Northeast Multispecies (Groundfish) Catch Share Review

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New England Fishery Management Council

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Acronyms

ABC	Acceptable Biological Catch
ACE	Annual Catch Entitlement
ACL	Annual Catch Limit
AM	Accountability Measure
Amd	Amendment
ASM	At-sea monitoring
ASMFC	Atlantic States Marine Fisheries Commission
B	Biomass
B_{MSY}	Biomass at MSY
BSA	Broad Stock Area
CAA	Catch at Age
CC	Cape Cod
CFDBS	Commercial Fisheries Database System
CPH	Confirmation of Permit History
CPUE	Catch per unit of effort
CRD	Center Reference Document
CV	Coefficient of Variation
DAS	Days-at-sea
DFO	Department of Fisheries and Oceans (Canada)
DMF	Division of Marine Fisheries (Massachusetts)
DMIS	Data Matching Imputation System
DMR	Department of Marine Resources (Maine)
DSM	Dockside monitoring
E GOM	Eastern Gulf of Maine
E GB	Eastern Georges Bank
EA	Environmental Assessment
EEZ	Exclusive economic zone
EFH	Essential fish habitat
EIS	Environmental Impact Statement
ELM	Extra-large mesh
EM	Electronic monitoring
ESA	Endangered Species Act
F	Fishing mortality rate
FAAS	Flexible Area Action System
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
FR	Federal Register
FSEIS	Final Supplemental Environmental Impact Statement
FW	Framework

FY	Fishing year
GARFO	Greater Atlantic Regional Fisheries Office
GB	Georges Bank
GARFO	Greater Atlantic Regional Fisheries Office
GMRI	Gulf of Maine Research Institute
GOM	Gulf of Maine
HAPC	Habitat area of particular concern
HCA	Habitat Closed Area
HPTRP	Harbor Porpoise Take Reduction Plan
IFQ	Individual fishing quota
ITQ	Individual transferable quota
LPUE	Landings per unit of effort
MA	Mid-Atlantic
MA DMF	Massachusetts Division of Marine Fisheries
MAFMC	Mid-Atlantic Fishery Management Council
MARFIN	Marine Fisheries Initiative
ME DMR	Maine Department of Marine Resources
MMPA	Marine Mammal Protection Act
MRFSS	Marine Recreational Fishery Statistics Survey
MRI	Moratorium Rights Identifier
MSA, MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSY	Maximum sustainable yield
MWT	Midwater trawl; includes paired mid-water trawl when referring to fishing activity or vessels in this document
mt	Metric tons
NAS	National Academy of Sciences
NEFMC	New England Fishery Management Council
NEFOP	Northeast Fishery Observer Program
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NMFS, NOAA Fisheries	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NS	National Standard
NSGs	National Standard Guidelines
OBDBS	Observer Databases
OFL	Overfishing Limit
OLE	Office for Law Enforcement (NMFS)
PBR	Potential Biological Removal
PDT	Plan Development Team

PR	Performance Report
PSC	Potential Sector Contribution
RMA	Regulated Mesh Area
SAP	Special Access Program
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
SFA	Sustainable Fisheries Act
SNE	Southern New England
SNE/MA	Southern New England/Mid-Atlantic
SSB	Spawning stock biomass
SSC	Scientific and Statistical Committee
TAC	Total allowable catch
TMGC	Trans-boundary Management Guidance Committee
TRAC	Trans-boundary Resources Assessment Committee
TRT	Take Reduction Team
USCG, or CG	United States Coast Guard
VMS	Vessel monitoring system
VTR	Vessel trip report
W GOM	Western Gulf of Maine
W GB	Western Georges Bank

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1 EXECUTIVE SUMMARY

To be provided.

The following table summarizes which sections of the report align to the catch share review elements.

Review Elements	**Report Section(s) where information can be found**
Eight Elements of NOAA's Guidance for Conducting Review of Catch Share Programs	
1. Purpose and need of the review (discuss legal and policy requirements);	Section 2.a and 2.b
2. Goals and objectives of the program, the FMP, and the MSA;	Section 2.c
3. History of management, including a description of management prior to the program's implementation, a description of the program at the time of implementation (including enforcement, data collection, and monitoring), and any changes made since the program's implementation or the previous review (including an explanation of why those changes were made);	Section 3
4. A description of biological, ecological/environmental, economic, social, and administrative environments before and since the program's implementation;	Section 4
5. An analysis of the program's biological, ecological/environmental, economic, social, and administrative effects;	Section 5
6. An evaluation of those effects with respect to meeting the goals and objectives (i.e., program performance), including a summary of the conclusions arising from the evaluation;	Sections 5 and 6
7. A summary of any unexpected effects (positive or negative) which do not fall under the program's goals and objectives; and	Throughout Sections 4.c and 5
8. Identification of issues associated with the program's structure or function and the potential need for additional data collection and/or research.	Section 6.a, b
FMP Goals and Objectives from Amendments 13 (as applied to Amendment 16):	
Goal 1: Consistent with the National Standards and other required provisions of the Magnuson-Stevens Fishery Conservation and Management Act and other applicable law, manage the northeast multispecies complex at sustainable levels.	Section 4.b
Goal 2: Create a management system so that fleet capacity will be commensurate with resource status so as to achieve goals of economic efficiency and biological conservation and that encourages diversity within the fishery.	Sections 5.b, 5.c and 5.h
Goal 3: Maintain a directed commercial and recreational fishery for northeast multispecies.	Section 5.c and 5.i The recreational fishery was considered only under catch utilization.
Goal 4: Minimize, to the extent practicable, adverse impacts on fishing communities and shoreside infrastructure.	Section 5.j
Goal 5: Provide reasonable and regulated access to the groundfish species covered in this plan to all members of the public of the United States for seafood consumption and recreational purposes during the stock rebuilding period without compromising the Amendment 13	In part, Sections 5h and 5.j

objectives or timetable. If necessary, management measures could be modified in the future to insure that the overall plan objectives are met.	
Goal 6: To promote stewardship within the fishery.	In part, 5.e
Objective 1: Achieve, on a continuing basis, optimum yield (OY) for the U.S. fishing industry.	Section 5.h
Objective 2: Clarify the status determination criteria (biological reference points and control rules) for groundfish stocks so they are consistent with the National Standard guidelines and applicable law.	Subject of recent stock assessments, SDC is not evaluated under this review.
Objective 3: Adopt fishery management measures that constrain fishing mortality to levels that are compliant with the Sustainable Fisheries Act.	Section 5.h
Objective 4: Implement rebuilding schedules for overfished stocks, and prevent overfishing.	Rebuilding schedules are not discussed under this review
Objective 5: Adopt measures as appropriate to support international transboundary management of resources.	Section 5.h.iii – the adoption of measures are not specifically reviewed
Objective 6: Promote research and improve the collection of information to better understand groundfish population dynamics, biology and ecology, and to improve assessment procedures in cooperation with the industry.	Section 5.d, and recommendations in 6.a
Objective 7: To the extent possible, maintain a diverse groundfish fishery, including different gear types, vessel sizes, geographic locations, and levels of participation.	Sections 5b and 5c
Objective 8: Develop biological, economic and social measures of success for the groundfish fishery and resource that insure accountability in achieving fishery management objectives.	NA
Objective 9: Adopt measures consistent with the habitat provisions of the M-S Act, including identification of EFH and minimizing impacts on habitat to the extent practicable.	Sections 4b. and 5.l
Objective 10: Identify and minimize bycatch, which include regulatory discards, to the extent practicable, and to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.	Section 5.h

2 PURPOSE, NEED, AND SCOPE

2.a Purpose and need

National Oceanic and Atmospheric Administration's (NOAA) catch share policy[1] explains that Councils should periodically review catch share programs to evaluate whether a program is meeting its goals and objectives. The policy also states, "NOAA recommends Councils apply the LAPP [limited access privilege program] review and duration principles to all catch share programs". The NOAA guidance for conducting reviews, explains that:

> *Section 303A(c)(1)(G) of the Magnuson Stevens Act (MSA)[2] requires the Councils and Secretary to "include provisions for the regular monitoring and review by the Council and the Secretary of the operations of the program, including determining progress in meeting the goals of the program and this Act, and any necessary modification of the program to meet those goals, with a formal and detailed review 5 years after the implementation of the program and thereafter to coincide with scheduled Council review of the relevant Fishery Management Plan (FMP); but no less frequently than once every 7 years)" of all LAPPs established after January 12, 2007.*

At its December 2017 meeting, the Council approved a list of priorities for 2018, which included a review of the groundfish sector/catch share program under the Northeast Multispecies Fishery Management Plan.

2.b Review Scope and Focus

This program review is focused on the sector program of the Northeast multispecies fishery; however, some of the analyses provided in this report combine both sector program and common pool program data. Furthermore, given the complexities of fisheries management and the dynamic social, economic and ecological environments in which fisheries operate, there persists a challenge with attributing change to a given intervention. This evaluation aims to identify the relevant factors alongside changes where appropriate but cannot identify causation.

The evaluation period of review is focused on fishing years 2010 to 2015 (May 1, 2010, to April 30, 2016). This period covers the first six years of the catch share program since implementation of Amendment 16 (NEFMC 2009). Information prior to program establishment will cover fishing years 2007 to 2009 (May 1, 2007, to April 30, 2010).[3] Similar assessments have sought to extend the baseline for contextual purposes[4]. Section 3.c provides an extended period for context across select metrics.

[1] https://www.fisheries.noaa.gov/national/laws-and-policies/fisheries-management-policy-directives
[2] The Magnuson-Stevens Act is the primary law governing marine fisheries in US federal waters. https://www.fisheries.noaa.gov/resource/document/magnuson-stevens-fishery-conservation-and-management-act
[3] According to NOAA Guidance for Conducting Review of Catch Share Programs, "A baseline period of at least 3 years is preferable, but this may be modified depending on circumstances surrounding the creation and implementation of each program." https://www.fisheries.noaa.gov/national/laws-and-policies/catch-shares
[4] The Measuring the Effects of Catch Shares Project selected a baseline period that covers 2002-2009. The project sought to cover a relatively long period prior to implementation of the catch share program, and 2002 represents a significant date from a fishery management perspective because the Congressional moratorium on new Individual Transferable Quota (ITQ) programs ended in 2002, setting the stage for establishment of the Northeast Multispecies Sector and West Coast Shorebased IFQ Program (http://www.catchshareindicators.org/about/baseline-period/).

There exists a wealth of information and research that has been undertaken - for example, through the Northeast Fishery Science Center (NEFSC) Social Sciences Branch (SSB), observer program reports, sector year-end reporting and required environmental impact analyses for Agency and Council actions. In the development of this review, given the tight timeline for completion, the evaluation relies primarily on those existing analyses where available, and identifies limitations and gaps for consideration in future evaluations.

2.c Key goals and objectives addressed in this review

The Northeast Multispecies sector program review follows the eight elements outlined in NOAA's Guidance for Conducting Review of Catch Share Programs and addresses the key goals and objectives of the program as specified for the FMP in Amendments 13 and 16. The sector program, unlike other catch share programs nationally, does not have independent goals and objectives by which to measure success. However, FMP-level goals and objectives have important implications for evaluating the success of the catch share program.

Eight Elements of NOAA's Guidance for Conducting Review of Catch Share Programs[5]

9. Purpose and need of the review (discuss legal and policy requirements);
10. Goals and objectives of the program, the FMP, and the MSA;
11. History of management, including a description of management prior to the program's implementation, a description of the program at the time of implementation (including enforcement, data collection, and monitoring), and any changes made since the program's implementation or the previous review (including an explanation of why those changes were made);
12. A description of biological, ecological/environmental, economic, social, and administrative environments before and since the program's implementation;
13. An analysis of the program's biological, ecological/environmental, economic, social, and administrative effects;
14. An evaluation of those effects with respect to meeting the goals and objectives (i.e., program performance), including a summary of the conclusions arising from the evaluation;
15. A summary of any unexpected effects (positive or negative) which do not fall under the program's goals and objectives; and
16. Identification of issues associated with the program's structure or function and the potential need for additional data collection and/or research.

FMP Goals and Objectives from Amendments 13 (as applied to Amendment 16[6]):

Goal 1: Consistent with the National Standards and other required provisions of the Magnuson-Stevens Fishery Conservation and Management Act and other applicable law, manage the northeast multispecies complex at sustainable levels.

[5] See 01-121-01, located here https://www.fisheries.noaa.gov/national/laws-and-policies/fisheries-management-policy-directives

[6] Available at: http://s3.amazonaws.com/nefmc.org/091016_Final_Amendment_16.pdf

Goal 2: Create a management system so that fleet capacity will be commensurate with resource status so as to achieve goals of economic efficiency and biological conservation and that encourages diversity within the fishery.
Goal 3: Maintain a directed commercial and recreational fishery for northeast multispecies.
Goal 4: Minimize, to the extent practicable, adverse impacts on fishing communities and shoreside infrastructure.
Goal 5: Provide reasonable and regulated access to the groundfish species covered in this plan to all members of the public of the United States for seafood consumption and recreational purposes during the stock rebuilding period without compromising the Amendment 13 objectives or timetable. If necessary, management measures could be modified in the future to insure that the overall plan objectives are met.
Goal 6: To promote stewardship within the fishery.

- **Objective 1**: Achieve, on a continuing basis, optimum yield (OY) for the U.S. fishing industry.
- **Objective 2**: Clarify the status determination criteria (biological reference points and control rules) for groundfish stocks so they are consistent with the National Standard guidelines and applicable law.
- **Objective 3**: Adopt fishery management measures that constrain fishing mortality to levels that are compliant with the Sustainable Fisheries Act.
- **Objective 4**: Implement rebuilding schedules for overfished stocks, and prevent overfishing.
- **Objective 5**: Adopt measures as appropriate to support international transboundary management of resources.
- **Objective 6**: Promote research and improve the collection of information to better understand groundfish population dynamics, biology and ecology, and to improve assessment procedures in cooperation with the industry.
- **Objective 7:** To the extent possible, maintain a diverse groundfish fishery, including different gear types, vessel sizes, geographic locations, and levels of participation.
- **Objective 8**: Develop biological, economic and social measures of success for the groundfish fishery and resource that insure accountability in achieving fishery management objectives.
- **Objective 9**: Adopt measures consistent with the habitat provisions of the M-S Act, including identification of EFH and minimizing impacts on habitat to the extent practicable.
- **Objective 10**: Identify and minimize bycatch, which include regulatory discards, to the extent practicable, and to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The Council identified four additional goals in Amendment 18. Amendment 18 was implemented in fishing year 2016, following the defined review period of this evaluation, but the actions imposed were in response to concerns over excessive consolidation in the fishery and reduced fleet diversity that could result under the catch share system. This document will include discussion in relation to these goals, but will not evaluate the fishery with respect to A18 goals.

Amendment 18[7] Additional Goals:

1. Promote a diverse groundfish fishery, including different gear types, vessel sizes, ownership patterns, geographic locations, and levels of participation through sectors and permit banks;
2. Enhance sector management to effectively engage industry to achieve management goals and improve data quality;
3. Promote resilience and stability of fishing businesses by encouraging diversification, quota utilization and capital investment; and
4. Prevent any individual(s), corporation(s), or other entity(ies) from acquiring or controlling excessive shares of the fishery access privileges.

2.d Data Sources and Considerations

Data and analyses for this evaluation comes from multiple sources. In most instances this compiled work represents a review of available work. In a few instances, data and analysis were updated to cover the evaluation period, or extend beyond the review period, depending on data availability. All work has been attributed to its source. Recent Council actions (and supporting documents) serve as the basis for much background and additional data, specifically Framework 58 and Amendment 23 to the Northeast Multispecies FMP. Generally, Greater Atlantic Regional Office (GARFO) datasets (e.g., VTR and dealer reports, permit information, and biological status determinations) serve as an important repository of a variety of social, economic, and biological information. Data pulled from common sources at different time periods can produce variant values, as can applying different assumptions or decisions to the data. This is particularly the case with the two primary sources relied on for the evaluation of economic impacts: (1) The 2015 Final Report on the Performance of the Northeast Multispecies (Performance Report, Murphy et. a1 2019), and (2) An Economic Analysis of the Multispecies Catch Share Program (Center Reference Document (CRD), *in review,* Werner 2019). These reports both provide useful information related to the economic performance of the groundfish fleet (as provided in Appendix 8.a).

3 NORTHEAST MULTISPECIES FISHERY

3.a Summary of management history

Groundfish stocks in the Northeast have been managed under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) since 1977, when NOAA's National Marine Fisheries Service (NOAA Fisheries) and the New England Fishery Management Council implemented a groundfish plan for Atlantic cod, haddock, and yellowtail flounder that was prepared by NOAA Fisheries and endorsed by the Council. The plan relied on hard individual species quotas to manage fishing mortality, which was similar to the quota-based management system of the International Convention for the Northwest Atlantic Fisheries (ICNAF), of which the U.S. had been a member.

The quotas applied to the catch of the three species; however, because there was no limit on the number of participants, the number of vessels increased dramatically between 1977 and 1980 as the stocks improved.[8] This higher number of vessels meant the quota was caught in less time, and caused the fishery

[7] Available at: http://s3.amazonaws.com/nefmc.org/160812-A18-FEIS-formal-submission-with-appendices.pdf
[8] Amendment 5: https://s3.amazonaws.com/nefmc.org/Amend5-with_OCR.pdf

to be closed more frequently and for longer periods of time. As a result, vessels raced to get the most catch before the fishery was closed for the fishing year. In 1977, the Gulf of Maine (GOM) and Georges Bank (GB) cod quotas were caught within five and six months, respectively.

In order to prevent to prevent long closures, alleviate the race for fish, and give small boats a chance to catch their historical share, the Council implemented individual vessel trip limits in 1978. Trip limits were recommended by certain industry groups such as the Massachusetts Inshore Draggermen's Association. The limits were set for each species and stock area for each of the three vessel size categories; however, fishermen perceived the limits as unfair because NOAA Fisheries could not adequately monitor daily landings of each vessel. Fishermen who obeyed regulations were at a serious competitive disadvantage. Fish were also being frequently mislabeled and landed illegally, and some fishermen misreported the area where fish were caught in an effort to keep certain areas open to fishing.[9] The mislabeling and misreporting of landings lead to unreliable data upon which to base management.

In 1982, the joint groundfish plan was replaced by the Interim Groundfish Fishery Management Plan (FMP), which eliminated the quota based management system, and instead controlled fishing mortality with minimum fish sizes and codend mesh regulations for the Gulf of Maine (GOM) and Georges Bank (GB). The FMP was intended to restore the reliability of the fisheries data, to give individual fishermen more flexibility, and to increase industry support for the management system. The FMP allowed small mesh fishing to continue throughout the Gulf of Maine within the framework of the Optional Settlement Program. Seasonal closed areas, intended to protect spawning haddock, were left in place.

In October 1984, the International Court of Justice established the maritime boundary in Gulf of Maine between the U.S. and Canada which became known as the Hague Line, the boundary line between the U.S. Exclusive Economic Zone (EEZ) and Canadian waters. The Hague Line put the most productive haddock grounds on the Northeast Peak of Georges Bank, traditionally fished by the largest U.S. vessels, on the Canadian side of the line. This delineation displaced these large vessels, forcing them to fish on other parts of Georges Bank and closer to shore, which increased congestion and fishing pressure on declining stocks. Many of these vessels eventually were forced out of the groundfish fishery due to the lack of fish.

The Council replaced the interim FMP with the Northeast Multispecies FMP in 1986, which relied on gear restrictions, minimum mesh size requirements, and minimum fish sizes to control fishing mortality. The Northeast Multispecies FMP was the first plan in the world to establish biological targets based on a percentage of maximum spawning potential. These targets theoretically allowed the Council to meet its biological objectives either by increasing the age-at-first capture (size of fish caught) or by controlling fishing mortality. The FMP also greatly expanded the number of species covered by the management plan, adding redfish, pollock, silver hake, red hake, white hake, American plaice, witch flounder, winter flounder, and windowpane flounder to the list of managed species. The FMP also enlarged one of the haddock spawning closed areas, Area I, and established a large seasonally closed area in southern New England to reduce mortality and protect spawning yellowtail flounder. The Exempted Fisheries Program, which replaced the Optional Settlement Program, substantially reduced the area and time period for small mesh fishing in the Gulf of Maine.

[9] Ibid.

Since implementation in 1986, the Northeast Multispecies FMP has been updated through a series of Amendments (Table 1) and Framework Adjustments (Table 2). Two significant changes to the FMP prior to 2000 included Amendments 5 and 7, which involved efforts to rebuild stocks.[10] In 1994, a major revision of the FMP (Amendment 5) established a moratorium on northeast multispecies permits, reduced days-at-sea (DAS) for major fleet components, and adopted year-round area closures to help reduce mortality. Shortly after, in 1996, the Sustainable Fisheries Act (SFA) amended the MSA and required FMPs to provide definitions for overfishing and overfished, specify a requirement for rebuilding overfished stocks, reduce bycatch, identify and protect Essential Fish Habitat (EFH), and minimize adverse effects of fishing on EFH to the extent practicable. It also created National Standards that emphasized minimizing impacts to fishing communities, improving safety at sea, significantly reducing bycatch, and improving the collection and use of fishery and biological data.[11]

In 1997, Amendment 7, in response to a continuing decline in groundfish stocks beginning before Amendment 5 could be fully implemented, accelerated the DAS reduction schedule, extended large area closures throughout the year, eliminated some exemptions from the effort control program, and implemented other conservation measures. To address Amendment 7 rebuilding needs, the Council held four annual reviews and made eight adjustments to the FMP (Frameworks 20, 24, 25, 26, 27, 30 and 33).[12] Frameworks 27 and 30 implemented trip limits for GOM and GB cod and authorized the Regional Administrator to reduce the trip limit when 75 percent of the target total allowable catch (TAC) for each stock was reached. Framework 31 (1999) addressed discards in the GB and GOM cod fisheries. Also, in 1999, Amendment 9 brought the FMP into compliance with SFA requirements through new status determination criteria (overfishing definitions) and optimum yield (OY) specifications for twelve groundfish species.

During the period from 1999 to 2003, further adjustments were made to the DAS management system in an effort to achieve target catch levels and other measures were adopted to meet SFA requirements for defining and minimizing impacts on EFH. During this same period, Amendment 13 was being developed to meet SFA requirements of ending overfishing on groundfish stocks and rebuilding all of the overfished groundfish stocks. The amendment addressed overfishing definitions, stock rebuilding, reduced fishing effort and capacity in the fishery, included measures to minimize bycatch, instituted improved reporting and recordkeeping requirements, and implemented EFH protections. Amendment 13 specified a process for the formation of sectors within the Northeast groundfish fishery. The Amendment approved the Georges Bank Cod Hook Gear Sector, authorized NOAA Fisheries to approve a legally binding operations plan for the sector, and authorized NOAA Fisheries to allocate a percentage of the TAC for GB cod to the sector based on the catch history of its members. Amendment 13 also implemented a requirement for periodic review of stock data midway through the implementation period and called for corrective action if necessary. Over the course of its management history, the fishery has experienced multiple declarations of fishery resource disaster[13] and multiple vessel buyback programs (Figure 1).

[10] Amendment 18: https://s3.amazonaws.com/nefmc.org/160812-A18-FEIS-formal-submission-with-appendices.pdf
[11] SFA. (1996). Sustainable Fisheries Act. Public Law 104-297, 16 USC 1801.
[12] For more information, see https://www.nefmc.org/management-plans/northeast-multispecies
[13] https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations

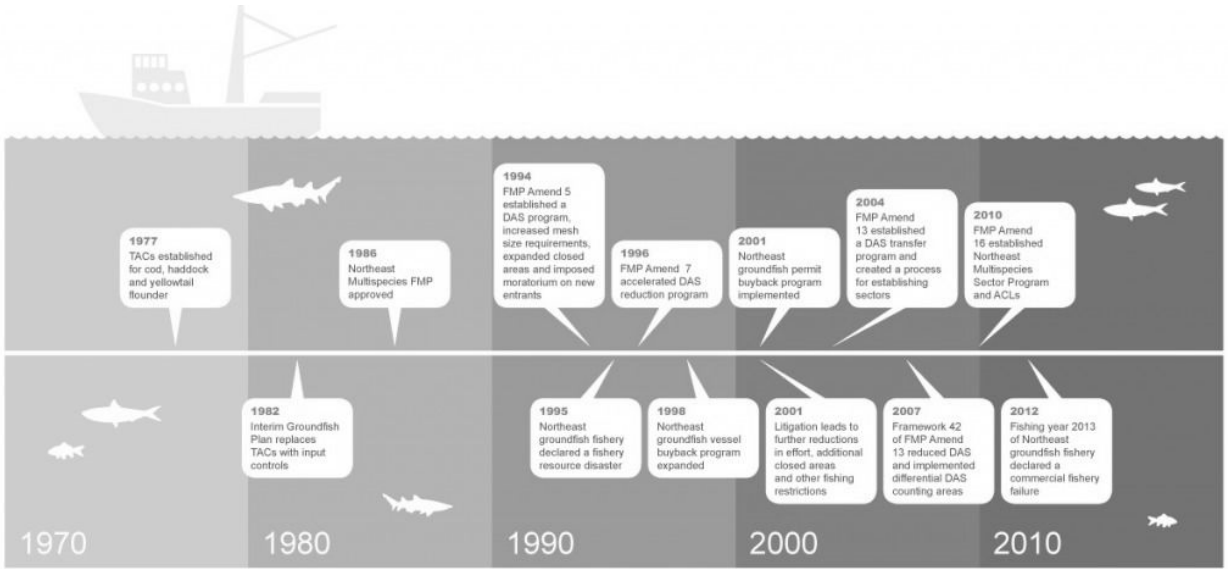

Figure 1. There have been a number of important events during the timeline of management in the NE groundfish fishery that prompted management interventions.[14],[15]

To improve the effectiveness of the Amendment 13 effort control measures and to mitigate the economic and social impacts of the Amendment, the Council implemented several framework adjustments to the FMP.[16] Frameworks 40A and 41 were developed to provide additional opportunities for vessels in the fishery to target healthy stocks. Framework 40B was developed to clarify DAS allocations to modify the DAS leasing and transfer programs, to improve opportunities to target healthy stocks, and to adjust the GB Cod Hook Sector provisions in order to meet those purposes. Framework 42 introduced several measures to achieve rebuilding of fishing mortality targets and implemented a vessel monitoring system (VMS) requirement for DAS vessels.

In 2006, amendments to the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA)[17] implemented additional requirements to prevent and end overfishing and rebuild overfished stocks. The added measures require regional fishery management councils to amend their FMPs to include a mechanism for specifying annual catch limits (ACL) (see Box 1. Setting Annual Catch Limits) and ensuring accountability for all stocks or stock complexes at a level such that overfishing does not occur, as well as to implement measures to ensure accountability for adhering to these limits. The MSA further directed that, unless otherwise provided for under an international agreement to which the U.S. participates, this mechanism had to be established by 2010 for stocks subject to overfishing, and by 2011 for all other stocks. ACLs were required for all federally managed stocks, whether the FMP includes a catch share program or not.

[14] Source: Measuring the Effects of Catch Shares Project, see http://www.catchshareindicators.org/
[15] *CLF v. Evans* was filed in December 2001 with decision in 2002; Amendment 16 revised and expanded" the sector program, since it was initially established in Amendment 13.
[16] For more information, see https://www.nefmc.org/management-plans/northeast-multispecies
[17] For more information, see https://www.fisheries.noaa.gov/resource/document/magnuson-stevens-fishery-conservation-and-management-act

In 2010, Amendment 16 set acceptable biological catches (ABCs), ACLs, and accountability measures (AMs) for all 20 regulated groundfish stocks in compliance with 2006 revisions to the MSA. Amendment 16 also expanded the existing sector-based approach into a system of catch share management. The expanded sector program included provisions allowing groundfish quota (called annual catch entitlement, or ACE) to be traded between members of the same sector or between different sectors, and a provision allowing inactive permits held in confirmation of permit history (CPH) to join sectors. In total, seventeen groundfish sectors were approved and operated during fishing year 2010; the first day of fishing under the Northeast multispecies sector program was May 1, 2010. For more information about how the sector program is administered, please see Section 4.

Amendment 16 also included additional mortality reduction measures for common pool (i.e., non-sector) vessels and the recreational component of the fishery. The amendment established that starting in fishing year 2012, the common pool sub-ACL for all allocated stocks[18] would be divided into trimester managed with a trimester total allowable catches (TAC). A Trimester TAC represents the percentage of the common pool sub-ACL for a stock that can be harvested during a given point in the fishing year. Trimester 1 runs from May 1 through August 31, Trimester 2 runs from September 1 through December 31, and Trimester 3 runs from January 1 through April 30. During any trimester, when it is projected that ninety percent of the trimester TAC for a stock will be caught, NOAA Fisheries will close the TAC area for that stock to all groundfish fishing using gear capable of catching that species until the start of the next trimester. In addition to adjustments to recreational management measures, a process from establishing recreational sub-ACLs was implemented, including sub-ACLs for GOM cod and GOM haddock.

When Amendment 16 was being developed and implemented, the public, Council, and NOAA Fisheries raised concerns that the transition to a fishery-wide catch share management system and low catch limits for many multispecies stocks could lead to consolidation of the fishery and reduced fleet diversity.[19] To address these concerns, the Council considered various measures to limit the amount of permits and/or potential sector contribution (PSC)[20] that individuals or groups of individuals may hold in addition to other measures to promote fleet diversity or enhance sector management. Amendment 18 reflected the work of the Council on this action; it was intended to prevent excessive acquisition of permit shares and to enhance sector management.[21]

Since Amendment 16, several additional framework adjustments have been implemented to set specifications and modify the sector and common pool programs. For example, Framework 48 revised monitoring requirements for trips targeting monkfish in the SNE BSA, allowed sectors to request exemptions to certain closed areas, and removed the dockside monitoring (DSM) requirement. Framework 53 revised rolling closures into GOM cod protection areas, established a mechanism to set

[18] At the time of Amendment 16, Southern New England/Mid-Atlantic winter flounder was a zero possession species and unallocated. SNE/MA winter flounder was allocated to sectors beginning in 2013, but the common pool sub-ACL was not divided into trimesters and is instead managed on an annual basis

[19] From Amendment 18: https://s3.amazonaws.com/nefmc.org/160812-A18-FEIS-formal-submission-with-appendices.pdf

[20] For a description on how Potential Sector Contributions (PSC) are calculated, see: NOAA Fisheries. 2010. Fisheries Statistics Office Publications. How is the Potential Sector Contribution Calculated? April 28, 2010. Online: https://www.greateratlantic.fisheries.noaa.gov/sfd/sectordocs/PSC_Calculation.pdf

[21] Ibid.

default specifications for groundfish and modified sector ACE carryover provisions. Amendment 17 authorized the function of NOAA-sponsored state-operated permit banks.

Table 1. Amendments and their objectives to the Multispecies FMP, listed in order of Final Rule publication date.

Amendment	Final Rule	Objective
Amendment 1	October 1, 1987	Decreased the area for the silver hake exempted fishery; increased the large mesh area to include some important yellowtail flounder grounds to the south; and tightened existing mesh size regulations and regulations for the southern New England yellowtail area.
Amendment 2	October 1, 1988	Eliminated the scheduled increase in codend mesh size to 6 inches, because of compliance and enforcement problems with mesh regulations, and implemented the following measures: 1) trip bycatch limits and stricter non-reporting penalties in the Exempted Fisheries Program; 2) increased the minimum size for yellowtail flounder to 13 inches and American plaice to 14 inches; 3) established a seasonal large mesh area on Nantucket shoals to protect cod; 4) applied mesh size regulations to the whole of mobile nets rather than only to the cod-end; 5) set all recreational minimum sizes to be consistent with commercial minimum sizes; and 6) excluded trawlers from Area II during the closure to improve enforcement of the closure.
Amendment 3	August 17, 1989	Established a Flexible Area Action System in an effort to enable the Council and NOAA Fisheries to respond quickly to protect large concentrations of juvenile, sub-legal (smaller than the minimum legal size) and spawning fish.
Amendment 4	June 27, 1991	Added more restrictions to the Exempted Fisheries Program; established a procedure for the Council to make recommendations for modifying northern shrimp gear to reduce the bycatch of groundfish; expanded the management unit to include silver hake, ocean pout and red hake; established management measures for the Cultivator Shoals whiting fishery; further tightened restrictions on the carrying of small mesh while fishing in the Regulated Mesh Area; and established a 5-1/2 inch mesh size in the Southern New England yellowtail flounder area.
Amendment 5	September 30, 1993	Established a moratorium on new vessel permits during rebuilding period; implemented a day-at-sea effort reduction program; set additional mesh size restrictions; implemented interim gillnet regulations to reduce harbor porpoise bycatch; set mandatory reporting system for landings; prohibited pair-trawling; required finfish excluder device for shrimp fishery; implemented minimum fish size; and expanded size of Closed Area II.
Amendment 6	May 1, 1994	Developed by NOAA Fisheries. Extended the 500-lb trip limit for haddock that had been implemented earlier by emergency action.
Amendment 7	May 31, 1996	Accelerated the days-at-sea (DAS) reduction schedule; allowed vessels to convert opportunity DAS to individual DAS, which eliminated the requirement to be tied to the dock for fixed periods but greatly increased potential fishing effort, extended large area closures throughout the year; and eliminated some exemptions from the effort control program and implemented other conservation measures.

Amendment 9	October 9, 1998	Described and identified essential fish habitat (EFH) for the specified fisheries; discussed measures to address the effects of fishing on EFH; identified other actions for the conservation and enhancement of EFH; and added Atlantic halibut to the groundfish FMP.
Amendment 10	February 19, 1999	Implemented regulations to achieve regulatory consistency on vessel permitting for FMPs that have limited access permits issued by the Northeast Region of NOAA Fisheries.
Amendment 8	March 3, 1999	Amended the Multispecies, the American Lobster, and the Atlantic Sea Scallop FMPs to include a framework procedure to resolve gear conflicts.
Amendment 11	April 21, 1999	Identified and described EFH for Atlantic herring, sea scallops, Atlantic salmon, and fifteen species of groundfish to better protect, conserve, and enhance this habitat; identified the major threats to EFH from both fishing and non-fishing related activities; and identified conservation and enhancement measures.
Amendment 12	March 29, 2000	Addressed management of silver hake (whiting), red hake, offshore hake, and ocean pout; implemented the framework measure approved in Amendment 11 to the FMP regarding EFH; established differential whiting possession limits based on the mesh size with which a vessel chooses to fish. The intended effect of this action is to reduce fishing mortality rates on whiting and red hake to eliminate overfishing and rebuild the biomass in accordance with the requirements of MSA.
Amendment 13	December 8, 2003	Implemented numerous measures with the intent of 1) ending overfishing on all stocks and constituting rebuilding programs for those groundfish stocks that require rebuilding and 2) providing flexibility and business options for permit holders.
Amendment 15	February 7, 2008	Implemented approved management measures contained in the Standardized Bycatch Reporting Methodology (SBRM) Omnibus Amendment (SBRM Amendment).
Amendment 16	October 16, 2009	Greatly revised and expanded the catch share sector program; implemented new requirements for establishing ABCs, ACLs, and AMs for each stock managed under the FMP; included mortality reduction measures for common pool vessels and the recreational component of the fishery; added Atlantic wolffish to the list of species managed by the FMP; and established that, starting in FY 2012, the common pool would be managed with a trimester TAC versus an annual one for all stocks except SNE/MA winter flounder, windowpane flounder, ocean pout, Atlantic wolffish, and Atlantic halibut.
Amendment 17	June 22, 2011	Approved a provision allowing NOAA Fisheries to issue a days-at-sea credit to a vessel that cancels a fishing trip and authorized NOAA-sponsored state-operated permit banks.
Amendment 18	July 1, 2014	Developed to promote fleet diversity, prevent the acquisition of excessive shares of permits, and enhance sector management.
Amendment 20	June 30, 2015	Established standards of precision for bycatch estimation for all Northeast Region fisheries.
Amendment 14	April 9, 2018	Implemented approved regulations for the New England Fishery Management Council's Omnibus EFH Amendment 2 to comply with MSA and minimize to the extent practicable the adverse effects of fishing on EFH.
Amendment 21	February 7, 2020	This amendment as a part of the Omnibus Industry-Funded Monitoring Amendment and Environmental Assessment would implement a process to

		standardize future industry-funded monitoring programs in New England Council fishery management plans.
Amendment 23	Under development	To implement measures to improve reliability and accountability of catch reporting and to ensure a precise and accurate representation of catch (landings and discards).

Table 2. Framework Adjustments to the Northeast Multispecies FMP following A16, listed in order of Final Rule effective date.

Framework	Final Rule	Action
Framework 45	May 1, 2011	Adopts further modifications to the sector program and fishery specifications.
Framework 46	September 14, 2011	Revised the allocation of haddock to be caught by the herring fishery.
Framework 47	May 1, 2012	Set specifications for some groundfish stocks for FY 2012 – 2014, modified AMs for the groundfish fishery and the administration of the scallop fishery AMs, and revised common pool management measures; modification of the Ruhle trawl definition and clarification of regulations for charter/party and recreational groundfish vessels fishing in groundfish closed areas were proposed under the RA authority.
Framework 48	September 30, 2013	Revised status determination criteria for several stocks, modified the sub-ACL system, adjusted monitoring measures for the groundfish fishery, and changed several accountability measures (AMs).
Framework 50	September 30, 2013	Set specifications for many groundfish stocks and modified the rebuilding program for SNE/MA winter flounder.
Framework 49	May 20, 2013	A joint Northeast Multispecies/Atlantic Sea Scallop action that modified the dates for scallop vessel access to the year-round groundfish closed areas.
Framework 51	May 1, 2014	Modified rebuilding programs for GOM cod and American plaice, set specifications for FY2014-2016 and modified management measures in order to ensure that overfishing does not occur including, additional management measures related to U.S./Canada shared stocks and yellowtail flounder in the groundfish and scallop fisheries.
Framework 52	January 14, 2015	This action made two revisions to the accountability measures (AMs) for the groundfish fishery for the northern (GOM/GB) and southern (SNE/MA) windowpane flounder stocks.
Framework 53	May 1, 2015	This action updated changes to the status determination criteria, set specifications for FY2015-2017, adopted U.S./ Canada Total Allowable Catches (TACs), established management measures for GOM cod that revise rolling closures and possession limits to enable GOM cod protection while providing opportunity for the groundfish fishery to prosecute healthy stocks in other times and areas, implemented default specifications, and to revised regulations governing Sector Annual Catch Entitlement (ACE) carryover.
Framework 54 / Monkfish FW 9	August 26, 2016	Modified regulations for vessels in the DAS program.

Framework	Final Rule	Action
Framework 55	May 1, 2016	Incorporated stock status changes for groundfish stocks, set specifications for all groundfish stocks for FY 2017- FY 2019, adopted an additional sector and modified the sector approval process, modified the definition of a haddock separator trawl so that the separator panel is easily identifiable, made changes to the groundfish monitoring program, made changes to the management measures for U.S./Canada TACs in order to move GB cod quota from the eastern management area to the western management area and modified the Gulf of Maine Cod Protection Measures so that the recreational possession limit for GOM cod can once again be modified by the Regional Administrator.
Framework 56	August 1, 2017	Adopted U.S./ Canada Total Allowable Catches (TACs), set specifications for witch flounder for FY 2016 – FY 2018, allocated a northern windowpane flounder sub-ACL to the Atlantic sea scallop fishery, increased the midwater trawl fishery sub-ACL for GB haddock, and temporarily changed the scallop fishery AM implementation policy for GB yellowtail flounder and northern windowpane flounder for FY 2017 and FY 2018.
Framework 57	April 26, 2018	Set catch limits for 20 groundfish stocks, adjusted trimester TAC allocations for several stocks; revised AMs for three stocks; and granted the Regional Administrator the authority to make adjustments to recreational management measures for GB cod.
Framework 58	July 18, 2019	Set catch limits for 7 stocks; established or updated rebuilding plans for 5 stocks; and revised the GB yellowtail flounder accountability measure for scallop vessels.

3.b Summary and status of groundfish resources

The groundfish fishery primarily occurs in the inshore and offshore waters of the Gulf of Maine, Georges Bank, and the southern New England/mid-Atlantic areas, within the Northeast U.S. Shelf Ecosystem (Figure 2). The Northeast multispecies fishery targets a diverse group of species, several of which are managed as two or more separate stocks, based on geographic region (Figure 3). Thirteen species[22], subdivided into twenty stocks, are managed as large mesh species based on fish size and type of gear used to harvest the fish (Table 3), and three species — silver hake (whiting), red hake, and offshore hake — are managed as a separate unit; known as small mesh multispecies program[23]. With regards to stock status, 'overfishing' is defined as occurring when the annual rate of catch is too high; a stock is 'overfished' is defined as the population is too small; and 'rebuilt' populations are those that were previously overfished and have increased in abundance to the target population size that supports its maximum sustainable yield.[24]

[22] The Northeast Multispecies FMP specifies OFLs, ABCs, and ACLs for 20 groundfish stocks. Sectors are allocated quota for 15 stocks; Atlantic halibut, ocean pout, two stocks of windowpane flounder, and Atlantic wolffish are not allocated to sectors.
[23] Amendment 12 to the Northeast Multispecies FMP (https://www.nefmc.org/library/amendment-12).
[24] https://www.fisheries.noaa.gov/national/population-assessments/status-us-fisheries

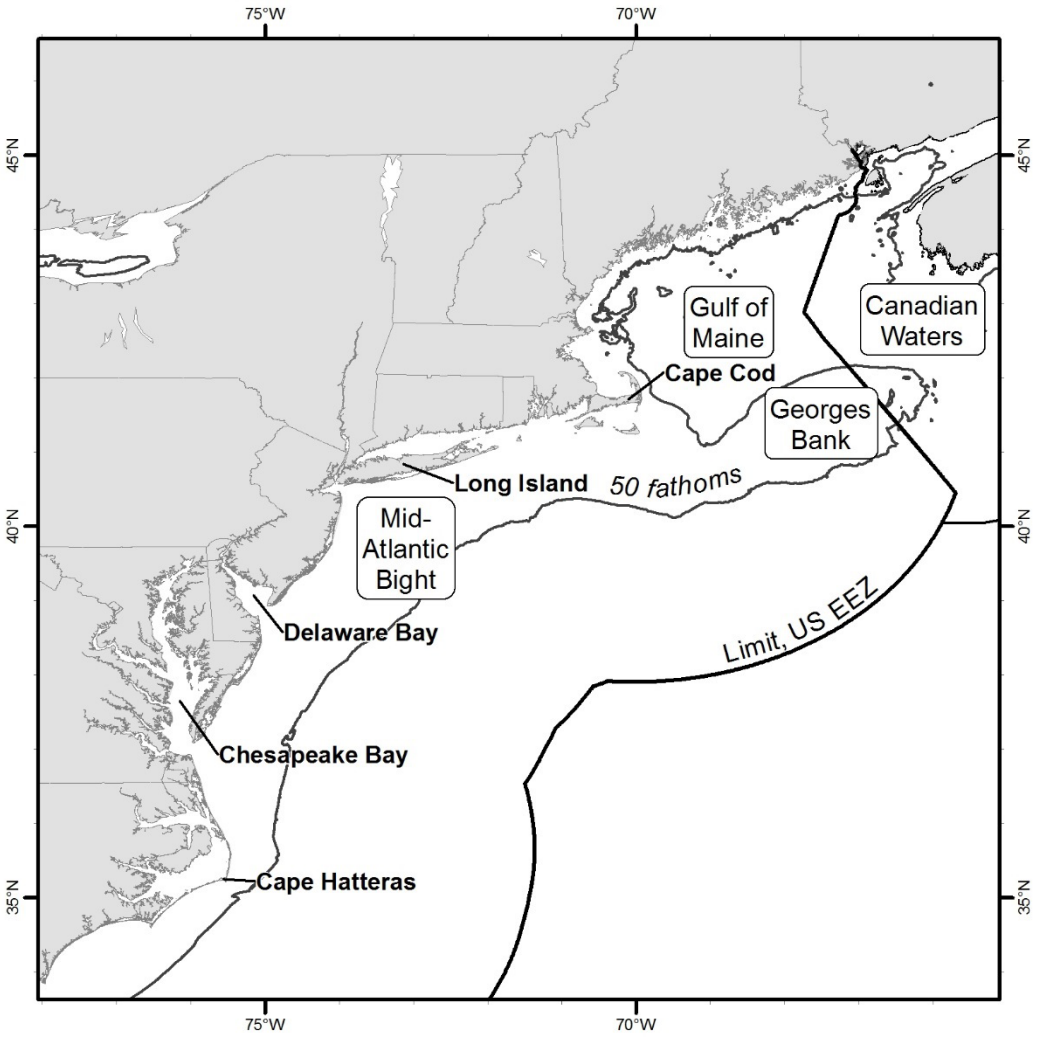

Figure 2. Northeast US Shelf Ecosystem.[25]

[25] Data source: NOAA/NMFS/GARFO

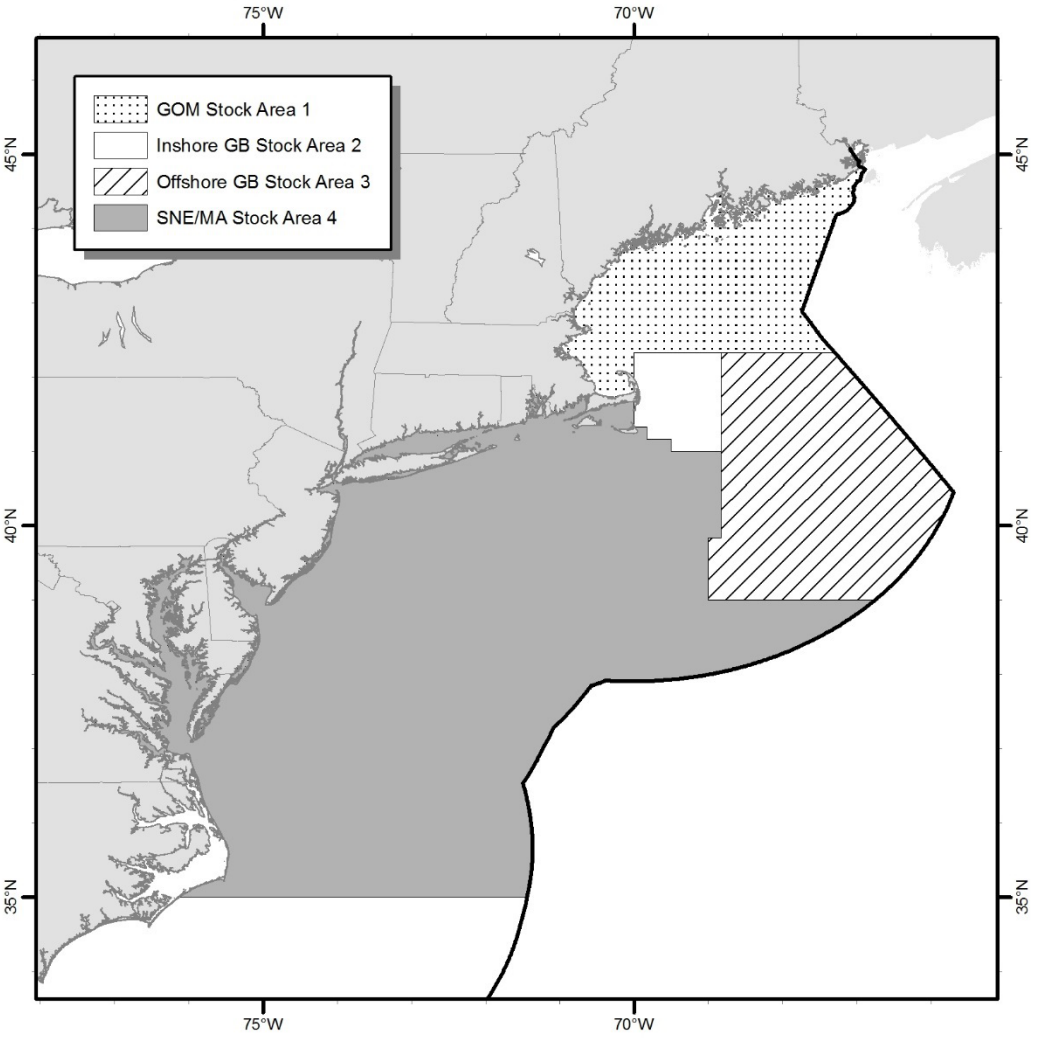

Figure 3. Northeast Multispecies Broad Stock Areas (GOM = Gulf of Maine; GB = Georges Bank; SNE = Southern New England; MA = Mid-Atlantic).[26]

Table 3. Allocated target stocks for the Northeast Multispecies FMP, status at the implementation of the Northeast Multispecies sector program and current status, as determined by NOAA Fisheries.

Species	Stock	GARM III (2008) Status		Current Status[(1)]	
		Overfishing?	Overfished?	Overfishing?	Overfished?
Cod (*Gadus morhua*)	GB*	Yes	Yes	Yes	Yes
	GOM	Yes	No	Yes	Yes
Haddock (*Melanogrammus aeglefinus*)	GB*	No	No	No	No
	GOM	No	No	No	No
Yellowtail Flounder (*Limanda ferruginea*)	GB*	Yes[(2)]	Yes	Yes	Yes
	SNE/MA	Yes	Yes	No	Yes

[26] Data source: NOAA/NMFS/GARFO

Species	Stock	GARM III (2008) Status		Current Status[(1)]	
		Overfishing?	Overfished?	Overfishing?	Overfished?
	CC/GOM	Yes	Yes	No	No
American Plaice *(Hippoglossoides platessoides)*	GB/GOM	No	No	No	No
Witch Flounder *(Glyptocephalus cynoglossus)*		Yes	Yes	Unknown	Yes
Winter Flounder *(Pseudopleuronectes americanus)*	GB	Yes	Yes	No	Yes
	GOM	Unknown	Unknown	No	Unknown
	SNE/MA	Yes	Yes	No	Yes
Acadian Redfish *(Sebastes fasciatus)*		No	No	No	No
White Hake *(Urophycis tenuis)*	GB/GOM	Yes	Yes	No	Yes
Pollock *(Pollachius virens)*	GB/GOM	Yes	Yes	No	No
Windowpane Flounder *(Scophthalmus aquosus)*	GB/GOM (N)	Yes	Yes	No	Yes
	SNE/MA (S)	Yes	No	No	No
Ocean Pout *(Zoarces americanus)*		No	Yes	No	Yes
Atlantic Halibut *(Hippoglossus hippoglossus)*		No	Yes	No	Yes
Atlantic Wolffish *(Anarhichas lupus)*		Unknown	Yes	No	Yes

*Transboundary stock fished by both US and Canada.
(1) Table represents assessment results at the time of sector program implementation; NOAA Fisheries formal stock status determinations can be viewed through annual status of stocks reports (https://www.fisheries.noaa.gov/national/population-assessments/status-us-fisheries).
(2) Overfishing status for GB yellowtail based on GARM III; subsequently TRAC 2009 indicated overfishing is no longer occurring on this stock.

Framework 58 provides the most updated information on the status of regulated fishery resources that are relevant to this evaluation period. ACLs were initially established for regulated stocks based on the status estimates provided in GARM III (2008). At a minimum, the Groundfish Plan Development Team (PDT) meets every other year to perform a review of the fishery, using the most current scientific information and other relevant information available, including: catch and landings, discards, DAS use and allocations, sector operations, other measures of fishing effort, survey results, stock status, social and economic impacts, and enforcement issues. In practice, this occurs annually. Based on this review, the PDT recommends ACLs for the upcoming fishing year(s) and develop management options for consideration by the Council as necessary to rebuild overfished stocks and achieve FMP goals and objectives. ACLs must be based on the projected fishing mortality levels required to meet the goals and objectives outlined in the FMP. Section 5.h.ii.1 details changes in ACLs that have resulted from this process.

The Council received letters from NOAA Fisheries following the 2015, 2017, and 2019 stock assessments, regarding stock status and inadequate rebuilding progress for several key groundfish stocks. In the context, it's important to recognize that stock status fluctuates with new information and updated

assessments, and that these assessments aren't always comprehensive of all stocks. While outside of the evaluation period, the current status of the stocks is relevant context for how the sector program has been performing. At the time of this report, the Northeast Fishery Science Center had recently completed operational stock assessments for 14 groundfish stocks through 2018[27].

3.c Historical activity

The size of the groundfish fleet has steadily declined since the mid-1990s (Figure 4) as fishing restrictions became more stringent and groundfish catch and revenue declined (Figure 5). Global economic forces, supply chain demands, stock biomass and productivity also contributed to reductions in fleet size.[28] As lower groundfish landings led to unpredictability of supply, dealers may have sought sources that were more reliable[29]. This shift may have caused downward pressure on prices for local groundfish. These downward trends were apparent well before development of Amendment 16 and expansion of the sector program in 2010.

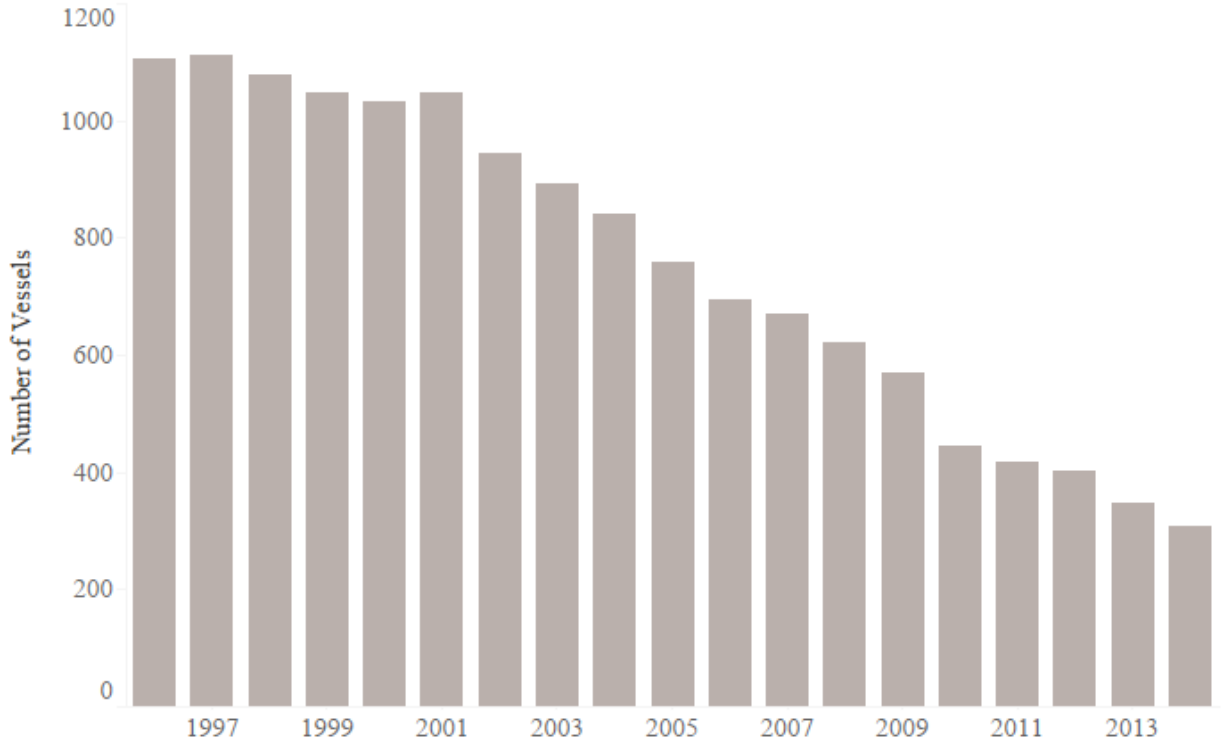

Figure 4. Changes in the number of vessels with limited access multispecies permits that landed groundfish in each fishing year.[30]

[27] NEFSC (2019): https://www.nefsc.noaa.gov/saw/2019-groundfish-docs/Prepublication-NE-Grndfsh-10-3-2019.pdf
[28] MECS (2018): https://www.catchshareindicators.org/northeast/economic-indicators/active-vessels/
[29] According to interviews conducted during the MECS project, "I've talked to a few guys that are also dealers. They need steady product coming in, and they didn't see a steady product coming from the groundfish fishery anymore. They've outsourced. I go to my supermarket. I see the cod. I know where it's coming from. It's coming from Norway, Iceland. I mean it's a beautiful product too." (Industry Representative)
[30] Data source: Analysis and Program Support Division, GARFO

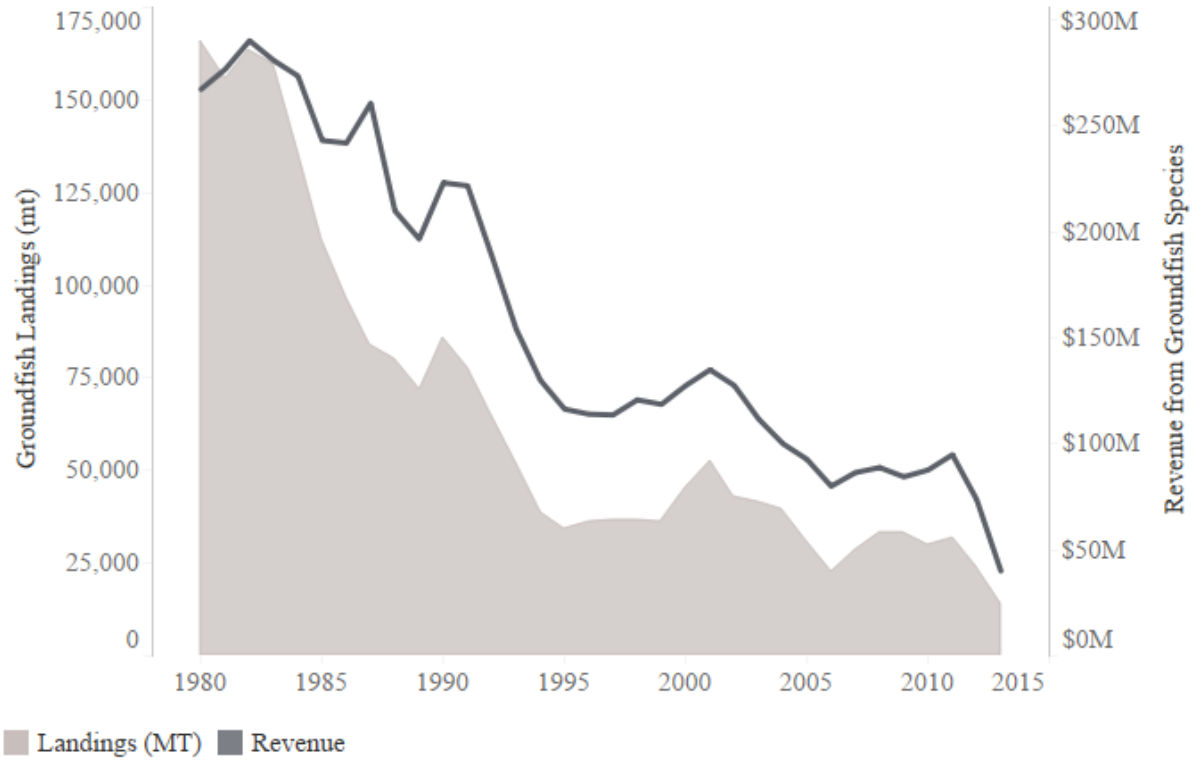

Figure 5. Changes in groundfish landings (landed weight) and revenue (2016 dollars) from groundfish species during 1980 – 2015.[31].

4 THE NORTHEAST MULTISPECIES SECTOR PROGRAM

Amendment 16 to the Northeast Multispecies Fishery Management Plan (FMP) made major changes to the Northeast Multispecies FMP with the designation of the fleet-wide sector program. The catch share program was designed to comply with catch limit requirements and stock rebuilding deadlines required under the MSA. The new groundfish management program contained two significant changes. The first was the establishment of "hard quota" annual catch limits (ACLs) (Box 1. Setting Annual Catch Limits; see Section 3.b on how the PDT sets ACLs) and accountability measures (AMs) that are designed to ensure catches remain below desired targets for all 20 stocks in the groundfish complex. The National Standard Guidelines provide advisory guidance (that does not have the effect or force of law) for the implementation of these requirements (50 CFR 600.310(f) and (g)). AMs are management controls to prevent ACLs from being exceeded and to correct or mitigate overages of the ACL if they occur. AMs should address and minimize both the frequency and magnitude of overages and correct the problems that caused the overages in as short a time as possible. AMs can be initiated either in season or following the fishing year after catch accounting of all fisheries has occurred[32].

[31] Data source: National Marine Fisheries Service, Office of Science and Technology. 2017. Annual Commercial Landing Statistics. Available online: http://www.st.nmfs.noaa.gov/commercial-fisheries/commercial-landings/

[32] NMFS acknowledged in the publication of the guidelines that there is no requirement that AMs and ACLs be implemented as hard TACs or quotas, but conservation and management measures must be implemented so that the ACL is not exceeded and AMs must apply if the ACL is exceeded (74 FR 3184). While many measures in the

The second significant change was the expanded use of "sectors"[33]. The sector program revised a previously existing framework for sector management and established 17 new sectors and modified two existing sectors. Sectors are designed to be voluntary and self-selecting, and Northeast groundfish fishery participants who do not join a sector have the right to continue fishing under the "common pool" system. Catch limits are allocated to sectors for all regulated species based on an individual's contribution, with the exception of Atlantic halibut, ocean pout, northern windowpane flounder, southern windowpane flounder, and Atlantic wolffish because these stocks had small total allowable catches (TACs)[34], and vessels have limited landings histories. Prior to implementation of the sector program, TACs were not assigned across all stocks, given the effort-based management under which the fishery operated.

4.a Allocations of regulated species

The acceptable biological catch (ABC) for each regulated groundfish species is set based on the overfishing limit (OFL), as reduced for scientific uncertainty. The ABC is divided into sub-ABCs for the commercial groundfish fishery, state water fisheries and other fisheries, including those that receive allocations (Figure 6). Sub-ABCs are reduced to account for management uncertainty, to become sub-ACLs for the commercial groundfish fishery and other fisheries that receive allocations. Sub-ABCs for state fisheries and other fisheries that are not receiving allocations are not reduced and are considered sub-components of the ABC. The state and other sub-components are not subject to AMs and are based on expected catch. The sub-ACL for the commercial groundfish fishery is then further divided between the sector and common pool systems.

GOM cod and haddock are allocated to the recreational and commercial fisheries. Because recreational catch could not be assigned accurately to state or federal waters, the allocation was based on catches from all areas. As a result, recreational catches from state and federal waters are counted against the recreational sub-ACL. The commercial sub-ABC is divided between the commercial groundfish (sector and common pool systems), state water commercial fisheries, and other fisheries. For other stocks, recreational catch is included as part of the state and other fishery sub-components. For select groundfish stocks, other fisheries, including scallops and the midwater trawl fishery, are allocated sub-ACLs from the total stock ACL, thus decreasing the available quota for the commercial groundfish fishery (Table 4).

Of the 20 stocks managed under the Northeast Multispecies FMP, 15 are allocated to sectors. Four stocks (northern windowpane flounder, southern windowpane flounder, ocean pout, and Atlantic wolffish) are not allocated to sectors, and possession is prohibited. Atlantic halibut is also not allocated, and vessels are permitted one legal-sized fish per trip. For the five unallocated stocks, catch by sector and common pool vessels is measured against the commercial groundfish sub-ACL for the stock.

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management program are intended to control fishing mortality and might be interpreted to be AMs since they are "management controls to prevent the ACL from being exceeded," the term AM is usually applied to specific, automatic measures that are implemented either as an ACL is approached or after an ACL is exceeded.

[33] A sector is defined as a self-selecting group of fishermen holding limited access groundfish permits that have voluntarily entered into a contract and agree to certain fishing restrictions for a specified period of time. A sector must be composed of at least three distinct individuals, none of whom have any common ownership interest in permits, vessels or businesses of the other two or more persons in that sector.

[35] For vessels participating in one of the previous existing sectors (GB Hook Sector or GB Cod Fixed Gear Sector, as established in Amendment 13) before March 1, 2008, the GB cod PSC is calculated based on landings history from FYs 1996 – 2001.

Amendment 13 (2003) specified a process for the formation of sectors within the Northeast groundfish fishery, which also designated that no one sector could be allocated more than 20% of a stock's TAC. The implementation of Amendment 16 eliminated this accumulation cap. The allocation a fisherman brings to a sector is determined by the proportion of the total landings for each allocated groundfish stock, with the exception of GB cod[35], during the time period 1996-2006 as calculated by a Northeast multispecies permit's landings history recorded in the NOAA Fisheries commercial dealer database. This allocation is the individual's potential sector contribution (PSC) [36]. For each allocated stock, the sum of the PSCs for each moratorium right identifier (MRI) participating in a sector is multiplied by the stock's commercial groundfish sub-ACL for that year to determine the sector's annual catch entitlement (ACE). The PSC and associated ACE for all MRIs not enrolled in a sector is used to calculate the common pool sub-ACL. There is no limit to the amount of a particular stock's ACL that a sector can be allocated. There is also no permanent allocation that can be fished or transferred; allocations are granted to a sector based upon the collective catch history of participating vessels and each stock's ACL, and because membership in sectors can change every year, the annual allocations to sectors can change as well. Evaluation of catch utilization is provided in Section 5.h.

[35] For vessels participating in one of the previous existing sectors (GB Hook Sector or GB Cod Fixed Gear Sector, as established in Amendment 13) before March 1, 2008, the GB cod PSC is calculated based on landings history from FYs 1996 – 2001.

[36] An individual vessel's share of the annual catch limit (ACL) for each stock of regulated species or ocean pout that is derived from the fishing history associated with the permit issued to that particular vessel for the purposes of participating in a sector and contributing to that sector's annual catch entitlement (ACE) for each stock allocated to sectors under the Northeast Multispecies Fishery Management Plan.

Box 1. Setting Annual Catch Limits

According to the National Standard Guidelines of the National Marine Fisheries Service, a regional fishery management council's ACL for a stock may not exceed the acceptable biological catch (ABC) recommendation of the council's Scientific and Statistical Committee for that stock. The ABC is a range of allowable catch for a stock that incorporates consideration of the stock's life history and reproductive potential, vulnerability to overfishing (Overfishing Limit, OFL), and uncertainty associated with factors such as stock assessment results, time lags in updating assessments, retrospective revision of assessment results, and projections. ACLs can apply to all fishermen combined (e.g., entire fleet) or be assigned to different groups of fishermen, such as commercial and recreational or state and federal fishermen. Each group may have its own ACL for the same fish stock. The National Standard Guidelines allow a council to divide an ACL for a stock into sub-ACLs, which in the case of the Northeast Multispecies Sector Program, are the shares of the ACL, or annual catch entitlements (ACEs), for each groundfish stock that is allocated to an individual sector.

For more information: https://www.fisheries.noaa.gov/insight/setting-annual-catch-limit

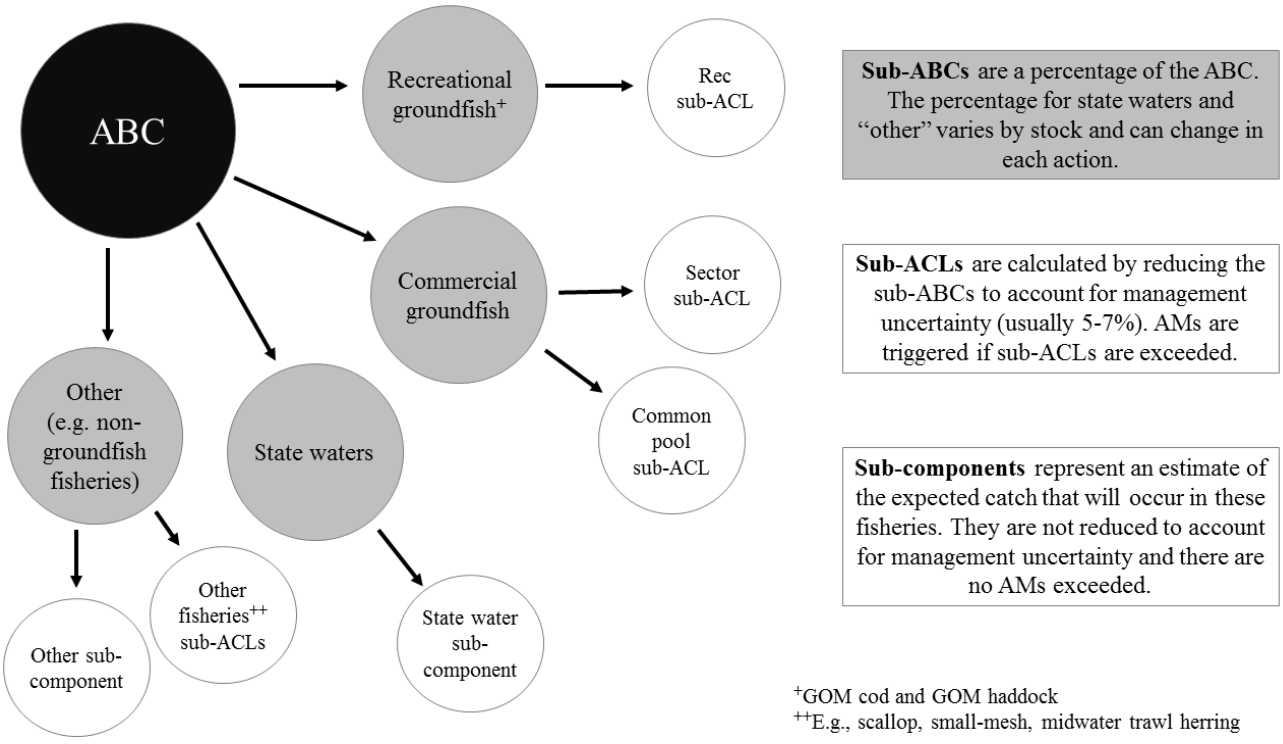


Figure 6. ABC distribution for groundfish stocks is done in stages. The figure represents the overall generic process for distributing available quota across fisheries. The ABC is determined following OFL determination and reduction to account for scientific uncertainty. The ABC may be further reduced to account for management (or implementation) uncertainty in setting the ACL. The commercial groundfish fishery gets the remainder of the ABC after accounting for the sub-components and other fisheries. The commercial groundfish sub-ACL is then further allocated between the sector and common pool systems. For GOM cod and GOM haddock, the recreational fishery also receives a portion of the ABC, reduced to a sub-ACL to account for management uncertainty.

Table 4. Allocation of groundfish stock ABCs.[37]

Stock	Total ACL[A]	Groundfish sub-ACL	Sector sub-ACL	Common Pool sub-ACL	Recreational sub-ACL	Midwater Trawl Fishery	Scallop Fishery[38]	Small-Mesh Fisheries	State Water sub-components	Other sub-components
GB Cod*	X	X	X	X					X	X
GOM Cod	X	X	X	X	X				X	X
GB Haddock*	X	X	X	X		X			X	X
GOM Haddock	X	X	X	X	X	X			X	X
GB Yellowtail Flounder*	X	X	X	X			X	X	X[B]	X
SNE/MA Yellowtail Flounder	X	X	X	X			X		X	X
CC/OM Yellowtail Flounder	X	X	X	X					X	X
American Plaice	X	X	X	X					X	X
Witch Flounder	X	X	X	X					X	X
GB Winter Flounder*	X	X	X	X					X[B]	X
GOM Winter Flounder	X	X	X	X					X	X
SNE/MA Winter Flounder	X	X	X	X					X	X
Redfish	X	X	X	X					X	X
White Hake*	X	X	X	X					X	X
Pollock	X	X	X	X					X	X
N Windowpane Flounder	X	O		O			X		X	X
S Windowpane Flounder	X	O		O			X		X	X
Ocean Pout	X	O		O					X	X
Atlantic Halibut*	X	O		O					X	X
Atlantic Wolffish	X	O		O					X	X

*Stocks that have a Canadian component

[A]ACLs are apportioned across various fisheries and sub-components as indicated by the 'X' in relevant columns of the table; for un-allocated stocks, as indicated by an 'O', the catches from both the common pool and sector vessels

[37] Table adapted from 2019 federal fishery management regulations (FW 58)

[38] NMFS is required to project the scallop fishery's catch of GB and SNE yellowtail flounder by January 15th of each year; if expected catch of each stock is less than 90% of the scallop fishery's sub-ACL, NMFS can reduce the scallop fishery's sub-ACL and transfer the reduced amount to the groundfish fishery sub-ACL for the remainder of the groundfish fishing year.

are evaluated against the groundfish sub-ACL. Table adapted from 2019 federal fishery management regulations. (https://www.fisheries.noaa.gov/bulletin/northeast-multispecies-groundfish-fishing-year-2019-regulations-sector-measures).

[B] Framework 58 updated these allocations for FY 2019-2020 and removed state subcomponents for GB yellowtail flounder and GB winter flounder.

4.a.i Accountability measures

Accountability measures (AMs), as mandated by the MSA, are management controls to minimize both the frequency and magnitude of ACL overages and to correct or mitigate in as short a time as possible overages that occur. In the sector program, the following AMs have applied to sectors since the beginning of the program (Section 4.b.xiii details changes to AMs since implementation of the program):

- If a sector exceeds its quota for any stock allocated to a sector, the sector is prohibited from fishing in the stock area for that stock for the remainder of the fishing year, or until such time that it has acquired additional quota from another sector[39].
- Any overages at the end of the fishing year will be deducted from that sector's quota of each stock for the following fishing year. A sector can balance such an overage by acquiring quota from another sector during the post reconciliation transfer window.
- If a sector disbands at the end of a fishing year following an overage, an appropriate days-at-sea or sector share penalty will apply to each permit during the following fishing year, depending on whether that permit enters the common pool or joins another sector.
- If a sector remains operational following an overage, but does not have sufficient allocation to cover the overage, vessels participating in that sector will be prohibited from fishing the stock areas associated with the overage until the sector acquires sufficient allocation to cover the overage of that stock for the stock area in question.
- Sector AMs for allocated stocks can be implemented when overages occur in other fisheries that do not have AMs.
- In addition to sector-specific AMs, a sector may be subject to AMs for non-allocated stocks (i.e., stocks for which the sector does not have any quota) resulting from an overage of the overall quota.

4.b Program design

Sector membership is annual, and participants who join a sector or opt to remain in the common pool must remain in that sector (or the common pool) for the entire fishing year. Sectors differ in terms of membership size, vessel type, predominant gear type and geographic distribution. A sector under the Northeast multispecies sector program must be a legal entity incorporated with Articles of Organization within a state jurisdiction, governed by a Board of Directors who will elect Officers of the Corporation. Board members and officers may be members of the sector (i.e. limited access northeast multispecies

[39] Sectors have an option to develop a plan to continue fishing in a BSA with no quota under guidelines provided by NOAA Fisheries in the Sector Operations Plan, Contract and Environmental Assessment Requirements.

permit holders) or other community representatives. The functions and affairs of the sector corporation are the responsibility of its officers and directors.

Sectors are typically managed by a sector manager that conducts daily operations and fulfills agency reporting requirements (Section 4.b.v). The sector manager has no direct input on the governance of the sector but works in conjunction with the Board of Directors to ensure the membership is compliant with the provisions of the approved sector operations plan. The individual responsibilities of a sector manager are determined by the Board of Directors and vary depending on the needs of each individual sector. The sector manager works on behalf of the entire sector and all its members. In this manner, sectors were designed to provide for self-governing and allow for business planning.

While NOAA Fisheries retains authority to enforce groundfish regulations, individual sectors (see discussion on joint and several liability in Section 5.e) have also been given a role in 'self-policing' of its members through its operations plan[40]. In advance of the fishing year, each sector must submit an operations plan for approval by NOAA Fisheries, detailing how the sector will operate for the defined fishing period, rules of the sector, and discipline procedures for sector operation plan infractions. In addition, sectors must include signed contracts by each member indicating they will abide by the rules and acknowledging the procedures.

Prior to the start of each fishing year (May 1 – April 30) every groundfish fishery participant must either apply to join a sector or elect to fish in the common pool. During the first season of the program in 2010, more than half of the limited access northeast multispecies permit holders – representing 98 percent of the groundfish harvested – chose to join sectors (participation in the fishery since FY 2010 is provided in Section 5.b). The remaining fishermen fished under the "common pool[41]" system. Vessels fishing in the common pool are subject to DAS restrictions and possession limits intended to prevent quota overages; when catch is projected to reach 90 percent of a stock's trimester quota, specific areas are closed to common pool vessels fishing with gear capable of catching that stock.

4.b.i Eligibility requirements

All permit holders with a limited access Northeast multispecies permit that was valid as of May 1, 2008, are eligible to participate in a sector. This includes Handgear A permits, holders of inactive permits registered to skiffs, and persons who do not currently own a fishing vessel but who retained the fishing and permit history of a vessel provided they have the permit held in Confirmation of Permit History (CPH), unless the permit has since been voluntarily relinquished or cancelled for any reason. Individual sectors may implement additional eligibility requirements.

