Department of Fish and Game

Massachusetts Division of Marine Fisheries 2017 Annual Report

Division staff conducting fyke net sampling for rainbow smelt on the north shore

Department of Fish and Game

Massachusetts Division of Marine Fisheries

2017 Annual Report

Commonwealth of Massachusetts
Governor Charles D. Baker
Lieutenant Governor Karyn E. Polito

Executive Office of Energy and Environmental Affairs
Secretary Matthew A. Beaton

Department of Fish and Game
Commissioner Ronald Amidon

Division of Marine Fisheries
Director David E. Pierce, Ph.D.

www.mass.gov/marinefisheries

January 1–December 31, 2017

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Introduction

The Massachusetts Division of Marine Fisheries (*MarineFisheries)* of the Department of Fish and Game is the Commonwealth's marine fisheries management agency. *MarineFisheries* is responsible for the development and promulgation of the Commonwealth's regulations governing commercial and recreational fishing activity conducted in the marine environment. The Division promotes and develops commercial and recreational fisheries through research, technical assistance, and the collection of statistics. Guidelines for managing marine fisheries come through Chapter 130 of Massachusetts General Law, the Atlantic Coastal Fisheries Cooperative Management Act, the Interjurisdictional Fisheries Management Act, and the Magnuson-Stevens Fishery Conservation and Management Act.

To successfully fulfill its responsibilities, the Division has established the following mission, vision, and goals.

Mission

To manage the Commonwealth's living marine resources in balance with the environment resulting in sustainable fisheries and contributions to our economy, stable availability of diverse, healthy seafood and enriched opportunities that support our coastal culture.

Vision

Sustainable fisheries and a healthy marine ecosystem achieved through innovation, collaboration, and leadership enriching the public's way of life.

Goals

Improve fisheries sustainability, promote responsible harvest and optimize production of our living marine resources.

Promote and support our commercial and recreational fisheries.

Promote and support industry and community involvement in the fisheries management process.

Foster partnerships that help accomplish the Division's mission.

Support continued development of an ecologically sustainable marine aquaculture industry.

Promote a high level of staff commitment and professionalism.

Ensure that marine spatial planning activities are compatible with fisheries management.

Frequently Used Acronyms and Abbreviations

Army Corps	US Army Corps of Engineers
ACCSP	Atlantic Coastal Cooperative Statistics Program
ALWTRP	Atlantic Large Whale Take Reduction Plan
ASMFC	Atlantic States Marine Fisheries Commission
CCB	Cape Cod Bay
CE	Conservation Engineering
CZM	Massachusetts Office of Coastal Zone Management
EOEEA	Executive Office of Energy and Environmental Affairs (Massachusetts)
EPA	Unites States Environmental Protection Agency
FMP	Fishery Management Plan
GIS	Geospatial Information System
GOM	Gulf of Maine
ILF	In-lieu Fee
ISSC	Interstate Shellfish Sanitation Conference
LCMA	Lobster Conservation Management Area
*Mass*DAR	Massachusetts Department of Agricultural Resources
*Mass*DCR	Massachusetts Department of Conservation and Recreation
*Mass*DEP	Massachusetts Department of Environmental Protection
*Mass*DFG	Massachusetts Department of Fish and Game
*Mass*DOT	Massachusetts Department of Transportation
*Mass*DPH	Massachusetts Department of Public Health
Massport	Massachusetts Port Authority
*Mass*Wildlife	Massachusetts Division of Fisheries and Wildlife
MAFMC	Mid-Atlantic Fishery Management Council
MFAC	Marine Fisheries Advisory Commission (Massachusetts)
MRIP	Marine Recreational Information Program
NEFMC	New England Fishery Management Council
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NSSP	National Shellfish Sanitation Program
OCC	Outer Cape Cod
OLE	Office of Law Enforcement (Massachusetts)
PCCS	Provincetown Center for Coastal Studies
PDT	Plan Development Team
PSP	Paralytic Shellfish Poisoning
SAFIS	Standard Atlantic Fisheries Information System
SMAST	School for Marine Science and Technology (at UMass Dartmouth)
SNE	Southern New England
USCG	United States Coast Guard
USFDA	United States Food and Drug Administration
USFWS	United States Fish and Wildlife Service
VTR	Vessel Trip Report
YOY	Young-of-the-year

FISHERIES MANAGEMENT SECTION

Dr. David Pierce, Director, Section Leader

Fisheries Policy and Management Program

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Overview

MarineFisheries is responsible for managing the Commonwealth's saltwater commercial and recreational fisheries. Management of marine resources unique to state waters and which cross state/federal boundaries is a constant, ongoing endeavor. A core of fisheries management professionals, with many years of practical experience and knowledge of Massachusetts fisheries, composes the team that initiates, evaluates, and selects fisheries management policy and strategies to implement rules and regulations. These rules and regulations frequently result from participation on, and in support of, federal fisheries management through the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC), and interstate fisheries management through the Atlantic States Marine Fisheries Commission (ASMFC).

Our fisheries policy and management staff gathers and analyzes biological and economic data, communicates with the media and public on state, interstate, and federal fisheries management issues, and ensures adherence to administrative and regulatory protocols and procedures. This process also relies on our technical staff to provide biological analyses and other technical reviews of management options to ensure sustainable fisheries and fisheries habitat protection.

Frequent communications with commercial and recreational fishery participants is another important element of policy and management development. This effort directly involves a diverse array of fishermen, dealers, processors, and many other stakeholders. Public hearings to propose regulation changes are held by the Commonwealth's Marine Fisheries Advisory Commission (MFAC) established by the Legislature in 1961. The MFAC and the Commissioner of the Department of Fish and Game must approve regulatory changes that *MarineFisheries* proposes in order for them to be implemented.

