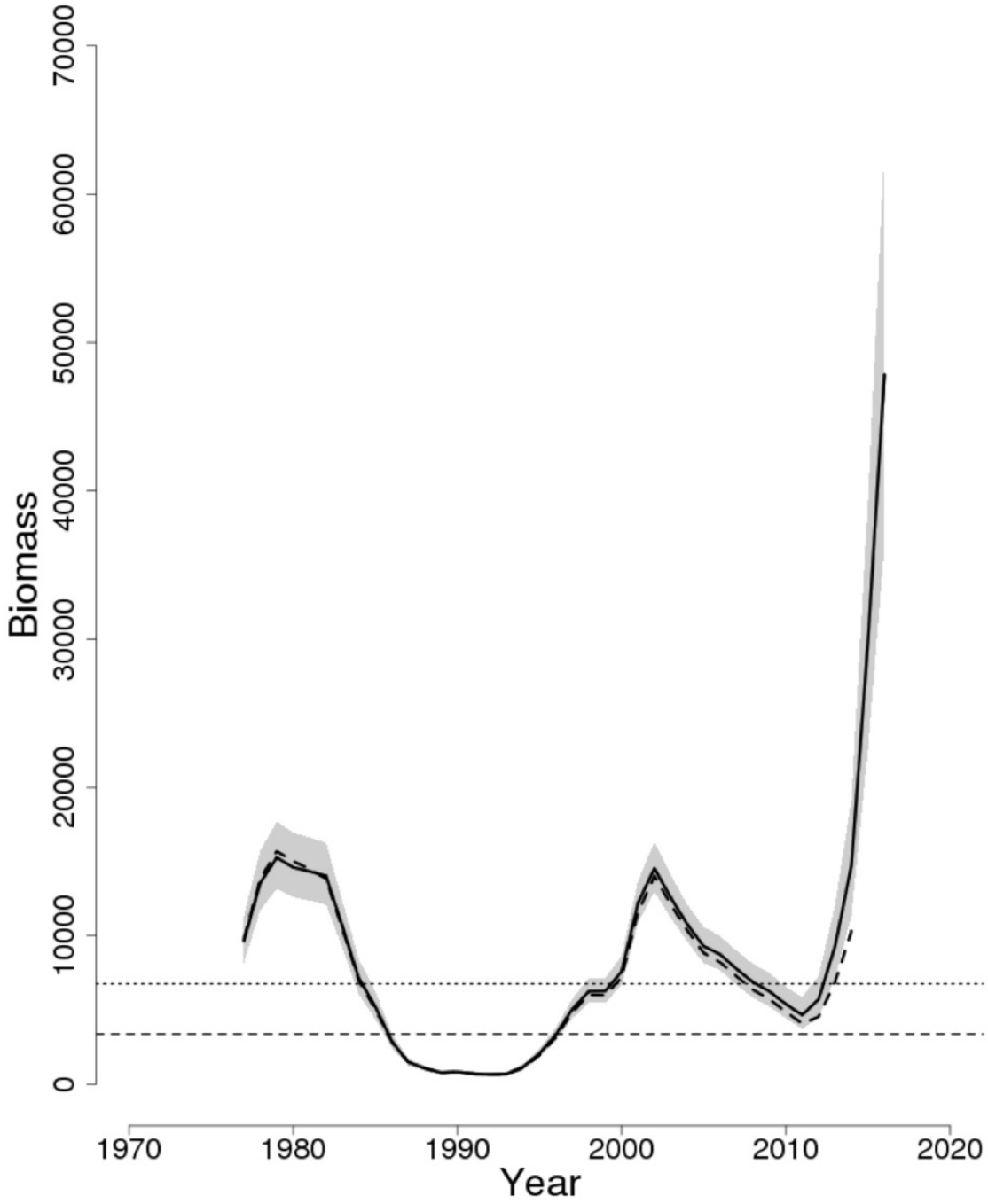

Figure 26: Trends in spawning stock biomass (SSB) of Gulf of Maine haddock between 1977 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown (Palmer 2017b).

Factor 2.2 - Fishing Mortality

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 Georges Bank haddock stock assessment, the 2016 numbers-weighted average fishing mortality on ages 5 to 7 was estimated to be 0.309, which is 88% of the overfishing threshold proxy (F_{MSY} proxy = 0.353; see Figure 27) (Brooks 2017). Because the stock is not undergoing overfishing, fishing mortality is scored a low concern.

Justification:

The F_{MSY} proxy is expressed as a numbers-weighted average F on ages 5 to 7 for comparability with the VPA estimated F. The retrospective adjustment changed the 2016 $F_{5–7}$ from 0.113 to 0.309 (Brooks 2017).

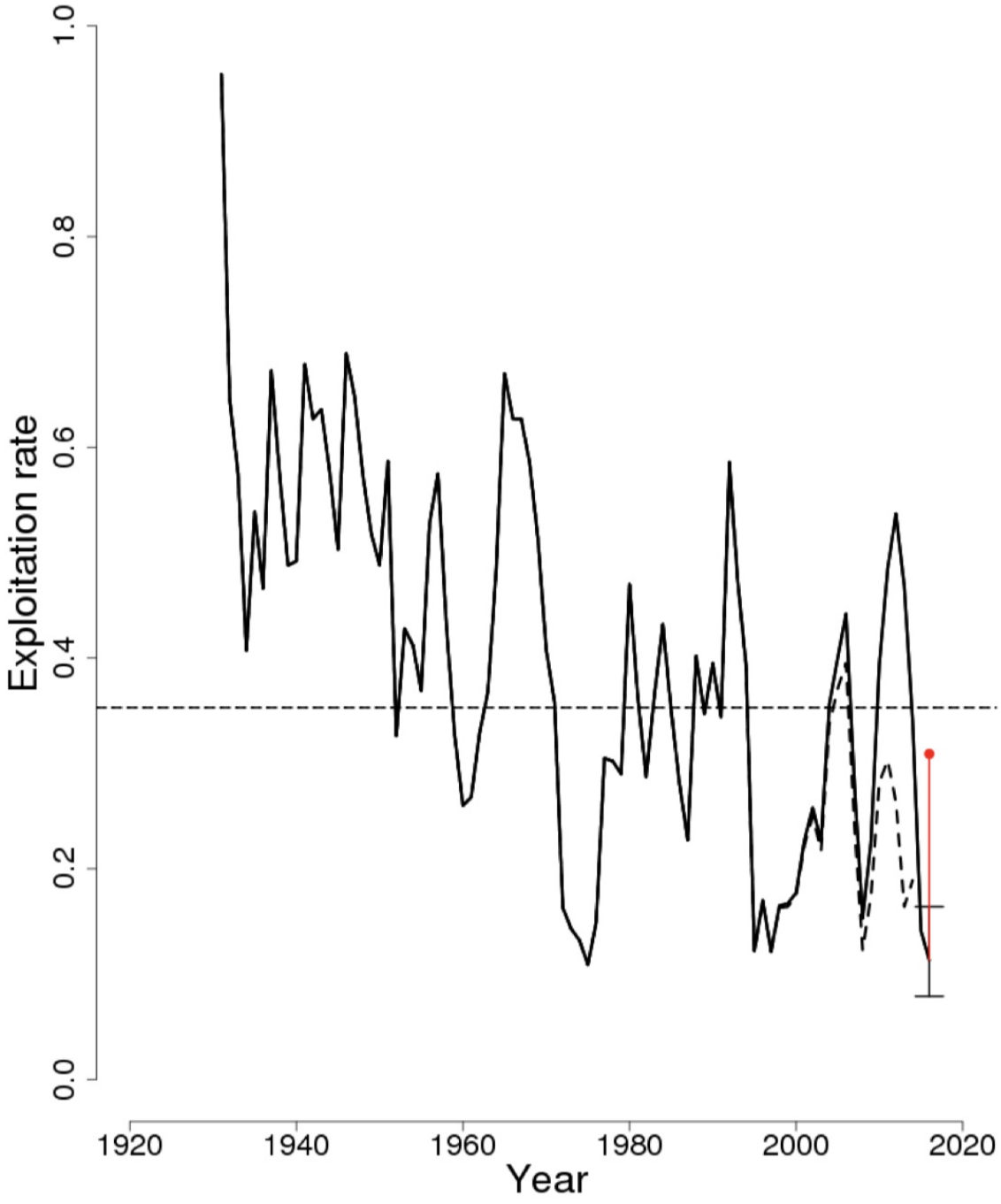

Figure 27: Trends in the numbers weighted fishing mortality (F_{5-7}) of Georges Bank haddock between 1931 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.353; horizontal dashed line) based on the 2015 assessment (Brooks 2017).

Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 Gulf of Maine haddock stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.137, which is 30% of the overfishing threshold proxy (F_{MSY} proxy = $F_{40\%}$ = 0.455; see Figure 28) (Palmer 2017b). Because the stock is not undergoing overfishing, fishing mortality is scored a low concern.

Justification:

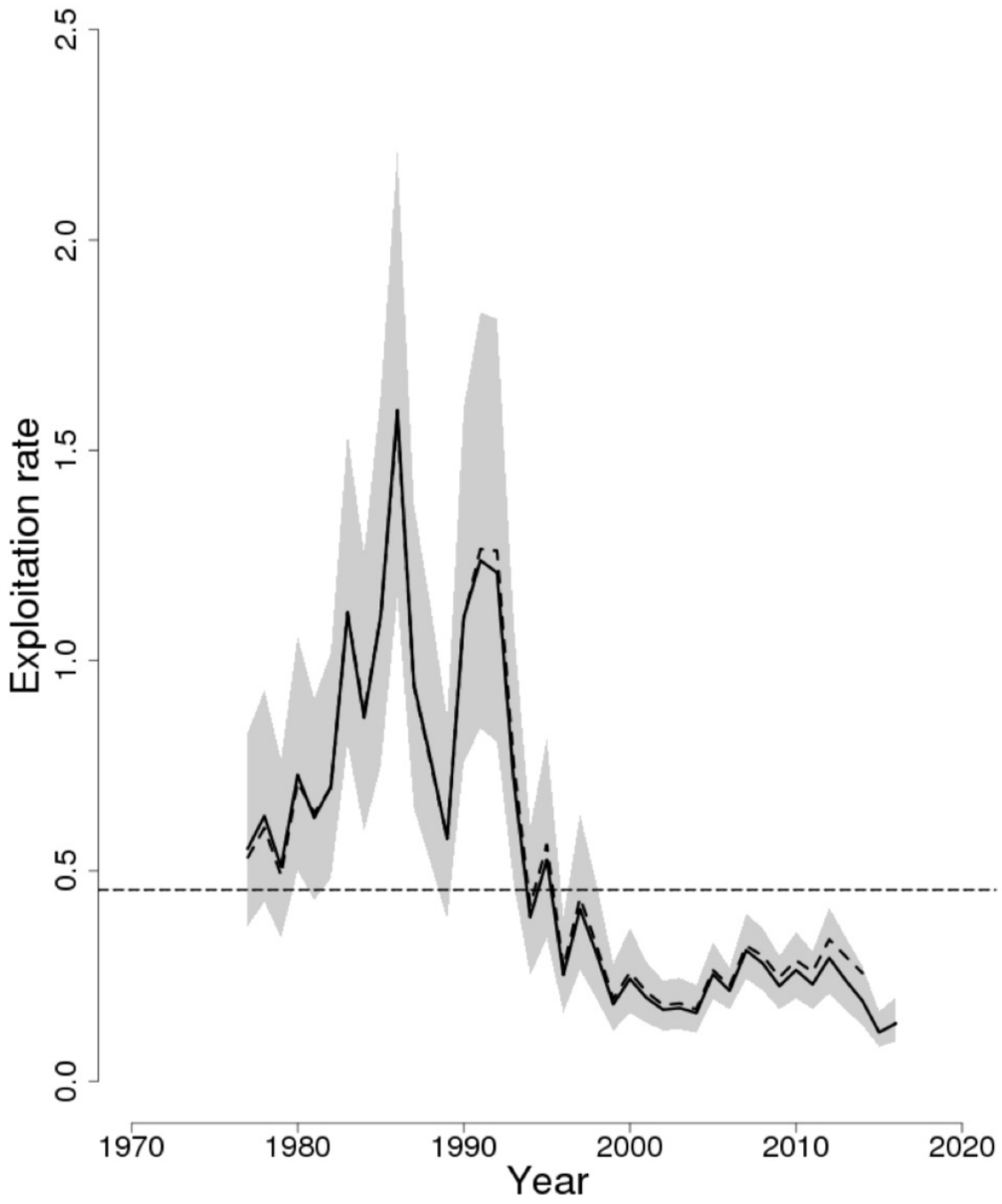

Figure 28: Trends in the fully selected fishing mortality (F) of Gulf of Maine haddock between 1977 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.455; horizontal dashed line) from the 2017 assessment model. The approximate 90% lognormal confidence intervals are shown (Palmer 2017b).

Harbor porpoise

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 95,543 individuals (CV = 0.31), with a minimum population size of 74,034, which is from a 2016 U.S. shipboard and aerial survey combined with a DFO aerial survey of the Bay of Fundy and Scotian Shelf {Hayes et al. 2021}. But, the surveyed area may not have covered the entire area of the stock's habitat at the appropriate time of the year, and the current abundance estimate did not account for availability bias due to the submergence of animals. Without a correction for availability bias, the abundance estimate is expected to be biased low {Hayes et al. 2021}. The status of this population relative to the optimum sustainable population (OSP) in the U.S. Atlantic EEZ is unknown, and a trend analysis has not been conducted for this species {Hayes et al. 2021}. The International Union for the Conservation of Nature (IUCN) considers this species as "Least Concern" (Hammond et al. 2008b), and because status and trend analysis are unknown, abundance is considered a moderate concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

The total annual estimated average fishery-related mortality or serious injury to the harbor porpoise stock during 2014 to 2018 was 150 harbor porpoises (CV = 0.14) from U.S. fisheries, with a potential biological removal (PBR) of 851 (Hayes et al. 2021). The Northeast bottom trawl fishery accounted for less than 1% (1.1/150 individuals) of the total by-catch across all fisheries {Hayes et al. 2021}. Because PBR is not exceeded, and the bottom trawl fishery accounts for less than 50% of the PBR, fishing mortality is considered a low concern.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

The total annual estimated average fishery-related mortality or serious injury to the harbor porpoise stock from 2014 to 2018 was 150 harbor porpoises (CV = 0.14) from U.S. fisheries, with a potential biological removal (PBR) of 851 (Hayes et al. 2021). The Northeast sink gillnet fishery is by far the primary contributor, accounting for 88% (132/150 individuals) of the total by-catch across all

fisheries, while the mid-Atlantic gillnet fishery accounts for 11% of fishing mortality (Hayes et al. 2021). But, because total U.S. fisheries mortality or serious injury does not exceed PBR, and mortality or serious injury for the bottom gillnet fishery specifically is less than 50% of the PBR, fishing mortality is considered a low concern.

Little skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern
For little skate, the 2017 to 2019 NEFSC spring average biomass index of 5.32 kg/tow is above the biomass threshold reference point (3.07 kg/tow), but below the B_{MSY} proxy (6.15 kg/tow; see Figure 29) (Sosebee 2020). Because the stock is not overfished, and biomass is greater than 75% of the biomass target, abundance is considered a low concern.

Justification:
For little skate, the B_{MSY} proxy is defined as the 75th percentile of the appropriate survey biomass index time series for that species.

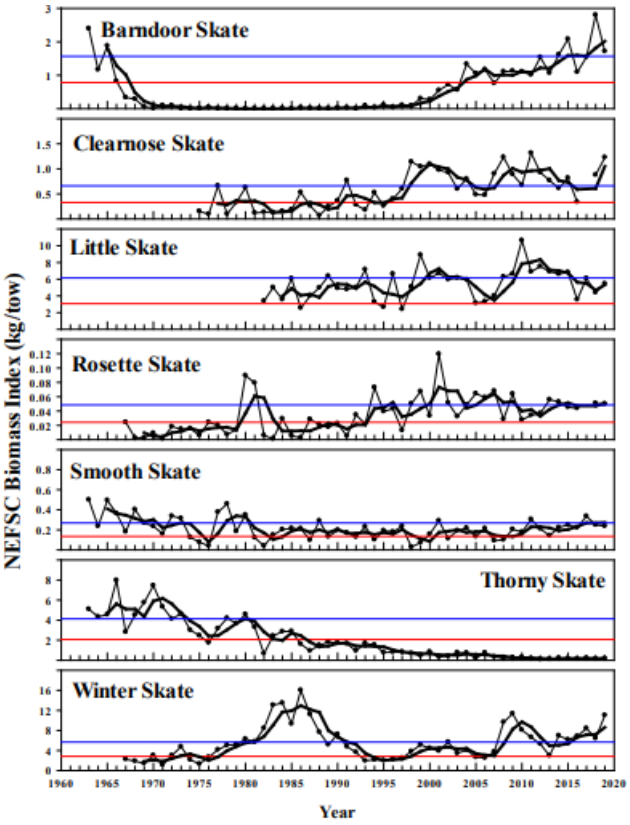

Figure 29: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For little skate, the 2017 to 2019 average index is above the 2016 to 2018 average by 13.4% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is considered a low concern.

Justification:

The fishing mortality reference points are based on changes in the 3-year survey biomass indices. If there is a decline in the 3-year moving average of the survey biomass index that is greater than the

average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY}, and overfishing is occurring for that skate species (Sosebee 2020).

Loggerhead turtle

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

Loggerhead turtle continues to be listed as "Threatened" in the Northwest Atlantic (NOAA Fisheries 2017). Therefore, based on conservation status, this factor is considered a high concern.

Justification:

Loggerhead turtle nesting numbers have declined in all but one of the nine major rookeries that likely contribute turtles to the population in the Northwest Atlantic, although the cause of the decline could be related to a number of factors, including recruitment failures in previous years, increased nesting of first-time females (which have fewer broods with fewer eggs), ship strikes, and fishing mortalities (TEWG 2009).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

Loggerhead turtle is known to interact with bottom trawl, gillnet, and pot/trap fisheries. The most recent biological opinion for the monkfish fishery used information from {Murray 2018} and data from the Sea Turtle Disentanglement Network (STDN) to estimate that 1,036 loggerhead turtles will interact with gillnet fisheries in the U.S. Atlantic region over a 5-year period, resulting in 808 mortalities (NMFS 2021a). It is uncertain what the impact of fishing activities in the region is on the loggerhead turtle population; however, it is not anticipated that monkfish fisheries will appreciably affect the population because the estimated number of mortalities is ≈0.7% of the population based on an estimate of the adult population (38,334 from {Richards et al. 2011}) (NMFS 2021a). Because monkfish fisheries are not expected to negatively impact green turtle populations, a score of low concern is given.

Long-finned pilot whale

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

The best available estimate for long-finned pilot whale in the western North Atlantic is 39,215 (CV = 0.30), with a minimum population size of 30,627 (Hayes et al. 2020). This estimate is from the U.S. summer 2016 surveys combined with the DFO Canada summer 2016 survey, providing coverage from Virginia to Labrador (Hayes et al. 2020). The status of this stock relative to the optimum sustainable population (OSP) in the U.S. Atlantic EEZ is unknown, and there are insufficient data to determine population trends. The International Union for the Conservation of Nature (IUCN) considers this species as "Least Concern" {Minton et al. 2018}, so abundance is considered a moderate concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

The total annual observed average fishery-related mortality or serious injury during 2013 to 2017 was 21 for long-finned pilot whale (CV = 0.15), with a potential biological removal (PBR) of 306 (Hayes et al. 2020). The Northeast bottom trawl fishery is the primary contributor, accounting for 71% (15/21 individuals) of the total by-catch across all fisheries (Hayes et al. 2020). Because the PBR is not exceeded, and the bottom trawl fishery accounts for less than 50% of the PBR, fishing mortality is considered a low concern.

North Atlantic right whale

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

The western Atlantic stock of North Atlantic right whale is listed as "Endangered" under the Endangered Species Act (ESA), and it is considered "Critically Endangered" by the International Union for the Conservation of Nature (IUCN) (Cooke 2020) because it is "considered to be facing an extremely high risk of extinction in the wild" (IUCN 2012). Minimum abundance from the most recent stock assessment was estimated at 364 individuals (best estimate 368) (Hayes et al. 2022), while the best estimate of the population from the North Atlantic Whale Consortium was 336 individuals at the end of 2020 {Pettis et al. 2022}. There are fewer reproductive females producing fewer calves each year, with experts estimating that there are 88 or fewer reproductively active females remaining {Pettis et al. 2022}(NOAA 2022c). The population has been declining since 2011 and calving rates have been low (2017–2019 calving rates averaged four per season, which is <33% of the previous annual average). But in 2020, calving increased (10 calves sighted; 1 involved in a vessel strike) (Pace et al. 2017)(NOAA 2020b). The cause of reduced productivity is unknown but several factors are likely contributing to the declining health of North Atlantic right whale, including climate-related shifts in prey distribution, anthropogenic noise, pollution, vessel strikes, and entanglement in fishing gear (Pace et al. 2017)(NOAA 2019c). Because the North Atlantic right whale is considered "Critically Endangered" by the IUCN, abundance is rated a high concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

The western Atlantic stock of the North Atlantic right whale (NARW) is considered a strategic stock because annual serious injury and mortality (SIM) (7.7 from all sources; 5.7 attributed to fisheries entanglement from 2015 to 2019) exceeds the potential biological removal (PBR) (0.7 whales) (Hayes et al. 2022). Due to a lack of information, it is often not possible to assign entanglements to a specific fishery. Documented entanglements from 2015 to 2019 involving gillnet gear or unidentified gear are attributed to unknown fisheries, of which the monkfish fishery may be a part. Annual SIMs attributed to entanglements in pot/trap gear in Canadian fisheries were 1.95 (279% of PBR), while none were attributed to pot/trap gear in United States fisheries. Serious injuries and mortalities first seen in the United States but not attributable to country were 2.65 (379% of PBR), and those first seen in Canada but not attributable to country were 1.05 (150% of PBR) (Hayes et al. 2022). In 2014, there was one SIM (0.2 average annual serious injuries and mortality, 29% of PBR) that was first seen in the U.S. but not attributable to country, and it was most likely caused by

entanglement in gillnet gear {Sharp et al. 2019}{Sharp et al. Supplemental 2019}.

Vessel strikes and entanglement (from pot/trap and anchored gillnet fisheries) are the two leading causes of mortality and serious injury to North Atlantic right whale, with entanglements increasing over the past decade (Moore 2019). Rope strengths have increased in recent decades (based on data from 1994 to 2010), leading to reduced escape success from entangling gear {Knowlton et al. 2016}. Sinking groundline (2009) and vertical line (2015) regulations have been implemented, resulting in gear configuration changes for which the effects on mitigation of whale entanglement have yet to be determined. Because of limited observation coverage, it is likely that the number of entanglements is severely underestimated {Kraus et al. 2019}. Based on mark-recapture studies through photo identification, <50% of entanglement-related mortality is estimated to be detected, with these same studies demonstrating that 59% of North Atlantic right whales have been entangled more than once (83% at least once), and new scars from entanglement are observed annually for at least 26% of the observed population {Knowlton et al. 2012}.

More than 90% of entanglements (based on 2010–2016 data and partial data for 2016/2017) are not linked to gear (7.8% of entangled NARW carry gear) and only 12% of those are linked to a location {Knowlton et al. 2012}{Knowlton et al. 2019}{Kraus et al. 2019}. Fisheries interactions with NARW have been documented with gillnet fisheries (15% of entanglements attributed to gillnets from 1984 to 2016) {Kraus et al. 2019}. An entanglement that results in gear remaining attached to the whale places an energetic strain that can compromise overall fitness and reproduction {van der Hoop et al. 2016}. Also, a new paper shows that whale lengths have been decreasing due to fishing gear entanglements and vessel strikes since 1981, possibly leading to reduced reproductive success and increased probability of the lethality of entanglements {Stewart et al. 2021}. Challenges in identifying the fishery involved in an entanglement occur due to ineffective gear marking (gear recovered from an entanglement does not carry a mark identifying the gear type, target species, and/or location) or the inability to recover gear from the entangled whale. A recent study estimated that, from 2010 to 2017, the carcass detection rate (how many whale deaths were identified) was 29% {Pace et al. 2021}. Pace et al. (2021) also concluded that, of the cryptic mortalities, the majority were likely caused by entanglement rather than blunt force trauma from vessel strikes.

An Unusual Mortality Event is in effect (since June 2017) for North Atlantic right whale, which includes 34 mortalities (21 in Canada and 13 in the U.S., based on the location of stranding, not the location of mortality) through December 2021 (NOAA 2021). Mortalities are attributed to a combination of human interactions including vessel strikes and rope entanglement (final results are pending; however, preliminary investigations list 11 suspected as vessel strikes, 9 suspected as entanglement, 13 as pending or unknown causes, and 1 as perinatal mortality) (NOAA 2021) (see Figure 30).