[40] Annual guidance on requirements for Sector Operations plans are detailed online: https://www.greateratlantic.fisheries.noaa.gov/sustainable/species/multispecies/

[41] There are fundamental differences in the characteristics of sector and common pool vessels and in their quota and DAS allocations. Common pool vessels are regulated by fleet-wide trimester and annual quotas, and by DAS, although a large number of common pool vessels have few or no DAS. Some permit categories are exempt from DAS constraints (small vessel category and handgear permits). Finally, vessels opting into the common pool cumulatively landed significantly less groundfish during the landings qualification period of 1996 through 2006 than those electing to operate in sectors, which resulted in the common pool being allocated only 1-2% of the total ACL for all stocks (Murphy et al, 2018).

Participation in the sector program is voluntary; a limited access permit holder retains the option to choose annually whether to enroll their permit in a sector or operate in the common pool. If a permit holder does not enroll in a sector for a given fishing year, the vessel will be subject to the common pool regulations. Open access permits cannot be enrolled in sectors. Vessels cannot change sector membership or move into the common pool mid-year.

4.b.i.1 New entrants

The sector program did not establish any programs to assist new entrants into the groundfish sector fishery. Opportunities to enter into the groundfish fishery remain the same as in the past: an individual must purchase a vessel with an eligible limited access Northeast multispecies permit, but does pose a new decision: whether or not to join a sector or be in the common pool. In principle, vessels and permits are available at any time but the purchase price could be prohibitive.

4.b.ii Life span of catch privileges

As indicated, sector eligibility is based on the ownership of a current valid limited access Northeast multispecies permit. Vessel owners with limited access multispecies permits must annually renew their permit in order to retain the privileges associated with that permit, unless the permit has been placed in CPH, thereby removing the requirement for annual renewal while retaining access to their PSC and associated allocations if enrolled in a groundfish sector. Renewal requirements extend to all Northeast multispecies permits that are attached to skiffs or other non-commercial fishing vessels. If a limited access Northeast multispecies permit is not renewed or is cancelled for any reason, the associated PSC is redistributed to all valid limited access Northeast multispecies permits[42].

4.b.iii Auctions and royalties

There are no auctions or royalties applicable to the Northeast multispecies sector program.

4.b.iv Cost recovery

There is no cost recovery provision associated with the sector program. The sector program is not considered an individual fishing quota (IFQ) program or other type of limited access privilege program (LAPP) as defined by the MSA[43], but it is a type of catch share program. NOAA Fisheries determined that the sector program is not an IFQ program because there is no individual vessel allocation made by NOAA Fisheries; instead, NOAA Fisheries distributes the annual allocation among the sectors. Because NOAA Fisheries concluded that sectors are not LAPPs or IFQs, the LAPP and IFQ provisions of the MSA, including the requirements that an IFQ program be approved by a two-thirds majority of eligible permit holders and crew members and that a cost recovery fee program be implemented to cover the costs

[42] Framework 45

[43] The MSA reauthorization contained a requirement specific to New England fisheries, stating that the NEFMC "may not approve or implement a fishery management plan or amendment that creates an individual fishing quota program, including a Secretarial plan, unless such a system, as ultimately developed, has been approved by more than 2⁄3 of those voting in a referendum among eligible permit holders…". Thus, a system for creating a referendum and determining voting eligibility would need to be formulated if the Council chose to pursue IFQs as a management tool. (NEFMC 2009, Amendment 16).

of management, data collection and analysis, and enforcement activities, do not apply to the Northeast Multispecies sector program.

4.b.v Sector operations

Sectors must submit a sector operations plan to be approved by NOAA Fisheries. The sector operations plan must include detailed information regarding the discipline procedures for sector members that do not abide by the sector rules. While NOAA Fisheries does hold the authority to enforce any and all Northeast multispecies regulations, sectors are also given the responsibility to enforce their own sector operations plan that outlines the sector rules for each sector member.

In general, these measures define:

- the roles and responsibilities of the sector manager and an appointed enforcement committee;
- the process for investigating alleged infractions and presenting facts as gathered through the investigation;
- an appeals process for members;
- defined penalty schedules for violations of the sector's operations plan; and
- reporting requirements of all infractions/violations by the sector to NOAA Fisheries.

The severity of the penalties will range with the severity of the infraction and the number of times a member has had an infraction. Actual penalties range from written or verbal warnings, to fines, to stop fishing orders to ultimate expulsion from the sector.

4.b.vi Sector allocations

A sector is allocated ACE for each allocated groundfish stock, based on the sum of its members' PSC. Sectors are responsible for managing the combined allocation of groundfish stocks by developing its own set of rules in the sector operations plan to distribute the sector's allocation among its membership. The distribution of sector ACE to its members can vary by sector. Sector ACE may be allocated to individual members based on defined criteria (e.g. based on each members total PSC) or it may be held in aggregate as a pool for all sector members to draw from regardless of individual PSC. As part of the distribution of sector ACE, the sector may determine whether any ACE will be held in reserve from the membership to provide a buffer against the total sector ACE and how previous fishing year carryover ACE will be distributed.

For sectors that allocate ACE to its individual members, sectors must develop mechanisms to move ACE between its members to account for individual fishing behavior. This includes the ability to trade or lease fish between members. Sectors may hold auctions for ACE held by inactive members. Additionally, a sector must determine which members will participate in fish transfers, such as whether deals will be completed only between two members or whether a larger portion of the membership will be permitted to participate in any particular transfer. This applies to both internal and inter-sector transfers of fish.

As a fundamental part of the sector program, in the event that a member is expelled from a sector, the ACE associated with that member's permit remains in the sector for the remainder of the fishing year, and the individual is unable to further participate in the groundfish fishery until the following fishing year, either in a sector or the common pool. Permit holders can change sector enrollment for the start of the

new fishing year, bringing their PSC with them, thereby altering a sector's total ACE for the new fishing year. Changes in ACLs and catch utilization as they relate to this evaluation are provided in Section 5.

The sector manager is generally responsible for managing sector ACE distribution and transfers (within and between sectors) and reporting requirements to NOAA Fisheries and the sector members. Details on sector operations and reporting requirements are provided in Section 4.b.v.

4.b.vi.1 Sector allocation carryover

Under Amendment 16, groundfish sectors were permitted to carry over up to 10% of their unused ACE for any stock into the next fishing year, except GB yellowtail flounder. This presented a concern where the 'total potential catch' (i.e., total ACL + maximum carryover) could exceed the ABC for the fishing year in which the carried over ACE may be harvested. Additionally, prior to FY 2013 (February 2013), concerns were raised over the depletion of the GOM cod stock and the potential for excessive catch if the full 10% carryover were permitted.

On April 4, 2014, the U.S. District Court for the District of Columbia ruled on NOAA Fisheries' carryover-related Framework Adjustment 50 measures, specifying that the value of the stock-specific ACL plus the carryover of unused ACE may not exceed the following year's ABC. NOAA Fisheries therefore reduced the GOM cod carryover allowance to 1.85% of unused FY 2012 through emergency rule making. This new rule, implemented in April 2014, incorporated accountability measures (pound-for-pound payback) for any overages of the 2013 ACLs resulting from carryover catch. Under this new rule, the FY 2012 carryover catch of witch flounder in FY 2013 resulted in an overage of the sector sub-ACL for this stock. The pound-for-pound payback AM was applied to those sectors that exceeded their individual allocation of witch flounder under the lower carryover limit.

Under Framework 51, sectors may carry over up to 10% of unused allocation from the previous fishing year minus any amount that would result in full carryover in excess of the ABC. In the event that the ACL is exceeded due to sector catch (i.e., the sector sub-ACL is also exceeded), sectors must pay back the overage, including carried over catch, minus a *de minimis* amount of 1% of sector allocation in the current fishing year.

4.b.vi.2 GB cod and haddock conversion

Framework 51 (2014)[44] adopted a mechanism allowing a sector to convert any of their eastern GB haddock allocation to a western GB haddock allocation at any time during the fishing year; this mechanism does not permit conversion of western GB haddock quota to eastern GB haddock quota. This provision added flexibility to harvest GB haddock allocation and ensures that the US does not exceed its TAC for eastern GB haddock, while not limiting the amount of haddock that could be caught in the Western area. Framework 55 (2016) adopted a similar mechanism for sectors to convert their eastern GB cod allocation to western GB cod allocation.

4.b.vi.3 Eastern U.S./Canada area quota monitoring

Initially, catches of cod, haddock and yellowtail flounder caught by vessels fishing both inside and outside the Eastern U.S./Canada Area on the same trip were counted against the applicable hard TAC

[44] https://s3.amazonaws.com/nefmc.org/Framework_Adjustment_51.pdf

specified for the U.S./Canada Management Area, regardless of where the fish were caught. This means that all cod and haddock caught on these trips was counted against the Eastern U.S./Canada TACs for GB cod and GB haddock, and all yellowtail flounder caught on these trips was counted against the overall TAC for GB yellowtail flounder. This was altered in FY 2013, when the joint final rule for Framework Adjustments 48 and 50 revised these catch accounting provisions. Under FW48/50, when vessels fished both inside and outside of the Eastern U.S./Canada Area on the same trip, GB cod and haddock caught on that trip were apportioned according to where the vessel actually fished, according to the statistical areas reported on VMS catch reports and VTRs.

4.b.vii Sector program start-up administrative costs

Throughout the development of Amendment 16, numerous workshops were held for all Northeast multispecies fishery stakeholders, including NOAA Fisheries and NEFMC staff, relevant state agency staff, fishermen, industry organizers, and non-profit organizations, to develop and work through issues related to the various alternative management ideas being proposed. As the Amendment 16 process developed, industry leaders realized that there was a need to develop a sector plan as a potential back up to alternative management proposals (e.g. points system, area-based management and modified DAS plans). After this point, future workshops focused on developing and working through the finer details of a sector management-based system. Among the topics of discussion at these workshops were allocation formulas, monitoring and reporting systems, legal aspects of sector management as well as basic tutorials in a sector-based catch share management system[45].

Significant administrative resources were needed by the industry to develop an individual sector. Each sector needed to develop and write a sector operational plan, environmental assessment and monitoring program; these documents needed to be completed by September 1, 2009, in order to be reviewed and approved by NOAA Fisheries prior to implementation of the program. Assistance was provided by several non-profit organizations such as the Gulf of Maine Research Institute (GMRI), Island Institute and Environmental Defense Fund (EDF) to industry sector organizers.

In April 2009, NOAA Fisheries committed over $47.2 million in federal funds to provide assistance in setting up the infrastructure for the catch share management system and sectors in the northeast. “These funds were distributed as direct grants to the industry, for training new sector managers, to cover dockside and at-sea catch monitoring and for cooperative research with the fishing industry to improve gear and fishing methods so that more of the available catch can be brought to shore.”[46]

The GMRI was awarded with a $2.1 million in grants by NOAA[47] to provide the financial support for sector start-up costs, these included:

- Start-up and sector operations expenses between October 1, 2009 - December 31, 2010 (grant amount of $18,824 per sector);
- Sector operational expenses between May 1, 2010 - June 30, 2011 (grant amount of $43,581 per sector);

[45] Singer, 2011.
[46] NOAA Fisheries (2010): https://web.archive.org/web/20111015112237/http:/nero.noaa.gov/nero/outreach/ChangingTides%20Fall2010.pdf
[47] Ibid.

- Redistribution of unspent 2009 DSM funds to cover sector operational expenses between May 1, 2011 - June 30, 2013 (grant amount of $28,191 per sector); and
- Redistribution of unspent 2010 DSM funds to cover sector operational expenses between May 1, 2011 - June 30, 2012 (grant amount of $37,500 per sector).

4.b.viii Costs associated with sector program participation

In addition to costs associated with general fishing operations, participants in the sector program typically incurred fees in order to help cover sector operating costs. From FY 2010-2015, each sector operated as a non-profit corporation, incurring costs related to business administration and management (e.g., salaries, insurance, travel, etc.). Specifics regarding which fees are collected, who must pay them, and how much they cost vary by sector. However, there are common types of fees collected by sectors from their membership:

- Entrance or application fees: Typically, a one-time fee that is collected when a member joins (or applies to join) a sector.
- Sector dues/membership fees: Typically collected on an annual basis and charged as a flat rate per vessel, permit, member, or pound of allocated ACE. Rates may be lower or removed for inactive members, and higher for active members.
- Landings fees: Collected on landings by sector vessels and typically charged as a rate (price per pound of landings or as a percentage of the total value of the landings) and may vary by species.
- ACE leasing fees: Collected on ACE that is leased out of or into a sector. Typically charged as a rate (price per pound of ACE being transferred) and may vary by species.
- At-sea monitoring (ASM) costs: When the cost of at-sea monitoring is the responsibility of the sectors[48] (Section 5.d.ii), the costs per member may vary by sector. In some sectors, the selected vessel is responsible for the full cost of their ASM, while other sectors collect a flat fee from their members for each trip/day fished to pay for the ASM costs incurred by the sector for that fishing year, regardless of whether an ASM observer was carried by an individual vessel in that fishing year.

4.b.ix Sector exemptions

All sector vessels are exempt from certain regulations that apply to common pool vessels. These "universal exemptions" only apply to Northeast multispecies regulations and not to the requirements of other management plans. For example, under the Monkfish FMP, sector vessels fishing for monkfish must use a Northeast multispecies day-at-sea (DAS) when fishing under a monkfish DAS[49].

All approved sectors receive "universal" exemptions from: trip limits for allocated groundfish stocks[50]; portions of the GOM Cod Protection Closures[51]; the GB Seasonal Closed Area[52]; and Northeast

[48] ASM costs were paid directly by NMFS in fishing years 2010-2014, and most of fishing year 2015 (i.e., Sectors were responsible for paying the ASM costs from March through April 2016 in FY 2015). NEFOP observer coverage is paid for by NMFS.
[49] https://www.greateratlantic.fisheries.noaa.gov/sustainable/species/multispecies/
[50] Excluding Atlantic halibut, ocean pout, windowpane flounder, and Atlantic wolffish, i.e., the unallocated stocks.
[51] Formerly named the GOM Rolling Closure Areas, the GOM Cod Protection Closures were implemented in fishing year 2015 by Framework 53.
[52] The GB Seasonal Closure Area was removed in April 2018 by the Omnibus Essential Fish Habitat Amendment 2.

multispecies DAS restrictions other than those required to comply with effort controls in other fisheries (dogfish, monkfish, and skate). Sectors are exempt from the requirement to use a 6.5-inch mesh codend when fishing within the GB Regulated Mesh Area with haddock separator trawls, rope trawls, and Ruhle trawls, provided the vessel uses a codend with 6-inch minimum mesh. In addition, each sector can request other regulatory exemptions through its operations plan and contract submitted to NOAA Fisheries for approval on an annual or bi-annual basis. The exemptions are intended to provide additional flexibility and improve profitability for sector vessels. Table 5 details approved sector exemptions during the evaluation period.

Sectors are prohibited from requesting an exemption on certain management measures. These include: Closed Areas to protect Essential Fish Habitat areas; Permitting restrictions (vessel upgrades, etc.); Gear restrictions designed to minimize habitat impacts (roller gear restrictions, etc.); and Reporting requirements (not including DAS reporting requirements).

Table 5. Approved sector exemptions for FY 2010 through FY 2019.[53]

Sector Specific Exemptions	Fishing Year Available
120-day block out of the fishery required for Day gillnet vessels	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
20-day spawning block out of the fishery required for all vessels	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Limit on the number of sink gillnets that a Day gillnet vessel may fish in any regulated mesh area (RMA)	2010, 2011, 2012, 2013[54]2014[13, 55]
Limit on the number of sink gillnets that a Day gillnet vessel may fish outside of the Gulf of Maine RMA	2015, 2016, 2017, 2018, 2019
Limit on the number of sink gillnets that a Day gillnet vessel may fish inside the Gulf of Maine RMA, provided the extra nets are 10-inch or larger mesh, fished east of 70 degrees West longitude	2018, 2019
Prohibition on a vessel hauling another vessel's gillnet gear	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Limits on the number of gillnets that may be hauled on GB when fishing under a groundfish/monkfish DAS	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Limits on the number of hooks that may be fished	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
DAS Leasing Program length and horsepower restrictions	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Minimum mesh size for a sink gillnet in the GOM RMA when fishing in the GOM RMA with roundfish nets from January 1 through April 30	2010, 2011, 2012
Extension of the minimum mesh size for a sink gillnet in the GOM RMA when fishing in the GOM RMA with groundfish nets from May 1 through May 31	2011, 2012
Prohibition on discarding of legal-sized unmarketable fish	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019

[53] The table lists the names of the exemptions that were approved annually, there may be some additional terms or restrictions associated with each exemption that are not described here.
[54] Except in Blocks 124 and 125 in May and Blocks 132 and 133 in June.
[55] The exemption from the limit on the number of gillnets that a Day gillnet vessel may fish inside the Gulf of Maine RMA was revoked on November 10, 2014.

Sector Specific Exemptions	Fishing Year Available
Daily catch reporting requirements by sector managers for sector vessels fishing in Closed Area (CA) I Hook Gear Haddock Special Access Program (SAP)	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Trawl gear requirements in the Eastern U.S./Canada Management Area	2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Powering a Vessel Monitoring System (VMS) while at the dock	2011, 2012, 2013, 2014
DSM requirements for vessels fishing west of 72°30" W Longitude, Handgear A-permitted sector vessels, and monkfish trips in the monkfish Southern Fishery Management Area	2011, 2012
Prohibition on fishing inside and outside of the CA I Hook Gear Haddock SAP while on the same trip	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Prohibition on a vessel hauling another vessel's hook gear	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Requirement to declare intent to fish in the Eastern U.S./Canada SAP and the CA II Yellowtail Flounder/Haddock SAP prior to leaving the dock	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Seasonal restrictions for the Eastern U.S./Canada Haddock SAP	2013, 2014, 2015, 2016, 2017, 2018, 2019
Seasonal restrictions for the CA II Yellowtail Flounder/Haddock SAP	2013, 2014, 2015, 2016, 2017. 2018. 2019
Sampling exemption	2013, 2014, 2015, 2016, 2017, 2018, 2019
Prohibition on groundfish trips in the Nantucket Lightship CA	2013, 2014, 2015, 2016, 2017
Prohibition on combining small-mesh exempted fishery and sector trips	2014, 2015, 2016, 2017, 2018, 2019
Exemption from temporary 200 lb trip limit for GOM cod	2014
Requirement to use a minimum mesh size of 6.5-inches for trawl gear on directed redfish trips	2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019
Requirement to fish exclusively with extra-large mesh (10-inch) gillnets to target groundfish on groundfish trips excluded from at-sea monitoring coverage	2016, 2017, 2018. 2019
Requirement to carry a VMS while on a sector trip for Handgear A vessels fishing in a single broad stock area	2017, 2018, 2019
Prohibition on hauling another vessel's trap gear	2016, 2017, 2018, 2019

4.b.x Transferability

In the Northeast multispecies fishery, the permit attached to a vessel confers the catch privileges necessary to participate in the fishery. These catch privileges can be permanently transferred from one fisherman to another through sale of the vessel with the attached permit by furnishing to NOAA Fisheries a copy of the bill of sale and the registration of the vessel in the new owner's name.

Under Amendment 16, transferability of quota is permitted both within and between sectors (see Section 5.i for evaluation of the quota market and leasing). This transferability of quota is a temporary transfer of catch privileges between permitted sector fishermen. At the beginning of each fishing year, the sector

Board of Directors allocates a portion of the sector's total ACE to each sector member[56]. Sector members then may choose to harvest any or all of their share, or they may transfer any or all of it to another sector fisherman. Transfers may be in the form of trading fish for money, for fish, or for a commodity or service. These transfers can occur at any time in the fishing year but are limited to that fishing year. Transfers of ACE between fishermen occur for various reasons, but include to account for different fishing activities, to balance individual or sector overages, or to balance available quota with ACE carryover limits.

Most sectors have defined procedures outlined in their operations plan to guide inter-sector transfers of fish. The process of Right of First Offer allows for sector members to accept, within a set time period, all terms of any fish transfer that would result in fish leaving their sector. This ability to intercede an inter-sector transfer may be limited to only active members of the sector.

ACE transfers between sectors must be submitted to NOAA Fisheries and approved by the Regional Administrator. Transfers can occur throughout the fishing year and up to two weeks after conclusion of the fishing year to allow for final reporting requirements (e.g. observer, VTR, dealer data). After completion of year-end data reconciliation, only sectors with overages are allowed to acquire additional ACE from other sectors in order to mitigate their overages. Members may conduct intra-sector ACE transfers with other sector members, in accordance with their sector operations plan; intra-sector transfers are not subject to NOAA Fisheries approval.

4.b.xi Catch monitoring

Catch share management regimes typically introduce additional monitoring requirements to account for catches against quotas. Amendment 16 implemented a program for monitoring in the groundfish fleet, which was further modified by Framework 45, Framework 48, and Framework 55 to the Northeast Multispecies FMP. At the onset of the program, the monitoring system added at-sea and dockside monitors to enhance coverage on sector vessels, in addition to the existing observer program (Section 4.b.xi.2). Revisions to dealer reporting and industry reporting requirements were also enhanced.

4.b.xi.1 Dockside monitoring program

The dockside monitoring program (DSM) was adopted to verify the accuracy of landings by commercial fishing vessels at the time they are weighed by a dealer and to certify the landing weights are accurate as reported on the dealer report. Independent DSMs were used to ensure that all landings are offloaded, sorted, and weighed correctly to ensure accurate catch accounting. The requirement was imposed immediately for vessels fishing in sectors and in FY 2012 for common pool vessels; a subsequent action set the DSM requirement for FY 2011 and 2012 to whatever level NOAA Fisheries could fund. Dealer reporting and record keeping requirements were revised to "require dealers to provide a copy of any dealer weigh-out documents or dealer receipts for a particular offloading event to dockside/roving monitors, allow the dockside/roving monitor to sign a copy of the official weigh-out document or dealer receipt retained by the dealer, or sign a dockside monitoring report provided by a dockside/roving monitor."

[56] It is up to the individual sectors to determine how that harvest share is calculated and the shares to its members, as documented in annual operations plans.

In FY 2010, dockside monitoring would cover 50 percent of trips for each sector, and for 20 percent of trips for each sector in subsequent fishing years; and 20 percent of landings by the common pool in FY 2012. This measure did not replace dealer reporting or VTRs, and therefore did not produce a new data stream that assisted the assessment and management of the fishery. After September 18, 2011, NOAA Fisheries stopped funding DSM effectively leaving zero DSM in 2011 and 2012; the common pool never had DSM. The DSM program was eliminated on May 1, 2013 (Framework 48) to reduce monitoring costs to industry and avoid duplication of effort; sectors still had the option to hire their own dockside monitoring as a part of their sector monitoring program.

4.b.xi.2 Observer program

With the implementation of Amendment 16, the Northeast Fisheries Observer Program (NEFOP) continued its operations to provide coverage that met the coefficient of variation in the Standardized Bycatch Reporting Methodology[57] (SBRM). Amendment 16 defines an observer as "any person required or authorized to be carried on a vessel for conservation and management purposes by regulations or permits under this Act." NEFOP covers states in the Northeast and Mid-Atlantic Region (Maine to North Carolina). Trips coved by a NEFOP observer count towards a sector's combined target at-sea monitoring coverage level (see section 4.a.x.3)

4.b.xi.3 At-sea monitoring

Amendment 16 established that at-sea monitoring and/or electronic monitoring would be used "to verify area fished and catch (landings and discards), by species and gear type, for the purposes of monitoring sector ACE utilization." Amendment 16 specified a total coverage level standard for sectors and required industry-funded ASM beginning in 2012 to achieve that total target coverage. This requirement focused on the coefficient of variation (CV) of discard estimates as designated in the SBRM, a measure of the precision of discard estimates, but also noted that other factors could be considered when determining coverage levels. NOAA Fisheries sets an annual target coverage level based on the amount of coverage necessary to achieve the CV30. Electronic monitoring pilot projects have been conducted under Exempted Fishing Permits (EFP) since 2012.

The ASM program is specific to groundfish sector monitoring. At-sea monitors are primarily tasked with recording all kept and discarded catch, with discard information as the priority; including weights of catch whenever possible. These duties are similar to those of a fishery observer within NEFOP, with the exception that at-sea monitors do not collect biological samples and do not record the same level of detail on protected species interactions. Amendment 16 (also clarified through FW 55) stated that: "[t]he primary goal of observers or at-sea monitors for sector monitoring is to verify area fished, catch, and discards by species, by gear type. This data will be reported to the sector managers and to the NOAA Fisheries. Electronic monitoring may be used in place of actual observers or at-sea monitors if the technology is deemed sufficient for a specific trip based on gear type and area fished. Less than 100% electronic monitoring and at-sea observation will be required."

The manner in which discard estimates are derived may differ annually and is based on the availability of data to determine a discard rate by fish stock and gear type. For trips without an observer onboard, an

[57] Standardized Bycatch Reporting Methodology and Sea Day Schedule: https://www.nefsc.noaa.gov/femad/fsb/SBRM/

estimated[58] sector specific discard rate would apply. An estimated sector-specific discard rate is based on the discard observations provided by at-sea observers

4.b.xii Sector operations plans

To be approved to operate, each sector must submit an operations plan and preliminary sector contract to the Regional Administrator no later than September 1 prior to the fishing year in which the sector intends to operate. The operations plan may cover a 1- or 2-year period. Each vessel and vessel operator and/or vessel owner participating in a sector must agree to and comply with all applicable requirements and conditions of the operations plan.

Sector operations plans must detail strategies for monitoring, reporting, and enforcing catch and landings for all members within the sector. The plans are required to detail how a sector would monitor its catch to assure that sector catch does not exceed the sector allocation. These detailed plans include:

1. A list of all parties, vessels, and vessel owners who will participate in the sector;
2. A list of the specific management rules the for participants will agree to abide by in order to avoid exceeding the allocated ACE for each stock, including a plan of operations or cessation of operations once the ACEs of one or more stocks are harvested and detailed plans for enforcement of the sector rules;
3. A plan that defines the procedures by which members of the sector that do not abide by the rules of the sector will be disciplined or removed from the sector, and a procedure for notifying NOAA Fisheries of such expulsions from the sector;
4. If applicable, a plan of how the ACE allocated to the sector is assigned to each vessel;
5. Detailed information about overage penalties or other actions that will be taken if a sector exceeds its ACE for any stock;
6. Detailed plans for the monitoring and reporting of landings and discards by sector participants, including, but not limited to, detailed information describing the sector's at-sea/electronic monitoring program for monitoring utilization of ACE allocated to that sector;
7. ACE thresholds that may trigger revisions to sector operations to ensure allocated ACE is not exceeded, and details regarding the sector's plans for notifying NOAA Fisheries once the specified ACE threshold has been reached; and
8. A list of existing regulations that the sector is requesting exemption from during the following fishing year pursuant to paragraph (c)(2) of this section.

4.b.xii.1 Sector reporting

In addition to vessel level VTR reporting requirements, sectors are required to report all landings and discards by sector vessels to NOAA Fisheries on a weekly basis, along with submission of annual year-end reports. Year-end reports must be submitted to NOAA Fisheries and the Council following completion of the fishing year, summarizing the fishing activities of its members, including harvest levels of all species by sector vessels (landings and discards by gear type), enforcement actions, and other relevant information required to evaluate the performance of the sector.

[58] Based on discard rates on observed trips for each fleet (see Wigley and Tholke 2017 for more information)

Since the inception of sectors, there have been shifts and changes in sectors' reporting requirements. Many of the changes, as detailed in Section 5.d, were implemented over several years as the fishery adjusted to the design of the program and efforts were made to increase efficiencies or added information needs were realized. In addition to individual fisher reporting requirements, sectors maintain information for submission and approval to NOAA Fisheries.

Under Amendment 16, sectors were required to submit final rosters detailing membership to NOAA Fisheries by September 1 each year. Framework Adjustment 45 was designated to provide more flexibility by adjusting the submission deadline for final rosters to December 1; sectors were permitted to accommodate changes in vessel ownership through April 30 for the upcoming fishing year. In addition, changes to sector weekly reporting from Thursday to the following Monday was intended to provide flexibility.

Table 6. Changes to Sector participant reporting requirements.

Fishing Year	Change to reporting requirements	Reason for change
2010	Temporary waiver of the requirement for a vessel to submit the VTR serial number of the trip prior to leaving port to begin the trip, provided that the vessel operator voluntarily submits the VTR serial number for that trip prior to crossing the demarcation line on its return to port	This modification was more consistent with the requirements for the submission of VMS catch reports that include the VTR serial number for the trip. This was redundant reporting.
2011	Vessel operators were required to provide the VTR serial number from their trips only once prior to returning to port via the VMS catch report	This modification was more consistent with the requirements for the submission of VMS catch reports that include the VTR serial number for the trip and made permanent the temporary waiver above. This was redundant reporting.
	Vessel operators were required to include whether an observer/ASM was present on the trip in the Trip Start Hail in order to assign and deploy DSM	DSM coverage was reduced to 50% of trips that were not observed at-sea and this modification was more efficient in the deployment of DSM.
	Trip Start Hail was removed as a mandatory requirement once mandatory DSM was removed	With the removal of mandatory DSM, there was no immediate need for the Trip Start Hail and it was deemed redundant reporting since Trip End Hails were still required.
	VTRs required for all trips, including "set only" fixed gear trips, mechanical breakdowns with no effort trips and transit trips	Allowed for more accurate monitoring of catch and vessel activity.
	Vessels on sector trips can re-declare to Monkfish DAS trips after leaving port without having to end the trip	Provide groundfish vessels more flexibility to continue fishing without returning to port to re-declare the trip or unnecessary discarding of legal sized monkfish catch.
2013	eVTR reporting was authorized in the Northeast Region for all trips	Eliminated the requirement to submit paper log book forms.
2014	VMS daily catch reporting for sector trips declared into the Eastern U.S./Canada Area	This action was to increase the accuracy of reporting of catch in the Eastern U.S./Canada Area.
2015	VMS daily catch reporting for sector trips declared to fish both inside and outside the Gulf of Maine Broad Stock Area on the same trip	This action was implemented to prevent misreporting of GOM cod catch.
	Removal of the monthly "Did Not Fish" VTR submission	Advancements in NOAA Fisheries monitoring systems rendered these reports unnecessary.

4.b.xiii Expansion of accountability measures

Implementation of the sector program required expansion of accountability measures as the fishery realized operations with respect to the new management regime. These AM changes adjusted the accountability with respect to non-allocated stocks.

- The adoption of reactive AMs for ocean pout, both stocks of windowpane flounder, and Atlantic halibut for sector and common pool vessels that would be triggered if the total ACL is exceeded. Previously, the AMs for these stocks only applied to common pool vessels and did not include measures to restrict catch by sector vessels if the ACL were exceeded. Exceeding the ACLs of southern or northern windowpane flounder or ocean pout, would trigger the requirement for trawl vessels to use selective trawl gear (no restrictions for longline or gillnet gear). Exceeding the total ACL for Atlantic halibut would trigger a zero possession limit for commercial groundfish vessels (Framework 47).
    - The size of the AM restricted gear area could be reduced if the windowpane flounder stock is determined to be healthier than expected. In addition, the duration of the gear restricted area could be shortened if the fishery is able to reduce its harvest so that an underage of the windowpane flounder ACL occurs the year following an overage (Framework 52). This resulted in the reduction in size of the southern windowpane flounder AM area during FY 2014.
- A revision to the timing of commercial groundfish fishery AMs. If reliable information shows an overage of a total ACL during the fishing year for one of these stocks, the respective AM for that stock would be implemented at the start of the next fishing year (Frameworks 48 and 50).
- For ACL overages for Atlantic halibut or Atlantic wolffish, trawl vessels would be required to use selective gears, and sink gillnets and longline vessels would not be allowed to fish in the designated areas (Frameworks 48 and 50).
- The AM for southern windowpane flounder would include an AM for "other" fisheries and apply to non-groundfish trawl vessels using a codend ≥ 5" mesh size (Frameworks 48 and 50).

4.b.xiv Highlighted Regulatory changes

Select regulatory changes caused shifts in the design of the program, with potential implications in shifts in effort, participation or monitoring under the sector program. This list is not exhaustive and additional changes are provided in preceding tables and sections:

- In FY 2011, the "Whaleback" GOM cod spawning protection area was created, prohibiting fishing from June 1 – 30, annually (FW 45).
- In FY 2013, allocation of SNE/MA winter flounder to the groundfish fishery (FW 48/50).
- In FY 2013, minimum fish sizes for cod, haddock, witch flounder, yellowtail flounder, American plaice and redfish reduced as of July 1 (FW 48/50).
- In FY 2014, temporary GOM Cod Management Measures, November 13, 2014 – May 12, 2015, including:
    - GOM rolling closures replaced with new area seasonal closures,
    - 200 lb trip limit for GOM cod for all vessels fishing in the entire GOM Broad Stock Area,
    - Vessels that declare to fish in the GOM Broad Stock Area may only fish in that BSA for the duration of that trip, and

    - Gillnet vessels allowed a one-time, mid-season opportunity to change their annual designation as a Day or Trip gillnet vessel.
- In FY 2015, new GOM seasonal closures to protect GOM cod (FW 53).

4.c Challenges during sector-based management

The sector program has undergone changes both to the design and operation of the program itself, along with the implementation of measures external to the fishery management plan that have effects on the fishery's operations. As the report scope describes (Section 2.b), given the complexities of fisheries management and the dynamic social, economic and ecological environments in which fisheries operate, there persists a challenge with attributing change to a given intervention. Table 7 summarizes major changes directly and indirectly to the fishery during the evaluation period. Some of these, where relevant to the evaluation, are further detailed in the following sections.

Table 7. Major changes directly and indirectly to the Northeast Groundfish Fishery. FMP Amendments and Framework Adjustments are summarized in Table 1 and Table 2.

Year	Change affecting the fishery
2011-12	Northeast groundfish fishery disaster declarations.
2013	NOAA Fisheries extended approval for the electronic vessel trip reporting (eVTR) program to all Northeast Region permitted fishing vessels; previously approved for use in July 2011 for a segment of the groundfish fleet. The eVTR program allows vessels to electronically submit vessel trip report information to NOAA Fisheries, eliminating the requirement for paper logbook forms.
2013	Framework 48 discontinued the Dockside Monitoring Program starting in the 2013 fishing year, because the information collected through the dockside monitoring program duplicated information collected by dealers; eliminating the requirement to collect duplicative information would reduce vessel operational costs in the future.
2014	Conservation Law Foundation v. Pritzker et al. (2014) challenged the Framework 50 rule for 2013 carryover accounting. The Court determined that the existing approach for carryover accountability violated the MSA and ordered NOAA Fisheries to implement new carryover measures incorporating accountability for overages of the overall 2013 ACLs resulting from carryover catch.
2014	Congress allocated $75 million (from fiscal year 2014 budget) to address the fishery disaster declarations (the Northeast groundfish declaration in 2012 along with five other fisheries). Six states would each receive a portion of the available monies and would be expected to apportion them for direct assistance, to be split among the states and used at their discretion, and for use in a federally funded buyout or industry-funded buyback.
2014	Scientific estimates concluded that the GOM cod and GB cod stock abundances were well below the levels deemed sustainable; in response, NOAA Fisheries implements interim measures of time and area closures, trip limits, additional regulations on the recreational fishery, modified sector gillnet exemption, and prohibition limiting fishing to a single management area in a trip.[59]

4.c.i.1 Groundfish fishery disaster declarations

Shortly following implementation of the program, the fishery was declared a federal disaster across multiple states. Between November 2011 and August 2012, the governors from Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut submitted letters to the Secretary of Commerce, each requesting for a disaster declaration for their respective states' northeast multispecies groundfish fishery fishermen. Each letter stated that the implementation of the catch share system resulted in significant

[59] https://www.greateratlantic.fisheries.noaa.gov/stories/2014/GOM_cod_interim_management_measures.html

effort reductions causing reduced landings and revenues. Some requests referenced concern over significant reductions in allocations for the upcoming 2013 fishing year. A recent social-psychological study of northeast multispecies permit holders suggested a link between fishery disaster declarations and chronic psychological distress[60].

On September 13, 2012, the Secretary of Commerce determined a commercial fishery failure due to a fishery resource disaster for the Northeast Multispecies Groundfish Fishery in FY 2013. This disaster determination was based upon Section 308(b) of the Interjurisdictional Fisheries Act of 1986[61] and Section 312 (a) of the Magnuson-Stevens Fishery Conservation and Management Act of 1976. The basis for this disaster declaration was that despite fishermen's adherence to catch limits set in the catch share system, data showed that several key Northeast groundfish stocks were not rebuilding (NEFSC 2012). This was going to result in significant cuts to FY2013 catch limits. The disaster determination[62] was made in anticipation of these significant quota cuts for groundfish fishermen in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut and New York.

As part of the Fiscal Year 2014 federal budget, Congress appropriated $32.8M in fishery disaster relief for the New England groundfish fishery. In partnership with NOAA, the state fishery directors from the affected states elected to distribute the funds into roughly three equal portions to be spent as: Direct assistance for qualified Northeast Multispecies permit holders; state-specific grants that allows each state some flexibility to determine the most appropriate way to address the unique and varied needs of their fishing communities; and to be held in reserve for development of a federally funded buyout or industry-funded buyback program. Ultimately, the third bin of funding became a hybrid in which most ($9.89 million) was provided directly to fishermen most affected by the disaster and the remainder ($200,000) was to be used to fund continued development work on a potential buyout/buyback program, which remains in discussion.

4.c.i.2 Sector misreporting

An integral part of the catch share sector system is the accurate accounting of removals of allocated groundfish stocks. As described (Section 4.b.xi), this requires a comprehensive monitoring system that includes industry reporting, observer programs, and dealer reports. Industry reported data sets, such as the Vessel Trip Report, provide a good faith estimate of catch by species and fishing area and hail weight of each species caught during a commercial fishing trip. Dealer reported landings are required to provide an accurate weight of all species landed for sale. Without accurate reporting by industry, the ability for a sector or NOAA Fisheries to correctly monitor a sector's stock allocations and catch utilization diminishes and can undermine fishing mortality objectives of the FMP.

On March 30, 2017, a sector member of IX Northeast Fishery Sector Inc. (NEFS 9) pleaded guilty to all counts in *United States* v. *Carlos Rafael* (No. 16-CR10124-WGY). Mr. Rafael, a federally permitted seafood dealer and multispecies groundfish vessel fleet owner, admitted to falsely reporting catch information (species and weights) for 13 of his vessels on vessel trips reports and dealer landing reports

[60] Scyphers et al. 2019
[61] https://legcounsel.house.gov/Comps/Interjurisdictional%20Fisheries%20Act%20Of%201986.pdf
[62] For details on Disaster Assistance Requests, Secretary of Commerce Determination and Appropriation, see item #56 https://www.fisheries.noaa.gov/national/funding-and-financial-services/fishery-disaster-determinations#numbers-72---54.

from 2012 through 2015. These activities fell directly within the evaluation period during the sector program.

On November 22, 2017[63], NOAA Fisheries published an interim final rule that disapproved the sector operations plan of NEFS 9, effective November 20, 2017. The rule prevented all members of NEFS 9 from taking groundfish trips within or outside the sector program. Justification for the rule included:

- Despite changes in response to the issues by NEFS 9 to the internal structure of the sector including new board members, officers, and a newly elected enforcement committee, as well as prohibiting sector members from using Carlos Seafood as a primary buyer and reporting dealer for any landings, NOAA Fisheries determined these measures to be insufficient from preventing further misreporting;
- The sector did not provide NOAA Fisheries with information regarding any investigation by the sector to determine if any of its members or vessel operators breached the sector operations plan;
- The sector did not provide NOAA Fisheries with any indication that the Board, Enforcement Committee or Manager took any sector operations plan measures to address any breach of the sector operations plan;
- The sector did not institute additional measures to ensure compliance by any vessel operators who may have assisted in the misreporting;
- The sector did not provide NOAA Fisheries with any accounting of the potential ACE overages or misallocations; and
- There were no substantial changes in the NEFS 9 FY 2017 and FY 2018 Sector Operations Plan compared to NEFS 9 Operations plans from previous fishing years when the misreporting occurred.

For these reasons, NOAA Fisheries determined that NEFS 9 failed to uphold their sector operations plan requirements to a degree and extent that undermined foundational principles necessary for successful sector operations.

On July 20, 2018[64], an interim final rule approved a newly reconstituted NEFS 7, composed mainly of members formally enrolled in NEFS 9, to receive its allocation of groundfish stocks, with conditions placed on permits owned by Mr. Rafael, requiring that the permits be sold to an independent third party before they could become active in the groundfish fishery. NEFS 9 was approved as a lease-only sector and paid back the ACE overage caused by misreported catch in prior fishing years.

The government brought a separate civil case against Mr. Rafael and his fishing captains. The settlement of the civil case resulted in financial penalties, relinquishment of dealer permits, cessation of all commercial fishing, and the requirement to sell all fishing permits and vessels[65]. However, the magnitude and repercussions of the misreporting on the ecological and economic impacts to the fishery remain unclear.

[63] https://www.federalregister.gov/documents/2017/11/22/2017-25299/magnuson-stevens-act-provisions-fisheries-of-the-northeastern-united-states-northeast-multispecies
[64] https://www.federalregister.gov/documents/2018/07/20/2018-15477/magnuson-stevens-act-provisions-fisheries-of-the-northeastern-united-states-northeast-multispecies
[65] Details summarized by NOAA Fisheries Enforcement, August 19, 2019: https://www.fisheries.noaa.gov/new-england-mid-atlantic/enforcement/details-settlement-governments-civil-case-against-carlos

4.c.i.3 Failure of cod stocks to recover

4.c.i.3.1 Gulf of Maine Cod

Atlantic cod has been a pivotal species in New England fisheries for over 400 years. With the implementation of the catch share sector system, ACLs were set for both GB and GOM stocks, based on the results of the 2008 GARM III, which estimated the GOM cod stock recovering from a previously depleted status and would be rebuilt by 2014. The FY 2012 ACL for GOM cod, set at just over 8,000 mt (Table 8), roughly 25% below an ABC at F_{MSY}.

In late 2011, a new stock assessment for GOM cod (SAW 53, NEFSC 2012) indicated that the results of GARM III were incorrect and that GOM cod was overfished and overfishing was occurring, requiring major reductions in catch limits necessary for FY 2012, as required under the MSA. NOAA and NEFMC worked with the fishing industry to find flexibility within the regulations that could both protect GOM cod and provide sustainable fishing opportunities. As a result, the ACL for FY 2012 was set at 6,700 mt which was well above the catch limit that would have been set (< 1,500 mt) based on the 2011 assessment results.

In late 2012, GOM cod was the subject of another stock assessment (SAW 55, NEFSC 2013). The results confirmed low biomass estimates and high fishing mortality rates. This required the steep cuts in ACL that were previously avoided; and for FY 2013 the GOM cod ACL set at 1,470 mt; representing an 82.8% reduction from just two years previous.

An unscheduled update assessment for GOM cod in the fall of 2014 indicated that the GOM cod stock was still overfished and overfishing was still occurring (Palmer 2014). Stock biomass was estimated to be at its lowest point ever (< 2,500 mt) and the FY 2014 ACL (set for 1,470 mt) was too high. As a result, NOAA Fisheries issued emergency management measures in November 2014 to further reduce GOM cod catch:

- Updated/modified commercial and recreational fishery closure areas in the GOM,
- Commercial trip limit of 200 pounds for all sector and common pool groundfish vessels fishing in the GOM broad stock area (BSA),
- Prohibition on recreational possession of GOM cod,
- Commercial trips declared into the GOM BSA could only fish there for the duration of the trip, and
- Revocation of the sector exemption that allowed for a higher number of gillnets to be fished by day gillnet vessels in the GOM.

The fishing industry did respond to these new drastic measures by developing a mechanism that would remove the trip limit provision as well as the single broad stock area limitation of this rule. Sectors worked together to assemble 30 mt of GOM cod ACE and transferred it to NEFS 4, a lease only sector, to render the volume unusable and prevent its use for potential carryover, if sectors were granted regulatory exemptions from the GOM cod trip limit and GOM BSA restrictions. In March 2015, NOAA Fisheries approved this exemption request. To further reduce fishing mortality, the FY 2015 ACL for GOM cod was set at 366 mt, representing a 75.1% decrease from the previous fishing and a total decrease of 95.7% from the highest ACL since implementation of the sector program (8,545 mt in FY 2011).

4.c.i.3.2 Georges Bank cod

The 2008 GARM III[66] assessment determined GB cod was overfished and that overfishing was occurring, and that fishing mortality was decreasing, and biomass was increasing for the stock. Based on the GARM III projections, and consistent with the control rule, ACLs for both FY 2011 and 2012 increased, from FY2010 levels (Table 8).

In late 2012, GB cod was reassessed[67]; the results of which determined that GB cod remained overfished and overfishing was still occurring. Biomass estimates were approximately 7% of the spawning stock biomass (SSB) and fishing mortality was much higher than expected. In response, the FY 2013 ACL was reduced by 60.8% from the previous fishing year.

Table 8. Annual catch limits (mt) for Atlantic cod stocks by fishing year[68].

Fishing Year	GOM cod	GB cod
2010	8,088	3,620
2011	8,545	4,540
2012	6,700	4,861
2013	1,470	1,907
2014	1,470	1,867
2015	366	1,886

5 EVALUATION OF THE SECTOR PROGRAM

5.a Introduction

Review of all national catch share programs (LAPP or otherwise) has been recommended under the NOAA Catch Share Policy since January 2017 (NOAA Fisheries Policy 01-121). Guidance advises that reviews should be initiated no later than 5 years after the implementation of the program. The Council initiated this review in early 2019. The boundaries of this review extend back to the three years prior to implementation of the program through the first six years under sector management: fishing years 2007-2015. These boundaries align with much of the existing analysis from which this this evaluation draws. Given the limited timeframe and resources, the evaluation was unable to update most analyses through more recent fishing years, but where feasible, does offer more recent results. As this review is the first of its kind for the sector program, the evaluation provides an opportunity to understand effects from and changes to the program since implementation, as well as isolate knowledge gaps, and offers the opportunity to develop recommendations for future reviews.

A challenge with any evaluation is attribution of cause to effect. Fisheries are dynamic systems influenced by many factors, and as the program evolved due to changing ecological, social, economic and management factors, so did the responses. Litigation, for example, was one of several forces that shaped

[66] NEFSC 2008
[67] SAW 55, NEFSC 2013
[68] From year end reports:
https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/h/groundfish_catch_accounting

U.S. catch share policy.[69] Throughout this evaluation, each section presents analyses with accompanying graphics and description of factors and potential causes, but actual causality is not possible with available analysis. In addition, a discussion of results and links to the goals and objectives of the program are provided in the conclusions.

5.b Groundfish fishery participation

A Moratorium Right Identifier (MRI) is a unique identifying number that is attached to a limited access eligibility, and it is used to track each limited access permit's landings history, qualifications, attributes, and specifications. An MRI may be attached to an active vessel permit, or it may be put into Confirmation of Permit History (CPH). If a vessel permit is transferred from one owner to another, the initial owner may opt to retain the MRI that was associated with the permit. In this case, once the permit is transferred, that permit number will no longer be associated with that MRI except for historical purposes. The number of MRIs represents the number of individual fishing privileges and catch histories associated with each Northeast multispecies permit, through which Potential Sector Contributions (PSC) are calculated.

There has been a decline in the total number of groundfish eligible MRIs between FY 2007 and FY 2018. Since the implementation of the sector program, the number of total (sector + common pool) eligibilities in CPH (Confirmation of Permit History – those permits not associated with a vessel) has increased, from 94 (in FY 2010) to 424 (in FY 2018) (Figure 7). This represents a decline in the number of permits associated with physical vessels. There was a larger percentage of permits going into CPH for sectors than experienced in the common pool.

[69] Iudicello, S. and S. B. Lueders. 2016. A survey of litigation over catch shares and groundfish management in the Pacific Coast and Northeast Multispecies Fisheries. Environmental Law, Lewis & Clark Law School. https://law.lclark.edu/live/files/21638-46-1iudicellopdf

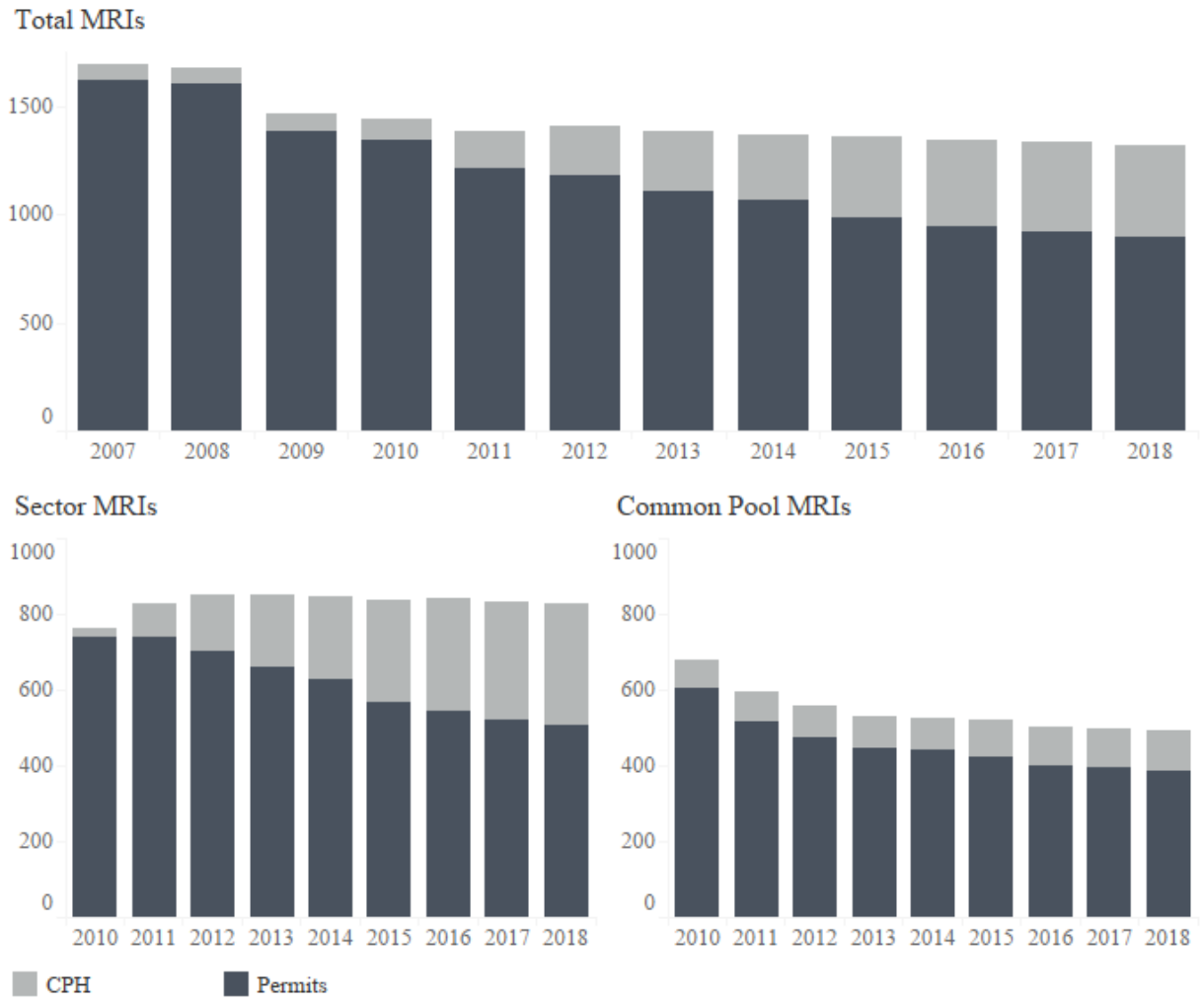


Figure 7. Number of total (top), sector (bottom left) and common pool (bottom right) MRIs that are eligible to participate in the groundfish fishery as of May 1 of each fishing year.[70]

For the limited access groundfish eligible permits attached to a physical vessel, less than half had allocated groundfish landings in all fishing years between FY 2007 through FY 2018 (Figure 8). Across all northeast multispecies permits, vessels with groundfish landings was on the decline between FY 2007 and FY 2018. Permits that did not actively land groundfish are comprised of permits either participating in other fisheries, landing non-groundfish stocks on groundfish trips, or were completely inactive in any fishery with no landings at all.

[70] GARFO sector tables and GARFO sector monitoring tables (https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/Sector_Monitoring/FY15_Groundfish_Tables.pdf.)

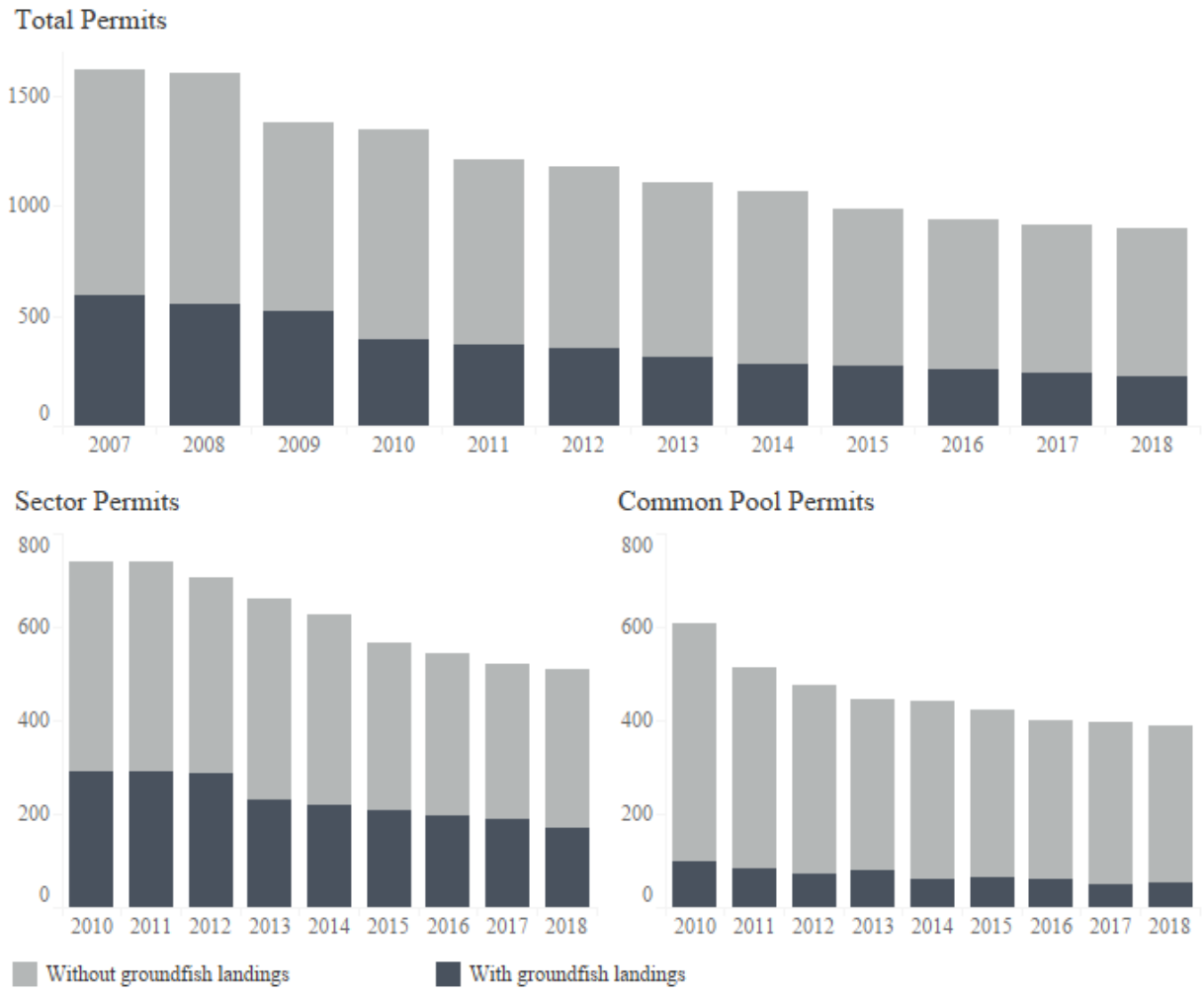


Figure 8. The total (top), sector (bottom left) and common pool (bottom right) number of limited access permitted vessels without groundfish landings (light grey) and the number with groundfish landings (dark grey) as of May 1[71] of each fishing year.**

5.b.i Sector and common pool participation

In 2010, approximately half (46%) of the limited access northeast multispecies permit holders opted to remain in the common pool, possibly because of their small individual potential contribution to a sector's total ACE.

[71] On this date the number of LA permits will equal to the number of eligibilities not in Confirmation of Permit History (CPH). These numbers exclude groundfish limited access eligibilities held as CPH. Starting in 2010, Amendment 16 authorized CPH owners to join sectors and to lease DAS, and sectors could use the ACE associated with the CPH permit. For purposes of comparison, CPH vessels are not included in the data for either Sector or Common Pool. ** Limited Access Permitted vessels includes the total eligible vessels at any time in the fishing year minus the number of vessels that did not renew a LA permit. Source: GARFO sector tables and GARFO sector monitoring tables (https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/Sector_Monitoring/FY15_Groundfish_Tables.pdf.)

At the outset of the program, 17 sectors were in operation with a total of 761 MRIs (Table 9). Unlike eligibilities in CPH in the common pool, under Amendment 16, sector eligibilities in CPH are eligible to lease their ACE and therefore may still have passive sources of income through their participation, regardless of if they no longer have a fishing vessel.

Over the first six years of the program, there was an overall increase in the number of operating sectors to 19. During this time period, two state-operated permit bank sectors (Maine in FY 2011 and New Hampshire in FY 2012) were approved, two new industry-based sectors (in FY 2011 and FY 2014) were approved, and two of the industry-based sectors ceased to operate (FY 2013 and FY 2014). The number of permits in the sector program increased through FY 2013, followed by a modest decline over the subsequent two years. For the common pool, participation peaked in the first year of the program followed by declines in every subsequent year as permits either enrolled into the sector program or were not renewed. With these changes, the fishery experienced an overall decrease in the number of active vessels over the six-year evaluation period.

Table 9. Number of MRIs and proportion of total MRIs enrolled in sectors and the common pool.[72]

Fishing Year	# of Operational Sectors	MRIs in Sectors	MRIs in Common Pool
FY 2010	17	761 (52%)	714 (48%)
FY 2011	19	828 (56%)	647 (44%)
FY 2012	20	850 (60%)	558 (40%)
FY 2013	19	851 (62%)	529 (38%)
FY 2014	19	845 (62%)	528 (38%)
FY 2015	19	838 (62%)	522 (38%)

5.b.ii Permit Banks

5.b.ii.1 State Operated Permit Banks

With implementation of the sector program, the Council, associated states, and NOAA Fisheries had an interest in promoting the effective implementation of catch share programs in New England, while minimizing any potential adverse socio-economic impacts to fishing communities and small-scale fishing businesses that can result from catch-share programs. In 2010, NOAA provided nearly $6 million in funding to the states of Maine, New Hampshire, Massachusetts, and Rhode Island, in the form of Federal grant awards, for the express purpose of establishing several "permit banks"[73] of Northeast multispecies fishing vessel limited access permits. The Federal grant awards were intended to facilitate partnerships between the states and NOAA Fisheries that seek to:

- "Preserve continued access to fishery resources for local, small-scale fishermen from small fishing communities throughout the states of Maine, New Hampshire, Massachusetts, and Rhode Island;
- Supplement existing access privileges held by fishermen in small communities; and

[72] https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/Sectors/PSC/psc_description.html
[73] A permit bank, in its most basic form, is a collection of fishing permits held by an organization or individual for the purpose of providing others the fishing privileges associated with those permits.

- Mitigate the effects of fishing effort consolidation on small-scale fishermen and fishing communities in these four states" (Amendment 17).

Given that these permit banks were not initially recognized under the provisions of the Northeast Multispecies FMP, and the only entities allocated, and authorized to transfer, ACE to sectors were other sectors, state permit banks were limited to joining an existing sector or creating a new sector in order to participate in ACE transfers. These options complicated the operation of permit banks; hence the need for Amendment 17. The Council developed Amendment 17 to define and facilitate the operation of NOAA-sponsored state-operated permit banks. Amendment 17 defines a state-operated permit bank as:

> "…a permit depository established through an agreement between NOAA and a state in which Federal grant funds are used by the state to obtain Federal fishing vessel permits so that the fishing access privileges associated with those permits may be allocated by the state to qualified sectors (77 FR 16942)."

With finalization of Amendment 17, New Hampshire and Maine developed and implemented their own state operated permit banks to assist fishermen in their respective states. Massachusetts and Rhode Island instead chose to develop revolving loan funds to offer capital to their groundfish fishermen for the ACE leasing and vessel improvements. Lastly, only NH and ME have permits banks in operation today.

5.b.ii.2 Private permit banking efforts

Several private entities have also developed their own permit bank models for assisting segments of the groundfish industry[74]:

- IV Northeast Fishery Sector Inc. was developed as one of the original sectors. Here, the majority of permits enrolled in the sector are owned by the Gloucester Fishing Community Preservation Fund (GFCP). GFCP was created with the mission to preserve and promote awareness of Gloucester fisheries and serve as a central repository/exchange for limited access multispecies fishing privileges and permits for fishing vessels based in Gloucester.
- The GB Cod Fixed Gear Sector (FGS) supplemented its roster of active and inactive permits with additional inactive permits purchased through the Cape Cod Fisheries Trust (CCFT) whose mission is to ensure local small-scale fishing businesses continue to be profitable & sustainable. The CCFT provides groundfish quota to FGS members.
- XI Northeast Fishery Sector Inc. (NEFS 11) was able to secure funding from the Coastal Economic Development Corporation in order to purchase two permits from its members. The allocation from these permits has remained within the sector and has been made available to its active groundfish fishermen. In addition, the State of New Hampshire provided NEFS 11 with additional funding through the groundfish disaster relief program to provide for the purchase of another permit from its membership, to allocate quota to all active members of the sector.
- The Nature Conservancy purchased limited access northeast multispecies permits and has typically enrolled them back into the sectors from which they were purchased. These permits are enrolled as inactive and the allocation is used primarily to provide access to below market quota

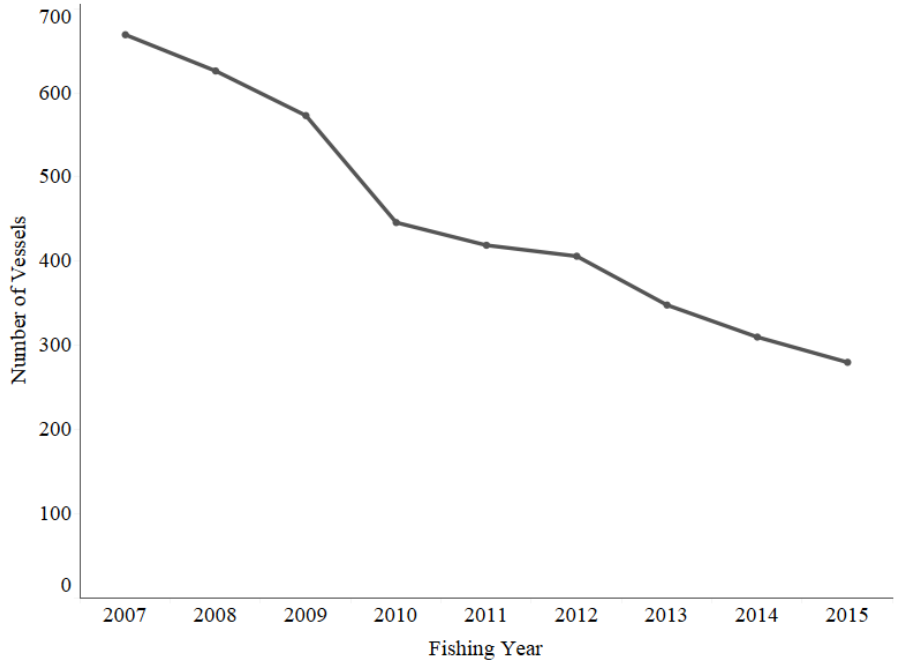
[74] Information provided from multiple sources: Personal communication, Vito Giacalone, Director, GFCPF (NEFS 4); Personal communication, Seth Rolbein, Director, CCFT (FGS); Personal communication, Daniel Salerno, Sector Manager, NEFS 11; Christopher McGuire and Alix Laferriere, TNC

leases as a tangible economic incentive for fishermen to participate in collaborative research projects.

5.c Fleet activity

A decrease in fleet size (across the total groundfish fleet, sectors and common pool)[75] has been observed within the groundfish fishery. A decrease in fleet size was precipitated by changes to the management regime (adoption of days-at-sea effort controls in 1994), and followed by buyback programs in 1996 and 2000 (Figure 4). More recently, the number of active vessels has continued to decline following implementation of the sector program.

Since FY 2007, there has been a steady decline in the total number of vessels with revenue from at least one groundfish trip, either from groundfish or non-groundfish stocks (Figure 9). During the three-year period prior to the implementation of the sector program, there was a 14% decrease in the number of vessels, compared with a 37% decrease between FY 2010 and 2015. This overall decline was not proportional across the fishery, and certain components of the groundfish fishery experienced different rates of decline. There was a considerable reduction in groundfish fishing activity prior to the 2007-2009 period (used here as the baseline); with a 25% decline in the number of permits using groundfish DAS from 2004 through 2008, and a 53% decline from 2001 to 2008. Looking solely at FY 2007 to 2008, the fleet experienced an 11% decline.[76]



[75] Data is presented for both, due to availability in Murphy et al. (2018) but the focus is on the performance on the sector program.
[76] Framework 44 to the Northeast Multispecies FMP (2010)

Figure 9. The total number of vessels with revenue from at least one groundfish trip between FY 2007 and FY 2015.[77]

Declines in the number of active groundfish vessels with revenue from at least one groundfish trip[78] (hereafter referred to as "groundfish vessels") for this section, unless otherwise noted in a footnote) were experienced across all vessel size classes, states and homeports (Table 10).

Table 10. Changes in the number and proportions of vessels with revenue from at least one groundfish trip during pre-catch share and post-catch share periods and across the evaluation period.[79]

	Number of Vessels		Change in vessels from FY 2007-2009		Change in vessels from FY 2010-2015		Change in vessels from FY 2007-2015	
	FY 2007	FY 2015	#	%	#	%	#	%
Total GF vessels	669	280	-96	-14.35%	-166	-37.22%	-389	-58.15%
Vessel size class								
<30'	26	12	7	26.92%	-10	-45.45%	-14	-53.85%
30' to < 50'	358	125	-45	-12.57%	-118	-48.56%	-233	-65.08%
50' to < 75'	207	97	-47	-22.71%	-26	-21.14%	-110	-53.14%
75' & above	78	46	-11	-14.10%	-12	-20.69%	-32	-41.03%
Homeport state								
ME	78	26	-14	-17.95%	-16	-38.10%	-52	-66.67%
NH	42	15	0	0.00%	-17	-53.13%	-27	-64.29%
MA	342	154	-31	-9.06%	-82	-34.75%	-188	-54.97%
RI	76	44	-16	-21.05%	-11	-20.00%	-32	-42.11%
CT	9	7	-1	-11.11%	0	0.00%	-2	-22.22%
NY	59	28	-12	-20.34%	-12	-30.00%	-31	-52.54%
NJ	47	3	-19	-40.43%	-18	-85.71%	-44	-93.62%
Other	16	3	-3	-18.75%	-10	-76.92%	-13	-81.25%
Major homeport city								
Portland	19	10	-6	-31.58%	-4	-28.57%	-9	-47.37%
Gloucester	93	45	3	3.23%	-29	-39.19%	-48	-51.61%
Boston	56	25	-12	-21.43%	-10	-28.57%	-31	-55.36%
Chatham	28	18	0	0.00%	-8	-30.77%	-10	-35.71%
New Bedford	61	32	-9	-14.75%	-1	-3.03%	-29	-47.54%
Point Judith	42	32	-10	-23.81%	1	3.23%	-10	-23.81%

[77] Data source: Murphy et al. 2018. Note, Murphy et al. has a specific and a possibly different definition of a groundfish trip relative to other section of the report, please refer to the appendix for the various definitions of groundfish trips used in this report.
[78] Several classes of active groundfish vessels are used by Murphy et al. 2018: vessels with a limited access groundfish permit that have revenue from any commercial fishery; vessels that landed of any species on at least one groundfish trip; or, vessels that landed allocated groundfish stocks on at least on groundfish trip.
[79] Data source: Murphy et al. 2018.

Gear type								
Trawl	313	145	-66	-21.09%	-33	-18.54%	-168	-53.67%
Gillnet	112	47	4	3.57%	-26	-35.62%	-65	-58.04%
Handline/Rod-reel	35	32	33	94.29%	-5	-13.51%	-3	-8.57%
Longline	43	7	0	0.00%	-18	-72.00%	-36	-83.72%
Other	58	30	16	27.59%	-7	-18.92%	-28	-48.28%

Decreases in number of groundfish vessels were unequal across vessel size categories. The steepest decline, in number and percent of vessels, was observed in the 30' to <50' size class, those vessels that typically operate shorter trips nearer to shore, with a 65% reduction in the number of groundfish vessels between FY 2007 and FY 2015; this included a 48.5% reduction in that size class during the first six years under the sector program (Figure 10). The 50' to <75' size class experienced the second sharpest decline over the nine-year period. Both the 75' and above and the < 30' size classes experienced smaller declines in the numbers of groundfish vessels across the nine-year time period, but proportionally this represented a loss of 53.8% and 41%, respectively.

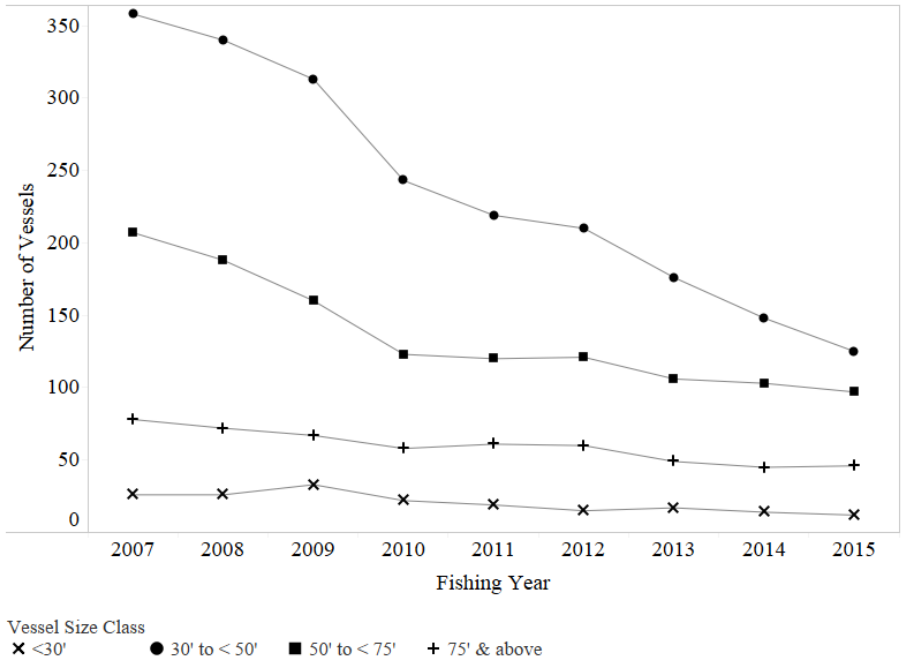


Figure 10. Number of vessels with revenue from at least one groundfish trip between FY 2007 and FY 2015 by vessel size.[80]

[80] Ibid.

Similarly, all states and homeports experienced decreases in the number of groundfish vessels with unequal numbers and rates of decline across the nine-year period. Across states, the number of vessels that homeport in Massachusetts experienced the greatest decline over FY 2007 and FY 2015, compared to other states that were active in the fishery (Figure 11). The second largest loss, in terms of number of vessels, occurred in Maine. Of the six major ports in the Northeast Region, Boston had the highest percent decrease in groundfish vessels, decreasing by 21% from 2007-2009 and 29% from 2010-2015, a loss of 31 vessels (55% decrease) total (Figure 12). Gloucester had the second highest percent decrease in number of vessels, decreasing by 52% (48 vessels) over 2007-2015 (Figure 12). Though Portland lost the fewest number of groundfish vessels (9 total) between FY 2007 and FY 2015, this translates to a large percent decrease (47% decrease) for this port.

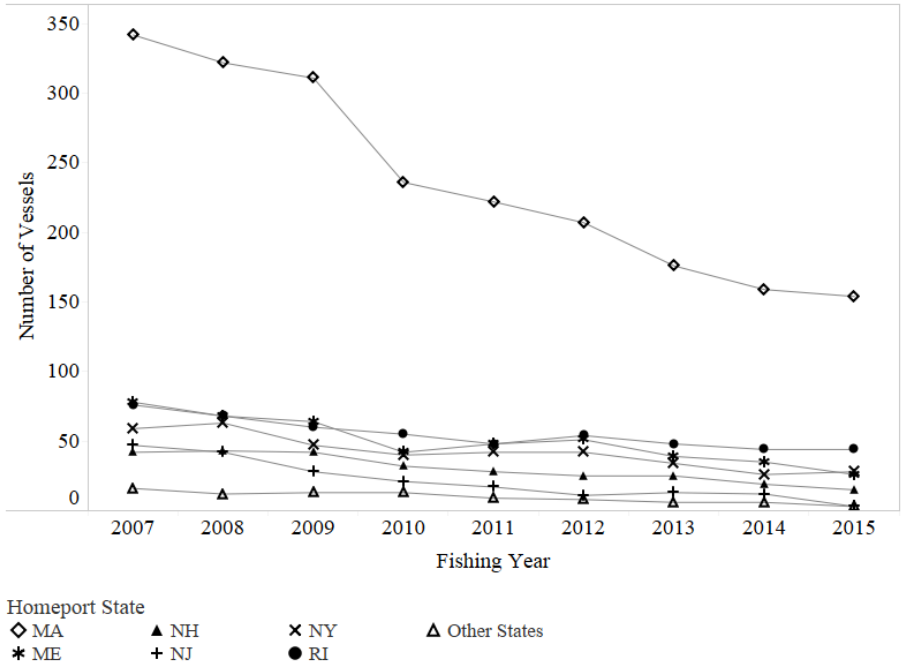


Figure 11. Number of vessels with revenue from at least one groundfish trip between FY 2007 and FY 2015 by home port state.[81]

[81] Ibid.

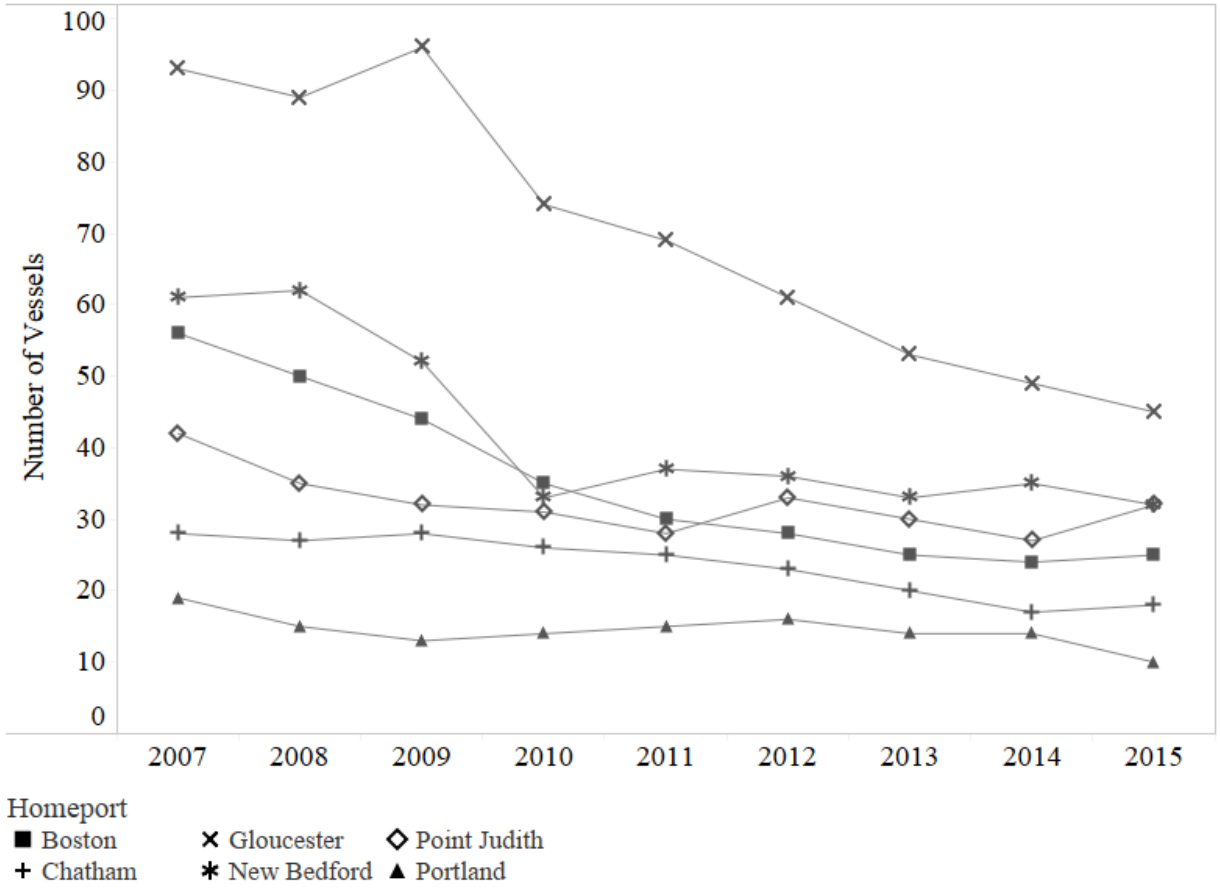


Figure 12. Number of vessels with revenue from at least one groundfish trip between FY 2007 and FY 2015 by major home port city.[82]

Vessels categorized by different gear types also experienced declines in numbers across all categories. Vessels employing trawl gear experienced the greatest overall declines (from 313 to 145 vessels from FY 2007 to FY 2015, respectively), followed by gillnet (from 112 to 47 vessels from FY 2007 to FY 2015, respectively), longline (from 43 to 7 vessels from FY 2007 to FY 2015, respectively), other (from 58 to 30 vessels from FY 2007 to FY 2015, respectively) and handline (from 35 to 32 vessels from FY 2007 to FY 2015, respectively); however, there were relatively fewer vessels that used these gear types in the time series (Figure 13).