Advisory Groups

Following below is a summary of 2017 proceedings by groups advising *MarineFisheries* on fishery management issues.

Marine Fisheries Advisory Commission

The Massachusetts Marine Fisheries Advisory Commission (MFAC) is a nine-member board, representing recreational and commercial fishing interests, from various parts of the Massachusetts coast. Commissioners are appointed by the Governor to three-year terms and attend monthly business meetings as well as public hearings. Proposed regulatory changes are approved or disapproved by a majority vote at the Commission's monthly business meetings.

The MFAC held nine business meetings and six public hearings during 2017. Regulatory revisions and fishery specifications that were approved by the Commission or became effective during 2017 are included in the summary of fisheries management actions beginning on page 9. Where possible, Commissioners also attended nine state scoping meetings on various management issues and seven Division-hosted ASMFC public hearings on interstate fishery management plans.

Changes to MFAC membership in 2017 included the resignation of Gloucester-based commercial fisherman Gus Sanfilippo near year's end. The vacated seat was expected to be filled in early 2018.

Marine Recreational Fisheries Development Panel

Pursuant to provisions of "An Act Instituting Saltwater Fishing Licenses", a Marine Recreational Fisheries Development Panel was established in 2010 to recommend how annual appropriations from the Marine Recreational Fisheries Development Fund should be spent. All fees collected from the sale of recreational saltwater fishing permits are deposited into this fund for the dedicated purpose of improving recreational fisheries or recreational fishery research in the Commonwealth, with a requirement that one-third of the annual appropriation be used for improved public access to marine recreational fisheries.

The Panel met during June 2017 to review spending of the Fiscal Year (FY) 2017 fund appropriation and make recommendations for spending of the expected FY2018 fund appropriation of roughly $1.3 million. The approved spending plan included, but was not limited to: partial funding for a new Deer Island Fishing Pier in Boston Harbor; continuation of a Small Grants Program through which municipalities can compete for funds to finance public access improvement projects; continuation of expanded and enhanced sampling and assessment of the recreational fishery; public informational and educational materials and programs; monitoring diadromous fish populations; and monitoring fish populations at artificial reefs.

Seafood Marketing Steering Committee

On August 13, 2014, "An Act Promoting Economic Growth Across the Commonwealth" established a Seafood Marketing Program within *MarineFisheries*. The legislation laid out initial objectives of the program, required the appointment of a 19-member steering committee to guide *MarineFisheries* in the administration of the marketing program, and designated funding of up to $250,000 per fiscal year from commercial harvester and dealer permit revenues. The steering committee, chaired by *MarineFisheries,* met twice during the year. See Seafood Marketing (page 107) for more information.

Shellfish Advisory Panel

MarineFisheries formed a Shellfish Advisory Panel in 2014 to provide guidance to the agency on emerging issues, matters of concern, and possible solutions with regards to the shellfish industry in the Commonwealth. The group includes harvesters, dealers, researchers, aquaculturists, and municipal shellfish officials. The panel met once in 2017 to provide industry input on a range of issues including, for example, *Vibrio* management, shellfish permitting issues, and aquaculture re-submergence protocols.

Fisheries Management Actions

American Lobster and Jonah Crab

American lobster and Jonah crab are managed under the same interstate FMP; their management actions are thus grouped.

Draft Addendum XXV: In March, *MarineFisheries* hosted an ASMFC public hearing on Draft Addendum XXV to Amendment 3 of the Interstate FMP for American Lobster. The draft addendum sought to address the depleted condition of the Southern New England stock while preserving a functional portion of the SNE lobster fishery. The document presented a suite of management measures to increase egg production so that, if environmental conditions become favorable, the SNE stock can benefit from a strong recruitment year. The Management Board later determined not to move forward with the addendum given split opinions on the need for and effectiveness of the proposed measures, and instead established a working group to further discuss ways to manage SNE lobster.

Non Trap Structures to Catch Lobsters: Effective April 7, the Division enacted a regulation that clarified the prohibition on the setting of materials on the ocean floor by SCUBA divers for purposes of attracting and retaining lobsters for eventual harvest. The rule explicitly prohibited the on-the-water possession and/or setting of non-trap structures capable of attracting lobsters (e.g., porcelain toilet tanks and fabricated cement shelters). Using such structures to harvest lobsters was illegal under existing state law and regulation, because they did not meet buoy and trap configuration requirements. However, this rule was proving challenging to enforce because officers had to prove the devices were being used to take lobsters. A more straightforward prohibition was preferred. The setting of these structures was also the cause of considerable user conflict off Provincetown in recent years. Public comment was collected at three multi-topic hearings in February.

Cancer Crab Bycatch Limits for Net Fishermen: Effective April 7, the cancer crab (Jonah and rock crab) bycatch limit for fishermen using gillnets or mobile gear was increased to 1,000 crabs, not to exceed 50% of the total catch (by weight). The rule change was prompted by Addenda I and II to the Interstate FMP for Jonah Crabs. (While the FMP applies only to Jonah crabs, our regulations apply to both rock and Jonah crabs for enforcement purposes, as these crab species are difficult to differentiate.) Public comment was collected at three multi-topic hearings in February.

Offshore Lobster Permitting: Effective April 7, *MarineFisheries* began allowing the transfer of Offshore Lobster Permits for trap fishing in conjunction with a federal trap permit authorized to fish in LCMA 1 (Gulf of Maine). This allows for lobster business to relocate to Massachusetts (e.g., from Rhode Island to Massachusetts) or be sold to Massachusetts residents. The Division also expanded the exception to the moratorium on Offshore Lobster trap permits to include eligibility for holder of federal trap permits authorized to fish in LCMA 2 (previously limited to holders of federal trap permits authorized to fish in LCMA 3). This regulation change allows Massachusetts LCMA 1 offshore lobster businesses to be transferred intact to a Massachusetts resident as existing permit holders seek to leave the industry. Public comment was collected at three multi-topic hearings in February.