The Mid-Atlantic and Northeast sink gillnet fisheries are each classified as a Category I fishery by NOAA (NMFS 2018c). Because cumulative fisheries mortality and serious injury far exceed PBR, and entanglement due to unknown fisheries (of which the sink gillnet fisheries may be a part) is considered a significant contributor, the impact of the sink gillnet fishery cannot be considered sustainable due to significant uncertainty in entanglement sources, so fisheries mortality is rated a high concern.

Justification:
Distributional shifts in the abundance of North Atlantic right whale (NARW) across its range may lead to shifts in regional fisheries interactions and entanglement risks. Based on data from passive acoustic monitoring (2004–2014), North Atlantic right whale is highly mobile and has a year-round presence across its geographic range {Davis et al. 2017}. In recent years (2010–2014), there has been a distributional shift, with presence increased in the Southern New England and mid-Atlantic regions and decreased in the Scotian Shelf and greater Gulf of Maine. Visual surveys in Canadian waters reported increased presence farther north in the Gulf of St. Lawrence, which may be related to increased fisheries interactions with North Atlantic right whale in Canada {Meyer-Gutbrod et al. 2018}. A recent study of individual whales identified in the Gulf of St. Lawrence found that there was a high return rate from year to year, indicating that this is an important feeding area for a specific group of NARW (Crowe et al. 2021). The study also found that, in 2019, a total of 137 individual NARW were estimated to have visited the Gulf of St. Lawrence (Crowe et al. 2021), which was 38% of the estimated 356 NARW alive at the end of 2019 (Pettis et al. 2021). Although this identifies the Gulf of St. Lawrence as an important foraging area for a significant proportion of the population, it does raise uncertainty regarding the location of the remaining individuals and the concern that they may be in areas that are offered less protection (Crowe et al. 2021).

In 2017, an Unusual Mortality Event for North Atlantic right whale was observed in the region (NOAA 2020). It is unclear if distributional shifts are due to environmental or anthropogenic effects; however, warming temperatures and shifting prey distributions are thought to play a part in the change {Meyer-Gutbrod et al. 2018}. The primary prey (*Calanus finmarchicus*) of the North Atlantic right whale currently remains in highest abundance in the western Gulf of Maine {Record et al. 2019}.

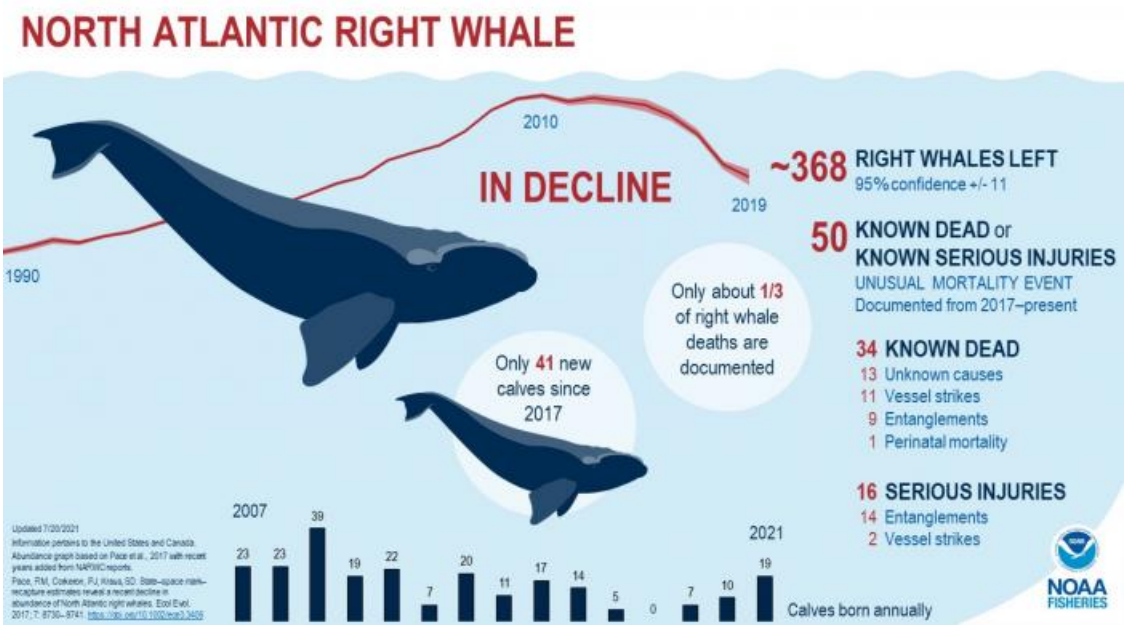

Figure 30: An infographic showing best estimates of current North Atlantic right whale population numbers and causes of death during the current Unusual Mortality Event, 2017 to present. (NOAA 2021)

Ocean pout

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 ocean pout stock assessment, the biomass proxy (B) in 2016 was estimated to be 0.223 (kg/tow), which is 5% of the biomass target (B_{MSY} proxy = 4.94; see Figure 31) (Wigley 2017a). According to the NMFS first quarter 2018 update, ocean pout is overfished and in year 14 of a 10-year rebuilding plan (NMFS 2018c). Therefore, abundance is scored a high concern.

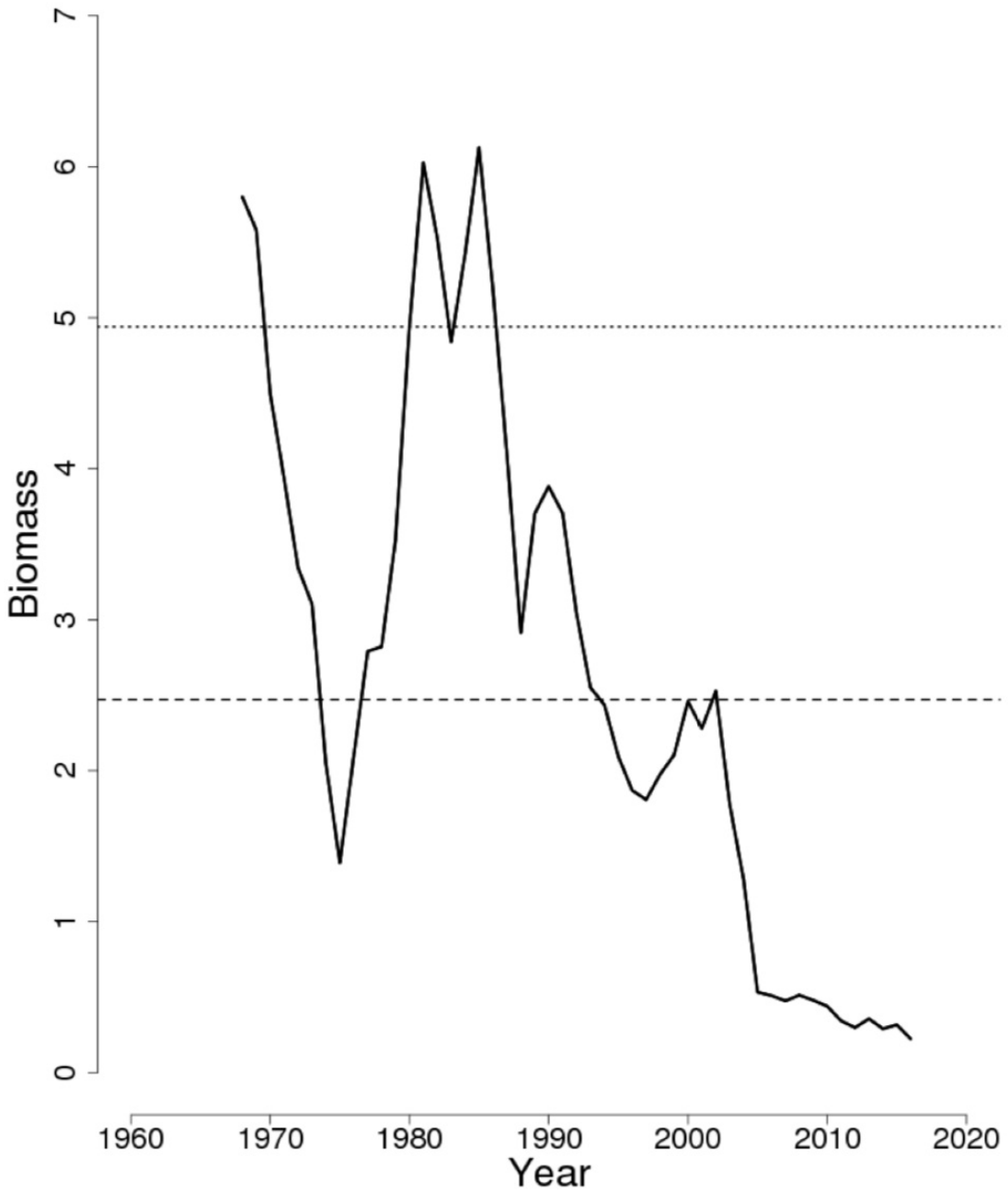

Figure 31: Trends in biomass (kg/tow) of ocean pout between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment, and the corresponding $B_{THRESHOLD}$ (1/2 B_{MSY} proxy; horizontal dashed line) as well as B_{TARGET} (B_{MSY} proxy; horizontal dotted line) based on the current assessment {Wigley 2017}.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

Based on the 2017 ocean pout stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.221, which is 29% of the overfishing threshold proxy (F_{MSY} proxy = 0.76; see Figure 32) (Wigley 2017a). Nevertheless, biomass is still decreasing, and further studies have been suggested to explore why this stock is not rebuilding as expected. Because there is a possibility that fishing mortality is preventing rebuilding of the stock, fishing mortality is scored a moderate concern.

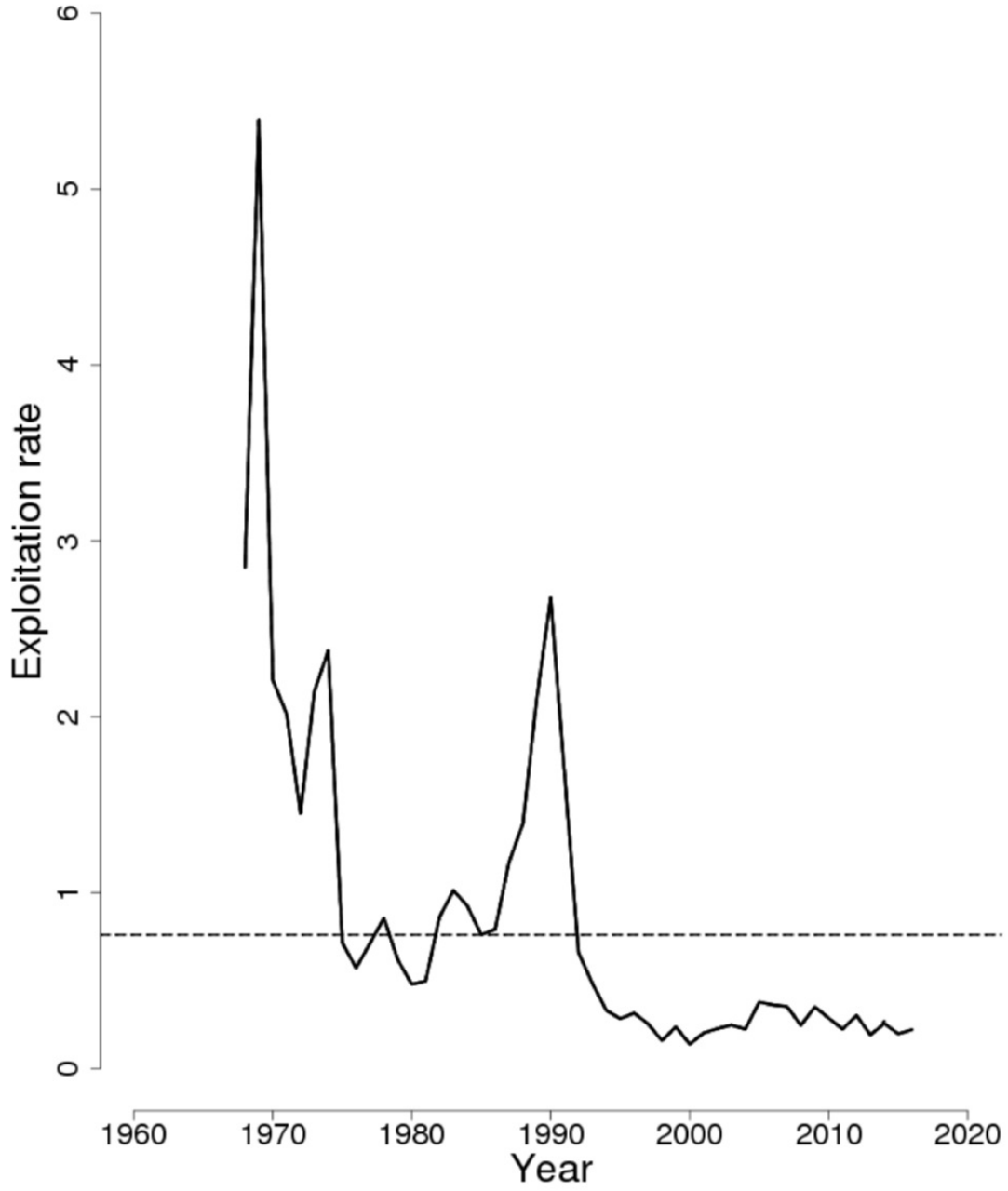

Figure 32: Trends in the exploitation rate of ocean pout between 1968 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.76; horizontal dashed line) based on the current assessment {Wigley 2017}.

Pollock

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Very Low Concern

Based on the 2017 pollock stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 183,907 mt under the base model and 72,889 mt under the "flat sel" sensitivity model, which is 174% and 120%, respectively, of the biomass target, an SSB_{MSY} proxy of SSB at $F_{40\%}$ (105,510 and 60,738 mt; see Figure 33) (Linton 2017a). Because pollock is not overfished and SSB is above the biomass target, abundance is scored a very low concern.

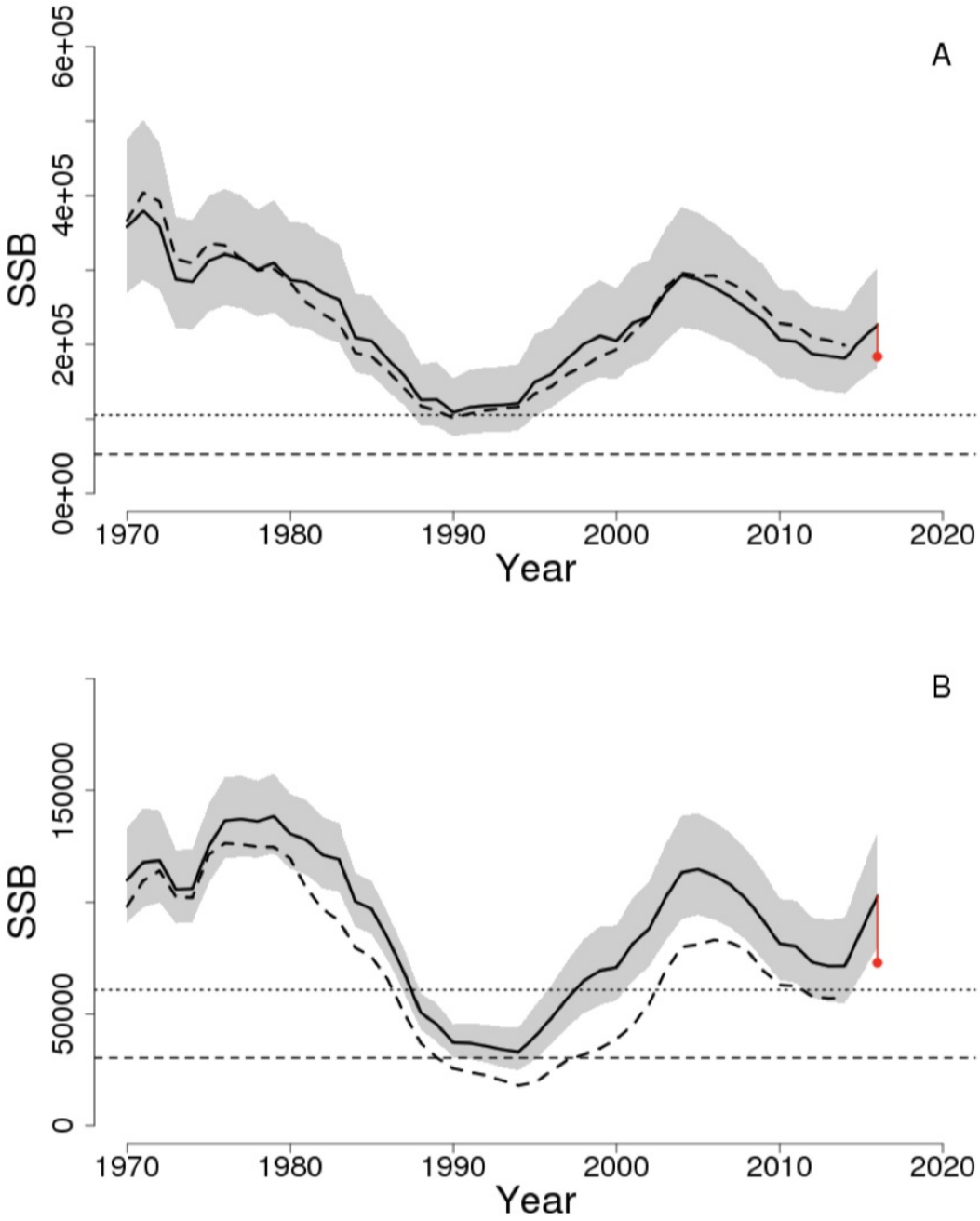

Figure 33: Estimated trends in the spawning stock biomass of pollock between 1970 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (0.5 × SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment models base (A) and flat sel sensitivity (B). The approximate 90% lognormal confidence intervals are shown (Linton 2017a).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

Based on the 2017 pollock stock assessment, 2016 age 5 to 7 average fishing mortality (F) was estimated to be 0.036 under the base model and 0.079 under the "flat sel" sensitivity model, which is 14% and 32%, respectively, of the overfishing threshold, an F_{MSY} proxy of $F_{40\%}$ (0.26 and 0.249; see Figure 34) (Linton 2017a). Because pollock is not undergoing overfishing, fishing mortality is scored a low concern.

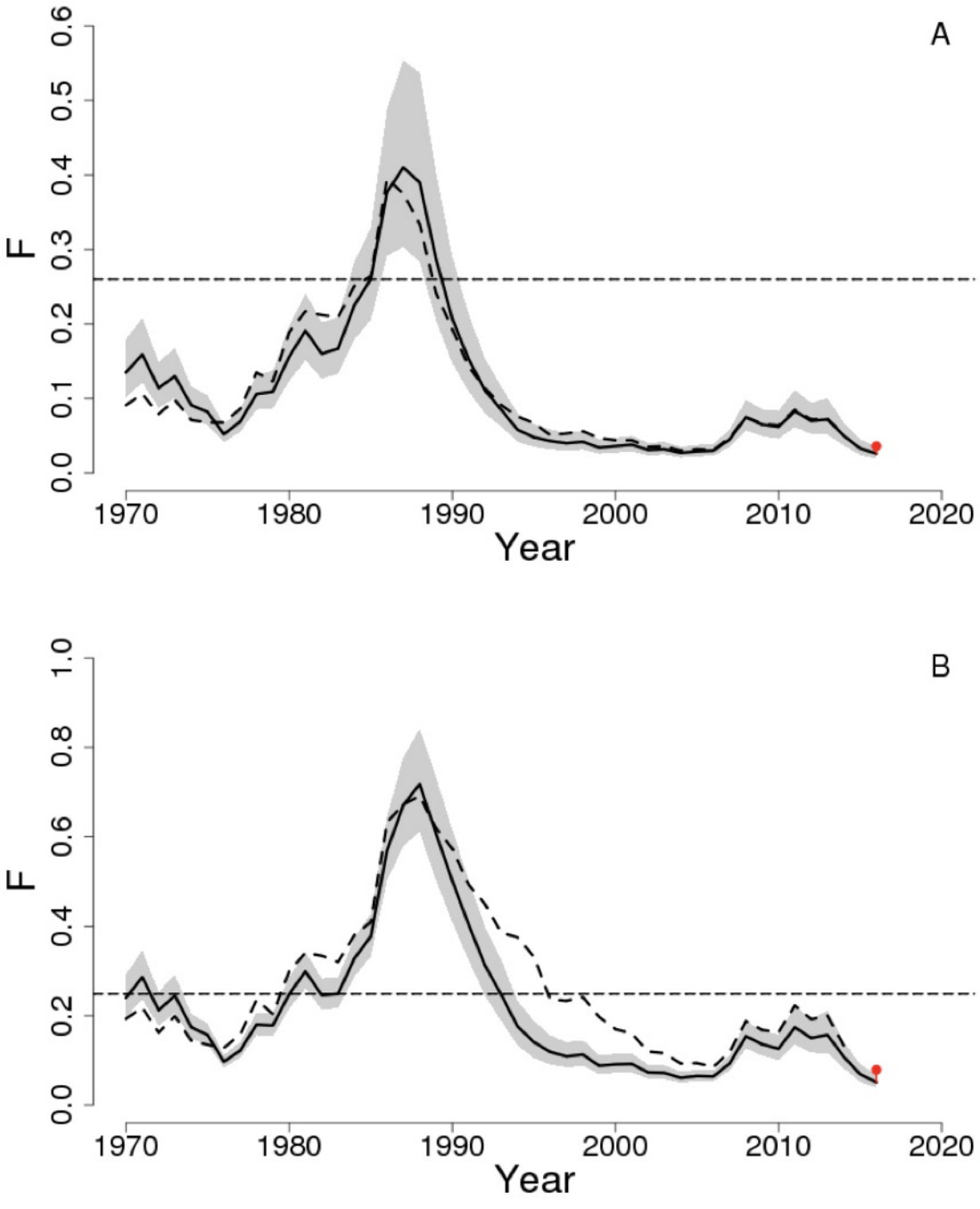

Figure 34: Estimated trends in age 5 to 7 average F (F_{AVG}) of pollock between 1970 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy; dashed line) based on the 2017 assessment models base (A) and flat sel sensitivity (B). The approximate 90% lognormal confidence intervals are shown (Linton 2017a).

Rosette skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For rosette skate, the 2017 to 2019 NEFSC autumn average biomass index of 0.050 kg/tow is above the biomass threshold reference point (0.024 kg/tow) and the B_{MSY} proxy (0.048 kg/tow; see Figure 35) (Sosebee 2020). Because the stock is not overfished, but there is uncertainty associated with using the survey index as a proxy for abundance, a score of low concern is given (rather than very low concern).

Justification:

For rosette skate, the B_{MSY} proxy is defined as the 75th percentile of the appropriate survey biomass index time series for that species (Sosebee 2020).

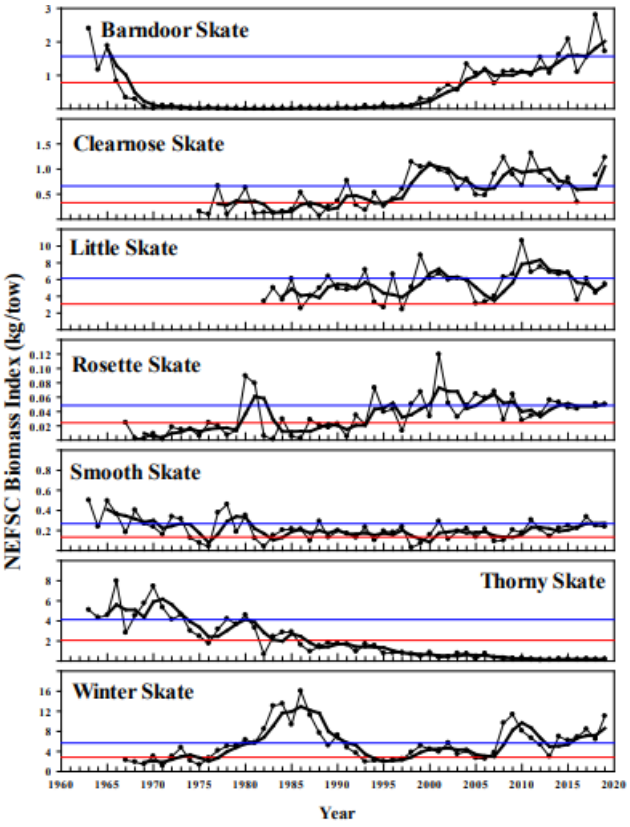

Figure 35: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For rosette skate, the 2017 to 2019 index is above the 2016 to 2018 index by 6.4% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is scored a low concern.

Justification:
The fishing mortality reference points are based on changes in the 3-year survey biomass indices. If there is a decline in the 3-year moving average of the survey biomass index that is greater than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY}, and overfishing is occurring for that skate species (Sosebee 2020).