[82] Ibid.

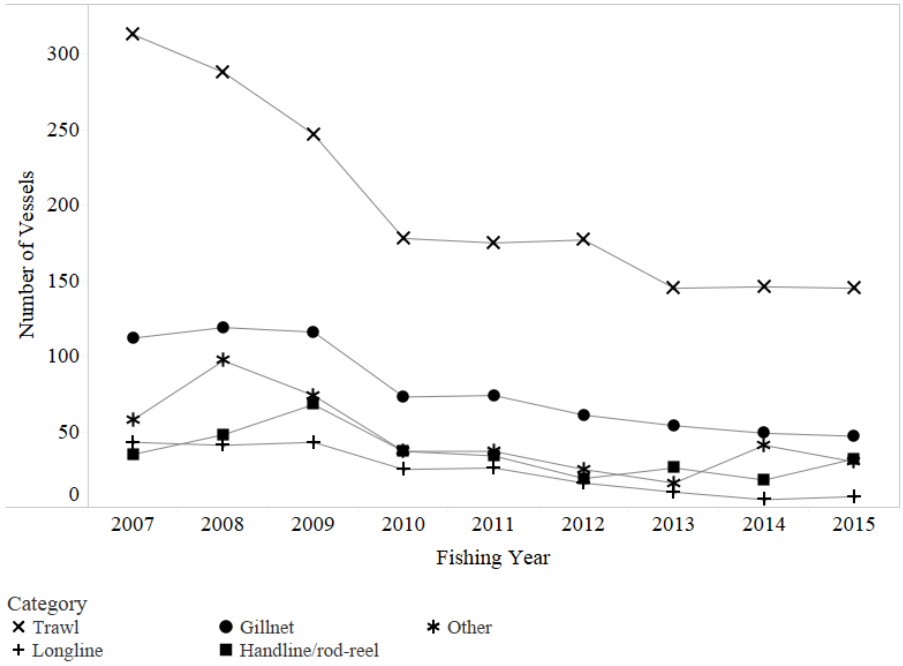


Figure 13. Number of vessels with revenue from at least one groundfish trip between FY 2007 and FY 2015 by gear type.[83]

VTR data pertaining to number of fishing trips, days absent from port, and average trip length were analyzed in Murphy et al. (2018), both in the aggregate and across vessel size classes. Effort by the groundfish fleet on groundfish trips generally decreased between 2007 and 2015 (Table 11), with the number of groundfish trips taken and the number of days absent on groundfish trips both hitting nine-year lows in FY 2015. The groundfish fleet took 8,453 groundfish trips in 2015, a 69.1% decrease from the 27,320 groundfish trips taken in FY 2007 (Figure 14). An exception to these declines was observed between FY 2010 and FY 2011, where an inter-annual increase was observed.

Table 11. Changes in the number and proportions of groundfish trips during pre-catch share and post-catch share periods and across the evaluation period.[84]

	Number of trips		Change in trips from FY 2007-2009		Change in trips from FY 2010-2015		Change in trips from FY 2007-2015	
	FY 2007	FY 2015	#	%	#	%	#	%
Total GF Trips	27,320	8,453	-1,097	-4.02%	-5,083	-37.55%	-18,867	-69.06%
By vessel size class								
<30'	263	153	147	55.89%	52	51.49%	-110	-41.83%
30' to < 50'	18,476	4,800	1,309	7.08%	-4,608	-48.98%	-13,676	-74.02%
50' to < 75'	7,139	2,510	-2,320	-32.50%	-355	-12.39%	-4,629	-64.84%
75' & above	1,442	990	-233	-16.16%	-172	-14.80%	-452	-31.35%

[83] Data request fulfilled by GRAFO.
[84] Ibid. (adapted from Table 14)

	Number of trips		Change in trips from FY 2007-2009		Change in trips from FY 2010-2015		Change in trips from FY 2007-2015	
	FY 2007	FY 2015	#	%	#	%	#	%
By major homeport city								
Portland	1,619	481	-77	-4.76%	-29	-5.69%	-1,138	-70.29%
Gloucester	9,041	1,808	2,874	31.79%	-2,593	-58.92%	-7,233	-80.00%
Boston	464	436	151	32.54%	-31	-6.64%	-28	-6.03%
Chatham	1,540	474	-141	-9.16%	-503	-51.48%	-1,066	-69.22%
New Bedford	1,499	847	-272	-18.15%	-89	-9.51%	-652	-43.50%
Point Judith	1,977	1,035	-1,245	-62.97%	522	101.75%	-942	-47.65%
By gear type								
Trawl	8,360	3,497	-878	-10.50%	-389	-10.01%	-4,863	-58.17%
Gillnet	6,520	1,257	1,926	29.54%	-2,115	-62.72%	-5,263	-80.72%
Handline/Rod-reel	320	196	465	145.31%	6	3.16%	-124	-38.75%
Longline	758	39	-304	-40.11%	-212	-84.46%	-719	-94.85%
Other	162	202	93	57.41%	-39	-16.18%	40	24.69%

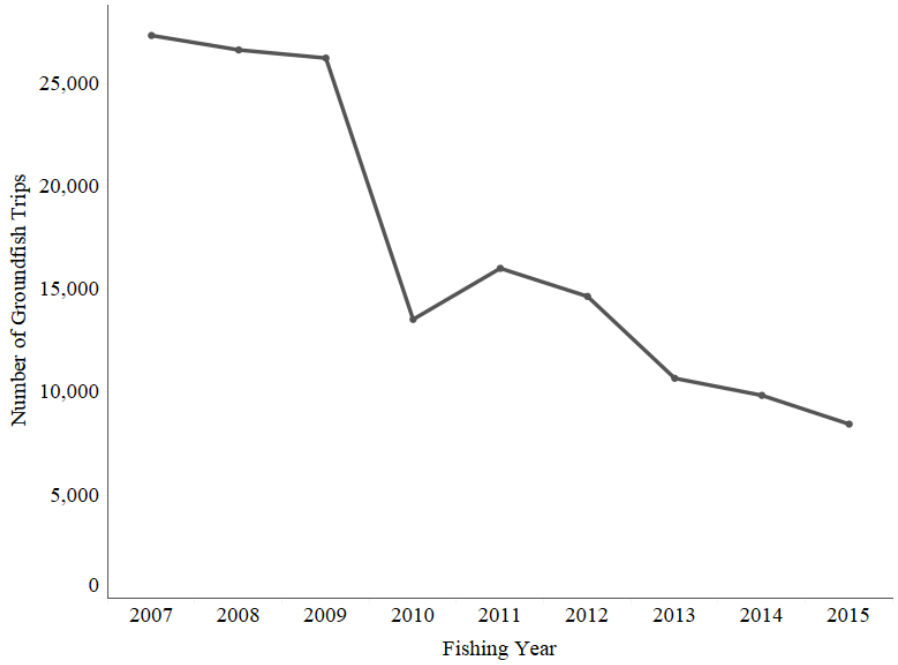


Figure 14. The total number of groundfish trips completed between FY 2007 and FY 2015.[85]

The overall decline in the number of groundfish trips was observed across all vessel size categories, with the steepest decline observed in the 30' to < 50' size class, corresponding with the sharp decline in active

[85] Ibid.

vessels in this category (Figure 15). This size class experienced a 74 % drop in the number of groundfish trip taken each year between FY 2007 and FY 2015, including nearly 50% decline during the first six years under the sector program. This is the largest operational size class in the fishery, all other size classes experienced declines, but not to the same extent.

Gloucester experienced the greatest decline in the number of annual groundfish trips across major homeports. With an overall loss of over 7,000 trips over the nine-year period, and over 2,500 trips over the six years under the sector program; this does include a slight increase in trips during the first year of the sector program (Figure 16). Chatham and Portland showed a similar decline in number of groundfish trips and Boston had the smallest decline. When assessing gear-based trends, gillnet vessels experienced the largest downward trend in annual number of trips followed by trawl vessels (Figure 17).

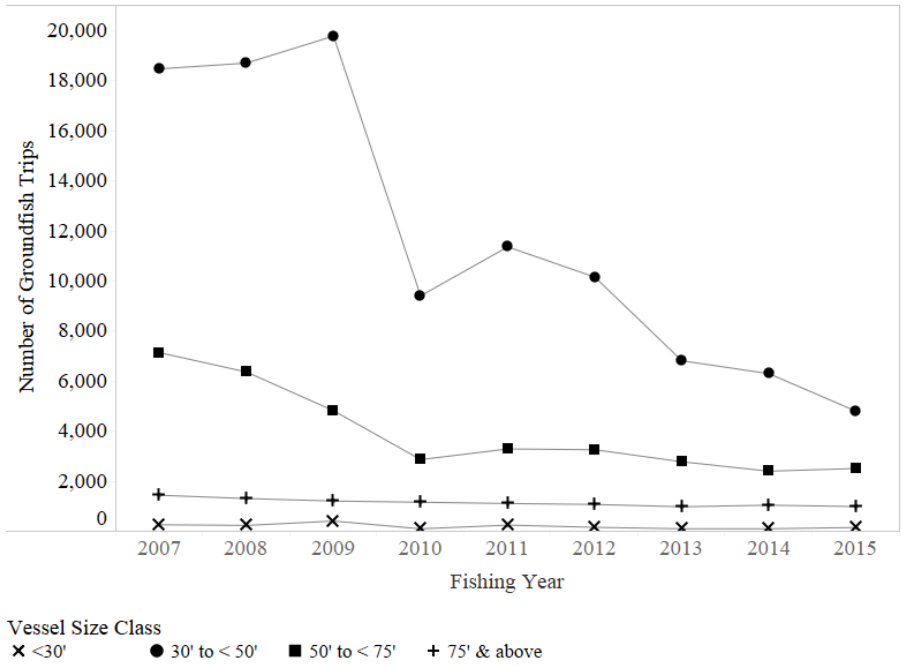


Figure 15. The total number of groundfish trips completed between FY 2007 and FY 2015 by vessel size.[86]

[86] Ibid.

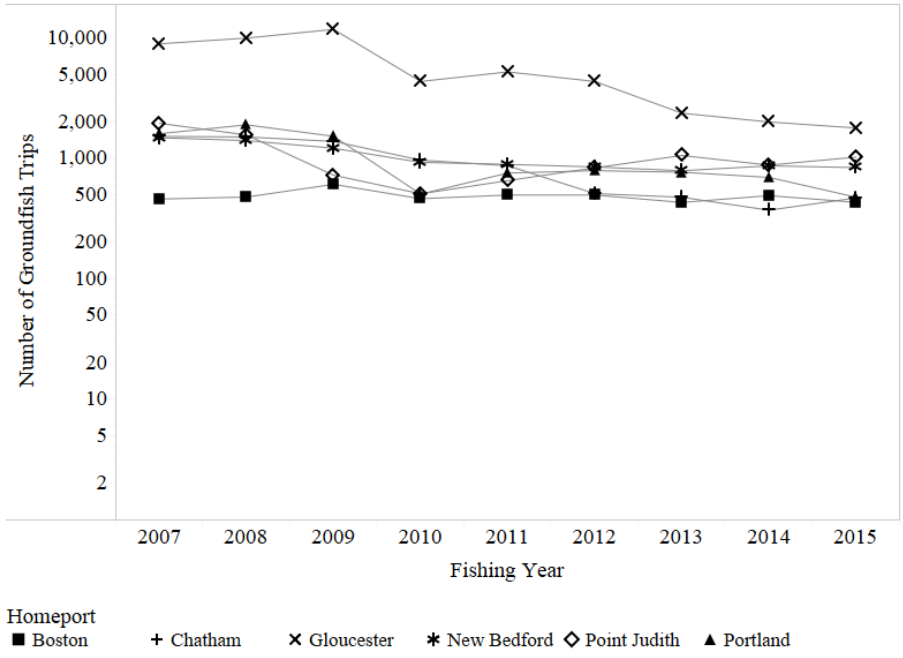


Figure 16. The number of groundfish trips completed between FY 2007 and FY 2015 by major home port city.[87]

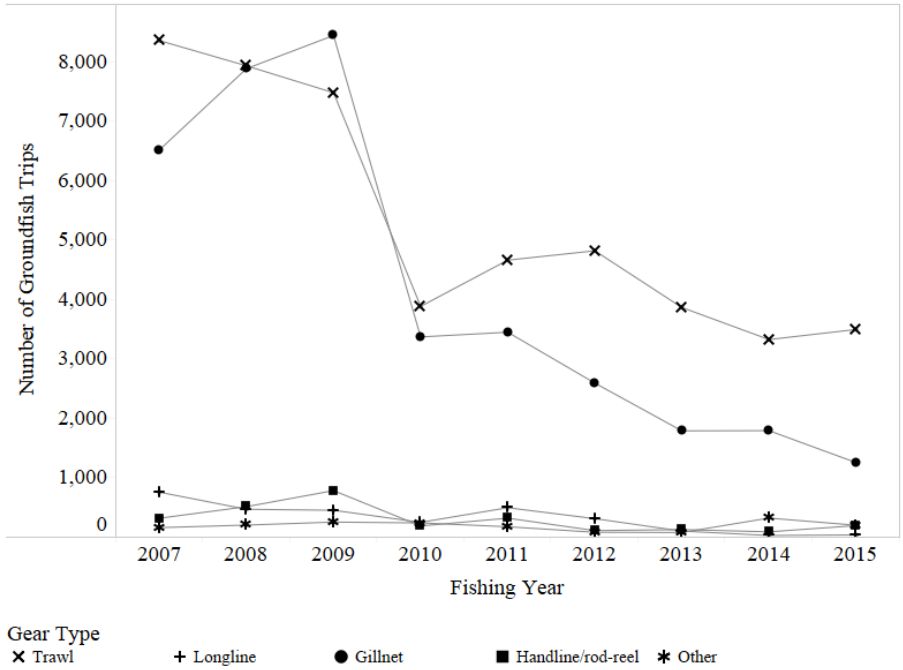


Figure 17. The number of groundfish trips completed between FY 2007 and FY 2015 by gear type.[88]

[87] Ibid
[88] Ibid.

In this analysis, declines across vessel activity and effort (as measured in number of trips)are considered across the full nine-year period, from the start of the baseline in FY 2007 through the most recent year of the evaluation period in FY 2015. Historically, the groundfish fishery has experienced consolidation for decades (Figure 4). In most cases, declines continued to be experienced following implementation of the sector program (see Table 10 and Table 11) with little stabilization during the six years under the sector program. Declines experienced prior to the sector program can be attributed in part to increased fishing restrictions and poor stock recruitment due to overfishing and other factors along with changing behaviors in response to oncoming management changes.[89]

According to Werner et al. (2019)[90], active groundfish vessels' length, tonnage, and horsepower follow an overall increasing trend from 2010 to 2015. When comparing pre and post-catch share averages, vessel length (ft) increased by 4%, gross tonnage by 10%, and horsepower by 5% (Figure 18). Moreover, the average vessel age followed a decreasing trend from 2010-2015, decreasing by 6% when comparing averages from pre and post-catch share enactment, exhibiting that older smaller vessels may have become inactive or exited the fishery during this time period. The changes in fleet characteristics may be driven by less efficient vessels exiting the fishery during 2010-2015.

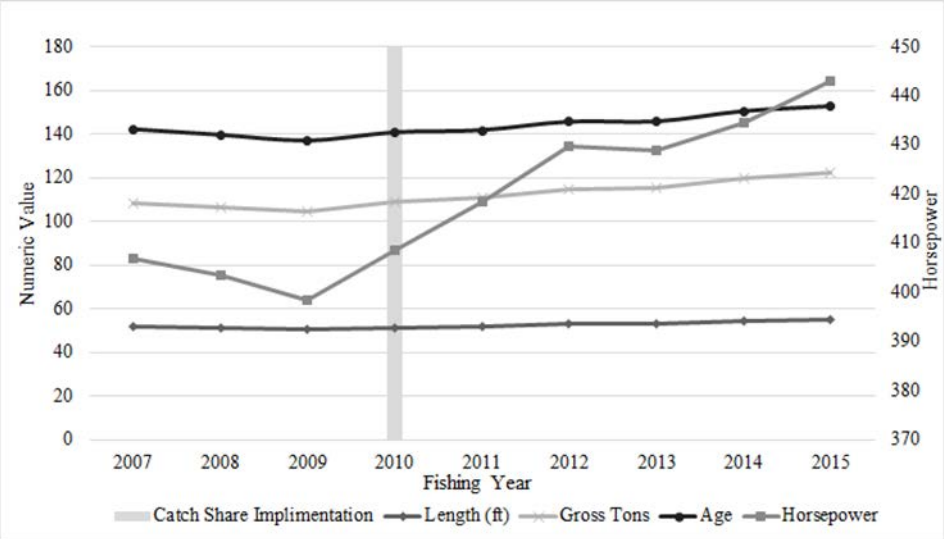


Figure 18. Average groundfish vessel characteristics by fishing year.[91]

5.c.i Fleet diversity

Fleet diversity has been of increasing concern to management as the size of the active fleet (sectors and common pool) has declined from over 1000 vessels in the 1990s to below 400 in recent years (Figure 4).

[89] Singer, 2011; MECS, 2018

[90] Note the definition for active groundfish trip and vessel differ from the Murphy et al. 2018 definition. Werner (2019) defines a groundfish trips as any commercial fishing trip that lands a groundfish species (≥1lb) while operating under a limited access groundfish permit. The classification of a groundfish vessel pertains to any vessel that took at least one groundfish trip, as previously defined, during a specific groundfish fishing year (FY 2007-2015). Data sources, descriptions and discrepancies, can be found in Appendix 9.a.

[91] Werner, 2019.

Generally, fleet diversity has been considered in terms of number of vessels based on characteristics such as size, gear, and region rather than their share in landings or economic value. Thunberg and Correia (2015, analysis updated for this review) measured fleet diversity using indices commonly used in the biodiversity literature such as richness (number of "species"), diversity based on the Shannon index, and evenness (relative abundance across species). These indices were applied to the Northeast groundfish fishery for the evaluation years of FY 2007 – 2015, where the "species", in this case, is defined as a particular type of vessel based on gear, vessel-size, and port group.[92]

The Shannon index is positively related to diversity so an increase in the index means that diversity has increased. Like other diversity indices that are based on proportional abundance, the Shannon index can be expressed as its numbers equivalent, which is interpreted as the minimum number of species that would be present in a population if they were all of equal abundance. This is also referred to as "effective" diversity. Over the nine-year evaluation period, the Shannon index showed little variation. Additionally, both richness and effective diversity[93] have been fairly stable since 2007 as richness has ranged from 62 to 47 vessel types and effective diversity ranged between 30 and 34 vessel types. This means that even though the size of the active groundfish fleet continued to decline, fleet diversity did not appreciably change from 2007 to 2015. The distribution of vessel types has also become more even as the evenness index (Overlap) has increased, which means that the proportional abundance among more common and less common vessel types has decreased (Figure 19).

The Shannon index is additive, which allows for understanding the relative roles of subcomponents of specific vessel types of interest. For example, in all years, the Shannon index was dominated by vessels of 30' to less than 50' (Figure 20), trawl gear vessels (Figure 21), and vessels landing in the state of Massachusetts (Figure 22). These results may not be surprising given the context for the dominant sub-components. Trawl gear dominates the diversity index because there are a comparatively large number of trawl gear vessel types with high relative abundance for some of these vessel types. Similarly, vessels of the 30' to less than 50' size class represent the large majority of vessels active in the fishery. Massachusetts lands the largest volume of groundfish compared with other landing states (Figure 36).

There were 33 vessel types that were present in every year from 2007 to 2015 (Table 12). These vessel types represented a low of 53% of richness during 2009 to a high of 70% of richness in 2014 but was at least 60% of richness in every year since 2010. Notably, the 33 vessels types is quite similar to the measure of effective diversity that ranged between 30 and nearly 34, which is an indication that vessel types that have persisted over time may be a core groundfish fleet. This is reinforced by the fact that the 33 persistent vessel types alone accounted for at least 93% of groundfish landings, 83% of all vessels that landed at least a pound of groundfish, and 83% of the Shannon index.

[92] Updated by E. Thunberg, based on analysis in Thunberg and Correia (2015).
[93] Thunberg and Correia (2015) define as: "Effective diversity is interpreted as the number of vessel types of equal abundance that would be associated with the calculated diversity index" (p.8)

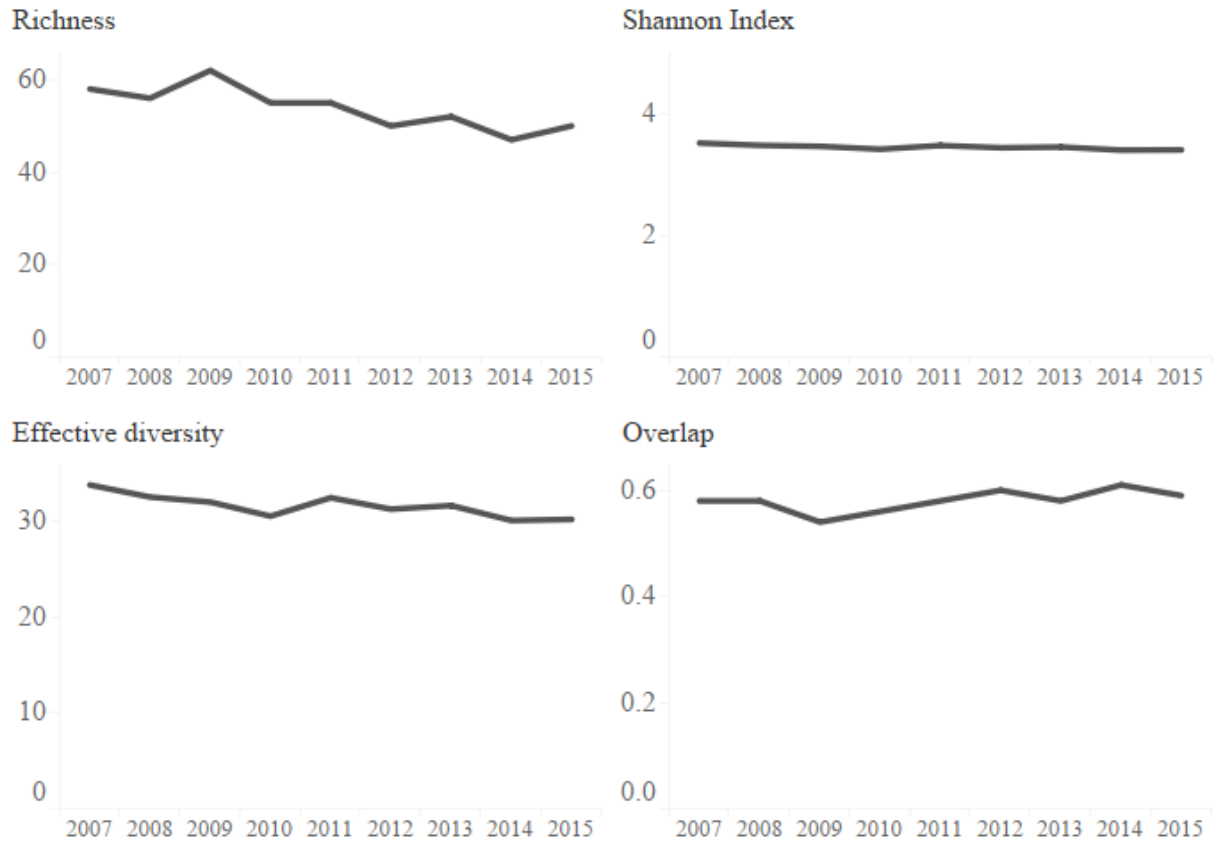


Figure 19. Fleet diversity indicators for the active limited access groundfish fleet.

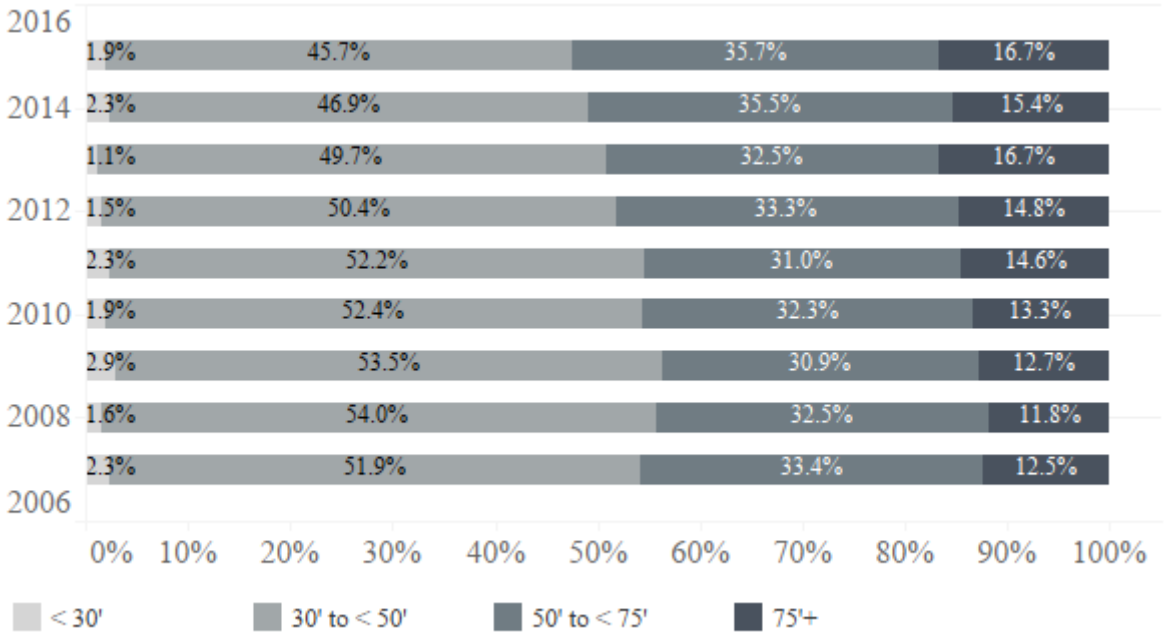


Figure 20. Shannon index percent share by vessel size category

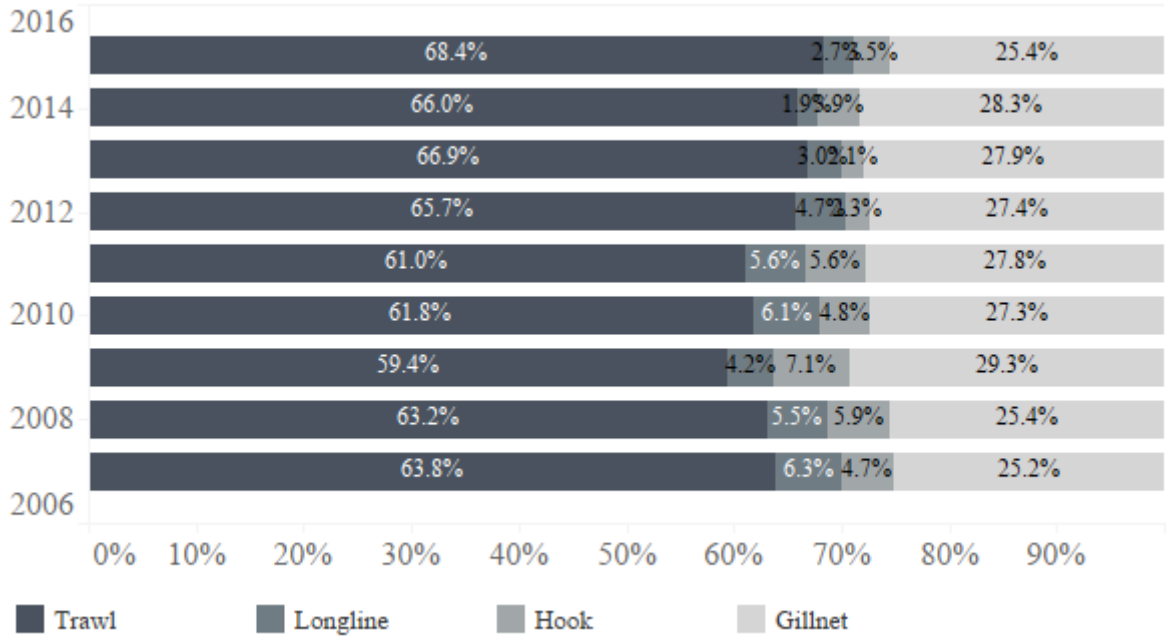


Figure 21. Shannon index percent share by gear.

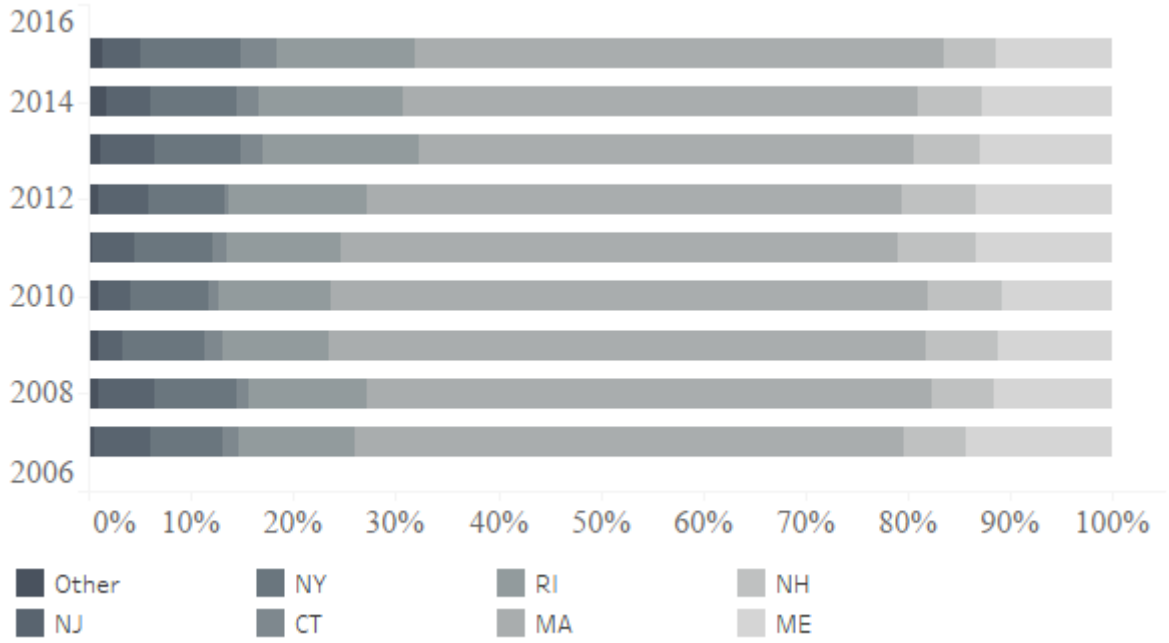


Figure 22. Shannon index percent share by primary landing state

Table 12. Vessel types that were present in all years from 2007 – 2015 based on majority of landings in a port. Each vessel is counted only once.

Region	Gear	Size class
Upper Mid-Coast Maine	Trawl	30 to < 50'
Upper Mid-Coast Maine	Gillnet	30 to < 50'
	Trawl	30 to < 50', 50 to <75'
NH Seacoast	Gillnet	30 to < 50'
	Trawl	30 to < 50'
Gloucester, North Shore	Gillnet	30 to < 50'
	Long-line	30 to < 50'
	Trawl	30 to < 50', 50 to <75', 75+
Boston Area	Gillnet	30 to < 50', 50 to <75'
	Trawl	30 to < 50', 50 to <75', 75+
Cape and Islands	Gillnet	30 to < 50'
	Hook	30 to < 50'
	Trawl	30 to < 50', 50 to <75'
New Bedford, South Shore	Gillnet	30 to < 50'
	Trawl	50 to < 75, 75+
Rhode Island	Gillnet	30 to < 50'
	Trawl	30 to < 50', 50 to <75', 75+
Connecticut, Seacoast	Trawl	30 to < 50'
New York, Seacoast	Gillnet	30 to < 50'
	Trawl	30 to < 50', 50 to <75'
Southern New Jersey	Trawl	30 to < 50', 50 to <75'

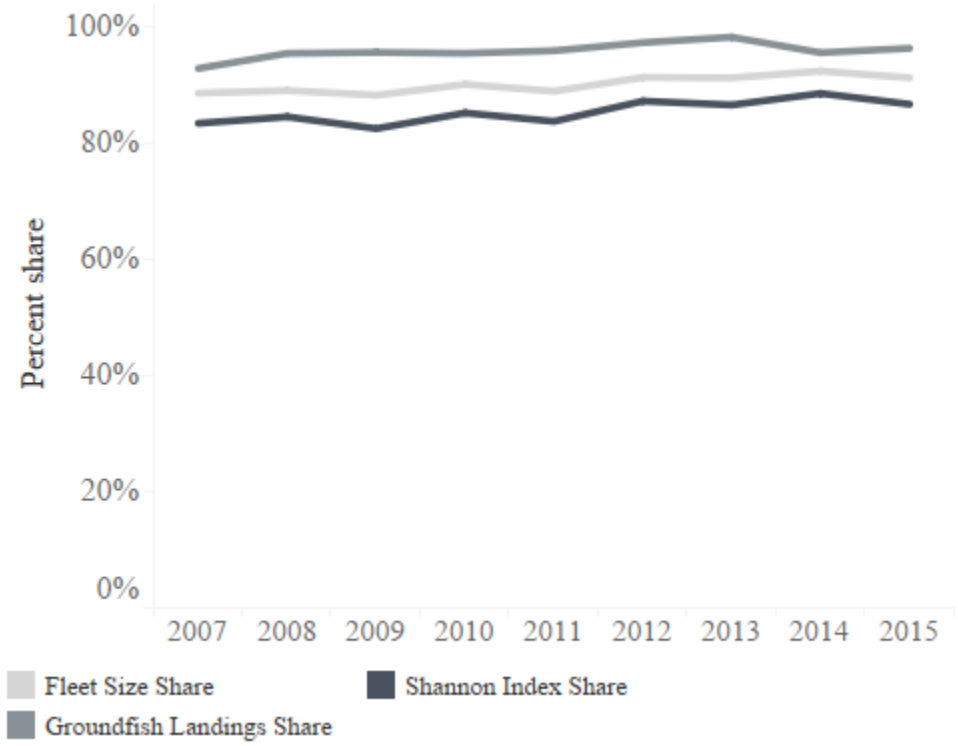


Figure 23. Percent share of fleet size, landed groundfish, and the Shannon index by vessel types present from 2007-2015.

5.c.ii Employment

It is difficult to obtain estimates, let alone actual counts, of crew and hired captain employment due to limited data availability and granularity. There are no registries or permitting requirements for commercial fishing vessel crews in the region. Crew employees are generally considered sole proprietors who assume liabilities and account for taxable income on their own. Where data do exist on crew information, these data are not actual counts and can only be used to derive rough estimates of potential crew positions and opportunities for employment and income. Chief among these data sources are Vessel Trip Reports (VTRs), which provide information on trip specific vessel crew size as indicated by a numeric, write-in field for vessel captains to record the number of crew they have on that trip. According to Murphy et al. (2018), the total number of crew positions for the limited access groundfish fleet decreased from 2,696 in 2007 to 1,913 in 2015, a 29% decline and a nine-year low point in available crew positions. This drop in available crew positions was consistent across all vessel size classes and all states in the region with the exception of Connecticut, which saw an increase over the period.

Based on these VTR data, crew employment opportunities can also be estimated by calculating metrics for crew trips and crew days. The crew trip metric provides a measure of earning opportunities for crew, while the crew days metric can help provide information about the amount of time per earning opportunity. Crew trips are calculated by summing the crew size of all trips taken in a given year by any aggregation of interest, such as vessel size category or home port state. Overall, the total number of crew

trips for the limited access groundfish fleet declined by 36% from a nine-year high of 156,432 in 2007 to a low of 100,438 in 2015. This drop in crew trips was generally experienced across all vessel size categories and home port states in the region over the period of analysis. Crew days, on the other hand, are calculated by multiplying per trip crew size by the days absent from port. Similar to crew positions and crew trips, crew days for the limited access groundfish fleet declined by 23.5% from 2007 to 2015. Crew trips declined more rapidly than crew days, however, and the ratio of crew days to crew trips indicated that over the same period crew working on limited access groundfish vessels spent more time per earning opportunity while overall earning opportunities decreased.[94]

5.c.iii Crew surveys

Socio-economic surveys of hired captains and crew were conducted throughout New England and Mid-Atlantic commercial fisheries (hereafter referred to as the Crew Survey[95]) by the Social Sciences Branch (SSB) of the NOAA Fisheries NEFSC. Information collected by the survey includes demographic information, wage calculations systems, well-being, fishing practices, job satisfaction, job opportunities, and attitudes towards fisheries management, among other subjects. To date, there have been two waves of Crew Survey data collection, Wave 1 in 2012-13 and Wave 2 in 2018-19 (Table 13). The following results summarize findings from both Waves to explore possible shifts in crew characteristics in the period since the inception of the sector program and draw some comparisons and differences; however, results from only Wave 1 data collection are directly relevant to the evaluation period.

Table 13. Response rate (total number of responses) for each survey and wave.

	Groundfish Crew	Other Crew	Total Crew
Crew Survey Demographics			
Wave 1 (2012-2013)	72	287	359
Wave 2 (2018-2019)	33	446	479
Crew Survey Job Characteristics			
Wave 1 (2012-2013)	72	287	359
Wave 2 (2018-2019)	33	446	479
Crew Survey Job Satisfaction			
Wave 1 (2012-2013)	72	287	359
Wave 2 (2018-2019)	33	446	479
Crew Survey Attitudes Toward Fisheries Management			
Wave 1 (2012-2013)	37	163	200
Wave 2 (2018-2019)	33	446	479

Attribution of causality to changes in crew characteristics is challenging, but these data do provide information that can illuminate how the catch share program may have had social or economic impacts on

[94] Murphy et al. 2018

[95] The Crew Survey is an ongoing effort intended to gather general information about the characteristics and experiences of commercial fishing crew members (including hired captains) because little is known about this critical segment of the commercial fishing industry.

crew and hired captains who primarily target groundfish. Survey results cover descriptive statistics for the entire sample and for respondents who identified groundfish as their primary fishery in terms of income, versus all other crew in the sample. Independent two-group *t*-tests and chi-squared tests are the primary bivariate and multivariate statistical hypothesis tests employed in these analyses. Sample sizes represented are 359 completed survey responses in 2012 and 478 completed survey responses in 2018. The full methodology is provided in Appendix 8.b.

The total number of crew respondents primarily targeting groundfish dropped 13% between 2012 and 2018. In 2012, about 20% of respondents reported that they primarily targeted groundfish, compared with 7% in 2018. This decline roughly corresponds to the catch share period under review and may be in part due to the transition to sector management but is likely the result of a multitude of confounding factors, including changes in management, market, and ecosystem conditions. Further, in the context of vessel consolidation (Section Fleet activity5.c), reductions in landings and revenues (Section 5.f), and decreased numbers of crew, both before and during the catch share program, these findings are not surprising. While these data do not track whether specific crew members shifted from primarily targeting groundfish to another fishery or left the commercial fishing industry altogether, the other two most common primary fisheries targeted have been scallop (28% in 2012 and 32% in 2018) and lobster (20% in 2012 and 18% in 2018).

5.c.iii.1 Crew Demographics

Demographics of crew captures age, race, income, education, marital status and health insurance status; as represented in Table 39 and Table 40 in Section 8.b, Appendices. The mean age for all crew increased from to about 38 in 2012 to about 40 years of age in 2018., with groundfish crew slightly older at a mean age of 40 in 2012 and 43 in 2018 (not statistically significant differences). The increasingly higher mean age among groundfish versus other crew may indicate that groundfish crew are undergoing a "graying of the fleet"[96] phenomenon at a rate higher than crew targeting other fisheries. However, generally, there wasn't much difference in the ages represented between the survey waves (Figure 24).

[96] The "graying of the fleet" concept refers to an increase in the average age of commercial fishermen, which may be due to a multitude of factors related to changing social, economic, and cultural conditions (see Cramer et al. 2018).

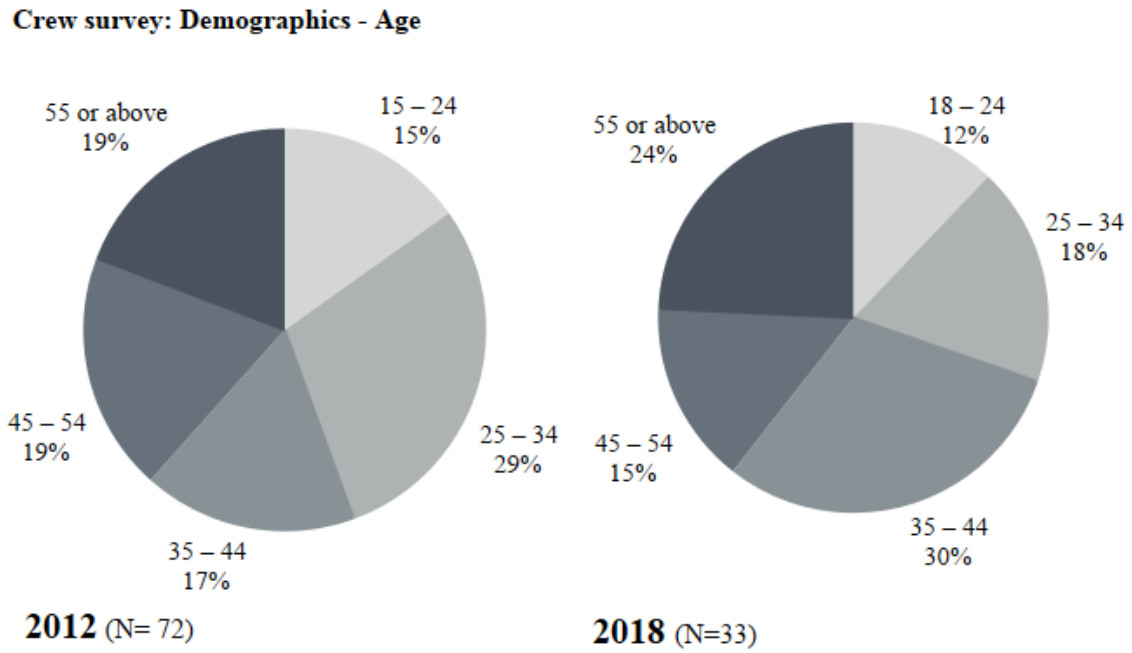


Figure 24. Groundfish crew age represented across respondents.

Self-reported annual fishing incomes (earnings received across all fisheries in which crew are active) among crew increased from 2012 to 2018 across all fisheries, but differences by fishery were not statistically significant. There are some notable percentage differences among self-reported incomes between groundfish and all other crew; in 2012, about 17% of groundfish crew reported that they earned less than $30,000 versus 24% of all other crew; about 42% of groundfish crew reported incomes between $30,000 and $59,999 versus 32% of crew in other fisheries; about 19% of groundfish crew reported between $60,000 and $89,999 versus 16% of other crew; and finally about 22% of groundfish crew reported over $90,000 in annual fishing incomes versus about 28% of crew in all other fisheries. This illustrates that while incomes increased over time across all fisheries, groundfish crew earnings did not increase as substantially as crew in other fisheries; however, there was high response from crew in the scallop fishery.

The mean self-reported income[97] across all fisheries in 2012 was between $30,000 and $59,999, compared with $80,000 to $89,999 in 2018. About three-quarters (75%) of crew reported incomes over $60,000 in 2018, compared with 41% in 2012. This is an interesting finding and may suggest that the earning potential has shifted some, however the 2018 results fall outside of the evaluation period.

A higher percentage of crew in other fisheries (compared with groundfish) reported incomes above $90,000; in 2012 this represented 28% in other fisheries and 22% in groundfish, and 43% in other fisheries and 36% in groundfish in 2018. While groundfish crew incomes have not differed significantly from crew in other fisheries, there is evidence for greater potential earnings among crew in non-

[97] This is a self-report survey item. Crew respondents were asked to identify which income category reflected their income from fishing in the past year, ranging from 0 to 120,000 or more in $10k increments.

groundfish fisheries; much of the observed difference may be representative of the high response rate from crew in the scallop fishery, which is currently one of the most lucrative fisheries in the Northeast.

The survey results did not find significant differences across educational attainment or health insurance coverage of crew in groundfish and non-groundfish fisheries in 2012 or 2018, actual results provided in Table 39 and Table 40. Though the source of health coverage did appear to differ, with the largest proportion of groundfish crew received insurance from a spouse's or partner's plan in 2012, and in 2018 the majority had purchased private insurance. Given the health risks associated with commercial fishing[98] and the high average costs of private insurance[99], groundfish crew likely spend a considerable amount of their relatively moderate earnings on health insurance coverage. As the cost of insurance can be inhibiting, this might explain why a large proportion of crew overall, and specifically groundfish crew, reported that they do not have health insurance coverage at all (in both survey waves). Finally, there appeared no statistical differences between crew marital statuses in 2012 to 2018.

5.c.iii.2 Employment Characteristics

The survey queried respondents on various characteristics of employment (primary port, time employed in commercial fishing, number of days per trip and hours worked per day, average size of crew, owner-operator status, position on the vessel, path to employment, payment systems, and fishing expenses deducted from crew payment); statistics for these data are provided in Table 41 and Table 42.

Fifty-four different ports were represented as primary ports where crew reported working in 2012, compared with sixty-six in 2018. In 2012, groundfish crew were concentrated mostly in Gloucester (36%) and New Bedford (11%), but other ports with substantial groundfish crew included Portland, ME (8%), Boston, MA (8%), Portsmouth, NH (7%), and Montauk, NY (6%) (Table 10, Figure 12); in 2018, the majority of groundfish crew worked mostly out of three primary ports – Gloucester, MA (33%), Boston, MA (27%), and Portland, ME (24%).

Groundfish crew appear to have been involved in commercial fishing longer but employed on their current vessels for less time than crew in other fisheries, these differences in length of employment by fishery were not statistically significant. Based on respondent results, crew took fewer single-day trips in 2018 (28%) than in 2012 (42%). Groundfish crew reported working about 15 hours per day on average in 2012, compared with about 17 hours per day in 2018. Findings illustrated that groundfish trips lasted less time than crew in other fisheries, groundfish crew reported working significantly more hours per day than crew in other fisheries (Figure 25).

[98] The National institute for Occupational Safety and Health (NIOSH) estimated that from 2000 to 2015 the fatality rate among commercial fishermen was 29 times higher than the national average (https://www.cdc.gov/niosh/topics/fishing/default.html).

[99] According to the Kaiser Family Foundation, annual health insurance premiums averaged $6,896 for single individual coverage and $19,616 for family coverage in 2018 (https://www.kff.org/report-section/2018-employer-health-benefits-survey-section-1-cost-of-health-insurance/).

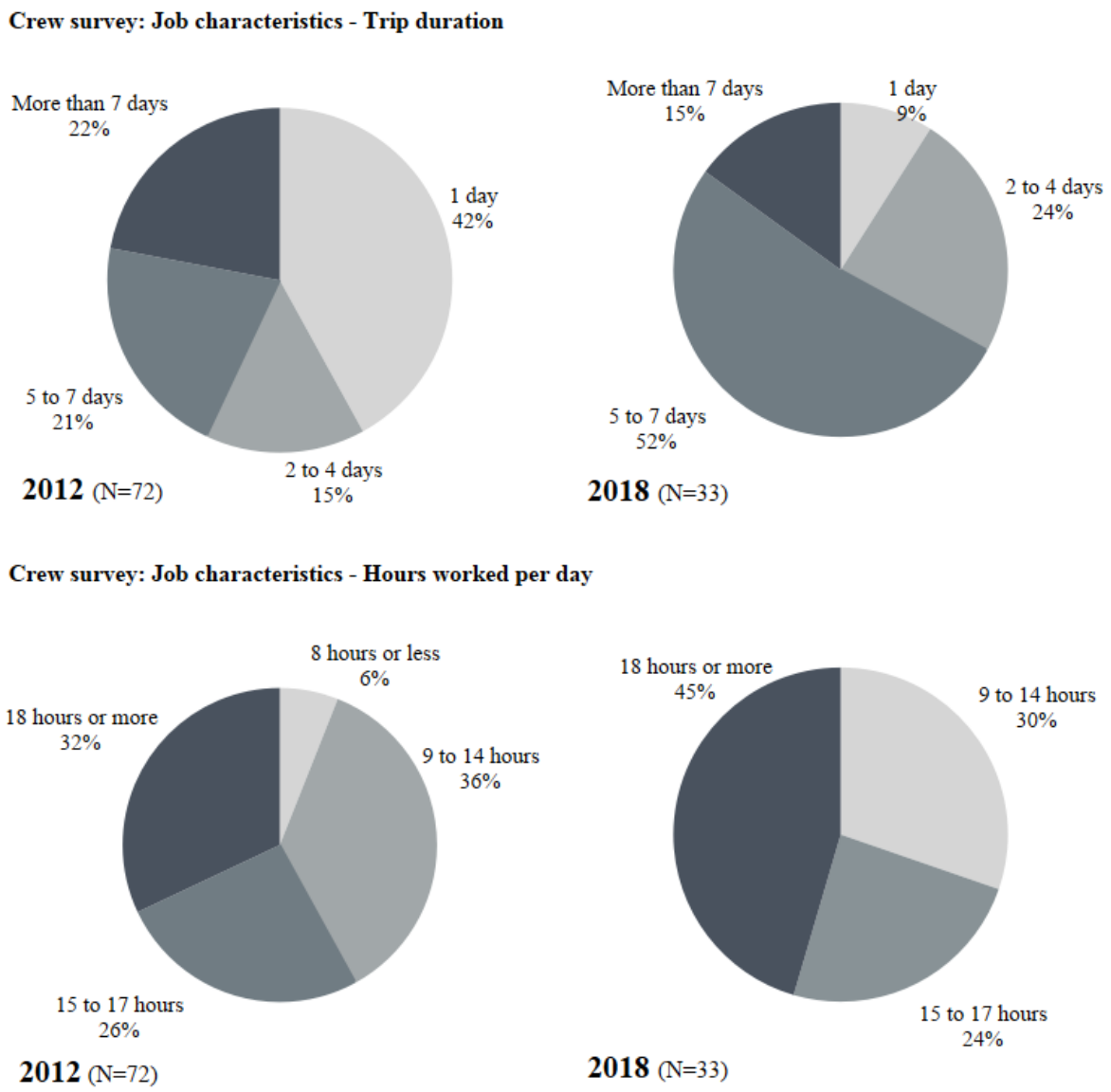


Figure 25. Average trip duration and hours worked per day by groundfish crew in 2012 and 2018.

Longer working hours may correspond to smaller crew sizes and groundfish crew in 2012 and 2018 reported working on vessels with fewer crew than crews in other fisheries. Just over half of crew respondents in 2012 (58%) worked on owner-operated vessels compared with 43% in 2018, whereas 42% (in 2012) and 57% in 2018 worked on vessels operated by a hired captain; these differences do not represent statistical differences.

The vast majority of groundfish crew respondents in both 2012 (93%) and 2018 (about 94%) reported that they were paid through a share system. Among groundfish crew paid through a share system, respondents on average reported (in 2012) that about 60% of the share goes to the vessel owner and 40% is divided among the crew. Crew in other fisheries reported slightly higher shares, with receiving, on average, 43% of the share. Dependent on the vessel and payment arrangement, fishing trip expenses may be deducted

from crew shares. The primary expenses deducted from crew shares, in order of highest cost, included fuel/oil, food, fishing supplies, ice, bait, and fishing quota, along with 'other' costs.

5.c.iii.3 Job Satisfaction

Survey results describe various levels of satisfaction with various aspects of their work (earnings, the predictability of earnings, job safety, time away from home, the physical fatigue of the job, the healthfulness (i.e., the overall impact on physical and mental health) of the job, the adventure of the job, the challenge of the job, and the opportunity to be their own boss), as assessed on a five-point, Likert-style scale that runs from "very dissatisfied" to "very satisfied." Descriptive statistics are provided in Table 43 and Table 44.

Satisfaction with earnings increased considerably among groundfish crew in 2018 from 2012, but there remained some substantial gaps in satisfaction levels between groundfish and other crew in the 2018 survey wave. In 2012, less than half (46%) of groundfish crew were either satisfied or very satisfied with their actual earnings, compared with three quarters (75%) of groundfish crew in 2018; in both years, these levels of satisfaction were higher among non-groundfish crew than groundfish crew. Groundfish crew were also less likely to be satisfied with the predictability of their earnings than crew in other fisheries. Only 13% of groundfish crew reported being either satisfied or very satisfied with the predictability of their earnings, compared with about 40% of crew in other fisheries (a statistic difference, $t = 4.6251$, $p<.001$); in 2018 this increased to 42% of groundfish crew were either satisfied or very satisfied with the predictability of their earnings, compared with and just over half (52%) of crew in other fisheries (Figure 26).

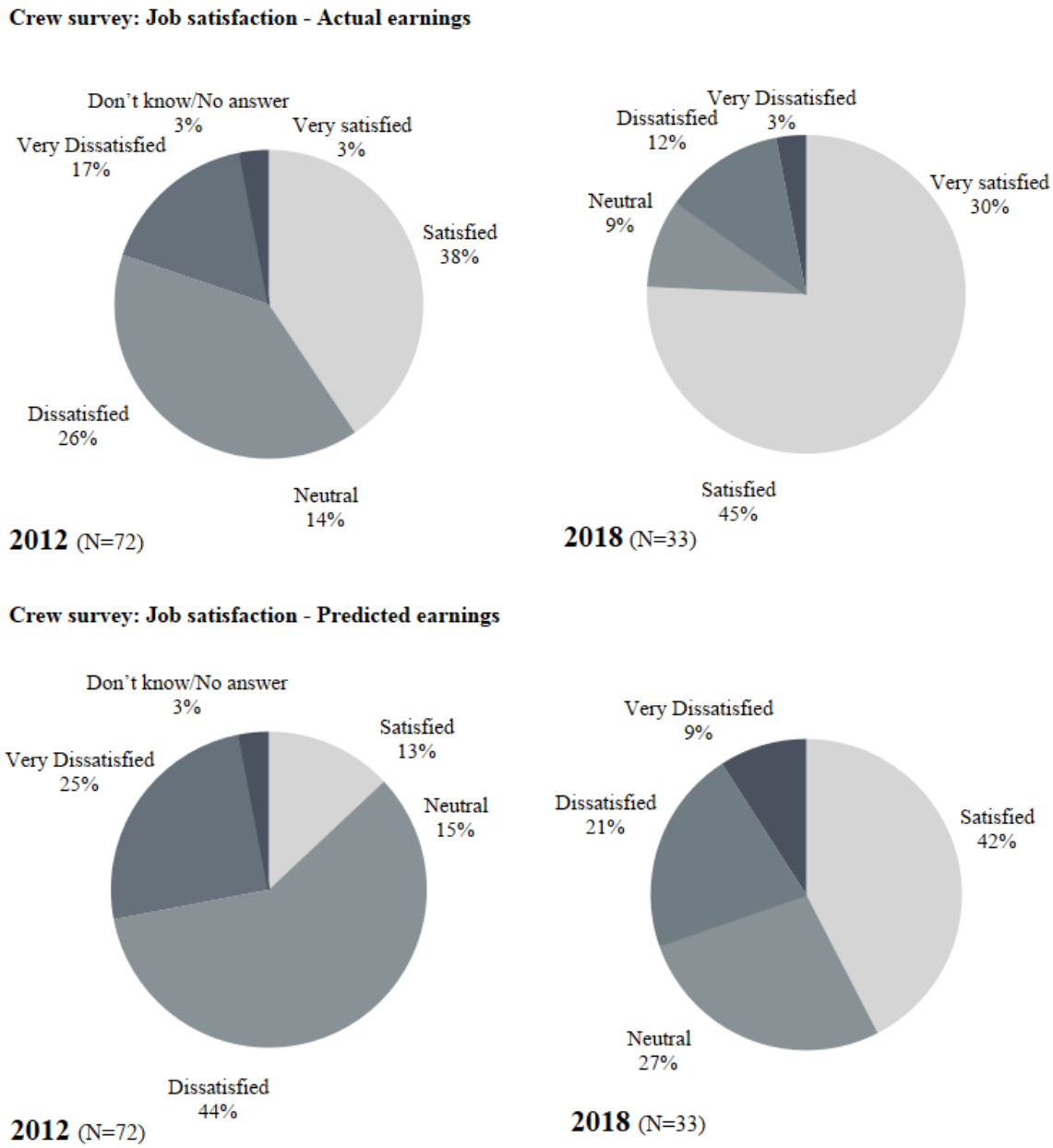


Figure 26. Actual earning and the predictability of earnings among groundfish crew in 2012 and 2018.

Feelings of safety on the job seemed to have increased among groundfish crew. About 44% of groundfish crew in 2012 were either satisfied or very satisfied with the safety of their jobs, compared with about 73% in 2018. Interestingly, there was a similar pattern of increased satisfaction in non-groundfish crew, from about 60% in 2012 to 70% in 2018. Groundfish crew in 2012 and 2018 were less satisfied with the amount time they spent away from home, compared with other fisheries; this difference was significant in 2018 (t = 3.2365, p<.001). Therefore, while satisfaction with job safety has increased among groundfish crew, satisfaction with time spent away from home has significantly declined over time relative to crew in other fisheries.

Crew in groundfish and other fisheries shared generally similar levels of satisfaction with the fatigue and impact on their overall health associated with the job in 2012 and expressed somewhat less satisfaction in 2018. About 43% of groundfish crew reported feeling satisfied or very satisfied with the physical fatigue of the job and the healthfulness of the job in 2012, compared with 30% satisfied or very satisfied with the physical fatigue of the job and 45% of groundfish crew were either satisfied or very satisfied with the healthfulness of the job in 2018. These findings comparing groundfish and non-groundfish crew suggests that groundfish crew are not experiencing similar improvements to the healthfulness of the job attained by crew in other fisheries. In both 2012 and 2018, most crew across both groundfish and other fisheries were satisfied with the adventure and challenge of the job, and the opportunity to be their own boss; these observations are detailed in Table 43 and Table 44.

5.c.iii.4 Attitudes toward fisheries management

The survey queried crew respondents' level of participation in fisheries management[100] and their attitudes towards various aspects of fisheries management policies; descriptive statistics for these data are provided in Table 45 and Table 46.

Over the two survey waves, there was a slight decrease in participation (i.e., attending meetings, writing letters, or any other participatory activities) in fisheries management by groundfish crew, with the majority not participating (Figure 27). Even though most crew do not participate in the fisheries management process, groundfish crew tend to have less favorable views about fisheries management policies and their impacts than crew in other fisheries. Groundfish crew in 2012 were significantly more likely than crew in other fisheries to agree that the rules and regulations change too quickly ($t = 3.5220$, $p<.001$). Attitudes towards management policies and their impacts had not improved from 2012 to 2018 among groundfish crew compared to crew in other fisheries. The vast majority of groundfish crew, about 91% in 2012, either agreed or strongly agreed that the rules and regulations change so quickly it's hard to keep up, compared with about 58% of non-groundfish crew. Groundfish crew in 2018 remained significantly more likely than crew in other fisheries to agree that the rules change too quickly (75% and 51%, respectively; $t = 1.9242$, $p<.05$) and less likely to agree that the fines associated with breaking rules were fair (27% and 48%, respectively; $t = 3.2489$, $p<.001$). In 2012, 77% of groundfish crew surveyed either agreed or strongly agreed that the rules and regulations were too restrictive, compared with 63% in 2018 (Figure 27). In both instances, these values are higher in groundfish crew than non-groundfish crew.

[100] In the 2012 implementation of the Crew Survey, there were many more survey questions dedicated to topic of fisheries management (than carried over into 2018), but they were divided across two separate versions of the survey instrument and not all respondents received the same set of questions. Therefore, a smaller sub-sample of respondents from the 2012 data are utilized for reporting and analyses. Additionally, in the 2018 implementation, many of the questions related to fisheries management from 2012 were not asked again due to the need to reduce the length of the survey along with the recognition that non-captain crew (i.e., the bulk of the sample) tended not to be as involved in fisheries management as owner-operators, non-operator owners, or even hired captains. Therefore, fisheries management issues were not as relevant data to collect compared with other metrics maintained on the survey.

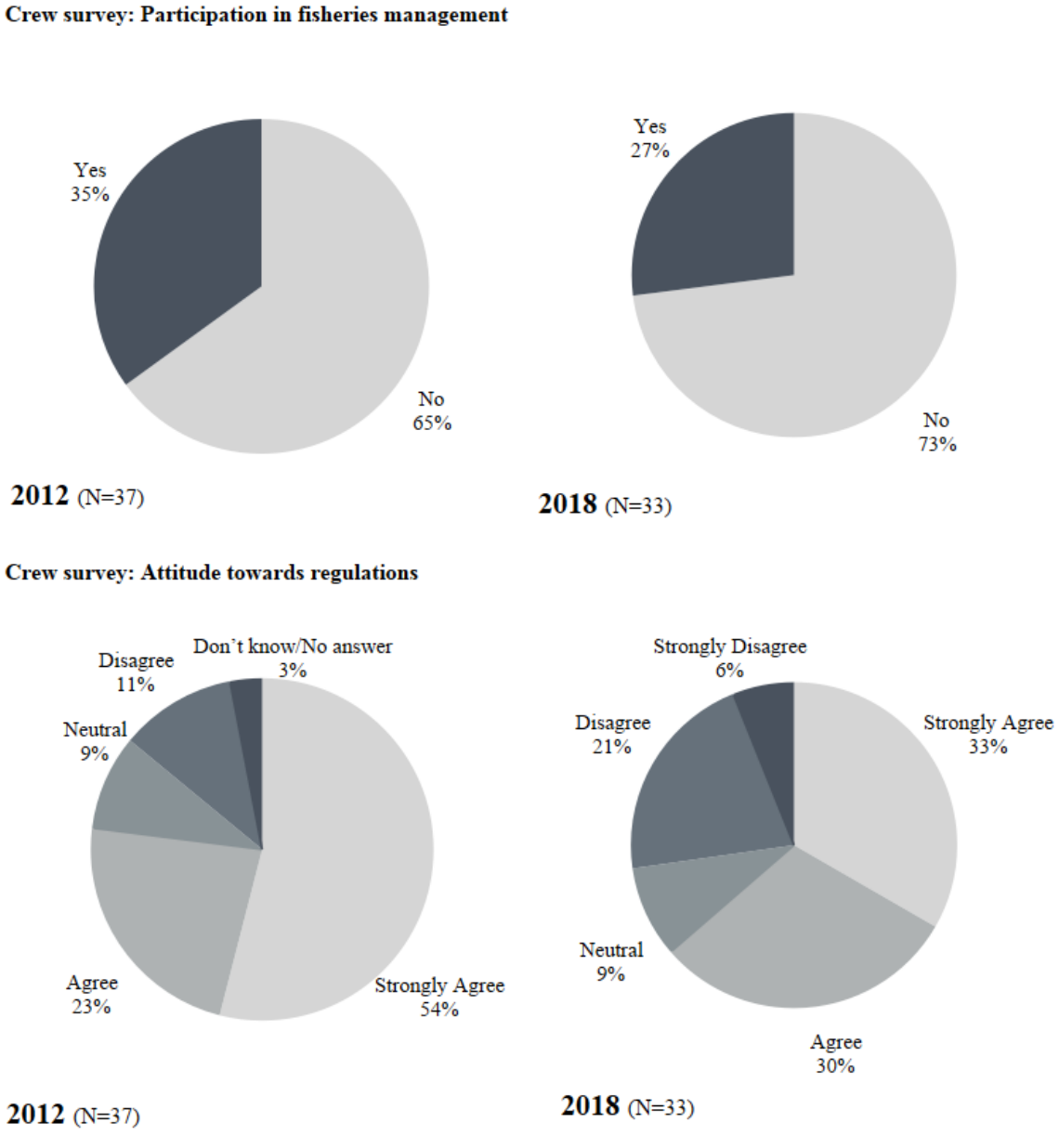


Figure 27. Attitudes towards fisheries management, as measured by participation and impressions on whether the rules and regulations were too restrictive, for groundfish crew in 2012 and 2018.

5.c.iv Vessel Ownership

Ownership of northeast multispecies permits was summarized by applying the Small Business Administration's principles of affiliation to ascertain ownership of limited access groundfish permits as well permits for other fisheries that may be held in common among multiple businesses or people. Although business names and associated names of people have always been required on annual permit renewal forms, until 2010 this information not been databased so it is not possible to reliably track changes in ownership prior to 2010. Since 2010, the NEFSC Social Sciences Branch (SSB) has

summarized ownership data from the universe of all valid permits as of July 1 to be used in support of required regulatory analysis for any given management action. This procedure was adopted to make sure all permit renewals had been completed. This would not capture changes in permit ownership that may have taken place prior to July 1 but does provide a basis for comparing ownership trends at a common point in time from one year to the next. In this analysis vessel affiliations are groups of vessels connected by common ownership where the size of an affiliation refers to the number of permits that are held in common and not to the number of owners. Some caveats that need to be kept in mind include that, (1) the number of permits held by an affiliated group of owners is determined annually; it is not possible to track specific affiliated entities over time, (2) the analysis only includes valid permits as of July 1, which excludes CPH permits that have no annual renewal requirement, (3) since the primary use of the database is to support regulatory analysis for all fisheries, the SSB data does not distinguish between limited access northeast multispecies permits that are in sectors and those that are in the common pool, and (4) although the SSB ownership data includes gross revenues, they are based on a calendar year to accommodate fisheries with different fishing years.

5.c.iv.1 Northeast multispecies permit ownership

The number of valid limited access northeast multispecies permits by affiliate size for 2010 to 2015 is shown in Table 14. For each year, size categories for affiliated business comprise the row headings. For example, an affiliate size of 1 means that only 1 permit was owned whereas an affiliate size of 5 means that 5 permits were owned. The column headings are categories for the number of northeast multispecies permits associated with each affiliate size such that a column heading of 3 means that 3 limited access permits were owned. The table cells indicate the total number of northeast multispecies permits by affiliate size and northeast multispecies permit categories. For example, in 2010 there were 596 limited access northeast multispecies permits associated with businesses where the northeast multispecies permit was the only permit that was owned. Note that all cells that have the same row and column headings mean that all permits owned were northeast multispecies permits; during 2010 there were 140 permits in which both permits owned were northeast multispecies permits; 63 northeast multispecies permits associated with an affiliate size of 3 and all 3 were northeast multispecies permits; and so on.

The total number of valid (i.e. permits not in CPH) in each year is the sum across rows and columns. As of July 1, 2010, there were a total of 1,201 limited access northeast multispecies permits. The number of valid groundfish limited access permits declined to 820 permits as of July 1, 2015. While there has been some attrition in limited access permits, the majority of the difference in valid limited access northeast multispecies permits between 2010 and 2015 is accounted for permits that have been transferred into CPH that are not associated with a vessel.

Table 14. Total number of valid northeast multispecies permits by size of affiliated businesses, 2010 to 2015 (excluding permits in CPH).

Affiliate Size	2010 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	596	0	0	0	0	0	
2	86	140	0	0	0	0	
3	19	26	63	0	0	0	

Affiliate Size	2010 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
4	6	8	15	28	0	0	
5	3	6	3	28	10	0	
6	2	2	3	0	0	18	
7	0	0	0	0	0	0	14
8	0	0	0	0	0	0	14
9	1	2	3	0	0	0	0
10	1	0	0	0	0	0	0
11+	2	0	6	0	9	11	76

Affiliate Size	2011 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	518	0	0	0	0	0	
2	66	108	0	0	0	0	
3	17	28	69	0	0	0	
4	6	10	12	24	0	0	
5	2	4	0	4	15	0	
6	1	0	3	0	10	6	
7	0	0	0	4	0	0	14
8	1	2	0	0	0	0	
9	1	0	0	0	0	0	8
10	1	0	3	0	0	6	
11+	2	2	9	0	0	0	61

Affiliate Size	2012 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	565	0	0	0	0	0	
2	75	116	0	0	0	0	
3	13	16	51	0	0	0	
4	4	4	9	20	0	0	
5	4	6	6	0	10	0	
6	0	2	0	4	5	6	
7	1	0	3	0	0	0	
8	0	0	0	0	0	0	
9	1	0	0	0	0	0	8
10	1	0	0	0	0	0	
11+	3	2	3	8	0	6	55

Affiliate Size	2013 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	527	0	0	0	0	0	
2	67	108	0	0	0	0	
3	22	18	45	0	0	0	
4	3	2	12	0	0	0	
5	2	6	6	0	10	0	

6	1	0	0	0	5	6	
7	1	0	3	0	0	0	
8	1	0	0	0	0	0	
9	1	0	0	0	0	0	
10	0	0	0	0	0	0	8
11+	3	2	3	0	0	6	55

Affiliate Size	2014 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	464	0	0	0	0	0	
2	69	92	0	0	0	0	
3	15	28	42	0	0	0	
4	8	6	3	12	0	0	
5	2	2	6	4	0	0	
6	2	2	0	4	0	0	
7	0	0	3	0	0	0	
8	1	0	0	0	0	6	
9	1	0	0	0	0	0	
10	1	0	0	0	0	0	
11+	2	2	6	4	0	6	42

Affiliate Size	2015 Number of Northeast Multispecies Permits						
	1	2	3	4	5	6	7+
1	451	0	0	0	0	0	
2	79	96	0	0	0	0	
3	11	24	30	0	0	0	
4	7	2	6	16	0	0	
5	3	4	3	0	0	0	
6	2	0	3	0	5	6	
7	0	0	3	0	0	0	
8	2	2	0	0	0	0	
9	0	0	0	0	0	0	
10	0	0	0	0	0	0	
11+	1	2	3	4	5	6	44

Changes in the distribution of groundfish limited access permits by affiliate size is summarized in Figure 28, illustrating the cumulative percent of northeast multispecies permits by year and size of affiliated businesses. Across all years, over 90% of limited access northeast multispecies permits were owned by affiliated businesses that held a total of 7 or fewer permits to any Northeast region fishery (note, these are the row headings, which is the total number of permits of any kind that are owned). The data indicate a difference in ownership accumulation between the years 2010-2011 and 2012-2015 where the proportion of limited access northeast multispecies permits owned by smaller affiliated businesses increased rather than the other way around. That is, the proportion of northeast multispecies permits owned by a single owner or owner group increased from 50% in 2011 to an average of nearly 56% during 2012 to 2015.

Similarly, the proportion of permits owned by affiliate sizes of 3 or less increased from about 78% to nearly 85%, so ownership is becoming more concentrated to individual owners

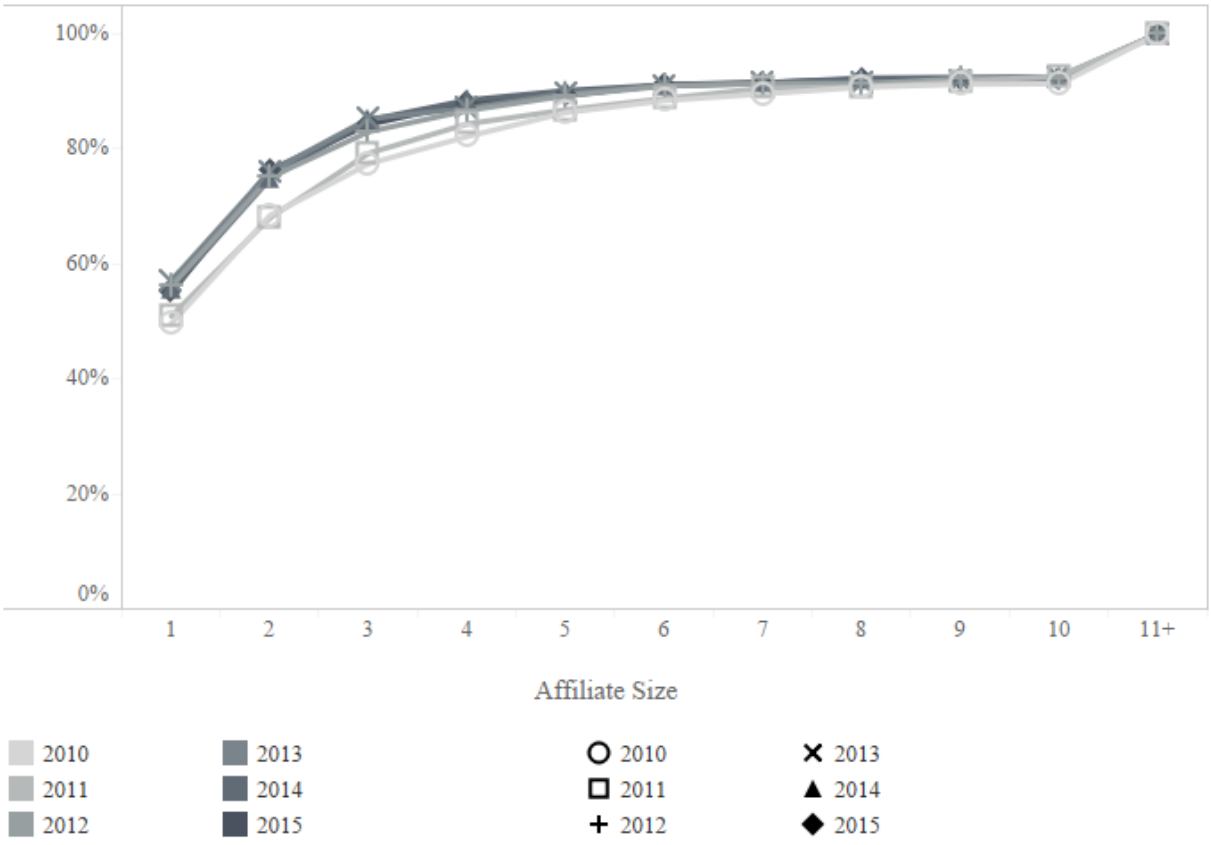


Figure 28 Cumulative percent of the number limited access northeast multispecies permits by affiliate size and year.

5.c.iv.2 Ownership of active limited access northeast multispecies permits

For purposes of analysis, an active limited access northeast multispecies permit was defined as having sales of any species. In 2010, 669 of a total of 868 active northeast multispecies permits were associated with ownership groups ranging in size from 1 to 11 or more that had only 1 active groundfish vessel (Table 15). Both the number of affiliates with active northeast multispecies permits and the total number of active northeast multispecies permits declined over time to a total of 562 affiliated business and 648 total active groundfish limited access vessels during 2015. In terms of changes in the distribution of active permits among larger and smaller affiliated business size there was relatively small difference in the proportion of active groundfish vessels by affiliated business size in any year from 2010 to 2015 (Figure 29).

Table 15. Total number of active limited access northeast multispecies permits held by affiliated businesses by affiliate size, 2010 to 2015.