Atlantic Herring

Addendum I: In April, *MarineFisheries* hosted an ASMFC public hearing on Draft Addendum I to Amendment 3 of the Interstate FMP for Atlantic herring. The draft addendum was initiated in response to the accelerated rate of landings from the inshore Gulf of Maine area during June–September in recent years and the increasingly dynamic nature of days out measures to control effort that have varied across states. As approved by the ASMFC in May, Addendum I established a vessel declaration protocol for federally

permitted herring vessels, implemented weekly landing limits in addition to the days out schedule, and limited the transfer of herring at sea. In response to the addendum, *MarineFisheries* developed a new protocol for harvesters to opt into the fishery and have their permits conditioned subject to the limits adopted by the ASMFC.

Inshore Gulf of Maine Management Measures: Consistent with Addendum I, *MarineFisheries* solicited declarations from herring permitted vessels to participate in the directed herring fishery in Management Area 1A for Trimester 2 (June –September). The days out schedule for the directed herring fishery included a three day 400,000-pound/week fishery from June 1–July 9, a four day 600,000-pound/week fishery from July 10–29, a five day 680,000-pound/week fishery from July 30–September 17, and a seven day 1,000,000-pound/week fishery from September 18–September 30. Additionally on July 30, carrier vessel weekly landing limits were increased from 80,000-pounds/week to 120,000-pounds/week and the prohibition on at-sea transfer of herring between participating fishing vessels was lifted. Vessels were otherwise restricted to the 2,000-pound incidental landing limit, unless participating in the Research Set-Aside Program with a valid Letter of Authorization from *MarineFisheries*.

For Trimester 3 (October–December), a three day/week fishery was authorized, increased to seven days/week on December 19.

Spawning Closure Protocol and Spawning Protection: *MarineFisheries* applied the herring spawning monitoring model, based on the Gonadal Somatic Index (GSI) of maturing females sampled from commercial catches, to determine timing for the Massachusetts/New Hampshire Spawning Area closure. Based on sampling of 12 trips from July 19–November 13, *MarineFisheries* closed the area to the directed fishery from October 1–November 11.

Atlantic Menhaden

Menhaden Trip Limit Thresholds: To promote more full utilization of the state's commercial menhaden quota, *MarineFisheries* amended one of the quota based triggers for making an in-season adjustment to the trip limit for the limited access fishery. The change allowed limited access commercial menhaden permit holders to fish at the 125,000 pound trip limit until 85% of the quota is taken, rather than 75%. Once the threshold is reached, the trip limit drops to 25,000 pounds. The rule became effective April 7, after public comment was collected at three multi-topic hearings in February.

Amendment 3: *MarineFisheries* hosted two ASMFC public hearings in October on Draft Amendment 3 of the Interstate FMP for menhaden. In November, the Management Board finalized the amendment.

Amendment 3 maintains the existing single-species reference points for menhaden while menhaden-specific ecological reference points that account for the needs of menhaden's predators (e.g., striped bass) are developed by the ASMFC over the next two years. Its most significant action was to reallocate the coastwide quota, providing each state at least a 0.5% share. Historical participation is added atop this fixed minimum, hence Massachusetts' share was increased from 0.84% to 1.27%. This action primarily shifted allocation away from Virginia, home to the last menhaden purse seine reduction fishery on the east coast, to provide more access to bait fisheries utilizing various gears along the coast.

The Amendment also maintains a 1% set-aside of the TAC for states in the Northeast (ME–NY) to harvest if they exhaust their quotas prior to September 1, allows for continued harvest of menhaden after a state's fishery closes by small scale and non-directed gears under a 6,000-lb bycatch limit, prohibits rollover of unused quota to the next year, allows for redistribution and transfer of unused quota between states within a year, and reduces the amount of menhaden that the purse seine reduction fishery can harvest from the Chesapeake Bay, an important nursery area for the species.

No significant changes to Massachusetts' menhaden regulations were made necessary by the new amendment. *MarineFisheries* expected to hold public hearings on and implement an inconsequential change to our bycatch allowance in 2018 for compliance.

Fluke, Scup, and Black Sea Bass

Fluke (summer flounder), scup, and black sea bass are managed as part of a multispecies FMP; their management actions are thus grouped.

Fluke Commercial Winter Weekly Limit Program*:* For the seventh year, *MarineFisheries* authorized interested fluke permit endorsement holders to land a weekly limit of fluke rather than the standard daily limit during the Period I (winter) fishery. The pilot program was created at the request of offshore trawl vessel fishermen to assist the fleet in achieving its seasonal quota allocation with the goal of also reducing discards. Whereas the regulations establish a 500-pound daily limit beginning February 1 (preceded by a January closure), participants of the 2017 pilot program were allowed to land 1,000 pounds per week beginning February 1. For enforcement purposes, participants had to land at a wholesale dealer reporting daily. The Division issued 62 Letters of Authorization for the 2017 program.