Scup

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Very Low Concern

The most recent stock assessment update has been conducted in 2019, with data from 2018 {NEFSC 2020}. Abundance data have been consistently collected over the years {NMFS & NEFSC 2017}. Because there is a recent stock assessment and update for scup that has been published by the Northeast Fisheries Science Center, and spawning stock biomass (SSB) has been well above the target reference threshold set for the scup fishery, abundance has been scored a very low concern.

Justification:

In 2018, the SSB was 186,578 mt, which was higher than the updated SSB_{MSY} or $SSB_{40\%}$, indicating that the stock is not overfished {NEFSC 2020}. The fishing mortality on the fully selected age 3 fish was 0.158 in 2018, which is lower than the updated biological reference point of F_{MSY} or $F_{40\%}$, indicating that the stock is not being overfished {NEFSC 2020}. The fishery is being well managed by NOAA Fisheries, the Mid-Atlantic Fishery Management Council, and the Atlantic States Marine Fisheries Commission. Nevertheless, the fishery needs to be closely watched in the future because SSB is projected to further decrease unless recruitment to the stock increases {NEFSC 2020}.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

The fishing mortality on the fully selected age 3 fish was 0.158 in 2018, which is lower than the updated biological reference point of F_{MSY} or $F_{40\%}$, indicating that the stock is currently not being overfished {NEFSC 2020}. The fishery is being well managed by NOAA Fisheries, the Mid-Atlantic Fishery Management Council, and the Atlantic States Marine Fisheries Commission. Nevertheless, fishing mortality needs to be closely monitored in the future because SSB is projected to further decrease unless recruitment to the stock increases {NEFSC 2020}. Because there is currently a probable chance that the fishing mortality from all sources is below the biological target reference point of F_{MSY} or $F_{40\%}$ that has been set specifically for the scup fishery, fishing mortality has been set a low concern.

Justification:

In the early 1990s, fishing pressure was high and the scup spawning stock biomass was low (Figure 4, {NMFS & NEFSC 2017}). Consequently, the stock was overfished and overfishing was occurring.

Gradually, the fishing pressure on the stock was reduced from the mid-1990s to 2000 and beyond. The stock likely responded to the reduced fishing pressure due to management strategies put in place between 2005 and 2009.

Per the 2018 assessment, fishing mortality on the fully selected age 3 fish was 0.158, which is lower than the updated biological reference point of $F_{40\%}$, which was set to 0.215, indicating that the stock is not being overfished (Figure 5, {NEFSC 2020}). But, managers must be cautious in the future to ensure that fishing pressure does not increase.

Short-beaked common dolphin

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

The current best abundance estimate for short-beaked common dolphin in the Northwest Atlantic is 172,947 (CV = 0.21), with a minimum population size of 145,216 (Hayes et al. 2021). This estimate is derived from 2016 shipboard and aerial surveys in the United States and Canada and covers most of the population's range. The status of common dolphin relative to the optimum sustainable population (OSP) in the U.S. Atlantic EEZ is unknown, and population trends have not been investigated (Hayes et al. 2021). The International Union for the Conservation of Nature (IUCN) considers this species as "Least Concern" {Braulik et al. 2021}, and because status and trend analysis are unknown, abundance is considered a moderate concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

The total annual estimated average fishery-related mortality or serious injury to the short-beaked common dolphin stock during 2014 to 2018 was 399 (CV = 0.10), with a potential biological removal (PBR) of 1,452 (Hayes et al. 2021). The Northeast bottom trawl fishery accounted for only 4.3% of the total U.S. fishery-related serious injury and mortality (17/399 individuals), whereas the Northeast sink gillnet fishery accounted for 24.6% (98/399 individuals) (Hayes et al. 2021). Because PBR is not exceeded, and neither the bottom trawl fishery nor the set gillnet fishery accounts for more than 50% of the PBR, fishing mortality is considered a low concern.

Smooth skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For smooth skate, the 2017 to 2019 NEFSC autumn average biomass index of 0.27 kg/tow is above the biomass threshold reference point (0.134 kg/tow) and meets the B_{MSY} proxy (0.27 kg/tow; see Figure 36) (Sosebee 2020). Because the stock is not overfished and biomass meets the target biomass, but there is uncertainty in the use of survey indices, abundance is considered a low concern (rather than a very low concern).

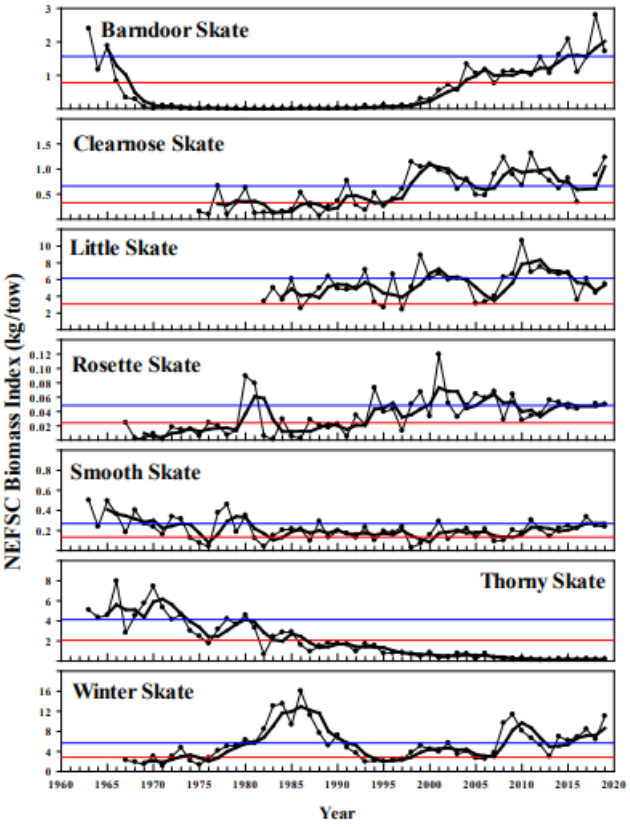

Figure 36: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For smooth skate, the 2017 to 2019 index is consistent with the 2016 to 2018 index (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is considered a low concern.

Justification:
The fishing mortality reference points are based on changes in survey biomass indices. If the 3-year moving average of the survey biomass index for a skate species declines by more than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY} and overfishing is occurring for that skate species (Sosebee 2020).

Spiny dogfish

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern
The most recent publicly available stock assessment for spiny dogfish is from 2011, so the results are not considered appropriate as an indicator of current abundance. In the absence of an up-to-date stock assessment, abundance is assessed using a productivity-susceptibility analysis (PSA) (see Justification).

A PSA was calculated to determine the inherent vulnerability of spiny dogfish, because biomass relative to a reference point is unknown. The PSA score = 3.414 (detailed scoring of each PSA attribute is shown below), and spiny dogfish is deemed to have high vulnerability. Because of the high vulnerability of spiny dogfish, Seafood Watch considers abundance a high concern.

Justification:
Productivity-Susceptibility Analysis:

Scoring Guidelines

1. Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

2. Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows: S = [(S1 × S2 × S3 × S4) – 1/40] + 1.

3. Vulnerability score (V) = the Euclidean distance of P and S using the following formula: V = √(P² + S²)

Vulnerability (V) = $\sqrt{(P^2 + S^2)}$

$V = \sqrt{(2.5^2 + 2.325^2)}$

V = 3.414

Productivity Attribute	Relevant Information	Score (1 = low risk, 2 = medium risk, 3 = high risk)

Average age at maturity	Female 12 years, males 6 years (NOAA 2022)	2
Average maximum age	75 years (Froese and Pauly 2018)	3
Fecundity	1–21 young (Froese and Pauly 2018)	3
Average maximum size (fish only)	160 cm (Froese and Pauly 2018)	2
Average size at maturity (fish only)	81.4 cm (Froese and Pauly 2018)	2
Reproductive strategy	Ovoviviparous (live-bearing) (Froese and Pauly 2018)	3
Trophic level	4.4 (Froese and Pauly 2018)	3
Density dependence (invertebrates only)	-	-
Habitat quality	Moderately altered (default)	2
Total Productivity (average)		**2.5**

Susceptibility Attribute	**Relevant Information**	**Score (1 = low risk, 2 = medium risk, 3 = high risk)**
Areal overlap (Considers all fisheries)	>30% overlap (default)	3
Vertical overlap (Considers all fisheries)	High overlap w/fishing gear (default)	3
Selectivity of fishery (Specific to fishery under assessment)	Retained species (default)	2
Post-capture mortality (Specific to fishery under assessment)	Retained species (default)	3
Total Susceptibility (multiplicative)		**2.325**

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

The most recent publicly available stock assessment is from 2011 and is no longer considered a reliable indicator of fishing mortality for this stock. Thus, the impact of fisheries relative to a sustainable level is considered unknown and scored a moderate concern.

Summer flounder

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Summer flounder has been rated as "Least Concern" by the International Union for the Conservation of Nature (IUCN), and the second quarter 2021 update from the National Marine Fisheries Service notes that this stock is not overfished or nearing an overfished state (NMFS 2021). SSB was estimated to be 44,552 mt in 2017, 78% of the 2018 SAW-66 SSB_{MSY} target proxy = $SSB_{35\%}$ = 57,159 mt, and 56% above the 2018 SAW-66 ½ SSB_{MSY} threshold proxy = ½ $SSB_{35\%}$ = 28,580 mt {NOAA 2019}. The stock was rebuilt in 2010 (GARFO 2017), and is not considered overfished {NOAA 2019}. Because the stock is not considered overfished and is at a level greater than 75% of SSB_{MSY}, abundance is scored a low concern.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

The most recently updated assessment of summer flounder in the mid-Atlantic Ocean states that the fishing mortality rate has increased and was 0.334 in 2017, 75% of the 2018 SAW-66 F_{MSY} proxy = $F_{35\%}$ = 0.448 {NOAA 2019}. Because overfishing of summer flounder is not occurring, we have awarded a score of low concern.

Thorny skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

For thorny skate, the 2017 to 2019 NEFSC autumn average biomass index of 0.18 kg/tow is well below the biomass threshold reference point (2.06 kg/tow; see Figure 37) (Sosebee 2020). Because the stock is overfished, abundance is considered a high concern.

Justification:

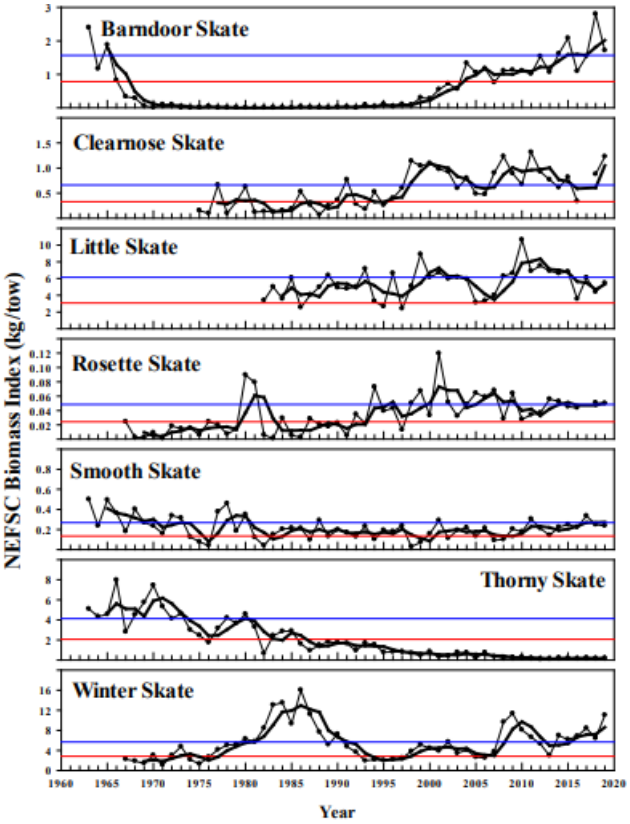

Figure 37: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Thorny skate is a data-poor species, and bottom trawls are known to have poor catchability for the species (Walsh 1992). Recent efforts to enhance fisheries surveys in the Northwest Atlantic by using benthic longline surveys on rough bottom show that the biomass of thorny skate may be higher than would have been expected from the trawl survey data (see Figure 38; presentation by Dave McElroy at NOAA's National Marine Fisheries Service 2018).

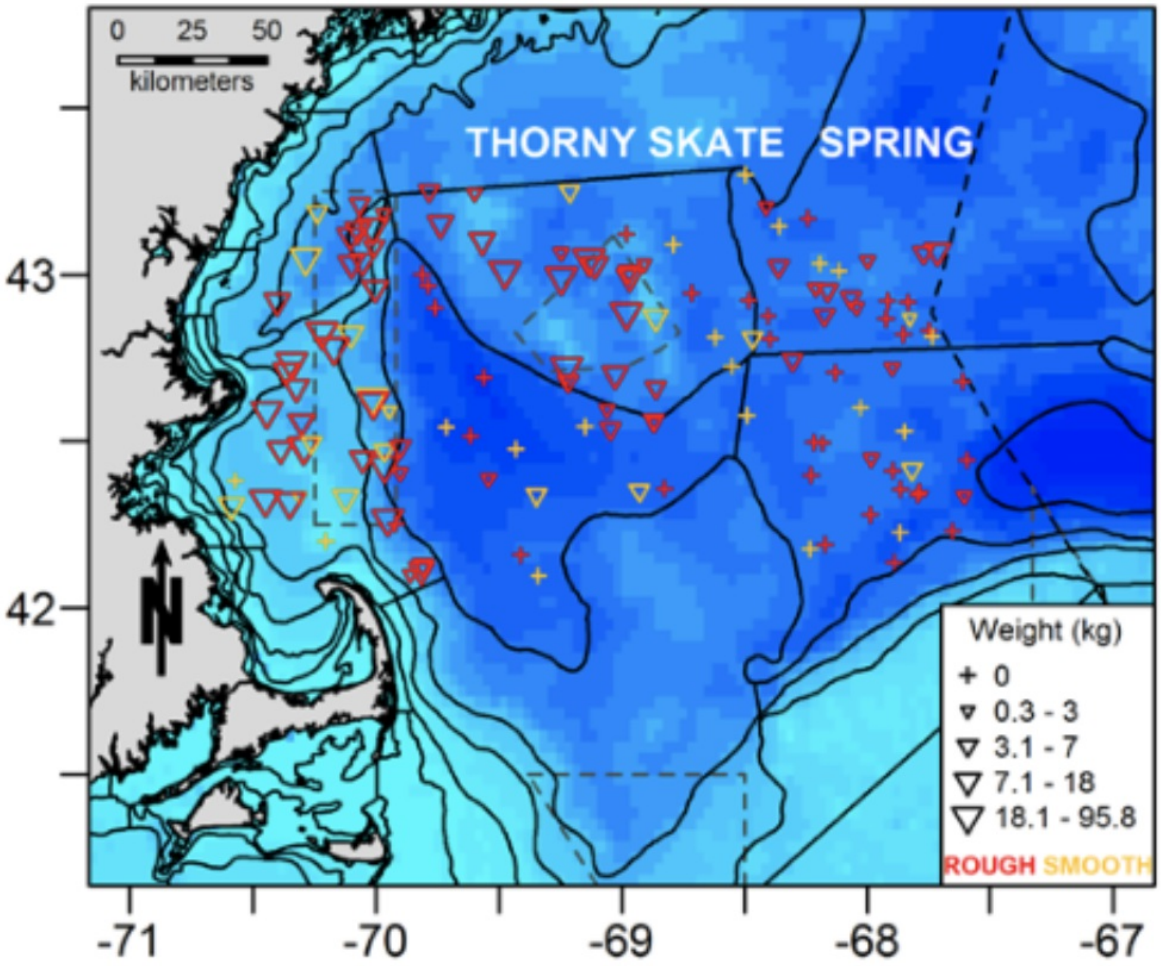

Figure 38: Benthic longline surveys of thorny skate on rough and smooth bottom in the Northwest Atlantic showing that the biomass of thorny skate may be higher than would have been expected from the trawl survey data. The red symbols represent survey efforts on rough bottom where the trawl survey does not reach. The yellow symbols represent survey efforts on smooth bottom where the trawl survey goes (presentation by Dave McElroy at NOAA's National Marine Fisheries Service 2018).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern
For thorny skate, the 2017 to 2019 index is higher than the 2016 to 2018 index by 11.4% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is considered a low concern.

Justification:
The fishing mortality reference points are based on changes in survey biomass indices. If the 3-year moving average of the survey biomass index for a skate species declines by more than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY} and overfishing is occurring for that skate species (Sosebee 2020).

White hake

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

Based on the 2017 white hake stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 21,276 mt, which is 69% of the biomass target (SSB_{MSY} proxy = 30,948; see Figure 39) (Sosebee 2017a). The white hake stock is not overfished, but because it is below 75% of the biomass target, abundance is scored a moderate concern.

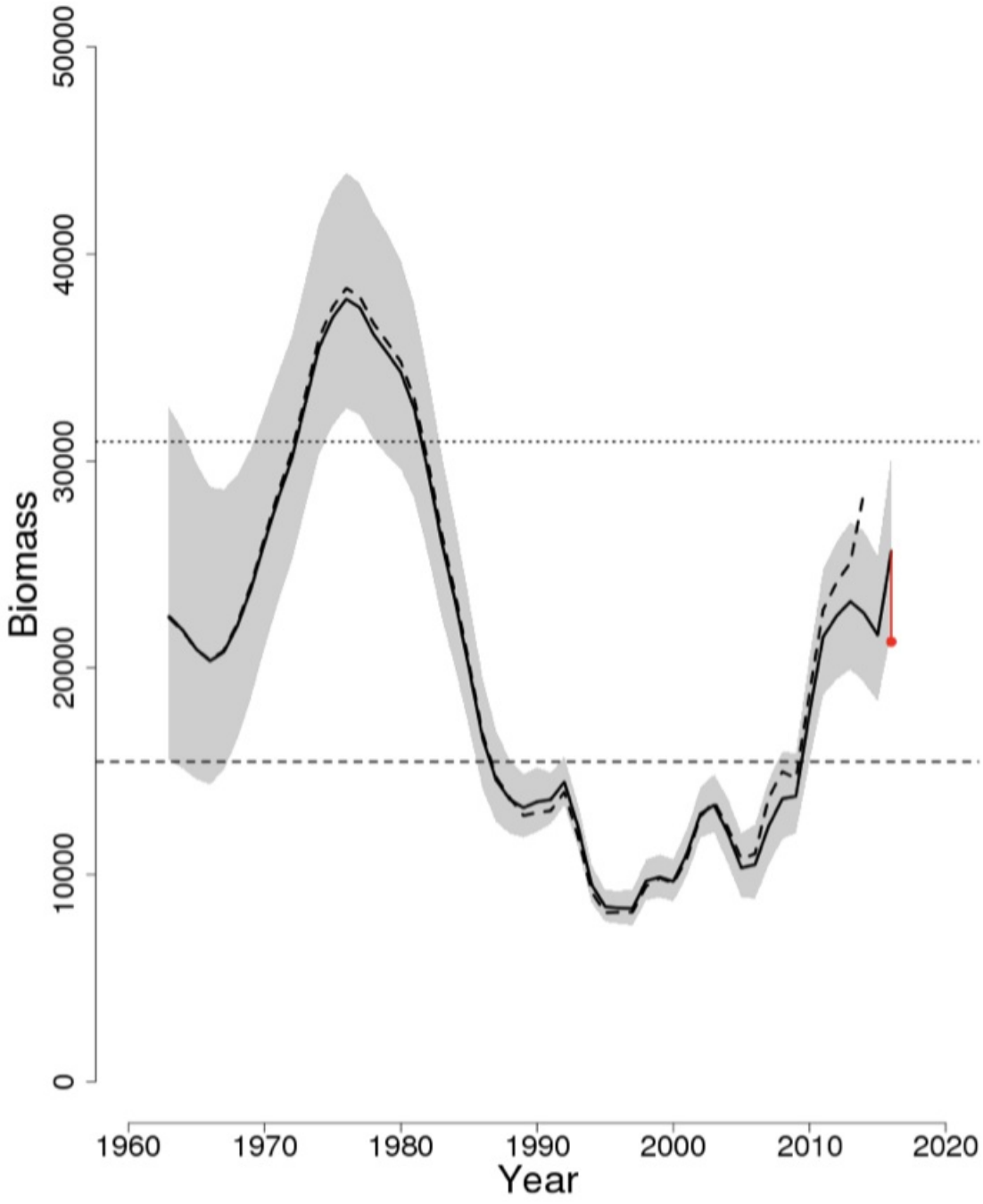

Figure 39: Trends in spawning stock biomass of white hake between 1963 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {Sosebee 2017}.

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

Based on the 2017 white hake stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.066, which is 36% of the overfishing threshold proxy (F_{MSY} proxy = 0.1839; see Figure 40) (Sosebee 2017a). The white hake stock is not undergoing overfishing, so fishing mortality is scored a low concern.

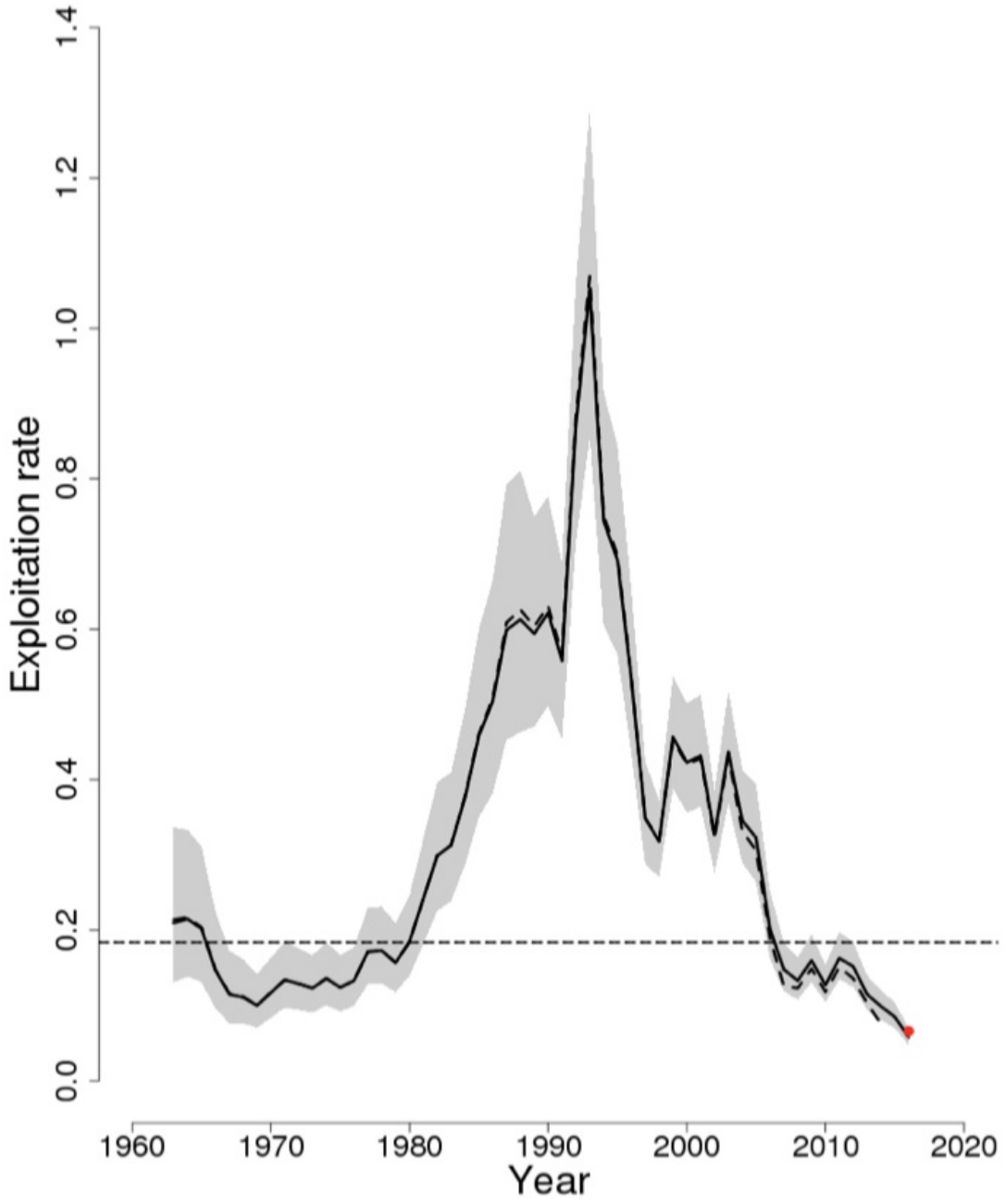

Figure 40: Trends in the fully selected fishing mortality (F_{FULL}) of white hake between 1963 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.1839; horizontal dashed line) based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {Sosebee 2017}.