Affiliate Size	2010 Number of Active Northeast Multispecies Permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	508	0	0	0	0	0	
2	104	58	0	0	0	0	
3	27	38	6	0	0	0	
4	12	16	3	0	0	0	
5	7	10	12	0	0	0	
6	2	6	3	0	0	0	
7	1	2	0	0	0	0	
8	0	0	3	0	5	0	
9	3	0	0	0	0	0	
10	1	0	0	0	0	0	
11+	4	0	3	4	5	6	19

Affiliate Size	2011 Number of Active Northeast Multispecies Permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	444	0	0	0	0	0	
2	78	48	0	0	0	0	
3	30	30	12	0	0	0	
4	6	22	3	0	0	0	
5	5	4	3	0	0	0	
6	2	4	0	0	0	0	
7	1	2	3	0	0	0	
8	1	0	0	0	0	0	
9	0	2	0	0	0	0	
10	2	0	0	0	0	6	
11+	2	2	6	0	0	0	16

Affiliate Size	2012 Number of Active Northeast Multispecies Permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	457	0	0	0	0	0	
2	84	52	0	0	0	0	

3	21	18	12	0	0	0	
4	4	6	9	0	0	0	
5	3	12	0	0	0	0	
6	1	2	3	0	0	0	
7	1	0	3	0	0	0	
8	0	0	0	0	0	0	
9	0	0	0	4	0	0	
10	1	0	0	0	0	0	
11+	3	0	3	8	0	6	15

Affiliate Size	2013 Number of Active Northeast Multispecies Permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	433	0	0	0	0	0	
2	78	42	0	0	0	0	
3	27	14	21	0	0	0	
4	8	6	3	0	0	0	
5	4	8	6	0	0	0	
6	2	0	0	0	0	0	
7	1	2	0	0	0	0	
8	1	0	0	0	0	0	
9	0	0	0	0	0	0	
10	0	0	0	0	5	0	
11+	3	0	3	8	5	6	16

Affiliate Size	2014 Number of Active Northeast Multispecies Permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	399	0	0	0	0	0	
2	78	42	0	0	0	0	
3	21	26	15	0	0	0	
4	10	4	6	0	0	0	
5	3	6	0	0	0	0	
6	3	0	0	0	0	0	
7	0	0	3	0	0	0	
8	1	0	0	0	5	0	
9	0	0	0	0	0	0	
10	0	0	0	0	0	0	
11+	3	0	6	4	5	6	16

Affiliate Size	2015 Number of Active Northeast multispecies permits by Affiliate Size						
	1	2	3	4	5	6	7+
1	388	0	0	0	0	0	
2	86	54	0	0	0	0	
3	18	18	3	0	0	0	
4	9	4	6	0	0	0	
5	3	2	3	0	0	0	
6	2	2	3	0	5	0	

7	0	0	3	0	0	0	
8	2	0	0	0	0	0	
9	0	0	0	0	0	0	
10	0	0	0	0	0	0	
11+	1	2	3	4	5	6	16

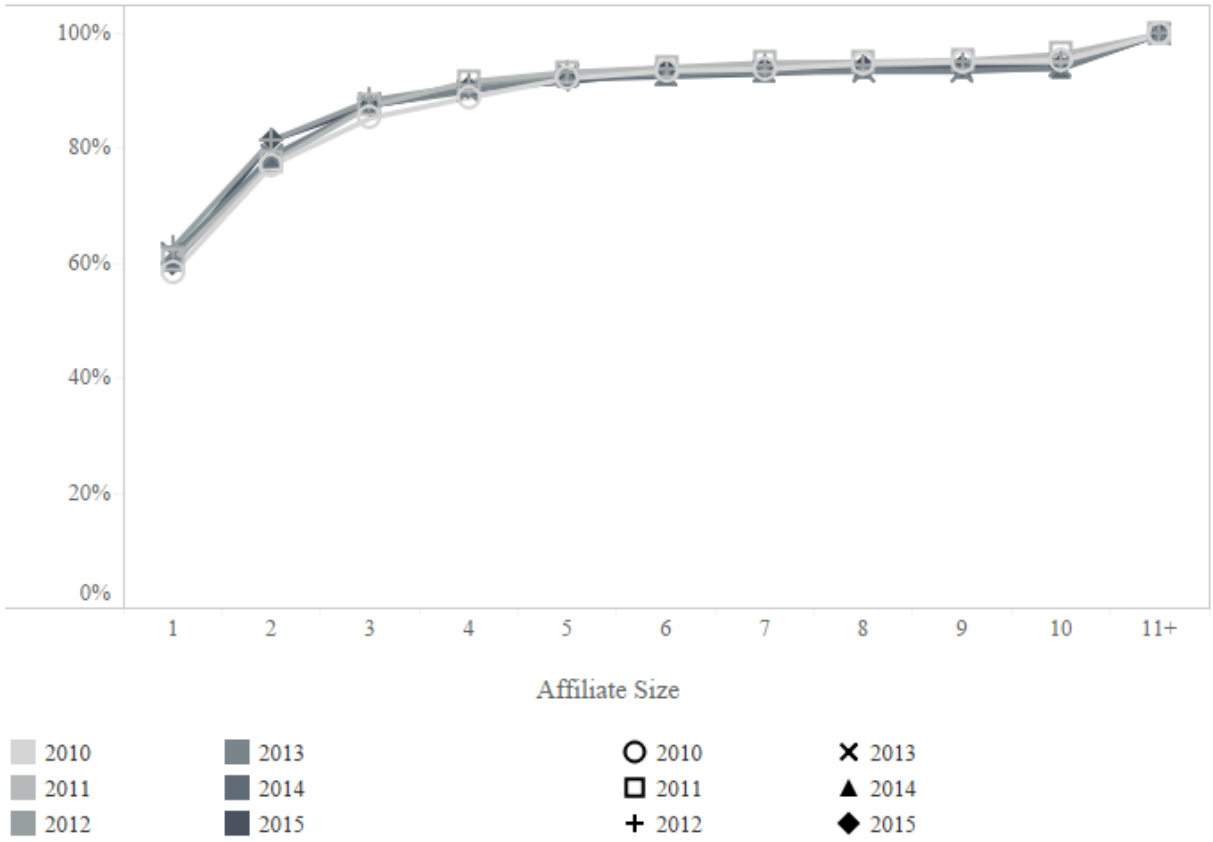


Figure 29. Cumulative percent of limited access northeast multispecies permits held by active Affiliates by affiliate size and year, 2010 to 2015.

5.c.iv.3 Ownership of Active Groundfish Vessels Landing Groundfish

During 2010 there were 238 of 472 vessels that landed groundfish that were associated with businesses that had only one limited access northeast multispecies permit (Table 16, Figure 30). Note that the difference between the number of groundfish vessels that landed any species and the number of vessels that landed groundfish yields the number of active limited access northeast multispecies permitted vessels that did not land any groundfish. This means that of the 1,202 valid limited access permits that were issued as of July 1, 2010 72% had sales of any species during calendar year 2010, and 39% had sales of groundfish. During 2015 the percent of limited access permits that active in any fishery increased to 79% (648 of 820) and the percent of active northeast multispecies permits that landed groundfish increased modestly to 41%.

Table 16. Number of active northeast multispecies permits by affiliate size, 2010 to 2015.

Affiliate Size	2010 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	238	0	0	
2	69	26	0	
3	19	20	3	
4	12	10	0	
5	7	8	6	
6	1	4	3	
7	1	2	0	
8	0	0	3	5
9	0	0	0	
10	0	0	0	
11+	3	2	0	30

Affiliate Size	2011 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	210	0	0	
2	60	16	0	
3	24	18	0	
4	7	14	0	
5	4	4	0	
6	0	4	0	
7	1	4	0	
8	0	0	0	
9	0	2	0	
10	2	0	0	
11+	3	2	0	13

Affiliate Size	2012 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	205	0	0	
2	53	24	0	
3	17	20	0	
4	4	2	3	
5	5	6	0	
6	1	2	3	
7	0	2	0	
8	0	0	0	
9	0	0	3	
10	0	0	0	
11+	1	2	3	14

Affiliate Size	2013 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	182	0	0	
2	45	18	0	
3	13	18	3	
4	5	6	0	
5	4	4	6	
6	1	0	0	
7	1	0	0	
8	1	0	0	
9	0	0	0	
10	0	0	0	
11+	2	2	3	

Affiliate Size	2014 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	142	0	0	
2	43	16	0	
3	17	16	9	
4	8	0	3	
5	1	4	0	
6	1	0	0	
7	1	0	0	
8	0	0	0	5
9	0	0	0	
10	0	0	0	
11+	3	0	0	14

Affiliate Size	2015 Number of Active Northeast multispecies permits by Affiliate Size			
	1	2	3	4+
1	136	0	0	
2	45	26	0	
3	15	10	3	
4	4	4	0	
5	2	2	0	
6	0	4	0	5
7	0	0	0	
8	2	0	0	
9	0	0	0	
10	0	0	0	
11+	0	0	0	14

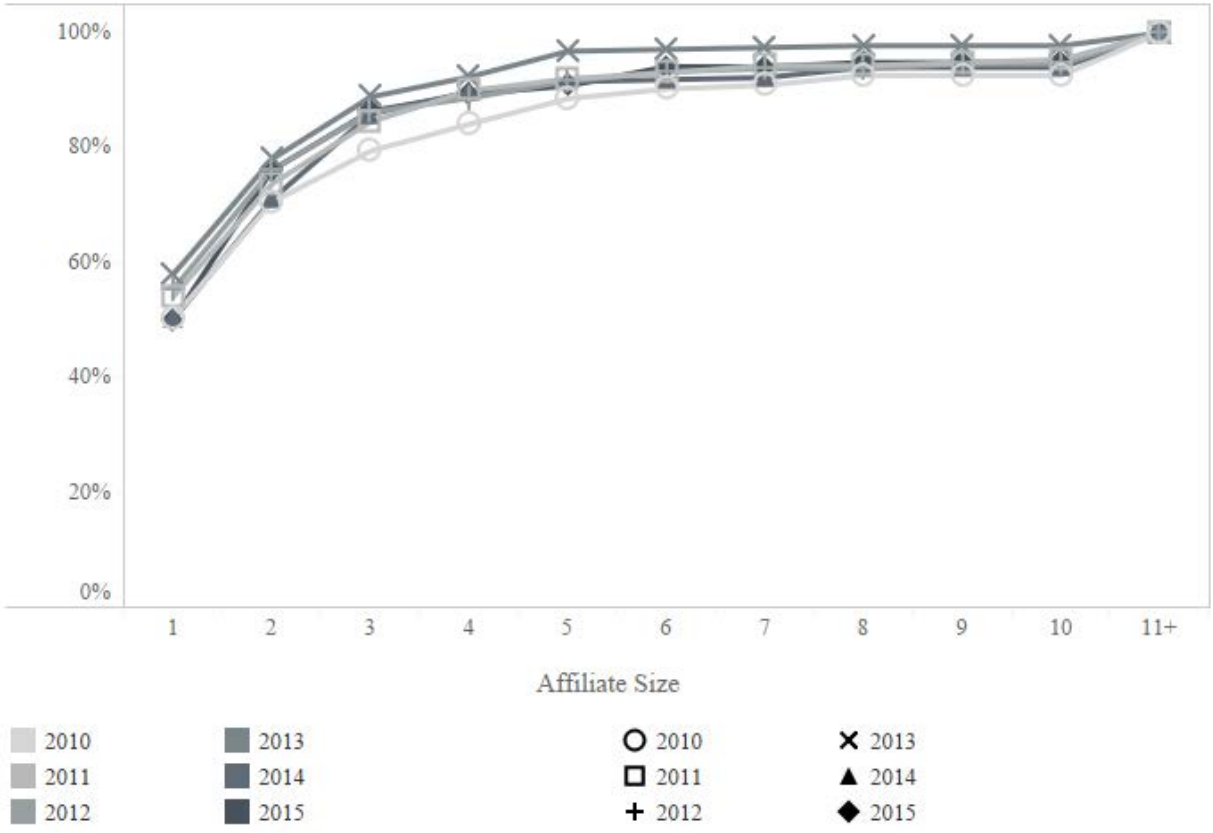


Figure 30. Cumulative Percent of Groundfish Revenue by Affiliated Business Size and Year

5.d Monitoring, enforcement, and compliance

A comprehensive monitoring program (summarized in Section 4.b.xi) is a critical component of any catch share system and is heavily relied on to inform management decisions and fishery enforcement. The

monitoring program in the northeast multispecies fishery relies on fisher reported data, sector reported data and observed activities. Aspects of the program are not entirely specific to the sector program, as many of the reporting elements and NEFOP coverage are also required for common pool participants. The fishing industry and managers have recognized redundant reporting and an inability of the monitoring program (observers and monitors) to provide timely and verified catch data. The challenges (i.e. biases) with the sector monitoring program are well documented in Amendment 23 to the NE Multispecies FMP, currently in development (as of March 2019). The purpose of Amendment 23 is to "implement measures to improve reliability and accountability of catch reporting and to ensure a precise and accurate representation of catch (landings and discards)." Related analyses have been conducted to provide a thorough evaluation of the catch monitoring programs within the sector program. The alternatives of Amendment 23 will not be discussed here as these were introduced following the focus period of this evaluation. The draft alternatives under Amendment 23 have required detailed evaluation on the monitoring program, much of which has provided the findings used here. This evaluation defers to the detailed analyses in the Amendment 23 Environmental Impact Statement but will detail changes and related causes for adjustments to catch monitoring systems in the fishery[101]. This section details the program as it was implemented, changes throughout the evaluation period, as well as some contemporary issues through FY2018.

5.d.i Data collection

Additional reporting requirements were instituted with the implementation of the catch share sector system. To ensure accurate groundfish catch accounting, the new requirements were on top of existing monitoring such as vessel trip reports and dealer reports. Figure 31 details the flow of data collection and management for sector groundfish trips, under the contemporary system. Prior to leaving the dock, sector vessels are required to give a notification 48 hours prior to going groundfish fishing; this notification system was used to determine whether the vessel will carry a NEFOP observer, ASM, or receive a waiver from at-sea coverage. In addition, under the original program, at the time of sailing, vessels were required to declare a groundfish trip via their VMS unit (or call into the IVR system when applicable) and send a trip start hail notification which alerted the dockside monitor provider that a sector trip would be occurring.

While at sea, VMS units provide real time tracking of sector vessel trip; at-sea catch and effort data may be collected by NEFOP or ASM on observed trips. Under certain circumstances, vessels may be required to submit daily VMS multispecies catch reports. At completion of fishing activity, vessels are required to submit multispecies catch reports and trip end hails. When landing their catch, vessels must submit Vessel Trip Reports detailing fishing effort and catch information by statistical area, gear type and mesh size to NOAA Fisheries, their sector manager and dockside monitor provider (if selected for DSM coverage). Detailed landings information is provided to NOAA Fisheries and sectors by all fish dealers and dockside monitoring data of the landing event is provided to the sector. Mandatory Vessel Trip Report and dealer landing report submission frequency was increased to a weekly basis.

Weekly, sectors are required to submit cumulative Sector Trip Issue Reports, Sector ACE Status Reports, and Sector Trip Detail Reports. These reports are used to ensure individual sectors are within their current allocations of individual groundfish stocks. The reports are generated from a combination of industry

[101] https://www.nefmc.org/library/amendment-23

reported data sets (VTRs, dealer weigh-out slips and DSM reports) as well as electronic data sets available from NOAA Fisheries that include: at-sea vessel selection, vessel groundfish declarations, Vessel Trip Reports, vessel multispecies catch reports, vessel trip hails, dealer landings reports, observer data reports, and updated discard rate reports. Sector weekly reports go through a reconciliation process where sector submitted data and NOAA Fisheries data are compared for differences; any discrepancies are investigated, and data errors are submitted for correction.

Daily ACE Status Reports are required for sectors when cumulative catch for any of the sector's allocated species reaches 90% of the ACE. Once this threshold is met, sectors must submit daily reports for the stock(s) in question when:

- A sector vessel returns to port after a sector trip that landed fish above that stock's threshold.
- A sector completes an inter-sector trade including the affected stock.

The requirement to submit Daily ACE Status Reports will be removed when a sector completes an inter-sector trade that decreases the ACE usage level below the 90 % threshold.

Sectors are also required to submit year end reports that quantitatively detail sector effort, catch and trading/leasing activity, along with descriptive detail of sector activity for the fishing year.

While each of these reporting requirements implemented with Amendment 16 serve specific functions, the increased level of reporting has led to redundant reporting of specific data fields (i.e. vessel name/permit number, VTR serial number, dates, etc.) and could provide increased opportunities for errors entered into the system.

As the sector catch share system evolved over time, changes to reporting requirements were instituted to address various concerns and overall changes to the sector program, such as:

- Trip Start Hails (specific for notification for dockside monitoring needs) were removed with the termination of the dockside monitoring program;
- Single provision of VTR serial numbers prior to returning to port via the multispecies catch report;
- Additional VTR reports that were required for fixed gear "Set Only Trips", mechanical breakdown trips and transit trips;
- Additional multispecies catch reporting that were required for sector specific exemptions;
- Removal of ASM requirements from extra-large mesh (ELM) sink gillnet trips targeting monkfish in the SNE/MA broad stock area;
- Authorization of electronic Vessel Trip Reporting (since Amendment 13 (2004); and
- VMS daily reporting for vessels fishing within the eastern Georges Bank area, as well as vessels declaring to fish both inside and outside of GOM broad stock area on the same trip.

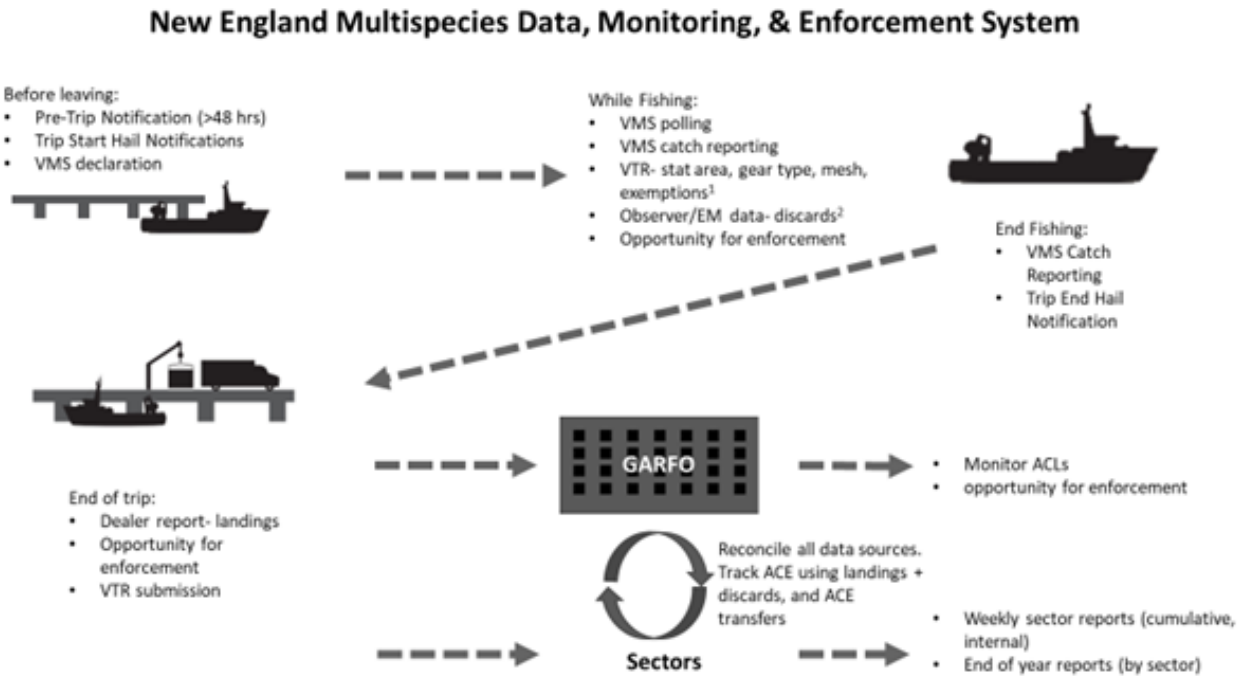


Figure 31. Data flow map for sector groundfish trips.[102]

5.d.ii Monitoring

Amendment 16 implemented an additional at-sea monitoring program to enhance catch monitoring of the sector program participants (i.e., in addition to NEFOP). Annually, the Greater Atlantic Regional Fisheries Office (GARFO) specifies coverage levels sufficient to at least achieve a coefficient of variation (CV) of 30 percent at the overall stock level for each stock of regulated species[103] and ocean pout, and to monitor sector operations, to the extent practicable, in order to reliably estimate overall catch by sector vessels. Determination of the annual coverage levels necessary to achieve the CV30 threshold relies on the most recent years of sector data available. Federally funded observer coverage provided by NEFOP to meet SBRM requirements partially satisfies the total monitoring coverage for groundfish sectors.

The Council modified the monitoring requirements for Northeast multispecies sectors several times since they were established in Amendment 16 to the Northeast Multispecies Fishery Management Plan, most

[102] Figured provided by GARFO. Depicts the catch monitoring system as of 2/29/2020.

[103] NMFS has indicated that it is not feasible to establish different coverage requirements for each sector or for other sub-stock strata, such as gear type, given the sheer number of strata this would vastly complicate the required deployment of observers and would require substantial changes to the NEFOP program. Changes to these requirements would also likely increase monitoring coverage costs, the costs may not be equally apportioned between sectors, and it is uncertain that there would be meaningful improvements to catch estimation. Last, increasing coverage to achieve the precision standard in a stratum with limited activity increases costs substantially to precisely measure discard rates in a stratum that likely generates a disproportionately small amount of the total discards.

recently in Framework 55[104], which became effective on May 1, 2016. The updated regulations at 50 C.F.R. § 648.87(b)(1)(v)(B)(1)(i) require that:

1. Coverage levels must be sufficient to at least meet the standard specified in the Standardized Bycatch Reporting methodology, CV30, at the overall stock level for each stock of regulated species and ocean pout and to monitor sector operations, to the extent practicable, in order to reliably estimate overall catch by sector vessels;
2. The coverage level shall reflect the primary goal of the program, to verify area fished, as well as catch and discards by species and gear type, in the most cost-effective means practicable, as well as the other goals and objectives;
3. The coverage levels will be based on the most recent 3-year average of the total required coverage level necessary to reach the required coefficient of variation for each stock;
4. The coverage level that will apply is the maximum stock-specific level after filtering out healthy stocks; and
5. Healthy stocks are defined as those in a given fishing year that are not overfished, with overfishing not occurring according to the most recent available stock assessment, and that in the previous fishing year have less than 75 percent of the sector sub-ACL harvested and less than 10 percent of catch comprised of discards.

From the start of the monitoring program in FY 2010 through fishing year 2015, realized annual coverage levels resulted in the vast majority of the 20 groundfish stocks far exceeding the CV30 standard, but failing to attain combined target levels (Table 17). Generally, shortfalls were limited to single stocks that had not experienced previous shortfalls[105]; however, there are a number of challenges associated with deploying observers on a diverse and geographically spread fishery. In FY 2013 (FW48/50), a subset of sector trips was exempted from ASM coverage due to the extremely low interaction with allocated and non-allocated groundfish stocks. Specifically, sector vessels fishing on a combined groundfish/monkfish days-at-sea in the SNE Broad Stock Area with extra-large mesh gillnets (10" or greater) were now only subject to NEFOP coverage. Expanded use of ASM is under review in the development of Amendment 23.

Amendment 16 stipulated that sectors would be responsible for the cost of ASM starting in FY 2012, however, federal funding has covered most of the costs of monitoring in every fishing year since (Table 17). Industry was fully reimbursed for the full cost of ASM in all years except the last two months of FY 2015 and in FY2016-FY2017, where industry was reimbursed for 85-87% of their monitoring costs.

Based on the cost sharing mechanism developed for FY 2016 and 2017, NOAA Fisheries provided funds to Atlantic States Marine Fisheries Commission (ASMFC) and as sectors incurred ASM costs, ASMFC reimbursed individual sectors. The reimbursement process was continued for FY 2018 when ASM was fully funded by NOAA Fisheries. During this process, sectors and ASM providers worked closely to

[104] Framework 55 (2011) modified the groundfish monitoring program to achieve NEFOP and ASM coverage rates; this modification falls outside of the evaluation period.
[105] GARFO. 2019. Summary Analyses Conducted to Determine At-Sea Monitoring Requirements for Multispecies Sectors FY 2019. Online: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/Sectors/ASM/FY2019_Multispecies_Sector_ASM_Requirements_Summary.pdf

ensure that industry only had to pay what was necessary for their share which may have resulted in delayed payments to the ASM providers for services rendered.

Table 17. Target and realized at-sea coverage levels for Northeast Fishery Observer Program (NEFOP) and At-Sea Monitoring Program (ASM) by fishing year, with funding source for the ASM program.

	Target Combined Coverage Level	Target NEFOP Coverage Level	Target ASM Coverage Level	Realized Coverage Level	ASM Funding Source
FY 2010	38 %	8 %	30 %	32 %	100 % Federal
FY 2011	38 %	8 %	30 %	27 %	100 % Federal
FY 2012	25 %	8 %	17 %	22 %	100 % Federal
FY 2013	22 %	8 %	14 %	20 %	100 % Federal
FY 2014	26 %	8 %	18 %	25.7 %	100 % Federal
FY 2015	24 %	4 %	20 %	19.8 %	100 % Federal (May 2015 – February 2016) 100 % Industry (March - April 2016)
FY 2016	14 %	4 %	10 %	14.8 %	100 % Industry (May - June 2016) Industry funded but reimbursed. 85 % Federal/15 % Industry (July 2016 – April 2017)
FY 2017	16 %	8 %	8 %	14.1 %	Industry funded but reimbursed. 87 % Federal/13 % Industry
FY 2018	15 %	5 %	10 %	14.6 %	Industry funded but reimbursed. 100 % Federal

Data from GARFO, 2019.

As mentioned in Section 4.b.xi.1, a Dockside/Roving Monitoring Program was developed under Amendment 16. Dockside monitors observed offloads directly to dealers to verify landings and to certify accuracy of dealer reports, while roving monitors observed offloads to trucks for later delivery to a dealer. In FY 2010, a target of 50 % of all sector trip offloads were randomly monitored through this program; this target was intended to decrease to 20% for subsequent fishing years. Federal funding covered the full cost of the DSM program in FY 2010.

Framework 45 altered some aspects of the 2010 Dockside Monitoring Program by exempting certain vessel permit categories in the common pool from. With respect to funding, FW 45 delayed industry (sector and common pool vessels) funding requirements until FY 2013. For fishing years 2011 and 2012, NOAA Fisheries would fund up to 100 percent of the program, based on availability of funds. While the utility of the data was deemed minimal when considering other data sources collecting similar information, including vessel trip reports and dealer reports, industry saw benefit in continuing the program with agency support to cover the dockside monitoring program costs[106]. With the intention of

[106] "Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Northeast (NE) Multispecies Fishery; Framework 45; Final Rule," 79 Federal Register 76 (25 April 2011),
pp. 23042-23076.

enhance enforceability of existing provisions minimize incentives to underreport/misreport, FW 45 also implemented an action requiring dockside monitors inspect the fish holds for any trip that is assigned a dockside/ roving monitor beginning in FY 2011. Prior to developing protocols and training for dockside monitors to board vessels, NOAA Fisheries responded to safety concerns raised by the NEFMC on samplers inspecting a fish hold, and "determined that retaining the vessel trip-end (pre-landing) hail requirement currently provides an efficient and effective means for observation and enforcement of vessel landing requirements through unannounced observation of vessel offloads at the discretion of law enforcement, which could include inspection of the hold."[107]

In July 2011, NOAA Fisheries announced DSM coverage levels were reduced to 50% of trips not observed at-sea, monitors were not required to inspect the vessels at the end of offloads and the mandatory DSM program would be phased out by September 18, 2011.

Framework 48 discontinued the Dockside Monitoring Program starting in the 2013 fishing year, and DSM requirements were removed from the list of reporting requirements. The information collected through program duplicated information collected by dealers and eliminating the requirement to collect duplicative information would reduce vessel operational costs in the future. To aid its enforcement activity at the docks, NOAA Fisheries maintained certain sector reporting requirements initially intended to support the dockside monitoring program, namely the requirement for sector vessel operators to submit trip end hails (see Section 4.c.i.2 regarding misreporting).

> "Dockside monitoring increases the operating costs of sectors. Landings information is already provided through the dealer reporting system. As long as unreported landings do not occur, the dealer reports can be used to monitor sector landings and there is little advantage to having dockside monitors verify these reports. By eliminating the program, sector operating costs are reduced, and redundant accounting is avoided."[108]

Framework 48 also clarified that "[t]he primary goal of observers or at-sea monitors for sector monitoring is to verify area fished, catch, and discards by species, [and] by gear type. Electronic monitoring may be used in place of actual observers or at-sea monitors if the technology is deemed sufficient for a specific trip based on gear type and area fished."[109] Limited electronic monitoring (EM) has been conducted under an EFP through pilot projects since 2012. Expanded use of EM to achieve coverage levels is under review in the development of Amendment 23, voluntary use of DSM is authorized under sector monitoring program.

5.d.iii Enforcement and compliance

Enforcement of unlawful discards is a primary concern for enforcement of the sector program and has proved very challenging. Enforcement activities related to discards are generally in response to complaints and findings from monitoring; proactive enforcement is more challenging and requires that

[107] "Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Northeast (NE) Multispecies Fishery; Framework 45; Interim Final Rule," 138 Federal Register 76 (19 July 2011). https://www.gpo.gov/fdsys/pkg/FR-2011-07-19/pdf/2011-18012.pdf
[108] New England Fishery Management Council. (Feb. 26, 2013). Framework 48 and EA to the Northeast Multispecies FMP. http://s3.amazonaws.com/nefmc.org/130307_FW48_Figures_Repaired.pdf
[109] New England Fishery Management Council. (Feb. 26, 2013). Framework 48 and EA to the Northeast Multispecies FMP. http://s3.amazonaws.com/nefmc.org/130307_FW48_Figures_Repaired.pdf

activities be conducted at sea, which can be easily avoided by violators. In instances where enforcement officers observe a possible violation, it can be difficult to make a case due to lack of evidence, such as inability to measure presumed undersized fish or recovery of discarded fish. Since implementation of the sector program, most discarded incidents raised to the NOAA Office of Law Enforcement (OLE) have been submitted by observers and largely lacking sufficient evidence for any action.

Under the sector system, it is illegal to discard legal sized fish, yet some operators might discard when they believe a low probability of detection exists. Enforcement agents are sometimes limited in their ability to strategically target vessels that are more likely to commit discard violations based on quota utilization. Quota usage is monitored on an annual basis and can change rapidly due to the leasing system, and it is not necessarily a reliable indicator of potential discarding violations. Under the common pool system, discarding legal size fish is not prohibited, and in fact, discarding is required if the vessel has reached a possession limit. Therefore, there is a difference in incentives due to the differences in regulations between the two programs.

The limitations to monitoring described above – redundant reporting, removal of dockside monitoring, low observer coverage to achieve goals of verified catch reporting and inability to achieve target coverage levels – affect the ability for enforcement agents to ensure compliance with regulations. It should be noted that duplicative report requirements can be valuable for quality control. Limitations in the monitoring program are explored in detail in the Amendment 23 Draft Environmental Impact Analysis (DEIS). OLE has made recommendations to the sector program monitoring system that would reduce potential noncompliance and enhance the ability to prosecute by providing reliable evidence. These recommendations include establishing a new dockside monitoring program with OLE access to monitoring to ensure reporting compliance, increase in at sea monitoring coverage, establishing defined offload times, implementing of a video monitoring/electronic monitoring program, and setting additional multispecies permit ownership caps beyond those currently in place[110]. Not all of these recommendations are directly under consideration in Amendment 23, and some would require significant development and resources, but they illustrate limitations of the monitoring system to ensure compliance with program regulations.

For groundfish species managed as a single stock, it does not matter geographically where a vessel catches these fish. They are all counted towards the same quota. Other species (cod, haddock, winter flounder and yellowtail flounder) are managed as multiple stocks, and therefore quotas[111] for these species are set and allocated based on stock area: Gulf of Main (GOM), Georges Bank (GB), and (for some species) Southern New England/Mid-Atlantic (SNE/MA). The stocks have distinct population sizes, growth rates, reproductive potential, etc., and therefore require different allowable harvest levels. Further, transboundary stocks require international agreement for management, where overharvesting can have international implications.

Palmer (2017) analyzed VMS positioning data to validate statistical area fished and stock apportionment of allocated groundfish landings from VTRs submitted between January 2007 through April 2016. This

[110] OLE 2019

[111] Vessels are allowed to fish in multiple stock areas on the same trip. However, the vessel operator must report how many pounds of each species he harvested from each stock area so that the totals can be deducted from the appropriate ACE.

time frame was chosen to examine whether changes in reporting patterns occurred after the transition to the sector catch share management system. Results indicated changes in VMS estimated catch and VTR reported catch changing noticeably beginning in FY 2010 for several quota limited stocks. These differences occurred even with improved compliance with statistical area reporting on VTRs over the same time period. For the majority of stocks, the overall error was small and may not have substantially impacted resource monitoring and stock assessments. However, for some stocks (E GB cod, GOM cod, GOM haddock, SNE/MA winter flounder), the estimated error was large in one or more years. The impact from these errors may be large but in terms of the number of vessels contributing to the error was small and could be mitigated through improved catch monitoring and/or management measures designed to improve catch accounting.

U.S. Coast Guard investigations and research by Palmer (2017) have revealed that sector fishing vessels have been found to harvest fish in one stock area and then report them as being harvested in another stock area. Analysis[112] conducted revealed over 350 trips from 2011-2015 where there appears evidence of misreporting. Each of these trips has a suspected amount of misreported fish associated with it based on the specific actions of the vessel during that trip coupled with various data sources available. Misreporting relates specifically to how allocated species and stocks are managed. In review of 60,713 northeast multispecies trips that occurred from calendar year 2011-2015, analysis flagged potential misreporting in 2,154 trips (3.5%), many were easily explained by legitimate fishing practices, cross-stock area tows, or errors in the data system and were therefore disregarded, resulting in 350 trips[113] with possible evidence of misreporting. While this amounts to less than one percent of the 60,000 trips taken during this five-year period, the analysis estimated that this could have been potentially up to 2.5 million pounds of regulated species were misreported by vessels from multiple sectors in the northeast multispecies fishery. The current regulation regime is vulnerable to stock area misreporting and limits the ability of enforcement to detect and document misreporting of stock areas. As indicated, there is already consideration of changes to the monitoring program in the multispecies fishery. Increased at-sea monitoring and/or implementation of EM in the groundfish fleet could bolster enforcement with these types of violations. Coast Guard officials have suggested that a simple program change – the requirement of standardized logbooks for sector vessels – would aid in the at-sea enforcement. Separate from VTRs and daily VMS Multispecies catch reporting, a standardized logbook requiring tow by tow documentation would facilitate increased efficiency of boardings at sea for both issues of catch discarding and misreporting[114].

5.d.iii.1 Industry driven provision

Due to concerns of the potential for misreporting of catch by BSA, sectors developed the Inshore Gulf of Maine Declaration provision. This measure was adopted for FY 2013 by all sectors and will remain in effect as long as this provision is kept in individual sector operations plan. The provision is intended to prevent fishing vessels from misreporting catch of species of concern found in the inshore GOM region as from other BSAs. A monitoring component to ensure compliance with this provision was included for all

[112] Analytical details can be found in "Summary of Stock Area Analysis and Investigation of Misreporting in the Northeast Multispecies Fishery" presented by the USCG First District Enforcement Staff (2019): https://s3.amazonaws.com/nefmc.org/USCG-Groundfish-Misreporting-Investigation-and-Analysis.pdf
[113] The proportion of these trips attributed to illegal behavior by NEFS 9 member, described in Section 4.c.i.2, is not known.
[114] LT Gregory DeYoung, personal correspondence.

sectors in the fishery via declaration download available in the Sector Information Management Module (SIMM). The provision details, as follows:

1. Inshore Gulf of Maine Declaration: A portion of Broad Stock Area 1 (BSA1) will be defined as the Inshore GOM Area as follows: west of 70° 15' longitude to the shoreline north to the Maine coast and south to Cape Cod.
    a. Observer/Monitor Onboard: The vessel may declare and execute its intent to fish inside the portion of BSA1 designated the Inshore GOM Area, as well as any other area.
    b. Observer/Monitor NOT Onboard: The vessel may select one of the following options:
        i. If the vessel wishes to fish in the Inshore GOM Area, the vessel must declare and execute its intent to fish inside BSA1 exclusively for the trip. The vessel cannot conduct fishing activities any other BSA.
        ii. If the vessel wishes to fish in more than one BSA, the vessel is prohibited from fishing in the Inshore GOM Area of BSA1. The vessel must also submit a Trip Start Hail as an acknowledgement of this restriction by checking the Inshore Gulf of Maine" from the list of sector specific provisions.

5.e Shared management responsibility

A key feature of catch share programs, specifically cooperative-style programs, is the ability for self-governance. While self-governance was not an explicit design decision of the sector program, it nevertheless has important implications, and effects, on the role of fishermen in management of the fishery.

The failure to rebuild fishery stocks in the early 2000s along with legislative actions increased engagement by the fishing industry in decision making processes. The process for designating sectors that began in Amendment 13, opened the process to more participatory management, organized groups of stakeholders began to have a determining voice in resource management[115]. While the sector system was not specifically designed to increase self-governance, it was noted in Amendment 16 that a benefit of the program would be the creation of incentives for self-governance. In general, it is expected that catch share systems, particularly cooperatives, will decentralize decision-making, devolving decisions about fishing from government to fishermen.

Under catch share programs, many governance activities shift from federal managers to individuals, sectors, or co-operatives, even though federal managers and the councils retain authority over setting catch limits, seasons, and other parameters of management. Sectors represent the use of business organizations to replace government in making many critical decisions about the use of allocated quota as well as monitoring, reporting, and other functions, albeit within the framework of government oversight. The decentralization of governance through catch shares may be expected to offer greater opportunities for self-governance[116].

While aspects of self-governance are difficult to measure, sectors do provide critical services in self-reporting, organization and enforcement, and analyses have illustrated reduced time spent on decision

[115] Hall-Arber 2005
[116] Townsend, R.; Shotton, R.; Uchida, H. (eds). 2008. Case studies in fisheries self-governance. FAO Fisheries Technical Paper. No. 504. Rome, FAO. 451p. http://www.fao.org/3/a1497e/a1497e00.htm

making[117]. Under sector management, members are required to adhere to joint and several liability and indemnification, under their signed sector contracts. These clauses make sector members collectively responsible for sector ACE overages, discarding of legal-sized fish and misreporting of catch landings or discards, thereby possibly increasing the likelihood of compliance across the sector program. Available data limit the ability to evaluate whether this happened, however it is known illegal activity occurred under the catch share period that was later learned about (Section 4.c.i.2).

While member compliance with sector operations plans and regulations is not public information, various reporting mechanisms have been developed so that sectors can report violations/incidents/issues both during and at the conclusion of each fishing year to NOAA Fisheries. These mechanisms include weekly submitted Sector Trip Issue Reports, which provides a brief summary of any issues that occur, Sector Incident Reports, which provide a more detailed explanation of the incident/issue/violation, the investigation by the sector and the outcome, and finally, all sector violations/issues/incidents are included in the sector yearend reports.

5.f Landings, gross revenues and ex-vessel prices

Landings and revenues serve as a valuable metric for the economic performance of a fishery. These data can be assessed across various units, such as vessel size categories, ports, states, gear types, and species/ stocks (including groundfish and non-groundfish species), which can generate a more holistic perspective of the realized economic impacts. Landings and revenues have both been declining in the groundfish fishery since the 1980s[118] (Figure 4 and Figure 5), in conjunction with changing regulations, reductions in fleet size, and decreases in stock biomass for some stocks. These downward trends have continued through the catch share analysis time period.

Though the days-at-sea program, trip limits, and other management measures that restricted landings prior to the catch share program were lifted for vessels participating in the sector program, other, often interrelated, factors led to a continuing decline in overall landings after implementation of the sector program. This section presents landings as landed weight (pounds) and gross revenues in constant value (2010 dollars0. Groundfish landings from groundfish trips[119] in 2015 were at a nine-year low of 41.5 million lbs. (Figure 32). The overall decrease in groundfish landings from 2007-2015 totaled 21.9 million lbs. (-34.5%), with the largest year-to-year decreases being between 2009 and 2010 (-11.4 million lbs.) and between 2011 and 2012 (-14.4 million lbs). These decreases in landings naturally contributed to decreases in gross revenues. Across the nine-year period, total gross revenues[120] from groundfish trips were lowest in 2015, at $72.1 million, with revenue from groundfish landings comprising $51.1 million – accounting for 70.9% of revenues earned. Following a few years of fluctuating revenues, groundfish

[117] See the governance indicators of management efficiency by the Measuring the Effects of Catch Shares project: http://www.catchshareindicators.org/northeast/governance-indicators/management-time/

[118] Measuring the effects of Catch Shares project provides extended baseline data on the financial variability of the fishery, for example see: http://www.catchshareindicators.org/northeast/economic-indicators/landings/

[119] The Groundfish Performance Report (Murphy et al. 2018) defines a groundfish trip as where the vessel owner or operator under a limited access multispecies permit declared the trip as a "groundfish trip" via VMS or through the interactive voice response system. This includes trips on which groundfish DAS were used, including monkfish (*Lophius americanus*) trips.

[120] Murphy et al. (2018) adjusted nominal revenues to real revenues, to account for inflation, using the GDP Implicit Price Deflator, with the second quarter (April-June) of calendar year 2010 as the base time period; revenues contained in that report are in constant 2010 dollars.

revenues essentially remained constant between 2013 and 2014, but decreased in 2015. The limited access groundfish fleet did participate in other fisheries as well, and the total gross revenue earned on all trips (including all groundfish and non-groundfish species) taken decreased by $36.6 million (-12.0%) from 2007 to 2015. The highest revenue year was 2011 ($324.5 million) and the lowest revenue year was 2014 ($257.6 million).[121]

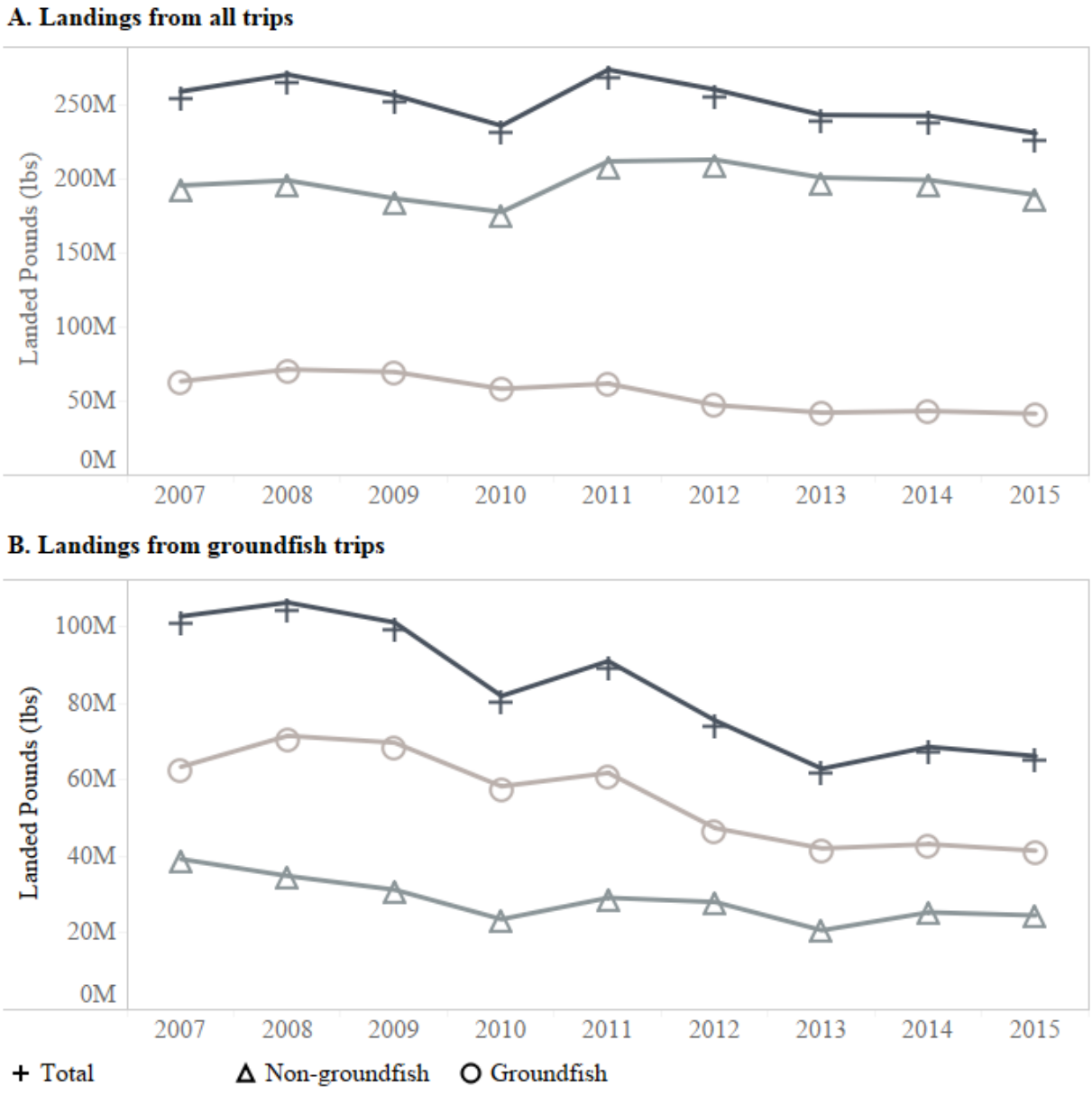


Figure 32. Landings from all trips (A) and groundfish trips (B), 2007-2015.[122]

[121] Murphy et al. 2018
[122] Data source: Murphy et al. 2018.

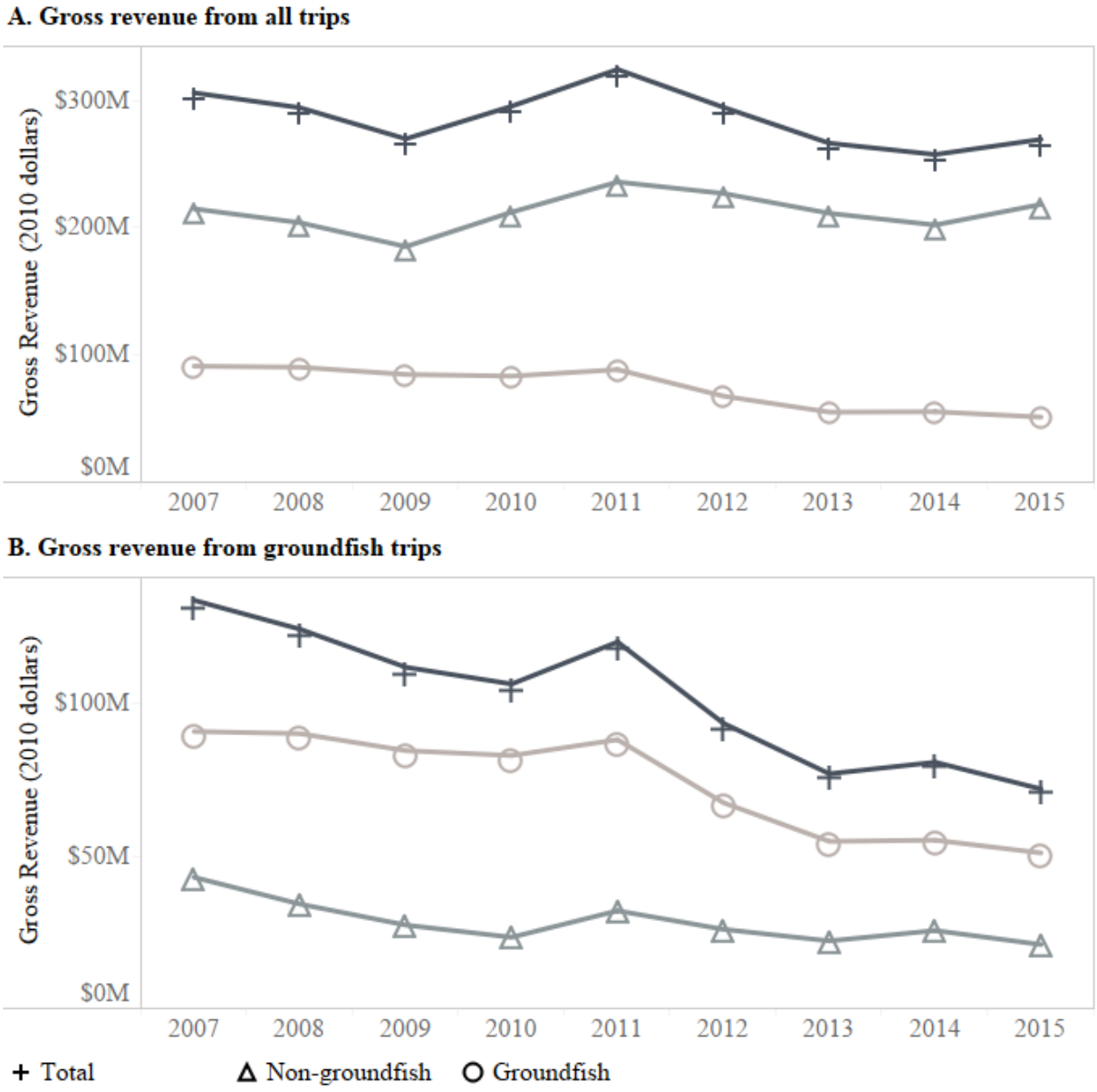


Figure 33. Gross revenues from all trips (A) and groundfish trips (B), 2007-2015.[123]

5.f.i Landings and revenues across states and ports

The distribution of groundfish revenue and revenue trends by home port state are both similar to those of the landing state. Gross revenue from groundfish decreased across all states when assessed by port of landing and home port (Figure 34, Figure 35 and Figure 36). In Massachusetts, by port of landing, revenue from groundfish landings increased from 2007-2011 before sharply declining in 2012 and 2013 and reached a nine-year low in 2015 ($42.7 million). Despite decreasing trends in groundfish revenues,

[123] Ibid.

Massachusetts remained the top earning state through every year of the nine-year period in both groundfish revenues and total gross revenues resulting from all species. In terms of groundfish revenues, Maine has been the second-highest ranking landing state every year from 2007-2015, though revenues are much lower relative to Massachusetts. In addition, trends in groundfish revenues in Maine differ from those observed with Massachusetts, with initial decreases in revenues followed by a period of fluctuation. Specifically, 2010 experienced the lowest revenues during the nine-year period ($4.3 million). Other landing states generally represent an increasingly smaller portion of total groundfish revenues throughout the time period. New Hampshire was the third-ranked state in aggregate groundfish revenues from 2007-2015, but 2015 revenues ($0.6 million) represent an 82.4% decline from the start of the evaluation period. Rhode Island was the fourth-ranked state in aggregate groundfish revenue during the period but ranked above New Hampshire from 2013-2015. Following initial declines during 2007-2008, groundfish revenues in Rhode Island have consistently remained around $2.0 million, annually. A complete description of the annual changes across states and primary ports are provided in Murphy et al. (2018), tracking a consistent set of ports, but omitting many of the smaller ports operating throughout the region.

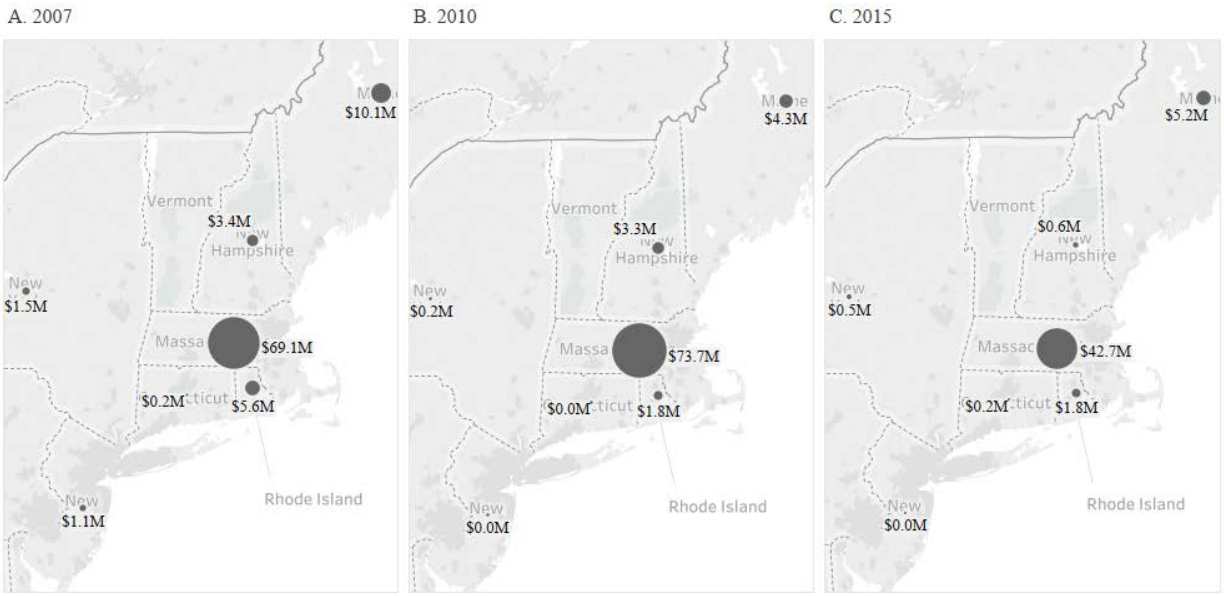


Figure 34. Value of groundfish landings by port of landing state (excluding 'other Northeast') for 2007, 2010 and 2015.[124]

[124] Ibid.

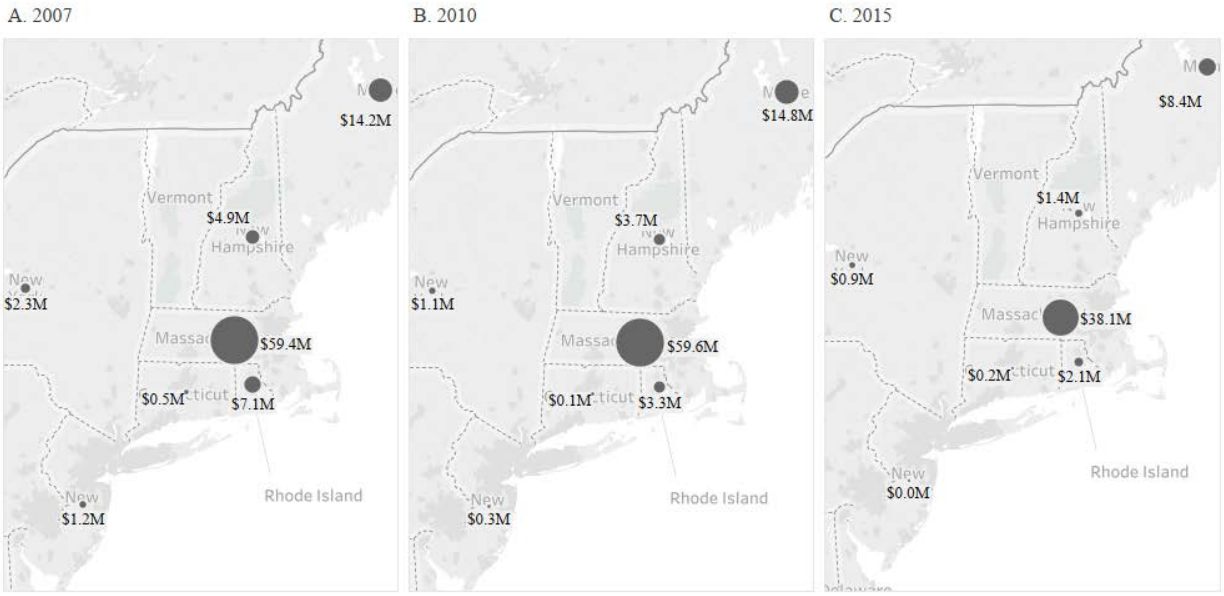


Figure 35. Value of groundfish landings by home port state (excluding 'other Northeast') for 2007, 2010 and 2015.[125]

[125] Ibid.

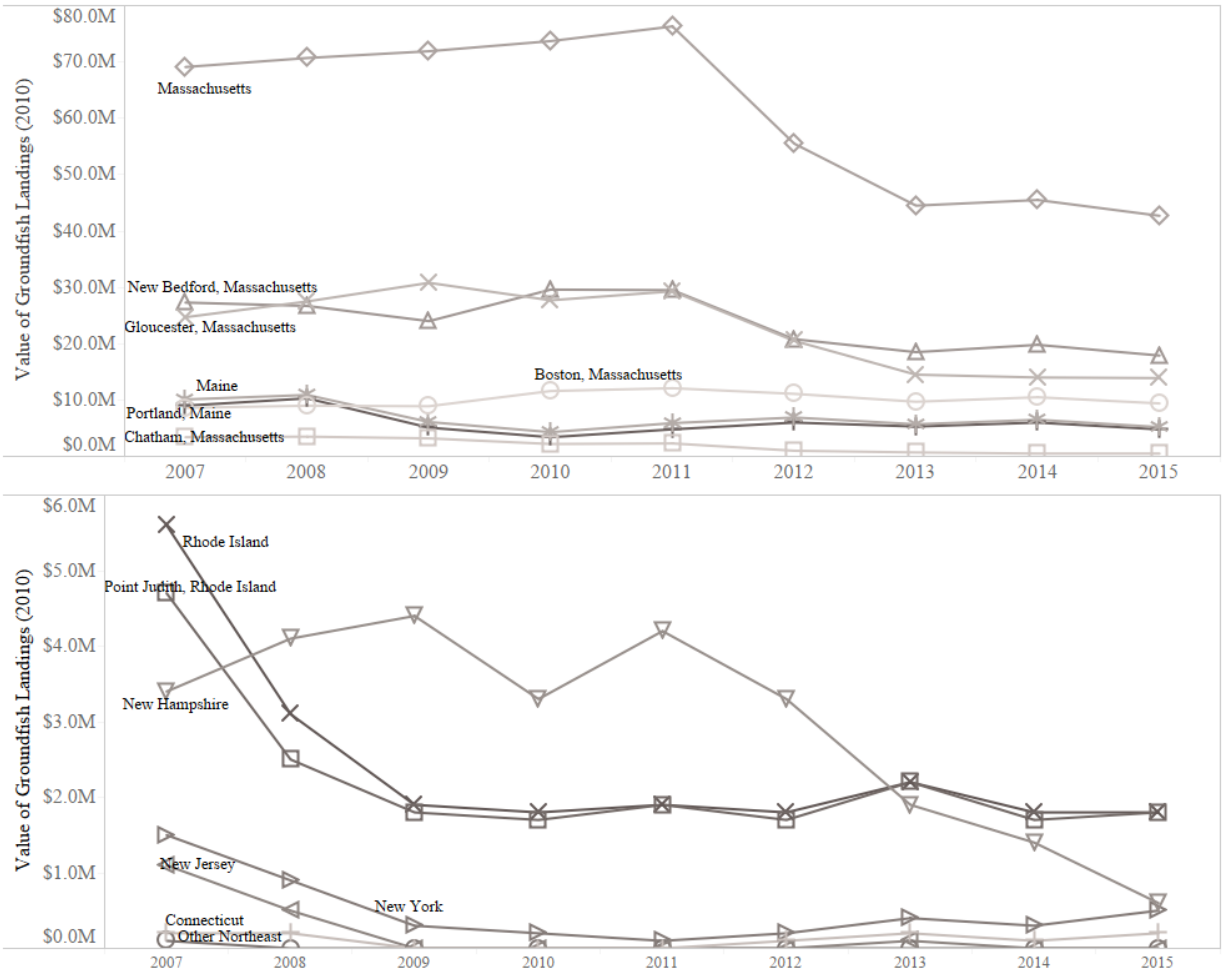


Figure 36. Changes in groundfish revenues by state and port of landing, 2007 – 2015.,[126]

5.f.ii Landings and revenues by individual allocated groundfish and non-groundfish species

Limited access permit holders generated revenue from both allocated groundfish and non-groundfish landings, including landings and revenues from non-groundfish trips, as described in Figure 33 A. Here, we highlight the trends and correlations between both groundfish and non-groundfish species over the 2007-2015 period in greater detail. Specifically, this section captures the activity of all limited access permit holders, independent of whether they operated on a declared groundfish trip, and we report the aggregate revenues and landings across the top landed and valued species. While groundfish landings and revenues declined over the evaluation period, revenues and landings from non-groundfish increased and leveled-off during the analysis period (Figure 37). Despite the increased landings and revenues from non-groundfish species, declines in groundfish revenue contributed to overall lower gross revenues 2015 than at the start of the nine-year period.

[126] Ibid.

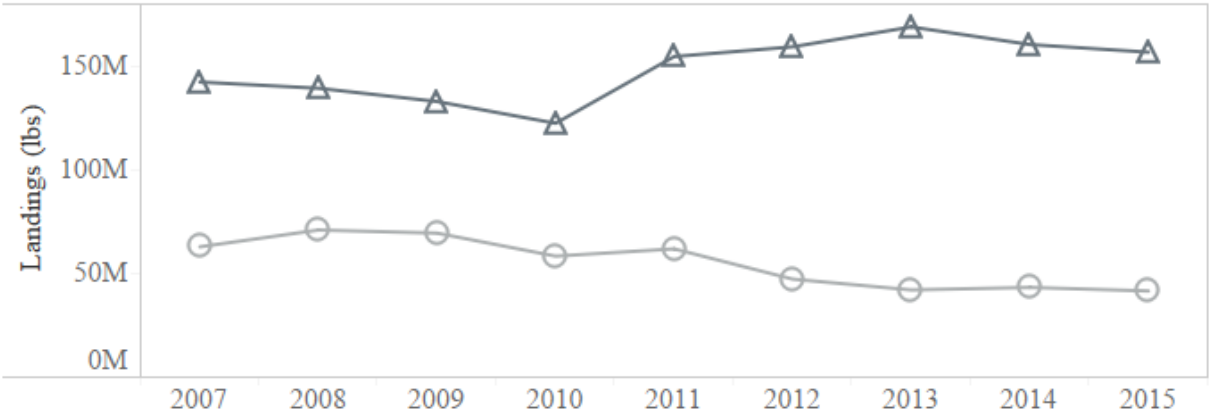
Of the 9 allocated species, pollock landings were the highest during 2007 and 2008 but were surpassed by cod and haddock in 2009. Though pollock landings declined, the revenues for this species remained relatively stable, comparatively to other species, including cod and haddock. Cod landings increased slightly over 2007-2009 but decreased from 2009-2010. After slightly rebounding in 2011, cod landings decreased from 2011 to a nine year low in 2015. The drop in cod landings after 2011 coincide with significant ACL reductions occurring in 2012 and 2013 (see Section 4.c.i.3 and Table 8). From 2007 to 2015, cod landings decreased by 79%, from 16.3 million lbs. to 3.4 million lbs. Pollock landings also reached their lowest point in 2015 to 5.5 million lbs., decreasing by 70% when comparing landings from 2007 (18,3 million lbs.) to those from 2015. Haddock landings, which were the highest of the allocated groundfish species in 2010, increased from 2007 to 2010 but then dropped to a low point in 2012 (2.2 million lbs) but then rebounded from 2012-2015 to 9.9 lbs. Overall, landings across time and allocated groundfish species were not uniform and require assessment on a species-by-species basis. When comparing landings averaged over 2007-2009 to those averaged over 2010-2015, hake, American plaice, and redfish were the only species with higher average landings during the post-catch share period comparatively to the pre-catch share period.

Across the nine allocated groundfish stocks, cod generated the highest annual revenues from 2007-2012, but revenues decreased significantly in subsequent years. Cod revenues decreased by 80% when comparing values from 2007 to 2015 (Figure 39). Pollock was the top revenue species in 2013, followed by haddock in 2014 and 2015. Cod was the highest revenue-generating species when aggregated over the nine-year period, and redfish was the lowest. Though average landings were higher during the post-catch share period for some species (hake, American plaice, and redfish) and landings rebounded for haddock during the post-catch share period, revenues did not follow the same rate of increase to those of the landings, which for haddock, this was due to decreased ex-vessel prices[127]. Average revenues from the top nine groundfish species decreased by 24% when comparing averages from the six years under the sector program to those averaged over the three-year average prior to the implementation of the sector program.

Among the top non-groundfish species landed, landings of Atlantic herring increased while landings of other species remained relatively stable. When assessing revenues, sea scallop earnings were consistently highest among the species, driven by high ex-vessel prices. Revenues from all other species remained relatively stable during the nine-year period (Figure 39). Overall, revenue generated by these top ten non-groundfish species was double that of the nine-allocated groundfish species during the nine-year period. The reliance of particular vessels on groundfish species revenues relative to non-groundfish species revenues is explored further in section 5.i.vi.

[127] Decrease in haddock prices documented in Murphy et al. 2018.

A. Aggregate landings of nine allocated groundfish and top ten non-groundfish species by limited access groundfish vessels.



B. Aggregate revenue of nine allocated groundfish and top ten non-groundfish species by limited access groundfish vessels.

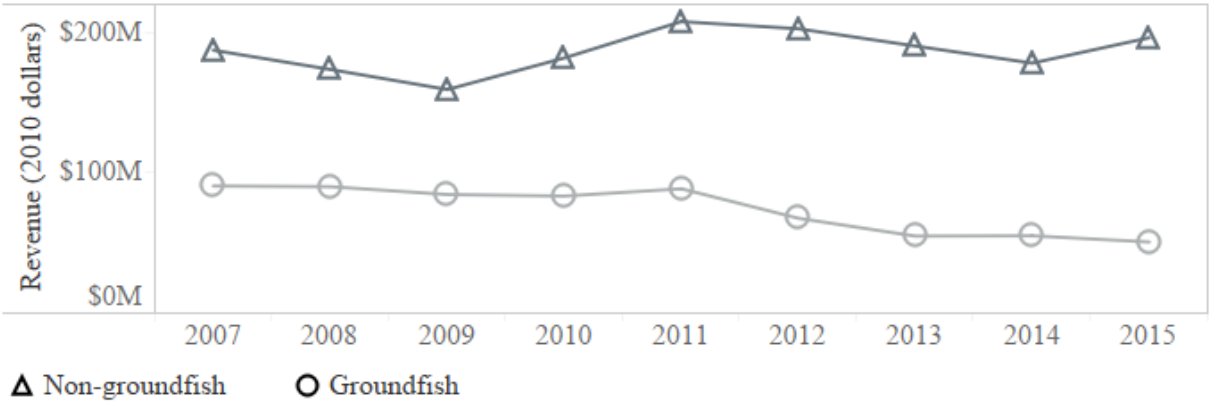


Figure 37. Aggregate landings (A) and revenues (B) of nine allocated groundfish and top ten non-groundfish species landed by limited access groundfish vessels, by fishing year.[128]

[128] Ibid.

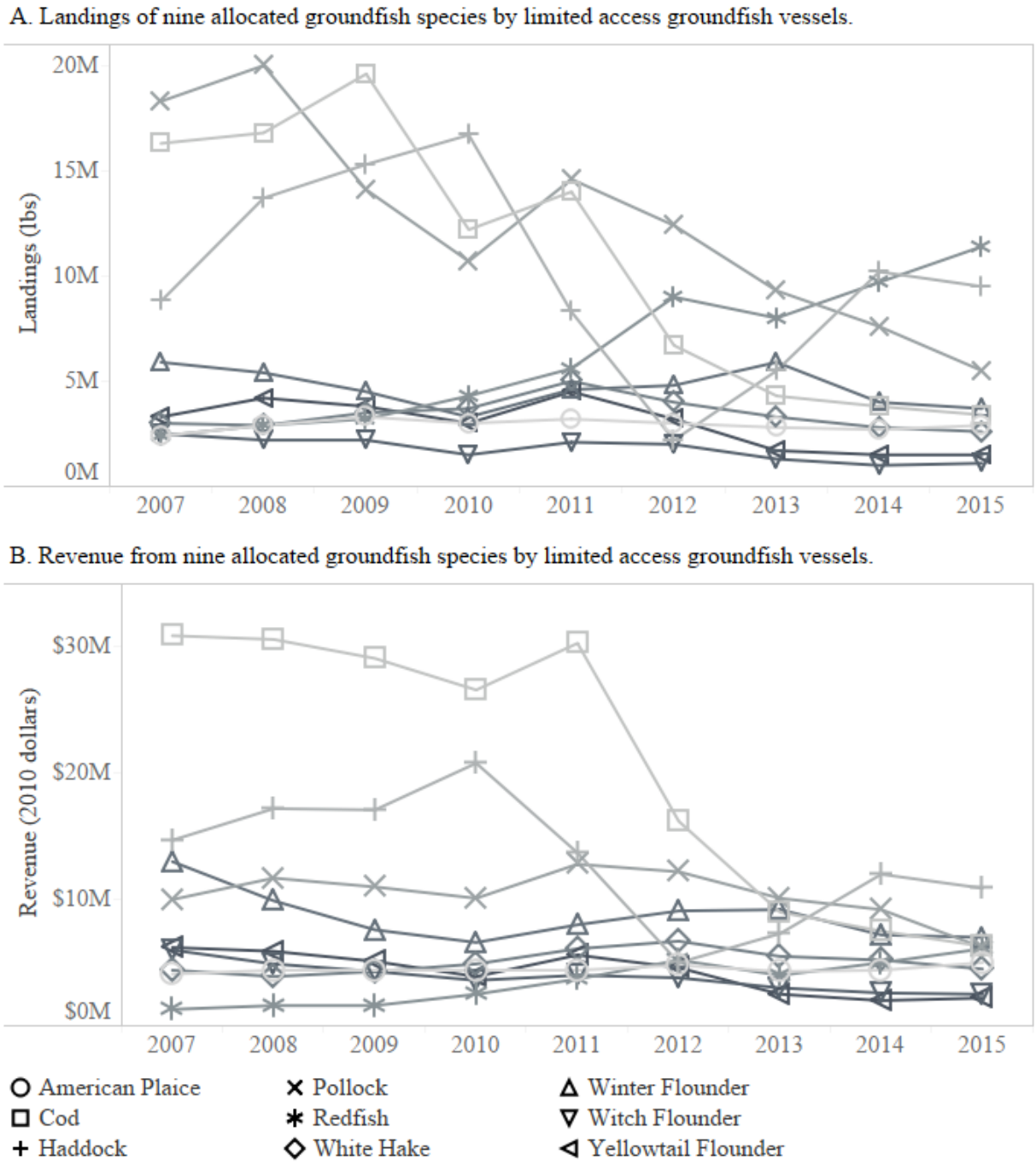


Figure 38. Landings (A) and revenues (B) of nine allocated groundfish species landed by limited access groundfish vessels, by fishing year.[129]

[129] Ibid.

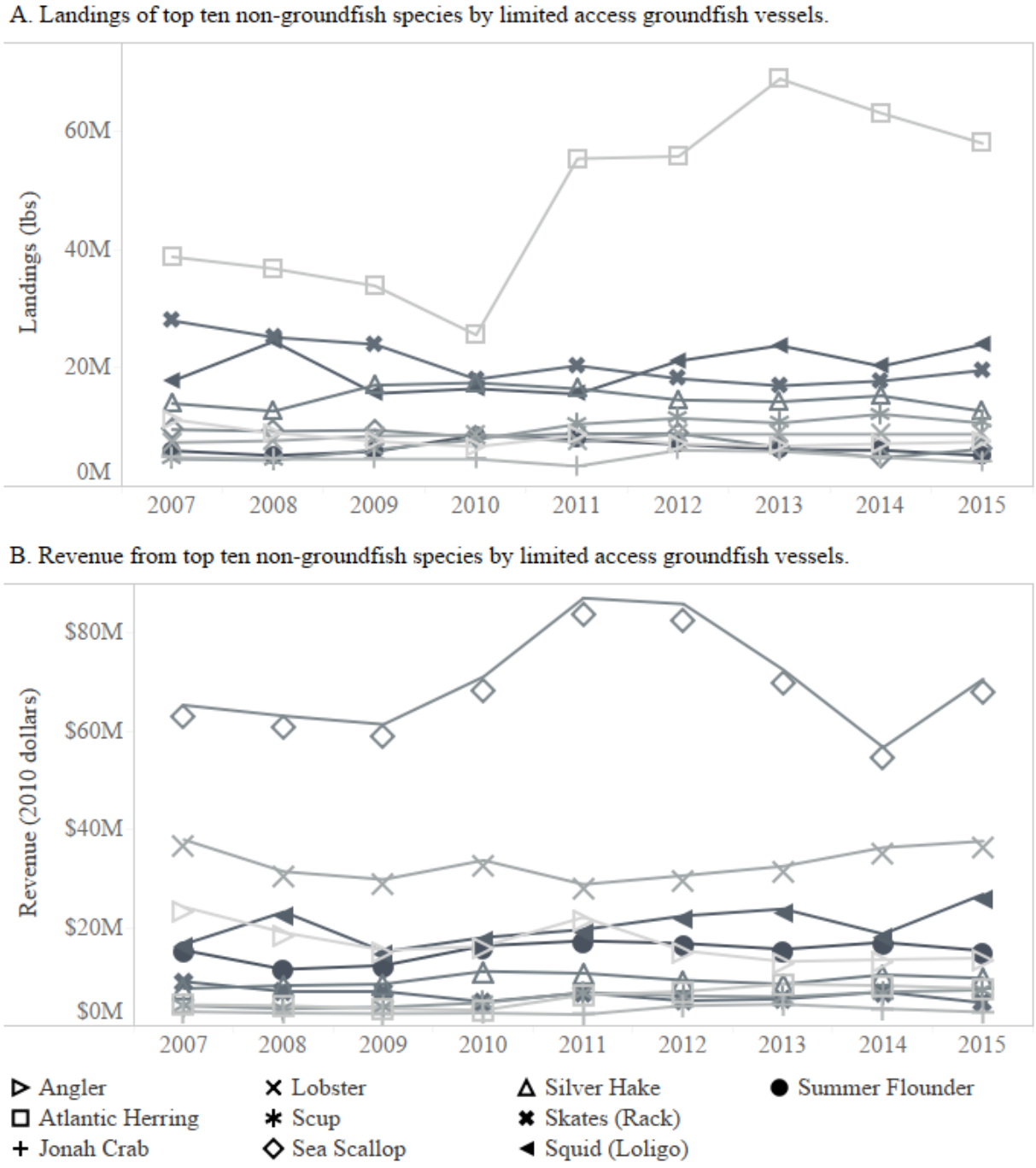


Figure 39. Landings (A) and revenues (B) of top ten non-groundfish species landed by limited access groundfish vessels, by fishing year.[130]

[130] Ibid.

5.f.iii Revenues across vessel size classes

Analysis by Murphy et al. (2018) illustrates that the number of active vessels that received revenue from at least one groundfish trip, annually, generally declined across all vessel size classes from 2007 to 2015 (Figure 40), reaching the nine-year low in 2015 for three of the four size classes. There was a noticeable drop in vessels in the 30 to 50 feet category as well as the 50 to 75 feet category in 2010. Though decreases are observed across all vessel size classes, there is not a consistent increase in average per vessel revenue across all vessel size classes. On average, mean revenues pre-catch share were higher for the two smaller vessel size classes, but were higher during the post-catch share period for the two larger vessel size categories (Figure 33). Decreases in average revenues correspond to the fact that revenues in the fishery have been steadily declining throughout the evaluation period (Figure 33).

Varying trends were observed in revenues across vessel size classes throughout the evaluation period (Figure 41). Vessels below 30 feet experienced the highest average total gross revenues on groundfish trips in 2015 ($7.0K), after hitting a nine-year low in 2013 ($1.5K). For vessels 30’ to < 50’ there was a slight decline towards the middle of the evaluation period, from 2011 through 2013, though the average revenue did not fluctuate much. The average total gross revenue on groundfish trips among vessels 50’ to <75’ was around $250K in most years. Vessels 75’ and above experienced higher average total gross revenues on groundfish trips during the catch share years, compared with the three years preceding the catch share program. When assessing mean revenues averaged over the pre and post-catch share period, the two smaller vessel size groups had higher revenues during the pre-catch share period while the two larger vessel size groups experienced higher average revenues over the post-catch share period.