Fluke Recreational Measures: In January, *MarineFisheries* hosted an ASMFC public hearing on Draft Addendum XXVIII, which proposed various regional approaches to manage the coastwide recreational fluke fishery to its coastwide harvest limit, which was decreased by 30% for 2017. The ASMFC approved the addendum in February, requiring Massachusetts to increase its minimum size limit from 16" to 17", decrease its possession limit from 5 fish to 4 fish, and maintain its May 22–September 23 season. *MarineFisheries* submitted an unsuccessful bid to retain a 5-fish limit given the negligible projected conservation benefit of going to 4 fish. The Division implemented the new regulations by emergency action (effective May 19). A public hearing was held in June, followed by final rule-making. Notably, New Jersey implemented alternative regulations to those in Addendum XXVIII based on their having a comparable total removals estimate, rather than harvest. For the first time ever, the U.S. Secretary of Commerce did not uphold an ASMFC noncompliance determination.

Scup Commercial Trip Limits: Effective April 7, several aspects of the state's summertime (May 1–October 31) commercial scup limits were liberalized to promote more utilization of the quota and reduce regulatory discarding. The closed fishing days of Friday and Saturday for trawl vessels during July 10–October 31 were lifted, allowing the landing of scup seven days per week throughout the summertime fishery. Also for trawl vessels, the 800-lb daily limit was replaced with a 10,000-pound weekly limit. This followed three years in which a pilot program authorized participating scup trawl vessels to fish under a weekly limit. The Friday and Saturday closed days for hook and line and pot fishermen during July 1–October 31 were also lifted, allowing the landing of scup seven days per week at the 1,500-lb daily limit. The quota set-aside for the weir fishery was also increased from 275,000 to 300,000 pounds annually. Public comment was collected at three multi-topic hearings in February.

Two Director's declarations set the 2017 Winter II and 2018 Winter I trip limits at 18,000 pounds and 50,000 pounds, respectively, complementing the federal limits. Public comment was collected prior to each declaration.

Scup Addendum XXIX: In March, *MarineFisheries* hosted an ASMFC public hearing on a draft addendum to the interstate scup plan that considered alternatives for revising the dates of the three commercial quota periods, with the goal of better allocating the quota. As approved by the ASMFC in May, Addendum XXIX moves the month of October from the Summer Period to the Winter II Period, effective in 2018. Extending the Winter II Period is expected to increase quota use given the larger trip limits in effect compared to the Summer Period. The Division expected to go to rule-making in early 2018 to implement the change.

Black Sea Bass Commercial Measures: *MarineFisheries* held three public hearings in February to accept comment on adjustments to the open fishing days based on industry interest to optimize marketability and a reduction in the trap limit to better reflect the trip limit. The public comment indicated a need to consider additional rule revisions based on a just announced quota increase of roughly 50%. The Division held a follow-up scoping meeting in April to vet proposals including an earlier season start, a bycatch allowance for trawlers, and increase in the weir fishery quota set-aside. In order to implement measures for the 2017 fishery, emergency measures effective May 9 were used to start the season on July 9 rather than the first Tuesday in August and increase the weir set-aside from 10,000 to 15,000 pounds. The pot gear haul-out period was adjusted according to the new start date of the directed fishery. A public hearing was held in June, followed by final rule-making.

Effective September 18, the Director used his declaration authority to adjust the open commercial fishing days and trip limits to help ensure the quota would be taken prior to the seasonal southward migration of black sea bass in the fall. The possession limit for fish pot fishermen was increased from 300 pounds to 400 pounds, and from 150 pounds to 200 pounds for all other gear types. Additionally, a fourth day was added to the normally three day/week fishery for all gears.

Black Sea Bass Recreational Measures: The ASMFC approved states retaining status quo regulations for 2017. In order to maintain the fishery's opening date on the third Saturday in May, the season was modified slightly from May 21–August 31 to May 20–August 29. Due to black sea bass harvest rates being higher in May than they are in August, two days were required to be taken off the end of the season to provide for an additional day at the start of the season. The revision was implemented by emergency action effective May 19. A public hearing was held in June, followed by final rule-making.

Gear Issues

Trawl Fishery Measures: Effective April 7, two minor changes were made to trawl fishery rules to complement existing federal regulations. First, the push-pull pressure for measuring large meshes was increased from 5 kg to 8 kg. Second, a 1 ⅞" minimum net mesh opening was established for the state waters squid trawl fishery. Additionally, windowpane flounder (a prohibited species) was struck from the mixed flounders bycatch allowance for the small mesh trawl squid fishery. Public comment was collected at three multi-topic hearings in February.

The minimum mesh size for the state waters squid trawl fishery arose from a public petition filed by Nantucket officials. The petition also requested the Division to adopt regulations that would: 1) close all waters within three miles of the Nantucket archipelago to all mobile gear fishing (i.e., dredge and trawl), except for dredge gear used to harvest shellfish managed by the town (i.e., bay scallops and bay quahogs) during the period of May 1–October 31; and 2) prohibit the use of net strengtheners in the squid trawl fishery. Comment was also accepted on these issues at the February public hearings, as well as an additional public meeting on Nantucket in March, but ultimately they were not adopted based largely on unsubstantiated claims.

Night Fishing in Conch and Fish Pot Fisheries: Effective April 7, *MarineFisheries* adopted a rule prohibiting the setting or hauling of conch pots and fish pots between ½ hour after sunset to ½ hour before sunrise. This restriction emulated that already in effect for the lobster and crab trap fishery since 1941.The rule was aimed at constraining poaching and theft of catch from other's gear, and enhancing safety. Public comment was collected at three multi-topic hearings in February.

Radar Reflectors on Gillnet Highflyers: Effective April 7, *MarineFisheries* eliminated the rule requiring gillnet fishermen to affix radar reflectors to the highflyers marking the ends of the gillnet. This longstanding regulation was likely implemented to prevent gear conflicts between gillnet fishermen and trawlers when

night trawling was allowed in state-waters. However, night trawling was banned in the 1990s, and the present day gillnet fleet is small and subject to spatiotemporal fishing restrictions. Public comment was collected at three multi-topic hearings in February.