Windowpane flounder

Factor 2.1 - Abundance

Gulf of Maine / Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 northern windowpane flounder stock assessment, the mean NEFSC fall bottom trawl survey index from years 2014, 2015, and 2016 (a 3-year moving average is used as a biomass index, B) was 0.359 kg/tow, which is lower than the $B_{THRESHOLD}$ of 1.030 kg/tow (see Figure 41) (NEFSC 2017g). According to the NMFS first quarter 2018 update, Gulf of Maine/Georges Bank windowpane flounder is overfished and in year 8 of a 7-year rebuilding plan (NMFS 2018). Because the stock is overfished, abundance is deemed a high concern.

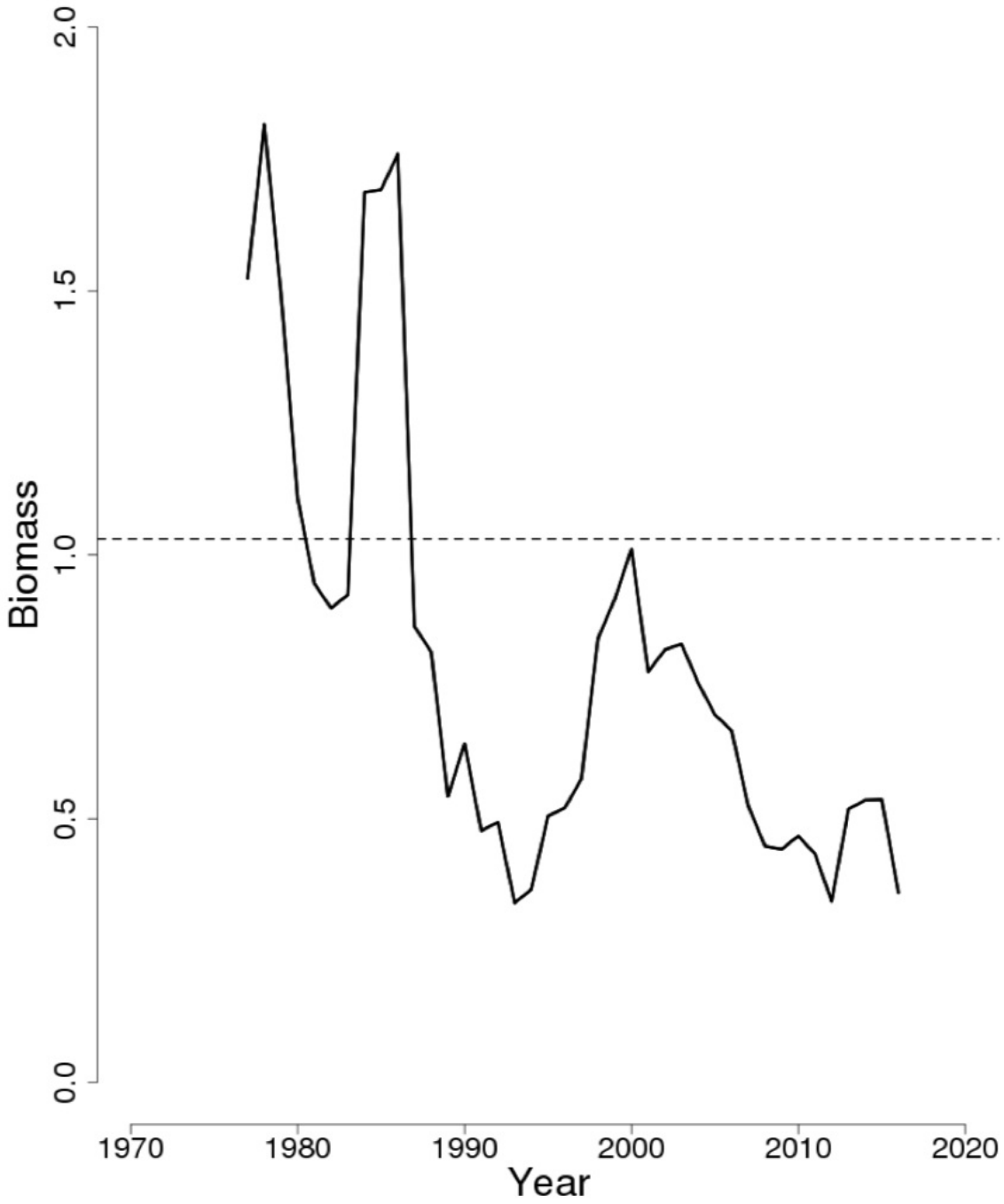

Figure 41: Trends in the biomass index (a 3-year moving average of the NEFSC fall bottom trawl survey index) of northern windowpane flounder from 1975 to 2016 from the current assessment, and the corresponding $B_{THRESHOLD}$ = 1, B_{MSY} proxy = 1.030 kg/tow (horizontal dashed line) (NEFSC 2017g).

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 southern windowpane flounder stock assessment, the mean NEFSC fall bottom trawl survey index from years 2014, 2015, and 2016 (a 3-year moving average is used as a biomass index, B) was 0.329 kg/tow, which is higher than the $B_{THRESHOLD}$ of 0.126 kg/tow (see Figure 42) (NEFSC 2017h). Because the stock is not overfished, and biomass is more than 75% of the target biomass, abundance is considered a low concern.

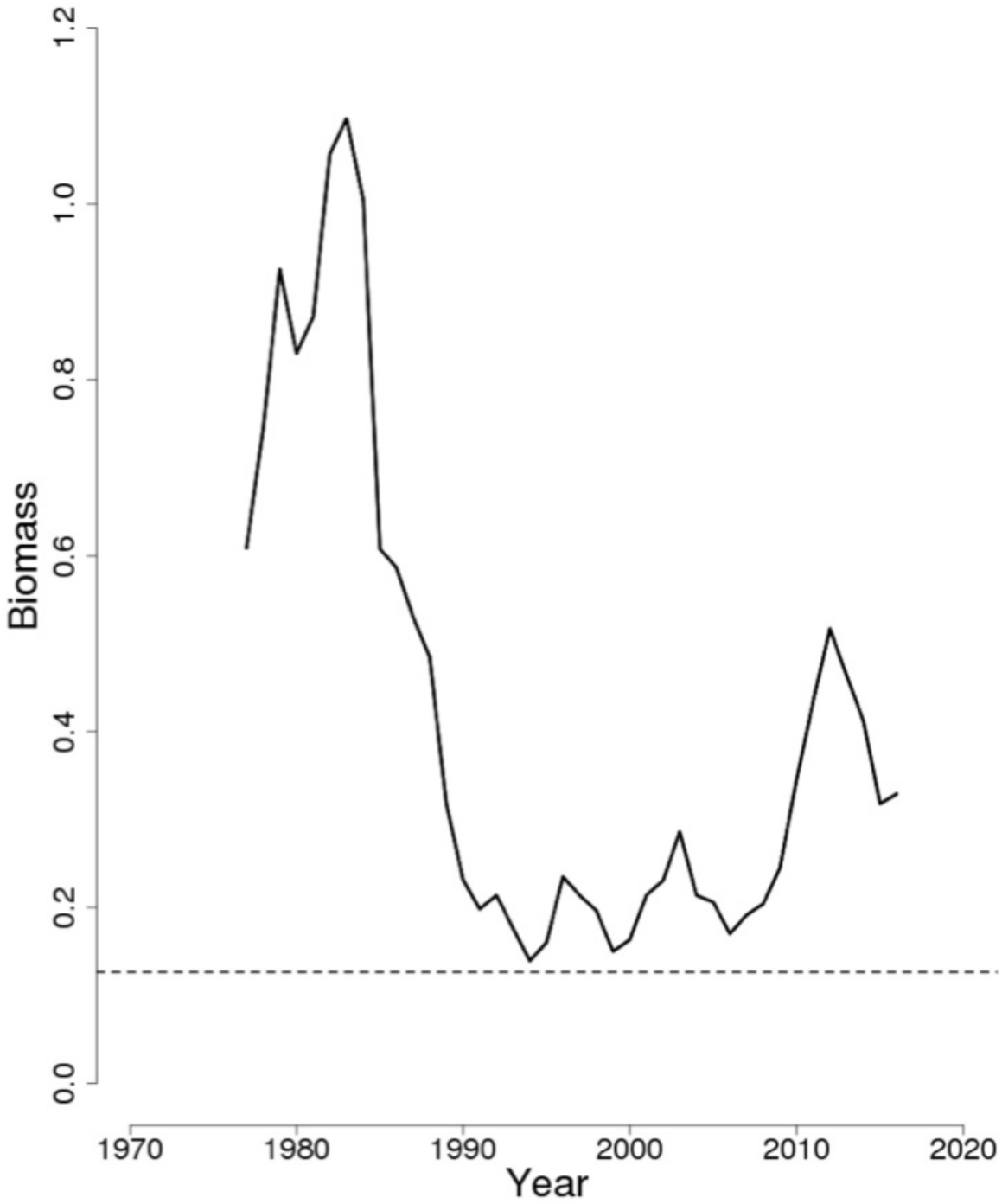

Figure 42: Trends in the biomass index (a 3-year moving average of the NEFSC fall bottom trawl survey index) of southern windowpane flounder from 1975 to 2016 from the current assessment, and the corresponding $B_{THRESHOLD}$ = 1, B_{MSY} proxy = 0.126 kg/tow (horizontal dashed line) (NEFSC 2017h).

Factor 2.2 - Fishing Mortality

Gulf of Maine / Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 northern windowpane flounder stock assessment, the 2016 relative fishing mortality was estimated to be 0.222 kt per kg/tow, which is lower than the F_{MSY} of 0.340 kt per kg/tow (see Figure 43) (NEFSC 2017g). According to the NMFS first quarter 2018 update, this stock is not yet rebuilt (in year 8 of a 7-year rebuilding plan) and biomass has decreased since 2015, but overfishing is not occurring (NMFS 2018); therefore, fishing mortality is considered a low concern.

Justification:

As of October 2011, NMFS prohibits possession of any windowpane flounder (NOAA 2011b), so there is effectively no targeted fishery for northern windowpane flounder (NEFSC 2017g).

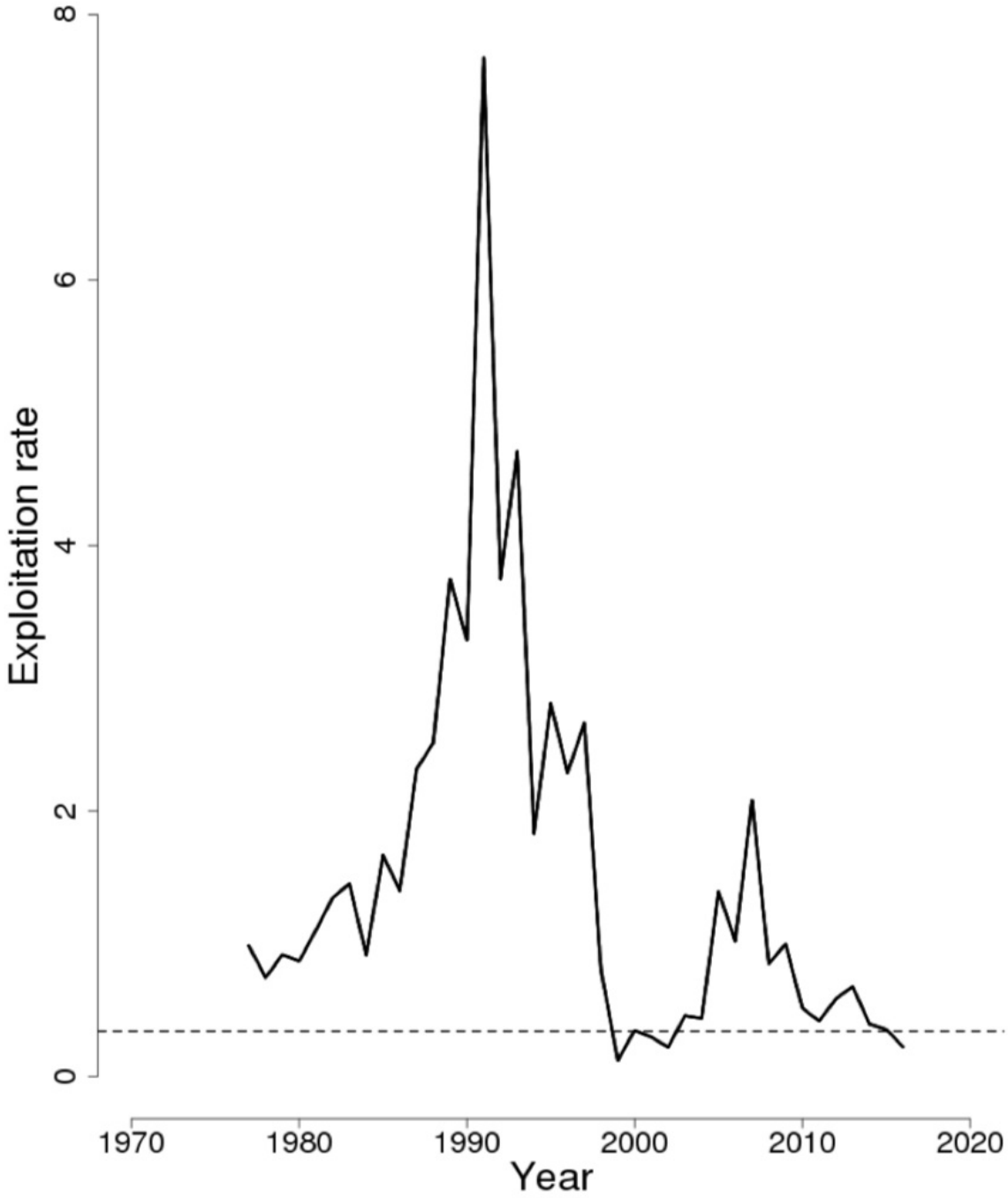

Figure 43: Trends in estimated relative fishing mortality of northern windowpane flounder from 1975 to 2016 from the current assessment, and the corresponding F_{MSY} proxy = 0.34 (horizontal dashed line) (NEFSC 2017g).

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Low Concern

Based on the 2017 southern windowpane flounder stock assessment, the 2016 relative fishing mortality was estimated to be 1.733 kt per kg/tow, which is lower than the F_{MSY} proxy of 1.918 kt per kg/tow (see Figure 44) (NEFSC 2017h). Because overfishing is not occurring, fishing mortality is considered a low concern.

Justification:

As of October 2011, NMFS prohibits possession of any windowpane flounder (NOAA 2011b), so there is effectively no targeted fishery for southern windowpane (NEFSC 2017h).

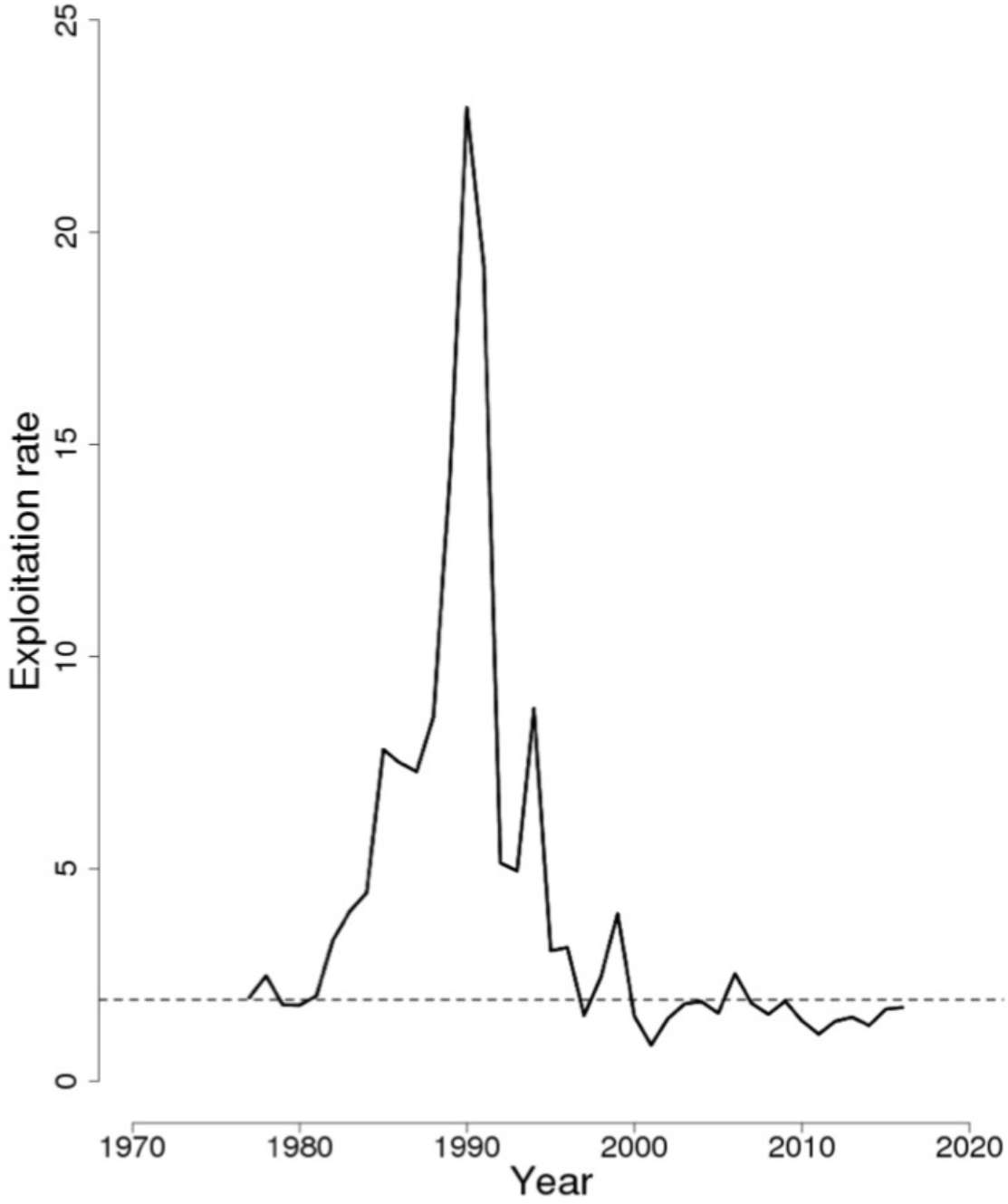

Figure 44: Trends in relative fishing mortality of southern windowpane flounder from 1975 to 2016 from the current assessment, and the corresponding F_{MSY} proxy = 1.918 (horizontal dashed line) (NEFSC 2017h).

Winter skate

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For winter skate, the 2017 to 2019 NEFSC autumn average biomass index of 8.61 kg/tow is above the biomass threshold reference point (2.83 kg/tow) and above the B_{MSY} proxy (5.66 kg/tow; see Figure 45) (Sosebee 2020). Because the stock is not overfished, but there is uncertainty associated with using the survey index as a proxy for abundance, a score of low concern is given (rather than a score of very low concern).

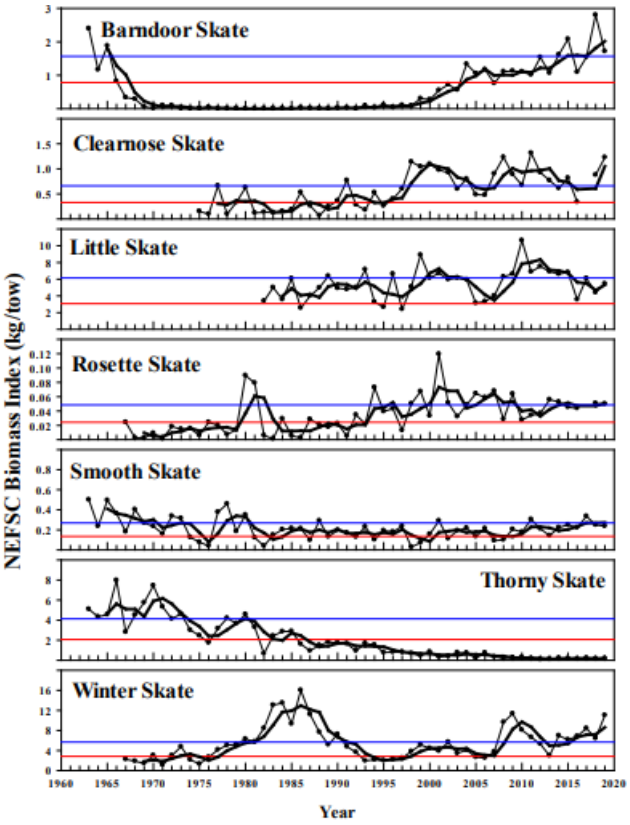

Figure 45: Northeast Fisheries Science Center survey biomass indices (kg/tow). Thin lines with symbols are annual indices, thick lines are 3-year moving averages, and the thin horizontal lines are the management biomass thresholds and targets. From (Sosebee 2020).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Low Concern

For winter skate, the 2017 to 2019 average index is above the 2016 to 2018 index by 19.2% (Sosebee 2020). Because the stock is not undergoing overfishing, fishing mortality is considered a low concern.

Justification:
The fishing mortality reference points are based on changes in survey biomass indices. If the 3-year moving average of the survey biomass index for a skate species declines by more than the average CV of the survey time series, then fishing mortality is assumed to be greater than F_{MSY}, and overfishing is occurring for that skate species (Sosebee 2020).

Witch flounder

Factor 2.1 - Abundance

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern
Based on the 2017 witch flounder stock assessment, the exploitable biomass in 2016 was estimated to be 14,563 mt (see Figure 46) (Wigley 2017b). The stock status is considered to be overfished, and stock condition remains poor (Wigley 2017b). According to the NMFS first quarter 2018 update, witch flounder is overfished and in year 8 of a 7-year rebuilding plan (NMFS 2018c). Although there is no biomass reference point defined, the stock is in poor condition and considered to be overfished; therefore, abundance is scored a high concern.

Justification:
Exploitable biomass is defined as the arithmetic average of the 2016 NEFSC spring and 2015 NEFSC fall surveys population biomass estimates and converted to exploitable biomass using 0.9, based on examination of survey and fishery selectivity patterns (Wigley 2017b).

The overfished and overfishing occurring NMFS stock status determinations for witch flounder are based on the 2016 assessment. There are no biomass or fishing mortality reference points in this stock assessment; however, stock condition was and remains poor (Wigley 2017b).

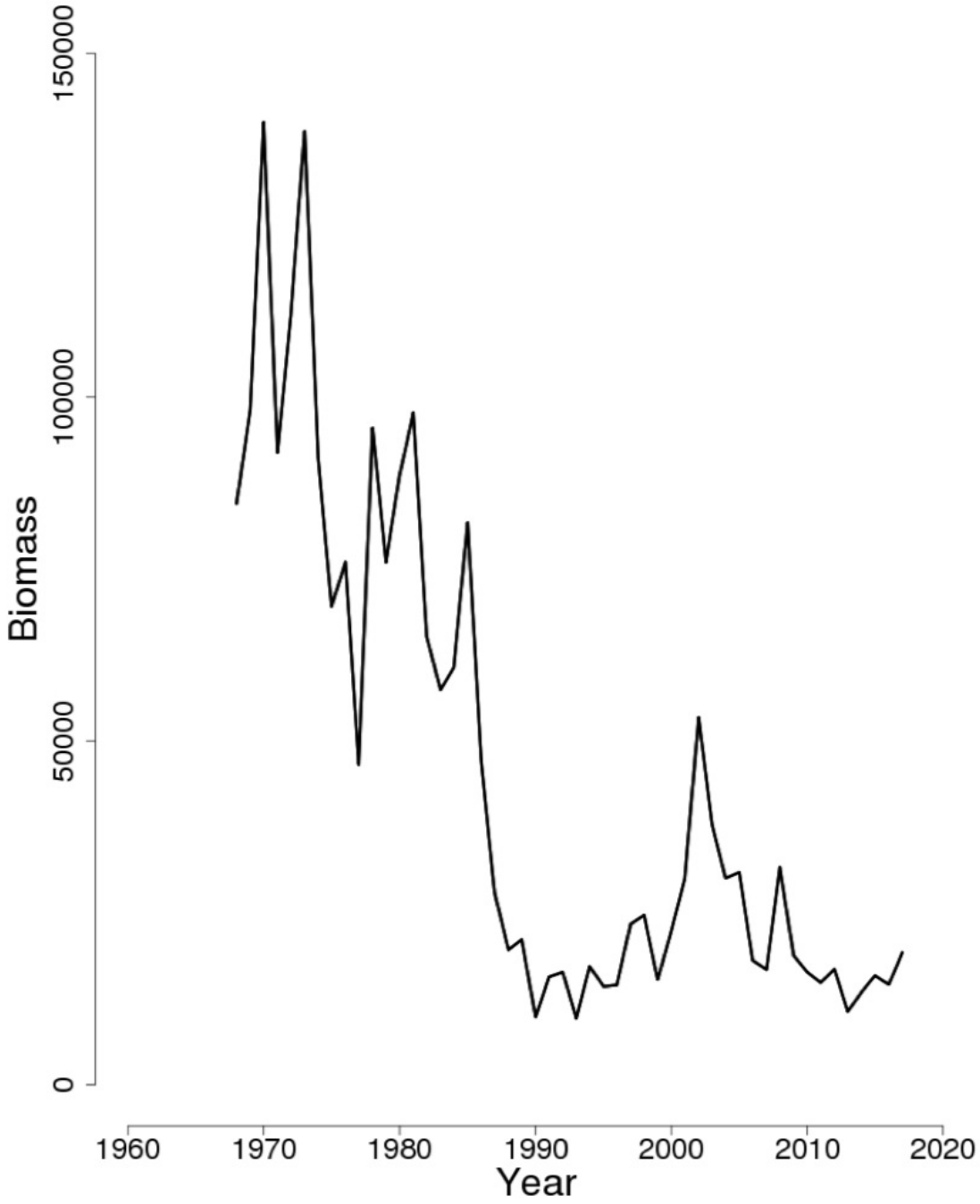

Figure 46: Trends in exploitable biomass (mt) of witch flounder between 1968 and 2017 from the current assessment (Wigley 2017b).