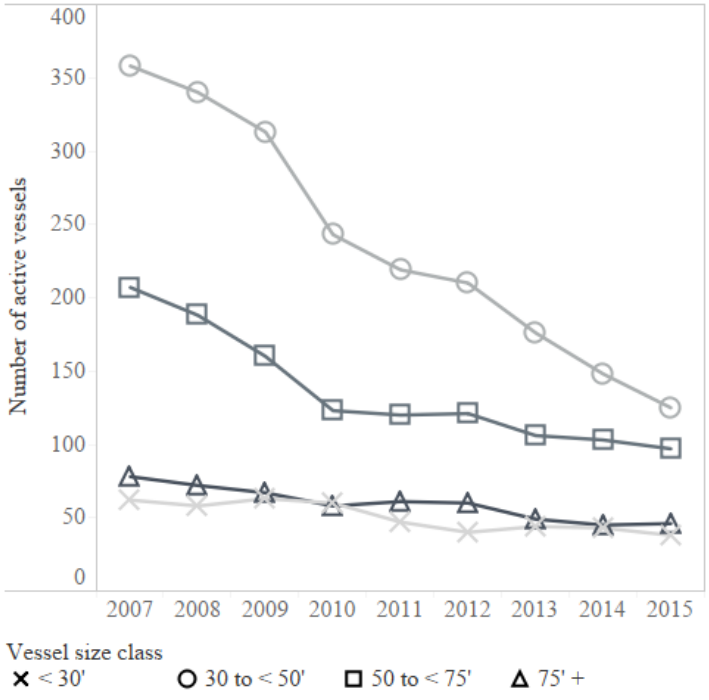


Figure 40. Number of active vessels that received revenue from at least one groundfish trip, by vessel size class and groundfish year.[131]

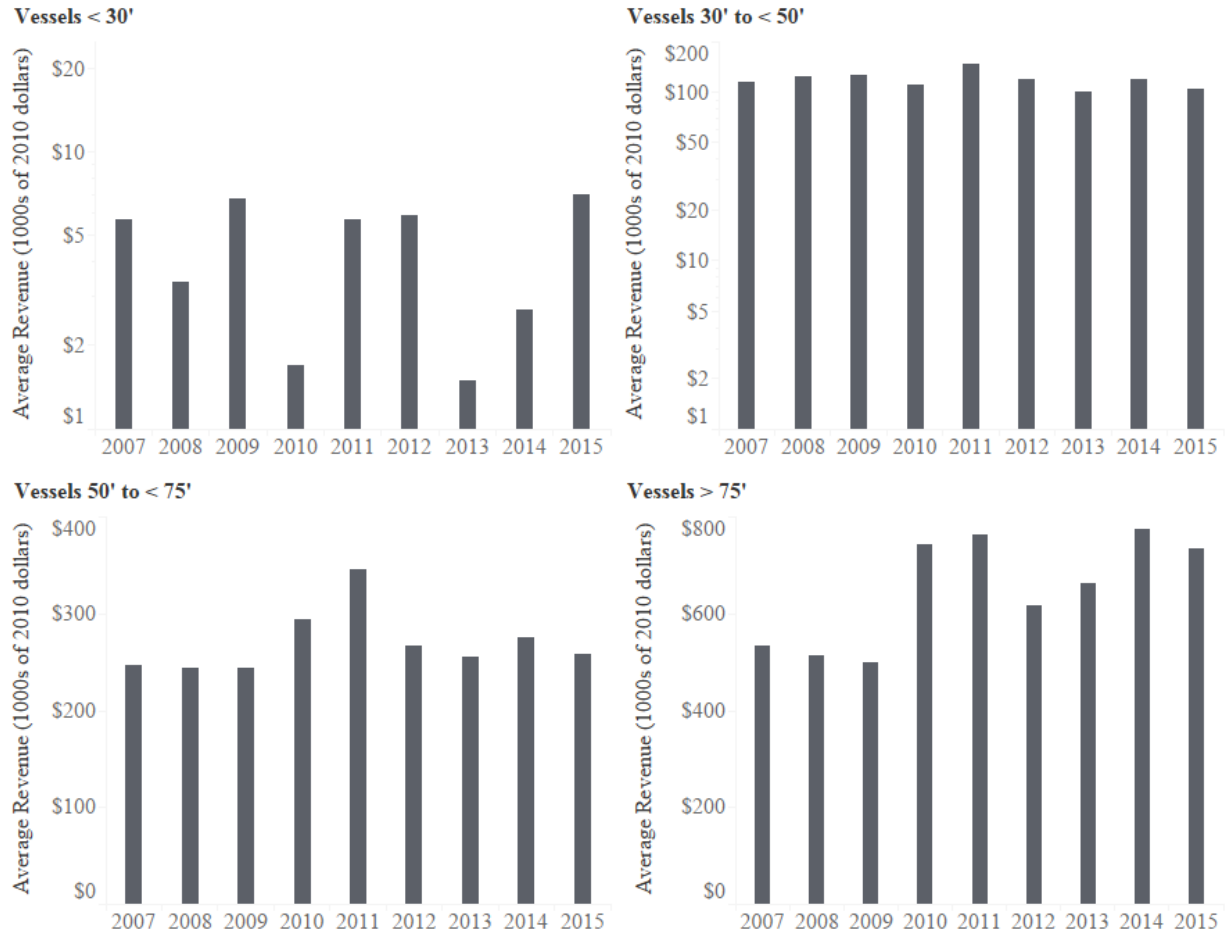


Figure 41. Average all species revenue (thousands of 2010 dollars) per active vessel on groundfish trips, by vessel size class and groundfish year.[132]

5.f.iv Ex-vessel pricing

Murphy et al. (2018) analyzed trends in ex-vessel prices. These were the best available analyses for use in this evaluation. Prior to the sector program, the total yearly average groundfish ex-vessel price (constant 2010 dollars) declined between FY 2007 and FY 2009 (Figure 42). With the implementation of catch shares in FY 2010, the total average ex-vessel price for groundfish stocks returned to the FY 2007 level of $1.43/lb. and remained steady through FY 2012. Fishing year 2013 saw a decline in the total average price for groundfish to its lowest point in FY 2015 at $1.23/lb. The yearly average price received by sector vessels mirrored the total yearly average price with a downward trend from FY 2010, reaching a low of $1.22 in FY 2015. Common pool vessels typically received a higher average groundfish price than

[131] Adapted from Table 15 in Murphy et al. 2018.
[132] Adapted from Table 15 in Murphy et al. 2018. Average revenue values should be taken in context with standard deviations, as most standard deviations are relatively high.

sector vessels during most years across the review period. Common pool vessel average groundfish price increased from $1.58/lb in FY 2010 to $1.74/lb in FY 2015.

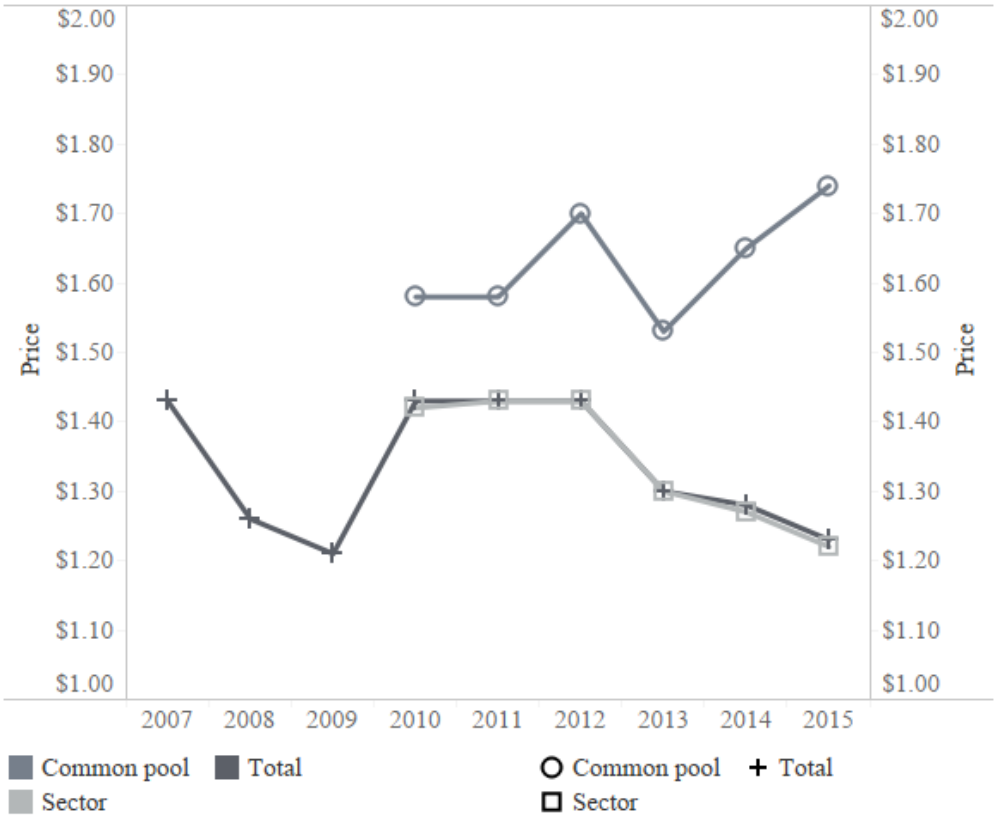


Figure 42. Yearly average ex-vessel price (in 2010 dollars per landed pound) of combined groundfish.[133]

Using simple average ex-vessel prices of all groundfish species combined to compare yearly changes can be misleading, as these prices do not take into account species landed, quantities of each species, market categories by species, or gear type used to harvest. For a better representation of changes in ex-vessel prices for all groundfish combined, Murphy et al. (2018) constructed a price index to more accurately reflect price trends of all groundfish species. The Fisher Ideal index values showed that ex-vessel prices for all groundfish were greater during the catch share program period (FY 2010 – FY 2015) as compared to the based period, May – July 2007. Ex-vessel prices showed an increasing trend for all groundfish species combined from FY 2010 through FY 2012, followed by a drop in FY 2013. Ex-vessel values remained relatively stable between FY 2013 and FY 2015.

At the species level, witch flounder most frequently had the highest average ex-vessel price followed by Atlantic cod and winter flounder (Figure 43). Redfish continually displayed the lowest ex-vessel price across the nine-year review period, while pollock had the second lowest ex-vessel price.

All species but pollock showed a decline in ex-vessel prices between FY 2007 and FY 2009. Several stocks showed an increasing trend in ex-vessel price from FY 2010 through FY 2015 including, pollock,

[133] Murphy et al. 2018

white hake, American plaice, and witch flounder. Other stocks such as Atlantic cod, haddock (FY 2012) and redfish (FY 2011) had price peaks early on in the review period but then declined through FY 2015.

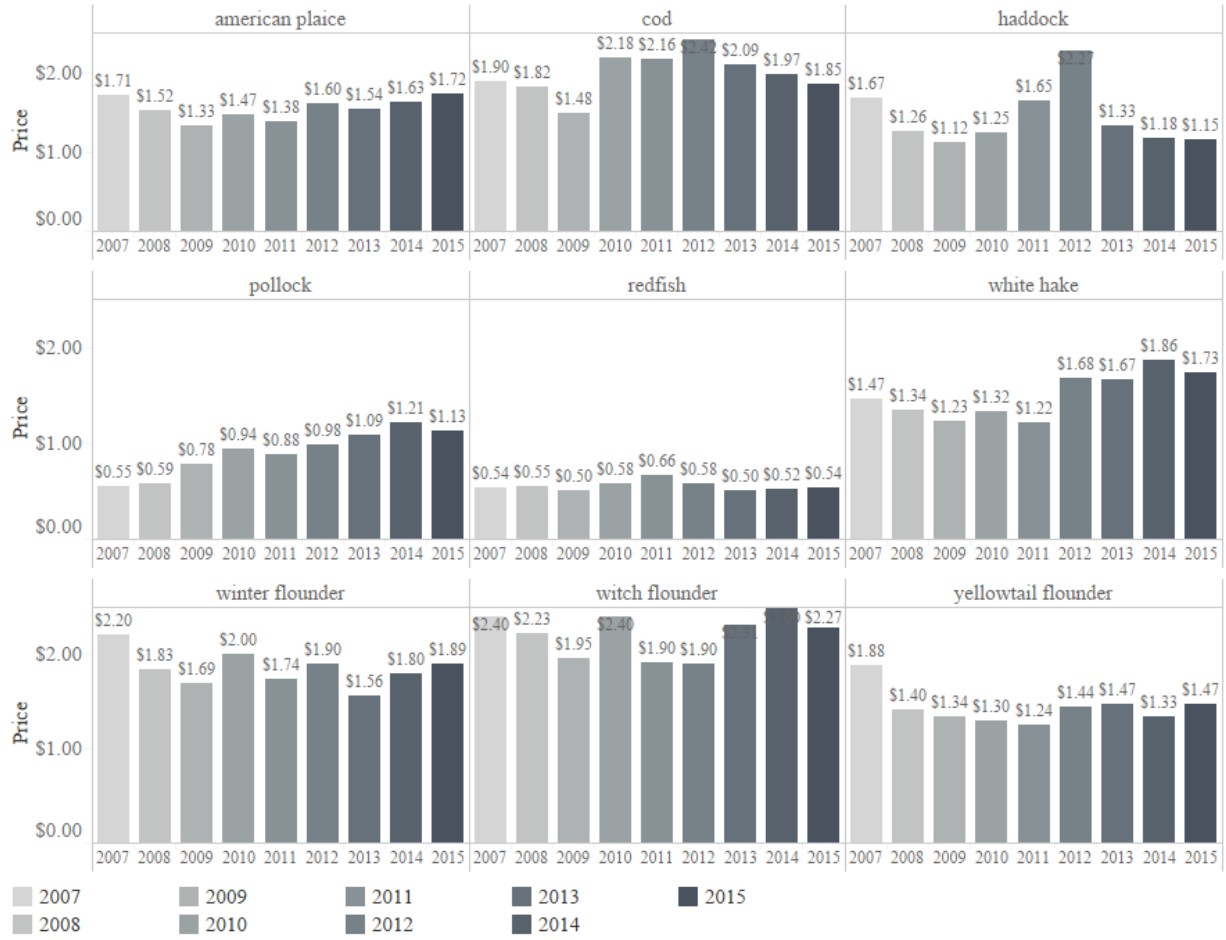


Figure 43. Yearly average ex-vessel price (in 2010 dollars per landed pound) by groundfish species.

5.g Economic performance measures

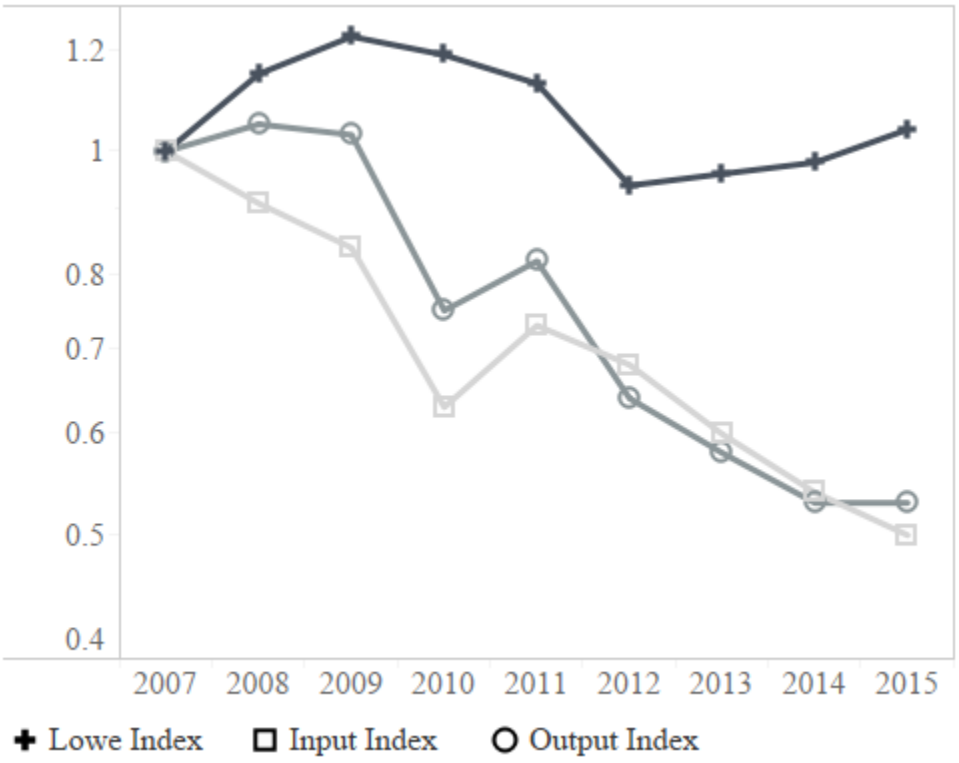
5.g.i Productivity

Economic productivity in general is the value of output obtained with one unit of input and is represented as a ratio; the higher the ratio, the more productive the system. With a complicated production process, such as in a multispecies fishery, productivity (known as the Total Factor Productivity, TFP) is measured as aggregate outputs divided by aggregate inputs. This serves as a general measure of productivity, and changes in the factor can be measured at the firm or aggregate industry level. This multiple input-output scenario - vessels use labor (crew), capital stock (vessel length and horsepower), and energy (fuel) on fishing trips to harvest a variety of fish and shellfish species – relies on index numbers which combine

outputs and inputs into a single number and compare those totals with a base year or time period total to measure TFP change.[134]

Productivity was measured using the Lowe index where the output index was constructed using the value of all species landed on groundfish trips and the input index is the aggregate value of capital services, labor services, fuel and materials used on all groundfish trips, for the base year of 2007. During the evaluation period, an index value greater than 1.0 indicates an improvement in productivity and a value less than 1.0 signifies a decline in productivity. Note that these numbers have not been adjusted to account for changes in biomass that may have occurred.

Productivity (the Lowe index) rose during the baseline years (2007-2009) and declined during the first two years under sector management, as the output index declined more than the input index. This was followed by increasing index values through the evaluation period as the input index declined more than the output index (Figure 44). The overall index in 2015 was 1.04, indicating higher productivity than in 2007. However, productivity gains were largely due to further reductions in input usage, with an index value in 2015 of half of that in 2007 (0.5 vs. 1.0). The decline in inputs was caused in part by decreases in the number of active vessels. In 2014 and 2015, the output index declined to and remained at a low of 0.53, nearly half 2007 levels (0.53 vs. 1). Despite the decreasing output index, the Lowe Index increased steadily from 2012-2015.



[134] See Murphy et al. (2018) for additional details.

Figure 44. Lowe Index (base year of 2007 = 1) of productivity change on groundfish trips taken by the limited access groundfish fleet, by fishing year.[135]

5.g.ii Net revenue analysis

Profitability is one metric commonly used to evaluate economic performance. Estimating profitability in commercial fishing requires a full account[136] of revenues, variable costs (costs associated with at-sea operation) and fixed costs (costs that are constant despite vessel operation). Sufficient data on the cost of crew as well as fixed costs are limited in the northeast region. Due to data limitations, trip costs including the cost of supplies, groceries, bait, fuel, ice, water and oil, are used to estimate net revenues (revenues less trip costs) resulting from groundfish trips. Trip cost data does not include costs associated with ACE leasing, crew, numeration, sector fees, or ASM costs due to data limitations; however, this report does provide some discussion of these costs in related sections (see section 4.b.vi). Net revenues are used here to track the financial performance of the groundfish fleet over the implementation of catch share management at the groundfish trip, vessel, and entity level.

In the net revenue analysis, in contrast to other analyses in this document[137], revenues include earnings from all species landed on groundfish trips[138], vessels, and entities. This becomes increasingly noteworthy when expanding the assessment from the trip to the vessel and finally to the entity-level. For example, if a vessel landed at least one pound of groundfish species under a LAGF on any trip within that fishing year, then all of the vessel's revenues and trip costs from that fishing year are taken into account in the net revenue assessment. This is true even on trips where no groundfish species were landed and the vessel was operating within a different fishery, given that the vessel took at least one groundfish trip[139] during that fishing year. In generating groundfish entities, a groundfish vessel[140] could be affiliated with a vessel that does not have LAGF permit but the revenues/trip costs from all affiliated vessels are taken into account for this analysis. This broader assessment of net revenues captures a more holistic view of groundfish businesses and their economic performance.

5.g.ii.1 Trip costs

Trends in trip costs per hour are important for interpreting trends in net revenues. Average and median trip costs per hour change marginally across the pre and post-catch share time period. Trip costs included in this analysis pertain to variable costs such as fuel, ice, bait, supplies, groceries, water and oil. The average cost of a trip per hour pre-catch share was $40.9/hour and increased to $43.4/hour post-catch share period (Figure 45). Median trip costs per hour were, overall, slightly lower than average trip costs and were marginally higher during the pre-catch share period relative to post-catch share, with rates of

[135] Data source: Murphy et al. 2018.
[136] Including data collected through census methodology or sampled through unbiased sampling methods where data can be used for revenue and/or cost estimation.
[137] Notably the Groundfish Performance Report (Murphy et al. 2018)
[138] Where, for the net revenue analysis, a groundfish trip is defined as any commercial fishing trip that lands a groundfish species (>1lb) while operating under a limited access groundfish permit (LAGF).
[139] Ibid.
[140] The classification of a groundfish vessel pertains to any vessel that took at least one groundfish trip, as previously defined in the net revenue analysis section, during a specific groundfish fishing year (FY).

$34.1/hour and $33.3/hour, respectively Average and median trip costs per hour are largely influenced by average fuel prices, as fuel expenditures generally account for a large share of total trip costs[141]. Average hourly trip costs mirror trends in average New England fuel prices, both of which peak in fishing year 2012 ($50.1/hour and $3.8/gallon, respectively) and decrease to a minimum value in 2015 ($32.1/hour and $2.4/gallon, respectively).[142] Median trip costs per hour also reached a low point in 2015, but peaked in 2007 with a median rate of $39.2/hour. This may suggest that vessels with low fuel efficiency, possibly driven by older, non-upgraded vessels, were more active during the pre-catch share period. This is further supported by the trends in fleet characteristics, which show a decline in average vessel age post-catch share enactment suggesting possible increases in fleet efficiency post-catch share (see Figure 18). The difference between average and median hourly trip costs demonstrates a skewed distribution of trip types with fewer trips incurring higher hourly costs than the majority of trips taken. Overall, trip costs per hour changed marginally over the pre and post-catch share time periods and mirrored trends in average New England fuel prices.

Vessel age

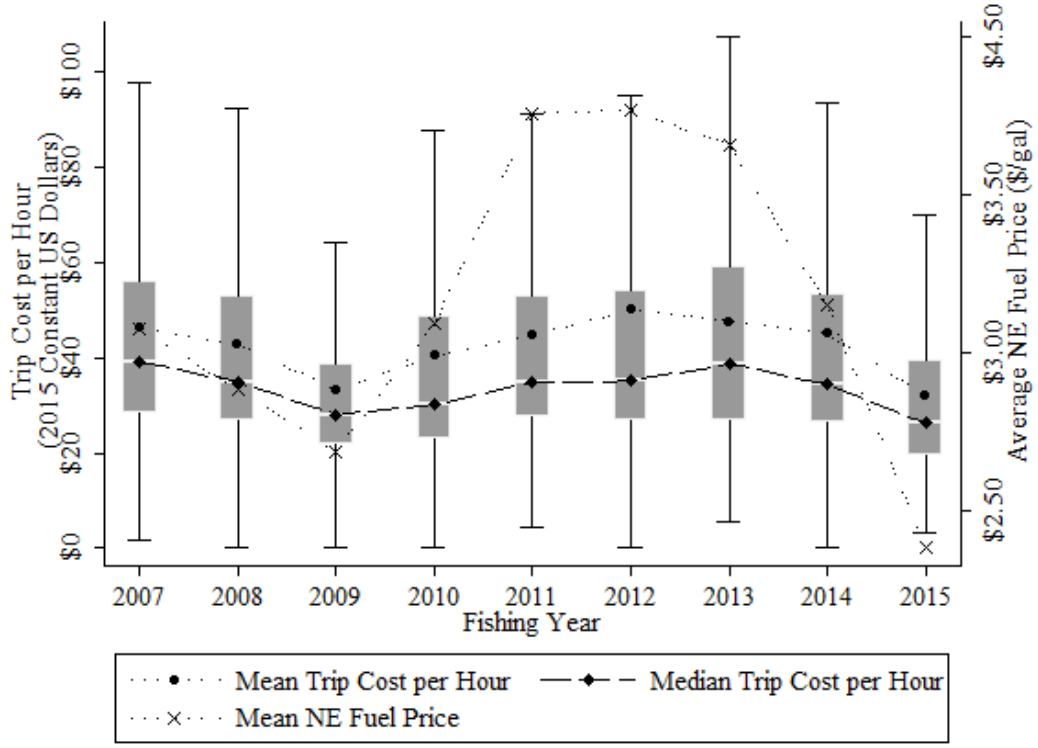


Figure 45. Average and median trip per hour costs by fishing year, 2007-2015, adjusted to 2015 constant US dollars.[143]

[141] Das 2013 reported that fuel expenditures account for 78% of total trip costs.
[142] Monthly New England PADD 1A retail gasoline prices in dollars per gallon (all grades and formulations) were accessed via the U.S. Energy Information Administration website and averaged by groundfish years. Values reflect non-adjusted US dollars. Source: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emm_epm0_pte_r1x_dpg&f=m
[143] Werner, 2019.

5.g.ii.2 Trip-level net revenue analysis

Net revenues, assessed at the trip, vessel, and entity-level, can reflect changes in fleet economic performance. Both average and median groundfish net revenues, assessed at the trip-level, were higher post-catch share implementation. Average net revenues for the 2010-2015 period (ranging from $5.5K to $8.6K per trip) were almost two times those averaged over 2007-2009 (ranging from $3.5K to $3.8K per trip) (Figure 46). Average net revenues on groundfish trips more than doubled from 2009 to 2010 from $3.6K to $7.8K, followed by declines in 2011 and 2012, and subsequent increases for 3 consecutive years. Median net revenues were also higher during the 2010-2015 time period comparatively to the pre-catch share period but are notably lower than average net revenues. Median net revenues during the pre-catch share time period range from $1.3K to $1.6K, comparatively to $2.0K to $2.7K over the post-catch share period. Maximum average net revenues per trip were earned in 2015 ($8.6K) and maximum median net revenues earned were in 2010 ($2.7K). The large difference between average and median net revenues demonstrates the disparity in earnings, where few trips earn extremely high net revenues relative to the larger majority of trips. Lastly, the decrease in fishing trips along with increases in net revenues may indicate decreases in excess capacity within the groundfish fleet during the post-catch share period.

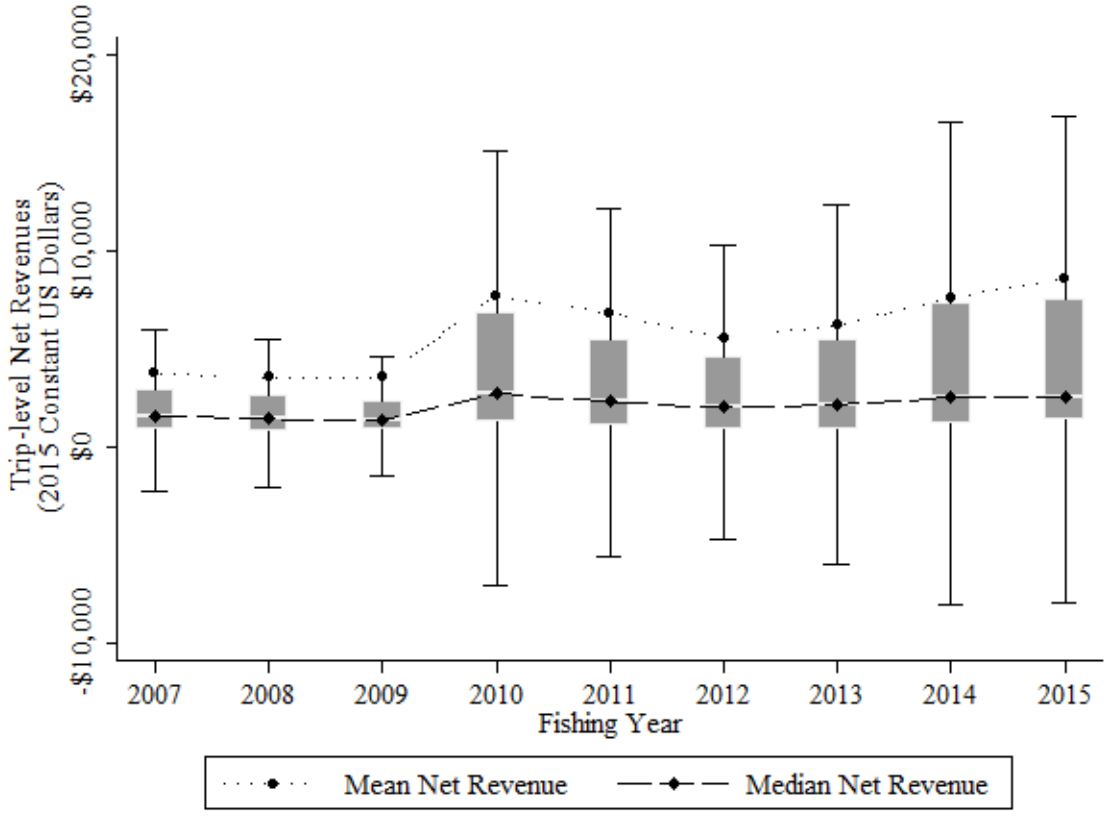


Figure 46. Average and median net revenue per groundfish trip by fishing year, 2007-2015.[144]

[144] Ibid.

5.g.ii.3 Vessel-level net revenue analysis

Net revenues per groundfish vessel were generally higher after the implementation of catch share management, as observed in trip-level net revenues. Average net revenues per vessel ranged from $199K to $224K (an average of $210K) over 2007-2009 to $283K to $364K (an average of $325K) over 2010-2015 (Figure 47). This represents a 55% increase in average net revenues from the pre to post-catch share time period. The largest inter-annual increase in average net revenues (41%) occurred between 2009 and 2010. From 2011, average net revenues decreased for 2 consecutive years, to $283K in 2013, but rose and peaked in 2015 ($364K). As with average net revenues, median net revenues at the vessel-level are higher during 2010-2015, ranging from $180K-$231K compared to $138K-$162K during 2009-2007, an increase of 36% when comparing average median values between the two time periods. There is higher variability in net revenues over 2010-2015, comparatively to 2007-2009 and interquartile ranges (IQRs) increase in the positive direction when comparing the pre and post-catch share time periods. The increase in the skewness of the distributions indicate that there are a few vessels earning extremely high net revenues comparatively to the rest of the fleet during the post-catch share period.

Median net revenues - for all vessel size groups - were lower on average, during the three-year period prior to catch share management than the following six-year period (Figure 48). During the nine-year period, minimum net revenues were earned in either FY 2007 or 2008 for most vessel size classes, and maximum net revenues occurred in either FY 2011 or 2015. Only vessels less than 30 feet earned negative median net revenues in any of the years analyzed. With the exception of the less than 30 feet size class, median net revenues increased across all vessel size classes from 2009-2011 and decreased from 2011 to 2012. In addition, median net revenues increased across all vessel size classes from 2014 to 2015. Generally, all vessel size classes incurred large percent increases in median net revenues during the 2008-2009, 2009-2010, or 2010-2011 time periods, while median net revenues earned during 2007-2008 changed marginally within each vessel size class.

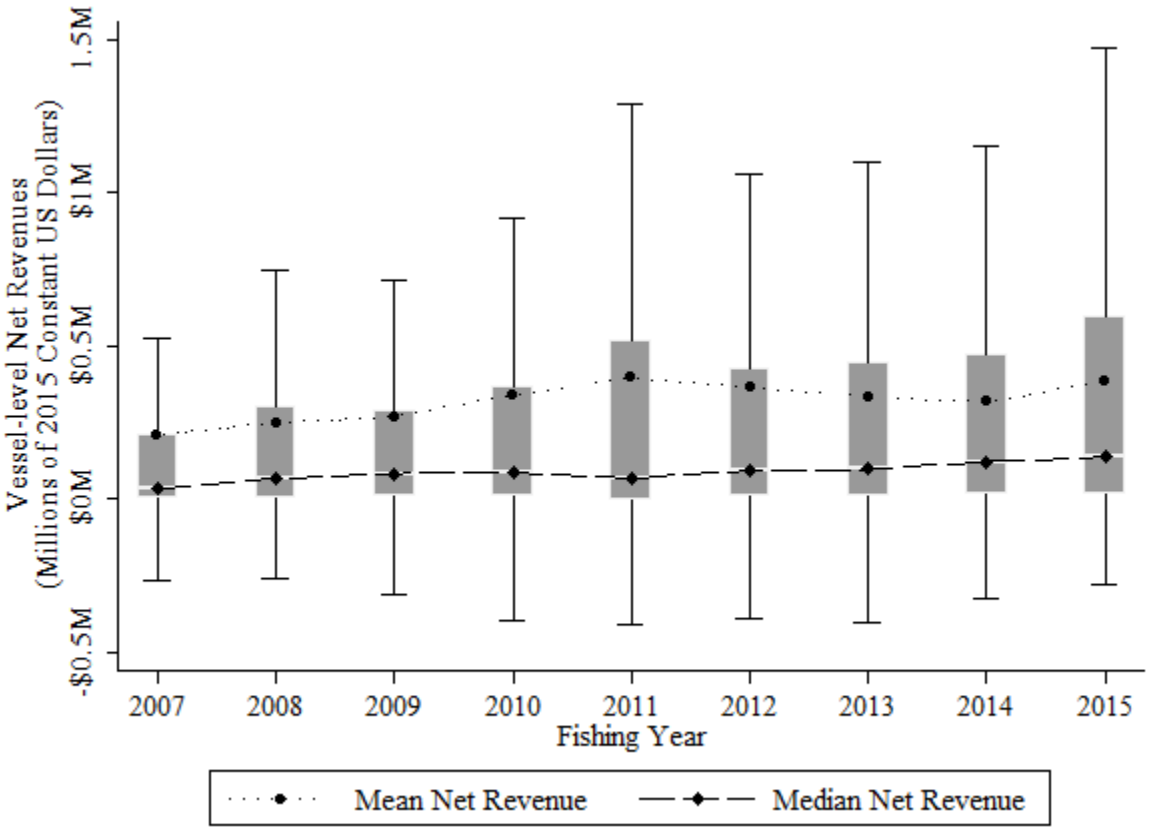


Figure 47. Average and median groundfish vessel net revenues by fishing year, 2007-2015.[145]

[145] Ibid.

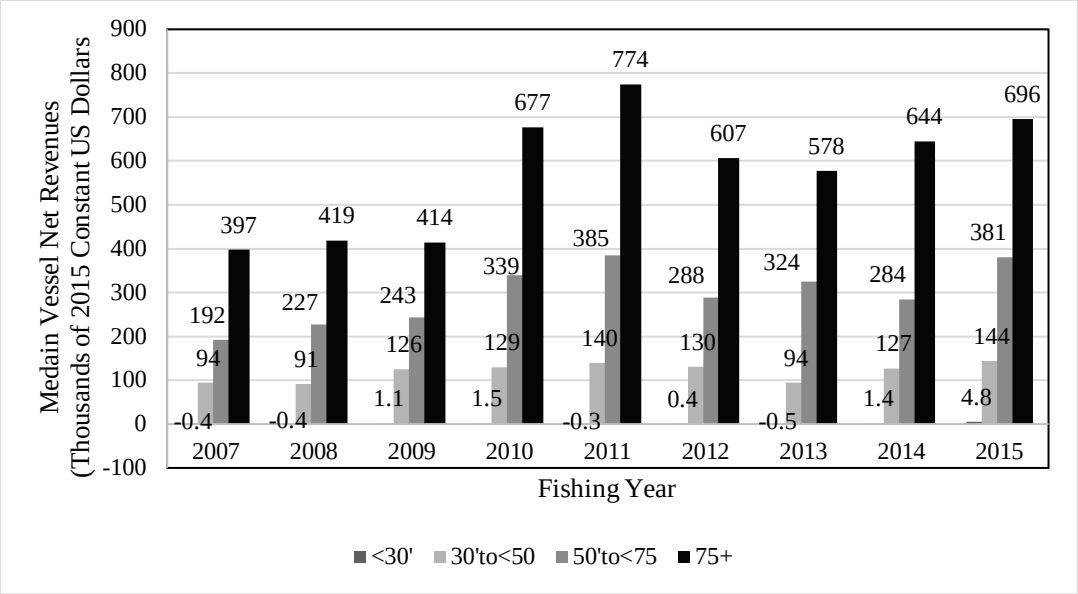


Figure 48. Median net revenues by vessel size class, 2007-2015.[146]

5.g.ii.4 Entity-level net revenue analysis

To convey a more holistic view the economic performance of groundfish businesses, net revenues are also reported at the entity-level.[147] Average groundfish entity net revenues varied during the post-catch share implementation time period- peaking in 2011 at $583K then decreasing for two consecutive years, and then rebounding in 2014 and 2015 to $537K (Figure 49). Median entity net revenues increased from 2010 to 2011 and decreased to a minimum value of $180K in 2013 before increasing to the 6-year maximum value ($231K) in 2015. Skewness of net-revenues at the entity-level, as with the trip and vessel-level analyses, is evident in all years post-catch share implementation.

On average, median net revenues earned from entities with two vessel affiliates are 0.7 times larger than those earned by single-vessel entities (Figure 50). Entities associated with 3 vessels earned median net revenues 1.5 times higher on average than entities affiliated with 2 vessels. Further, 2 entities with 4 vessels earned median net revenues that are about 1.2 times greater than those of entities with 3 vessel associates. Notably, entities with 5 or more vessels earned median net revenues 5.7 times larger than those affiliated with 4 vessels, on average. The differences in net revenue earnings between entity size groups increased over 2010-2015 for most comparisons.

[146] Ibid.

[147] Groundfish entities are created based on the guidance of the Regulatory Flexibility Act (RFA) definition, such that entities are based on unique ownership groups.

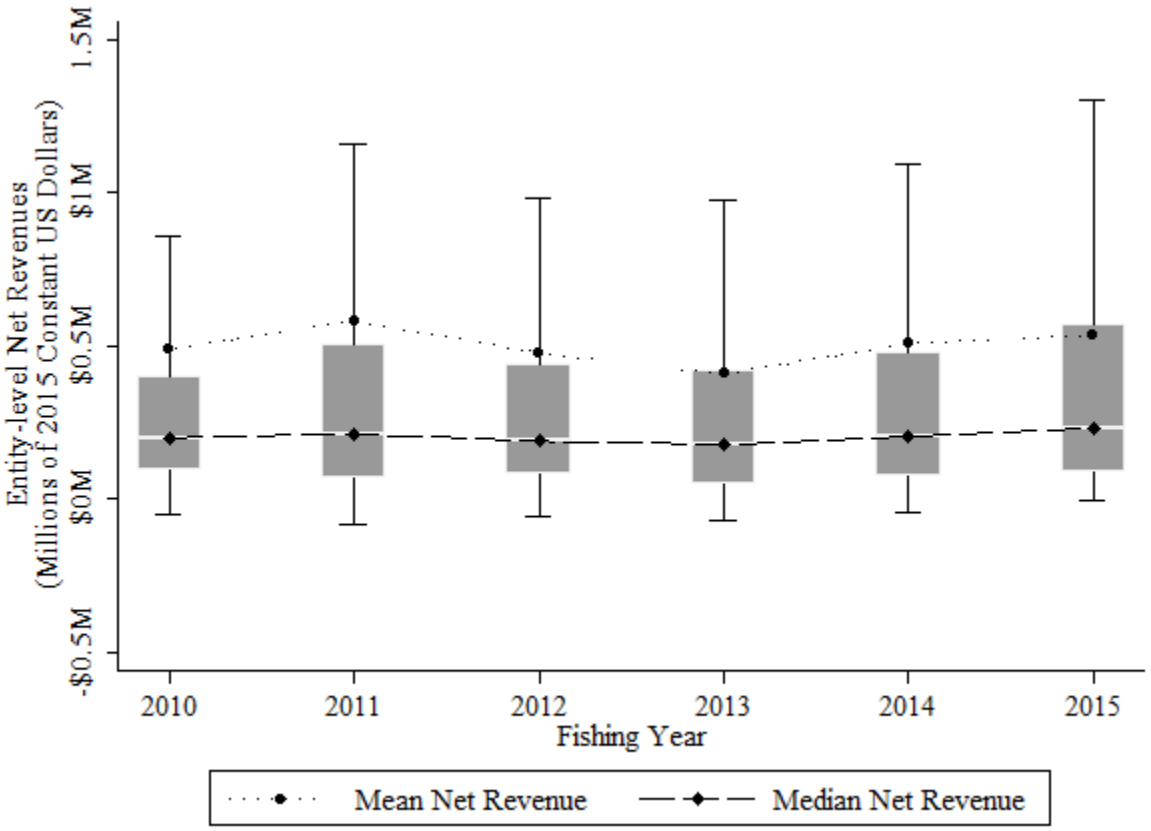


Figure 49. Average and median groundfish entity net revenues by fishing year, 2010-2015.[148]

[148] Ibid.

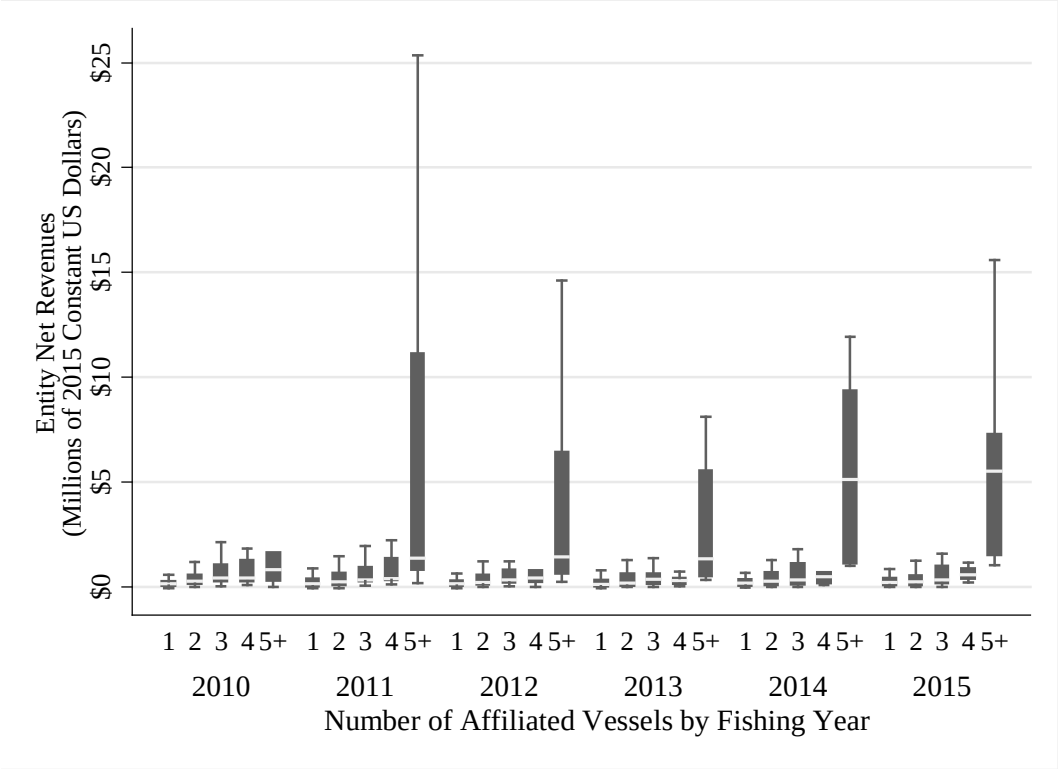


Figure 50. Entity net revenues by number of affiliated vessels by fishing year, 2007 – 2015[149].

5.h Catch and sustainability

Catch shares generally offer fishermen more flexibility on when to fish for their quota, thereby enabling the fishery to better stay within catch limits. However, decreased biomass for some stocks have constrained the ability of the fishery to target more abundant stocks. Generally, across the evaluation period, most stocks were caught at 80% or less of their available quota, with very few quota overages on allocated stocks.

5.h.i Status of regulated stocks

The status of groundfish stocks has not changed considerably over recent years. The proportion of stocks subject to overfishing increased from 26% to 42% between 2000 and 2003, where it remained until 2012, to ultimately decrease to 36% in 2015 (Figure 51). Where average fishing mortality rate equals 1, F is equal to F_{MSY}. Only three stocks – GB haddock, pollock, and redfish – did not experience overfishing in any year. The average fishing mortality rate varied slightly over the evaluation period, with a peak in 2012 followed by subsequent declines (Figure 52). This apparent stability in aggregate measures masks considerable variability in fishing mortality rates on individual stocks. Fishing mortality rates increased for several species (SNE/MA yellowtail flounder, SNE/MA winter flounder, GOM winter flounder, and GB winter flounder), while decreased for others (GB cod, eastern GB cod, GOM cod, eastern GB haddock, CC/GOM yellowtail flounder, and witch flounder). Extreme overfishing ($F/F_{MSY} > 1.5$) remained common for some species. For instance, eastern GB cod, GB cod, GOM cod, and witch

[149] Werner 2020

flounder experienced extreme overfishing for all six years of the catch share period, while CC/GOM yellowtail flounder and SNE/ MA yellowtail flounder experienced extreme overfishing in 4 of the years. In contrast, Acadian redfish, all three winter flounder stocks, haddock, and Atlantic pollock were fished below overfishing limits for all six years of the catch share program.

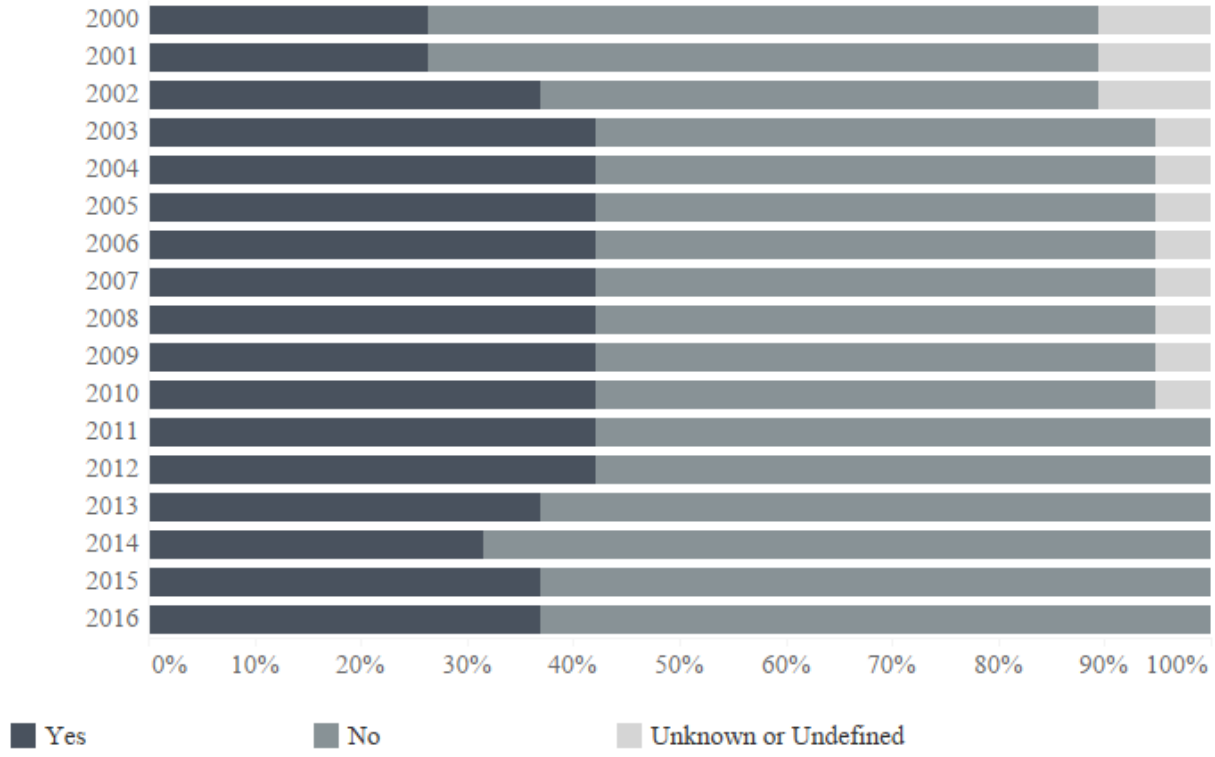


Figure 51. Proportion of regulated groundfish subject to overfishing in each year for 2000 – 2016.[150]

[150] Data provided by NOAA Fisheries Office of Sustainable Fisheries, February 2020.

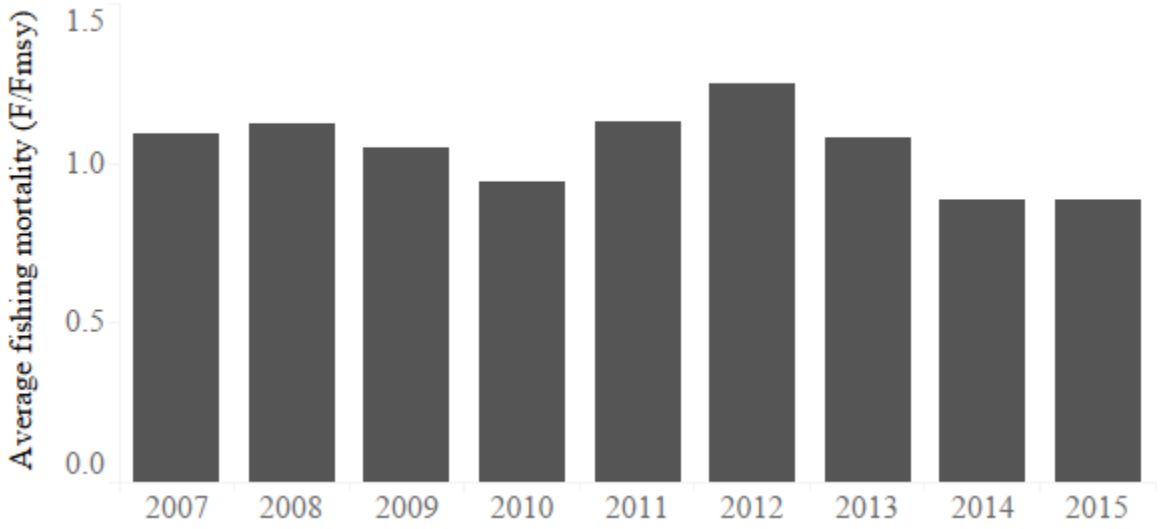


Figure 52. Average fishing mortality rate for groundfish stocks.[151]

From 2000 to 2016, there was variability in the proportion of stocks overfished, with an increase to a high of 52.6% of stocks overfished following implementation of the catch share program. The proportion of stocks overfished in general did not demonstrate notable increasing or decreasing trends (Figure 53). Average biomass across managed stocks has changed little during the nine-year period. Where average biomass equals 1, B is equal to B_{MSY}. Although the average biomass ratio of allocated stocks increased from 2010 to 2015 by 21%, the proportion of stocks overfished remained just above 36% since implementation of the sector program (Figure 54). The aggregate picture of stock status masks considerable differences in individual stock status. Both GB and GOM cod stocks remained overfished during 2010 through 2015, as did SNE/MA yellowtail flounder. In contrast, other stocks have recovered from historical overfishing, and other stocks have reached high abundances. Most prominently, haddock stocks are all well above B_{MSY}. In general, few stocks exhibited either a strong positive or negative change in status during the first six years of the catch share program, and it may take one or more fish generations (at least 5 years) to see improvements in biomass levels.

[151] Analysis from Measuring the Effects of Catch Shares: http://www.catchshareindicators.org/northeast/ecological-indicators/fishing-mortality/

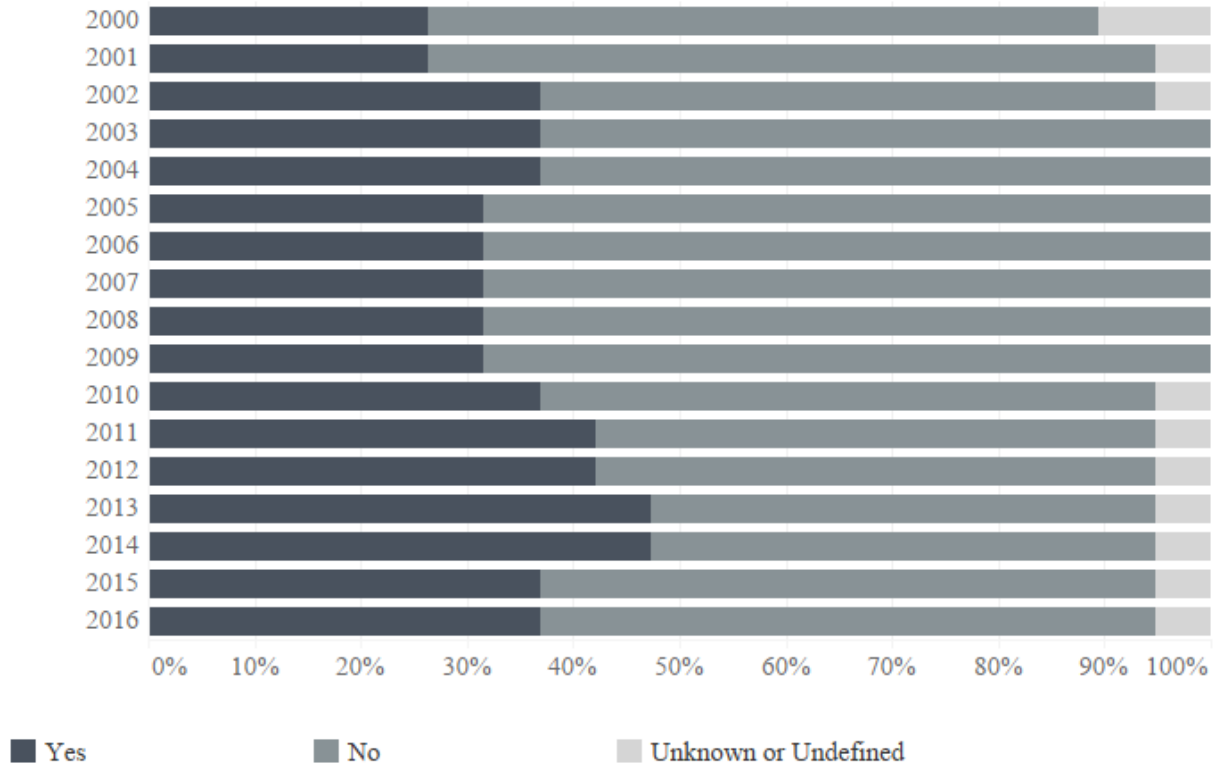


Figure 53. Proportion of regulated groundfish overfished in each year for 2000 – 2016.[152]

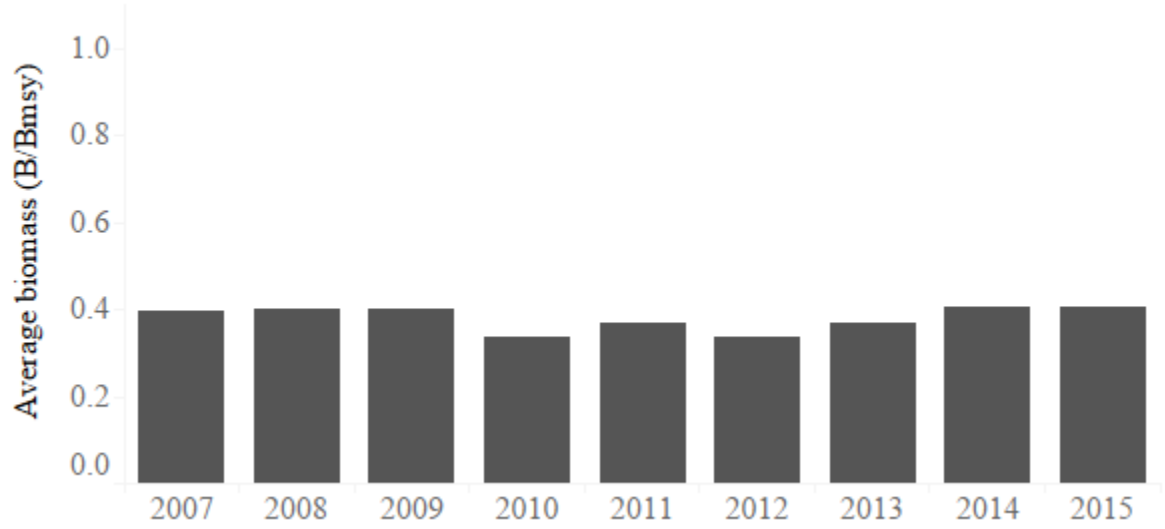


Figure 54. Average biomass for groundfish stocks.[153]

[152] Data provided by NOAA Fisheries Office of Sustainable Fisheries, February 2020.
[153] Analysis from Measuring the Effects of Catch Shares: http://www.catchshareindicators.org/northeast/ecological-indicators/biomass/

5.h.ii Catch limits

Under days-at-sea management stocks were not managed to strict catch limits, and fishermen did not have strong incentives to avoid overfished species. However, fishermen in the groundfish fishery had difficulty catching large amounts of available fish due to few days-at-sea or low trip limits for overfished species like Atlantic cod. Management response to depleted species was to reduce the number of allowable days-at-sea, which prevented the fishery from catching abundant and healthy stocks resulting in low catches of some target species compared with target catch limits. In most cases, fishery-wide catch limits prior to implementation of the sector program were set as targets, complicating any comparison between pre and post-catch share periods.

Catch share programs do not directly affect decisions about ACLs, but indirectly can affect determinations because of the enhanced catch accounting and monitoring requirements (Sections 4.b.xi and 5.d.ii) that are implemented with the program, which can reduce management uncertainty and scientific uncertainty. The AMs implemented together with the intended increased levels of at-sea observer coverage (Section 5.d.ii) were expected to contribute to a reduction in uncertainty. However, the ACLs for many stocks have fluctuated or decreased, and biomass estimates for some stocks decreased since the implementation of the catch share program. Under the sector program, catch limits are set annually for regulated stocks (Section 4.a) with sectors receiving a sub-ACL as depicted in Figure 60; minor changes to the proportion of the commercial groundfish sub-ACL that is allocated to sectors may result from permits moving between sectors and the common pool. There have been some considerable changes in the annual allocations to the sector program from FY 2010 to 2015 (Figure 55). Over the six-year period from 2010 to 2015, half of the allocated stocks experienced cuts in sector sub-ACLs: eastern GB cod (-62.7 percent), western GB cod (-47 percent), GOM cod (-95.4 percent), western GB haddock (-46.3 percent), GB yellowtail flounder (-75.2 percent), CC/GOM yellowtail flounder (-40.1 percent), American plaice (-49.7 percent), pollock (-15.7 percent). For eight stocks, the sector sub-ACL was higher in FY 2015 than in FY 2010: eastern GB haddock (+26.3 percent), GB winter flounder (+2.7 percent), GOM haddock (+18.4 percent), GOM winter flounder (+178.8 percent), Acadian redfish (+62.4 percent), SNE/MA yellowtail flounder (+95.8 percent), white hake (+72.1percent), and witch flounder (+27.9 percent). SNE/MA winter flounder, a stock that was first allocated to the fishery in 2013 also displayed a slight increase in sector sub-ACL (+ 6.8 percent) between 2013 and 2015.

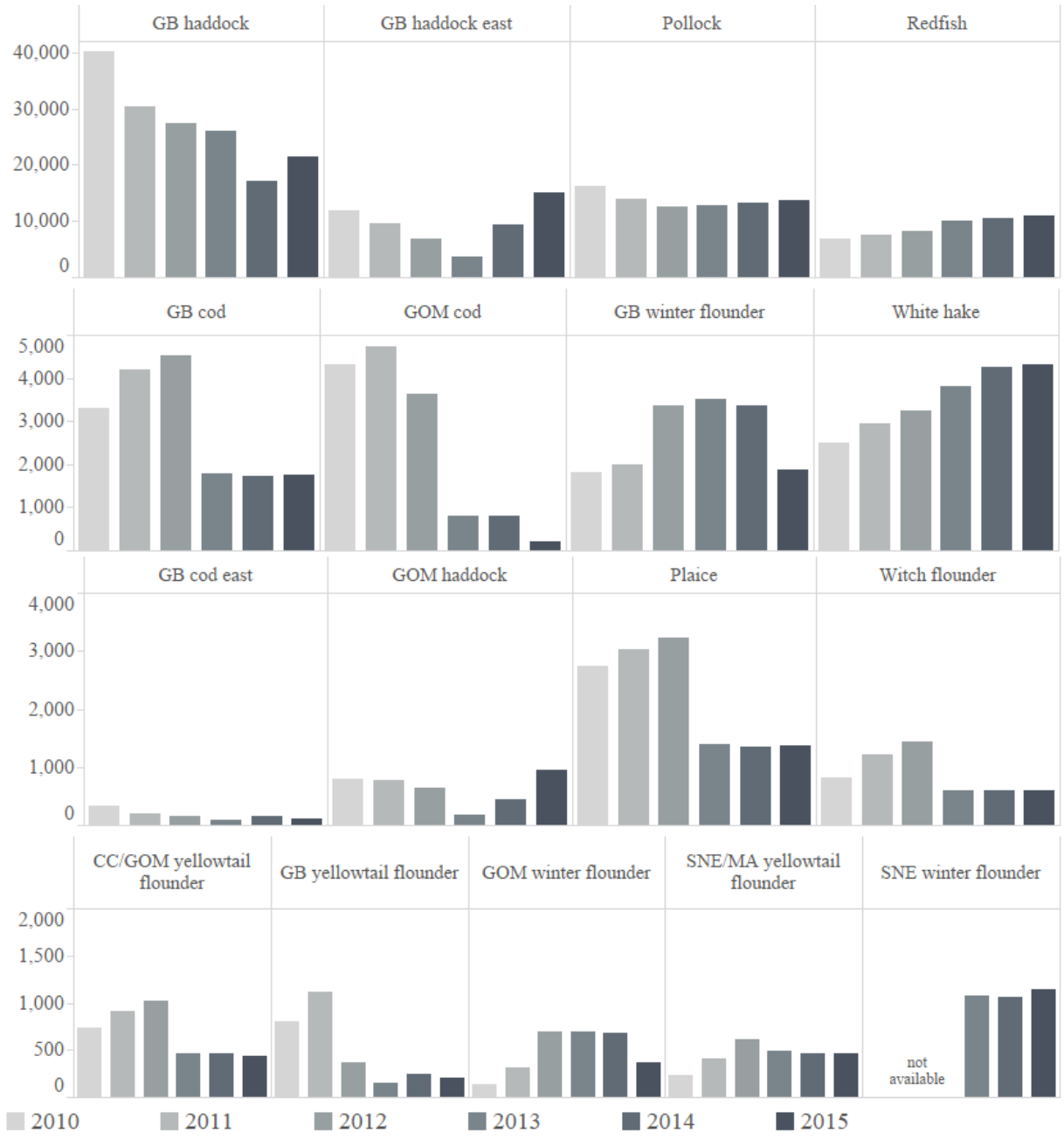


Figure 55. Changes in annual catch limits allocated to the sector program for fishing years 2010-2015.[154]

Over the first six years of the program, the common pool sub-ACL for allocated groundfish has averaged 1.2% (or 862 lb) while the sector sub-ACL has averaged 98.8% (or 67,685 lbs) (Figure 56). The sector program has consistently landed over 97% of the total groundfish landings (Figure 57). Interestingly, the sector program has dominated the allocation and landings in the fishery, but the common pool has

[154] Data source: GARFO Groundfish Monitoring Reports

maintained 38-48% of the MRIs in the fishery; this illustrates that the large majority of allocation are linked to sector program permits.

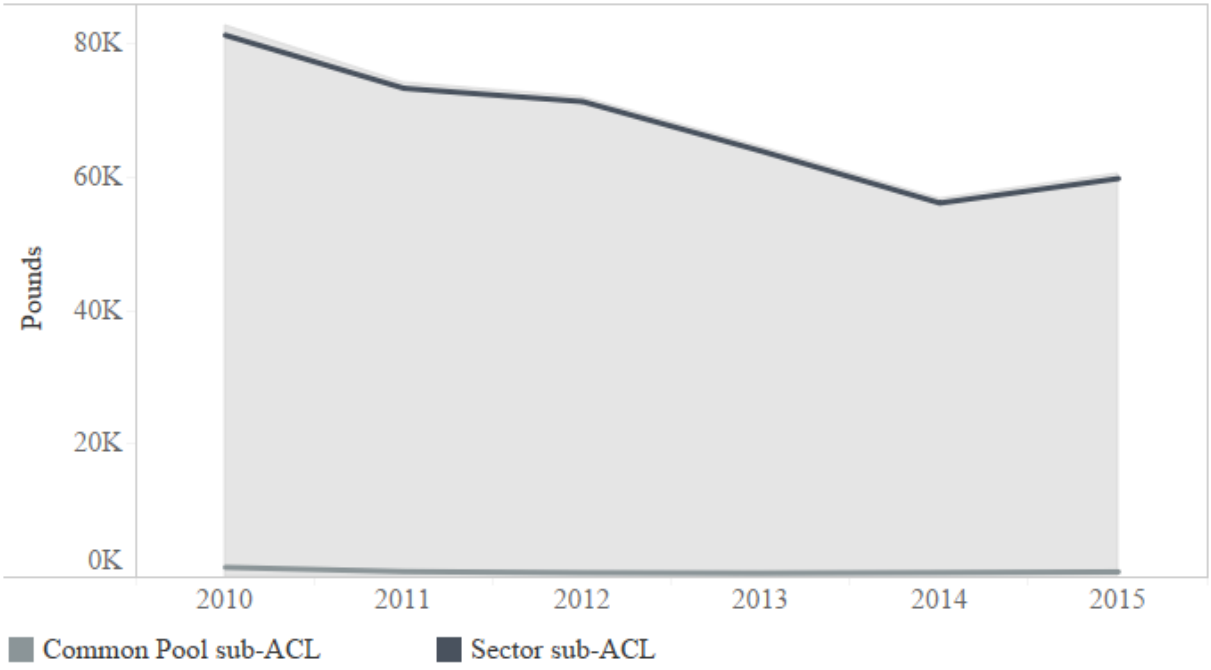


Figure 56. Total groundfish sub-ACL (lbs) denoted in gray area, along with allocation to the sector program and common pool, 2010-2015.[155]

[155] Ibid.

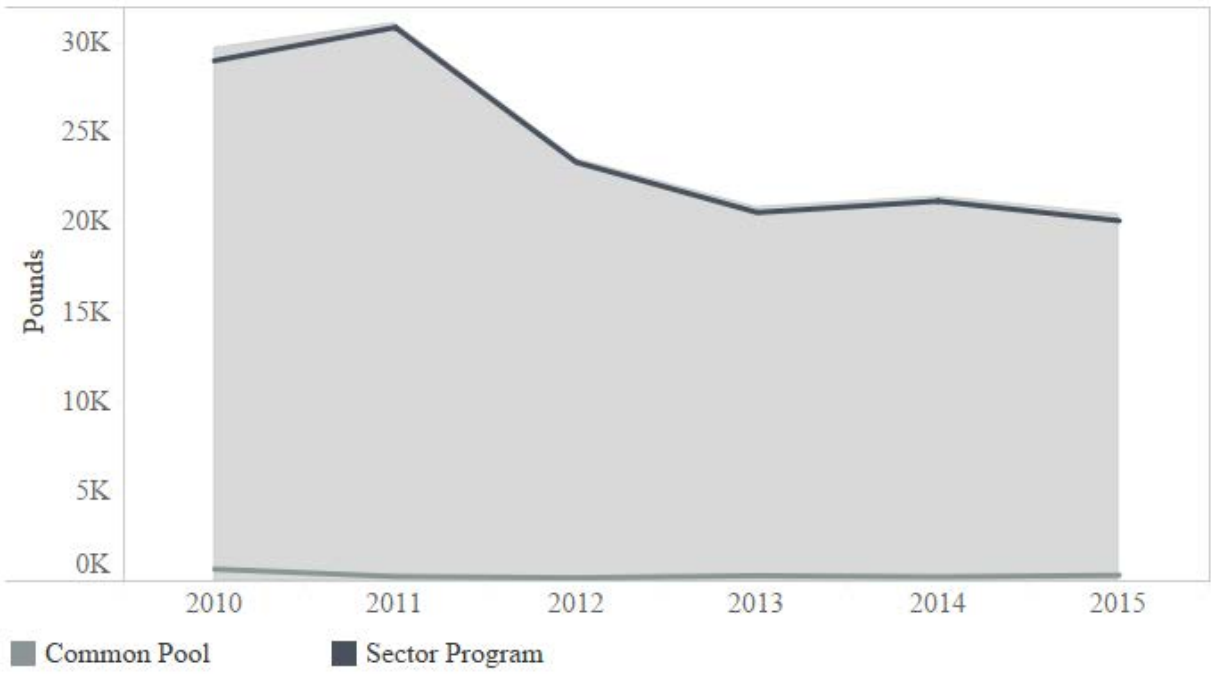


Figure 57. Total groundfish landings (lbs) denoted in gray areas along with landings by the sector program and common pool.[156]

5.h.ii.1 Total groundfish catch utilization

Across fishing years, the majority of allocated groundfish stocks were caught below their total ACLs, with the exception of GOM haddock in FY 2013 and 2014 at 147.9% and 159%, respectively. In FY 2013, overages in both the common pool (108.9%) and the recreational fishery (312.2%) contributed to the overall catch over the stock ACL; in FY 2014 it was the recreational overage (380.7%) that contributed. In both years, accountability measures were implemented on these fishery components. However, the GOM haddock sub-ACL for the sector program was not exceeded in any year.

Among non-allocated stocks, Atlantic halibut, northern and southern windowpane each had catch exceeding total ACLs in multiple years, triggering AMs for both northern and southern windowpane flounder stocks (Table 18). In FY 2015, Atlantic halibut catch exceeded the total ACL by 105.2%, the state water sub-component contributed with an overage of 137.1%. The total ACL overage was within stock specific buffer thresholds and therefore no accountability measures were implemented. Atlantic halibut AMs only apply to the groundfish fishery (sectors + common pool) and there no AMs applied to the state waters sub-component.

Catches of both northern and southern windowpane flounder have exceeded ACLs in nearly every year (Table 18). For both stocks, overages have been the result of catch from multiple fishery components across all fishing years. In FY 2012 (FW47), AMs restricting bottom otter trawl gear access to certain

[156] Ibid.

areas were developed for both windowpane flounder stocks. The magnitude of the overages would dictate the size of the gear restrictive AM areas. Initially only applied to the groundfish fishery (sectors and common pool), Framework 48/50 revised the AM for southern windowpane flounder to include "other" fisheries that use bottom otter trawl gear with codends of 5" or larger mesh size.

Overages in FY 2012 implemented the AM restricted gear areas in FY 2014 for both stocks. Later in FY 2014, the southern windowpane flounder AM area was reduced based on criteria developed under FW 52. Overages for northern windowpane in FY 2013 and 2014 implemented the AM area in FY 2015; the overage of southern windowpane in FY 2013 was within stock specific buffer thresholds and therefore didn't trigger an AM. Overages for both stocks in FY 2015 resulted in both AM restricted gear areas being implemented in FY 2017 but only for one month as both stocks had an underage in FY 2016. Stock and fishery specific utilization tables for all groundfish stocks are expanded in Appendix 8.d.

Table 18. Percent usage of total ACL for both stocks of windowpane flounder by fishing year. Overages indicated in italics triggered accountability measures.[157]

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
northern windowpane flounder	*101.0%*	*118.8%*	*128.2%*	*195.0%*	*187.5%*	*131.8%*
southern windowpane flounder	*237.7%*	*224.0%*	*136.7%*	*105.3%*	90.8%	*122.1%*

5.h.ii.2 Sector utilization of allocated stocks

Sector utilization[158] of stock sub-ACLs allocations varied considerably by fishing year and allocated stock. The average catch to quota (utilization) has been variable over the six-year period with a declining trend for both sector program and common pool participants. On average annual catch-to-quota ratios (total annual utilization) over all stocks have ranged from 51 to 67 percent for sector vessels and 22 to 52 percent in the common pool (Figure 58).

[157] Data source: GARFO Groundfish Monitoring Reports
[158] Independent of previous fishing years carry-over.

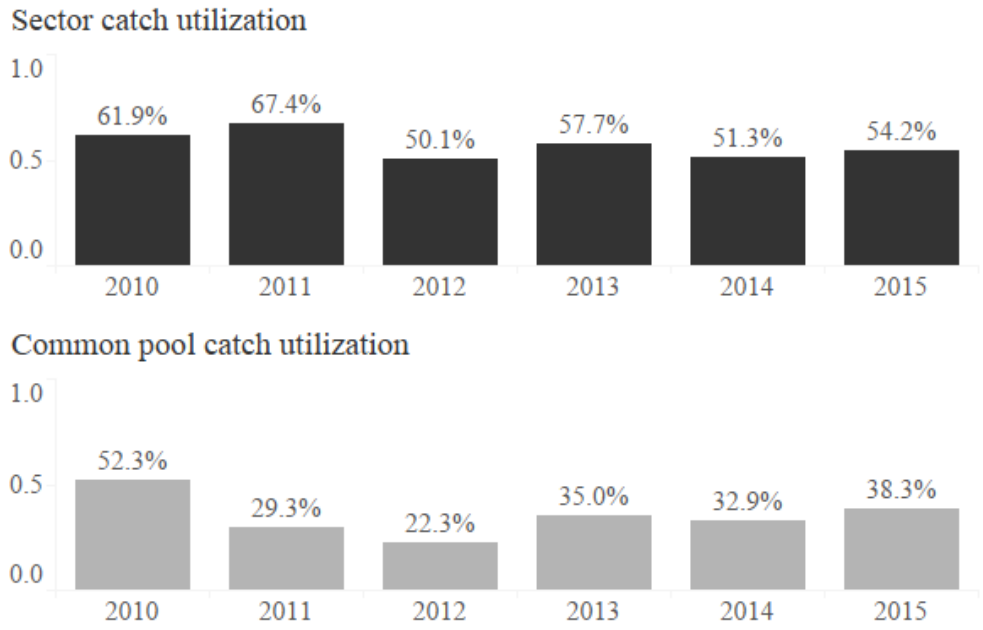


Figure 58. Average catch utilization for sector program (top) and common pool (bottom) participants.[159]

For the 16 stocks that had allocations for every year of the program, 10 stocks had catches equal to or exceeding 50 percent of the quota, on average. Catch-to-quota ratios (total annual utilization) across all stocks have fluctuated from roughly 50 to 70 percent. Still, some stocks were consistently fished well below quota levels, most notably both eastern and western GB haddock, pollock and redfish. The continued inability to harvest the allowable quotas for abundant species is in part a reflection of highly constraining stocks with very low allocations, such as GOM cod and GB yellowtail flounder (Figure 55). Large catch overages did not occur for any stock; though catch of only two stocks by sector program participants exceeded their respective sub-ACL in one fishing year each during the time period (Figure 59).

GOM cod and witch flounder catch exceeded 80% quota utilization in five out of six years, followed by CC/GOM yellowtail flounder usage in four fishing years, and western GB cod and American plaice in three fishing years. Two stocks were consistently well below their available quotas (< 50 % utilization rate) in every fishing year - eastern and western GB haddock. redfish was caught at a rate below 50% utilization for five fishing years, and GOM winter flounder and pollock were caught below 50% utilization for four fishing years.

During the six-year evaluation period, in each year select stocks were caught closer to their available quotas (> 80% utilization) and others well below (< 50% utilization). Fishing year 2014, however, saw the lowest quota utilization rates across allocated stocks, with ten out of seventeen stocks achieving less than 50 % catch-to-quota; this year also saw considerable decreases across sub-ACLs (Figure 55).

[159] Data source: GARFO Groundfish Monitoring Reports

The sector sub-ACL was exceeded for only two stocks in two years during the evaluation period. White hake was caught at 102.3% of its sub-ACL in FY 2011; however, there was sufficient FY 2010 carryover quota to cover the overage and no accountability measure was implemented for FY 2012. Witch flounder sub-ACL was exceeded in FY 2013 (106.6%), this was a result of changed carry-over rules affecting the available quota. A 10% carryover quota (from FY 2012) was expected to be applied to the FY2013 initial allocation, however the 10 % carryover rules applied to sectors were changed in the final month of the fishing year. This overage triggered the pound for pound payback AM for those individual sectors that exceeded their allocation and their *de minimus* amount of carryover for witch flounder.