Extension of Trap Fishing Gear Closure in Cape Cod Bay: By regulation, all trap gear is required to be removed from an area north and east of Cape Cod during the period of February 1–April 30 to reduce the risk of entanglement with large whales. By emergency action of the Director, the closure was extended for four days within most of Cape Cod Bay due to the continued presence of right whales. Throughout April, an unprecedented number of whales was observed in the Bay, with an estimated 100 to 200 individuals present throughout the month. The extension was initially announced for seven days, but was scaled back after an aerial survey on May 4 observed only 10 whales within the closure area that were widely scattered and expected to leave shortly.

Kelp Aquaculture: Interest in kelp aquaculture continued to grow in 2017. The Division issued a new permit for the installation of a novel macroalgae-farming array in the southern portions of Horseshoe Shoal within the boundaries of the Cape Wind lease area. Prior to issuing the permit, the Division held a public meeting in August to evaluate possible stakeholder concerns and determine if modifications to location, gear marking and design, or other features of the experimental project were warranted. See Aquaculture Project (page 43) for more information.

Temporary Fish and Conch Pot Closure: *MarineFisheries* extended into 2017 the temporary closure of Cape Poge Bay, Edgartown (Martha's Vineyard) to fish pots and conch pots by way of permit conditions. This closure was instituted in 2016 to allow the U.S. Army Corps of Engineers to conduct work identifying and removing unexploded munitions left from WWII training exercises. The presence of fixed fishing gear was found to interfere with the underwater sensors being used to identify munitions buried in the sediment.

Temporary Surf Clam/Ocean Quahog Dredge Closure: The Division implemented a temporary closure within a discrete nearshore area of Western Cape Cod Bay adjacent to Ellisville (Plymouth/Sandwich) to the use of surf clam/ocean quahog dredge gear. The August 28–October 31 closure responded to ongoing gear conflicts in the area between dredge fishermen and lobster trap fishermen and need to protect egg-bearing and new-shell lobsters from interactions with this mobile gear. Division staff met with stakeholders in August prior to enacting the closure through the Director's declaration authority, followed by a written public comment period.

Describing Mobile Gear Closures: In September, *MarineFisheries* held two scoping meetings on modernizing its mobile gear closure regulations in order to improve the clarity of the closure coordinates, especially those that reference the "Line of 1881." This is a historic line that previously delineated the exterior boundary of the Commonwealth, for which coordinates compatible with modern day GPS technology are not readily available. *MarineFisheries* was also willing to consider minor modifications to the existing closures, provided they did not jeopardize the agency's conservation and management objectives. This action item was requested by Law Enforcement and the MFAC; gear conflicts, particularly south of Cape Ann, created a pressing need for the Division to address this. For 2017, *MarineFisheries* issued permit conditions to all state waters mobile gear fishermen that established spatial coordinates for the various mobile gear closure areas in Massachusetts Bay. The Division expected to have public hearings and enact regulations in 2018 to formally adopt these spatial coordinates.

Groundfish

American plaice, cod, haddock, halibut, ocean pout, pollock, redfish, windowpane flounder, winter flounder, witch flounder, wolfish and yellowtail flounder are managed as part of a federal multispecies FMP.

MarineFisheries also includes monkfish in its definition of multispecies groundfish. These species' management actions are thus grouped.

Commercial Witch Flounder Trip Limits: Effective April 7, the commercial witch flounder (grey sole) state-waters trip limit was reduced from 1,000 to 750 pounds. In recent years, the Massachusetts state-waters groundfish fishery had increasingly exceeded the state-waters witch flounder ACL sub-component (for all New England states) set by the federal government. By reducing trip limits to constrain state-waters catch, the Division hoped to balance a sustainable state-waters fishery with avoidance of potential federal management intervention. Public comment was collected at three multi-topic hearings in February.

Recreational Gulf of Maine Cod and Haddock: The 2017 federal recreational fishing limits for Gulf of Maine (GOM) cod and haddock became effective July 27. Consequently, the Division filed emergency regulations effective July 28 to adjust the Massachusetts state waters limits. A public hearing was held in August, followed by final rule-making.

For GOM cod, private angler regulations were held status quo at 1 fish of at least 19" allowed year round in state waters. The fishery was closed entirely to the for-hire angler mode, which in 2016 was allowed 1 fish of at least 24" only during August–September. Federal waters were closed to all harvest.

GOM haddock regulations were also tightened in an effort to reduce cod discard mortality when targeting haddock. The possession limit for all anglers was reduced from 15 to 12 fish (at the status quo 17" minimum size limit). The season for private anglers remained open year round in state waters, while a second 45-day closure was added (in the fall) to the for-hire mode, making for a April 15–September 16 and November 1–February 28 season. This season applied to all anglers fishing in federal waters.

Groundfish Disaster Economic Assistance Program: Refer to Grants Program (page 101).

Quota Transfers

Fluke: In November, Massachusetts accepted a transfer of commercial fluke quota from Virginia (3,585 pounds) to account for landings made by a vessel bound for that state but granted safe harbor here due to a medical emergency.

Black Sea Bass: In November, Massachusetts accepted a transfer of commercial black sea bass quota from Virginia (330 pounds) to account for landings made by a vessel bound for that state but granted safe harbor here due to a medical emergency.

Scup: In September, Massachusetts agreed to transfer 25,000 pounds of Summer Period commercial scup quota to Connecticut. The quota was projected to go unused in Massachusetts, and did not impact the length of our scup fishery.