Factor 2.2 - Fishing Mortality

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

Based on the 2017 witch flounder stock assessment, the 2016 exploitation rate was estimated to be 0.035 (see Figure 47) (Wigley 2017b). Overfishing is unknown due to a lack of biological reference points associated with the empirical approach, but the stock condition remains poor (Wigley 2017b). Because it is unclear whether the stock is undergoing overfishing, fishing mortality is scored a moderate concern.

Justification:

The exploitation rate is defined as the catch divided by the 2016 exploitable biomass (Wigley 2017b).

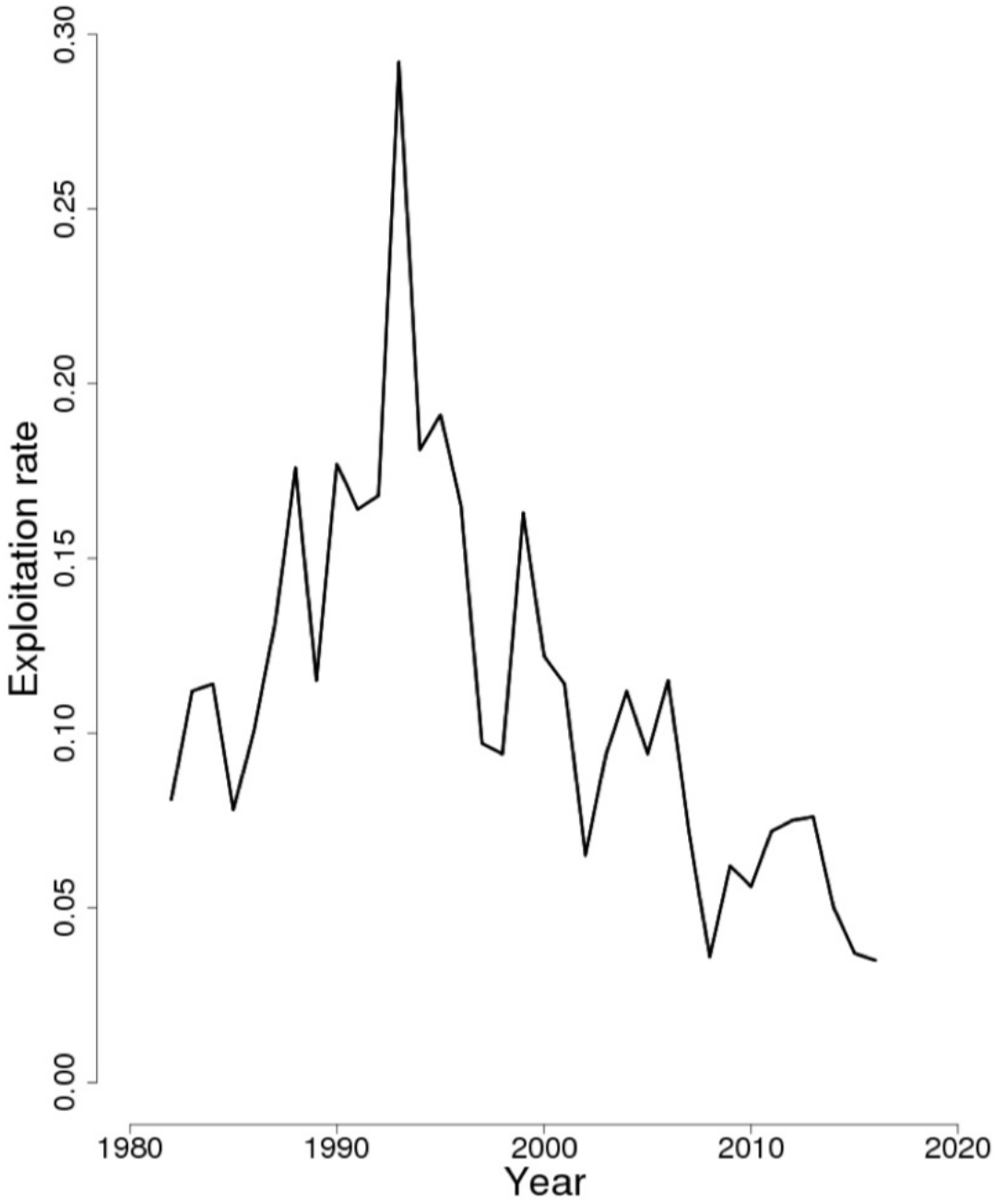

Figure 47: Trends in the exploitation rate (catch/exploitable biomass) of witch flounder between 1982 and 2016 from the current assessment (Wigley 2017b).

Yellowtail flounder

Factor 2.1 - Abundance

Cape Cod / Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Cape Cod–Gulf of Maine yellowtail flounder stock assessment, spawning stock biomass (SSB) in 2016 was estimated to be 1,191 mt, which is 26% of the biomass target (SSB_{MSY} proxy = 4,640; see Figure 48) (Alade 2017). According to the NMFS fourth quarter 2017 update, Cape Cod–Gulf of Maine yellowtail flounder is overfished and in year 14 of a 19-year rebuilding plan {NMFS 2017}. Because the stock is overfished, abundance is scored a high concern.

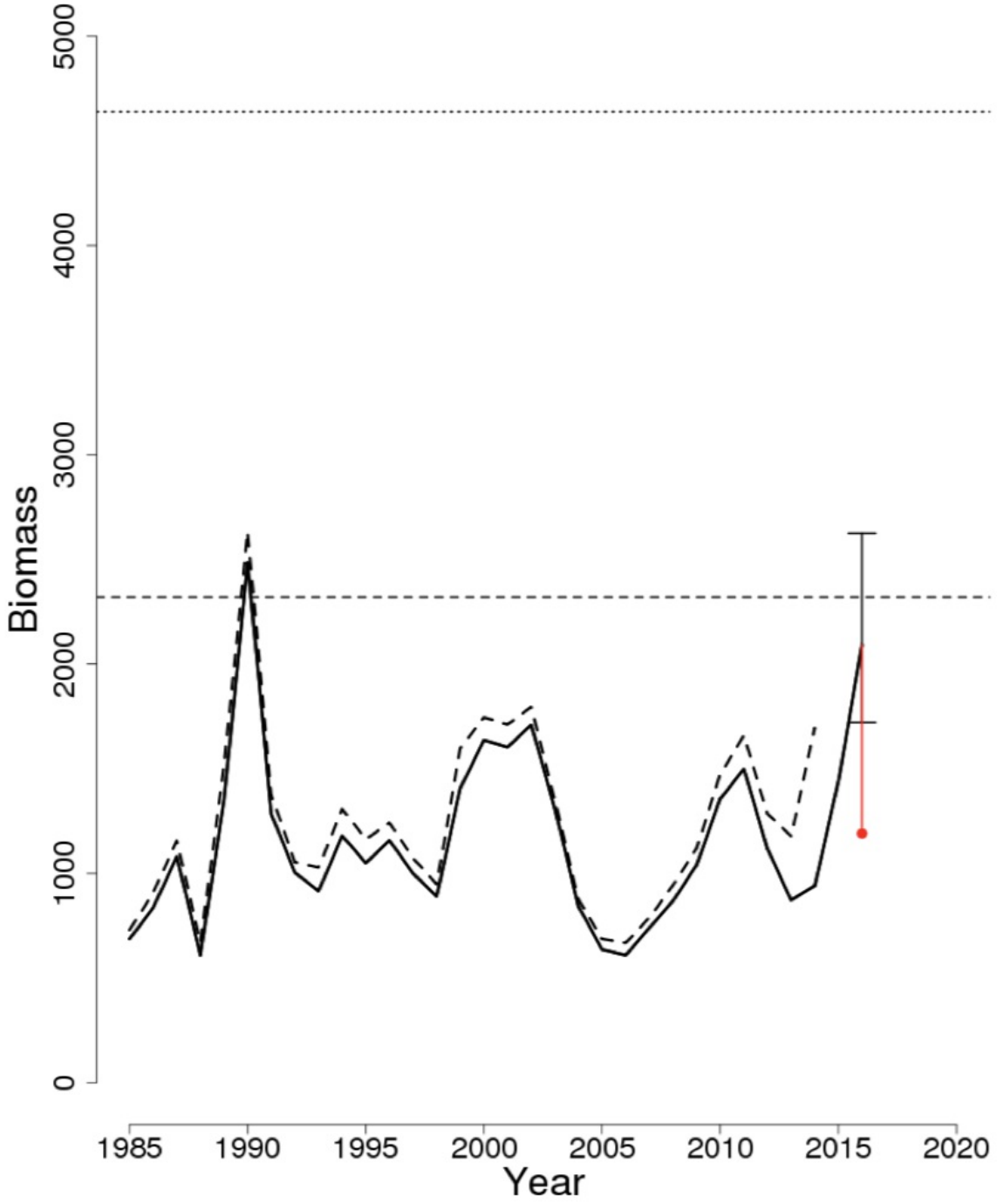

Figure 48: Trends in spawning stock biomass of Cape Cod–Gulf of Maine yellowtail flounder between 1985 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment. The 90% bootstrap probability intervals are shown (Alade 2017).

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

The most recent biomass estimate for Georges Bank yellowtail flounder is 2,077 mt, based on the 2019 NMFS fall bottom trawl survey and the 2020 DFO spring survey (the 2020 NMFS spring bottom trawl survey was not conducted due to the COVID-19 pandemic) (TRAC 2020). There is no biological reference point available for the biomass of Georges Bank yellowtail flounder; however, the current biomass reflects a 97% decrease in survey abundance since 2010 (TRAC 2020). According to the NMFS second quarter 2021 update, Georges Bank yellowtail flounder is overfished and in year 15 of a 26-year rebuilding plan (NMFS 2021). Because the stock is considered overfished, abundance is scored a high concern.

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

Based on the 2017 New England/Mid-Atlantic yellowtail flounder stock assessment, spawning stock biomass (SSB) in 2016 was estimated at 152 mt, which is 8% of the biomass target (SSB_{MSY} proxy = 1,987 mt; see figure) (NEFSC 2017e). Because the stock is overfished, this factor is deemed a high concern.

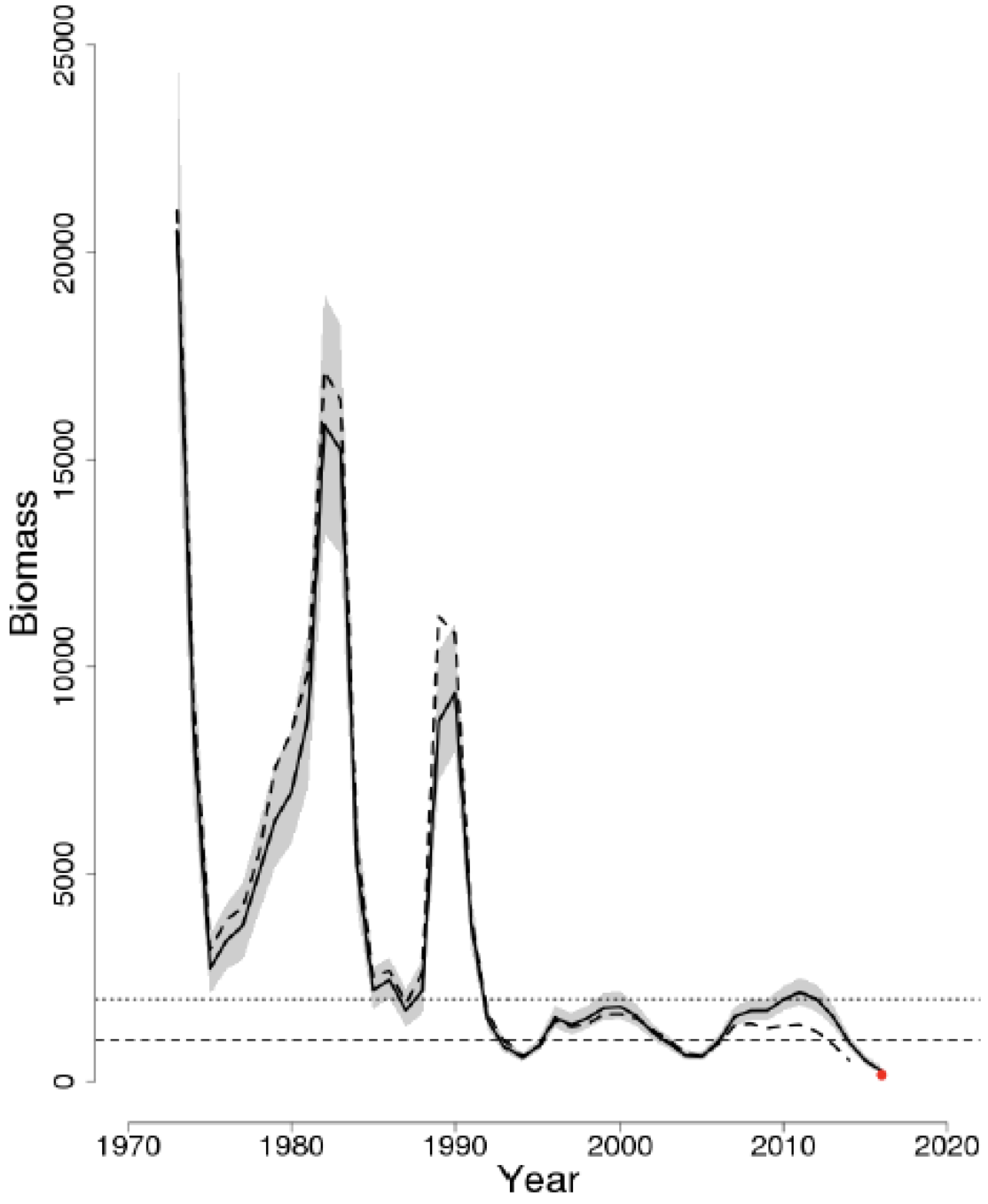

Figure 49: Trends in spawning stock biomass of Southern New England/Mid-Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $SSB_{THRESHOLD}$ (1/2 SSB_{MSY} proxy; horizontal dashed line) as well as SSB_{TARGET} (SSB_{MSY} proxy; horizontal dotted line) based on the 2017 assessment. Biomass was adjusted for a retrospective pattern (shown in red). The approximate 90% lognormal confidence intervals are shown {NEFSC 2017}.

Factor 2.2 - Fishing Mortality

Cape Cod / Gulf of Maine Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

Based on the 2017 Cape Cod–Gulf of Maine yellowtail flounder stock assessment, the 2016 fully selected fishing mortality was estimated to be 0.314, which is 115% of the overfishing threshold proxy (F_{MSY} proxy = 0.273; see Figure 49) (Alade 2017). The stock is undergoing overfishing, so fishing mortality is scored a high concern.

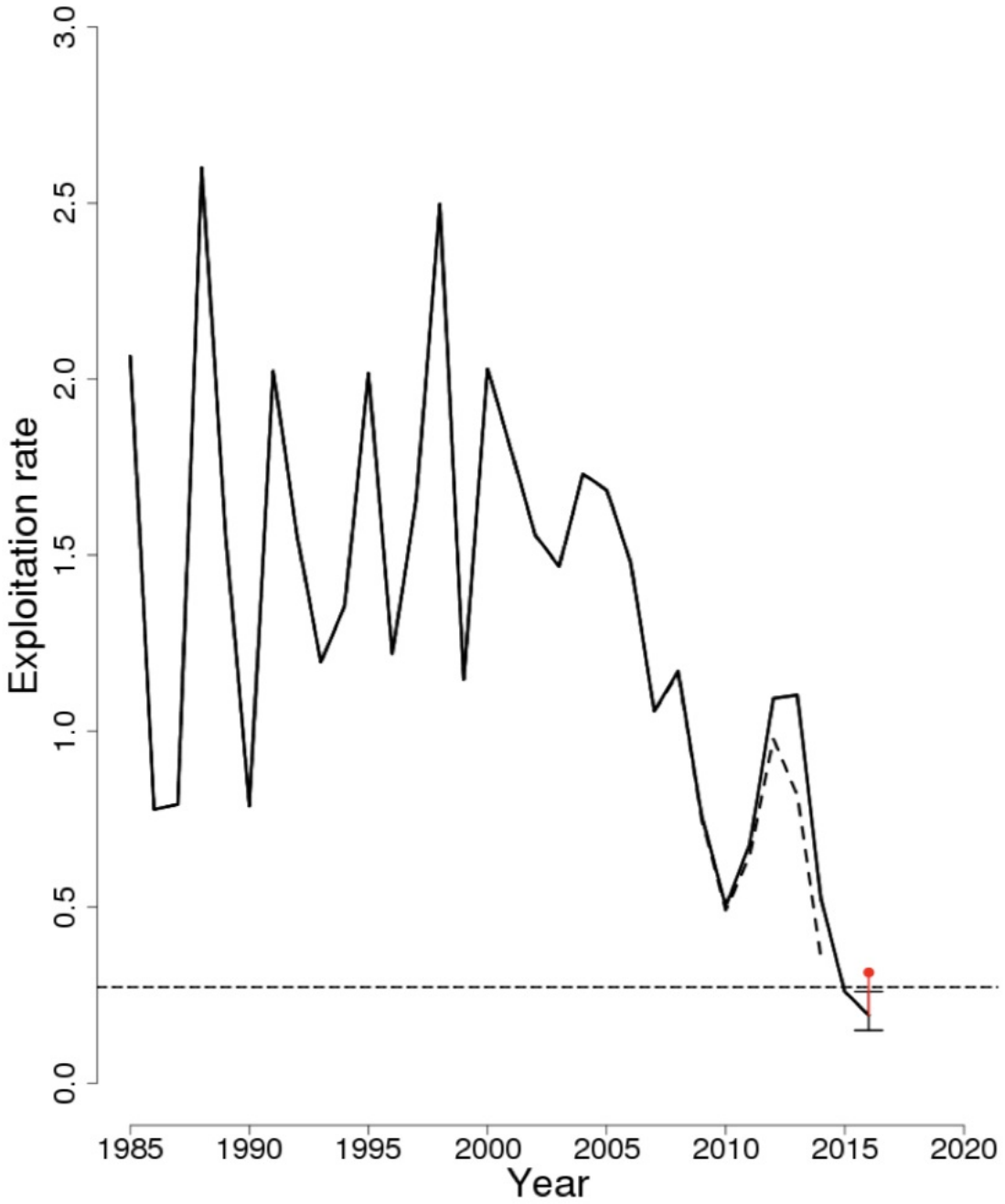

Figure 50: Trends in the fully selected fishing mortality (F_{FULL}) of Cape Cod–Gulf of Maine yellowtail flounder between 1985 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.273; horizontal dashed line). The 90% bootstrap probability intervals are shown (Alade 2017).

Georges Bank Stock | Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

High Concern

The Transboundary Management Guidance Committee (TMGC) has implemented a strategy that seeks to minimize the risk of exceeding the fishing mortality reference, F_{REF} = 0.25 (TRAC 2020). Currently, there is no assessment model, and as a result, current fishing mortality cannot be determined. The current catch is low relative to the estimated biomass from surveys, resulting in a low relative F; fishing is not believed to be a major contributor to current stock status (TRAC 2020). But, total catches are uncertain because some elements are poorly understood (e.g., research catch is not included, and fisher behavior has been found to change on observed trips). This uncertainty makes it difficult to estimate fishing mortality and total mortality (TRAC 2020).

According to the NMFS second quarter 2021 update, Georges Bank yellowtail flounder is undergoing overfishing and in year 15 of a 26-year rebuilding plan (NMFS 2021). Because there is significant uncertainty regarding the impact of fishing on Georges Bank yellowtail flounder and NMFS considers overfishing to be occurring, a score of high concern is given.

Southern New England / Mid-Atlantic Stock | Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

High Concern

Based on the 2017 New England/Mid-Atlantic yellowtail flounder stock assessment, the 2016 fully selected fishing mortality was estimated to be 1.14, which was 329% of the overfishing threshold proxy (F_{MSY} proxy = 0.347; see figure) (NEFSC 2017e). This stock is experiencing overfishing and is no longer considered rebuilt. Therefore, this factor is considered a high concern.

Justification:

An $F_{40\%}$ proxy was used for the overfishing threshold and was based on long-term stochastic projections (NEFSC 2017e).

Both the 2015 operational assessment and the 2017 update assessment of SNE/MA yellowtail flounder indicated that the overfishing status of the stock was, in part, due to very low recruitment of young fish, which are contributing little to the overall adult biomass {NEFSC 2015}(NEFSC 2017e). Continued weak recruitment of SNE/MA yellowtail flounder suggests that the stock is in a new productivity regime {NEFSC 2015}, which, if it continues, will impede stock recovery {NEFSC 2015}. Poor recruitment further suggests that the causes for overfishing may not necessarily be due to fishing pressure {NEFSC 2015}(NEFSC 2017e).

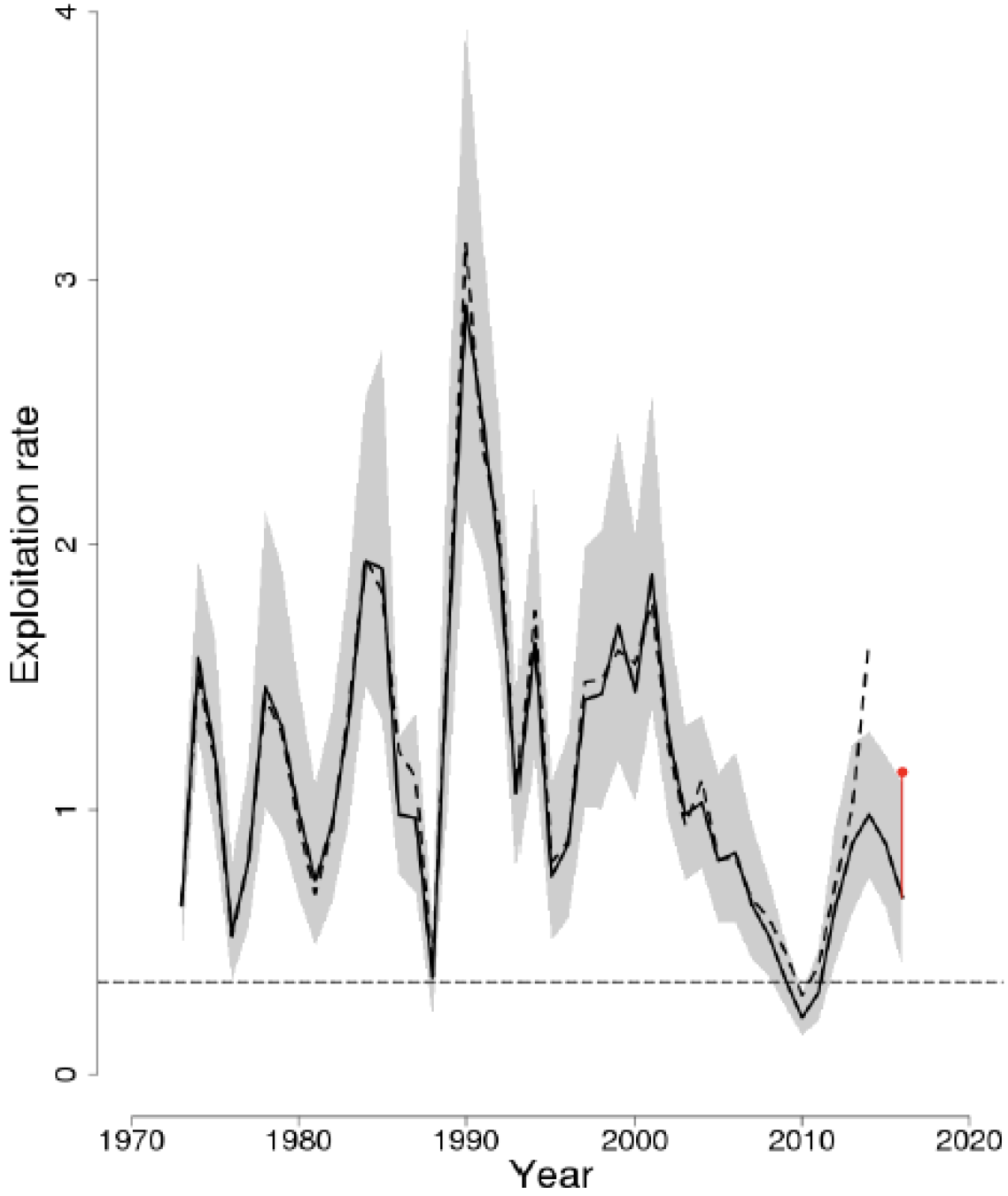

Figure 51: Trends in the fully selected fishing mortality (F_{FULL}) of Southern New England/Mid-Atlantic yellowtail flounder between 1973 and 2016 from the current (solid line) and previous (dashed line) assessment and the corresponding $F_{THRESHOLD}$ (F_{MSY} proxy = 0.347; horizontal dashed line). F_{FULL} was adjusted for a retrospective pattern and the adjustment is shown in red based on the 2017 assessment. The approximate 90% lognormal confidence intervals are shown {NEFSC 2017}.