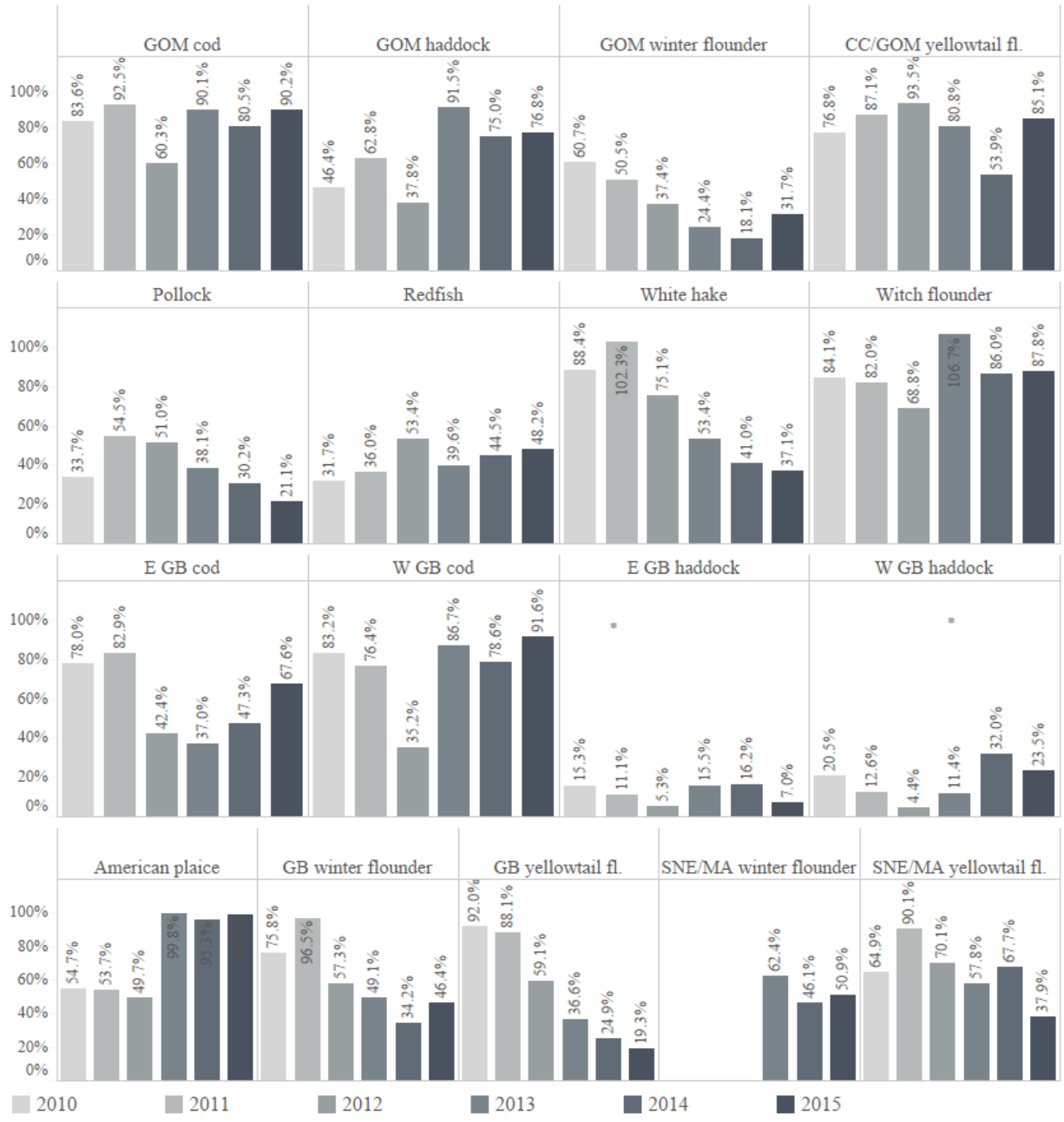


Figure 59. Percentage of sector sub-ACL caught for all sectors combined by fishing year and allocated stock. The percentage of catch reflects total catch against the corresponding fishing year

sector sub-ACL which does not include the previous fishing years' carryover. Catch of only two stocks (*) exceeded their respective sub-ACL in one fishing year each.[160]

Across most stocks, while utilization rates were low, the catch tracks the trend of available quota across fishing years (Figure 60), suggesting that catch proportionally tracked available quota. Specifically, catch of constraining stocks (such as GOM cod and haddock), those with steep declines in available quota, likely affected the catch of other allocated groundfish. However, in other stocks, such as eastern GB and western haddock and GOM winter flounder, the sub-ACL may have had limited influence on the catch of that stock. In extreme cases such as white hake and pollock, there is a divergence between the two metrics indicating that perhaps the sub-ACL is not reflective of the biomass available to the groundfish fishery. For GB yellowtail flounder, catch tracked closely to the sub-ACL that reached its lowest point in FY 2013, and the catch remained low even after the sub-ACL increased. This would indicate that the fishery moved away from catching GB yellowtails even as the sub-ACL started increasing. American plaice displayed an opposite trend where the sub-ACL did not have an influence on the catch until the sub-ACL was significantly lowered in FY 2013. This would indicate that the groundfish fishery was at its "carrying capacity" for catching this stock in the first four years but then as the sub-ACL was reduced the industry had to reduce effort on this stock.

[160] Data source: GARFO Groundfish Monitoring Reports

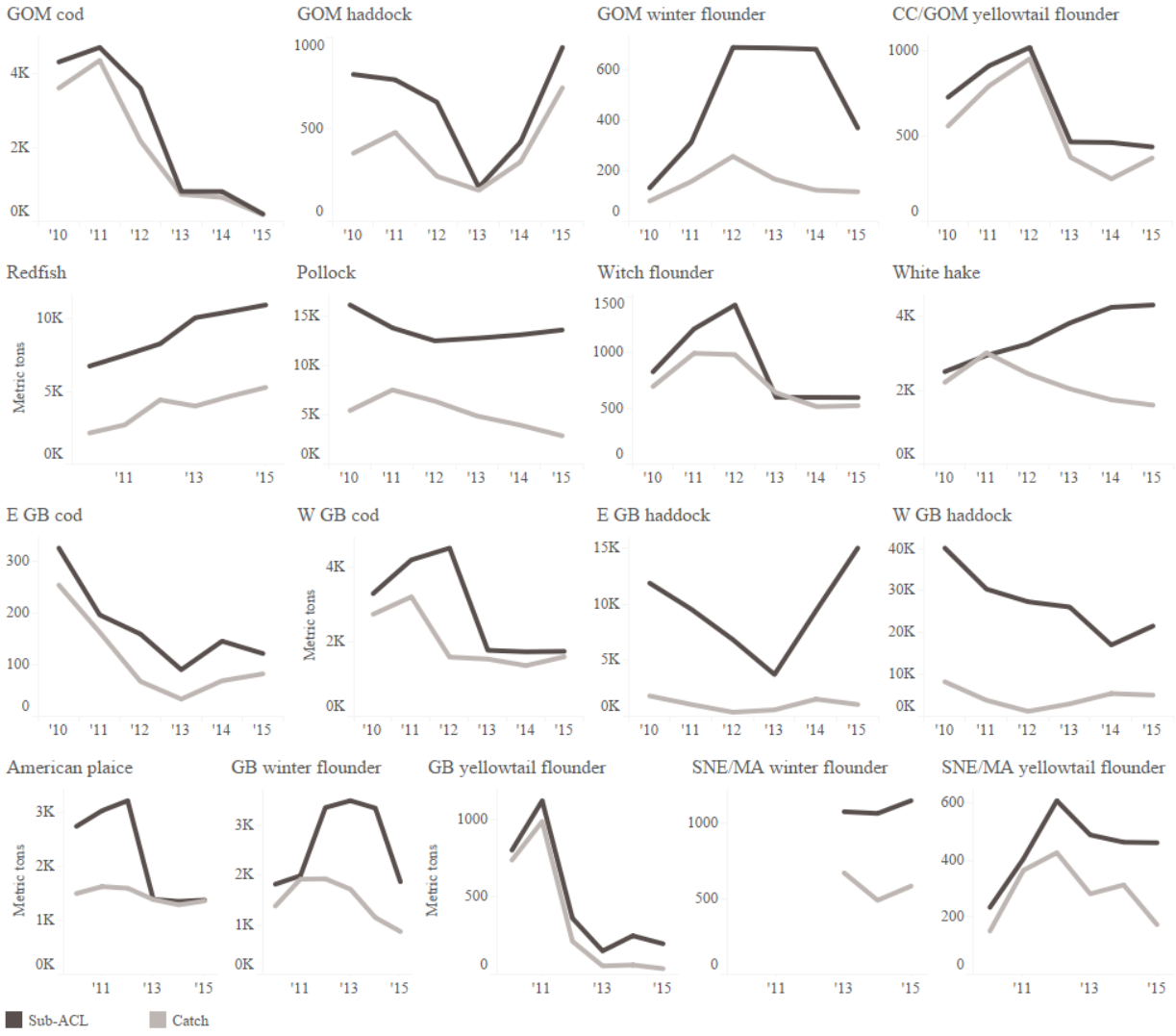


Figure 60. Sector sub-ACL and catch for all allocated stocks by fishing year in metric tons.[161]

5.h.ii.3 Common pool utilization of allocated stocks

For the 16 stocks that had allocations for every year of the program, 3 stocks were fished at catches equal to or exceeding 50 percent of the quota, on average, in the common pool. The common pool fishery has struggled even more to catch quotas and was less successful at avoiding large catch overages. The average annual ratio was highest at 53 percent in the initial year but declined to around 20 to 30 percent thereafter (Figure 58).

While sectors were able to achieve a high utilization (> 80 %) across about one-third of the stock/fishing year combinations, the common pool achieved fewer high utilization rates. Low utilization (< 50 %) was more pronounced in the common pool than in sectors. Catches across a number of stocks declined

[161] Data source: GARFO Groundfish Monitoring Reports

steadily over the time period, notably GB haddock, pollock, GB yellowtail flounder and GB winter flounder.

Fishing year 2010 was the most proficient catch year, with high utilization rates across five allocated stocks (Figure 61). There were fewer stocks being highly utilized for every other year during the time period. GOM cod and SNE/MA winter flounder were the most fully utilized stocks with three out of six years exceeding 80 % usage. Eastern and western GB haddock as well as GB winter flounder and redfish were consistently underutilized in all six fishing years.

The common pool had two overages greater than 10% during the evaluation period: witch flounder in FY 2010 and eastern GB cod in FY 2014. Fishing year 2011 saw an accountability measure for the witch flounder overage, an increase in the days-at-sea accounting for common pool trips in regions where witch flounder are predominantly caught. Fishing year 2014 GB cod sub-ACLs for the common pool were reduced by 2.3 MT and by 1.2 MT for GOM haddock to account for overages in FY 2013; though these overages were at 1% and 8.9% above quotas, respectively. The sub-ACL for eastern GB cod in FY 2015 was reduced by 1.3 MT for the common pool overage in FY 2014.

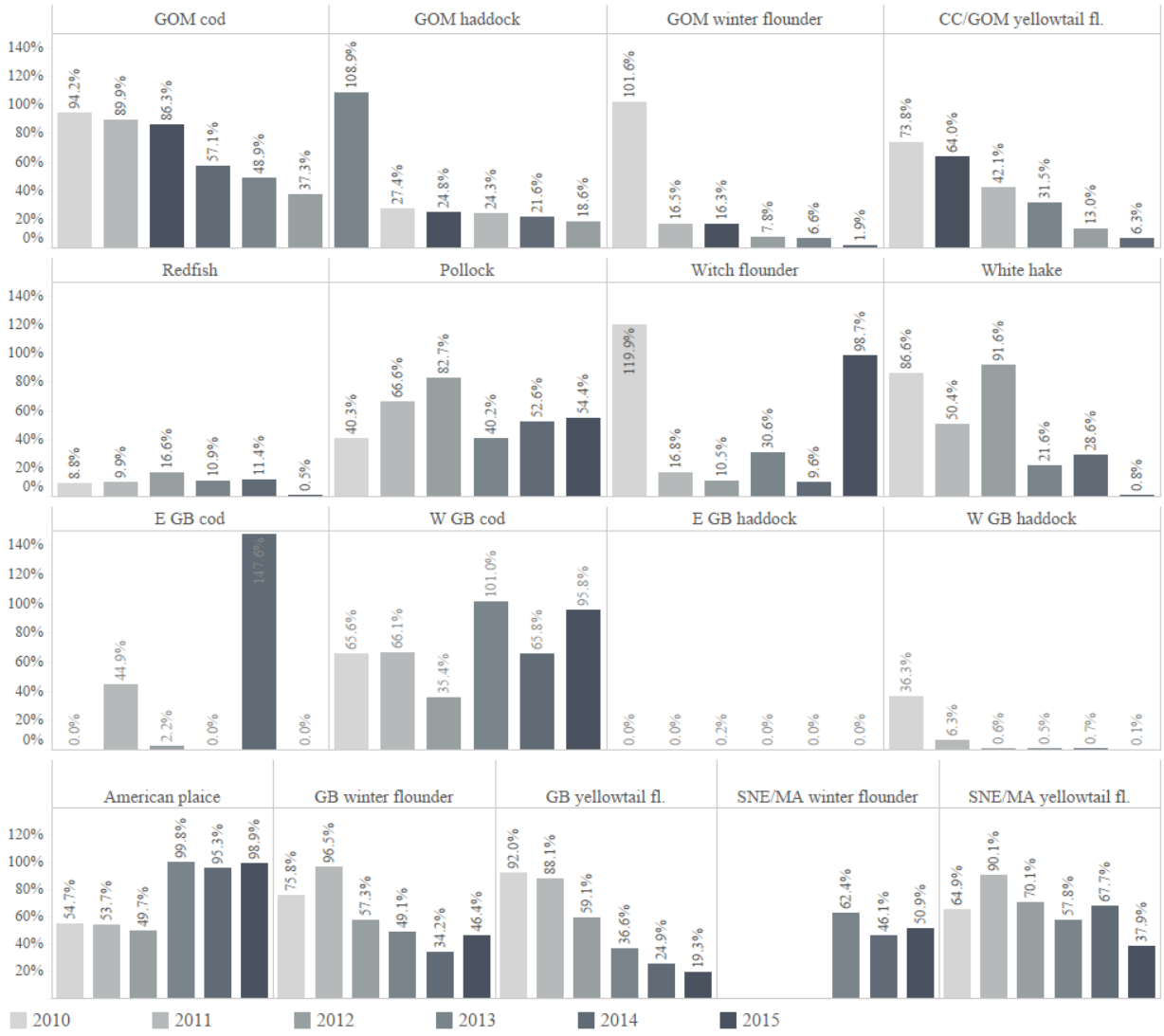


Figure 61. Percentage of common pool sub-ACL caught by fishing year and allocated stock.[162]

5.h.ii.4 Recreational sub-ACL

The recreational fishery is allocated a sub-ACL for GOM cod and GOM haddock. Catch of GOM cod remained within the recreational sub-ACL for the first three years of the time period, exceeded the quota in FY 2013 and 2014, then fell to slightly below the quota in FY 2015 (Figure 62). This coincides with significant decreases in available quota. The overage in FY 2013 triggered an AM that implemented an increase in the minimum fish size from 19" to 21" and added two months to the prohibited season in FY 2014. For FY 2015, recreational anglers were prohibited from retaining any GOM cod due to the FY 2014 overage.

[162] Data source: GARFO Groundfish Monitoring Reports.

Recreational catch of GOM haddock exceeded the sub-ACL in five of the six fishing years during the six-year period (Figure 62). In two fishing years, 2013 and 2014, the recreational catch was more than three times the sub-ACL. The overage in FY 2010, according to Marine Recreational Fisheries Statistics Survey (MRFSS) data, triggered an accountability measure for FY 2011 that decreased the bag limit from unlimited to nine fish per angler per day and increased the minimum fish size from 18" to 19". In April 2012, data from the Marine Recreational Information Program (MRIP) indicated no overage in FY 2010. The MRIP data is considered less biased and more accurate than the MRFSS data, therefore the accountability measures for FY 2011 were removed for the remainder of the fishing year. The FY 2012 overage resulted in an increased minimum fish size from 18" to 21" in FY 2013. The FY 2013 overage resulted in a decreased bag limit from unlimited to three fish per angler per day and added four months to the prohibited season in FY 2014. The FY 2014 overage maintained the AM of limited possession to three fish and extending the closed season for FY 2015.

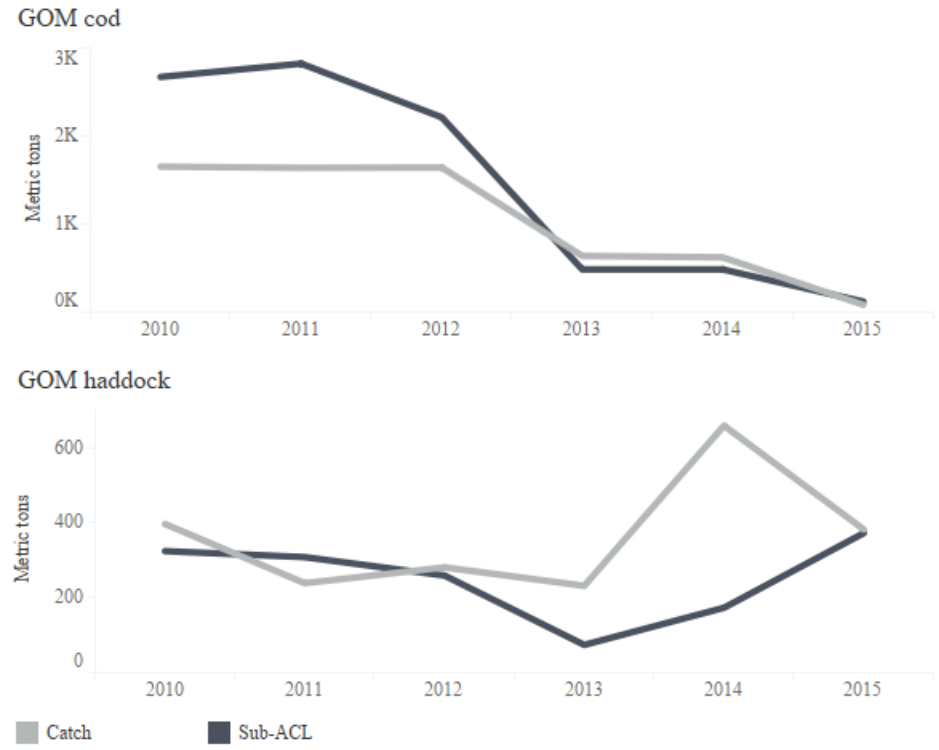


Figure 62. The recreational fishery sub-ACL and catch in metric tons for Gulf of Maine cod (top) and Gulf os Maine haddock (bottom).[163]

5.h.ii.5 Discards of groundfish by the groundfish fishery

Data on discards in the groundfish fishery are provided through fishery observers and at-sea monitors. Observed discard data are used to calculate fleet-based discard rates for observed trips. Starting in FY 2010, a discard mortality rate (a component of the discard rate calculation) of 1.0 (assuming 100% discard mortality) was applied for all stocks across all gears, with the exception of a rate of 0.5 for GOM winter

[163] Data source: GARFO Groundfish Monitoring Reports

flounder and SNE/MA winter flounder. This method remained until FY 2013, when the discard mortality rate for SNE/MA yellowtail flounder was reduced from 1 to 0.9 for all gear types and the rates applied to the three cod stocks (GOM, eastern GB, western GB) were updated by gear code. Cod discard mortality rates for handgear was reduced to 0.2, longline was reduced to 0.33, trawl was reduced to 0.75 and gillnet was reduced to 0.8.

Total discards across all allocated groundfish stocks by sectors ranged between 3.0% and 6.3% of total ACE used (landed + discards) between FY 2010 and 2015. Just over half of the stock/fishing year combinations showed discards less than 5% of the total ACE used (Figure 63). For three stocks discards were greater than 20 % of the total ACE used for select fishing years, this included eastern GB cod in FY 2011, 2012, and 2013 and GB haddock (eastern and western) in FY 2012. The highest proportion (6.3%) of total ACE used attributed to discards was in FY 2015, however in FY 2012 discards represented 10% or more of the ACE used across had six of the sixteen allocated stocks. Low discards (< 5%) in all six fishing years were attributed to three species representing five allocated stocks, white hake, pollock and winter flounder (GOM, GB, SNE/MA).

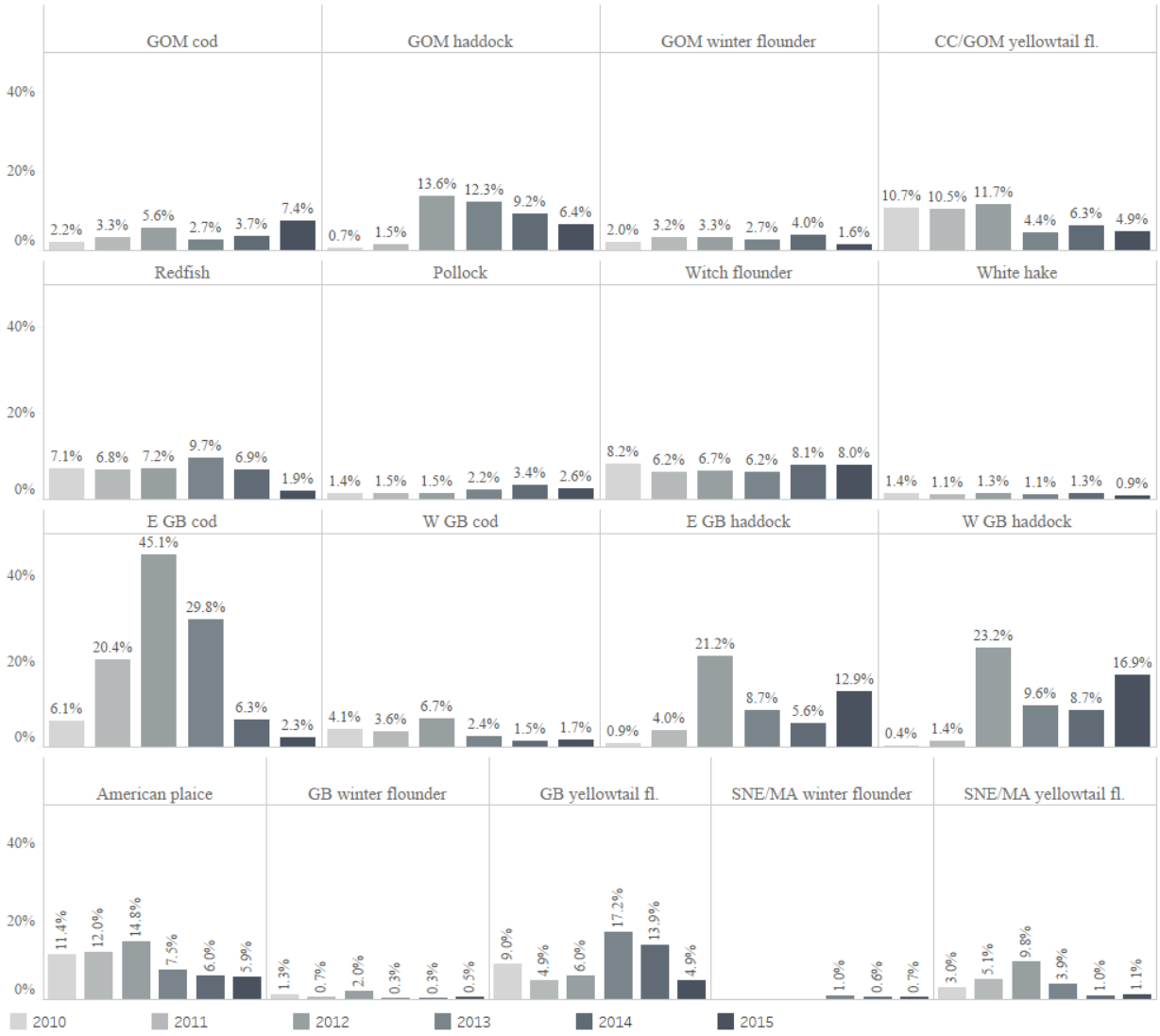


Figure 63. The proportion of ACE utilized that was attributed to discards by fishing year and allocated stock for all sectors combined.[164]

5.h.ii.6 Discards of allocated groundfish by other fisheries

Several other fisheries in the Northeast are allocated a separate sub-ACL for select groundfish stocks (Section 4.a). These allocations are intended as a bycatch allocation and not to promote directed effort on these stocks.

The scallop fishery has exceeded its bycatch allocation five times over the six-year period across three stocks (Table 19). There were no consecutive overages for any single stock; the largest observed overage exceeded the allocation by 35% for SNE/MA yellowtail flounder in FY 2011. This did not trigger any accountability measures for either GB or SNE/MA yellowtail flounder, because neither of the AM criteria

[164] Data source: GARFO Groundfish Monitoring Reports

designated in Framework 47 were met: (1) the scallop fishery sub-ACL is exceeded and the total ACL for that stock is also exceeded; or (2) the scallop fishery sub-ACL is exceeded by 50 % or more.

In FY 2015, the scallop fishery caught 115% of their southern windowpane allocation, the AM triggered a gear restricted area west of 71° W Longitude (excluding the Mid-Atlantic access areas) for the month of February 2018. The gear restrictions prohibited trawl gear from the area for the entire month and set gear restrictions on dredge gear limiting to a maximum of five rows of rings and hanging ratio of 1.5 to 1.

Table 19. Percent usage of the scallop fishery sub-ACL by stock and fishing year. Overages indicated in italics.[165]

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
GB yellowtail flounder	12.1%	41.8%	*104.5%*	90.3%	*116.4%*	98.8%
SNE/MA yellowtail flounder	83.7%	*135.2%*	42.5%	*111.4%*	98.2%	79.1%
S windowpane flounder	n/a	n/a	n/a	70.5%	76.5%	*115.1%*

The Atlantic herring midwater trawl fishery (MWT) has been allocated both GB and GOM haddock quota since FY 2010. The largest percentage of GOM haddock quota used in FY 2010 at 25.5% of the sub-ACL. In subsequent fishing years, GOM haddock catch by MWT fishery was minimal and raged between 0 and 1.7% though FY 2015. GB haddock was caught at a much higher rate, in fishing years 2012, 2013 and 2015, the MWT fishery exceeded its sub-ACL by 100.9%, 106.2% and 103.9%, respectively. Only the FY 2013 overage (106.2 %) resulted in a pound for pound payback AM (16.98 mt) for FY 2014.

The small mesh fishery on Georges Bank targeting silver hake has been allocated a share of the GB yellowtail flounder ACL since FY 2013. This fishery has stayed well within its sub-ACL, with catch at 63.7%, 18.1 % and 1.0 % in fishing years 2013, 2014 and 2015, respectively.

5.h.iii Transboundary management

The Transboundary Management Guidance Committee (TMGC) was established in 2000 to facilitate shared (US-CAN) management of three transboundary stocks in the groundfish fishery: Eastern GB cod and haddock, and GB yellowtail flounder. The TMGC, comprised of government and fishing industry representatives from both the United States and Canada, develops guidance in the form of harvest strategies, resource sharing, and management processes for the shared transboundary resources. The TMGC meets regularly to establish recommendations on F-based harvesting strategies that are consistent with US and Canadian objectives, on U.S. and Canadian harvest levels, others as necessary for shared management, develop a process for implementing those recommendations, and provide guidance for determining a U.S./Canadian resource sharing strategy.

The TMGC is also the committee responsible for reviewing the annual Transboundary Resource Advisory Committee (TRAC) Terms of Reference, identifying an agreed procedure for accounting for overages, and sharing survey data and other pertinent scientific information. The TMGC has an established formula for shared quotas of the three stocks, based on a combination of catch history and stock distribution in

[165] Data source: GARFO Groundfish Monitoring Reports

three Research Vessel Surveys; the TRAC applies the formula to determine annual quotas (Table 20). The application of this formula has not changed with implementation of the sector program.

To date, the TMGC has achieved consensus on quota recommendations on all stocks in all years, except for GB yellowtail flounder in 2010. In addition to normally scheduled meetings, the TMGC has reconvened in three separate years to provide revised advice on GB yellowtail flounder. In 2007, the NEFMC remanded the GB yellowtail flounder quota recommendation back to TMGC for further consideration due to concerns that the recommended quota exceeded the agreed-upon TMGC harvest strategy of $F \leq 0.25$; the TMGC subsequently reduced the TAC advice for yellowtail flounder to 1,250 mt, consistent with the harvest strategy. In early 2011, the U.S. *International Fisheries Agreement Clarification Act* removed constraints on the US TMGC members related to the domestic rebuilding plan for GB yellowtail flounder, and developed new guidance, increasing the 2011 quota from 1900 mt to 2650 mt. In October 2011, the NEFMC rejected the guidance for GB yellowtail flounder quota for 2012 due to advice from the Science and Statistical Committee that indicated a higher catch level would be acceptable; the 2012 GB yellowtail flounder quota was subsequently adjusted from 900 mt to 1150 mt.

Table 20. Canada/U.S. Quotas for 2004-2014 in metric tons.[166]

TMGC agreed upon combined Canada/U.S. Quota	Eastern GB Cod	Eastern GB Haddock	GB Yellowtail Flounder
for 2004	1,300	15,000	7,900
for 2005	1,000	23,000	6,000
for 2006	1,700	22,000	3,000
for 2007	1,900	19,000	1,500
2007 **Revised Quota**	No Change	No Change	1,250
for 2008	2,300	23,000	2,500
for 2009	1,700	30,000	2,100
for 2010	1,350	29,600	Consensus not reached
for 2011	1,050	22,000	1,900
2011 **Revised Quota**	No Change	No Change	2,650
for 2012	675	16,000	900
2012 **Revised Quota**	No Change	No Change	1,150
for 2013	600	10,400	500
for 2014	700	27,000	400

The final quotas have provided higher proportions of haddock and cod quota to Canada, and higher proportions of yellowtail flounder to the US across all years (Figure 64). Generally, TMGC has developed consensus quota recommendations that are in line with the best available science, as provided by TRAC. However, these agreements are challenged by differences between each country's management regime in developing cohesive advice, especially regarding rebuilding timelines or regulatory requirements. Challenges are furthered by competing views within the TRAC, particularly with respect to Atlantic cod and by the high levels of uncertainty in fisheries science, along with the lack of recovery of Atlantic cod and yellowtail flounder, despite quotas generally being set in line with TRAC advice.

[166] TMGC, 2015.

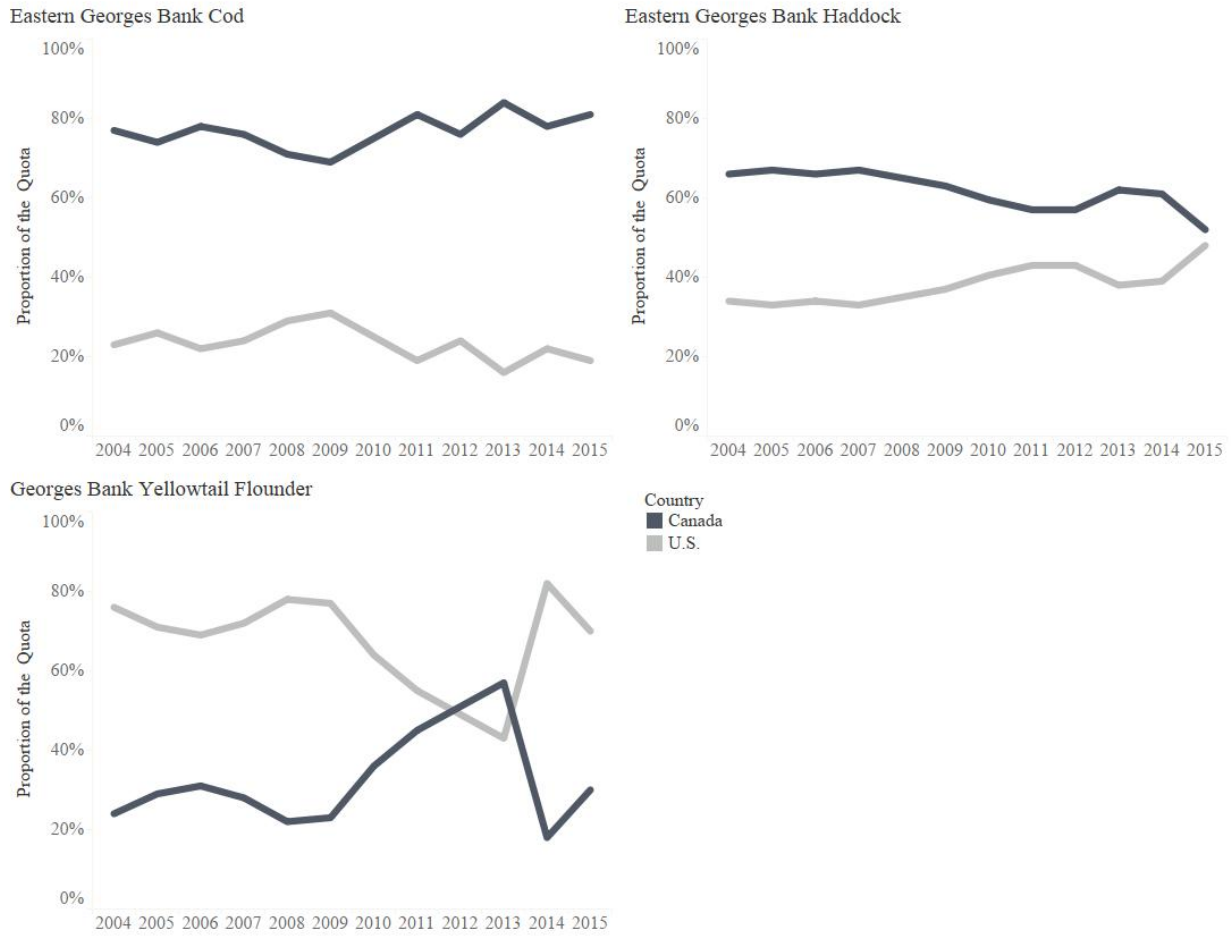


Figure 64. Proportions of quota allocated to the US and Canada for transboundary stocks, 2004-2014.[167]

5.h.iv Bycatch in the groundfish fishery

Based on total observer discards for groundfish trips, it would appear that the implementation of the catch share program reduced discards of all groundfish stocks combined from pre-catch share program levels. Under the sector system, it is illegal to discard legal sized fish, as opposed to regulations under DAS. However, this reduction in discards was only particular to groundfish species when compared to other significant segments of observed groundfish trip discards. For the skate complex, the proportion of observed discards remained relatively stable between pre and post-catch share implementation and the proportion of observed spiny dogfish discards appeared to increase with the implementation of the catch share system (Table 21).

Table 21. Percentage of observed discards by species groups and fishing year.

Fishing Year	All skates combined	Spiny dogfish	All groundfish combined
2007	62.0 %	11.8 %	13.8 %

[167] Ibid.

2008	67.8 %	8.7 %	10.4 %
2009	68.0 %	8.4 %	12.6 %
2010	70.4 %	15.1 %	4.9 %
2011	65.7 %	19.9 %	5.7 %
2012	61.9 %	21.4 %	7.5 %
2013	64.0 %	18.7 %	5.2 %
2014	62.6 %	16.0 %	5.8 %
2015	64.5 %	12.1 %	6.3 %

5.h.v Protected species bycatch

Numerous protected species inhabit the environment[168] within the Northeast multispecies FMP management unit (Table 22) and there have been observed/documented interactions in the fishery or with gear type(s) similar to those used in the fishery (bottom trawl or gillnet gear). These species are under NOAA Fisheries jurisdiction and are afforded protection under the Endangered Species Act (ESA) of 1973 and/or the Marine Mammal Protection Act (MMPA) of 1972.

Table 22. Species protected under the ESA and/or MMPA that may occur in the affected environment of the Northeast multispecies fishery. Marine mammal species (cetaceans and pinnipeds) italicized and in bold are considered MMPA strategic stocks.[a]

Species	Status[b]	Potentially impacted by this action?
Cetaceans		
North Atlantic right whale (Eubalaena glacialis)	***Endangered***	***Yes***
Humpback whale, West Indies DPS (*Megaptera novaeangliae*)[c]	Protected (MMPA)	Yes
Fin whale (Balaenoptera physalus)	***Endangered***	***Yes***
Sei whale (Balaenoptera borealis)	***Endangered***	***Yes***
Blue whale (Balaenoptera musculus)	***Endangered***	***No***
Sperm whale (Physeter microcephalus	***Endangered***	***No***
Minke whale (*Balaenoptera acutorostrata*)	Protected (MMPA)	Yes
Pilot whale (Globicephala spp.)[C]	Protected (MMPA)	Yes
Risso's dolphin (*Grampus griseus*)	Protected (MMPA)	Yes
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	Protected (MMPA)	Yes
Short Beaked Common dolphin (*Delphinus delphis*)	Protected (MMPA)	Yes
Spotted dolphin (*Stenella frontalis*)	Protected (MMPA)	No
Bottlenose dolphin (Tursiops truncatus[d])	***Protected (MMPA)***	***Yes***
Harbor porpoise (*Phocoena phocoena*)	Protected (MMPA)	Yes
Sea Turtles		
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Yes
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Yes
Green sea turtle, North Atlantic DPS (*Chelonia mydas*)	Threatened	Yes
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic Ocean DPS	Threatened	Yes
Hawksbill sea turtle (*Eretmochelys imbricate*)	Endangered	No
Fish		

[168] Detailed information on species occurrence in the affected environment of the multispecies fishery is provided in the Amendment 23 Affected Environment document. Table Source: NEFMC 2019, Amendment 23 Affected Environment.

Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered	No
Atlantic salmon (*Salmo salar*)	Endangered	Yes
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight DPS, Chesapeake Bay DPS, Carolina DPS & South Atlantic DPS	Endangered	Yes
Cusk (*Brosme brosme)*	Candidate	Yes
Pinnipeds		
Harbor seal (*Phoca vitulina*)	Protected (MMPA)	Yes
Gray seal (*Halichoerus grypus*)	Protected (MMPA)	Yes
Harp seal (*Phoca groenlandicus*)	Protected (MMPA)	Yes
Hooded seal (*Cystophora cristata*)	Protected (MMPA)	Yes
Critical Habitat		
North Atlantic Right Whale	ESA (Protected)	No
Northwest Atlantic DPS of Loggerhead Sea Turtle	ESA (Protected)	No

Notes:
[a] A strategic stock is defined under the MMPA as a marine mammal stock for which: (1) the level of direct human-caused mortality exceeds the potential biological removal level; (2) based on the best available scientific information, is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; and/or (3) is listed as a threatened or endangered species under the ESA, or is designated as depleted under the MMPA (Section 3, 1972).
[b] The status of the species is defined by whether the species is listed under the ESA as endangered (species are at risk of extinction) or threatened (species at risk of endangerment) or protected under the MMPA. Note, marine mammals listed under the ESA are also protected under the MMPA. Candidate species are those species in which ESA listing may be warranted.
[c] There are two species of pilot whales: short finned (*G. melas melas*) and long finned (*G. macrorhynchus*). Due to the difficulties in identifying the species at sea, they are often just referred to as *Globicephala spp.*
[d] This includes the following Stocks of Bottlenose Dolphins: Western North Atlantic Offshore, Northern Migratory Coastal (strategic stock), and Southern Migratory Coastal (strategic stock).

Protected species are vulnerable to interactions with various types of fishing gear, with interaction risks associated with gear type, quantity, and soak or tow time. Available information on gear interactions with a given species (or species group) is limited to the NEFOP program, which only covers a portion of the groundfish fishery (see Section 4.b.xi.2).

5.h.v.1 Finfish interactions

Atlantic sturgeon interactions (i.e., bycatch) with sink gillnet and bottom trawl gear have been observed since 1989 and have the potential to result in the injury or mortality (NMFS NEFSC FSB 2019). The annual estimated bycatch of Atlantic sturgeon is 1,239 and 1,342 sturgeon in gillnet and bottom otter trawl gear, respectively.[169]. Atlantic sturgeon interactions were observed in trawl gear with small (< 5.5 inches) and large (≥ 5.5 inches) mesh sizes, as well as gillnet gear with small (< 5.5 inches), large (5.5 to 8 inches), and extra-large mesh (>8 inches) sizes. Estimated mortality rates in gillnet gear were 20.0%, while those in otter trawl gear were 5.0%.[170]

However, these estimates are based on data collected between 2006 and 2010 which is prior to implementation of the catch share program. Information on assigning bycatch to a particular fishery is

[169] NMFS 2013, based on Miller and Shepard 2011
[170] Miller and Shepard 2011; NMFS 2013

limited, the total Atlantic sturgeon mortality associated with gillnet or trawl gear in the groundfish fishery remains uncertain.

Atlantic salmon interactions (i.e., bycatch) with gillnet and bottom trawl have been observed since 1989; in many instances, these interactions have resulted in the injury and mortality of Atlantic salmon.[171] Between 1989 and 2013, NEFOP and ASM programs documented 15 individual Atlantic salmon incidentally caught in gillnet (11) and bottom trawl (4) gear, from more than 60,000 observed commercial fishing trips; five were reported as fatalities.[172] Since 2013, no additional Atlantic salmon have been observed in gillnet or bottom trawl gear.[173] Interactions with Atlantic salmon are considered rare events and with information on fishery specific, the effect of the catch share program on Atlantic salmon bycatch unknown, though likely minimal.

Cusk are NOAA Fisheries "candidate species" under the ESA[174]. Cusk is not an allocated stock, nor are there any regulations pertaining to the catch of this species. Cusk is a minor bycatch species of the groundfish fishery (Table 23), larger specimens may be retained for sale. Cusk discards as a percentage of total discards on groundfish have remained below 0.5% through FY 2015.

Table 23. Percent of cusk discards to the total observed groundfish species discards on commercial groundfish trips by fishing year.[175]

Fishing Year	Bycatch Rate
2007	0.044%
2008	0.014%
2009	0.006%
2010	0.005%
2011	0.004%
2012	0.002%
2013	0.002%
2014	0.001%
2015	0.005%

5.h.v.2 Marine Mammals

5.h.v.2.1 Large Whales

With the exception of minke whales, there have been no observed large whale interactions with bottom trawl gear in the northeast region[176]. The earliest documented bottom trawl interaction with a minke whale was in 2004, where one minke whale was found fresh dead in trawl gear attributed to the northeast

[171] NMFS NEFSC FSB 2019
[172] NEFMC 2019, Amd 23 affected environ - NMFS 2013; Kocik *et al*. 2014
[173] NMFS NEFSC FSB 2019
[174] Candidate species are those petitioned species for which NMFS has determined that listing may be warranted under the ESA and those species for which NMFS has initiated an ESA status review through an announcement in the Federal Register. If a species is proposed for listing the conference provisions under Section 7 of the ESA apply (see 50 CFR 402.10); however, candidate species receive no substantive or procedural protection under the ESA.
[175] Data source: NEFOP Request
[176] https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region; https://www.nefsc.noaa.gov/fsb/take_reports/nefop.html; https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries; https://www.nefsc.noaa.gov/publications/crd/

bottom trawl fishery.[177] In 2008, several minke whales were observed dead in bottom trawl gear attributed to the northeast bottom trawl fishery; estimated annual mortality attributed to this fishery in 2008 was 7.8 minke whales.[178] Since 2008, serious injury and mortality records for minke whales in U.S. waters have shown zero interactions in the northeast or Mid-Atlantic with bottom trawl gear[179]; this information suggests large whale interactions with bottom trawl gear are rare to nonexistent events.

The greatest entanglement risk to large whales is posed by fixed fishing gear (e.g. trap.pot gear, sink gillnet gear) with vertical or ground lines that rise into the water column.[180] Large whale interactions (entanglements) with fishing gear have been observed and documented in the waters of the Northwest Atlantic (both U.S. and Canadian territorial waters); however, these interactions have not been attributed to any specific fishery, including the Northeast multispecies fishery.[181]

5.h.v.2.2 Small Cetaceans and Pinnipeds

Small cetaceans and pinnipeds are vulnerable to interactions with both sink gillnet and bottom trawl gear.[182] Based on the most recent Marine Mammal List of Fisheries[183], Table 24 provides a list of species that have been observed (incidentally) seriously injured and/or killed by MMPA LOF Category I (frequent interactions) gillnet and/or Category II (occasional interactions) bottom trawl fisheries that operate in the affected environment of the multispecies fishery. Of the small cetacean and pinniped species provided in Table 24, gray seals, followed by harbor seals, harbor porpoises, short beaked common dolphins, and harps seals are the most frequently bycaught in sink gillnet gear in the Greater Atlantic Region. In terms of bottom trawl gear, short-beaked common dolphins and Atlantic white-sided dolphins are the most frequently observed bycaught marine mammal species in the region, followed by gray seals, long-finned pilot whales, Risso's dolphins, bottlenose dolphin (offshore), harbor porpoise, harbor seals, and harp seals.[184]

[177] Waring et al. 2007
[178] Waring et al. 2015
[179] Henry et al. 2016; Henry et al. 2017; Hayes et al. 2019; Waring et al. 2015; 84 Federal Register 22051
[180] Kenney and Hartley 2001; Knowlton and Kraus 2001; Hartley et al. 2003; Johnson et al. 2005;Whittingham et al. 2005a,b; Cassoff et al. 2011; Knowlton et al. 2012; NMFS 2014; Henry et al. 2015; Henry et al. 2016; Henry et al. 2017; Henry et al. 2019; see Marine Mammal Stock Assessment Reports: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region
[181] Henry et al. 2019
[182] Read et al. 2006; Lyssikatos 2015; Chavez-Rosales et al. 2017; Hayes et al. 2017; Hayes et al. 2018; Hayes et al. 2019; 84 FR 22051 (May 16, 2019)
[183] LOF, May 16, 2019, 84 FR 22051
[184] Lyssikatos 2015; Chavez-Rosales et al. 2017

Table 24. Small cetacean and pinniped species observed seriously injured and/or killed by Category I and II sink gillnet or bottom trawl fisheries in the affected environment of the multispecies fisheries.

Fishery	Category	Species Observed or reported Injured/Killed
Northeast Sink Gillnet	I	Bottlenose dolphin (offshore)
		Harbor porpoise
		Atlantic white sided dolphin
		Short-beaked common dolphin
		Risso's dolphin
		Long-finned pilot whales
		Harbor seal
		Hooded seal
		Gray seal
		Harp seal
Mid-Atlantic Gillnet	I	Bottlenose dolphin (Northern Migratory coastal)
		Bottlenose dolphin (Southern Migratory coastal)
		Bottlenose dolphin (offshore)
		Harbor porpoise
		Short-beaked common dolphin
		Harbor seal
		Harp seal
		Gray seal
Northeast Bottom Trawl	II	Harp seal
		Harbor seal
		Gray seal
		Long-finned pilot whales
		Short-beaked common dolphin
		White-sided dolphin
		Harbor porpoise
		Bottlenose dolphin (offshore)
		Risso's dolphin
Mid-Atlantic Bottom Trawl	II	White-sided dolphin
		Short-beaked common dolphin
		Risso's dolphin
		Bottlenose dolphin (offshore)
		Gray seal
		Harbor seal
Source: MMPA LOF 84 FR 22051 (May 16, 2019).		

Several species have experienced such great losses to their populations due to interactions with Category I and/or II fisheries that they are now considered strategic stocks under the MMPA; these include several stocks of bottlenose dolphins, pilot whales, and until recently, the harbor porpoise. This required implementation of the Harbor Porpoise Take Reduction Plan (HPTRP) and the Bottlenose Dolphin TRP

(BDTRP)[185], along with the Atlantic Trawl Gear Take Reduction Strategy (ATGTRS)[186] due to the incidental mortality and serious injury of small cetaceans, incidental to bottom and midwater trawl fisheries.

The bycatch of harbor porpoise in the northeast sink gillnet fishery became problematic to GOM gillnet groundfish fishermen in FY 2012. The average bycatch rate for harbor porpoise calculated from NEFOP data from September 2010 through May 2011 was determined to be 0.078, well above the target of 0.031[187]. Given the more than double bycatch rate over target rate, even if no harbor porpoise were observed being caught in the following year, the two-year average (September 2010 – May 2011 and September 2011 – May 2012) would still have exceeded the target rate for the GOM. This was proved to be true as the NEFOP calculated two-year average bycatch rate for harbor porpoise was determined to be 0.057, which is much higher than the two-year target HPTRP bycatch rate of 0.031[188]. Bycatch exceeding the target rate triggered the Coastal GOM Consequence Closure Area beginning October 1, 2012 (Harbor Porpoise Take Reduction Plan (HPTRP) implemented in 2010), the closure area encompassed all coastal waters west of 70°15' W and north of 42°15' N. This would essentially eliminate the inshore northeast groundfish sink gillnet fishery for two months (October and November) during the profitable fall pollock season.

In response to industries concerns of losing the fall pollock season along with recent harbor porpoise bycatch trends, NOAA Fisheries shifted the closure period to February and March; the two-month duration and closure boundaries were not changed. This regulation was in place for one year only based on the commitment by the gillnet fleet to invest in newly developed LED pingers that would increase pinger usage compliance rates to reduce harbor porpoise interactions.

According to the harbor porpoise take reduction team, the consequence area bycatch rates no longer accurately reflect bycatch rates in New England and the HPTRP was amended[189] to remove the consequence closure areas. Bycatch of harbor porpoise has been decreasing in the northeast sink gillnet fishery (Table 25) and is well under the Potential Biological Removal (PBR) level[190].

[185] Although the most recent U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment (Hayes et al. 2018) no longer designates harbor porpoise as a strategic stock, HPTRP regulations are still in place per the mandates provided in Section 118(f)(1).
[186] Additional information on each TRP or Strategy is at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-take-reduction-plans-and-teams.
[187] Orphanides CD, Palka D. 2012. 2010-2011 HPTRP Consequential Bycatch and Compliance Rates. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-08; 25 p. https://www.nefsc.noaa.gov/publications/crd/crd1208/
[188] Orphanides CD. 2012. New England harbor porpoise bycatch rates during 2010-2012 associated with Consequence Closure Areas. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-19; 15 p. https://www.nefsc.noaa.gov/publications/crd/crd1219/
[189] Harbor Porpoise Take Reduction Plan: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/harbor-porpoise-take-reduction-plan
[190] The Potential Biological Removal (PBR) level is defined as the maximum number of animals, not including in natural mortalities that may be removed annually from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population level.

Table 25. Observed Harbor porpoise incidental takes in northeast sink gillnets.[191]

Year	Estimated mortality
2007	395
2008	666
2009	591
2010	387
2011	273
2012	277
2013	399
2014	128
2015	177
2016	125

5.h.v.3 Sea Turtles

Sea turtle interactions with trawl gear have been observed in the Gulf of Maine, Georges Bank and the Mid-Atlantic regions; however, most of the observed interactions have occurred in the Mid-Atlantic.[192] As few sea turtle interactions have occurred in the GOM and GB regions, there is insufficient data available to produce valid estimates of bycatch in these regions. Current bycatch estimates in the trawl fishery are only specific to the Mid-Atlantic with no distinction to fishery. These estimates are available only for loggerhead sea turtles. Estimates from multiple sources, ranging 1996 – 2013 have generally illustrated a decrease in interactions over time[193], which may be the result of decreased fishing effort in high interaction areas.

Commercial sink gillnet interactions with sea turtles (loggerhead, Kemp's ridley, leatherback, and unidentified hard-shell sea turtle) in the Mid-Atlantic and Georges Bank were analyzed using Northeast Fisheries Observer Program, At-Sea Monitoring Program, and Vessel Trip Report data from 2012-2016.[194] Sea turtles were observed in gillnets with mesh sizes ranging between 3.25 inches to 12 inches; in the groundfish fishery, gillnets fished in these regions must have mesh sizes at 6.5 inches or greater.

No conclusions can be drawn as to whether the catch share program has had an effect on sea turtle bycatch; the majority of the observed interactions occur in the Mid-Atlantic region where groundfish activity is minimal, data are limited and observed bycatch is not assigned to a specific fishery.

5.i Quota market and leasing

An important component of the catch share system is the ability to transfer individual allocations (PSC) of groundfish stocks between fishermen. Transfer can occur internally within a sector (intra-sector) or between approved sectors (inter-sector). There are several reasons why transfers, both intra and inter-sector, occur. The primary reason is the need to acquire additional ACE to account for fishing activity but also to move unused or unwanted ACE. As the fishing year progresses other reasons for transfer are to

[191] Data source: TM F/NE-258: US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018, by Sean A Hayes, Elizabeth Josephson, Katherine Maze-Foley, Patricia E Rosel. June 2019. https://www.nefsc.noaa.gov/publications/tm/tm258
[192] see Murray 2011; Warden 2011a, b; Murray 2015a, Murray 2015b
[193] Warden 2011a, b; Murray 2015a, b; Murray 2008
[194] Murray 2018

balance out individual member or sector overages as well as to balance sector allocations within ACE carryover limits[195].

There are several types of transfers of ACE that may occur during a fishing year; transfer types will occur both intra-sector and inter-sector:

- pounds of a single stock for a single price;
- pounds of multiple stocks for a single price (basket trades);
- pounds of single or multiple stocks swapped for pounds of single or multiple stocks (fish for fish deals);
- pounds of single or multiple stocks for a commodity or services performed;
- single fleet owner moving pounds of fish between vessels; and
- unpriced transfers of pounds of fish from permit banks or donations/gifts between fishermen.

Over the years of the sector program, sectors worked out ways of notifying fishermen of available ACE. Currently, the system is a decentralized listing of available quota. Some sectors have available quota listed on their website. Sector managers may also send listings of available allocations via email to their members as well as to other sectors. At the dock, word of mouth has been another way for individual fishermen to notify others what they may have available.

Participation by individual sector members in transfers can vary from deal to deal. An individual transfer may involve one or more fishermen as the lessee and/or the lessor. Some sectors may contractually restrict a subset of their members (inactive members) from acquiring ACE. Additionally, a sector may restrict the level of input individual fishermen have as participants in the lease market.

All sectors have a Right of First Offer (ROFO) process that governs inter-sector leases. This process is designed to allow all active sector members within a sector a window of time (5-7 days) to accept the terms on any ACE transfer that results in ACE leaving that sector. The ROFO process may lead to higher inter-sector leasing costs versus intra-sector leasing costs as a fisherman may need to offer more money to acquire ACE from another sector. Some unified sectors have a second layer of ROFO to fellow sectors, thus increasing the chance of a deal being intercepted in the ROFO process. The ROFO process can be waived only by each sector's Board of Directors and would only be done on a case by case basis. The sector manager has no ability to interfere with the ROFO process. Additionally, some sectors may have an internal ROFO process for intra-sector leasing for some stocks.

Inter-sector leasing can be restricted by NOAA Fisheries under certain conditions. If NOAA Fisheries determines that a sector does not have the sufficient ACE in a requested transfer, the transfer will be denied. If a sector's operation plan has been revoked by NOAA Fisheries, that sector is no longer able to participate in the inter-sector lease market for any stocks. Additionally, given that NOAA Fisheries monitors groundfish trips via VTR submission to verify compliance by sector; all pending transfers will be denied if noncompliance levels exceed a certain threshold, until the sector is VTR submission compliant.

[195] Details provided based on the personal experience of one of the authors, Daniel Salerno, who has been a groundfish sector manager since FY 2010.

5.i.i ACE leasing

As part of the sector catch share program, ACE is transferable between individual sectors during the fishing year. Transfer of ACE from one sector to another may take the form of a single stock transfer (i.e., one sector transfers ACE for a single stock to another sector), or they may take the form of "basket" transactions in which multiple stocks are transferred (i.e., one sector transfers ACE for more than one stock to another sector). The total number of individual stock transfers represents all individual stock movements between sectors regardless of whether the transfer was for one or more stocks. When we present data on the number of inter-sector transfers that occurred during a given fishing year, a basket transfer of ACE from one sector to another is counted as a single inter-sector transfer. However, when we present data on the number of individual stock transfers that occurred during a given fishing year, a basket transfer of ACE is counted as multiple transfers. For example, if one sector transferred ACE for three stocks to another sector as part of a single transaction, that transaction would count as one inter-sector transfer, but three individual stock transfers. As a result, the total number of individual stock transfers in a given fishing year may exceed the total number of inter-sector transfers in a given fishing year presented in Table 26.

The total number of inter-sector transfers between sectors in the six-year period was 2,531 (Table 26). Fishing year 2011 had the most inter-sector transfers with 585 while FY 2014 had the least with 188 transfers. Between FY 2010 and 2018, The number of inter-sector transfers conducted annually increased overall from FY 2010 to FY 2018. The highest number of total individual stock transfers (1,345) occurred in FY 2011, while the least number of individual stock transfers (862) occurred in FY 2014.

In Table 26, the 'difference' column identifies the difference between the total number of individual stock transfers and inter-sector transfers. The difference in the number of individual stock transfers and total inter-sector transfers declined over time, which could suggest that, as the catch share program evolved, the characteristics of inter-sector ACE transfers changed. This may indicate that package (or basket) deals became less frequent compared with single stock transfers. It may also indicate that the number of stocks being transferred in each basket deal has declined over time.

Table 26. Number of inter-sector transfers by fishing year.

Fishing Year	Number of inter-sector transfers	Number of Individual fish transfers	Difference
2010	188	1073	885
2011	585	1345	760
2012	375	1139	764
2013	489	1222	733
2014	383	862	479
2015	511	1011	500
2016	546	1171	625
2017	546	1070	524
2018	526	1062	536

The most common stock moved between sectors over the first six years of the sector program was GOM cod with a total of 770 individual transfers of this one stock. GOM cod was also one of the top three stocks with respect to number of transfers in five of the six years; witch flounder was also transferred at a high level between sectors, being ranked in the top three stocks in four out of six years and second overall in the total six-year period. Both eastern and western GB haddock were the least moved stocks between sectors, by number of transfers, in each of the six years, and overall. GB winter flounder was also transferred at a low rate between sectors and was in the bottom three of total transfers in four out of the six years. SNE/MA winter flounder did display a low overall total number of transfers; however, this stock was only allocated to sectors in the last three years of the review time period.

Table 27. The total number of individual fish transfers by stock and fishing year.[196]

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	total
CC/GOM Yellowtail Flounder	70	127	150	118	55	93	613
E GB Cod	75	76	71	59	35	43	359
W GB Cod	124	117	83	83	76	127	610
E GB Haddock	31	19	26	18	12	10	116
W GB Haddock	29	25	26	27	15	13	135
GB Winter Flounder	34	64	28	27	16	20	189
GB Yellowtail Flounder	45	65	44	32	21	15	222
GOM Cod	144	175	87	126	108	130	770
GOM Haddock	61	104	61	98	86	87	497
GOM Winter Flounder	53	83	64	30	20	15	265
Plaice	53	53	63	142	128	164	603
Pollock	59	56	59	45	19	18	256
Redfish	39	35	58	51	27	36	246
SNE/MA Winter Flounder	n/a	n/a	n/a	76	31	26	133
SNE/MA Yellowtail Flounder	41	62	98	85	73	44	403
White Hake	108	167	108	61	26	35	505
Witch Flounder	107	117	113	144	114	135	730
Total	1,073	1,345	1,139	1,222	862	1,011	6,652

The total live weight (pounds) transferred between sectors in the six-year period was 95,017,350 lb. (Table 28). The most weight transferred was in FY 2012 (at 21,432,767 lb), while FY 2014 had the least (10,027,309 lb). The stock with the greatest total weight transferred between sectors combined over the first six years of the sector program was pollock (16,183,161 lb), which was also one of the top three stocks by weight transferred annually in all six years. Redfish was also moved between sectors at a high weight (13,9243,92 lb), being ranked in the top three stocks by weight transferred annually in four out of six years and second overall across the period. GOM winter flounder (582,041 lb) and eastern GB cod

[196] Data compiled from GARFO ACE transfers: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/h/nemultispecies.html

(715,937 lb) had the fewest pounds moved between sectors overall. GB yellowtail flounder (1,196,395 lb) also had few pounds being transferred between sectors as this stock was ranked lowest by weight moved in the four out of the six years. SNE/MA winter flounder did display a low overall total amount of pounds transferred between sectors (797,599 lb); however, it was only allocated to the sectors in the last three years of the review period.

Table 28. The total live pounds of inter-sector transfers by stock and fishing year.[197]

	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Total
CC/GOM Yellowtail Flounder	391,706	666,325	793,258	397,668	206,318	472,347	2,927,621
E GB Cod	200,302	102,710	125,636	66,690	106,565	114,034	715,937
W GB Cod	2,352,423	2,637,216	2,059,194	1,364,675	1,326,482	1,472,093	11,212,083
E GB Haddock	947,992	377,266	1,424,883	355,071	232,875	400,790	3,738,877
W GB Haddock	1,793,167	1,275,787	3,568,405	2,417,139	177,760	1,520,832	10,753,090
GB Winter Flounder	248,287	471,393	740,109	593,875	237,833	259,353	2,550,850
GB Yellowtail Flounder	331,509	554,552	183,071	46,606	56,814	23,843	1,196,395
GOM Cod	2,148,941	2,751,483	1,651,949	610,927	785,504	196,280	8,145,084
GOM Haddock	510,807	653,028	319,780	150,257	221,786	630,331	2,485,989
GOM Winter Flounder	78,819	107,651	253,569	62,450	46,179	33,373	582,041
Plaice	799,928	663,439	1,415,041	1,450,994	1,083,446	1,107,218	6,520,066
Pollock	3,240,814	3,394,642	3,428,682	2,687,856	1,481,523	1,949,644	16,183,161
Redfish	1,139,517	514,264	2,453,413	3,363,228	2,415,350	4,038,619	13,924,392
SNE/MA Winter Flounder	n/a	n/a	n/a	461,606	162,627	173,366	797,599
SNE/MA Yellowtail Flounder	105,143	329,686	488,730	320,229	340,815	255,245	1,839,848
White Hake	1,629,748	2,165,121	1,664,527	947,009	731,600	1,044,296	8,182,300
Witch Flounder	429,935	674,808	862,520	483,168	413,832	397,753	3,262,016
Total	16,349,038	17,339,371	21,432,767	15,779,448	10,027,309	14,089,417	95,017,350

No stocks had more than 50 % of the sector sub-ACL by live weight transferred between sectors in any of the six years under review. By weight, less than 20 % of the sector sub-ACL was transferred between sectors in all six years for eastern and western GB haddock, GB winter flounder, SNE/MA winter flounder, pollock and redfish. The total weight of transfers in each fishing year for CC/GOM yellowtail flounder, eastern and western GB cod, GOM cod, GOM haddock, SNE/MA yellowtail flounder and witch flounder ranged between 20% and 50 % of the overall stock specific sector sub-ACL (Figure 65).

[197] Ibid.

Figure 65. The percent of total weight of transfers to the sector sub-ACL by stock and fishing year.

5.i.ii Inter-sector ACE lease pricing

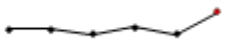
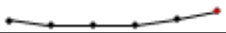
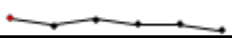
In order to estimate lease values for all 17 stocks leased between FY 2010 and FY 2015, a hedonic price model was used to analyze price and quantity data for the inter-sector leases[198]. For most stocks, modelled ACE lease price values generally declined across the six-year sector review period (Table 29). GOM cod, American plaice, and witch flounder were the only three stocks where ACE lease values increased across the full time series. The increase in modelled lease prices could most likely be attributed to the

[198] Murphy et al. 2018: The specification of the model is $P = \beta_0 + \beta_1\chi_1 + \ldots + \beta_n\chi_n + \varepsilon$. The weights, β, are the portion of the total price (*P*) attributable to each quantity of ACE stock leased (*x*) and represent the marginal price of ACE lease. In this case *n* is the seventeenth ACE stock. Additional variables were added to estimate the contribution of bundled and swap leases, as well as the effects on prices for ACE leased by Northeast Fishery Sector IV, a lease-only sector, and state permit banks. To include swap leases in the model, price was set at zero dollars and one side of the swap recorded negative lease quantities while the other recorded positive quantities. By using swap, bundle, and single-stock lease data, it is possible to provide a comprehensive estimate of ACE lease values. Leases were validated in the case of fish-for-cash trades if positive compensation values were reported. Leases were validated in the case of stock swaps if the estimated lease prices lay within two standard deviations of the fish-for-cash price estimates.

corresponding sharp reductions in the sector sub-ACL for each stock (Section 5.h.ii.2). Nine of 17 stocks leased in 2015 had statistically significant lease prices: western GB cod; GOM cod; GOM haddock; plaice; pollock; white hake; witch flounder; GB yellowtail flounder; and CC/GOM yellowtail flounder.

Increased average annual ex-vessel values were apparent for nine stocks across the review period: GOM cod, American plaice, pollock, redfish, white hake, GB winter flounder, SNE/MA winter flounder, witch flounder, and SNE/MA yellowtail flounder. For those stocks with minimal (< $0.10/lb) lease values, these increased ex-vessel prices represent potential increased income for those vessels landing these stocks.

Table 29. Trends (prices range $0.00 - $2.70) in ex-vessel and ACE lease prices (from hedonic model, in 2010 dollars per live pound) by stock and fishing year, 2010-2015.[199] Colored dots denote highest price in trend.

stock	hedonic model lease price trends	ex-vessel price trends
E GB cod		
W GB cod		
GOM cod		
E GB haddock		
W GB haddock		
GOM haddock		
Am. Plaice		
pollock		
redfish		
white hake		
GB winter flounder		
GOM winter flounder		
SNE/MA winter flounder		
witch flounder		
CC/GOM yellowtail flounder		
GB yellowtail flounder		
SNE/MA yellowtail flounder		
	FY 2010 - 2015	FY 2010 - 2015

[199] Adapted from Murphy et al. 2018, Table 24. Western and Eastern GB haddock values not available. Non-significant values for other stocks are represented by the absence of data points in the lines.

The difference between ACE lease and ex-vessel prices for the three stocks with increasing modelled ACE lease values remained positive for American plaice and witch flounder across the six-year evaluation period with a peak in difference in FY 2012 and FY 2013, respectively (Figure 66). Overall, however, the differences in values did decline between FY 2010 and FY 2015. The price difference for GOM cod peaked in FY 2012, followed by an overall decline in ex-vessel to ACE lease price value. During the time period, GOM cod was the only stock where the ACE lease value did exceed the ex-vessel value which occurred in FY 2015. It is assumed sector members who leased in GOM cod during FY 2015 were doing so in order to remain active in the GOM BSA targeting other stocks and not targeting GOM cod directly.

Figure 66. Ex-vessel minus ACE lease prices (from hedonic model, in 2010 dollars per live pound) for select stocks and fishing year.[200]

These three stocks (GOM cod, American plaice and witch flounder) were considered highly utilized stocks across all sectors (Section 5.h.ii.1) and each also had significant reductions in their respective sector sub-ACL (Section 5.h.ii.2) during the FY 2010 to FY 2015 review period. Modelled ACE lease

[200] Data from Murphy et al. 2018.

prices were plotted with stock specific sector sub-ACL and catch to see if these factors had any bearing on ACE prices (Figure 67). For GOM cod, lease price did not directly mirror changes in the sector sub-ACL. The decline in ACE lease price in FY 2012 appears to be more reflective of the catch than the sub-ACL. The ACE lease price in FY 2013 appears to follow the steep decline in sector sub-ACL that year but not in FY 2014 where there was a decrease in the ACE lease price again. In FY 2015, the dramatic increase in ACE lease price coincides with the minimal allocation of that fishing year.

American plaice and witch flounder showed similar patterns in ACE lease prices throughout the review period. Initial lease prices were higher in FY 2010 than during the subsequent fishing years when the sector sub-ACL was not constraining catch. Both stocks had a steep decline in the sector sub-ACL in FY 2013; however, ACE lease prices remained relatively flat during that year. Significant increases in ACE lease prices did not occur until FY 2014 and 2015 well after the decreases in sector sub-ACLs.

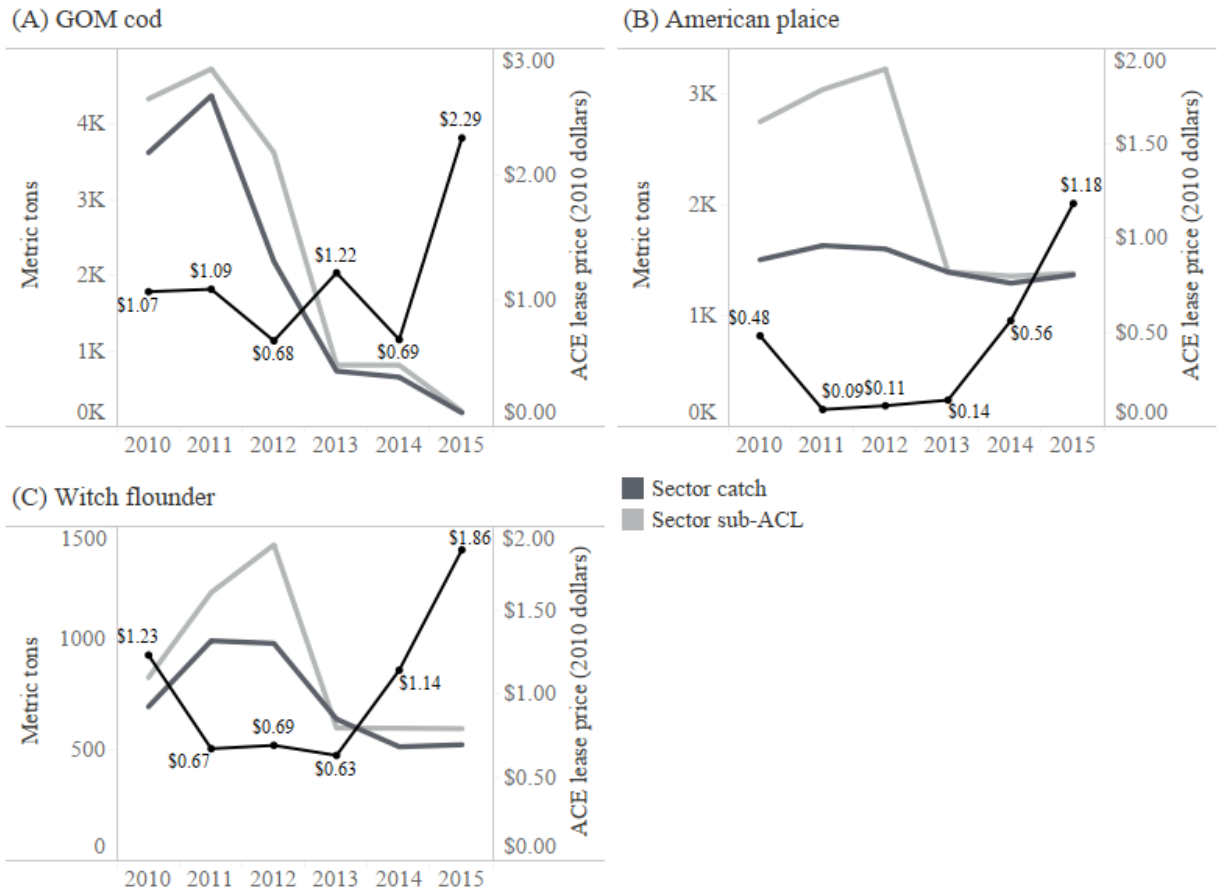


Figure 67. Sector sub-ACL and catch in metric tons and modelled ACE lease prices (in 2010 dollars per live pound), by fishing year for (A) GOM cod, (B) American plaice, and (C) witch flounder.[201]

[201] Ibid.

5.i.iii Network analysis of inter-sector ACE leasing

In order to begin to understand how groundfish ACE moved between sectors during the first six years of sector management, this review relied on the "Network Analysis of the Northeast Multispecies (Groundfish) Annual Catch Entitlement (ACE) Transfer Network"[202]. The research compiled summary data on inter-sector ACE leases during fishing years 2010-2015 and used UCINet and Netdraw software to analyze and visualize changes in network structure and composition (additional detail on the background, methods, and findings are provided in Vasta, 2019.

Network analysis results indicate that, during the period from 2010-2015, the structure of the inter-sector groundfish ACE leasing network remained relatively stable. In total, 22 sectors were approved and operated in at least one year during 2010 – 2015; 14 sectors operated continuously during all six years of the time series. Each sector actively participated in the groundfish ACE transfer network at least once during this six-year study period. In other words, each sector either transferred ACE to, or received ACE from, another sector during 2010 – 2015. The size of the network increased slightly during this period, as both the annual number of sectors (nodes) and the annual number of unique sector-sector trade relationships (ties) comprising the network increased from 2010 to 2015 (Figure 68). At the same time, the inter-sector ACE leasing network also got less active over time, as both the total number of ACE leases conducted annually, as well as the total volume of ACE leased annually, declined overall from 2010 to 2015 (Table 26 and Table 27).

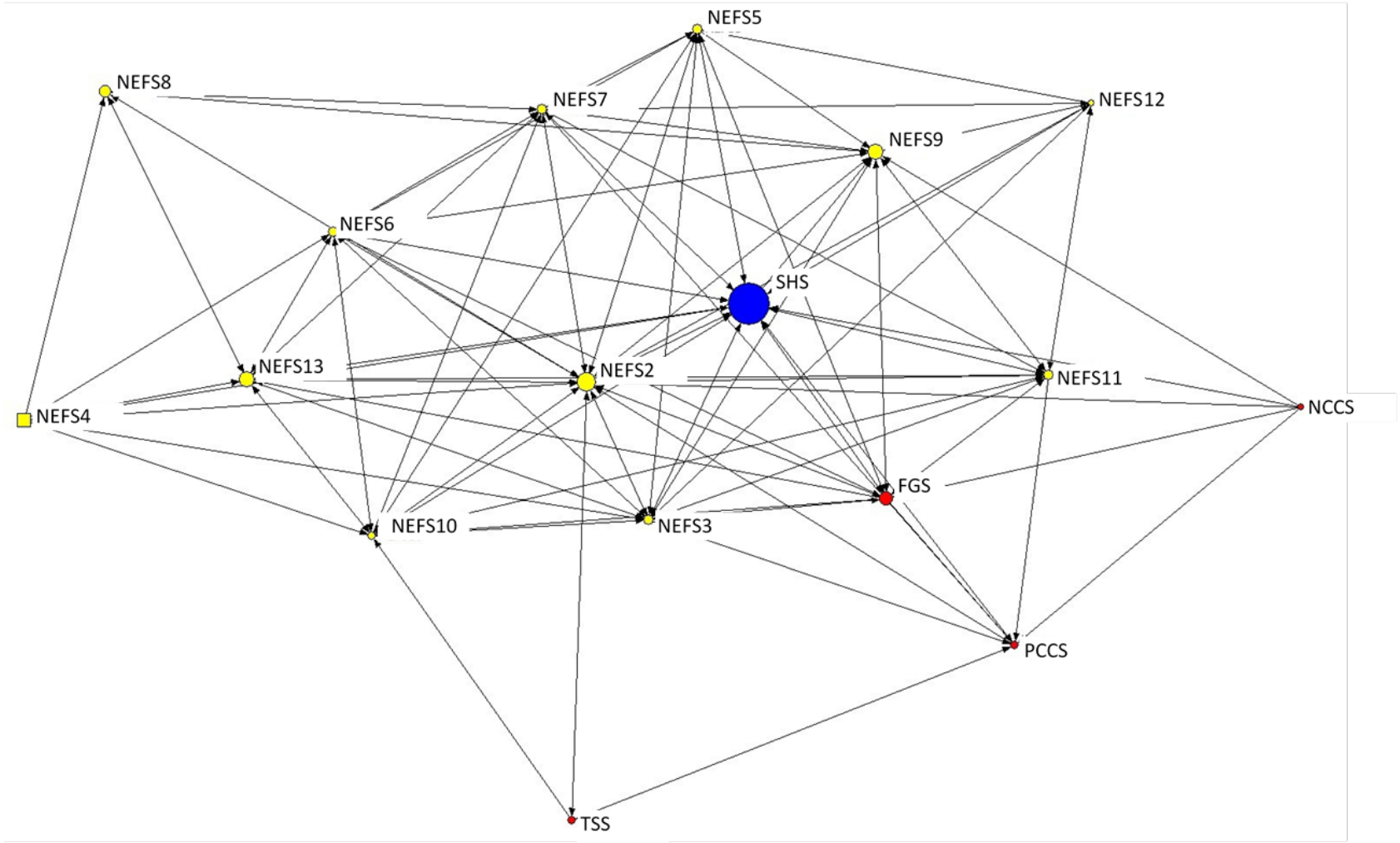
In terms of network composition, both density[203] and percent tie reciprocity[204] declined slightly during 2010-2015, indicating that the network became slightly less cohesive over time. Network in-degree centralization and out-degree centralization[205] scores indicated that the network was more centralized around ACE lessees and less organized around ACE lessors. That is, a small number of sectors played an important role as ACE lessees within the network, while a larger number of sectors played an important role as quota lessors. The majority of the unique trade relationships (ties) that formed between pairs of sectors during 2010-2015 formed between pairs of NEFS sectors. There are many underlying factors that might impact the composition of the groundfish ACE transfer network. Some of these changes in network composition could reflect the fact that there was an adjustment period following the transition to catch share management during which sector members were learning how to manage their fishing businesses and sector managers were learning how to manage the needs of their respective members. For example, the fact that the number of unweighted ties in the network was at its second-lowest point in 2010 suggests that sector members and managers may not have known how to accurately anticipate their ACE needs during the first year of catch share management, how to advertise available ACE, how to find needed ACE, or how to negotiate trade compensation.

[202] Vasta, 2019
[203] Network density refers to the ratio of existing ties to potential ties in a network (e.g., Freeman 1982).
[204] In the case of the groundfish ACE transfer network, a reciprocated tie would occur if Sector A leased ACE to Sector B during a fishing year, and Sector B also leased ACE to Sector A in that same year.
[205] Degree centralization is a measure of the variability in the degree centrality scores (number of trade partners) of each individual node in the network (Bodin and Crona 2009). Therefore, a highly centralized inter-sector ACE leasing network would contain sectors with many ACE leasing partners and sectors with few ACE leasing partners.

Groundfish ACE transfer network remained fairly stable throughout the first 6 years of catch share management. The network increased slightly in size during 2010 – 2015, both in terms of the number of nodes and number of ties present. However, the number of ACE transfers and the total volume of ACE transferred annually both fell overall during this time period. Small reductions in network density and percent tie reciprocity during 2010 - 2015 suggest that the network became slightly less cohesive throughout this time period. Data showed that NEFS 2, NEFS 9, NEFS 13, and SHS 1 had relatively high in-degree centrality scores during 2010-2015; in other words, these sectors tended to actively lease ACE in from a wide variety of other sectors. Conversely, FGS, NEFS 2, NEFS 3, and SHS 1 tended to exhibit relatively high out-degree centrality scores during this period, meaning that those sectors tended to actively lease ACE out to a wide variety of other sectors. This may indicate that these sectors occupy advantageous positions as ACE lessors in the network.