River Herring

Opening River Herring Spawning Runs: Effective April 7, new regulations were enacted that created standards for opening spawning runs to the harvest of river herring. For a spawning run to be opened, the run must have a Sustainable Management Plan that *MarineFisheries* has submitted to the ASMFC. Such a plan requires a minimum of 10-years of demographic data and biological targets such as spawning stock biomass, fish passage counts, mortality rates, repeat spawning ratios and juvenile abundances. Public comment was collected at three multi-topic hearings in February.

No runs were opened in 2017. The Nemasket Run in Middleborough and Lakeville has met the criteria for an ASMFC-approved plan, but the Middleborough-Lakeville Herring Commission has not petitioned the Division to go to rule-making to open the run to harvest. Once a run is opened, the managing municipality is required

to issue annual harvest permits to named individuals and daily harvest receipts demonstrating the river herring harvest for that calendar day.

Shellfish

2017 Vibrio Control Plan for Oysters: *MarineFisheries* held three industry outreach meetings to provide information on the 2017 Vibrio Control Plan for Oysters. Since 2012, the U.S. Food and Drug Administration has required Massachusetts to develop and implement a plan to minimize the risk of illness associated with *Vibrio parahaemolyticus* related to the consumption of raw oysters. These plans are crafted by MarineFisheries and the Massachusetts Department of Public Health *(Mass*DPH*)* and establish certain time-to-temperature, labeling, and reporting standards for the commercial harvest of wild and aquaculture-raised oysters to safeguard public health. No regulatory changes were required for 2017. See Vibrio Management (page 48) for more information.

Whelk Management*:* Effective April 7, *MarineFisheries* adopted several measures to improve management of the state waters whelk fishery. All commercial fishermen fishing for or in the possession of knobbed or channeled whelks ("whelks") were required to possess a chute gauge matching Division-prescribed dimensions to determine the effective minimum size of whelks. To determine if whelks are of a legal size, they must be measured using the chute gauge with the operculum facing down and as flat as possible on the gauge and the siphonal canal in any orientation to the side walls of the gauge. A whelk is considered sub-legal sized if it fits through the chute gauge using this method of measurement. Dealers and processors are exempt from the legal harvest size standard for whelks caught and imported into the state from out-of-state dealers provided all containers have shellfish tags naming the state of origin. Public comment was collected at three multi-topic hearings in February.

For 2017 and 2018, a chute gauge of at least 2⅞" internal width by 6" length by 1½" wall height is required. *MarineFisheries* sampling studies indicated that utilizing this chute gauge and method of measurement would result in an approximate 1/10" increase in the legal harvest size when compared to 2016, when a 3" chute gauge was used with the parallel method of measurement. This was consistent with the Division's proposal to biennially increase the legal harvest size by 1/8" beginning in 2017. Additional sampling will be conducted to determine a biennial gauge increase that will result in bringing the legal harvest size to 50% size at maturity (3 7/8" shell width) by 2029. Future public hearings will be needed to enact this gauge increase schedule. Commercial fishermen and seafood dealers were invited to a public meeting in July to discuss whelk management issues, with a focus on compliance and enforcement with the new minimum size management measures.

The Division did not enact a summertime conch pot haul-out period or whelk fishery closure as was also proposed. *MarineFisheries* instead planned to further study interactions between fixed gear and sea turtles to determine what—if any—suitable future actions may be necessary to address turtle entanglements in vertical lines. In the interim, the Division advocated that trap fishermen fishing in Buzzards Bay, Vineyard Sound and Nantucket Sound remove their gear from the water during late July through early September if it is not being actively fished.

Bay Scallop Shucking Endorsement: A rule change effective April 7 corrected the language establishing the bay scallop shucking endorsement to clarify that this permit endorsement authorizes shucking only on shore and not at-sea. Public comment was collected at three multi-topic hearings in February.

Scallop Exempted Fishery: Near the end of 2016, *MarineFisheries* submitted to the National Marine Fisheries Service (NMFS) a request for a state waters exempted scallop fishery in the Northern Gulf of Maine scallop management area. After allowing for public comment, NMFS approved the exemption request effective October 25 determining that the exemption will not have an impact on the effectiveness of federal

management measures for the scallop fishery overall or within the Northern Gulf of Maine management area.

Scallop Fishery Research: A Scallop Research Set-Aside grant, "Factors Influencing Scallop Landings per Unit Effort (LPUE)" was awarded to examine the range of parameters that affect scallop fishing behavior and landings. The grant for $270,199 supports researchers from *MarineFisheries* and SMAST to work with members of the scallop fishing industry to identify the primary factors that influence fishing behavior, including landings prices, season and fishing area. The factors will be modeled to predict future fishing behavior and reduce management uncertainty associated with the Days-At-Sea fishery management system.

Striped Bass

Commercial Striped Bass Limits: *MarineFisheries* issued a rule effective April 7 to further clarify to whom the 15-fish and 2-fish commercial trip limits apply. The Division implemented the tiered trip limit system in 2014, allowing boat permit holders to take 15-fish (regardless of fishing location), whereas other permit holders were limited to two fish. In subsequent years, it come to the Division's and Law Enforcement's attention that certain individuals were purchasing boat permits for kayaks or other small boats, but then fishing under the 15-fish limit from shore and using other shore-side fishermen as their "crew" or facilitating the transfer of fish from shore-side fishermen to help take the limit. The Division was petitioned to address this loophole following the 2016 fishing season. The rule was amended to require fishermen authorized to take 15 fish under a boat permit to be onboard the vessel named on the permit. All other commercial striped bass fishing activity was made subject to the 2-fish limit. Public comment was collected at three multi-topic hearings in February.