Factor 2.3 - Discard Rate/Landings

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

< 100%
The discard to landings ratios in the fisheries are as follows (NMFS 2011b):

Bottom trawl: 15% to 60%;

Set gillnet: 15% to 40%.

Justification:
Discard to landings ratios are calculated averages from the Northeast Region fisheries characteristics of the U.S. National By-catch Report (NMFS 2011b). They represent a ratio of the full discard biomass to the full biomass of landings of all species in the fishery.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	RESEARCH AND MONITORING	ENFORCEMENT	INCLUSION	SCORE
Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC	Moderately Effective	Moderately Effective	Moderately Effective	Moderately Effective	Highly effective	**Yellow (3.000)**
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC	Moderately Effective	Ineffective	N/A	N/A	N/A	**Red (1.000)**

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion
Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderately Effective

The goosefish fishery falls under a fishery management plan (FMP) jointly administered by the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council

(MAFMC). Regional differences in primary fishing gear create some difficulties in discussing the fishery as a whole; in the Northern Fishery Management Area (NMA), most goosefish are landed as part of the Northeast (NE) multispecies groundfish fishery, while in the Southern Fishery Management Area (SMA), most goosefish are landed with targeted extra-large-mesh gillnets. The FMP was established in 1999 to address concerns that the average size of landed goosefish was declining (FishWatch 2017), and is reviewed and updated frequently.

The original FMP focused on rebuilding depleted stocks, a goal that was accomplished in 2007 after the biomass reference points were revised and both the northern and southern stocks were deemed to be no longer overfished (NEFMC and MAFMC 2011). The measures imposed by the FMP include mandatory permitting, target catch levels, trip limits, minimum size limits, gear restrictions, temporal closures, area closures, by-catch allowances, and days-at-sea limitations (NEFMC and MAFMC 2011)(Richards 2016).

Species managed under the New England Multispecies Fishery Management Plan are also caught and retained in this fishery, so these species are considered in scoring this criterion. There are a number of stocks of concern affected by the fisheries managed under the NE Multispecies FMP, and the management plan has had varying degrees of success in recovering these stocks. The most recent stock assessments have shown that a number of stocks of concern have not yet been rebuilt and that the targets set within the rebuilding programs have not been met (e.g., Georges Bank cod, Gulf of Maine cod, GoM yellowtail flounder, Georges Bank yellowtail flounder, GoM windowpane flounder, witch flounder, thorny skate, SNE blackback, ocean pout, and summer flounder (which is undergoing overfishing) (Terceiro 2016)(Palmer 2017a)(Legault 2017a)(Legault 2017b)(Alade 2017) (NEFSC 2017f)(NEFSC 2017g)(Wigley 2017a)(Wigley 2017b)(Sosebee 2017b). But, a number of stocks have rebuilt before the end of the rebuilding period (typically due to strong recruitment and good survival of abundant year-classes during periods of reduced exploitation). These stocks include Georges Bank haddock, Gulf of Maine haddock, Acadian redfish, and pollock (Brooks 2017)(Palmer 2017b)(Linton 2017a)(Linton 2017b). Although there is concern that some of the stocks have yet to meet their rebuilding targets, other stocks have rebuilt within the specified timelines, and the current management system is likely to improve rebuilding of stocks due to reduced levels of discarding (which was a result of Amendment 16).

There have been some concerns with the management strategy in the past, particularly with respect to depleted stocks. In addition, target total allowable catches (TACs) have been set too high because of errors in stock assessments (a retrospective pattern suggesting that the stock was in better shape than it was), and there has been a need for increased precaution. But the management system has substantially changed under Amendment 16, which is expected to reduce the race to fish and to improve conservation outcomes. For example, discarding appears to have been reduced, and the fishery now relies on hard allowable catch limits (ACL) (which include discards) rather than target TACs—all of which helps reduce the likelihood of exceeding sustainable fishing mortality rates for targeted stocks. In addition, sectors have not exceeded their ACEs, whereas in the past it was possible for target TACs to be exceeded because the regulations were based on effort control (days at sea) rather than output control (Kitts et al. 2011){GARFO 2018} (pers. comm., J. Cournane July 13, 2018). But, the Groundfish Plan Development Team's preliminary analysis of observer data to explore potential discarding of legal-sized cod revealed evidence that suggests

noncompliance may be occurring (NEFMC 2018).

Goosefish stocks have been rebuilt from an overfished status, and ACLs/AMs based on scientific input are in place for more than 70% of the stocks in the FMP. Amendment 16 has led to improvements in constraining harvest to ACLs and reduced discarding, resulting in sectors not exceeding their ACEs. But, because rebuilding targets for certain species have not yet been met (mostly in the NE groundfish fishery), and there is potential underreporting of discarding, there is insufficient evidence that fishery management is being implemented successfully. Therefore, management strategy and implementation is scored moderately effective.

Justification:
Goosefish stocks in both the NMA and SMA have seemingly recovered from an overfished state due to a combination of management measures, changes to the stock assessment methods, and an alteration of reference points; management has taken a precautionary approach to preventing the stocks from becoming overfished in the future (NEFMC and MAFMC 2011)(Richards 2016). Both the latest benchmark assessment in 2013 and the operational assessment in 2016 indicate that goosefish stocks in both management areas are not overfished and overfishing is not occurring; however, the model and the BRPs used in these assessments were deemed inappropriate for this stock (Richards 2016)(Richards and Nitschke 2013).

The original goosefish FMP has been updated several times: Framework 9 in 2016 and Framework 10 in 2017. Framework 9 was developed by both councils to enhance the operational efficiency to better achieve optimum yield (Federal Register 2016). The goosefish fishery has not fully harvested the TAC target since 2011, especially in the NMA (Federal Register 2016). The newly accepted rule changes eliminate goosefish possession limits for vessels fishing under both a goosefish and NE Multispecies DAS (days at sea) in the NMA (Federal Register 2016) to help increase goosefish landings in the NMA. The second rule will revise the minimum mesh size and possession restriction in certain areas of the SMA in order to increase operational efficiency (Federal Register 2016).

The current annual catch targets (ACTs), days at sea (DAS), and trip limits per Framework 10, which allow for higher goosefish landings in order to better utilize the available TAC {NEFMC 2016}, are as follows for the NMA: an ACT of 6,338 mt; incidental landing limits for vessels fishing on a groundfish DAS are 900 lb tail weight/DAS for permit Category C, and 750 lb weight/DAS for permit Category D (GARFO 2018a)(GARFO 2018b). The SMA has an ACT of 9,011 mt, and trip limit increases for limited access vessels to 700 lb tail weight/DAS for permit Category A and C, and 575 lb tail weight/DAS for permit Category B and D. Days at sea were increased from 32 to 37 (GARFO 2018a)(GARFO 2018b). Management in the trawl and gillnet fisheries has brought goosefish stocks back from depletion and currently has a precautionary strategy that has maintained stock abundance of goosefish. But, the effectiveness of the entire Northeast multispecies groundfish fishery needs to be considered because most goosefish caught using trawl gear are caught as incidental landings, rather than being targeted catch (Hermsen 2010).

Moderately Effective

The goosefish fishery falls under a fishery management plan (FMP) that is jointly administered by the New England Fishery Management Council (NEFMC) and the Mid-Atlantic Fishery Management Council (MAFMC). Regional differences in primary fishing gear create some difficulties in discussing the fishery as a whole; in the Northern Fishery Management Area (NMA), most goosefish are landed as part of the multispecies groundfish fishery, while in the Southern Fishery Management Area (SMA), most goosefish are landed with targeted extra-large-mesh gillnets. The FMP was established in 1999 to address concerns that the average size of landed goosefish was declining (FishWatch 2017), and is reviewed and updated frequently.

The original FMP focused on rebuilding depleted stocks, a goal that was accomplished in 2007 after the biomass reference points were revised and both the northern and southern stocks were deemed to be no longer overfished (NEFMC and MAFMC 2011). The measures imposed by the FMP include mandatory permitting, target catch levels, trip limits, minimum size limits, gear restrictions, temporal closures, area closures, by-catch allowances, and days-at-sea limitations (NEFMC and MAFMC 2011)(Richards 2016).

Species managed under the New England Multispecies Fishery Management Plan are also caught and retained in this fishery, so these species are considered in scoring this criterion. A number of stocks of concern are affected by the fisheries managed under the NE Multispecies FMP, and the management plan has had varying degrees of success in recovering these stocks. The most recent stock assessments have shown that a number of stocks of concern have not yet been rebuilt and that the targets set within the rebuilding programs have not been met (e.g., Georges Bank cod, Gulf of Maine cod, GoM yellowtail flounder, SNE/MA yellowtail flounder [caught only in the gillnet fishery], Georges Bank yellowtail flounder, GoM windowpane flounder, witch flounder and thorny skate [both of which are also caught in the gillnet fishery], SNE blackback, ocean pout, and summer flounder [which is undergoing overfishing]) (Terceiro 2016)(Palmer 2017a)(Legault 2017a)(Legault 2017b)(Alade 2017)(NEFSC 2017e)(NEFSC 2017f)(NEFSC 2017g)(Wigley 2017a)(Wigley 2017b)(Sosebee 2017b). But, a number of stocks have rebuilt before the end of the rebuilding period (typically due to strong recruitment and good survival of abundant year-classes during periods of reduced exploitation). These stocks include Georges Bank haddock, Gulf of Maine haddock, Acadian redfish, and pollock (Brooks 2017)(Palmer 2017b)(Linton 2017a)(Linton 2017b). Although there is concern that some of the stocks have yet to meet their rebuilding targets, other stocks have rebuilt within the specified timelines, and the current management system is likely to improve rebuilding of stocks due to reduced levels of discarding (which was a result of Amendment 16).

There have been some concerns with the management strategy in the past, particularly with respect to depleted stocks. In addition, target total allowable catches (TACs) have been set too high because of errors in stock assessments (a retrospective pattern suggesting that the stock was in better shape than it was), and there has been a need for increased precaution. But the management system has substantially changed under Amendment 16, which is expected to reduce the race to fish and to improve conservation outcomes. For example, discarding appears to have been reduced, and the fishery now relies on hard allowable catch limits (ACL) (which include discards) rather than target TACs—all of which helps reduce the likelihood of exceeding sustainable fishing mortality rates for targeted stocks. In addition, sectors have not exceeded their ACEs, whereas in the past it was

possible for target TACs to be exceeded because the regulations were based on effort control (days at sea) rather than output control (Kitts et al. 2011){GARFO 2018} (pers. comm., J. Cournane July 13, 2018). But, the Groundfish Plan Development Team's preliminary analysis of observer data to explore potential discarding of legal-sized cod revealed evidence that suggests noncompliance may be occurring (NEFMC 2018).

Goosefish stocks have been rebuilt from overfished status ACLs/AMs that are based on scientific input and in place for more than 70% of the stocks in the FMP. Amendment 16 has led to improvements in constraining harvest to ACLs and reduced discarding, resulting in sectors not exceeding their ACEs. But, because rebuilding targets for certain species have not yet been met (mostly in the NE groundfish fishery), and there is potential underreporting of discarding, there is insufficient evidence that fishery management is being implemented successfully. Because of the rebuilding of the goosefish stocks as well as the current management methods, management strategy and implementation is considered moderately effective.

Justification:
Goosefish stocks in both the NMA and SMA have seemingly recovered from an overfished state due to a combination of management measures, changes to the stock assessment methods, and an alteration of reference points; management has taken a precautionary approach to prevent the stocks from becoming overfished in the future (NEFMC and MAFMC 2011)(Richards 2016). Both the latest benchmark assessment in 2013 and the operational assessment in 2016 indicate that goosefish stocks in both management areas are not overfished and overfishing is not occurring; however, the model and the biological reference points (BRP) used in these assessments were deemed inappropriate for this stock (Richards 2016)(Richards and Nitschke 2013).

The original goosefish FMP has been updated several times: Framework 9 in 2016 and Framework 10 in 2017. Framework 9 was developed by both councils to enhance the operational efficiency to better achieve optimum yield (Federal Register 2016). The goosefish fishery has not fully harvested the TAC target since 2011, especially in the NMA (Federal Register 2016). The newly accepted rule changes eliminate goosefish possession limits for vessels fishing under both a goosefish and NE Multispecies DAS (days at sea) in the NMA (Federal Register 2016), to help increase goosefish landings in the NMA. The second rule will revise the minimum mesh size and possession restriction in certain areas of the SMA in order to increase operational efficiency (Federal Register 2016).

The current annual catch targets (ACTs), days at sea (DAS), and trip limits per Framework 10, which allow for higher goosefish landings in order to better utilize the available TAC {NEFMC 2016}, are as follows for the NMA: an ACT of 6,338 MT; incidental landing limits for vessels fishing on a groundfish DAS are 900 lb tail weight/DAS for permit Category C, and 750 lb weight/DAS for permit Category D (GARFO 2018a)(GARFO 2018b). The SMA has an ACT of 9,011 mt, and trip limit increases for limited access vessels to 700 lb tail weight/DAS for permit Category A and C, and 575 lb tail weight/DAS for permit Category B and D. Days at sea were increased from 32 to 37 (GARFO 2018a)(GARFO 2018b). Management in the trawl and gillnet fisheries has brought goosefish stocks back from depletion and currently has a precautionary strategy that has maintained stock abundance of goosefish. But, the effectiveness of the entire Northeast multispecies groundfish fishery needs to be considered, because most goosefish caught using trawl gear are caught as incidental landings,

rather than being targeted catch (Hermsen 2010).

Factor 3.2 - Bycatch Strategy

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderately Effective

The Magnuson-Stevens Act (MSA) requires fisheries management to prevent overfishing from occurring, and for depleted and overfished stocks to be rebuilt. Marine mammals are further protected under the Marine Mammal Protection Act (MMPA) of 1972, which requires the maintenance of marine mammal populations above their optimum sustainable level and the rebuilding of depleted populations. The Endangered Species Act (ESA) of 1973 provides protection for species that are endangered or threatened with extinction, including fish, marine mammals, turtles, and seabirds. These three pieces of legislation provide a framework directed at ensuring that FMPs are designed and implemented in a way that prevents overfishing and allows recovery of stocks caught within a fishery, whether the stocks are targeted or caught incidentally.

The MSA requires that all management measures must minimize by-catch to the extent practicable, and minimize mortality of by-catch when by-catch is unavoidable (Magnuson-Stevens Fishery Conservation and Management Act 1976). To comply with the MSA requirement of including a standardized by-catch reporting methodology (SBRM) in all FMPs, and prompted by successful lawsuits by Oceana, the Conservation Law Foundation, and the Natural Resources Defense Council, the NEFMC and the Mid-Atlantic Fisheries Management Council jointly developed an omnibus amendment, corresponding to Amendment 15 to the NE multispecies FMP. The SBRM amendment is meant to "establish, maintain, and utilize biological sampling programs designed to minimize bias to the extent practicable, thus promoting accuracy while maintaining sufficiently high levels of precision" {Federal Register 2008}. The original SBRM was considered inadequate and was vacated by the courts in 2011. A revised SBRM Amendment was adopted by both the Mid-Atlantic and New England Councils in 2014, and approved by NMFS in March 2015; the final rule became effective in July 2015 {NEFMC 2015}{NEFSC 2018a}. This action establishes standards of precision for by-catch estimation (selecting the combined ratio method using discard-to-kept pounds, using a coefficient of variation (CV) of 30%, deciphering the number of observed sea days [and trips] necessary to achieve a CV of 30% for each species, and conducting analyses to evaluate potential sources of bias in NEFOP data) for all Northeast Region fisheries, and serves to document the SBRM established for all fisheries managed through the two Councils {NEFMC 2015}{NEFSC 2018a}.

To be approved to operate, sectors must submit an operations plan to the regional administrator (NEFMC) that details (among other things) how by-catch of regulated species and ocean pout will be avoided to prevent allowable catch entitlement overages. Currently, two types of observers are associated with the NE multispecies fishery: Northeast Fishery Observer Program (NEFOP) observers, which is a federally funded program, and at-sea monitors (ASM), funded by a third party and managed by the Northeast Fisheries Science Center's Fisheries Sampling Branch {NEFSC

2018c}.

Amendment 23 to the NE multispecies FMP has been proposed to adjust the groundfish monitoring program in order to improve reliability and accountability (NEFMC 2017). The Council plans to explore alternatives to at-sea observers, and may consider changes to any part of the monitoring and reporting system for groundfish (NEFMC 2017). At this point, there is adequate observer coverage (15%, which is the coverage requirement specified in the Standardized By-catch Reporting Methodology), and data collection and analysis are sufficient to ensure that goals are being met for both by-catch and retained species (NOAA 2018b).

In the bottom trawl fishery, large amounts of landed by-catch are being discarded in high quantities (refer to Criterion 2.3), such as skate complex species, spiny dogfish, and certain large mesh groundfish, mostly because of their lack of market value {Wigley and Tholke 2017}. In addition, endangered, threatened, and protected (ETP) species (Atlantic halibut); marine mammals (Atlantic white-sided dolphin, gray seal, harp seal, harbor seal, harbor porpoise, long-finned pilot whale, minke whale, and short-beaked common dolphin); and overfished species (ocean pout, thorny skate, witch flounder, and yellowtail flounder) are being caught as by-catch. Any mitigation measures to address these by-catch species have not been fully effective.

Because there are by-catch reduction measures in place, but mitigation measures with respect to ETP species, marine mammals, and overfished species have not been fully successful, management strategy is scored moderately effective.

Justification:
As stated in the BO, the continued operation of the goosefish fishery under the goosefish FMP would likely adversely affect, but not jeopardize, the continued existence of species of concern. An incidental take statement was prepared for both the gillnet and trawl fisheries, and lists the annual or 5-year average takes that would be expected for sea turtles and marine mammals. Many of the factors that serve to mitigate the impacts of the goosefish fishery on protected species are currently being implemented in the Northeast Region under either the Atlantic Large Whale Take Reduction Plan (ALWTRP) or the Harbor Porpoise Take Reduction Plan (HPTRP).

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Ineffective
The goosefish and NE multispecies FMPs contain several guidelines for reducing harmful interactions between fishing gear and associated catch, particularly for marine mammals and sea turtles, though most regulations apply to gillnets rather than trawl gear.

The Atlantic Large Whale Take Reduction Plan (ALWTRP) was developed under the MMPA in 1997 to reduce mortality and serious injury (SIM) to whales due to incidental take in U.S. commercial fisheries that interact with strategic stocks (NOAA 2012)(NOAA 2018c). To achieve this goal, several measures have been implemented, including requirements of sinking groundline, weak links, a vertical line rule, gear marking requirements, and area closures {Gouveia & Swails 2017}(NOAA

2018c). But, the Take Reduction Plans (TRPs) in the northeastern U.S. have been regarded as the least successful of the U.S. TRPs at reducing marine mammal by-catch {McDonald et al. 2016}. To date, the ALWTRP has failed to meet its statutory goal of reducing SIM to a level below the potential biological removal (PBR), and to a level approaching zero (the Zero Mortality Rate Goal). Many management measures have been ineffective in reducing entanglement rates (based on data from 1999 to 2009, inclusive of entanglements attributed to unidentified fisheries) {Pace et al. 2014}, because annual SIM due to entanglement continues to exceed PBR (NOAA 2019c). The impacts of introducing regulations such as the "sinking groundline rule" in 2009 and the "vertical line rule" (50 Federal Register 2014) in 2015 are not fully understood, because of limited data and analyses (the latest marine mammal stock assessments consider data from 2014 to 2018). But, for most entanglement interactions, gear is not recovered or is unidentifiable (77% of entanglements between 2000 and 2018) and, although the goosefish gillnet fishery has not been identified specifically in recent interactions, most interactions cannot be attributed to a specific fishery (NOAA 2019c). In 2014, a whale carcass was found south of Nantucket entangled in what was most likely gillnet gear {Sharp et al. 2019}{Sharp et al. 2019 Supplemental}.

A batched biological opinion published in May 2021 considers the impact of fisheries in U.S. federal waters on species listed under the Endangered Species Act (ESA) (NMFS 2021a). Although the biological opinion reached a determination that fisheries in U.S. federal waters will not jeopardize the continued existence of North Atlantic right whale, NOAA predicts that the Conservation Framework will take 9 years to reduce the impact of U.S. fisheries to below PBR (currently 0.8) (Table 1). NOAA's analysis indicates that the proposed management measures will fail to limit the impact of U.S. fisheries to below PBR within a reasonable time frame consistent with the Seafood Watch Fisheries Standard with respect to the Marine Mammal Protection Act (MMPA). The impact of the Risk Reduction Rule is expected to reduce the impact of U.S. pot and trap fisheries from 4.57 SIMs per year to 2.56 SIMs, and 2.69 SIMs per year in federal waters inclusive of gillnet interactions.

Table 1: Actions to be taken under the ALWTRP Conservation Framework. From 2021 Batched Biological Opinion (NMFS 2021a).

Phase	Year	Framework Action Description
	Annually	Provide updates, as appropriate, on the implementation of the Framework to the New England and Mid-Atlantic Fishery Management Councils, Atlantic States Marine Fisheries Commission, and ALWTRT.
1	2021	NMFS implements the MMPA ALWTRP rule-making focused on 60% reduction in right whale M/SI incidental to American lobster and Jonah crab trap/pot fisheries. In federal waters, this action reduces M/SIs, on average annually, to 2.69. Implementation for certain measures will begin in 2021; others will be phased over time.
2	2023	NMFS implements rule-making to reduce M/SI in federal gillnet and other pot/trap (i.e., other than lobster and Jonah crab fisheries included in Phase 1) fisheries by 60%, reducing M/SI, on average annually, to 2.61. The ALWTRT will convene in 2021 to recommend modifications to the ALWTRP to address risk in the remaining fixed gear fisheries. This phase will consider how any changes to the ALWTRP contribute to achieving the target reduction under this Framework.
Evaluation	2023–2024	NMFS evaluates any updated or new data on right whale population and threats to assess progress toward achieving the conservation goals of this Framework. At this time, we will also assess measures taken by Canada to address M/SI in Canadian waters.
3	2025	NMFS implements rule-making to further reduce M/SI by 60% in all federal fixed gear fisheries, reducing M/SI, on average annually, to 1.04.

Evaluation	2025–2026	NMFS evaluates measures implemented in 2025 action as well as new data on right whale population and threats to assess progress toward achieving the conservation goals of this Framework. Based on the results of this evaluation, NMFS will determine the degree to which additional measures are needed to ensure the fisheries are not appreciably reducing the likelihood of survival and recovery. As described above, if actions outside the federal fisheries reduce risk to right whales by 0.5 M/SI on average annually (one whale every 2 years), the M/SI reduction requirement in Phase 4 will be reduced from 87% to 39%. If M/SI from other sources is reduced by greater than one M/SI on average annually, we will evaluate whether further action in the federal fisheries is needed.
4	2030	In accordance with the goals identified in the 2025–2026 evaluation, NMFS implements regulations to further reduce M/SI (up to 87%) in fixed gear fisheries.

In July 2022, a District Court ruled that the 2021 Final Rule and 2021 Biological Opinion were invalid, in part due to the concerns noted above. Specifically, the court ruled that the Risk Reduction Rule and 2021 Biological Opinion violated requirements of the Endangered Species Act and Marine Mammal Protection Act on two accounts: 1) "through its failure to satisfy the required antecedent in section 101 (a)(5)(E) of the MMPA before issuing an ITS"; and 2) "the Final Rule did not attempt to meet the take-reduction measures that it was obligated to under the MMPA within the required timeline" {US District Court 2022}.