There are many socioeconomic, regulatory, and ecological factors that may impact the composition and structure of the groundfish ACE transfer network. For example, some of the observed changes in the network composition, density, and betweenness centralization could have resulted as sector managers and members gained familiarity and experience working within the sector management system. Over time, sector manager and members may have formed trade loyalties to other managers or members with whom they had traded successfully in the past. Sector managers and members may have also learned how to balance their sector's ACE portfolios more efficiently over time, achieving their desired mix of stocks in fewer transactions with fewer partners. In addition, the movement of members from one sector to another, or the movement of members out of sectors completely, could have impacted the way various sectors interact in the ACE transfer network.

Changes in resource abundance or fishing regulations may also have influenced the structure and composition of the ACE transfer network. Fluctuations in resource availability or adjustments to fishing regulations (e.g., cuts to stock ACLs, implementations of closed areas) impact the extent to which groundfish fishermen target certain species. Changes in fishing behavior may impact sector fishermen's annual ACE demands, which in turn could impact their level of involvement in the ACE transfer network. Overall reductions in the number of sector vessels fishing for groundfish and the number of groundfish trips taken over time likely also impacted the dynamics of the ACE transfer network.


NEFS5
NEFS8
NEFS7
NEFS12
NEFS9
NEFS6
SHS
NEFS13
NEFS2
NEFS11
NEFS4
NCCS
FGS
NEFS10
NEFS3
PCCS
TSS

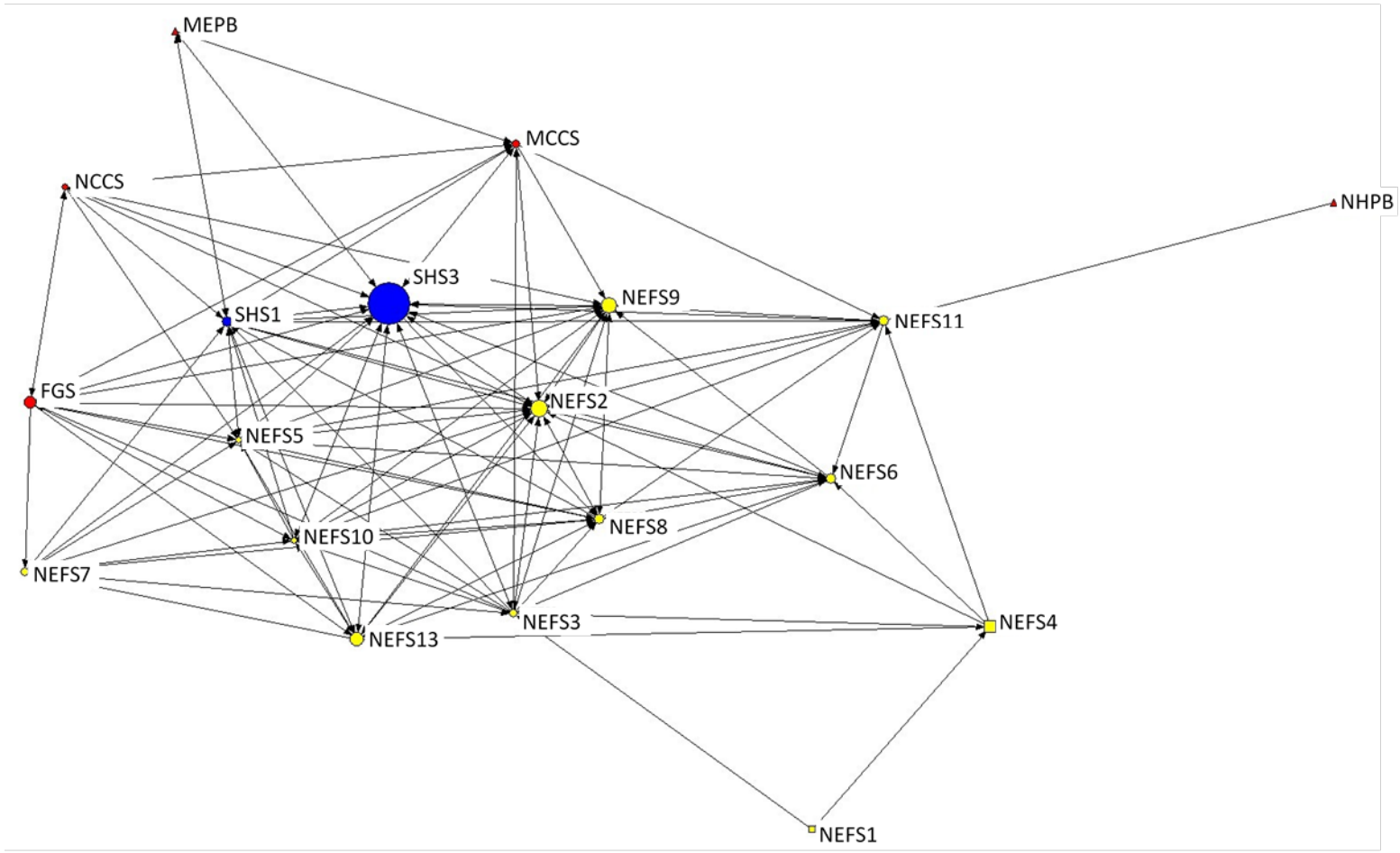


Figure 68. Sociograms of the annual groundfish ACE transfer network in fishing year 2010 (top) and fishing year 2015 (bottom).[206] **Acronyms as follows: FGS = Fixed Gear Sector; PCCS/MCCS = Port Clyde Community Groundfish Sector/Maine Coast Community Sector; NCCS = Northeast Coastal Communities Sector; TSS = Tri-State Sector; NEFS 1 – 13 = Northeast Fishery Sector 1 – 13; SHS = Sustainable Harvest Sector; SHS 1 = Sustainable Harvest Sector 1; SHS 3 = Sustainable Harvest Sector 3; MEPB = Maine Permit Bank; NMPB = New Hampshire Permit Bank.**

[206] Node size is scaled to reflect initial ACE allocations. Node color indicates NEFS sectors (yellow), SHS sectors (blue), and all other sectors(red). Node shape indicates status as an active sector (circle), lease-only sector (square), or state permit bank sector (triangle).

5.i.iv Excessive Shares

Many U.S. catch share programs implement limits on the number of permits, or the proportion of quota that one entity (e.g., person or business interest) can either own or use[207]. The purpose of these limits, or share caps, is to prevent excessive, or undesirable amounts of consolidation. While consolidation of fishery effort to more efficient operations may lead to many benefits expected under catch shares, such as improved profitability, consolidation may also lead to undesirable consequences such as increasing numbers of absentee shareholders (slipper skippers)[208], investment speculators, migration of fishing privileges to urban centers[209], and high lease prices may lead to barriers for new entrants[210]. Other tools that have been used include owner-on-board requirements, where the use of hired skippers is limited—such as in the halibut and sablefish IFQ fisheries in Alaska[211].

Amendment 16 removed share caps for sectors initially implemented in Amendment 13[212]; however, in 2016, Amendment 18 implemented ownership accumulation limits on the amount of permits and PSC that could be held in aggregate by an entity across all stocks. Specifically, an entity is limited to holding no more than 5% of all limited access northeast multispecies permits, no more than 15.5 PSC for each allocated groundfish stocks on average, and no more than 232.5 total PSC aggregated across all stocks. Amendment 18: :

> "…[imposed] accumulation limits to prevent the acquisition of excessive shares. For Amendment 18 analyses purposes, an excessive share of fishing privileges was interpreted as a share of PSC that would allow an entity to influence the marker to its advantage (i.e., market power). Based on this analysis, it was determined that no entity currently holds excessive shares. Also, analysis showed that the accumulation limits and the associated measures established in this action should sufficiently prevent an entity from acquiring an excessive share of fishing permits and exerting market power over the fishery. The limits were also designed, though, to avoid placing adverse impacts on fishing entities that would reduce operational flexibility and market efficiency."[213] (82 FR 18706)

Compass Lexecon was contracted by the Council to analyze market power and accumulation limits in support of Amendment 18. In 2013, approximately 50 interviews were conducted with fishery participants, including vessel captains and owners, NGOs, processors, researchers, and auction operators. In addition, two dozen surveys were completed, and an economic analysis of market power dynamics over fishing years 2010 to 2012 was also completed. Ultimately, the report concluded that there was no evidence that market power was being exercised in the fishery and provided the following recommendations:

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[207] Brinson and Thunberg 2016
[208] Pinkerton and Edwards 2009
[209] Carothers et al., 2010
[210] Squires et al. 1998
[211] Szymkowiak and Himes-Cornell, 2015
[212] While not aimed at permit holders, individual sectors were limited to 20 percent of the PSC of a stock, implemented by Amendment 13. Amendment 16 removed that requirement.
[213] 82 FR 18706: https://www.govinfo.gov/content/pkg/FR-2017-04-21/pdf/2017-08035.pdf

"1. The information NMFS has on permit ownership may not be sufficient, for all potential permit transactions, to reliably define ownership and control of permits and the PSC they confer.

2. There is sufficient competitive information to determine that the relevant markets for ACE trading are the markets for the trading of each stock's ACE. If an operator requires the ACE for a particular stock, there is not a good substitute available.

3. We cannot exclude the possibility of the exercise of market power as the result of the fishery's output regularly reaching the regulated level, which would indicate competitive conduct within the framework of the output regulation. Thus, examination of appropriate caps is necessary.

4. It is reasonable for the NEFMC to recommend that NMFS establish an excessive-share cap to maintain unconcentrated (HHI below approximately 1,500) distribution of PSC by capping individual the PSC for each stock that can be conferred to any permit owner.

5. The cap required to ensure an HHI below 1,500 would be 25 percent with a competitive fringe of 38 percent, or 15.5 percent with no competitive fringe.

6. Sectors do not own or control PSC or ACE. Therefore, capping the amount of PSC or ACE held in the aggregate by members of a particular sector would not provide protections against the exercise of market power or the development of inordinate control."[214]

5.i.v Reliance on the groundfish fishery

Reliance of active northeast multispecies permit holders on other sources of fishery revenue were available for 2016-2018, looking at sector and common pool participation and days absent on groundfish trips. Groundfish fishermen may participate in other fisheries during and across years for many reasons: weather, prices, quota availability, and/or due to regulatory changes (closures, etc.). Here we assess total vessel revenue from any vessel that caught greater than 1 pound of groundfish (live pounds) but did not necessarily report selling any groundfish in an effort to more comprehensively represent "active" northeast multispecies permit holders. Moreover, this analysis further highlights those who may be primarily engaged in other fisheries. Over the last 3 fishing years where data are available, sector vessels were generally more reliant on groundfish revenue than common pool vessels. The median (50^{th} percentile), or typical common pool vessel, received 0% to 4% of its total revenue from groundfish species, compared to the median sector vessel which ranged from 24% to 31% (Table 30).

Vessels more reliant on groundfish revenue appear to be those who spend more days absent on groundfish trips (Table 31). Sector vessels that spent 5 or less days absent on groundfish trips per year generally earned less than 1% of their revenue from groundfish, as opposed to those fishing more than 160 days a year, which received over 70% of their revenue from groundfish species. Total revenues across all activities were highest for those who spent more than 160 days absent on groundfish trips with 22 vessels cumulatively landing between $33 and $35 million across FY2016 - FY2018. The least reliant class of vessels (≤ 5 days absent) also had high cumulative revenues, between $19 and $32 million per year, but

[214] Compass Lexecon, 2013

spread across roughly twice as many vessels (47, 42, and 43 in FY 2016, 2017, and 2018, respectively) with, again, much of their revenue resulting from non-groundfish species. Common pool vessels are less active in the groundfish fishery, with no vessels spending more than 50 days absent per year over the last two fishing years. Common pool vessels who spend between 20 and 50 days absent per year are slightly less reliant than sector vessels who spend just as much time at sea, with common pool vessels earning less than 18% of total revenue from groundfish species in any year, while sector vessels earned 18% and 26% of their revenue from groundfish species.

Table 30. Reliance on groundfish revenue by group (sector, common pool) and fishing year (nominal dollars). Total revenue (on all trips) is shown for vessels with a LA northeast multispecies permit, as well as groundfish revenue when fishing on declared groundfish trips. The proportion of groundfish revenue to total revenue is shown for the median vessel, as well as for those in the 25th and 75th percentiles.[215]

Fishing Year	Group	Trips	Vessels	Length (mean)	Total Rev ($)	Total GF Rev ($)	Median ($)	Median GF ($)
2016	common	4,755	71	45	$15,517,143	$803,276	$120,586	$1,104
2017	common	4,221	72	48	$19,220,009	$435,376	$105,538	$566
2018	common	4,588	69	47	$26,449,760	$290,826	$176,700	$480
2016	sector	13,871	215	59	$131,301,571	$48,668,437	$417,275	$64,963
2017	sector	12,696	204	57	$109,934,945	$45,448,322	$343,474	$66,302
2018	sector	12,853	190	56	$114,228,547	$49,201,682	$367,293	$50,605

Fishing Year	Group	Proportion of GF Revenue			Total live GF(lbs)
		Median	25th	75th	
2016	common	4.0%	0.0%	25.0%	344,569
2017	common	1.0%	0.0%	13.0%	194,970
2018	common	0.0%	0.0%	4.0%	152,928
2016	sector	24.0%	2.0%	68.0%	36,869,621
2017	sector	31.0%	3.0%	70.0%	40,894,825
2018	sector	24.0%	2.0%	73.0%	49,129,476

[215] Source: GARFO DMIS tables accessed 01/2020

Table 31. Reliance on groundfish revenue for sector vessels by days absent (DA) category in fishing years 2016-2018 (nominal dollars). Total revenue (on all trips) is shown for vessels with a LA northeast multispecies permit, as well as groundfish revenue when fishing on declared groundfish trips. The proportion of groundfish revenue to total revenue is shown for the median vessel, as well as for those in the 25th and 75th percentiles.[216]

FY	DA category	Trips	Vessels	Length (mean)	Total Rev ($)	Total GF Rev ($)	Median ($)	Median GF ($)
2016	≤5	2,763	47	60	32,462,134	194,287	551,228	1,672
	>5≤20	3,670	46	49	13,997,990	1,993,502	195,587	31,764
	>20≤50	3,670	40	50	14,020,146	3,519,141	310,301	68,394
	>50≤80	1,851	27	58	14,411,932	4,431,407	385,741	160,321
	>80≤160	1,105	29	69	22,741,938	12,228,146	714,110	410,162
	>160	812	26	76	33,667,432	26,301,954	1,138,618	858,124
2017	≤5	2,705	42	54	19,884,755	182,143	329,601	1,255
	>5≤20	2,503	39	51	16,672,502	1,644,602	169,243	28,782
	>20≤50	4,298	53	51	14,636,198	4,021,504	242,769	67,059
	>50≤80	1,437	20	59	8,995,195	3,797,571	346,166	162,809
	>80≤160	933	25	65	15,091,689	8,891,800	603,620	310,214
	>160	820	25	76	34,654,606	26,910,703	1,272,254	916,142
2018	≤5	2,828	43	58	29,747,415	124,872	569,928	237
	>5≤20	2,004	30	44	6,891,702	1,156,686	126,456	21,531
	>20≤50	4,431	48	48	13,072,509	2,799,738	238,548	45,322
	>50≤80	1,696	24	57	10,967,242	4,695,653	366,731	161,133
	>80≤160	1,099	23	63	17,743,811	11,697,047	841,040	428,872
	>160	795	22	76	35,805,868	28,727,686	1,641,481	1,118,251

FY	DA category	Proportion of GF Revenue		
		Median	25th	75th
2016	≤5	0.01	0	0.02
	>5≤20	0.22	0.06	0.5
	>20≤50	0.19	0.03	0.42
	>50≤80	0.26	0.16	0.76
	>80≤160	0.62	0.49	0.72
	>160	0.76	0.67	0.88
2017	≤5	0	0	0.04
	>5≤20	0.12	0.03	0.61
	>20≤50	0.26	0.09	0.67

[216] Source: GARFO DMIS tables. Accessed 01/2020.

FY	DA category	Proportion of GF Revenue		
		Median	25th	75th
	>50≤80	0.47	0.24	0.67
	>80≤160	0.65	0.46	0.73
	>160	0.72	0.68	0.82
2018	≤5	0	0	0.02
	>5≤20	0.21	0.08	0.6
	>20≤50	0.18	0.01	0.54
	>50≤80	0.54	0.15	0.73
	>80≤160	0.73	0.57	0.82
	>160	0.75	0.69	0.88

5.j Community Impacts

The impact of fisheries management on communities is extremely challenging to estimate and assess because there are multiple definitions of a community, and depending upon which definition is used the scale and scope of the analyses can differ dramatically. Community can encompass entire geographic locations or be limited to only particular individuals within geographic locations who participate in certain industries or activities. National Standard 8 of the Magnuson-Stevens Act (MSA) defines fishing communities as communities that "are substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew, and fish processors that are based in such communities." The act further details that, "[a] fishing community is a social or economic group whose members reside in a specific location and share a common dependency on commercial, recreational, or subsistence fishing or on directly related fisheries-dependent services and industries (for example, boatyards, ice suppliers, tackle shops)." While some smaller and remote ports across the Northeast region may qualify as fishing communities under the MSA National Standard definition, most important ports to the limited access groundfish fleet are situated within urban areas that cannot be narrowly defined in terms of their specific dependence on fishing and fishing-related business activities alone. Therefore, the MSA definition of fishing communities is too narrow for the purposes of analyzing impacts to the communities in which the vessels involved in the limited access northeast multispecies permit program are most active, such as New Bedford or Boston, MA. A broader definition and understanding of community is required in order to meaningfully assess the effect of the limited access groundfish program on communities in the Northeast region.

The Social Indicators of Fishing Community Vulnerability and Resilience (CSVIs) developed by NOAA Fisheries provide useful measures of the relative engagement and reliance of communities on commercial fishing activities. Fishery dependence is considered a combination of engagement and reliance. High engagement may not correspond necessarily with high reliance, as in the case of Boston, MA, which boasts a relatively high level of engagement in commercial groundfish fishing activity but is not reliant upon this activity for economic sustainability. On the other hand, a highly reliant, yet small and remote port, may not register as highly engaged relative to other ports that have higher volumes or landings and revenue. The CSVI commercial engagement and reliance scores are able to provide this nuance that

generally lacks from other more traditional measures of fishery dependence, such as simple net landings, revenue, or other similar metrics.

The CSVIs also provide information on broader community characteristics, such as social and economic factors that may contribute to fishing industry participants' ability to adapt to or recover from major disruptions such as fisheries management changes or environmental hazards.

5.j.i Social indicators of community vulnerability and resilience

Analysis conducted by the Social Indicators of Fishing Community Vulnerability and Resilience (hereafter referred to as the Social Indicators)[217] represent a number of social indicators that measure the impacts of the catch share program on communities in terms of social and economic factors. These include Groundfish-Specific Engagement and Reliance Indicators, that offer numerical indices that reflect the level of a community's engagement in and reliance upon the groundfish fishery relative to other communities in the Northeast; CSVIs that offer indices of labor force structure, housing characteristics, poverty, population composition, and personal disruption; and Gentrification Pressure Indicators that measure housing disruption, urban sprawl, and retiree migration. This analysis provides a look at the vulnerability of these communities to the changes in the groundfish fishery; however, the analysis period does not align with the sector program evaluation score. In order to match fishing engagement and reliance indicator scores to the 5-year American Community Survey data that underpin many of the CSVIs, all indicator scores are represented as statistical averages for the period of 2012-2016. Additionally, due to limited data availability there are no CSVIs or groundfish-specific fishing engagement and reliance indicators available for any periods prior to the sector program. Therefore, we are unable to draw comparisons to pre-sector program activities. Detailed methodology for this analysis is provided in Appendix 8.c.

5.j.i.1 Community-level Commercial Groundfish Fishing Engagement

Over the five-year period, from 2012-2016, eleven Northeast groundfish communities had "high" average engagement in commercial groundfish fishing. The engagement index factor scores are commonly categorized from low to high based on the number of standard deviations from the mean, which is set at zero. Categories rank from 0.00 or below as "low", 0.00 – 0.49 as "medium," and 0.50 – 0.99 as "medium-high," and 1 standard deviation or above as "high. Among these eleven, New Bedford, MA, and Gloucester, MA, far exceeded the other nine highly engaged communities with more than twice the level of engagement in commercial groundfish than the third most highly engaged community, Boston, MA (Figure 69). The remaining eight highly engaged communities included, in order of their levels of engagement: Narragansett/Point Judith, RI, Portland, ME, Montauk, NY, Chatham, MA, Scituate, MA, Hampton Bays/Shinnecock, NY, Cape May, NJ, and Portsmouth, NH.

[217] Compiled by the Social Sciences Branch (SSB) of the National Oceanic and Atmospheric Administration (NOAA) Fisheries Northeast Fisheries Science Center (NEFSC).

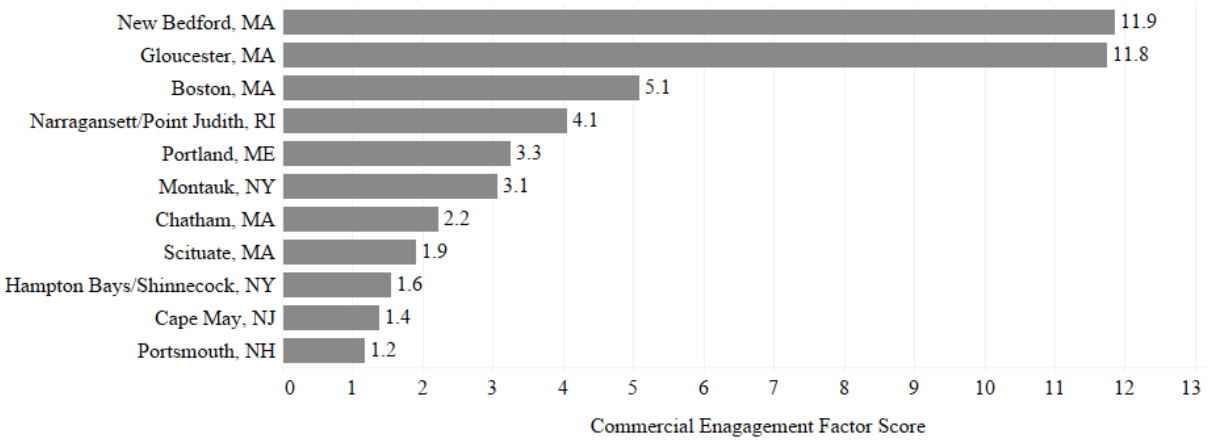

Figure 69. Community engagement rankings for the eleven highly engaged communities in the Northeast groundfish fishery, from 2012.2016.

5.j.i.2 Community-level Commercial Groundfish Fishing Reliance

Community commercial groundfish reliance is a measurement drawn from the value of landed groundfish, pounds of groundfish landed, and federal permits purchased per 1,000 population. Groundfish-specific commercial reliance is designed to measure the amount that a community may be reliant upon the commercial groundfish fishery, however, the total population size of a given community can have an outsized influence on the level of reliance reflected in the index scores.

Over the five-year period, from 2012-2016, eighteen Northeast communities had "high" average reliance on commercial groundfish fishing. The reliance index factor scores are commonly categorized from low to high based on the number of standard deviations from the mean, which is set at zero. Categories rank from 0.00 or below as "low", 0.00 – 0.49 as "medium," and 0.50 – 0.99 as "medium-high," and 1 standard deviation or above as "high". Chatham, MA, and Gloucester, MA, had more than double the level of reliance on commercial groundfish fishing than the third most reliant community, Montauk, NY (Figure 70). Beyond the top three communities, the remaining fifteen highly reliant communities, in order of their levels of reliance on commercial groundfish, included: New Bedford, MA, Barnegat Light, NJ, Woods Hole, MA, Matinicus Isle, NY, Narragansett/Point Judith, RI, Kennebunkport, ME, Saint George/Port Clyde/Tenants Harbor, ME, Monhegan, ME, Provincetown, MA, Seabrook, NH, Harwich Port, MA, Portland, ME, Beals, ME, Frenchboro, ME, and Amagansett, NY.

A number of the same communities have been both highly engaged and highly reliant on commercial groundfish fishing over the 5-year analysis period. These communities are New Bedford, MA, Gloucester, MA, Chatham, MA, Montauk, NY, Narragansett/Point Judith, RI, and Portland, ME. Some of the communities that were highly engaged in commercial groundfish fishing, however, were not highly reliant upon it (Table 32). There may have been many factors that contribute to a community's level of reliance upon commercial groundfish, but some distinguishing characteristics of certain places likely have had an outsized influence on whether the community is recognized as reliant upon it. For example, Boston, MA, is a major city with an estimated average population of over 650,000 from 2012 to 2016. Many different sources of economic activity and employment are present in Boston, including the more

robust and pervasive industries of finance, service, and information technologies. Given these characteristics of Boston, it is unsurprising that commercial fishing in general, and groundfish fishing specifically, does not represent an activity upon which Boston would be highly reliant. Other communities, however, may remain highly engaged without being reliant for reasons related fisheries management and changing fisheries conditions over time. Scituate, MA, is among the communities that may have once been highly reliant upon commercial groundfish, but due to a confluence of factors related to changing stock conditions and the implementation of the catch share system those involved in groundfish fishing activity in Scituate may have been forced to diversify or leave the industry altogether.

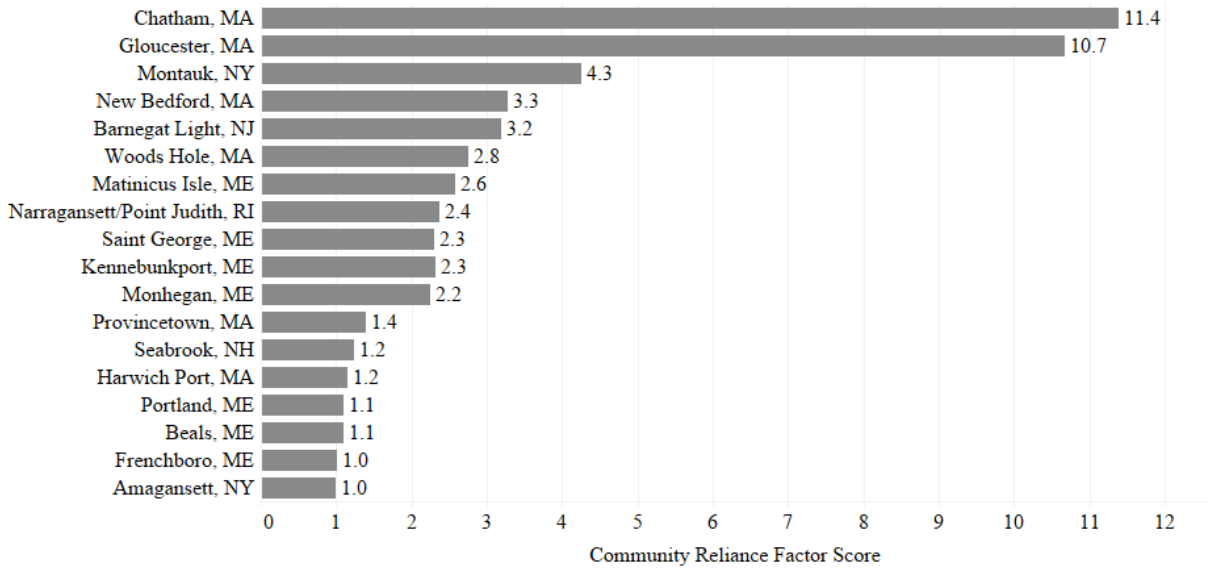

Figure 70. Community reliance for the eighteen highly reliant communities in the Northeast groundfish fishery, from 2012-2016.

5.j.i.3 Social Vulnerability among Highly Engaged and/or Reliant Communities

Communities that rank highly in both engagement and reliance on commercial groundfish have varying levels of social vulnerability across the five dimensions (poverty, labor force, housing characteristics, population composition, and personal disruption) captured by the CSVIs. These dimensions of social vulnerability correspond to the ways in which these communities may be impacted by changes in fisheries conditions and management. While some communities may be more vulnerable due to social inequalities (such as relatively high levels of poverty or personal disruption), others may have significant vulnerabilities resulting from a challenges labor force and housing characteristics, which may indicate fewer alternative sources of employment and a lack of affordable housing. Across the five dimensions of social vulnerability, the analysis found two communities that ranked highly in both engagement and reliance on commercial groundfish, also had at least “medium” vulnerability in three out of the five dimensions of social vulnerability: New Bedford and Chatham. These communities, however, are very distinct in terms of the specific challenges they face with respect to these social vulnerability dimensions (Table 32). New Bedford displayed high vulnerabilities in poverty, and medium-high in housing characteristics, population composition and personal disruption.

These indicate that New Bedford community members may have been more likely to experience poverty, lack affordable housing, live in communities with vulnerable populations, and have lower levels of educational attainment and/or employment, compared with other communities either highly engaged in or highly reliant on commercial groundfish fishing activities. Chatham, however, displayed medium vulnerability to poverty and housing characteristics, and medium-high vulnerability to labor force vulnerability. This indicates that while community members in Chatham may have experienced poverty and a lack of affordable housing, albeit at a lower level than New Bedford community members, they also faced substantial challenges due to a lack of alternative employment opportunities in the local economy; by contrast, New Bedford was not characterized as being vulnerable to labor force characteristics.

5.j.i.4 Gentrification Pressure among Highly Engaged and/or Reliant Communities

Across the communities that measured as both highly engaged in and reliant upon commercial groundfish, all have moderate vulnerability in at least two of the three dimensions (housing disruption, retiree migration, urban sprawl) of gentrification pressure captured by these indicators (Table 33). New Bedford and Gloucester had moderate housing disruption and urban sprawl. Boston had moderately high housing disruption and high urban sprawl. Narragansett/Point Judith had undergone moderately high housing disruption and moderate retiree migration. Portland had dealt with moderately high housing disruption and moderate urban sprawl. Montauk had experienced high levels of housing disruption, moderately high retiree migration, and moderately high urban sprawl. Finally, those in Chatham have experienced moderate housing disruption and urban sprawl, as well as high levels of retiree migration.

Table 32. Community Social Vulnerability Indicators (CSVI) for Communities Highly Engaged in and Reliant upon on Commercial Groundfish. Those communities that have been both highly engaged and highly reliant are indicated in bold.

Community	Total Population	Poverty	Labor Force	Housing Characteristics	Population Composition	Personal Disruption	Highly Engaged	Highly Reliant
Amagansett, NY	1055	Low	Med-High	Low	Low	Low	N	Y
Barnegat Light, NJ	574	Low	High	Low	Low	Low	N	Y
Beals, ME	405	Low	Med-High	N/A	Low	Low	N	Y
Boston, MA	658279	Med-High	Low	Low	Med-High	Medium	Y	N
Cape May, NJ	3529	Low	High	Medium	Low	Low	Y	N
Chatham, MA	**1429**	**Medium**	**Med-High**	**Medium**	**Low**	**Low**	**Y**	**Y**
Frenchboro, ME	43	N/A	Low	N/A	Low	Low	N	Y
Gloucester, MA	**29546**	**Low**	**Low**	**Medium**	**Low**	**Low**	**Y**	**Y**
Hampton Bays/Shinnecock, NY	13040	Low	Low	Low	Low	Low	Y	N
Harwich Port, MA	1721	Low	High	Low	Low	Low	N	Y
Kennebunkport, ME	1089	Low	Low	N/A	Low	Low	N	Y
Matinicus Isle, ME	66	Low	Low	N/A	Low	Med-High	N	Y

Community	Total Population	Poverty	Labor Force	Housing Characteristics	Population Composition	Personal Disruption	Highly Engaged	Highly Reliant
Monhegan, ME	40	Medium	Low	N/A	Low	Low	N	Y
Montauk, NY	**3510**	**Low**	**Medium**	**Low**	**Low**	**Low**	**Y**	**Y**
Narragansett/Point Judith, RI	**15672**	**Low**	**Medium**	**Low**	**Low**	**Low**	**Y**	**Y**
New Bedford, MA	**94988**	**High**	**Low**	**Med-High**	**Med-High**	**Med-High**	**Y**	**Y**
Portland, ME	**66649**	**Med-High**	**Low**	**Medium**	**Low**	**Low**	**Y**	**Y**
Portsmouth, NH	21458	Low	Low	Medium	Low	Low	Y	N
Provincetown, MA	2680	Low	Medium	Medium	Low	Medium	N	Y
Saint George, ME*	2591	Low	Low	Medium	Low	Low	N	Y
Scituate, MA	18390	Low	Low	Low	Low	Low	Y	N
Seabrook, NH	8772	Low	Low	Med-High	Low	Medium	N	Y
Woods Hole, MA	1045	Low	Medium	Low	Low	Low	N	Y

Table 33. Gentrification Pressure Indicators for Communities Highly Engaged in and Reliant upon Commercial Groundfish. Those communities that have been both highly engaged and highly reliant are indicated in bold.

Community	Total Population	Housing Disruption	Retiree Migration	Urban Sprawl	Highly Engaged?	Highly Reliant?
Amagansett, NY	1055	High	High	High	N	Y
Barnegat Light, NJ	574	High	High	Med-High	N	Y
Beals, ME	405	Medium	Medium	Low	N	Y
Boston, MA	658279	Med-High	Low	High	Y	N
Cape May, NJ	3529	High	High	Low	Y	N
Chatham, MA	**1429**	**Medium**	**High**	**Medium**	**Y**	**Y**
Frenchboro, ME	43	High	Low	Low	N	Y
Gloucester, MA	**29546**	**Medium**	**Low**	**Medium**	**Y**	**Y**
Hampton Bays/Shinnecock, NY	13040	High	Medium	Med-High	Y	N
Harwich Port, MA	1721	Medium	High	Medium	N	Y
Kennebunkport, ME	1089	Low	Low	Medium	N	Y
Matinicus Isle, ME	66	High	Low	Low	N	Y
Monhegan, ME	40	N/A	Low	Low	N	Y
Montauk, NY	**3510**	**High**	**Med-High**	**Med-High**	**Y**	**Y**
Narragansett/Point Judith, RI	**15672**	**Med-High**	**Medium**	**Low**	**Y**	**Y**
New Bedford, MA	**94988**	**Medium**	**Low**	**Med-High**	**Y**	**Y**
Portland, ME	**66649**	**Med-High**	**Low**	**Medium**	**Y**	**Y**
Portsmouth, NH	21458	Med-High	Low	Medium	Y	N
Provincetown, MA	2680	High	Medium	Medium	N	Y

Community	Total Population	Housing Disruption	Retiree Migration	Urban Sprawl	Highly Engaged?	Highly Reliant?
Saint George, ME*	2591	Low	Med-High	Low	N	Y
Scituate, MA	18390	Med-High	Low	Med-High	Y	N
Seabrook, NH	8772	Low	Medium	Medium	N	Y
Woods Hole, MA	1045	Low	Med-High	Med-High	N	Y

5.j.ii Shoreside infrastructure

Shoreside infrastructure is a broad term that encompasses a myriad of businesses that are needed to support and sustain the fishing industry. Examples include gear manufacturers, machinists, ice and bait suppliers, dockage, processors, restaurants and fish markets. For the groundfish fishery specifically, data on shoreside infrastructure is generally limited. Furthermore, understanding the effects that fisheries have on shoreside infrastructure is challenging, as these components of the fishing sector are dependent on other sectors as well, such as tourism and recreation, and data rarely untangles the dependency on these sectors.

Federal regulations dictate that all permitted vessels must sell their catch of federally regulated species to a permitted dealer. These dealer reports and dealer permits give a sense of where dealers are registered and where they buy groundfish, but it is more difficult to get information on types of buyers—ranging across auctions, restaurants, wholesalers, seafood markets, or processors. Such information is available across all fisheries through county business patterns but is not specific to any particular fishery. Interviews conducted by The Measuring the Effects of Catch Shares project found that processors could no longer rely on a secure supply of New England groundfish and that support service employment may have decreased[218]. This was further supported through the stakeholder engagement conducted by the Gulf of Maine Research Institute in 2019. Groundfish fishermen are increasingly relying on alternate markets to sell their supplies, such as community supported seafood initiatives[219].

Here, we examine how the number of dealers reporting buying groundfish stocks has changed over the catch share period by sale state.[220] This both serves as an indicator about the level of shoreside activity across the region and is a complement to other analyses about economic impact of groundfish activity across communities.

Dealer data captures groundfish landings on all sector and common pool trips across fishing years 2010 to 2018, 3 years outside the review period, due to data availability. Overall, the number of dealers purchasing groundfish in each state has remained relatively constant, particularly for Massachusetts, which accounts for the most unique dealers[221] in any state. In Massachusetts, the number of dealers has fluctuated between 38 and 48 dealers reporting buying groundfish between 2010 and 2018, with the most dealers in fishing year 2012, corresponding with a period of relatively high ACLs and revenue (revenue

[218] See http://www.catchshareindicators.org/northeast/social-indicators/support-service-employment/ and http://www.catchshareindicators.org/northeast/social-indicators/seafood-processor-employment/
[219] For example, the Fish Locally Collaborative (Tolley et al. 2015.).
[220] Note the number of dealers by state does not equal the number of unique dealer entities since the same dealer may purchase groundfish in multiple states.
[221] A 'unique' dealer permit, (e.g. a fish market chain) is not necessarily location specific

on groundfish trips peaked in 2011). Interestingly, while groundfish landings and revenue were relatively low in 2015, more dealers (at 128) bought groundfish across states in 2015 than in any other year, meaning that purchasing activity was geographically diverse across dealers in that year—not necessarily that there were more unique dealers. Several states experienced increases in the number of dealers purchasing groundfish between 2010 and 2015— notably Connecticut, Maine, North Carolina, New Hampshire and New Jersey. The largest decline in dealers occurred in New York and Rhode Island, each from around 35 dealers in 2012-2013 to around 18 dealers each in 2018, but is still relatively high as compared to other states (Table 34, Figure 71). In New Hampshire, by 2015 the number of dealers buying groundfish dropped from 12 in 2010 to 6 but rebounded to 13 in 2018.

However, while it is interesting to note the changes in dealer activity across states, changes are not necessarily representative of changes in groundfish landings or revenue-- for example in New Hampshire, where its share of revenue has declined from 5% in 2011 to 1% in 2018. New York, with just as many dealers reported purchasing some groundfish as in Maine in 2018, accounted for less than half a percent of groundfish revenue, while Maine accounted for 5% (Table 35). More research is needed to fully understand purchasing decisions across groundfish dealers, and changes in other types of shoreside infrastructure across New England, in general. Processing reports and business county patterns may be a source for further consideration in future evaluations, but these data are unlikely to be limited to groundfish, and especially sector program, activity. With decreased activity in the fishery in general, we can expect an impact on these businesses but as with fishermen participating in other fisheries, these businesses may have compensated the loss of activity resulting from a consolidated groundfish fleet with alternate sources.

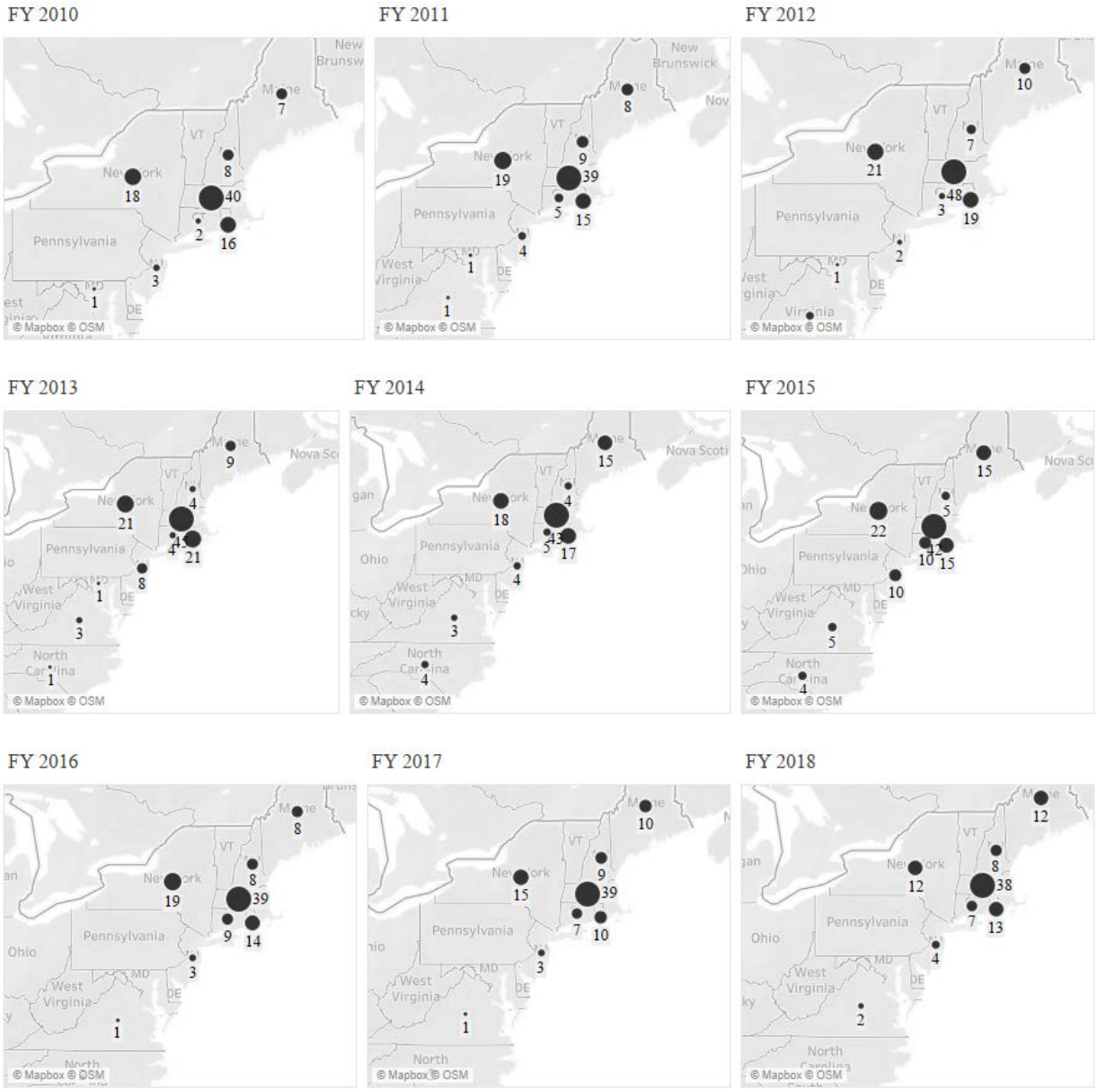

Figure 71. Number of registered dealers (by sale state) reporting buying groundfish stocks from groundfish trips. Data for some states in some years not available.[222]

[222] GARFO DMIS tables. Accessed 8/14/2019

Table 34. Number of registered dealers (by sale state) reporting buying groundfish stocks from groundfish trips.

Sale State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	2	5	3	4	5	10	9	7	7
MA	40	39	48	45	43	42	39	39	38
MD	1	1	1	1	NA	NA	NA	NA	NA
ME	7	8	10	9	15	15	8	10	12
NC	NA	NA	NA	1	4	4	2	2	NA
NH	8	9	7	4	4	5	8	9	8
NJ	3	4	2	8	4	10	3	3	4
NY	18	19	21	21	18	22	19	15	12
RI	16	15	19	21	17	15	14	10	13
VA	NA	1	5	3	3	5	1	1	2
TOTAL*	95	101	116	117	113	128	103	96	96

Note: NA indicates no data were available.

*total does not indicate distinct dealer entities since dealers may purchase landings across multiple states.

Source: GARFO DMIS tables. Accessed 8/14/2019.

Table 35. Share of GF landings on groundfish trips by dealer sale state. Zeroes do not reflect true zeros but less than half a percent may be rounded to zero.

State	2010	2011	2012	2013	2014	2015	2016	2017	2018
CT	0%	0%	0%	0%	0%	0%	0%	0%	1%
MA	89%	86%	82%	83%	85%	87%	91%	92%	92%
MD	0%	0%	0%	0%	NA	NA	NA	NA	NA
ME	5%	7%	11%	9%	10%	8%	7%	6%	5%
NC	NA	NA	NA	0%	0%	0%	0%	0%	NA
NH	3%	5%	4%	3%	2%	1%	1%	1%	1%
NJ	0%	0%	0%	0%	0%	0%	0%	0%	0%
NY	0%	0%	0%	1%	0%	1%	0%	0%	0%
RI	2%	2%	2%	3%	2%	2%	1%	1%	1%
VA	NA	0%	0%	0%	0%	0%	0%	0%	0%

NA indicates no data were available. Source: GARFO DMIS accessed 8/14/2019

5.j.iii Safety

National Standard 10 of the MSA requires that federal regulations be designed "to the extent practicable, to promote the safety of human life at sea[223]" without compromising conservation objectives[224]. Research on catch share fisheries suggests that transitioning to this type of management system may contribute to improved safety outcomes in the regulated fisheries.[225] In two U.S. examples, the number of vessel incidents and diving accidents occurring in the British Columbia geoduck fishery declined after individual vessel quotas were implemented in 1989[226], and the number of vessel casualties and fishermen fatalities in the Alaska halibut and sablefish fishery declined after individual fishing quotas (IFQs) were implemented in 1995[227]; and a 2016 study on the Alaska sablefish fishery found the probability of a vessel operator starting a trip in bad weather declined by 79% after the implementation of IFQs[228].

Recent analyses of occupational fatalities completed for the "Risk Assessment of the Northeast Limited Access Multispecies (Groundfish) Fishery"[229] were used to evaluate whether changes in safety at sea have occurred since the implementation of sector management. The analysis relies on data on fatal vessel disasters[230] and other occupational fatalities involving limited access groundfish vessels were obtained from the National Institute of Occupational Safety and Health (NIOSH) Commercial Fishing Incident Database (CFID).[231]

CFID records indicate that 14 occupational (resulting from work) fatalities occurred in the limited access groundfish fishery during fishing years 2006-2015. The majority (11) of these fatalities occurred prior to the implementation of sector management (2006-2009), while the remainder of the fatalities (3) occurred after sector management was implemented (2010-2015). Most of the fatalities (10) that occurred in the fishery during this time resulted from vessel disasters during fishing years 2006-2008. The remaining four resulted from falls overboard (2), falls from a pier (1), and winch entanglements (1). All of the vessels involved in fatal safety incidents during fishing years 2010-2015 were enrolled in sectors at the time of the incident.[232]

While data on the absolute number of safety incidents occurring in a fishery can help reveal patterns in safety outcomes, fluctuations in fishing effort make it challenging to gauge whether safety is improving or

[223] Commercial fishing has long been one of the most dangerous occupations in the U.S., despite the development of numerous measures designed to reduce risk and improve safety (Pfeiffer and Gratz 2016).
[224] 50 CFR § 600.355
[225] e.g., Heizer 2000; McCay 2004; Hughes and Woodley 2007; Grimm et al. 2012; Pfeiffer and Gratz 2016; Brinson and Thunberg 2016
[226] Heizer 2000
[227] Hughes and Woodley 2007
[228] Pfeiffer and Gratz 2016
[229] Fenton et al. *in prep*
[230] Fatal vessel disasters are defined as "sinkings, capsizings, groundings, fires, or other events that force crews to abandon ship" (NIOSH 2017, p. 2).
[231] Fenton et al. *in prep*
[232] Ibid.

declining over time. In order to control for these changes, standardized fatality rates were calculated to measure fatality risk[233] within the limited access groundfish fishery.[234]

During fishing years 2006-2015, the limited access groundfish fishery experienced an average annual occupational fatality rate of 21.89 fatalities per 10,000 full-time equivalent employees (FTEs)[235]. The majority (11) of these fatalities occurred prior to the implementation of sector management (2006-2009), while the remainder occurred after sector management was implemented (2010-2015). The average annual occupational fatality rate during 2006-2009 was 39.85 fatalities per 10,000 FTEs; this dropped to 9.92 fatalities per 10,000 FTEs during 2010-2015; this represents a 75-percent decline (Figure 72).[236]

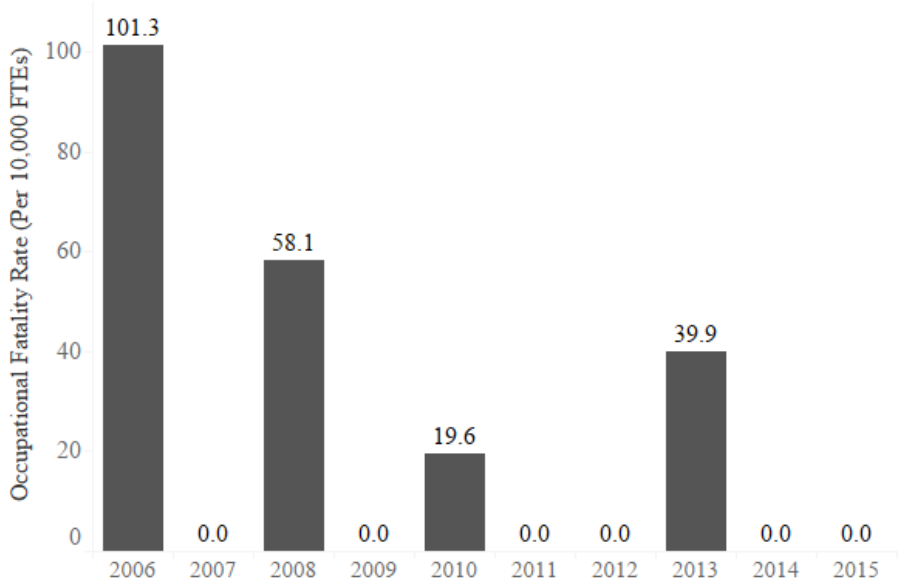

Figure 72. Annual occupational fatality rates (number of fatalities per 10,000 FTEs) in the limited access groundfish fishery during 2006-2015.[237]

The fact that the occupational fatality rate in the limited access groundfish fishery declined markedly from 2006 to 2015 suggests safety at sea has improved over time. However, it is impossible to attribute this observed decrease to the implementation of sector management. There are many factors, both regulatory and otherwise, that may have contributed to this trend. For example, the likelihood of a fatality occurring on a limited access groundfish vessel may have declined as the size of the fleet contracted over time. The number of active vessels that landed groundfish annually declined from 596 vessels in 2007 to 269 vessels in 2015, and the number of groundfish trips taken annually by the fleet declined from 27,370 trips in 2007 to 8,453 trips in 2015.[238] Fewer vessels taking fewer groundfish trips may mean fewer

[233] NIOSH defines risk as "the probability of a fatality occurring" (NIOSH 2017, p. 5); therefore, reductions in occupational fatality rates may indicate improvements in safety.
[234] NIOSH 2017
[235] This rate provides an estimate of "how many fatalities would have occurred in [fishing] fleets if they all had 10,000 fishermen working regular 40-hour weeks throughout the year" (NIOSH 2017, p. 5).
[236] Fenton et al. *in prep*
[237] Ibid.
[238] Murphy et al. 2018

opportunities for fatalities to occur. Additionally, conversations with commercial fishermen and safety trainers suggest that safety at sea has improved as emergency response training and safety resources became more widely available in the Northeast.[239]

It is also important to note that the incidents and incident rates discussed in this section focus solely on occupational fatalities that occurred in the limited access groundfish fleet during 2006-2015. Therefore, it is not possible to determine whether changes in other safety metrics, such as non-fatal injuries, accidents, or near misses, also occurred during this time. The occupational fatalities described in this section only reflect fatalities that occurred while the affected vessels were participating in the groundfish fishery. Therefore, these data do not include information on fatalities that may have occurred while limited access groundfish vessels were redirecting effort into other state or Federal fisheries.

5.j.iii.1 Industry perspectives on safety at sea

Informational interviews with commercial fishermen (14), safety training professionals (2), and current and former fishery observers (16) provided additional insight into whether the transition to sector management may have impacted safety at sea in the limited access groundfish fishery. Interviewees had mixed opinions on if, and how, sector management has impacted safety. Several fishermen reported that the change in management did not impact where, when, or how they target groundfish, so they did not perceive any major changes in safety. Others felt that, in some ways, sector management has contributed to improvements in safety for sector fishermen. These interviewees explained that exemptions from many traditional effort control regulations, such as DAS restrictions and landing/possession limits, have granted them more flexibility to avoid fishing in hazardous weather. Interviewees explained that prior to the implementation of sectors, they frequently remained at sea in bad weather in order to "ride out" the DAS clock or avoid wasting DAS that they had paid to lease-in. Since joining sectors, these interviewees reported that they feel less pressure to start trips or to remain at sea in deteriorating conditions.[240]

While interviewees perceived some flexibility-related improvements in safety, many also explained that other aspects of the sector management program have had negative impacts on safety. One fisherman explained that he has been forced to fish farther from port since joining a sector because ACE for inshore stocks is too expensive to lease in. Many respondents believed that the increased costs associated with sector management, such as ACE leasing costs and sector administrative costs, have contributed in part to a decline in profitability for many sector vessels. This has made it difficult for some operators to afford routine vessel and gear maintenance, leaving those vessels relatively vulnerable to mechanical or structural failures. Financial strain has also made it more difficult for operators to locate and hire experienced crew. As a result, many operators have resorted to fishing short-handed, which can exacerbate fatigue, compromise wheel-watches, and leave few people available to respond in the event of an emergency at sea. Other operators have hired inexperienced crew who are unfamiliar with the hazards of fishing.[241]

[239] Fenton et al. *in prep*
[240] Fenton et al., *in prep*
[241] Ibid.

5.k Stakeholder engagement and cooperation

The development of Amendment 16 was enabled by a series of stakeholder workshops with regional office and Council staff with topics focused on challenges related to the proposed management alternatives. Industry leaders led the proposals to develop a sector-based management approach, which became the new focus, with subsequent workshops dedicated to design elements of the catch share system.[242] Advisory panels (APs) play an important role in the fisheries management process to provide information and recommendations to the Council during the development of fishery management plans, amendments, specifications, and management measures; this section is considering the broader opportunities for engagement and collaboration beyond the AP process.

The new system was a considerable dissent from management under DAS, with the catch share elements of explicit catch allocations, sector-based management approach, monitoring requirements and transferability. This required both engagement and collaboration between management and stakeholders along with dedicated resources, particularly in the development of sector operational plans, environmental assessments and monitoring program details. These resources were provided largely by grants through regional non-profit organizations to industry organizers (Section 4.b.vii).

A regional assessment and management review of the NE fishery management progress was conducted in response to frustrations following the implementation of MSA requirements for ACLs and AMs.[243] The study examined the relationships between NEFMC, NERO (GARFO), NEFSC, and stakeholders, and identified strengths and challenges across the entire process as well as recommendations to improve stakeholder engagement and collaboration. Specific themes with respect to stakeholders to emerge were the need to improve science collaboration, simplify governance, maximize collaboration and simplify communications. The subsequent sections and tables in this section summarize the increased efforts dedicated to improving engagement and collaboration; however, it is likely that both redundancy and a lack of clear objectives along with other challenges persist.

5.k.i Science engagement

The Science Center has consistently created opportunities for engagement in the stock assessment process, and increased engagement in management with the implementation of the sector program generally led to increased science engagement. The NEFSC Population Dynamics Branch (PDB) conducts pre-assessment meetings to ensure (1) that the process is understood, and that (2) there is opportunity for input. Previously the PDB did not have time to respond to identified needs due to lack of advance planning; however, in recent years, the PDB have changed the timing and planning considerably and research is planned for five-year tracks, allowing for programs to plan research priorities for when information is used.

There did not appear a reduction in stakeholder engagement with the implementation of the catch share program. Pre-assessment outreach meetings to allow for industry and other stakeholder input have been held both prior to and following the change in management. Relevant results from cooperative research projects are included in stock assessments where needed. The goal of these meetings is to provide for a

[242] Singer, 2011
[243] Pate and Touchstone, 2011

forum to address when science and stakeholder feedback are in disagreement, though this may provide for engagement without the benefits of collaboration.

The Population Dynamics Branch worked with the Cooperative Research Program to host workshops or to use their data across identified science needs (Table 36). There were several specific instances of stock assessment outreach during catch share program years (2010-2015), with respect to the catch share program select research was focused on gear research and study fleet.

Table 36. Stock assessment outreach for 2010-2015.[244]

Topic Area	Reference
Cooperative research in stock assessments	
Yellowtail flounder (2012)	Northeast Fisheries Science Center. 2012. 54th Northeast Regional Stock Assessment Workshop (54th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 12-18; 600 p.
Direct engagement with industry before an assessment	
Groundfish inclusion of the NTAP estimates of catchability (2) 8 webinars and public comments about the assessments. A record of comments and summaries by location available.	CRD 15-24: Operational Assessment of 20 Northeast Groundfish Stocks, Updated through 2014, Northeast Fisheries Science Center. November 2015.
Pollock (2010) (Meeting summary which largely focuses on scientific issues)	2010. SAW 50. Port meeting with groundfish fishermen in Gloucester. Appendix C1: SAW 50.
Other Research	
Marine Resources Education Program (2011-2015)	Through Gulf of Maine Research Institute
FishTank Workshops (2015)	Through Gulf of Maine Research Institute

5.k.ii Cooperative research related to the sector system

As the New England groundfish fishery transitioned to sector-based catch share management, assistance was provided throughout the region to sectors through a number of cooperative research projects funded by the NEFSC Cooperative Research Program or private NGO foundations (Table 37).

Table 37. Research projects related to sector-based management.

Topic Area	Purpose	Organization(s) engaged
eVTR	Facilitate the adoption of electronic trip reporting throughout the northeast groundfish sectors	GMRI
Codend Sensors	Test, compare and demonstrate various brands of codend catch sensors to determine if they are a practical operational tool for sector quota management.	GMRI
Bycatch Avoidance	Improving fishing efficiency through spatio-temporal tools to reduce bycatch	CCCHFA, Duke University & Island Institute
	Spatial and temporal information management for bycatch avoidance in New England groundfish sectors	GMRI, Ocean Data Products, NERACOOS, UMASS/SMAST & CCCHFA

[244] Personal comms. Ariel Baker, Population Dynamics Branch, NEFSC

Topic Area	Purpose	Organization(s) engaged
GEARNET	Network approach to conservation engineering for the New England groundfish fishery: collaboration, outreach and demonstrations of alternative fishing gears	GMRI, UMASS/SMAST, Superior Trawl, Mass DMF
REDNET	Network approach to redevelop a sustainable redfish trawl fishery in the GOM	Mass DMF, Maine DMR, UMASS/SMAST, GMRI, Trawlworks, Associated Fisheries of Maine
Sector Viability	Developing strategies for long term economic viability of individual sectors based on groundfish effort and landings	GMRI

5.k.iii Sector level coordination and support

Engagement had been provided to help the sectors sift through the processes of operating under the management regime, likewise, there was a learning curve for management. Since FY 2011, sector managers and NOAA Fisheries Sustainable Fisheries Division staff began participating in monthly phone conferences. These calls were an open forum for both sector managers and NOAA Fisheries staff to directly communicate on all sector related business. In addition, in person meetings were also scheduled as needed to work through more specific topics. Workshops have been conducted throughout the region during the evaluation period (and continue to be convened) bringing together fishermen, scientists, managers and other stakeholders to discuss groundfish related issues (Table 38).

Table 38. Selected sector related coordination and support initiatives.[245]

Purpose	Organization(s) engaged
2011: Sector Review Workshop	NEFMC
2012: Northeast Groundfish Science Forum	NEFSC/NERO/NEFMC
2012: Establishing Discard Mortality Rates for Atlantic Cod Stock Assessments Using a Modified Delphi Technique	NEFSC
2014: Developing Solutions to Improve Groundfish Businesses	GMRI
2014: Workshop to Explore Fishing Behavior and Constraints in FY 2012	GMRI
2014: Northeast Federal Fishery Dependent Data Visioning Project Industry Workshop	NOAA/GMRI/SMAST
2014: Exempted Fishing Permit Informational Session	GMRI
2015: Taking Stock: A Workshop to Collaboratively Improve Stock Assessments	GMRI

5.l Essential Fish Habitat

The Northeast U.S. Shelf Ecosystem (See Figure 2, Section 3.b) includes the area from the Gulf of Maine south to Cape Hatteras, extending from the coast seaward to the edge of the continental shelf, including the slope sea offshore to the Gulf Stream[246]. The continental slope includes the area east of the shelf, out to a depth of 6,562 ft (2,000 m). Four distinct sub-regions are identified, including the Gulf of Maine, Georges Bank, the Mid-Atlantic Bight, and the continental slope. The groundfish fishery primarily occurs

[245] An expanded list of sector data and analysis projects can be found online: http://archive.nefmc.org/nemulti/cte_mtg_docs/110418/5_Sector%20Projects%20for%20GF%20Cte.pdf
[246] Sherman et al. 1996

in the inshore and offshore waters of the Gulf of Maine, Georges Bank, and the Southern New England/Mid-Atlantic areas. Each of these regions are characterized by diverse habitats with respect to depths, substrates and currents that results in varying assemblages of invertebrate and fish species.

The groundfish fishery is prosecuted with several different gear types, including trawls, gillnets, and hook and line gear (jigs, handline, and non-automated demersal longlines). Essential Fish Habitat (EFH) is defined by the Sustainable Fisheries Act as "[t]hose waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The geographical distributions and habitat characteristics of EFH designations for benthic fish species managed in the Greater Atlantic Region are well defined for juvenile and adult life stages (e.g. see Amendment 23, DEIS). These designations are critical for development of management actions and reviewing potential impact from fishing activities.

In general, EFH for species and life stages that rely on the seafloor for shelter (e.g., from predators), reproduction, or food is vulnerable to disturbance by bottom tending gear, such as used in the multispecies fishery. The most vulnerable habitat is more likely to be hard or rough bottom with attached epifauna. The Council's recently published Omnibus Habitat Amendment 2 includes an assessment of relative habitat vulnerability to the gear types used in the northeast region, recently updated in 2019.[247]

Amendment 13 (2003) included a comprehensive evaluation of gear effects on habitat. The amendment described the general effects of bottom trawls on benthic marine habitats. This analysis primarily used an advisory report prepared for the International Council for the Exploration of the Seas.[248] The report generally concluded that: (1) low-energy environments are more affected by bottom trawling; and (2) bottom trawling affects the potential for habitat recovery (i.e., after trawling ceases, benthic communities and habitats may not always return to their original pre- impacted state).

The Committee on Ecosystem Effects of Fishing for the National Research Council's Ocean Studies Board[249] prepared an evaluation of the habitat effects of trawling and dredging that was also evaluated during Amendment 13. This report identified four general conclusions regarding the types of habitat modifications caused by bottom trawls:

- Trawling reduces habitat complexity;
- Repeated trawling results in discernible changes in benthic communities;
- Bottom trawling reduces the productivity of benthic habitats; and
- Fauna that live in low natural disturbance regimes are generally more vulnerable to fishing gear disturbance.

In order to determine whether the implementation of the catch share system had an effect on EFH, analysis must consider changes to fishing operations that occurred with implementation; these would include changes in effort and number of vessels, gear type employed, spatial scale of the fishery and overlap with habitats.

Analysis from Murphy et al. (2018) indicates there the general decline in groundfish effort continued under the sector system. However, the change from pre and post sector program (FY 2009 to FY 2010)

[247] NEFMC 2019
[248] ICES 2000
[249] NRC 2002

showed a dramatic decrease in both total number of groundfish vessels (- 22.2 %) and number of groundfish trips (-48.4 %) (Section 5.c). This would imply that there was less bottom disturbance and thus disturbance of EFH as there was less bottom tending gear used in the fishery.

Effort reductions were seen across all vessel size classes following implementation of the sector program, with the smallest reduction in the 75' and greater vessel size class both number of vessels (-13.4 %) and number of groundfish trips (-3.9 %). These larger vessels are generally equated to offshore, multi-day trip vessels. Effort reductions by gear type were also observed with the implementations of the catch share system. Trawl vessels experienced the least consolidation across gear types, with a 27.9% reduction in number of vessels since implementation of the sector program. Trawl and longline vessels experienced the least reduction (-48.1 % and – 44.7 %, respectively) in number of trips compared with other gear types operating in the fishery.

Data from observed trips does indicate a shift in fishing effort for large trawl vessels from inshore to offshore following implementation of the catch share program, though for small vessels most fishing occurred in coastal statistical areas and this pattern did not change with implementation of the program[250]. Theme maps[251] relying on VMS data broadly characterizing commercial fishing activity developed by the Northeast Data Portal[252] similarly illustrate shifts in activity from inshore to offshore from earlier to later periods of (calendar years) 2006 – 2010 to 2011 – 2014 and 2016 – 2016. While this doesn't align exactly with the evaluation period, it does demonstrate spatial shifts over the timeframe. These analyses are lacking fine scale geographic patterns of fishing activity, along with information on types of gear that were used, the footprints of those gears, and the sensitivity of seabed habitats in different areas, VMS data alone do not reliably indicate when fishing was occurring and may need to be considered along with vessel trip reports.

Reductions in effort (numbers of vessels and numbers of trips) were not realized proportionally; decreases in trips and vessels weren't linear across gear types and vessel sizes. Large vessels and trawl vessels, which are shown to have largest habitat impacts had smallest decline by gear type & trips, whereas smaller day boat vessels and gillnets which have lower habitat impacts experienced greater declines. Therefore, the potential decrease in EFH impacts as a result of the decrease in effort was not proportional throughout the groundfish fishery. In addition, it is believed that the implementation of the catch share system resulted in some displacement of effort into both other federally managed fisheries and state water fisheries thus further reducing potential realized gains to EFH with the implementation of the catch shares. No data were readily available to consider changes (expanded or contracted) to the footprint of the groundfish fishery with the implementation of catch shares.

[250] http://www.catchshareindicators.org/northeast/ecological-indicators/fishing-effort/

[251] Maps broadly characterizes Northeast multispecies (groundfish) commercial fishing vessel activity in the Northeast based on Vessel Monitoring System (VMS) data from 2006 through 2016 (full calendar years). The maps do not necessarily distinguish between fishing activity, vessel transit, and other vessel activities. Some maps show vessel activity at less than four knots—a speed threshold that was determined with industry input to attempt to better highlight fishing areas. Nevertheless, those maps still likely show some non-fishing activities that occur at low speeds, such as processing catch, sorting, drifting, or idling in port. The most accurate interpretation of these maps is that they indicate relative levels of vessel presence.

[252] https://www.northeastoceandata.org/data-explorer/?commercial-fishing|vessel-activity

6 KEY FINDINGS

This review aligns with the eight elements of NOAA's Guidance for Conducing Reviews of Catch Share Programs based on the best available analysis and information. The boundaries of the review (largely restricting analysis to available and completed work) and evaluation period (covering fishing years 2007 – 2015) limited the extent to which this review could evaluate the sector program and addresses the key goals and objectives of the program as specified for the FMP in Amendments 13 and 16. The sector program, unlike other catch share programs nationally, does not have independent goals and objectives by which to measure success. However, as the first of its kind for the sector program, the evaluation provides an opportunity to understand effects from and changes to the program since implementation and isolate gaps to develop recommendations for more thorough future reviews.

Key findings point to a fishery that has experienced further declines in the number of active vessels since implementation of the catch share program, a period of adjustment to a new management regime, constraining quotas limiting the ability to land some stocks, reduced revenues, a process of adapting to a leasing market, along with challenges external to the program that affected its operations and restricted opportunities for fishermen. A central theme throughout the evaluation was the limitations on data for deeper analysis. While there is a considerable amount of information collected and maintained, available data and analysis limited the ability to draw causal conclusions about changes that occurred during the review period.

While this review focuses on how the fishery has changed since sectors were implemented, the sector system has also been the focus of considerable study and literature in academia, by NGOs and others, with a variety of different scopes. The sheer volume of publications on catch shares in general and the northeast multispecies sector program, specifically, speak to the complexities of the system and difficulties in attributing changes experienced to the various variables interacting in socio-ecological systems. Arguments made in published literature have pointed to management's inability to respond to the complex factors that shape management systems[253]; the lack of effective conservation, due largely to the interaction of social, political and economic variables that have contributed to what has been deemed a fishing failure[254]; a mismatch and inability for policy to take account of local needs and local ecological knowledge in management, particularly with industry consolidation that often results from catch shares[255]; among others, based on experience, interviews and fishery information. This literature is an additional, complementary source of information to the discussions regarding cause and effects that have reverberated throughout the fishery; where appropriate the published literature was referenced in the report, but did not shape the main analyses included in this review.

The following subsections highlight the key findings presented throughout the main body of this report.

[253] Acheson 2011
[254] Acheson and Gardner 2014
[255] Brewer 2011

Groundfish Fishery Participation

Implementation of and initial years in operation during the sector program saw declines in both the number of northeast multispecies permits and active participation. Concurrently there was an increase in the number of sector permits held in CPH, corresponding with continued reductions in active participation, the number of vessels, total revenues and landings.

The number of operational sectors varied slightly during the evaluation period from 17 to 19 by FY 2015. Over the six-year review period there was an increase in sector participation as more MRIs left the common pool, but this does not equate to active participation, as participants must be enrolled in a sector to lease quota.

Permit banks provide a mechanism to create additional opportunities to participate in the fishery and to promote and maintain diversity across the fishery; permit banks in New Hampshire and Maine make ACE and DAS available to assist fishermen in their respective states; whereas Massachusetts and Rhode Island developed revolving loan funds to offer capital to support fishermen in leasing ACE and vessel repairs. Only NH and ME have permits banks in operation today. Several private entities have also developed their own permit bank models for assisting their communities.

Fleet Activity, Diversity and Consolidation

The number of vessels taking groundfish trips has been declining since the mid-1990s and continued during the nine-year review period. During the three-year baseline prior to the implementation of the sector program, there was a 14% decrease in the overall number of vessels taking groundfish trips, compared with a 37% decrease between FY 2010 and 2015. The largest overall year to year decline (22%) was observed in the transition of management systems between FY 2009 and FY 2010. And a 58% decline in all groundfish vessels was recorded across the review period, FY 2007 through FY 2015.

Similarly, during the pre-catch share period, there was a 4% decrease in the overall number of groundfish trips, compared with a 38% decrease between FY 2010 and 2015; the largest single year to year decline in groundfish trips (48%) was observed during the transition of management systems between FY 2009 and FY 2010 – as with the decrease in number of vessels. A 69 % decline in all groundfish trips was recorded across the entire nine-year review period.

Different components of the groundfish fishery experienced different rates of decline in the number of vessels participating in the groundfish fishery and the number of groundfish trips across the nine-year review period, and there was some similarity. By vessel size class, 30’ to < 50’ vessels had the largest decline in participation by percentage and numbers (65% and 233 vessels, respectively), and the largest decline in groundfish trips by percentage and numbers (74% and 676 trips, respectively). The largest vessel size class (75’ and above) had the lowest rate of decline in numbers of vessels (41%) and groundfish trips (31%), across vessel size classes. The lowest decline in number of vessels and groundfish trips was in the < 30’ size class (14 vessels and 110 trips, respectively).

New Jersey registered vessels had the largest rate of decline (94%) while Massachusetts had the largest decline in number of vessels (188 vessels). Number of trips taken was not available by home port state. By major homeport city, Boston had the highest rate of decline in groundfish vessels (55%) but the lowest decline in groundfish trips by percentage and number of trips (6% and 28 trips, respectively). Gloucester

had the highest decline in the number of vessels (48 vessels) and the highest rate of decline in groundfish trips by percentage and number (80% and 7,233 trips, respectively). Point Judith had the lowest rate of decline (24%) while Portland had the lowest decline in the number of vessels (9 vessels). By gear type, the rate of decreasing participation and groundfish trips was highest in longline vessels (84% and 95%, respectively) while by number, decreases by trawl vessel participation was greatest (168 vessels) and trips taken by gillnet vessels had the greatest decline in groundfish trips (5,263 trips). The lowest decrease in groundfish participation and number of trips taken was observed in the handline/rod-reel gear type by rate and number (9% of vessels removed and 39% of trips).

Declines in fleet activity prior to the sector program can be attributed in part to increased fishing restrictions and poor stock recruitment due to overfishing along with other factors such as changing behaviors in response to oncoming management changes; the continued decline indicates a lack of stabilization during the six years under the sector program.

While the number of vessels taking groundfish trips declined, the diversity of the fleet did not appreciably change, as measured by both richness and effective diversity over 2007-2015. The actual number of vessel types ('richness' – as measured across four vessel characteristics: 4 gear types, 4 vessel sizes, and 23 regions, potentially resulting in 368 unique vessel types), in any given fishing year ranged from a high of 98 in 1996 to a low of 47 vessel types in 2015. Thirty-one vessel types were present in every year from 2007 – 2015 and represent the "core" groundfish fleet.

While there is no explicit definition of what would comprise a diverse fleet for the groundfish fishery (as presented in Objective 7 "*To the extent possible, maintain a diverse groundfish fishery, including different gear types, vessel sizes, geographic locations, and levels of participation*"), analyses illustrates that there were unequal reductions across vessel size classes and geographic locations; however, over the nine-year period there was little variation in fleet diversity (i.e., in terms of types of vessels within the groundfish fishery).

Further, there is no evidence of consolidation in ownership, despite declines in the number of vessels and the number of valid northeast multispecies permits (1,210 in 2010 to 820 permits as of July 1, 2015); the majority of the decline is accounted for by permits that have been transferred into CPH. Between 2012-2015 the proportion of limited access northeast multispecies permits owned by smaller affiliated businesses increased rather than the other way around. That is, the proportion of groundfish permits owned by a single owner or owner group increased from 50% in 2011 to an average of nearly 56% during 2012 to 2015. Both the number of affiliates with active groundfish permits and the total number of active groundfish permits declined over time. In terms of changes in the distribution of active permits among larger and smaller affiliated business size there was relatively no difference in the proportion of active groundfish vessels by affiliated business size in any year from 2010 to 2015.

Employment and Crew Survey

Accurate estimates of employment are challenging to attain, a picture of crew and employment does speak to the participation in the fishery, but there are known limitations with these analyses, which are further detailed in the recommendations and methods. VTR information that reports on trip-specific crew information found a 29% decrease over the nine-year period. Decreases in the number of crew trips (as an

indicator of earning opportunities for crew) were generally experienced across all vessel size categories and home port states in the region over the period of analysis.

Crew surveys were conducted in 2012-13 and 2018-19, therefore one wave fell within the evaluation period and one outside. For the purposes of analysis, the report compared findings between the two survey waves. Groundfish crew and hired captains have a higher mean age than crew in other fisheries, indicating a possible "graying of the fleet" at a higher rate among those in the groundfish fishery. While incomes increased for crew across all fisheries between 2012 and 2018, groundfish crew incomes did not increase as much as those in other fisheries, gross revenues were known to decrease over the evaluation period, but there is no related analysis comparing with all other fisheries in which crew and captains may participate. Without health insurance or purchased private health insurance plans, health care costs may be a substantial burden on crew, especially given the health risks associated with commercial fishing as an occupation. While groundfish crew were generally more satisfied with several aspects of their work over time, there were substantial gaps in satisfaction by fishery. For example, groundfish crew were much less likely than crew in other fisheries to be satisfied with the predictability of their earnings.

Groundfish crew surveyed were mostly concentrated in Gloucester and New Bedford, but with substantial proportions also working out of Portland and Boston. These survey data correspond with commercial fisheries data that indicate these to be among the most highly engaged ports in terms of groundfish landings. Longer working hours among groundfish crew seem to correspond to smaller crew sizes than for those in other fisheries. Results identified that the majority of groundfish crew were paid through a share system and on average groundfish crew had slightly smaller shares than crew in other fisheries. Groundfish crew tend to hold less favorable views about fisheries management than crew in other fisheries.

Monitoring, Enforcement and Compliance and Shared Management Responsibility

Over the course of the catch share program, additional monitoring has been put in place to improve catch accounting, while this has added some valuable data streams, it has contributed to redundant reporting recognized by the fishing industry and managers and an inability of the monitoring program (observers and monitors) to provide timely and verified catch data, leading to issues associated with documented non-compliance to suspected non-compliance with retention requirements.

At implementation, additional reporting and monitoring requirements were instituted including: trip notifications and additional VMS reporting, additional observer coverage (at-sea monitoring program) and dockside monitoring program (removed in 2011), as well as sector level reporting of weekly trip issues, and ACE status and detail reports, and year-end reports.

In most years the target combined observer coverage levels were not achieved (when combining realized coverage levels for ASM and NEFOP) between FY 2010 – 2018. The funding source for the costs associated with increased monitoring have been variable over the years, with some portion of funding covered by the federal government in all years. Enforcement of unlawful discards and stock area misreporting are primary concerns for enforcement of the sector program.

Enforcement has noted these measures may still not be sufficient to ensure compliance with increased catch accounting requirements instituted under the sector program. Limitations to the monitoring program

affect the ability for enforcement agents to ensure compliance with regulations, as evident through analysis of VMS and VTR data. Differences identified in VMS estimated catch and VTR reported catch beginning in FY 2010 for several quota limited stocks occurred even with improved compliance with statistical area reporting on VTRs over the same time period. The current regulation regime is vulnerable to stock area misreporting, which has been revealed by the US Coast Guard to have occurred on sector fishing trips and limits the ability of enforcement to detect and document misreporting of stock areas.

The sector-led development of Inshore Gulf of Maine Declaration provision, adopted by all sectors in FY 2013, was to hinder fishing vessels from misreporting catch of species of concern found in the inshore GOM region as from other broad stock areas.