Other

Mixing of Commercial and Recreational Fishing Trips: Effective April 7, the Division enacted a rule prohibiting fishing commercially and recreationally on the same trip. In other words, if a vessel or individual is commercially fishing, then all catch on the vessel must conform to the state's commercial fishing regulations; no recreational catch can be retained. Previously, it was the Division's interpretation that other regulations precluded this activity, but it was not explicit, resulting in enforcement challenges. Allowing the mixing of commercial and recreational trips presented numerous monitoring, equitability, and compliance issues. The new rule did not change the allowance for commercial fishermen to retain any portion of their commercial catch for personal use (with proper reporting). One exemption was included: to allow for the possession and sale of a giant Atlantic bluefin tuna taken by rod and reel during a trip when other species were caught for recreational purposes. This activity was accommodated to allow the occasional sale of giant tuna without encouraging the discarding of recreational catch. Public comment was collected at three multi-topic hearings in February.

Free Saltwater Fishing Days: The Director declared June 17 and 18 as the 2017 Free Saltwater Fishing Days. The law that established the Commonwealth's recreational saltwater fishing permit requirements also authorized the designation of not more than two days annually when the permit is not required to recreationally harvest finfish.

Horseshoe Crab Limits for Mobile Gear Fishermen: *MarineFisheries* took comment, including at three multi-topic public hearings in February, on liberalizing the horseshoe crab limits for mobile gear fishermen. The proposal was designed to increase the supply of bait crabs available for biomedical use on a temporary basis during the summer period. Based on the public comment received and additional analysis of the cause of the issue, no regulatory action was taken.

However, the Division did authorize one mobile gear fisherman to harvest horseshoe crabs at a level above the normal bait trip limit provided a net with certain specifications was used. The experimental net's features (e.g., 10" codend, no top square, floated head rope) were selected with the aim of minimizing finfish bycatch, particularly species subject to quota closure (i.e., fluke, black sea bass, scup). In addition to enhancing crab supply for bait and biomedical uses, the aim was to collect data that could potentially be used to establish a biomedical horseshoe crab trawl fishery in the future. To date all trawler harvest in MA has been by vessels participating in the bait fishery. Work on the net design was expected to continue in 2018; protocols for trawlers fishing for biomedical crabs regarding handling and release would also need to be developed

Spiny Dogfish Trip Limit: Consistent with ASMFC action, *MarineFisheries* declared a 6,000-pound possession and landing limit for the 2017/2018 commercial spiny dogfish fishery, effective May 1, 2017.

Tautog

Commercial Season: By a rule change effective April 7, the spring commercial tautog season was eliminated, thereby allocating the annual quota entirely to the fall commercial period beginning on September 1. Previously, the rules allocated MA's commercial tautog quota between a spring fishery, beginning on April 16 until 28% of the quota was taken, and the fall fishery. The Division had received multiple requests in recent years to take this action. We agreed with the petitioners' rationale for possible conservation and management benefits (i.e., reducing fishing mortality on springtime pre-spawning and spawning aggregations; improved quota management and enforcement by moving the fishery to a time when catch rates are slower). Public comment was collected at three multi-topic hearings in February.

Amendment 1: The Division hosted an ASMFC public hearing on Draft Amendment 1 to the interstate FMP for tautog in June. As approved by the ASMFC in October, the amendment institutes a fundamental change in tautog management from a coastwide to regional basis due to differences in biology and fishery characteristics. The four regions of MA–RI, Long Island Sound, NJ–NY Bight, and DE–VA are required to implement measures to achieve their regional fishing mortality target. The MA–RI region was not required to take harvest reductions, and instead focused on regionalizing recreational measures. The Division expected to proceed to rule-making in early 2018 with new rules for the recreational fishery that closely align with RI. Additionally, the amendment established a commercial harvest tagging program to address an illegal, unreported, and undocumented fishery. State tagging programs will need to be implemented in 2019 and require that tags be applied by the commercially-permitted harvester at harvest or prior to offloading.

Control Date: The Division promulgated emergency regulations to enact a control date of August 28, 2017 for the commercial tautog fishery. A control date is a tool that can be used to address access to a fishery. The control date was established in anticipation of Amendment 1 being approved by the ASMFC with a point-of-harvest tagging program requirement. The implementation and administration of such a program may require adjusting access to the fishery (e.g., a limited entry permit). Any future action to utilize the control date would be subject to public comment and MFAC approval. A public hearing was held in October, followed by final rule-making. The Division also prepared to issue (open entry) regulated fishery permit endorsements for tautog in 2018.

Other Activities

Committee Work and Leadership Positions

D. Pierce served as a NEFMC Council Member and ASMFC Commissioner. Pierce, M. Griffin, and C. O'Keefe served on various NEFMC committees and teams, with Pierce having the role of vice-chair of the Spiny

Dogfish Committee and Risk Policy Working Group. Pierce, D. McKiernan, M. Armstrong (Fisheries Biology Section), and N. Meserve served on various ASMFC Management Boards and other committees. S. Reed (Permitting and Fisheries Statistics Program) also contributed to several ASMFC committees. Pierce was co-Chair of the Massachusetts Marine Fisheries Institute (MFI), member to the MFI Executive Committee, and served as the state's representative to the Stellwagen Bank Advisory Council. McKiernan chaired the agency's Shellfish Advisory Panel.

Marine Fisheries Institute

The Massachusetts Marine Fisheries Institute (MFI) is a cooperative venture between *MarineFisheries* and the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST). Founded in 2002, the MFI exists to promote sustainable fisheries through scientific study and the provision of timely information to protect, conserve, and manage Massachusetts and New England marine fisheries and their habitats in a manner that balances the economic, environmental, and cultural interests of the citizens of the Commonwealth.