Based on the 2021 Biological Opinion, several management measures to mitigate effects on sea turtles include: 1) in the Mid-Atlantic, management measures that prohibit gillnet vessels from using large mesh (7 in or greater) gillnets in some areas during certain times of the year to protect migrating sea turtles; 2) closures that are timed-based on projected sea surface temperatures in fishing areas, because sea turtles are known to migrate into these areas when temperatures are about 52 °F or higher (NMFS 2021); and 3) the closures moving large-mesh gillnetting north in advance of sea turtles migrating into fishing areas and, along with other precautions, have greatly reduced incidental catch of sea turtles in the goosefish fishery (NEFSC 2013)(NEFMC and MAFMC 2014)(FishWatch 2017).

Ghost fishing impacts are a concern for gillnet gear because they tend to have the highest risk of ghost fishing compared to other gears, such as traps/pots and trawls (GGGI 2018). Because of the amount of fishing gear used in deepwater net fisheries, the length of the fleets, and the fact that nets are unattended for a majority of the time, it is highly likely that large quantities of nets are lost, and large quantities of by-catch are caught (Brown et al. 2005). But, there is no information available from this fishery to indicate how ghost fishing has been effectively addressed.

Although there are measures in place to reduce the impacts of the sink gillnet fishery on by-catch species, current management measures to prevent by-catch are insufficient, given the potential impacts of the fishery on endangered North Atlantic right whale, and the planned framework to implement risk reduction measures is not anticipated to reduce the impact of U.S. fisheries to below PBR until 2030. Therefore, the by-catch strategy is rated ineffective.

Justification:
There is a need for improved cooperation between United States and Canadian agencies in addressing the impact of fisheries on North Atlantic right whale. Since 2010, there has been a shift in North Atlantic right whale distribution, with whales migrating to the Gulf of St. Lawrence during the summer months {Davis et al. 2017}. The number of entanglements involving Canadian fisheries, including snow crab fisheries, increased starting in 2016 (NOAA 2021); during the ongoing Unusual

Mortality Event, 21 of the 34 known mortalities have been attributed to Canadian waters (NOAA 2021). Although U.S. and Canadian agencies have introduced measures aimed at reducing the impact of, and the risk posed by, commercial fisheries (and other human activities) on North Atlantic right whale, the effectiveness of these measures remains unproved, and the impact of these activities continues to exceed a sustainable level (Hayes et al. 2021). Cumulative impacts (average of 8.15 SIMs per year from 2014 to 2018), particularly on SIMs from unknown sources (5.1 SIMs), remain far above levels that would allow the population to recover (PBR = 0.8) (Hayes et al. 2021), and the Conservation Framework will allow continued impacts above PBR for the next 9 years. Cumulative impacts must be addressed through a comprehensive and coordinated management strategy, to account for the transboundary nature of North Atlantic right whale that migrate between U.S. and Canadian waters.

New scientific data indicate additional risks that have not been addressed in the Conservation Framework: specifically, risks related to entanglements that do not result in SIMs {Steward et al. 2021}, and range shifts due to climate change and the impact this has on food availability {Meyer-Gutbrod et al. 2021}. There is a growing body of evidence indicating that entanglements that do not result in SIMs can still have a negative impact on North Atlantic right whale populations, as a result of decreased growth {Steward et al. 2021}, increased energy consumption {van der Hoop et al. 2017}, declining body condition {Pettis et al. 2017}, and reduced reproductive output {Fauquier et al. 2020}; as scientific understanding of these issues improves, there will likely be a need for improved management to ensure that negative impacts of entanglements are avoided.

In addition to the federal management measures described above, the Massachusetts Division of Marine Fisheries has implemented a suite of measures to reduce the risk to North Atlantic right whale in Massachusetts state waters effective from May 1, 2021 (Massachusetts Register 2022). A seasonal closure has been implemented prohibiting the use of traps and gillnets within 53% of state waters from February 1 to May 15 (with the possibility of opening after April 30, or extending beyond May 15, dependent on the presence of North Atlantic right whale in the area). All buoy lines in the trap fisheries are required to have a 1,700-lb breaking strength contrivance, and buoy lines shall be no thicker than 3/8" in diameter. Further to the federally required gear marking, MDMF requires all trap fisheries in state waters to include a 3-ft red mark within the surface system, and four 2-ft red marks along the buoy line (two within the top 50%, and two within the bottom 50% of the line) (MDMF 2022).

Factor 3.3 - Scientific Research And Monitoring

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderately Effective

The Northeast Fisheries Science Center and members of the goosefish industry collaborated to run the Cooperative Monkfish Research Program, which conducts a number of research programs related to goosefish, including industry-based trawl surveys (Richards et al. 2008)(NEFSC 2012a). The program tags goosefish to track their movements, and coordinated a goosefish egg veil sighting

network to help scientists better understand goosefish reproduction and distributions.

In addition, the Monkfish Research Set-Aside Program annually sets aside fishing days at sea (DAS) to fund and execute goosefish research (NEFSC 2018b). In July 2018, three new cooperative research projects to improve understanding of monkfish biology and how to reduce catch of skates in monkfish gillnet gear were announced by the New England and Mid-Atlantic Fishery Management Councils, managed by NOAA Fisheries in the region (NOAA 2018c)(NEFSC 2018b). These are as follows:

1) A two-year study (296 monkfish RSA days at sea) to test ultrasound methods for determining sex and maturity stage in Southern New England monkfish, and to conduct hormone analyses to create a reproductive profile based on sex and maturity stage of monkfish (The Coonamessett Farm Foundation).

2) A two-year study (401 monkfish RSA days at sea) using histological aging techniques on monkfish vertebrae and illicia. This work will validate earlier, preliminary results from a pilot study done on vertebrae, and will also test the method on illicia. The research team will also collect reproductive data to estimate age and size at maturity (The University of New England).

3) A two-year study (303 monkfish RSA days at sea) evaluating a modified gillnet designed to reduce skate by-catch. Monkfish vessels also have a skate quota. If that quota is caught too quickly, it can constrain monkfish trips for the remainder of a fishing year. Researchers hope to find a gear solution that will reduce skate in the catch without affecting monkfish harvest rates (The Cornell University Cooperative Extension of Suffolk County).

The Northeast Fisheries observer program assigns observers to vessels of all fisheries in the northeast, and the groundfish trawl fishery in New England also participated in an at-sea observer monitoring program that included observers on 2% to 10% of trips during the period 2005–2008 (NMFS 2011b).

There is a recent quantitative assessment that is independently peer-reviewed, as well as fishery-dependent and -independent monitoring; however, stock assessments have used proxies that have not before been used as a basis for proxies for biological reference points, leading to a good deal of uncertainty in the results. In addition, observer coverage in this fishery is low and was conducted over a decade ago. Hence, this factor is scored moderately effective.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

N/A

In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.3 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.3.

Factor 3.4 - Enforcement Of Management Regulations

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderately Effective

The goosefish and northeast multispecies fisheries participate in the vessel monitoring system (VMS), which transmits time and position data to allow enforcement to detect fishing vessels that may be fishing in closed areas. Enforcement of fishing regulations is provided at sea by the U.S. Coast Guard and on shore by the National Marine Fisheries Service and state agencies. Although there is a somewhat strong enforcement, total allowable catch (TAC) limits are often exceeded on fishing vessels. The goosefish fishery as a whole has a mediocre record of adhering to TACs; from 2000 to 2009, the average percent of TAC landed was 119.5%, with the northern management region adhering slightly better, at 114%, than the southern management region, at 125% (NEFMC and MAFMC 2011). These numbers represent the entire goosefish fishery; thus, it is difficult to divide the landings between gear types.

But, the northern fishery management region primarily lands goosefish with trawl gear, while the southern fishery management region primarily lands goosefish with gillnet gear. Adherence to TAC limits is improving in both fishery management areas, with the fishery last exceeding TAC limits in 2007 in the northern management area and in 2008 in the southern management area. Because adherence to TAC limits has improved and, in fact, has remained below the annual TAC since 2009 (but this is likely due to other factors, such as groundfish management restrictions in the north and market demand, price, and sturgeon by-catch in gillnets (Richards 2016)), this factor is considered moderately effective.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

N/A

In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.4 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.4.

Factor 3.5 - Stakeholder Inclusion

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Highly effective

The NEFMC and MAFMC have an open and transparent policy that allows stakeholder participation and feedback through meetings and scoping hearings throughout their affected areas. Both councils also utilize industry advisory panels that provide information during the development of FMPs. Public meeting schedules for the NEFMC and MAFMC are online at

http://www.nefmc.org/calendar/index.html and http://www.mafmc.org/council-events/, respectively. As a result, this factor is scored highly effective.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

N/A

In cases where either Factor 3.1 or 3.2 scores ineffective, Factor 3.5 is not scored because the overall score for Criterion 3 is a very high concern (1), regardless of how a fishery performs against Factor 3.5.

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	SCORE
Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC	Score: 2	Score: 0	Moderate Concern	**Yellow (2.449)**
Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC	Score: 3	Score: 0	Moderate Concern	**Yellow (3.000)**

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*

- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl) Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.*

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*
- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but*

detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.

- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Score: 2

The bottom trawl fishery for monkfish occurs primarily over mud and sand habitats. Therefore, based on SFW criteria, this factor is considered a 2.

Justification:

Concern over the effects of trawling on benthic ecosystems grew during the 1990s, and a host of scientific papers have since documented the damage to benthic communities resulting from these fishing methods (for reviews, see (Watling and Norse 1998) (Thrush and Dayton 2002)).

Bottom trawls not only remove an extensive amount of biomass, they destroy biogenic habitat structures such as sponges and tubes (Schwinghamer et al. 1988)(Watling and Norse 1998)(Thrush and Dayton 2002)(Dinmore et al. 2003). These impacts led to the comparison of dredging with forest clearcutting (Watling and Norse 1998). As with forest clearing, benthic ecosystems can be slow to recover, and recovery times will vary with the exact species, habitat, and depth considered (Watling and Norse 1998)(Dinmore et al. 2003).

The Gulf of Maine and Georges Bank have been trawled for decades, and impacts on the benthic megafauna on habitats have been studied by Auster et al., Collie et al., and Grabowski et al. {Auster et al. 1995}{Collie et al. 1997}{Grabowski et al. 2014}. These studies found an abundance of organisms, biomass, and species diversity that were significantly greater at nontrawled sites than at trawled sites, and found that complexity was reduced both directly (by removal of biogenic and sedimentary structures) and indirectly (by removal of organisms that create structures). But, the average recovery time for geological features in mud and sand substrates affected by bottom trawls was much shorter than in low-energy granule-pebble and low- and high-energy cobble and boulder substrates.

In addition to removal of biomass and biogenic structures, mobile fishing gear (i.e., trawls) alter physical habitat. Even in sandy areas, where dredge impacts are expected to be minimal, experimental dredging has revealed significant changes to the physical habitat, such as the loss of topographic relief (Schwinghamer et al. 1988).

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Score: 3

Most bottom gillnet fishing occurs over sandy habitats in the southern fishery management area, but some also occurs over mud and gravel. Based on the SFW criteria, this factor receives a score of 3.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Score: 0

Managers have closed a number of areas to trawling to protect essential fish habitat (EFH) and other important areas (see Figures 50 and 51), and there are ongoing measures to reduce fishing effort in the monkfish trawl fishery (NEFMC and MAFMC 2011). For the Northern Management Area (NMA), where goosefish is incidental catch, a number of permanent and temporary spatial closures are in place in the Gulf of Maine (GoM) and Georges Bank. There are two groundfish closed areas (Western GoM Groundfish Closure, Cashes Ledge Groundfish Closure), eight applicable habitat management areas (HMAs), and two dedicated habitat research areas (Stellwagen DHRA and Georges Bank DHRA) in place to protect EFH from the impacts of bottom trawling and set gillnets (Figure 50) (NOAA 2018b)(GARFO 2018c). These areas are either closed year-round to all bottom-tending mobile gears, or closed to all fishing vessels with certain exemptions (see details in Justification).

In addition, there are five GoM cod protection closures in which certain areas are closed to all fishing vessels, with handline (HL) and pelagic longline (LL) exemptions, during certain months (NOAA 2018b)(GARFO 2018c). There are also four seasonal closure areas closed to all fishing vessels, with HL and LL exemptions: 1) Closed Area 1 North Seasonal Closure (1,937 km^2), closed from February 1 to April 15; 2) Winter Massachusetts Bay Spawning Protection Area (310 km^2), closed from November 1 to January 31; 3) Spring Massachusetts Bay Spawning Protection Area (46 km^2), closed from April 15 to 30; and 4) "Whaleback" GoM Cod Spawning Protection Area (114 km^2), closed from April 1 to June 30 (Figure 51) (NOAA 2018b)(GARFO 2018c). These closures are primarily designed to protect important spawning grounds and juvenile fish (NOAA 2018b)(GARFO 2018c)(pers. comm., M. Bachman July 16, 2018).

The large majority of monkfish trawl landings occur in the NMA, but approximately only 7.5% to 18% of these habitats are closed to bottom trawling at any given time (taking into consideration spatial and temporal overlap); therefore, this factor is scored as 0.

Justification:

Closed year-round to all fishing vessels, with exemptions: 1) Western GoM Groundfish Closure (3,030 km^2; HL and LL gears exempted) and the Stellwagen DHRA (large: 1,177 km^2, small: 670 km^2; HL and LL gears exempted); 2) Cashes Ledge Groundfish Closure Area (1,373 km^2; HL and LL

gears exempted); 3) the Ammen Rock HMA (15 km^2; closed to all fishing, except lobster traps); and 4) Closed Area II (2,650 km^2; HL and LL gears exempted) {NEFMC 2016b}(GARFO 2018c)(GARFO 2018d).

Closed year-round to all bottom-tending mobile gears: 1) Western GoM Habitat Closure Area (2,272 km^2); 2) Cashes Ledge (443 km^2) HMA; 3) Fippennies Ledge (45 km^2) HMA; 4) Eastern Maine HMA (483 km^2); 5) Jeffrey's Bank (499 km^2) HMA; 6) Georges Bank DHRA (584 km^2); 7) Closed Area II Habitat Closure Area (641 km^2, which is an HMA); and 8) two Great South Channel HMAs (2,301 km^2) {NEFMC 2016b}(GARFO 2018c)(GARFO 2018d) (pers. comm., M. Bachman July 16 2018).

The total fishing area for cod, haddock, and pollock in the U.S. EEZ area was estimated at 131,464 km^2. Closures to set gillnet and bottom trawl gear roughly equated to 9,810 km^2 in total closure area, not including seasonal closures, and 13,430 km^2 in total closure area including seasonal closures, where overlapping closures were accounted for {NEFMC 2016b}(GARFO 2018c)(GARFO 2018d). GoM cod protection closures in May and June provided an additional 10,000 km^2 of closure area. This gives an approximate total closure range of 7.5% to 18% (possibly slightly more at certain times during the season, because of those overlapping closures that did not overlap completely but were not included in these values).

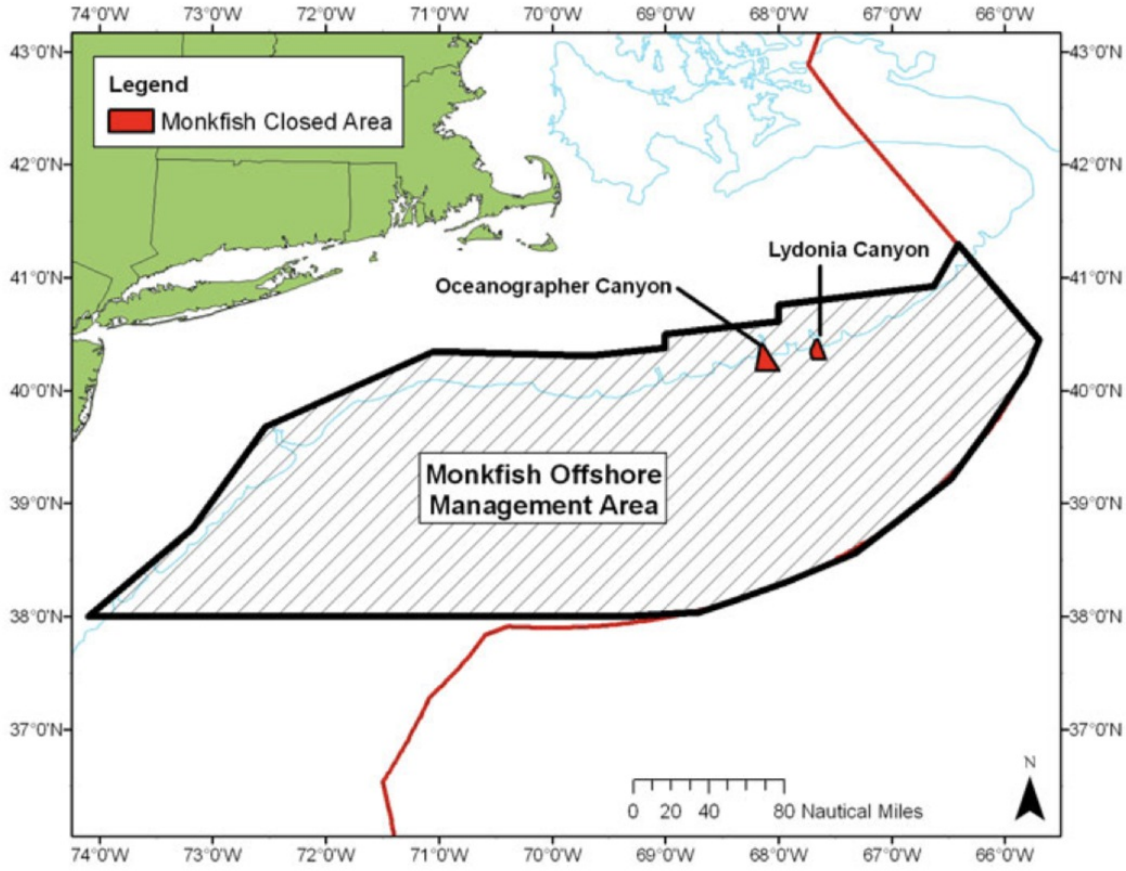

Figure 52: Goosefish closed areas in two offshore canyons (Lydonia Canyon Closed Area and Oceanographer Canyon Closed Area) (GARFO 2018a).

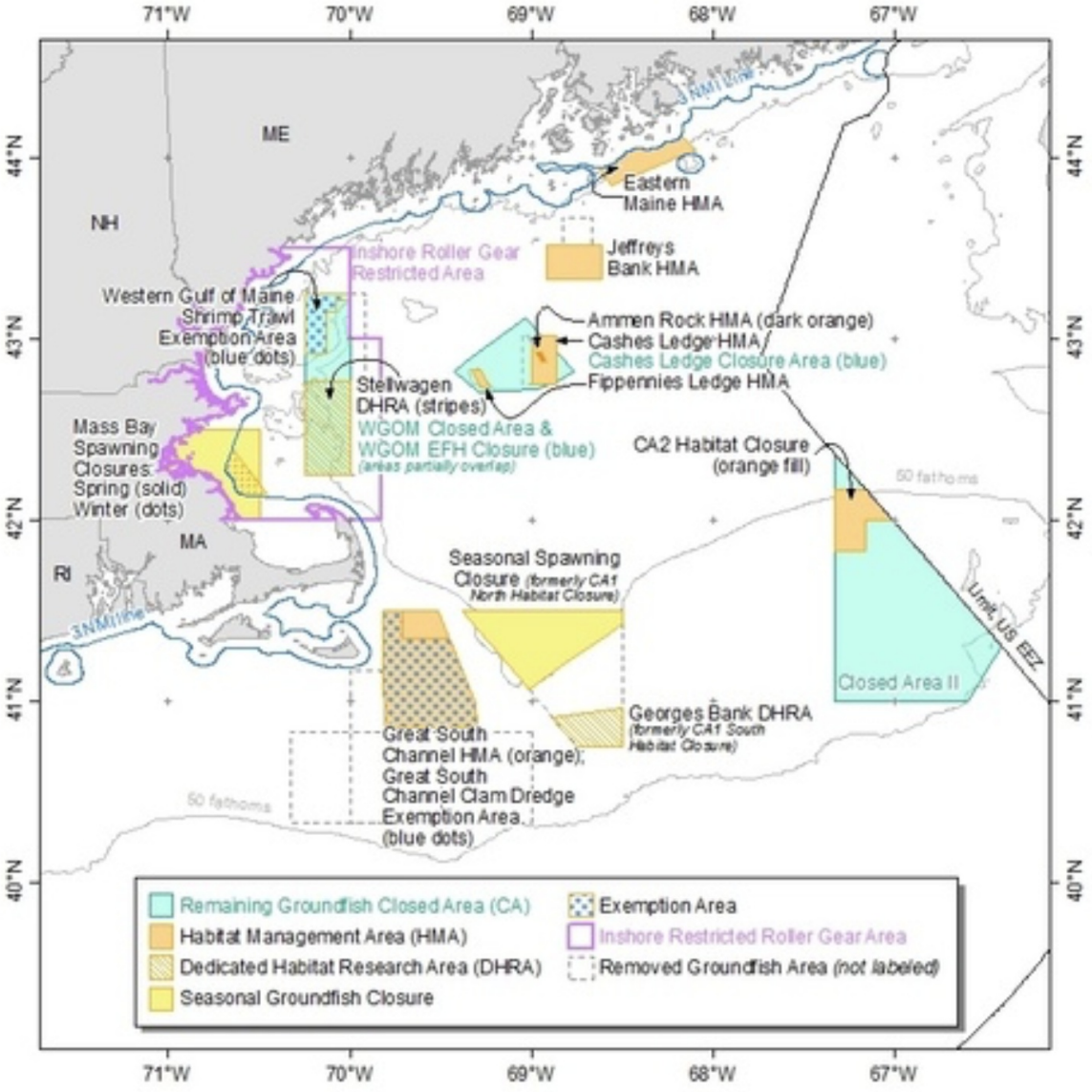

Figure 53: Year-round and seasonal closures in the Georges Bank and the Gulf of Maine (NOAA 2018b).

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Score: 0

Days at sea (DAS), total allowable catch (TAC), and trip limits are ongoing measures to control fishing effort in the goosefish gillnet fishery (NEFMC and MAFMC 2011), and there are few benthic protected areas.

In Amendment 13 to the Multispecies FMP, the NEFMC implemented a variety of measures to minimize the impacts of bottom trawling in the Gulf of Maine, Georges Bank, and Southern New England. In addition to the significant reductions in DAS and some gear modifications, the Council

closed 2,811 square nautical miles (nm^2) to bottom-tending mobile fishing gear (known as Habitat Closed Areas) (NEFMC and MAFMC 2009). Because the monkfish fishery overlaps significantly with the groundfish fishery in the NMA, and the habitat closed areas extend into the SMA, measures to protect habitat in Amendment 10 (to the scallop FMP) and Amendment 13 aid in minimizing the effect of fishing on essential fish habitat (EFH) in the monkfish fishery (NEFMC and MAFMC 2009). In addition, the Councils closed Oceanographer Canyon and Lydonia Canyon deeper than 200 m (a total closure of 116 nm^2) to vessels on a monkfish DAS, in order to minimize the impacts of the directed monkfish fishery on deepwater canyon, hard-bottom communities. These two canyon areas are outside the range of the multispecies fishery, but could be areas in which, or adjacent to where, deepwater monkfish fisheries occur (NEFMC and MAFMC 2009).

But, because the closed areas and measures in place are primarily in the NMA, are not always specific to the gillnet fishery (which is not included in "bottom-tending" gear closures), and do not protect more than 20% of the habitat, this factor is scored as 0.

Factor 4.3 - Ecosystem-based Fisheries Management

Atlantic and adjacent areas | Atlantic, Northwest | Bottom trawls | United States | NEFMC

Moderate Concern

Ecosystem-based management in the United States has been given attention with the President Obama-era National Ocean Policy, established under presidential order on 19 July 2010 (White House Executive Order 13547 2010). Since then, NOAA Fisheries has developed a draft Northeast Regional Implementation Plan that identifies priority actions and milestones for the next 5 years (NOAA 2018d). The policy identifies six guiding principles: 1) implement ecosystem-level planning; 2) advance our understanding of ecosystem processes; 3) prioritize vulnerabilities and risks of ecosystems and their components; 4) explore and address trade-offs within an ecosystem; 5) incorporate ecosystem considerations into management advice; and 6) maintain resilient ecosystems (NOAA 2018d).

On a regional level, the NEFMC has formed a committee to explore EBFM, and has produced a draft operational framework and three operational models for implementing EBFM in Georges Bank (NEFMC 2017). This new approach that involves all species and fisheries in a specific area, "recognizes the energetic limits of the system, takes into account the trophic relationships among species, allows for greater adaptability to variability and change, and addresses multifaceted goals and objectives" (NOAA 2018d). A report to provide ecosystem-scale information for fishery managers to consider along with existing species-scale analyses using a conceptual model was published in April 2018 (NEFSC 2018).