A key feature of catch share programs, specifically cooperative-style programs, is the ability for self-governance. Aspects of self-governance are difficult to measure, sectors do provide critical services in self-reporting, organization and enforcement, and literature has illustrated reduced time spent on decision making. Sector members are contractually required to adhere to joint and several liability and indemnification, under their signed sector contracts, making sector members collectively responsible for sector ACE overages, discarding of legal-sized fish and misreporting of catch landings or discards. member compliance with sector operations plans and regulations is not public information, various reporting mechanisms have been developed so that sectors can report violations/incidents/issues both during and at the conclusion of each fishing year to NOAA Fisheries. This may indicate an increase in stewardship of the fishery; however, 'stewardship' is not necessarily a clear term that can be effectively measured against.

Landings and Gross Revenues

Landings and gross revenues can be assessed across various units, such as vessel size categories, ports, states, gear types, and species/ stocks (including groundfish and non-groundfish species), which can generate a more holistic perspective of the realized economic impacts.

We can consider these results, along with catch utilization, as indicators to whether the sector program met aspects of Goal 3 to "*Maintain a directed commercial and recreational fishery for northeast multispecies*." The groundfish fishery experienced declines in landings and revenues since the 1980s. Though decreased revenues and landings were larger across groundfish trips compared with all trips taken by the limited access groundfish fleet. On groundfish trips, aggregate landings of non-groundfish and revenue from non-groundfish exceeded those of groundfish landings and groundfish revenue across the nine-year review period.

Across the review period, groundfish landings and revenue from groundfish stock landings were at a nine-year low in FY 2015, with 41.5 million pounds and $51.1 million (2010 dollars) respectively. Total revenue from groundfish trips (including all species) was also at a nine-year low in FY 2015 at $72.1 million. Geographically (by port of landing), gross revenue from groundfish landings were highest in Massachusetts and increased between FY 2007 through FY 2011 but then declined in FY 2012 and 2013 and reached a nine-year low in FY 2015 at $42.7 million. Maine was the second highest ranked state with respect to gross revenue from groundfish landings, with the highest revenue (of $10.9 million) observed in FY 2008, while two years later a low of $4.3 million was recorded in the first year of the sector program. Groundfish gross revenue in New Hampshire (by port of landing) declined considerably, from

$3.3 million in FY 2010 to $0.6 million in FY 2015. Rhode Island groundfish revenues declined between FY 2007 and 2009 from $5.6 million to $1.8 million and remained relatively stable through FY 2015. By major port (of landing), New Bedford and Gloucester alternated as the top groundfish revenue ports in Massachusetts followed by Boston across the review period.

By groundfish species, Atlantic cod generated the highest fleetwide revenue from FY 2007 through FY 2012, pollock was the top revenue species in FY 2013, followed by haddock in FY 2014 and 2015, and redfish generated the lowest aggregate revenue across the nine-year period.

While average gross revenue varied by vessel size class, the larger the vessel size class the greater the overall average gross revenue was achieved. Average gross revenue for vessels below 30' varied greatly across the nine-year time period, while vessels in the 30' to <50' and 50' to < 75' category remained relatively stable across the evaluation period. Average gross revenue for vessels 75' and above were higher during the catch share time period (FY 2010-2015) than in the previous three fishing years.

With the implementation of catch shares in FY 2010, the total average ex-vessel price for groundfish stocks returned to the FY 2007 level of $ 1.43/lb. and remained steady through FY 2012. The lowest price during the evaluation period was in FY 2015 at $1.23/lb. Simple average ex-vessel prices of all groundfish species combined to compare yearly changes can be misleading, as these prices do not take into account species landed, quantities of each species, market categories by species, or gear type used to harvest.

Productivity, the value of output obtained with one unit of input, was generally was lower under the sector program than during the baseline period, decreasing sharply between 2011 and 2012, and continued to decline, largely driven by decreases in the input (e.g. labor, capitol stock and energy) indexes. The decline in inputs was caused in part by decreases in the number of active vessels.

Analysis on reliance of active northeast multispecies permit holders on other sources of fishery revenue were available for 2016-2018, looking at sector and common pool participation and days absent on groundfish trips. Even though this extends beyond the review period, during this time sector vessels were generally more reliant on groundfish revenue than common pool vessels. However, the proportion of revenue from groundfish species for a typical sector vessel ranged from 24% to 31%, whereas the typical common pool vessel, received 0% to 4% of its total revenue from groundfish species.

Net Revenues and Costs

Estimating profitability in commercial fishing requires a full account of revenues, variable costs (costs associated with at-sea operation) and fixed costs (costs that are constant despite vessel operation). Cost data applied considers costs associated with trips (e.g. supplies, groceries, bait, fuel, ice, water and oil), but does not account for the costs associated with ACE leasing, crew, numeration, sector fees, or ASM costs due to data limitations. However, net revenues are valuable to track the financial performance of the groundfish fleet.

Overall, net revenues are higher during the post-catch share period comparatively to the pre-catch share period when assessed at the groundfish trip and vessel-level. A greater difference between mean and median net revenues at the trip level during the post-catch share period relative to the pre-catch share period and a shift in of the interquartile ranges in the positive direction suggest that there are a few trips

and vessels which earn much higher net revenues relative to the majority of groundfish trips and vessels, particularly during the post-catch share period.

There is greater variability in groundfish trip and vessel net revenues during the post-catch share period, with overall higher maximum and lower minimum net revenues comparatively to the pre-catch share period. Increases in trip and vessel net revenues in conjunction with decreases in fishing effort may indicate decreases in overcapacity within the groundfish fleet following the implementation of catch share management. On average, median net revenues are higher across all vessel size classes during the post-catch share time period relative to the pre catch share period. Net revenues reflect only a partial view of the economic performance of the groundfish fleet. Additional economic analyses and indicators, such as profitability, are restricted by data limitations.

Status of Regulated Stocks

The status of groundfish stocks has not changed considerably over recent years. It is not clear whether measured have constrained fishing mortality to SFA compliant levels, as the proportion of stocks subject to overfishing has decreased only from 42% (from 2003 to 2012) to 36% in 2015. Only three stocks – GB haddock, pollock, and redfish – did not experience overfishing in any year. Overfishing at levels greater than 150% F_{MSY} remained common for some stocks, such as eastern GB cod, western GB cod, GOM cod, and witch flounder, which experienced these high levels of overfishing for all six years of the catch share period.

There was variability in the proportion of stocks overfished, with an increase to a high of 52.6% of stocks overfished following implementation of the catch share program, down to 36% in FY 2015. Although the average biomass ratio of allocated stocks increased from 2010 to 2015 by 21%. The aggregate picture of stock status masks considerable differences in individual stock status. Both GB and GOM cod stocks remained overfished during 2010 through 2015, as did SNE/MA yellowtail flounder. In contrast, other stocks have recovered from historical overfishing, and other stocks have reached high abundances (e.g. haddock).

Groundfish Catch Utilization

Accountability measures (AMs) implemented together with the increased levels of at-sea observer coverage 5.d.ii were expected to contribute to a reduction in uncertainty. However, the ACLs for many stocks have fluctuated or decreased, and biomass estimates for some stocks have decreased since the implementation of the catch share program. Utilization across sector, common pool and recreational components of the fishery can describe the program's ability to "*Maintain a directed commercial and recreational fishery for northeast multispecies*" (Goal 3).

The ACLs for many stocks had dramatic changes across the first six years of the sector program. Several high-utilization stocks saw large reductions in the sector-sub ACL, particularly between FY 2011 and FY 2012 (GB yellowtail flounder) and between FY 2012 and FY 2013 (GOM cod, GOM haddock, American plaice, CC/GOM yellowtail flounder, and witch flounder). Some stocks saw increases overall, such as redfish, GOM haddock, white hake, GOM winter flounder, and SNE/MA yellowtail flounder.

Across all fishing years, allocated groundfish stocks were caught below their total ACLs with the exception of GOM haddock in FY 2013 and 2014. These overages were associated with common pool

catch (FY 2013) and recreational catch (FY 2013 and 2014). For non-allocated stocks, Atlantic halibut, northern and southern windowpane flounder each had overages of their total ACLS in multiple fishing years. AMs were triggered for both windowpane stocks in multiple fishing years. Approximately 97% of all groundfish allocation and landings were attributed to sector vessels versus common pool vessels even though the common pool maintained 38-48% of the MRIs in the groundfish fishery.

Sectors participants stayed within the sector sub-ACLs for all allocated stocks with the exception of witch flounder in FY 2013 and white hake in FY 2011. The witch flounder overage was a result of changes in carryover rules late in the fishing year and resulted in the pound for pound payback AM for those individual sectors that had overages. For white hake, there was sufficient FY 2010 carryover to cover the FY 2011 overage, therefore no AM was applied. Sector utilization rates fluctuated by stock and fishing year, sometimes reflecting sub-ACL trends and at other times in opposite of sub-ACL trends. GOM cod and witch flounder were the most utilized stock across the six-year period for sectors followed by CC/GOM yellowtail flounder and then western GB cod and American plaice. Eastern and western haddock were consistently the least utilized stocks by sectors across the six-year followed by redfish, GOM winter flounder and pollock. FY 2014 saw the lowest combined utilization rate for all allocated stocks for sector vessels.

Total common pool utilization was highest in FY 2010 with a rate of 53% but declined to 20-30% thereafter. GOM cod and SNE/MA winter flounder (FY 2014-2016) were the most utilized stocks by the common pool. Eastern and western GB haddock, GB winter flounder and redfish were the least utilized stocks in the common pool. Common pool catch resulted in overages for witch flounder (FY 2010), western GB cod (FY 2013), GOM haddock (FY 2013) and eastern GB cod (FY 2014). Appropriate AMs were applied as necessary to account for the overages, the following fishing year.

The recreational fishery had poor performance of staying within recreational sub-ACLs for GOM cod (catch exceeded sub-ACL in FY 2013 and 2014) and GOM haddock (catch exceeded sub-ACL in FY 2012, 2013, 2014, and 2015). AMs triggered included increasing minimum fish sizes, decreasing bag limits and increasing prohibited seasons.

Discards and Bycatch in the Groundfish Fishery

Implementation of catch shares appears to have reduced discards of regulated groundfish species. Sector vessels are required to retain all legal-sized groundfish catch, and results from total observer discards for groundfish trips indicate a reduction in discards of all allocated groundfish stocks combined compared to pre-catch share program levels. This reduction in discards was not seen for other, non-groundfish species that are frequently caught on groundfish trips, as those fisheries do not have the same discard prohibitions.

Total discards across all allocated groundfish stocks by sectors ranged between 3.0 and 6.3% of total ACE utilization. Three stocks had discards of more than 20% of total ACE used, eastern GB cod (FY 2011, 2012 and 2013) and eastern and western GB haddock (FY 2012). Low discards (< 5% of total ACE usage) were seen in all six years for three species representing five allocated stocks, white hake, pollock, and winter flounder (GOM, GB and SNE/MA). The scallop fishery exceeded its bycatch allocation five times over the six-year period across three stocks, GB yellowtail flounder (FY 2012 and 2014), SNE/MA yellowtail flounder (FY 2011 and 2013) and southern windowpane flounder (FY 2015). Only the 2015

southern windowpane flounder overage triggered an AM. The Atlantic herring midwater trawl fishery exceeded its bycatch allocation of GB haddock in fishing years (FYs 2012, 2013 and 2015). Only the FY 2013 overage resulted in the pound for pound payback AM. The GB small mesh fishery had no overages of its GB yellowtail bycatch allocation in the six-year review period.

Across non-groundfish observed discards, discards of all skates combined remained steady (62-70%) across the nine-year review period. Spiny dogfish observed discards increased during the six-year sector program with respect to the previous three years.

Numerous protected species have been observed/documented to interact with the groundfish fishery or with gear type(s) similar to those used in the fishery (bottom trawl or gillnet gear). Cusk, a species of concern, showed a decrease in observed bycatch on groundfish trips with the implementation of the sector system. Limited information is available on Atlantic sturgeon bycatch since the implementation of the catch share program. Between 1989 and 2013, fifteen Atlantic salmon have been incidentally caught in gillnet and trawl gear, with five being reported as fatalities; no interactions have been documented in any fishery dependent data since. Protected species bycatch rates (mammals & sea turtles) are very low but no analysis has been completed to attribute catch rates to any specific fishery. Observed harbor porpoise incidental takes has been on the decline since FY 2013.

Quota Market and Leasing

An important component of the catch share system is the ability to transfer individual allocations (PSC) of groundfish stocks between fishermen. Transfer can occur internally within a sector (intra-sector) or between approved sectors (inter-sector) and may be done for a variety of reasons. Many types of inter- and intra-sector ACE transfers occur among sectors and participants, ranging from fish-for-cash, fish-for-fish, basket trades, or gifts.

Inter-sector transfers are governed by a Right of First Offer process in all sectors, allowing sector members to accept the terms on any ACE transfer that results in ACE leaving that sector, and could result in higher inter-sector leasing costs versus intra-sector leasing costs. Further, inter-sector leasing can be restricted by NMFS under certain conditions.

There were 2,531 distinct inter sector transfer between FY 2010 and 2015. GOM cod was the most common stock traded (770 individual transfers) followed by witch flounder (730 transfers), while eastern and western GB haddock were the least transferred. A total of 95,017,350 live pounds were transferred between sectors in six years; with the most weight (21,432,767 live lbs.) transferred in FY 2012 and the least (10,027,309 live lbs.) transferred in FY 2014. Pollock and redfish had the greatest weight transferred between sectors in the six years, while GOM winter flounder and eastern GB cod had the fewest pounds moved between sectors. No stock had more than 50% of the sector sub-ACL by live weight transferred between sectors in any given year. Transfers of CC/GOM yellowtail flounder, eastern and western GB cod, GOM cod, GOM haddock, SNE/MA yellowtail flounder and witch flounder ranged between 20% and 50% of the overall yearly stock specific sector sub-ACL.

Modelled average annual ACE lease prices declined across the six-year period for most stocks with the exceptions of GOM cod, American plaice and witch flounder. For these three stocks, current data indicates increase in ACE lease price most likely were the result of high utilization rates and significant

reductions in ACLs; however, the increases in lease price appear to be delayed by a fishing year after the reductions have occurred. A network analysis of all inter sector leases indicates that level of leasing quota in and out of individual sector varied by sector.

Community Impacts

Analysis of fleet activity, landings and gross revenues illustrated disproportionate impacts across communities, but do not reveal the reliance of those communities on the fishery. According to the commercial engagement (metrics that look at the value, landings, permits, dealer purchases, and vessels) and reliance (metrics that look at the value, landings, permits, dealer purchases, and vessels per unit of population) indicator factor scores, New Bedford and Gloucester, MA, were far more engaged in commercial groundfish activities than any other ports in the region. Both ports had twice the level of engagement than the next highest engagement port, Boston, MA. In terms of reliance on commercial groundfish, Chatham and Gloucester, MA, demonstrated by far the highest levels of reliance on this fishery over the period of 2012 to 2016. Both ports were more than two times more reliant on commercial groundfish activities than the next most reliant port, Montauk, NY. New Bedford, MA, had the greatest level of social vulnerability among highly engaged commercial groundfish ports over the period under consideration, including high poverty, moderate-high housing instability, moderate-high population composition vulnerability, and moderate-high personal disruption. Chatham, MA, and Montauk, NY, had the highest levels of gentrification pressure vulnerability among highly engaged commercial groundfish ports.

Data available on shoreside infrastructure is very limited and only capture number of dealers that reported purchasing groundfish stocks. Between FY 2010 and 2015, the total number of dealers that reported purchasing groundfish stocks increased from 95 to 128 with increases observed mostly in Maine and the Mid-Atlantic States and decreases in dealers purchasing groundfish in New Hampshire. Between 2006 and 2015, the annual occupational fatality rate in the groundfish fishery declined; however, there are many factors (including an overall decrease in groundfish effort) that may have contributed to this decline.

Industry perspective on safety and the catch share system varies widely, with some believing it has improved safety while others believe the sector system has decreased safety and still other lie somewhere in between.

Stakeholder Engagement and Cooperation

The new system was a considerable dissent from management under DAS, and therefore required both engagement and collaboration between management and stakeholders along with dedicated resources, particularly in the development of sector operational plans, environmental assessments and monitoring program details. A regional assessment and management review of the NE fishery management process identified the need to improve science collaboration, simplify governance, maximize collaboration and simplify communications. The NEFSC Population Dynamics Branch conducts pre-assessment meetings to ensure (1) that the process is understood, and that (2) there is opportunity for input. Pre-assessment outreach meetings to allow for industry and other stakeholder input have been held both prior to and following the change in management. Assistance was provided throughout the NE region to sectors through a number of cooperative research projects funded by the NEFSC Cooperative Research Program

or private NGO foundations. Engagement opportunities were increased to help the sectors sift through the processes of operating under the management regime, these have included monthly phone conferences for sector managers and NMFS Sustainable Fisheries Division staff (since FY 2011); in person meetings scheduled as needed; and workshops convened throughout the region during the evaluation period (and continue to be convened) bringing together fishermen, scientists, managers and other stakeholders to discuss groundfish related issues

Essential Fish Habitat

In order to determine whether the implementation of the catch share system had an effect on EFH, analysis must consider changes to fishing operations that occurred with implementation. The general decline in groundfish effort since implementation of the sector program, both by total number of groundfish vessels and number of groundfish trips, would imply that there was less bottom disturbance and thus disturbance of EFH as there was less bottom tending gear used in the fishery. Effort reductions were seen across all vessel size classes following implementation of the sector program, with the smallest reduction in the 75' and greater vessel size class both number of vessels and number of groundfish trips. These larger vessels are generally equated to offshore, multi-day trip vessels. Across gear types, trawl vessels experienced the least consolidation, with a 27.9% reduction in number of vessels since implementation of the sector program. This potential decrease in EFH impacts as a result of the decrease in effort was not proportional throughout the groundfish fishery. Observer data indicates a shift in fishing effort for large trawl vessels from inshore to offshore following implementation of the catch share program, though for small vessels most fishing occurred in coastal statistical areas and this pattern did not change with implementation of the program. It is believed that the implementation of the catch share system resulted in some displacement of effort into both other federally managed fisheries and state water fisheries thus further reducing potential realized gains to EFH with the implementation of the catch shares.

6.a Recommendations for future reviews

The scope of this review, timeline for conducting the work, available resources, and data collections all in part limited the ability to conduct a more in-depth evaluation of the sector program. This is the first review of this program, and therefore presents an opportunity to not only draw conclusions but identify shortcomings in the capacity to evaluate program performance and its ability to deliver on expectations. The analyses presented in this report were largely dependent on existing work between 2007 and 2015 and therefore do not accurately reflect all of the current challenges faced by the fishery participants, managers, scientists and all interested stakeholders, but do provide a picture of the challenges that were faced following implementation and the adjustments made over the first six years of the program.

The working group that developed this report along with contacts that provided valuable information and review have provided recommendation to be considered prior to the undertaking of future evaluations. Some recommendations broadly relate to the process of evaluation, while others are applied to specific needs to further certain analyses. While it is unlikely realistic or feasible to attend to all of the recommendations listed, we present them all as considerations for the Council and future technical working groups.

A key recommendation is to dedicate sufficient resources to provide for closer alignment in fishing years with evaluation years, to the extent feasible. A monitoring and evaluation program should be developed – and doesn't have to be extensive beyond much of the key information already maintained – but should provide for the tracking of progress against FMP goals and objectives using measurable metrics that both track the progress and recognize information gaps.

Topic Area	Observations and Recommendations
Broad Considerations	• The next review should be conducted sooner; this review was undertaken in year 10 of the program looking back at years one through six. This challenges the efficacy of the results as they misalign with the current fishery operations and management. • In order to achieve a more efficient process and enhanced analyses less dependent on previously completed work, the timing of the next programmatic review should not coincide with a major amendment process, as this limited the availability of key staff to participate. • Stakeholder engagement in the review should be designed from the onset of the process and not as a parallel activity, this will inform the findings of the evaluation rather than exist extern to the process. • There would be benefit in convening a stakeholder workshop to focus on the effects of the catch share system (under ten years in operation) at the individual sector level and not solely reviewing effects at the program level. • Further investigations into variation in responses between the common pool and sectors should be conducted across analyses, such as effort, activity and catch in attempt to consider what effects would exist in the absence of the sector program.
Social Sciences Survey Work	• The two waves of the Socioeconomic Survey of Hired Captains and Crew in NE and MA Commercial Fisheries: This was not a simple or stratified random sample. Probability sampling proportional to port size and convenience sampling because there is no sample frame. Additionally, an intercept method at the docks was necessary to interview crew. Therefore, representativeness by fishery, vessel size class, geographic location, or other factors is not guaranteed. • 2012-2016 Community Social Vulnerability Indicators: Relied heavily on Census American Community Survey data to produce five-year estimates. This may not reflect individual-level vulnerabilities specific to fishing industry participants, but rather provide overview of fishing community vulnerability in terms of standard measures of community vulnerability, such as poverty, housing instability/affordability/, gentrification pressure, etc. • 2012-2016 Commercial Groundfish Engagement and Reliance Indicators: Relied on federal permit and landings data. This may not reflect cultural or historical dependence on fishing for some communities because these are measures of active participation at the community level. Reliance is a per capita measure so it is highly susceptible to population size bias.

Topic Area	Observations and Recommendations
	• Crew statistics: Generally, there is a need improved information on crew employment, crew remuneration, and detailed analysis into commercial fishing health and safety. • Additional survey work should be considered to dig into perceptions of specific management actions, such as the sector program and all of its intricacies.
Costs of Operations	• Costs related to operating a groundfish fishing business, such as vessel repair and maintenance, vessel insurance, and additional overhead costs, comprise a significant portion of total costs. The accounting of these costs is largely incomplete due to non-mandatory data collection efforts which yield low response rates and possibly unrepresentative/incomplete data.[1] • Mandatory and systematic sector participation costs data (e.g. sector fees, lease costs, ASM costs) are necessary in order to incorporate these costs into economic analyses. Mandatory cost data collection would decrease uncertainty and strengthen the economic performance analyses moving forward.
Net Revenues	• Net Revenues reflect only a partial view of the economic performance of the groundfish fleet. Additional economic analyses and indicators, such as profitability, are restricted by data limitations. • Additional cost data, such as fixed/quasi-fixed costs, are required to estimate groundfish trip, vessel, and entity profitability. • Costs related to operating a groundfish fishing business such as vessel repair and maintenance, vessel insurance, and additional overhead costs comprise a significant portion of total costs. The accounting of these costs is largely incomplete due to non-mandatory data collection efforts which yield low response rates and possibly unrepresentative/incomplete data.[256] • Data on crew payments along with crew payment systems are also necessary to create a full profitably assessment. These data are also collected through non-mandatory data collection which has resulted in poor data quality. • Costs pertaining to sector participation costs (e.g., sector dues/membership fees, landing fees and ACE leasing fees) are also non-mandatory and reported through non-standardized methodologies, yielding inconsistent and incomplete sector cost data. • Mandatory data collection of all costs incurred by a groundfish business, both variable and fixed, is necessary to generate the most accurate and complete representation of the economic performance of the groundfish fleet. • Allocation of additional resources to database management, such that information pertaining to trips, vessels, and sectors, particularly cost and revenue data, can be linked across databases effectively and efficiently.

[256] Commercial fishing business cost data have been collected periodically by the Northeast Fisheries Science Center's Social Sciences Branch (NEFSC SSB) via non-mandatory mixed-mode survey methodology. Results on response rates and data usability are currently in review (Ardini, Murphy, and Werner, 2020).

Topic Area	Observations and Recommendations
Effort/Activity	• Further investigations into drivers of differences between common pool and sector vessels (effort/ activity/catch). • Analysis to understand the redistribution of effort and real dependency on the groundfish fishery. • Develop a comprehensive look at how people are using their GF permits and where they are active, if at all, when not in the groundfish fishery.
ACE Leasing	• Data on ACE lease prices can be improved. Some data are missing because sectors were not required to report intra-sector ACE leasing data • Not all sectors report the same level of detail on their ACE leasing activity. • Development of QA/QC for inter & intra sector lease pricing, along with comparisons across inter and intra sector leasing activity. • Further detailed investigation or reporting of intra-sector ACE leasing activity would aid in the understanding of the performance of the ACE lease market.
Shoreside Infrastructure	• Limited information is available on shoreside/post-dealer industries and infrastructure. • More research is needed to fully understand purchasing decisions across groundfish dealers, and changes in other types of shoreside infrastructure across New England, in general. • Processing reports and business county patterns may be a source for further consideration in future evaluations, but these data are unlikely to be limited to groundfish, and especially sector program, activity. With decreased activity in the fishery in general, we can expect an impact on these businesses but as with fishermen participating in other fisheries, these businesses may have compensated the loss of activity resulting from a consolidated groundfish fleet with alternate sources. • There is a need for additional information of support industries for the groundfish fishery, such as: fishing gear; equipment; haul out and repair services; dockage; ice; fuel; vessel brokerage; maritime attorneys; settlement houses/bookkeepers; sectors as corporate entities.
Safety	• Health and safety analysis is virtually non-existent for the fishery except for CDC statistics on fatalities and occasional surveys capturing perceptions of safety.
Monitoring and Enforcement	• Improve catch accounting under the sector system. Partial at-sea observer coverage does not ensure full catch accounting and allows for non-compliance with reporting requirements. • Improved monitoring programs to ensure accuracy of catch (kept & discards). • Explore reasons why observer/ASM target coverage levels are not met and develop potential solutions to better achieve target coverage rate. • Develop automated comparison reports of fishery dependent data (observer/VTR/dealer data) that are available to sector managers to better monitor fishing behavior and vessel stock BSA reporting. • Development of data streams and metrics for download by sectors to monitor fishing behavior (observed vs unobserved trips). • Analysis on sector participant specific incidents investigated by OLE during the relevant evaluation period.

Topic Area	Observations and Recommendations
	• Additional research regarding the difficulty of enforcing discard and broad stock regulations. • Further development of sector incident reports or enforcement self-reporting in weekly reports to NMFS.
Habitat Interactions	• To measure a shift in habitat vulnerability related to the catch share program, we would need to understand fine-scale geographic patterns of fishing activity, along with information on types of gear that were used, the footprints of those gears, and the sensitivity of seabed habitats in different areas. • The New England Fishery Management Council worked with a wide range of experts to create a Swept Area Seabed Impacts model that can be used to judge the vulnerability of seabed habitats to fishing. However, fine-scale information on fishing locations was not available because vessel monitoring system (VMS) data alone do not reliably indicate when fishing was occurring. • In the future, detailed analysis of VMS data along with vessel trip reports could be used to document the spatial footprint of groundfish trawling and how it may have changed after implementation of the catch share program. Once that analysis is in hand, the Swept Area Seabed Impacts model could be applied to judge shifts in habitat vulnerability.

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8 APPENDICES

8.a Data sources relied on for economic evaluation

The Groundfish Performance Report draws from GARFO's Data Matching Imputation System (DMIS) database over fishing year 2007 – 2015. DMIS is an algorithm generated database combining seafood dealer reports, vessel trips reports, and quota monitoring reports. Data prior to 2007 are generally not compatible with the algorithm generated in DMIS, thereby complicating the use of extended baselines for comparisons.

The CRD relies on the Vessel Trip Report database as a foundation to account for all commercial fishing trips in the northeast. The Permits database was used for information pertaining to vessel characteristics and the Commercial Fisheries Database System (aka dealer data or CFDBS) was used for landings, trip revenues, and price data. Commercial fishing trip costs were estimated using the Observer Databases (OBDBS) via econometric modeling within the CRD.

Both data sources are relied on regularly and provide useful information but have their disadvantages. For example, DMIS has a specific code which is used to identify declared groundfish trips but the data system is organized using algorithms which pull from various sources. As a result, replication of report results can be difficult given data updates and changes to the algorithm's configuration. VTR and other data sources are more static over time and are directly imputed from hard paper copies filled by commercial fishermen, however, matching across databases is time consuming due to imperfect links between parallel databases.

Definition of groundfish fishing trips and groundfish vessels

- The Performance Report defines a groundfish trip as any trip where a vessel owner operated under a limited access multispecies permit and declared the trip as a "groundfish trip" via VMS or through an interactive voice response system. This includes trips which used groundfish DAS including monkfish trips. A "groundfish vessel" has a limited access multispecies permit and generated revenue from a commercial fishing trip taken in that fishing year , regardless of groundfish species landings. The Performance Report definition of a groundfish trip captures the universe of vessels operating in the fishery but also includes trips which may be targeting non-groundfish species under groundfish DAS, such that non-groundfish targeted trips and revenues are included in this definition.
- The CRD defines groundfish trips as any commercial fishing trip that lands a groundfish species ($\geq$1lb) while operating under a limited access northeast multispecies permit. The classification of a groundfish vessel pertains to any vessel that took at least one groundfish trip, as previously defined, during a specific groundfish fishing year (FY 2007-2015). This definition is more restrictive by excluding trips which did not land groundfish, such as a monkfish trip which operated under groundfish DAS and did not land any groundfish species.

Definition of a groundfish entity

- The Performance Report defines a groundfish entity based on a definition of business partners/affiliations. This method can link individuals who are loosely or not at all members of the same groundfish business. This is a fairly liberal definition that results in a wider population of entities.
- The CRD uses the Regulatory Flexibility Act (RFA)[257] to define entities of varying sizes, this method is applied, and additional criteria are layered in to only present groundfish fishing entity/affiliations. This definition is more conservative and precise in defining groundfish business affiliations. This is also the consistently used by other members of the Social Sciences Branch for mandated RFA analysis purposes.

Definition of trip costs

- The Performance Report trip cost components include the following elements: fuel, oil, ice, supplies, bait, food, water, damage, lumper fees and sector membership fees.
- The CRD trip cost definition includes fuel, oil, ice, supplies, bait, food, and water. This definition omits lumper fees due to limitations on the data, inclusion of these data would add unnecessary variability to the post catch share review time period. Sector membership fees were also removed due to data limitations in the Annual Sector Year-end reports, which may be biased given the limited number of sectors reporting.

Estimation of trip costs

- Trip costs are only collected from a small sample of commercial fishing trips on which there was an observer, and therefore trip costs for trips which did not carry an observer must be estimated. The Performance Report creates an average trip cost value based on the vessel size class, gear type and trip duration (less than or equal to 24 hours or greater). This is applied to all trips which

[257] https://www.epa.gov/reg-flex/learn-about-regulatory-flexibility-act

did not carry an onboard observer. Applying an average cost across all trips is an oversimplification of trip costs as it assumes consistent operations across a range of vessel sizes and trip durations which directly affect the cost of any one trip.

The CRD uses econometric modeling[258] to predict trip costs for trips where costs were not observed. The econometric modeling adjusts for biases within the trip cost data, as data collectors are stratified by biological data needs rather than economic. This is a more statistically sound method of trip cost estimation and was therefore used to generate a more accurate description of groundfish costs and net revenues.

8.b Methodology employed and supplemental tables for Crew Survey Analysis

The following methodology applies to the analysis of community vulnerability and resilience provided in Section 5.c.

8.b.i 2012-13 Wave 1 Sample

The 2012 implementation of the Crew Survey began in the fall of 2012 and lasted approximately one year. Given the lack of a registry or population database to draw a crew sample from, the Crew Survey was conducted mainly through in-person interviews using an intercept method at the docks of sampled ports. Ports from Maine to North Carolina were randomly sampled based on a stratified sampling design that took into consideration seasonally-based fishing activity and geographic diversity in the region's fisheries (Henry and Olson 2014). A sample size of 1,330 was calculated from an estimated crew population of 30,000. Population estimates were derived from prior SSB research utilizing data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages and the Bureau of Economic Analysis Regional Economic Information System (Henry and Olson 2014; Steinback and Thunberg 2006). Crew members were interviewed using an intercept method with interviewers approaching crew on the docks and entering survey responses into Nook tablet computers. The random intercept method is commonly used to maximize response rates among hard-to-reach populations, such as crew, who are transient and for whom contact information is unavailable (Miller et.al. 1997; Kitner 2006). Prior survey research of fishermen in this region have achieved response rates of up to 90 percent (Pollnac et al. 2014). The final number of completed surveys was 359, with 42 incompletes and 654 refusals (Henry and Olson 2014). A variety of factors contributed to the difficulty SSB had in obtaining a higher response rate, including scheduling problems related to the arrival and departure times being at odd/random hours and outright refusals to participate. The ports with the largest number of respondents were (in descending order) New Bedford, MA (n = 58), Gloucester, MA (n = 48), Cape May, Newport News, VA (n = 29), NJ (n = 27), Point Judith, RI (n = 27), Chatham, MA (n = 17), Rockland, ME (n = 14), Portland, ME (n = 14), Montauk, NY (n = 14), and Wanchese, NC (n = 14), and Portsmouth, NH (n = 11).

8.b.ii 2018-19 Wave 2 Sample

The 2018-19 Wave 2 sample for the Crew Survey was again collected using an intercept method, but a different sampling strategy than the 2012 design was used to derive a sample of ports at which to conduct

[258] The econometric modeling manuscript is undergoing peer review in the journal Marine Resource Economics.

intercept interviews. Prior to port-level sampling, a target sample of 452 respondents was calculated using Cochran's (1977) formula for categorical data with a 20% buffer to accommodate nonresponse due to the logistical challenges of the intercept method. This sample size calculation was based on an estimated 21,616 employed in commercial fishing in the Northeast and Mid-Atlantic. To establish a list of ports to visit for intercepts, a quasi-random sample of fishing ports was selected from the universe of ports in the Northeast and Mid-Atlantic states. In order to ensure that the most active ports were selected, a probability proportional to size (PPS) sampling method was applied in order to purposively add weight in the selection process to ports with more fishing activity. Under the PPS approach a port's probability of being selected into the sample is related to the "size" of the port, with larger ports being more likely to be selected into the sample. The PPS approach was necessary to ensure that selected ports were more active and thus, more likely to result in completed crew surveys. Port size was assessed using a commercial fishing engagement index from the 2014 NOAA Fisheries Social Indicators (Jepson and Colburn 2013). This index is reported by community and was generated from a principal component factor analysis of variables associated with fishing activity. The "community level" here refers to data at the level of Census Designated Place (CDP) nested within a set of counties designated as "coastal" by their connection to the ocean through a coastline, river, bay, or estuary. The variables used to determine commercial fishing engagement included the number of commercial fishing permits, the value of landings, dealers with landings, and the total landings in pounds. A sample of fifty CDPs containing moderately and highly engaged ports throughout the Northeast and the Mid-Atlantic was drawn using the PPS method.

8.b.iii Supplemental Tables

Table 39. Wave 1 (2012-2013) Crew Survey Demographics.

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	72 (100%)	287 (100%)	359 (100%)
15 – 24	11 (15%)	52 (18%)	63 (18%)
25 – 34	21 (29%)	72 (25%)	93 (26%)
35 – 44	12 (17%)	82 (29%)	94 (26%)
45 – 54	14 (19%)	56 (20%)	70 (20%)
55 or above	14 (19%)	25 (9%)	39 (11%)
Hispanic	3 (4%)	31 (11%)	34 (9%)
Non-Hispanic	69 (96%)	256 (89%)	325 (91%)
White	66 (92%)	240 (84%)	306 (85%)
Black/African-American	0 (0%)	10 (3%)	10 (3%)
American Indian or Alaskan Native	1 (1%)	7 (2%)	8 (2%)
Asian	0 (0%)	0 (0%)	0 (0%)
Native Hawaiian or Pacific Islander	0 (0%)	0 (0%)	0 (0%)
Some Other Race	1 (1%)	17 (6%)	18 (5%)
Person of Two or More Races	1 (1%)	10 (3%)	11 (3%)
Don't Know/No Answer	3 (4%)	3 (1%)	6 (2%)
Less than $30,000	12 (17%)	69 (24%)	81 (23%)
$30,000 - $59,999	30 (42%)	92 (32%)	122 (34%)
$60,000 - $89,999	14 (19%)	47 (16%)	61 (17%)
$90,000 or More	16 (22%)	79 (28%)	95 (26%)
Less than High School	9 (13%)	51 (18%)	60 (17%)
High School or GED	44 (61%)	167 (58%)	211 (59%)

Associate's/Two-year Degree	9 (13%)	39 (14%)	48 (13%)
Bachelor's/Four-year Degree	5 (7%)	25 (9%)	30 (8%)
Graduate Degree	2 (3%)	1 (<1%)	3 (1%)
Don't Know/No Answer	3 (4%)	4 (1%)	7 (2%)
Health Insurance	38 (53%)	169 (59%)	207 (58%)
From Vessel Owner	*1 (1%)*	*8 (3%)*	*9 (3%)*
From Another Employer	*0 (0%)*	*3 (1%)*	*3 (1%)*
From Spouse/Partner	*15 (21%)*	*40 (14%)*	*55 (15%)*
Private Insurance	*10 (14%)*	*72 (25%)*	*82 (23%)*
Federal/State Insurance	*9 (13%)*	*29 (10%)*	*38 (11%)*
Other	*2 (3%)*	*13 (5%)*	*15 (4%)*
Don't Know/No Answer	*1 (1%)*	*4 (1%)*	*5 (1%)*
No Health Insurance	32 (44%)	115 (40%)	147 (41%)
Don't Know/No Answer	2 (3%)	3 (1%)	5 (1%)
Married	32 (44%)	126 (44%)	158 (44%)
Widowed	1 (1%)	0 (0%)	1 (<1%)
Divorced	8 (11%)	37 (13%)	45 (13%)
Separated	1 (1%)	6 (2%)	7 (2%)
Never Married	23 (32%)	101 (35%)	124 (35%)
Living with Partner	6 (8%)	16 (6%)	22 (6%)
No Answer	1 (1%)	1 (<1%)	2 (1%)

Table 40. Wave 2 (2018-2019) Crew Survey Demographics.

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	33 (100%)	446 (100%)	479 (100%)
18 – 24	4 (12%)	49 (11%)	53 (11%)
25 – 34	6 (18%)	146 (33%)	152 (32%)
35 – 44	10 (30%)	89 (20%)	99 (21%)
45 – 54	5 (15%)	99 (22%)	104 (22%)
55 or above	8 (24%)	63 (14%)	71 (15%)
Hispanic	0 (0%)	32 (7%)	32 (7%)
Non-Hispanic	33 (100%)	414 (93%)	447 (93%)
White	31 (94%)	392 (88%)	423 (88%)
Black/African-American	0 (0%)	6 (1%)	6 (1%)
American Indian or Alaskan Native	0 (0%)	1 (<1%)	1 (<1%)
Asian	0 (0%)	5 (1%)	5 (1%)
Native Hawaiian or Pacific Islander	0 (0%)	1 (<1%)	1 (<1%)
Some Other Race	0 (0%)	22 (5%)	22 (5%)
Person of Two or More Races	2 (6%)	7 (2%)	9 (2%)
Don't Know/No Answer	0 (0%)	12 (3%)	12 (3%)
Less than $30,000	2 (6%)	41 (9%)	43 (9%)
$30,000 - $59,999	5 (15%)	88 (20%)	93 (19%)
$60,000 - $89,999	13 (39%)	80 (18%)	93 (19%)
$90,000 or More	12 (36%)	191 (43%)	203 (42%)
No Answer	1 (3%)	46 (10%)	47 (10%)
Some High School	6 (18%)	59 (13%)	65 (14%)
High School or GED	20 (61%)	280 (64%)	300 (63%)
Associate's/Two-year Degree	1 (3%)	53 (12%)	54 (11%)

Bachelor's/Four-year Degree	6 (18%)	45 (10%)	51 (11%)
Graduate Degree	0 (0%)	3 (1%)	3 (1%)
Health Insurance	16 (48%)	262 (59%)	278 (58%)
From Vessel Owner	*1 (3%)*	*2 (<1%)*	*1 (3%)*
From Another Employer	*0 (0%)*	*1 (<1%)*	*1 (<1%)*
From Spouse/Partner	*1 (3%)*	*47 (11%)*	*48 (10%)*
Private Insurance	*11 (33%)*	*118 (26%)*	*129 (27%)*
Federal/State Insurance	*3 (9%)*	*61 (14%)*	*64 (13%)*
Other	*0 (0%)*	*32 (7%)*	*32 (7%)*
Don't Know/No Answer	*0 (0%)*	*1 (<1%)*	*1 (<1%)*
No Health Insurance	16 (48%)	184 (41%)	200 (42%)
Don't Know/No Answer	1 (3%)	0 (0%)	1 (<1%)
Married	12 (36%)	164 (37%)	176 (37%)
Widowed	1 (3%)	6 (1%)	7 (1%)
Divorced	6 (18%)	58 (13%)	64 (13%)
Separated	0 (0%)	11 (2%)	11 (2%)
Never Married	12 (36%)	177 (40%)	189 (39%)
Living with Partner	2 (6%)	29 (7%)	31 (6%)
No Answer	0 (0%)	1 (<1%)	1 (<1%)

Table 41. Wave 1 (2012-2013) Crew Survey Job Characteristics.

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	72 (100%)	287 (100%)	359 (100%)
Years in the commercial fishing industry			
Less than 5	10 (14%)	56 (20%)	66 (18%)
5 to 15	20 (28%)	80 (28%)	100 (28%)
16 to 29	20 (28%)	89 (31%)	109 (30%)
30 or More	20 (28%)	61 (21%)	81 (23%)
Don't know/No answer	2 (3%)	1 (<1%)	3 (1%)
Years on current vessel			
Less than 5	39 (54%)	170 (59%)	209 (58%)
5 to 15	23 (32%)	91 (32%)	114 (32%)
16 to 29	8 (11%)	18 (6%)	26 (7%)
30 or more	2 (3%)	8 (3%)	10 (3%)
Trip Duration			
1 day	30 (42%)	121 (42%)	151 (42%)
2 to 4 days	11 (15%)	44 (15%)	55 (15%)
5 to 7 days	15 (21%)	34 (12%)	49 (14%)
More than 7 days	16 (22%)	88 (31%)	104 (29%)
Hours worked per day			
8 hours or less	4 (6%)	46 (16%)	50 (14%)
9 to 14 hours	26 (36%)	88 (31%)	114 (32%)
15 to 17 hours	19 (26%)	42 (15%)	61 (17%)
18 hours or more	23 (32%)	111 (39%)	134 (37%)
Owner-operator	40 (56%)	168 (59%)	208 (58%)
Hired Captain	32 (44%)	118 (41%)	150 (42%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
Position on vessel			

Captain	16 (22%)	52 (18%)	68 (19%)
Deckhand	37 (51%)	178 (62%)	215 (60%)
Other	4 (6%)	25 (9%)	29 (8%)
Multiple positions	15 (21%)	32 (11%)	47 (13%)
Payment system			
Share system	67 (93%)	238 (83%)	305 (85%)
Owner share, mean % (n)	*60% (57)*	*57% (225)*	*58% (282)*
Crew share, mean % (n)	*40% (57)*	*43% (225)*	*42% (282)*
Don't know/No Answer, (n)	*-15*	*-62*	*-77*
Other payment system	5 (7%)	39 (14%)	44 (12%)
Multiple payment systems	0 (0%)	8 (3%)	8 (2%)
Don't know/No Answer	0 (0%)	2 (1%)	2 (1%)
Expenses deducted from share, N (discrete %)			
	67 (100%)	246 (100%)	313 (100%)
Fuel	27 (40%)	145 (59%)	172 (55%)
Food	30 (45%)	130 (53%)	160 (51%)
Ice	16 (24%)	78 (32%)	94 (30%)
Bait	3 (4%)	28 (11%)	31 (10%)
Supplies	20 (30%)	84 (34%)	104 (33%)
Fishing quota	8 (12%)	1 (<1%)	9 (3%)
Other	11 (16%)	43 (17%)	54 (17%)

Table 42. Wave 2 (2018-2019) Crew Survey Job Characteristics

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	33 (100%)	446 (100%)	479 (100%)
Years in the commercial fishing industry			
Less than 5	5 (15%)	72 (16%)	77 (16%)
5 to 15	10 (30%)	159 (36%)	169 (35%)
16 to 29	6 (18%)	104 (23%)	110 (23%)
30 or More	12 (36%)	111 (25%)	123 (26%)
Years on current vessel			
Less than 5	23 (70%)	266 (60%)	289 (60%)
5 to 15	8 (24%)	141 (32%)	149 (31%)
16 to 29	2 (6%)	34 (8%)	36 (8%)
30 or more	0 (0%)	5 (1%)	5 (1%)
Trip Duration			
1 day	3 (9%)	131 (29%)	134 (28%)
2 to 4 days	8 (24%)	77 (17%)	85 (18%)
5 to 7 days	17 (52%)	87 (20%)	104 (22%)
More than 7 days	5 (15%)	150 (34%)	155 (32%)
No answer	0 (0%)	1 (<1%)	1 (<1%)
Hours worked per day			
8 hours or less	0 (0%)	50 (11%)	50 (10%)
9 to 14 hours	10 (30%)	128 (29%)	138 (29%)
15 to 17 hours	8 (24%)	119 (27%)	127 (27%)
18 hours or more	15 (45%)	149 (33%)	164 (34%)
Owner-operator	9 (27%)	198 (44%)	207 (43%)
Hired Captain	24 (73%)	247 (55%)	271 (57%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
Position on vessel			

Captain	10 (30%)	93 (21%)	103 (22%)
Deckhand	13 (39%)	231 (52%)	244 (51%)
Other	6 (18%)	78 (18%)	84 (18%)
Multiple positions	10 (12%)	44 (10%)	48 (10%)
Payment system			
Share system	31 (94%)	378 (85%)	409 (85%)
Owner share, mean % (n)	*57% (19)*	*55% (232)*	*55% (251)*
Crew share, mean % (n)	*43% (19)*	*45% (232)*	*45% (251)*
Don't know/No Answer, (n)	*-12*	*-146*	*-158*
Other payment system	2 (6%)	67 (15%)	69 (14%)
Don't know/No Answer	0 (0%)	1 (<1%)	1 (<1%)
Expenses deducted from share, N (discrete %)			
Fuel	19 (58%)	324 (73%)	343 (72%)
Food	18 (55%)	264 (59%)	282 (59%)
Ice	17 (51%)	237 (53%)	254 (53%)
Bait	4 (12%)	86 (19%)	90 (19%)
Supplies	9 (27%)	139 (31%)	148 (31%)
Fishing quota	16 (48%)	23 (5%)	39 (8%)
Other	5 (15%)	24 (5%)	29 (6%)

Table 43. Wave 1 (2012-2013) Crew Survey Job Satisfaction.

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	72 (100%)	287 (100%)	359 (100%)
"Your actual earnings"			
Very satisfied	2 (3%)	48 (17%)	50 (14%)
Satisfied	27 (38%)	137 (48%)	164 (46%)
Neutral	10 (14%)	20 (7%)	30 (8%)
Dissatisfied	19 (26%)	58 (20%)	77 (21%)
Very Dissatisfied	12 (17%)	20 (7%)	32 (9%)
Don't know/No answer	2 (3%)	4 (1%)	6 (2%)
"Predictability of your earnings"			
Very satisfied	0 (0%)	13 (5%)	13 (4%)
Satisfied	9 (13%)	100 (35%)	109 (30%)
Neutral	11 (15%)	47 (16%)	58 (16%)
Dissatisfied	32 (44%)	84 (29%)	116 (32%)
Very Dissatisfied	18 (25%)	41 (14%)	59 (16%)
Don't know/No answer	2 (3%)	2 (1%)	4 (1%)
"Job safety"			
Very satisfied	11 (15%)	37 (13%)	48 (13%)
Satisfied	21 (29%)	135 (47%)	156 (43%)
Neutral	17 (24%)	54 (19%)	71 (20%)
Dissatisfied	20 (28%)	45 (16%)	65 (18%)
Very Dissatisfied	3 (4%)	14 (5%)	17 (5%)
Don't know/No answer	0 (0%)	2 (1%)	2 (1%)
"Time spent away from home"			
Very satisfied	6 (8%)	26 (9%)	32 (9%)
Satisfied	17 (24%)	104 (36%)	121 (34%)
Neutral	16 (22%)	54 (19%)	70 (20%)
Dissatisfied	21 (29%)	69 (24%)	90 (25%)

Very Dissatisfied	10 (14%)	33 (12%)	43 (12%)
Don't know/No answer	2 (3%)	1 (<1%)	3 (1%)
"Physical fatigue of the job"			
Very satisfied	2 (3%)	17 (6%)	19 (5%)
Satisfied	29 (40%)	92 (32%)	121 (34%)
Neutral	16 (22%)	75 (26%)	91 (25%)
Dissatisfied	18 (25%)	81 (28%)	99 (28%)
Very Dissatisfied	6 (8%)	19 (7%)	25 (7%)
Don't know/No answer	1 (1%)	3 (1%)	4 (1%)
"Healthfulness of the job"			
Very satisfied	7 (10%)	45 (16%)	52 (14%)
Satisfied	24 (33%)	100 (35%)	124 (35%)
Neutral	14 (19%)	53 (18%)	67 (19%)
Dissatisfied	23 (32%)	69 (24%)	92 (26%)
Very Dissatisfied	2 (3%)	15 (5%)	17 (5%)
Don't know/No answer	2 (3%)	5 (2%)	7 (2%)
"Adventure of the job"			
Very satisfied	36 (50%)	170 (59%)	206 (57%)
Satisfied	23 (32%)	97 (34%)	120 (33%)
Neutral	7 (10%)	10 (3%)	17 (5%)
Dissatisfied	4 (6%)	7 (2%)	11 (3%)
Very Dissatisfied	1 (1%)	2 (1%)	3 (1%)
Don't know/No answer	1 (1%)	1 (<1%)	2 (1%)
"Challenge of the job"			
Very satisfied	28 (39%)	110 (38%)	138 (38%)
Satisfied	31 (43%)	142 (50%)	173 (48%)
Neutral	6 (8%)	21 (7%)	27 (8%)
Dissatisfied	5 (7%)	11 (4%)	16 (4%)
Very Dissatisfied	1 (1%)	1 (<1%)	2 (1%)
Don't know/No answer	1 (1%)	2 (1%)	3 (1%)
"Opportunity to be your own boss"			
Very satisfied	15 (21%)	98 (34%)	113 (31%)
Satisfied	23 (32%)	96 (33%)	119 (33%)
Neutral	14 (19%)	43 (15%)	57 (16%)
Dissatisfied	13 (18%)	36 (13%)	49 (14%)
Very Dissatisfied	6 (8%)	10 (3%)	16 (4%)
Don't know/No answer	1 (1%)	4 (1%)	5 (1%)

Table 44. Wave 2 (2018-2019) Crew Survey Job Satisfaction.

	Groundfish Crew	**Other Crew**	**Total Crew**
	N (%)	N (%)	N (%)
Total	33 (100%)	446 (100%)	479 (100%)
"Your actual earnings"			
Very satisfied	10 (30%)	98 (22%)	108 (23%)
Satisfied	15 (45%)	259 (58%)	274 (57%)
Neutral	3 (9%)	59 (13%)	62 (13%)
Dissatisfied	4 (12%)	23 (5%)	27 (6%)
Very Dissatisfied	1 (3%)	6 (1%)	7 (1%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Predictability of your earnings"			
Very satisfied	0 (0%)	19 (4%)	19 (4%)

Satisfied	14 (42%)	212 (48%)	226 (47%)
Neutral	9 (27%)	113 (25%)	122 (25%)
Dissatisfied	7 (21%)	76 (17%)	83 (17%)
Very Dissatisfied	3 (9%)	25 (6%)	28 (6%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Job safety"			
Very satisfied	3 (9%)	72 (16%)	75 (16%)
Satisfied	21 (64%)	242 (54%)	263 (55%)
Neutral	6 (18%)	98 (22%)	104 (22%)
Dissatisfied	3 (9%)	26 (6%)	29 (6%)
Very Dissatisfied	0 (0%)	7 (2%)	7 (1%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Time spent away from home"			
Very satisfied	1 (3%)	20 (4%)	21 (4%)
Satisfied	5 (15%)	156 (35%)	161 (34%)
Neutral	6 (18%)	122 (27%)	128 (27%)
Dissatisfied	16 (48%)	113 (25%)	129 (27%)
Very Dissatisfied	5 (15%)	34 (8%)	39 (8%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Physical fatigue of the job"			
Very satisfied	0 (0%)	8 (2%)	8 (2%)
Satisfied	10 (30%)	185 (41%)	195 (41%)
Neutral	14 (42%)	149 (33%)	163 (34%)
Dissatisfied	7 (21%)	91 (20%)	98 (20%)
Very Dissatisfied	2 (6%)	12 (3%)	14 (3%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Healthfulness of the job"			
Very satisfied	1 (3%)	27 (6%)	28 (6%)
Satisfied	14 (42%)	235 (53%)	249 (52%)
Neutral	8 (24%)	121 (27%)	129 (27%)
Dissatisfied	9 (27%)	52 (12%)	61 (13%)
Very Dissatisfied	1 (3%)	9 (2%)	10 (2%)
Don't know/No answer	0 (0%)	2 (<1%)	2 (<1%)
"Adventure of the job"			
Very satisfied	18 (55%)	223 (50%)	241 (50%)
Satisfied	11 (33%)	160 (36%)	171 (36%)
Neutral	2 (6%)	54 (12%)	56 (12%)
Dissatisfied	2 (6%)	7 (2%)	9 (2%)
Very Dissatisfied	0 (0%)	1 (<1%)	1 (<1%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Challenge of the job"			
Very satisfied	12 (36%)	157 (35%)	169 (35%)
Satisfied	17 (52%)	214 (48%)	231 (48%)
Neutral	3 (9%)	60 (13%)	63 (13%)
Dissatisfied	1 (3%)	14 (3%)	15 (3%)
Very Dissatisfied	0 (0%)	0 (0%)	0 (0%)
Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)
"Opportunity to be your own boss"			
Very satisfied	7 (21%)	124 (28%)	131 (27%)
Satisfied	12 (36%)	190 (43%)	202 (42%)
Neutral	8 (24%)	74 (17%)	82 (17%)
Dissatisfied	4 (12%)	36 (8%)	40 (8%)
Very Dissatisfied	2 (6%)	21 (5%)	23 (5%)

Don't know/No answer	0 (0%)	1 (<1%)	1 (<1%)

Table 45. Wave 1 (2012-2013) Crew Survey Attitudes Toward Fisheries Management.

	Groundfish Crew	Other Crew	Total Crew
Total	37 (100%)	163 (100%)	200 (100%)
"Have you ever participated in fisheries management?"			
Yes	13 (35%)	52 (32%)	65 (33%)
No	24 (65%)	111 (68%)	135 (68%)
Total	35 (100%)	124 (100%)	159 (100%)
"The rules and regulations change so quickly it's hard to keep up."			
Strongly Agree	13 (37%)	28 (23%)	41 (26%)
Agree	19 (54%)	43 (35%)	62 (39%)
Neutral	2 (6%)	10 (8%)	12 (8%)
Disagree	1 (3%)	35 (28%)	36 (23%)
Strongly Disagree	0 (0%)	2 (2%)	2 (1%)
Don't know/No answer	0 (0%)	6 (5%)	6 (4%)
"The fines that are associated with breaking the rules and regulations of my primary fishery are fair."			
Strongly Agree			
Agree	0 (0%)	2 (2%)	2 (1%)
Neutral	8 (23%)	27 (22%)	35 (22%)
Disagree	1 (3%)	16 (13%)	17 (11%)
Strongly Disagree	8 (23%)	26 (21%)	34 (21%)
Don't know/No answer	16 (46%)	21 (17%)	37 (23%)
	2 (6%)	32 (26%)	34 (21%)
"I feel that the regulations in my primary fishery are too restrictive."			
Strongly Agree	19 (54%)	29 (23%)	48 (30%)
Agree	8 (23%)	48 (39%)	56 (35%)
Neutral	3 (9%)	13 (10%)	16 (10%)
Disagree	4 (11%)	29 (23%)	33 (21%)
Strongly Disagree	0 (0%)	2 (2%)	2 (1%)
Don't know/No answer	1 (3%)	3 (2%)	4 (3%)

Table 46. Wave 2 (2018-2019) Crew Survey Attitudes Toward Fisheries Management.

	Groundfish Crew	Other Crew	Total Crew
Total	33 (100%)	446 (100%)	479 (100%)
"Have you ever participated in fisheries management?"			
Yes	9 (27%)	181 (41%)	190 (40%)
No	24 (73%)	264 (59%)	288 (60%)
No answer	0 (0%)	1 (<1%)	1 (<1%)
"The rules and regulations change so quickly it's hard to keep up."			
Strongly Agree	13 (39%)	85 (19%)	98 (20%)
Agree	12 (36%)	187 (42%)	199 (42%)
Neutral	2 (6%)	94 (21%)	96 (20%)
Disagree	6 (18%)	73 (16%)	79 (16%)
Strongly Disagree	0 (0%)	5 (1%)	5 (1%)
Don't know/No answer	0 (0%)	2 (<1%)	2 (<1%)

"The fines that are associated with breaking the rules and regulations of my primary fishery are fair."			
Strongly Agree			
Agree	0 (0%)	23 (5%)	23 (5%)
Neutral	9 (27%)	190 (43%)	199 (42%)
Disagree	10 (30%)	134 (30%)	144 (30%)
Strongly Disagree	6 (18%)	56 (13%)	62 (13%)
Don't know/No answer	8 (24%)	41 (9%)	49 (10%)
	0 (0%)	2 (<1%)	2 (<1%)
"I feel that the regulations in my primary fishery are too restrictive."			
Strongly Agree	11 (33%)	96 (22%)	107 (22%)
Agree	10 (30%)	130 (29%)	140 (29%)
Neutral	3 (9%)	113 (25%)	116 (24%)
Disagree	7 (21%)	97 (22%)	104 (22%)
Strongly Disagree	2 (6%)	8 (2%)	10 (2%)
Don't know/No answer	0 (0%)	2 (<1%)	2 (<1%)

8.c Methodology employed for Social Indicators of Fishing Community Vulnerability and Resilience

The following methodology applies to the analysis of community vulnerability and resilience provided in Section 5.j.i.

8.c.i 2012-2016 Groundfish-Specific Commercial Engagement and Reliance Indicators

The Groundfish-Specific Engagement and Reliance Indicators are numerical indices that reflect the level of a community's engagement in and reliance upon the groundfish fishery relative to other communities in the Northeast. These indices were generated using a principal components factor analysis (PCFA) of variables related to groundfish fishing activity from NOAA Fisheries regional datasets. PCFA is a common statistical technique used to identify factors that are related, yet linearly independent, and likely represent a latent or unobservable concept when considered together, such as factors that contribute to the level of a community's social vulnerability or engagement in commercial fishing. The variables that were identified to best reflect community engagement in the groundfish fishery were the value of groundfish landings (in dollars), the groundfish pounds landed, the number of federally permitted dealers that purchased at least one pound of groundfish, and the number of vessels with at least one category of large mesh northeast multispecies permit (multiple permits on one vessel in a given year are not double counted).

Variables that represent community commercial groundfish reliance were the value of landed groundfish per 1,000 population, groundfish pounds landed per 1,000 population, the number of federally-permitted dealers that purchased at least one pound of groundfish per 1,000 population, and the number of vessels with a northeast multispecies permit per 1,000 population. It should be noted that while groundfish-specific commercial reliance is designed to measure the amount that a community may be reliant upon the commercial groundfish fishery, the total population size of a given community can have an outsized influence on the level of reliance reflected in the index scores. Also, the groundfish-specific commercial reliance indicator does not necessarily mean that a community or its fishery participants are solely dependent upon commercial groundfish fishing activities. There may be other commercial fishing or

economic activities that may sustain the livelihoods of individuals or entities within these communities that have relied in groundfish historically.

8.c.ii Groundfish Fishing Community Social Vulnerability and Gentrification Pressure

8.c.ii.1 2012-2016 Community Social Vulnerability Indicators

The Community Social Vulnerability Indicators (CSVI) include indices of labor force structure, housing characteristics, poverty, population composition, and personal disruption. The labor force structure index measures the makeup of the labor force and is reversed scored so that a higher factor score represents fewer employment opportunities and greater labor force vulnerability. The housing characteristics index measures vulnerability related to infrastructure and home and rental values. It is also reversed score so that a higher score represents more vulnerable housing infrastructure. The poverty index captures multiple different factors that contribute to an overall level of poverty in a given area. A higher poverty index score would indicate a greater level of vulnerability due to a higher proportion of residents receiving public assistance and below federal poverty limits. The population composition index measures the presence of vulnerable populations (i.e., children, racial/ethnic minorities, and/or single-parent, female-headed households) and a higher score would indicate that a community's population is composed of more vulnerable individuals. Finally, the personal disruption index considers variables that affect individual-level vulnerability primarily and include factors such as low individual-level educational attainment or unemployment. Higher scores of personal disruption likely indicate greater levels of individual vulnerability within a community, which can in turn impact the overall level of community social vulnerability.

Data used to develop these indices come from multiple secondary data sources, but primarily the U.S. Census American Community Survey (ACS) at the place level (Census Designated Place (CDP) and Minor Civil Division (MCD)). More information about the data sources, methods, and other background details can be found online at https://www.st.nmfs.noaa.gov/humandimensions/social-indicators/.

The CSVI categorical rankings for those communities that have high commercial engagement with groundfish are provided in Table 1 of the social indicator methodology online. The index factor scores are commonly categorized from low to high based on the number of standard deviations from the mean, which is set at zero. Categories rank from 0.00 or below as "low", 0.00 – 0.49 as "medium," and 0.50 – 0.99 as "medium-high," and 1 standard deviation or above as "high."

8.c.ii.2 2012-2016 Gentrification Pressure Indicators

Gentrification Pressure Indicators include housing disruption, urban sprawl, and retiree migration. The Housing Disruption Index combines factors that correspond to unstable or shifting housing markets in which home values and rental prices may cause residents to become displaced. The Urban Sprawl Index indicates the extent of population increase due to migration from urban centers to suburban and rural areas, which often results in cost of living increases and gentrification in the destination communities. The Retiree Migration Index characterizes communities by the concentration of retirees or individuals above retirement age whose presence often raises the home values and rental rates, as well as increase the need for health care and other services. Data used to develop these indices come from multiple secondary data sources, but primarily the U.S. Census American Community Survey (ACS) at the place level (Census Designated Place (CDP) and Minor Civil Division (MCD)). More information about the data

sources, methods, and other background details can be found online at https://www.st.nmfs.noaa.gov/humandimensions/social-indicators/. The Gentrification Pressure categorical rankings for those communities that have high commercial engagement with groundfish are provided in Table 2 of the social indicator methodology online.

These components of gentrification pressure influence the degree to which the current residents, communities, and local economies can remain in place, generally, and the extent to which those in the fishing industry in these communities are able to withstand or overcome changes to fisheries conditions and management, specifically. As places go through the process of gentrification, housing becomes less available and/or unaffordable for the existing population and the historically significant local fishing businesses and industries that had once thrived become displaced or replaced by new and emerging industries, such as tourism, finance, real estate, and service.

Data used to develop these indices come from multiple secondary data sources, but primarily the U.S. Census American Community Survey (ACS) at the place level (Census Designated Place (CDP) and Minor Civil Division (MCD)). More information about the data sources, methods, and other background details can be found online at https://www.st.nmfs.noaa.gov/humandimensions/social-indicators/.

8.d Groundfish Usage by all Components

The following tables display the percent of TAC used by fishery components. Total ACL represents all fisheries combined. Commercial groundfish sub-ACL represents the combined percent usage of sectors, common pool and recreational (GOM cod and GOM haddock only). All overages are indicated in italics.

Eastern GB cod	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	75.20%	82.40%	42.50%	35.00%	48.10%	66.30%
Commercial Groundfish sub-ACL	75.10%	82.10%	41.60%	36.20%	49.20%	66.10%
Sector sub-ACL	78.00%	82.80%	42.40%	37.00%	47.30%	67.60%
Common Pool sub-ACL	0.00%	44.90%	2.20%	0.00%	*147.60%*	0.00%

Western GB cod	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	83.70%	68.00%	26.90%	84.80%	81.10%	97.30%
Commercial Groundfish sub-ACL	82.50%	68.80%	26.10%	87.00%	78.40%	91.60%
Sector sub-ACL	83.20%	76.40%	35.20%	86.70%	78.60%	91.60%
Common Pool sub-ACL	65.60%	66.10%	35.40%	*101.00%*	65.80%	95.80%
State Water sub-component	73.00%	881.10%	42.20%	46.00%	99.50%	*230.00%*
Other sub-component	*112.80%*	47.20%	39.70%	42.80%	*138.50%*	*193.20%*

GOM cod	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	71.00%	69.20%	58.30%	96.50%	94.90%	88.80%
Commercial Groundfish sub-ACL	75.90%	74.10%	60.40%	*104.90%*	97.80%	82.60%
Sector sub-ACL	83.60%	92.50%	60.30%	90.10%	80.50%	90.20%

Common Pool sub-ACL	94.20%	89.90%	37.30%	48.90%	57.10%	86.30%
Recreational sub-ACL	61.90%	58.10%	74.20%	*131.50%*	*128.30%*	69.80%
State Water sub-component	33.60%	36.30%	17.60%	34.70%	37.10%	*181.20%*
Other sub-component	20.40%	9.60%	6.90%	5.70%	*136.50%*	58.80%

Eastern GB haddock	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	15.70%	11.40%	5.40%	16.20%	14.80%	6.70%
Commercial Groundfish sub-ACL	15.20%	11.00%	5.30%	15.40%	15.40%	6.00%
Sector sub-ACL	15.30%	11.10%	5.30%	15.50%	16.20%	7.00%
Common Pool sub-ACL	0.00%	0.00%	0.20%	0.00%	0.00%	0.00%

Western GB haddock	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	20.00%	1.30%	1.10%	11.90%	34.80%	25.90%
Commercial Groundfish sub-ACL	20.60%	12.60%	4.40%	11.40%	31.70%	23.30%
Sector sub-ACL	20.50%	12.60%	4.40%	11.40%	32.00%	23.50%
Common Pool sub-ACL	36.30%	6.30%	0.60%	0.50%	0.70%	0.10%
Herring Fishery sub-ACL	82.30%	32.00%	*100.90%*	*106.20%*	70.10%	*103.90%*
State Water sub-component	0.30%	1.10%	4.60%	2.10%	4.20%	10.30%
Other sub-component	7.30%	22.30%	2.00%	4.80%	*103.10%*	68.60%

GOM haddock	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	65.50%	57.70%	47.30%	*147.90%*	*159.00%*	82.90%
Commercial Groundfish sub-ACL	67.40%	59.40%	49.30%	*154.40%*	*161.50%*	83.60%
Sector sub-ACL	46.40%	62.80%	37.80%	91.50%	75.00%	76.80%
Common Pool sub-ACL	27.40%	24.30%	18.60%	*108.90%*	21.60%	24.80%
Recreational sub-ACL	*122.30%*	77.40%	*108.40%*	*312.20%*	*380.70%*	*102.70%*
Herring Fishery sub-ACL	25.50%	1.70%	0.60%	0.00%	0.00%	0.00%
State Water sub-component	94.60%	54.60%	11.10%	30.40%	47.90%	38.20%
Other sub-component	4.40%	24.10%	7.10%	25.30%	*207.70%*	*116.80%*

GB yellowtail flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	79.30%	78.90%	70.30%	44.70%	38.60%	28.40%
Commercial Groundfish sub-ACL	92.10%	86.70%	58.50%	36.10%	24.50%	18.90%
Sector sub-ACL	92.00%	88.10%	59.10%	36.60%	24.90%	19.30%
Common Pool sub-ACL	93.10%	10.10%	6.10%	0.40%	1.40%	0.20%
Scallop Fishery sub-ACL	12.10%	41.80%	*104.50%*	90.30%	*116.40%*	98.80%
Small Mesh Fisheries sub-ACL	n/a	n/a	n/a	63.70%	18.10%	1.00%

Other sub-component	66.20%	59.10%	23.90%	0.60%	0.20%	0.10%

SNE/MA yellowtail flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	67.00%	76.70%	59.30%	70.10%	74.70%	49.00%
Commercial Groundfish sub-ACL	55.40%	67.30%	55.80%	63.70%	71.00%	48.90%
Sector sub-ACL	64.90%	90.10%	70.10%	57.80%	67.70%	37.90%
Common Pool sub-ACL	25.90%	10.20%	24.40%	93.10%	85.70%	91.70%
Scallop Fishery sub-ACL	83.70%	*135.20%*	42.50%	*111.40%*	98.20%	79.10%
State Water sub-component	*134.40%*	15.60%	*120.20%*	*206.50%*	8.90%	15.40%
Other sub-component	*115.50%*	98.90%	*161.50%*	*106.30%*	*111.70%*	22.50%

CC/GOM yellowtail flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	81.70%	78.90%	83.50%	86.70%	64.10%	88.90%
Commercial Groundfish sub-ACL	76.60%	78.30%	82.90%	79.40%	52.30%	84.10%
Sector sub-ACL	76.80%	87.10%	93.50%	80.80%	53.90%	85.10%
Common Pool sub-ACL	73.80%	42.10%	13.00%	31.50%	6.30%	64.00%
State Water sub-component	*368.60%*	*384.80%*	96.40%	*130.20%*	*139.20%*	*137.10%*
Other sub-component	*118.70%*	19.30%	91.00%	*271.30%*	*354.60%*	*101.90%*

American plaice	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	53.50%	42.30%	38.80%	97.50%	93.10%	96.90%
Commercial Groundfish sub-ACL	53.90%	43.80%	39.70%	98.30%	94.10%	98.00%
Sector sub-ACL	54.70%	53.70%	49.70%	99.80%	95.30%	98.90%
Common Pool sub-ACL	32.80%	6.40%	6.10%	14.30%	31.30%	51.50%
State Water sub-component	78.30%	35.50%	42.50%	63.00%	57.90%	75.50%
Other sub-component	36.70%	9.10%	15.70%	95.70%	78.60%	70.60%

witch flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	92.60%	84.80%	67.40%	99.20%	83.10%	85.10%
Commercial Groundfish sub-ACL	85.10%	74.10%	59.60%	*105.30%*	84.50%	88.00%
Sector sub-ACL	84.10%	82.00%	68.80%	*106.70%*	86.00%	87.80%
Common Pool sub-ACL	*119.90%*	16.80%	10.50%	30.60%	9.60%	98.70%
State Water sub-component	*261.20%*	*161.00%*	57.50%	*115.50%*	*162.80%*	*171.20%*
Other sub-component	*220.20%*	*302.50%*	*246.20%*	64.50%	60.00%	53.00%

GB winter flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015

Total ACL	78.30%	85.10%	53.40%	48.40%	34.20%	45.40%
Commercial Groundfish sub-ACL	75.10%	86.90%	52.60%	48.80%	34.00%	45.90%
Sector sub-ACL	75.80%	96.50%	57.30%	49.10%	34.20%	46.40%
Common Pool sub-ACL	30.30%	8.20%	3.90%	0.00%	0.10%	0.00%
Other sub-component	*136.00%*	53.50%	67.00%	36.50%	40.60%	29.30%

GOM winter flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	83.80%	52.40%	28.10%	23.60%	23.10%	42.10%
Commercial Groundfish sub-ACL	67.20%	45.00%	32.00%	23.70%	17.40%	30.90%
Sector sub-ACL	60.70%	50.50%	37.40%	24.40%	18.10%	31.70%
Common Pool sub-ACL	*101.60%*	16.50%	7.80%	6.60%	1.90%	16.30%
State Water sub-component	*107.10%*	69.50%	22.10%	24.80%	41.70%	92.00%
Other sub-component	*192.90%*	41.30%	4.90%	16.50%	6.00%	49.10%

SNE/MA winter flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	61.20%	35.50%	52.40%	63.60%	43.60%	55.20%
Commercial Groundfish sub-ACL	9.10%	12.90%	35.00%	65.20%	45.10%	52.70%
Sector sub-ACL	n/a	n/a	n/a	62.40%	46.10%	50.90%
Common Pool sub-ACL	n/a	n/a	n/a	87.00%	37.90%	65.60%
State Water sub-component	*341.40%*	55.60%	33.70%	23.70%	30.30%	72.60%
Other sub-component	*443.10%*	*366.40%*	*120.80%*	*108.10%*	51.50%	61.60%

redfish	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	30.00%	25.70%	42.10%	38.50%	43.50%	46.40%
Commercial Groundfish sub-ACL	31.40%	26.90%	44.20%	39.50%	44.40%	47.90%
Sector sub-ACL	31.70%	36.00%	53.40%	39.60%	44.50%	48.20%
Common Pool sub-ACL	8.80%	9.90%	16.60%	10.90%	11.40%	0.50%
State Water sub-component	13.90%	4.30%	14.50%	17.30%	15.80%	3.60%
Other sub-component	1.70%	3.10%	0.80%	1.80%	19.00%	1.20%

white hake	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	86.90%	88.90%	67.20%	51.70%	46.60%	35.80%
Commercial Groundfish sub-ACL	88.40%	93.50%	70.50%	53.10%	40.90%	36.80%
Sector sub-ACL	88.40%	*102.30%*	75.10%	53.40%	41.00%	37.10%
Common Pool sub-ACL	86.60%	50.40%	91.60%	21.60%	28.60%	0.80%
State Water sub-component	90.20%	7.90%	3.80%	5.50%	3.30%	1.50%

Other sub-component	52.80%	3.30%	11.00%	9.90%	*331.70%*	7.20%

pollock	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	39.80%	46.10%	45.50%	47.10%	31.10%	25.20%
Commercial Groundfish sub-ACL	33.80%	43.00%	40.30%	38.10%	30.40%	21.30%
Sector sub-ACL	33.70%	54.50%	51.00%	38.10%	30.20%	21.10%
Common Pool sub-ACL	40.30%	66.60%	82.70%	40.20%	52.60%	54.40%
State Water sub-component	89.20%	90.30%	70.60%	*104.90%*	56.60%	44.30%
Other sub-component	73.30%	52.40%	80.10%	*103.70%*	17.40%	54.20%

Northern windowpane flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	*101.00%*	*118.80%*	*128.20%*	*195.00%*	*187.50%*	*131.80%*
Commercial Groundfish sub-ACL	*139.50%*	*142.20%*	*100.50%*	*242.40%*	*160.90%*	75.10%
State Water sub-component	0.40%	0.50%	*115.90%*	62.20%	*180.50%*	84.10%
Other sub-component	18.60%	71.00%	*233.20%*	95.00%	*248.60%*	*262.30%*

Southern windowpane flounder	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	*237.70%*	*224.00%*	*136.70%*	*105.30%*	90.80%	*122.10%*
Commercial Groundfish sub-ACL	47.80%	72.40%	*147.90%*	*113.70%*	94.40%	*134.90%*
Scallop Fishery sub-ACL	n/a	n/a	n/a	70.50%	76.50%	*115.10%*
State Water sub-component	*1550.10%*	*829.10%*	88.30%	67.90%	42.70%	71.30%
Other sub-component	*623.60%*	*544.90%*	*140.70%*	*146.40%*	*117.10%*	*137.50%*

ocean pout	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	40.50%	35.70%	22.20%	26.90%	54.60%	34.70%
Commercial Groundfish sub-ACL	27.30%	25.40%	18.30%	16.90%	16.80%	26.80%
State Water sub-component	1.10%	0.00%	38.50%	62.60%	*163.90%*	74.30%
Other sub-component	*337.40%*	*268.50%*	56.30%	*116.40%*	*393.50%*	94.70%

Atlantic halibut	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	52.50%	68.60%	91.20%	82.10%	74.20%	*105.20%*
Commercial Groundfish sub-ACL	92.80%	*129.10%*	*168.70%*	*105.20%*	83.90%	92.20%
State Water sub-component	18.20%	18.10%	30.80%	57.50%	65.90%	*137.10%*
Other sub-component	45.90%	61.60%	42.20%	31.00%	38.80%	63.10%

wolffish	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
Total ACL	29.20%	42.80%	42.00%	59.30%	23.10%	30.40%
Commercial Groundfish sub-ACL	30.70%	45.10%	41.30%	27.60%	23.00%	30.10%
State Water sub-component	2.70%	0.00%	99.20%	*185.00%*	97.90%	99.30%
Other sub-component	2.70%	2.40%	40.60%	26.30%	5.90%	12.60%

8.e Catch Share Program Review related materials

At onset of the review, public comments were solicited by the Council. Comments received provided valuable information and references for consideration in the review. Much of the work received fell outside of this current evaluation period, but should be revisited in subsequent review. All written public comments received are accessible online: https://www.nefmc.org/library/groundfish-catch-share-program-review and https://s3.amazonaws.com/nefmc.org/All-Catch-Share-Comments-sept-27-2019.pdf.

The Gulf of Maine Research Institute (GMRI) conducted a series of port meetings throughout the summer of 2019 to solicit public comments about the review. These meetings did not limit the scope to the evaluation period of 2007-2015. The input received was very valuable and will serve well for subsequent reviews but was not collected in time to inform the analyses of this report. A summary of that report is available online: https://www.nefmc.org/library/september-2019-groundfish-catch-share-program-review

This document will be updated with links to the final related materials.