Nevertheless, until the plan has been implemented, this factor is considered a moderate concern.

Atlantic and adjacent areas | Atlantic, Northwest | Set gillnets | United States | MAFMC

Moderate Concern

Ecosystem-based management in the United States has been given attention with the President Obama-era National Ocean Policy, established under presidential order on July 19, 2010 (White House Executive Order 13547 2010). Since then, NOAA Fisheries has developed a draft Northeast Regional Implementation Plan that identifies priority actions and milestones for the next 5 years (NOAA 2018d). The policy identifies six guiding principles: 1) implement ecosystem-level planning; 2) advance our understanding of ecosystem processes; 3) prioritize vulnerabilities and risks of ecosystems and their components; 4) explore and address trade-offs within an ecosystem; 5) incorporate ecosystem considerations into management advice; and 6) maintain resilient ecosystems (NOAA 2018d).

On a regional level, the MAFMC adopted the transitional approach being taken by the Pacific Fishery Management Council to introduce ecosystem considerations into Council management actions in a step-wise, evolutionary fashion, referred to as an Ecosystem Approach to Fisheries Management (EAFM) (MAFMC 2016). Their EAFM document focuses on the following major ecosystem-related issues: 1) forage/low trophic-level species considerations; 2) incorporation of ecosystem-level habitat conservation and management objectives in the current management process; 3) effects of systematic changes in oceanographic conditions on abundance and distribution of fish stocks and ramifications for existing management approaches/programs; and 4) interactions (species, fleet, habitat, and climate) and their effects on sustainable harvest policy and achievement of OY (optimum yield) (MAFMC 2016).

Nevertheless, until the EAFM plan has been implemented, this factor is scored a moderate concern.

Acknowledgements

Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

Seafood Watch would like to thank four anonymous reviewers for graciously reviewing this report for scientific accuracy.

References

50 Federal Register Part 229. 2014. Taking of Marine Mammals Incidental to Commercial Fishing Operations; Atlantic Large Whale Take Reduction Plan Regulations. Federal Register. Vol 79., No. 124. June 27, 2014.

A. Richards and P. Nitschke 2013. .2013 Monkfish Operational Assessment. NEFSC CRD13-23 (2013)

Alade, L. 2017. Gulf of Maine Yellowtail Flounder. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/cc_gom_yellowtail_flounder.pdf.

ASMFC.2017. http://www.asmfc.org/species/atlantic-sturgeon.

Brooks, L. 2017. Georges Bank Haddock. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17.

Brown, J, G. Macfadyen, T. Huntington, J. Magnus and J. Tumilty. 2005. Ghost Fishing by Lost Fishing Gear. Final Report to DG Fisheries and Maritime Affairs of the European Commission. Fish/2004/20. Institute for European Environmental Policy / Poseidon Aquatic Resource Management Ltd joint report.

Chikarmane, H.M., A. Kuzirian, R. Kozlowski, M. Kuzirian, and T. Lee. 2000. Population genetic structure of the goosefish, Lophius americanus. Biol. Bull. 199, 227-228.

Choi, Y.M., J.T. Yoo, J.H. Choi, K.H. Choi, J.K. Kim, Y.S. Kim, J.B. Kim. 2008. Ecosystem structure and trophic level to the oceanographic conditions around the waters of Jeju Island. Journal of Environmental Biology. 29:4, 419-25. Available at: https://www.ncbi.nlm.nih.gov/pubmed/19195374.

Collette, B. and G. Klein-MacPhee. 2002. Bigelow and Schroeder's Fishes of the Gulf of Maine, Third edition. Smithsonian Institution Press. 748 p.

Cooke, J.G. 2020. Eubalaena glacialis. The IUCN Red List of Threatened Species 2020: e.T41712A162001243. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T41712A162001243.en

Cooke, J.G. 2020. Eubalaena glacialis. The IUCN Red List of Threatened Species 2020: e.T41712A162001243. https://dx.doi.org/10.2305/IUCN.UK.2020-2.RLTS.T41712A162001243.en

Crowe, L.M., Brown, M.W., Corkeron, P.J., Hamilton, P.K., Ramp, C., Ratelle, S., Vanderlaan, A.S.M., & Cole, T.V.N., 2021. In plane sight: a mark-recapture analysis of North Atlantic right whales in the Gulf of St. Lawrence. Endangered Species Research. Vol. 46:227-251 https://doi.org/10.3354/esr01156

Dinmore, T. A., D. E. Duplisea, B. D. Rackham, D. L. Maxwell and S. Jennings. 2003. Impact of a large-scale area closure on patterns of fishing disturbance and the consequences for benthic communities. Ices

Journal of Marine Science 60(2): 371-380.

Federal Register. 2016. Fisheries of the Northeastern United States; Monkfish; Framework Adjustment 9. Federal Register/Vol. 81, No. 166/Friday, August 26, 2016. 50 CFR Part 648 [Docket No. 150306232–6736–02]. Available at: http://s3.amazonaws.com/nefmc.org/Final-rule.FW-9-Monkfish.pdf.

FishWatch. 2017. U.S. Seafood Facts: Monkfish (Goosefish) (Lophius americanus). National Marine Fisheries Service. Available at: http://www.fishwatch.gov/profiles/monkfish

Froese, R., D. Pauly. Editors. 2018. FishBase. World Wide Web electronic publication. Available at: www.fishbase.org.

GARFO (Greater Atlantic Regional Fisheries Office). 2018c. Northeast (NE) Multispecies Information Sheet Closed Area Regulations. Available at: https://www.greateratlantic.fisheries.noaa.gov/regs/infodocs/multsclosedareas.pdf.

GARFO. 2018a. Monkfish. Available at: https://www.greateratlantic.fisheries.noaa.gov/sustainable/species/monkfish/index.html.

GARFO. 2018b. Monkfish Fishery Management Plan Framework Adjustment 10. Available at: https://www.greateratlantic.fisheries.noaa.gov/nr/2017/July/17monkfw10frphl.html.

GARFO. 2018d. Omnibus Essential Fish Habitat Amendment Changes to Year-Round and Seasonal Closure Areas. April 9. 9pp. Available at: https://www.greateratlantic.fisheries.noaa.gov/nr/2018/April/180405_oa2_final_rule_phl_corrected.pdf.

GGGI (Global Ghost Gear Initiative). 2018. Development of a Best Practice Framework for the Management of Fishing Gear. Part 2: Best Practice Framework for the Management of Fishing Gear. 46 pp.

Hammond, P.S., Bearzi, G., Bjørge, A., Forney, K., Karczmarski, L., Kasuya, T., Perrin, W.F., Scott, M.D., Wang, J.Y., Wells, R.S. & Wilson, B. 2008a. Lagenorhynchus acutus. The IUCN Red List of Threatened Species 2008: e.T11141A3255721. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T11141A3255721.en. Downloaded on 03 May 2018.

Hammond, P.S., G. Bearzi, A. Bjørge, K. Forney, L. Karczmarski, T. Kasuya, W.F. Perrin, M.D. Scott, J.Y. Wang, R.S. Wells, B. Wilson. 2008b. Phocoena phocoena. The IUCN Red List of Threatened Species 2008: e.T17027A6734992. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T17027A6734992.en. Downloaded on 25 March 2018. Available at: http://www.iucnredlist.org/search.

Haring, P. and J-J. Maguire. 2008. The monkfish fishery and its management in the northeastern USA. ICES J. of Mar. Sci. 65: 1370-1379.

Hayes, S.A., Josephson, E., Maze-Foley, K., & Rosel, P.E., 2020. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019. NOAA Technical Memorandum NMFS-NE-264.

Hayes, S.A., Josephson, E., Maze-Foley, K., Rosel, P.E. & Turek, J., 2021. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2020. US Department of Commerce. National Oceanic and Atmospheric Administration. National Marien Fisheries Service. Northeast Fisheries Science Center. Woods Hole, Massachusetts.

Hayes, S.A., Josephson, E., Maze-Foley, K., Rosel, P.E., & Wallace, J. Eds. 2022. U.S. Atlantic and Gulf of Mexico Marien Mammal Stock Assessments 2021. National Marine Fisheries Service.

Hendrickson. L. Georges Bank Winter Flounder. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/georges_bank_winter_flounder.pdf.

Hermsen, J. 2010. Monkfish northern fishery management area daily landings and days-at-sea limit allocation calculation for FY2011-FY2013. Appendix I in Framework 7 of the Monkfish Fishery Management Plan. Available at http://www.nefmc.org/monk/index.html.

https://www.greateratlantic.fisheries.noaa.gov/sustainable/species/skate/index.html. Accessed June 2017.

IUCN. 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.

Kitts, A., E. Bing-Sawyer, J. Walden, C. Demarest, M. McPherson, P. Christman, S. Steinback, J. Olson, and P. Clay. 2011. 2010 final report on the performance of the Northeast Multispecies (groundfish) fishery (May2010-April 2011). Northeast Fisheries Science Center, National Marine Fisheries Service, US Department of Commerce, Woods Hole, Massachusetts.

L. J. Buckley, A. S. Smigielski, T. A. Halavik, E. M. Caldarone, B. R. Burns, G. C. Laurence. 1991. Winter flounder Pseudopleuronectes americanus reproductive success. II. Effects of spawning time and female size on size, composition and viability of eggs and larvae. Marine Ecology Progress Series 74, 125-135.

Legault, C. 2017a. Georges Bank Atlantic Cod. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/georges_bank_cod.pdf.

Legault, C. 2017b. Georges Bank Yellowtail Flounder. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at:
https://www.nefsc.noaa.gov/publications/crd/crd1717/georges_bank_yellowtail_flounder.pdf.

Linton, B. 2017a. Pollock. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17.

Linton, B.. 2017b. Acadian redfish. 2015 Assessment Update Report. Operational Assessment of 19

Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/acadian_redfish.pdf.

Lux, F.E., 1973. Age and Growth of the Winter Flounder, Pseudopleuronectes americanus, on Georges Bank. Fishery Bulletin. Vo. 71:2 pp 505-512

MAFMC. 2016. Mid-Atlantic Fishery Management Council Ecosystem Approach to Fisheries Management Guidance Document. August 8. 67 pp. Available at: https://static1.squarespace.com/static/511cdc7fe4b00307a2628ac6/t/589a2b61d2b8575c64fe05ff/1486498674225/EAFM_Guidance+Doc_2017-02-07.pdf.

Massachusetts Register 2022. 322 CMR 12.00: Protected Species. Mass. Register #1463 2/18/22.

MDMF 2022. Buoy Line Marking Rules for Trap Fisheries in 2022. The Commonwealth of Massachusetts Division of Marine Fisheries. Boston, MA.

Miller, T., D.E. Richardson, P. Politis, J. Blaylock 2017. Northeast Fisheries Science Center bottom trawl catch efficiency and biomass estimates for 2009- 2017 for 8 flatfish stocks included in the 2017 Northeast Groundfish Operational Assessments. Available at: https://www.nefsc.noaa.gov/groundfish/operational-assessments-2017/docs/catch-efficiency-biomass-estimates-wp.pdf.

Moore, M.J. 2019. How we can all stop killing whales: a proposal to avoid whale entanglement in fishing gear. ICES Journal of Marine Science, Volume 76(4): 781–786. https://doi.org/10.1093/icesjms/fsy194

NEFMC and MAFMC. 2009. Monkfish Fishery Management Plan, Amendment 5: Incorporating Stock Assessment and Fishery Evaluation (SAFE) Reports for the 2007 & 2008 Fishing Years and the Draft Environmental Assessment. November 2. 186pp.

NEFMC and MAFMC. 2011. Monkfish Fishery Management Plan, Framework Adjustment 7. Incorporating stock assessment and fishery evaluation (SAFE) report for the 2009 fishing year and the environmental assessment. 146pp.

NEFMC and MAFMC. 2014. Monkfish Fishery Management Plan Framework Adjustment 8.Incorporating Stock Assessment and Fishery Evaluation (SAFE) Report For the 2012 Fishing Year and the Environmental Assessment.

NEFMC. 2017. A Framework for Providing Catch Advice for a Prototype Georges Bank Fishery Ecosystem Plan. Available at: http://s3.amazonaws.com/nefmc.org/2_A-Framework-for-Proividing-Catch-Advice-for-a-Prototype-Georges-Bank-FEP.pdf.

NEFMC. 2018. Memorandum to Groundfish Committee: Additional Analyses for Amendment 23/Groundfish Monitoring. May 29. Available at: https://s3.amazonaws.com/nefmc.org/180529-GF-PDT-memo-to-GF-CMTE-re-additional-analyses-for-A23_revised.pdf.

NEFSC. 2010. 50th Northeast Regional Stock Assessment Workshop (50th SAW): assessment report. NOAA Fisheries Service, Woods Hole, Massachusetts.

NEFSC. 2012a. Assessment or data updates of 13 Northeast groundfish stocks through 2010. Northeast Fisheries Science Center, National Marine Fisheries Service, US Department of Commerce, Woods Hole, Massachusetts.

NEFSC. 2013. 2013 Monkfish Operational Assessment. Northeast Fish. Sci. Cent. Ref. Doc. 13-23; 116p. U.S. DEPARTMENT OF COMMERCE National Oceanic and Atmospheric Administration National Marine Fisheries Service Northeast Fisheries Science Center Woods Hole, Massachusetts.

NEFSC. 2013a. 55th Northeast Regional Stock Assessment Workshop (55th SAW) Assessment Summary Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 13-11; 41 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NEFSC. 2015a. Atlantic halibut 2015 Assessment Update Report. U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service. September 15.

NEFSC. 2015b. Part A. Scup Benchmark Stock Assessment for 2015. 60th Northeast Regional Stock Assessment Workshop (60th SAW) Assessment Report. Northeast Fisheries Science Center Reference Document 15-08. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1508/.

NEFSC. 2017e. Southern New England-Mid Atlantic Yellow Tail Flounder, 2017 Assessment Update Report. US Dept Commer, Northeast Fisheries Science Center draft report. 9pp.

NEFSC. 2017f. Southern New England-Mid-Atlantic Winter Flounder, 2017 Assessment Update Report. US Dept Commer, Northeast Fish Sci Cent draft report.

NEFSC. 2017g. Northern windowpane flounder 2017 Assessment Update Report. U.S. Department of Commerce, National Oceanic and Atmospheric Administration National Marine Fisheries Service. August. 7pp.

NEFSC. 2017h. Southern windowpane flounder 2017 Assessment Update Report. U.S. Department of Commerce, National Oceanic and Atmospheric Administration National Marine Fisheries Service. August. 7pp.

NEFSC. 2018. State of the Ecosystem - Gulf of Maine and Georges Bank. April 3. Available at: https://s3.amazonaws.com/nefmc.org/SOE_NE_2017_180605_144012.pdf.

Nitschke, P. 2017. Gulf of Maine Winter Flounder. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17.

NMFS (National Marine Fisheries Service). 2018. Summary of Stock Status for FSSI stocks, 1st Quarter 2018 Update. Available at: https://www.fisheries.noaa.gov/national/population-assessments/fishery-

stock-status-updates.

NMFS (National Marine Fisheries Service). 2018c. Summary of Stock Status for FSSI stocks, 1st Quarter 2018 Update. Available at: https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates.

NMFS 2021. National Marine Fisheries Service 2nd Quarter 2021 Update. Summary of Stock Status for FSSI and non-FSSI stocks.

NMFS 2021a. Endangered Species Act Section 7 Consultation on the: (a) Authorization of the American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and (b) Implementation of the New England Fishery Management Council's Omnibus Essential Fish Habitat Amendment 2. Consultation No. GARFO-2017-00031. National Marine Fisheries Service. Greater Atlantic Regional Fisheries Office.

NMFS 2022. 1st Quarter 2022 Update: Summary of Stock Status for FSSI Stocks. Available at https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates

NMFS. 2011b. U.S. National Bycatch Report [W.A. Karp, L.L. Desfosse, and S.G. Brooke, Editors]. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO/117C.

NMFS. 2012a. Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus). Available at: https://www.fisheries.noaa.gov/species/atlantic-sturgeon

NMFS. 2017a. Fisheries Statistics. NMFS Fisheries Statistics Division (ST1), NOAA. Accessed att https://www.st.nmfs.noaa.gov/pls/webpls/MF_ANNUAL_LANDINGS.RESULTS.

NOAA 2020c. Georges Bank Winter Flounder 2020 Assessment Update Report. NOAA. NMFS. Woods Hole, Massachusetts.

NOAA 2021. 2017-2021 North Atlantic Right Whale Unusual Mortality Event. Accessed 9th November 2021. Available at https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2021-north-atlantic-right-whale-unusual-mortality-event.

NOAA 2022. Fishwatch U.S. Seafood Facts: Spiny Dogfish. Accessed 10th January 2022. Available at https://www.fishwatch.gov/profiles/atlantic-spiny-dogfish

NOAA 2022c. North Atlantic Right Whale Calving Season 2022. Available at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2022

NOAA Fisheries. 2012b. Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus). Office of protected resources. Available at: http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm.

NOAA Fisheries. 2017. Available at : http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.html

NOAA. 2011b. NE Multispecies Information Sheet - Landing/Possession Limits. National Oceanic and Atmospheric Administration.

NOAA. 2012. Atlantic Large Whale Take Reduction Plan (ALWTRP) Enforcement Update Draft. Available at:http://www.nero.noaa.gov/whaletrp/trt/meetings/day1/Enforcement%20update%20ALWTRT_southeast.pdf

NOAA. 2018b. The Omnibus Essential Fish Habitat Amendment; Changes to Year-Round and Seasonal Closure Areas. April 9. Available at: https://www.fisheries.noaa.gov/bulletin/omnibus-essential-fish-habitat-amendment-changes-year-round-and-seasonal-closure-areas.

NOAA. 2018c. 2018-2019 Monkfish Research Awards Announced. Available at: https://www.fisheries.noaa.gov/feature-story/2018-2019-monkfish-research-awards-announced.

NOAA. 2018c. Atlantic Large Whale Take Reduction Plan: Mid-Atlantic Gillnet Fisheries Requirements and Management Areas. Available at: https://www.greateratlantic.fisheries.noaa.gov/protected/whaletrp/docs/Outreach%20Guides%20Updated%20May%202015/mid_atlantic_gillnet_2018_2.pdf.

NOAA. 2018d. The Northeast Regional Implementation Plan of NOAA Fisheries Ecosystem-Based Fisheries Management Roadmap. 16 pp. Available at: https://www.fisheries.noaa.gov/national/ecosystems/ecosystem-based-fishery-management-draft-implementation-plans.

NOAA. 2019c. 2019 Draft U.S. Atlantic and Gulf of Mexico Draft Marine Mammal Stock Assessment. Available at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/draft-marine-mammal-stock-assessment-reports

NOAA. 2020. Active and Closed Unusual Mortality Events. Available at: https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events

NOAA. 2020b. New North Atlantic Right Whale Calves Born off Florida, Georgia, and South Carolina. February 12, 2020 Available at: https://www.fisheries.noaa.gov/feature-story/new-north-atlantic-right-whale-calves-born-florida-georgia-and-south-carolina

Orphanides, C.D. and G. M. Magnusson. 2007. Characterization of the Northeast and Mid-Atlantic bottom and midwater trawl fisheries based on vessel trip report (VTR) data. Northeast Fisheries Science Center Reference Document 07-15. 127 pp. Available at: http://www.nefsc.noaa.gov/publications/crd/crd0715/crd0715.pdf.

Pace, R.M., III, P.J. Corkeron, S.D. Kraus. 2017. State space model abundance estimates reveal right whales falling off the track to recovery. Ecol. and Evol. DOI: 10.1002/ece3.3406.

Palmer, M. 2017a. Gulf of Maine Atlantic Cod. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/gulf_of_maine_cod.pdf.

Palmer, M. 2017b. Gulf of Maine Haddock. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17.

Palmer, M.C. 2014. 2014 Assessment update report of the Gulf of Maine Atlantic cod stock. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-14; 119 p. Available from: National Marine Fisheries Service,166 Water Street, Woods Hole, MA 02543-1026.

Pettis, H.M., Pace, R.M. III, Hamilton, P.K. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium.

Richards RA. 2016. 2016 Monkfish Operational Assessment. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 16-09; 109 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Richards, A. 2006. Goosefish (Lophius americanus). Status of fishery resources off the Northeastern US. Available at: http://www.nefsc.noaa.gov/sos/spsyn/og/goose/.

Richards, A. 2013. Goosefish (Lophius americanus). Status of Fishery Resources off the Northeastern US NEFSC - Resource Evaluation and Assessment Division. Available at: https://www.nefsc.noaa.gov/sos/spsyn/og/goose/.

Richards, R. A., P. C. Nitschke, and K. A. Sosebee. 2008. Population biology of monkfish Lophius americanus. ICES J. of Mar. Sci. 65: 1291-1305.

Schwinghamer, P., D. C. Gordon, T. W. Rowell, J. Prena, D. L. McKeown and G. Sonnichsen. 1988. Effects of experimental otter trawling on surficial sediment properties of a sandy-bottom ecosystem on the Grand Banks of Newfoundland. Conservation Biology 12(6): 1215-1222.

Sosebee, K. 2020. 2019 NE Skate Stock Status Update. Northeast Fisheries Science Center. 15pp.

Sosebee, K. 2017a. 2016 NE Skate Stock Status Update. Northeast Fisheries Science Center. Available at: http://s3.amazonaws.com/nefmc.org/2.2-NEFSC_SkateMemo_July_2017.pdf.

Sosebee, K. 2017b. 2016 NE Skate Stock Status Update. Northeast Fisheries Science Center. Available at: http://s3.amazonaws.com/nefmc.org/2.2-NEFSC_SkateMemo_July_2017.pdf.

Steimle, F. W., W. W. Morse, D. L. Johnson. 1999. Essential Fish Habitat Source Document: Goosefish, Lophius americanus, Life History and Habitat Characteristics. NOAA Technical Memorandum NMFS-NE-127. 31 pp. Available at: https://www.nefsc.noaa.gov/publications/tm/tm127/tm127.pdf.

Terceiro M. 2016. Stock Assessment of Summer Flounder for 2016. US Dept Commer, Northeast Fish Sci

Cent Ref Doc. 16-15; 117 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/publications/

Terceiro, M. 2017. Gulf of Maine - Georges Bank American Plaice. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/gom_gb_american_plaice.pdf.

TEWG (Turtle Expert Working Group). 2009. An assessment of the loggerhead turtle population in the western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575. Available at: http://www.sefsc.noaa.gov/turtles/TM_575_TEWG.pdf.

Thrush, S. F. and P. K. Dayton. 2002. Disturbance to marine benthic habitats by trawling and dredging: Implications for marine biodiversity. Annual Review of Ecology and Systematics 33: 449-473.

TRAC. 2020. Georges Bank Yellowtail Flounder. TRAC Status Report 2020/03.

Walsh, S.J. 1992. Size-Dependent Selection at the Footgear of a Groundfish Survey Trawl. North American Journal of Fisheries Management 12:3, 625–633. Available at: https://s3-us-west-2.amazonaws.com/sfwart/comments/61625/walsh%201992.pdf.

Watling, L. and E. A. Norse. 1998. Disturbance of the seabed by mobile fishing gear: A comparison to forest clearcutting. Conservation Biology 12(6): 1180-1197.

Wigley, S. 2017a. Ocean Pout. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17.

Wigley, S. 2017b. Witch Flounder. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. Northeast Fisheries Science Center Reference Document 17-17. Available at: https://www.nefsc.noaa.gov/publications/crd/crd1717/witch_flounder.pdf.

Appendix A: Report Review and Update

This report was reviewed and updated in September 2022 for any significant stock status or management updates to the fishery. Additional data and scientific information were found that significantly affected some of the ratings.

The overall recommendation for goosefish caught in the U.S. gillnet fishery was downgraded to Avoid. The overall rating for goosefish caught in the U.S. bottom trawl fishery remains a Good Alternative.

The most recent stock status information was used to update answers for Factors 2.1 and 2.2 for North Atlantic right whale. This did not result in a change in the score for either factor.

Information on recent entanglements of North Atlantic right whale resulting in serious injury was considered with respect to the effectiveness of management measures implemented in the U.S. gillnet fishery for goosefish to minimize the impact on this endangered marine mammal. The cumulative impact of fishing mortality, the potential for the U.S. gillnet fishery for goosefish to contribute to this excessive fishing mortality, and the failure of management measures to prevent entanglement leading to serious injury or mortality of North Atlantic right whale resulted in a score of ineffective (a downgrade from the previous moderately effective score).

Red criterion scores for Criteria 2 and 3 result in an overall rating of Avoid for the U.S. gillnet fishery for goosefish.