The MFI received its first external, competitive research grant in August from NMFS' Bycatch Reduction Engineering Program. The two-year project, "Developing and testing a pelagic species distribution model to forecast river herring bycatch hotspots", submitted by principal investigators from SMAST and *MarineFisheries* received $116,789 to evaluate the impact of fisheries-dependent data on river herring, Atlantic herring and Atlantic mackerel habitat forecasts and compare predicted bycatch hotspots to observed river herring bycatch to determine utility in predicting bycatch.

The MFI secured $450,000 in earmarked state funds in the Division's appropriation for collaborative research that applies innovative technology to assess the biomass of groundfish fish in the region. Specifically, the funds supported continued development and application of the open cod-end video trawl survey system to estimate stock size for cod, teaching and advising on stock assessment methods, and continuation of the MFI Distinguished Senior Scientist position.

The MFI continued and expanded collaborative research projects in 2017, including the river herring/shad bycatch avoidance program for the Atlantic herring fishery, use of fishery-dependent effort data in stock assessment, scallop meat quality research, electronic monitoring pilot projects, and the use of Management Strategy Evaluation to determine alternative management procedures.

The MFI Advisory Council met in May and November to review the status of regional science related to Gulf of Maine cod, advance the survey efforts of *MarineFisheries'* Industry-Based Survey for Cod and SMAST's open cod-end video trawl survey, and receive updates on new and ongoing MFI research projects.

In November, the MFI hosted a regional workshop, "Accountability Measures for Northeast Fisheries: A Workshop to Examine Best Practices", including participation from the Chairman and Executive Director of the New England Fishery Management Council, staff from the Mid-Atlantic Fishery Management Council, Greater Atlantic Regional Fisheries Office, Northeast Fisheries Science Center, and several environmental and academic institutions.

The MFI promoted the new *MarineFisheries*/SMAST facility in New Bedford by updating an informational brochure highlighting the mission, objectives and policies of the Institute. Notable highlights include number of SMAST graduates supported by MFI resources, *MarineFisheries* employment opportunities for MFI graduates, and the wide variety of research that the MFI has supported.

Coordination of NEFMC Nominations

MarineFisheries coordinated the process of gubernatorial nominations to vacant seats on the NEFMC, including solicitation of potential candidates and submission of nominations by the Governor's office.

Publications

Advisories: *MarineFisheries* released 80 electronic advisories to subscribers of our listserv on various rule changes, public hearings, quota closures, and other important information.

DMF News: *MarineFisheries* published its newsletter twice in 2017 (Figure 1). These editions of "DMF News" were mailed to subscribers and are available through the Division's website.

Annual Report: *MarineFisheries* published its 2016 Annual Report.

Figure 1. The covers of the two 2017 editions of the DMF News.

Permitting and Fisheries Statistics Program

Personnel

Story Reed, Program Manager
Anna Webb, Fisheries Statistics Project Leader & Harvester Reporting Coordination
Kerry Allard, Permitting Project Coordinator
Kim Lundy, Dealer Reporting Coordination & Quota Monitoring
Erich Druskat, Fisheries Data Analyst
Mary Ann Fletcher, Fisheries Data Entry
Rosemary Mitchell, Permitting & Support for Fisheries Reporting
Whitney Sargent, Permitting & Support for Fisheries Reporting
Kerry Faugno, Permitting Receiving Teller
Sandra Downing, Permitting Receiving Teller
Kim Trotto, Permitting Receiving Teller
Lynne Besse, Permitting Receiving Teller
Leah Derleth, Permitting & Support for Fisheries Reporting (July–December)
Thomas Hoopes, Contractor

Overview

The **Permitting Project** is responsible for the issuance of commercial fishing, seafood dealer, recreational fishing, scientific, and other types of Division-issued permits; overseeing and approving the transfer of limited entry fishing permits and endorsements; issuing trap tags; and issuing Letters of Authorization as needed. The project follows applicable laws, regulations, and policies relative to these activities. Project staff fulfill public data requests for non-confidential permit data and provide support to administrative staff as needed. Project staff also interact with the public on a routine basis to answer questions on permitting and regulations.

The **Fisheries Statistics Project** collects fisheries dependent data from both commercial harvesters and dealers designated as primary buyers. Both data sets are collected in a standardized trip-level format from all commercial permit holders. These data have broad applications and uses, both within *MarineFisheries* and to fulfill requests made from outside the agency. Project personnel also participate in the planning and development of the ASMFC's Atlantic Coastal Cooperative Statistics Program (ACCSP) and provide support to administrative staff for policy and permitting. In addition, Project staff act as a liaison to the Administration's Energy and Environmental Affairs Information Technology Group for the Gloucester facility and, along with other agency personnel, continue to maintain the agency's websites and Oracle databases.

Permitting Project

Commercial Fisherman Permits

Anyone who lands and sells finfish, shellfish, lobsters, edible crabs, or other living marine resources in Massachusetts must have a *MarineFisheries* commercial fishing permit and must sell only to licensed Massachusetts dealers. *MarineFisheries* issued a total of 7,542 commercial fisherman permits in 2017 (Table 1). Over the past decade, *MarineFisheries* has seen a steady decrease in commercial fisherman permit sales, with the exception of small boats, 0–59' in length (Figure 2). Generally, this change can be attributed to more restrictive regulations and the increasing cost of operation within the fisheries.

Table 1. 2017 commercial fisherman permit issuance.

Permit Type	Permits Issued (#)	
	Residents	Non-residents
Coastal Lobster	1,083	5
Offshore Lobster	305	102
Seasonal Lobster	95	4
Boat 100'+	12	17
Boat 60-99'	71	162
Boat 0-59'	3,400	347
Individual	206	5
Shellfish and Seaworm	840	2
Shellfish and Rod & Reel	411	1
Rod & Reel	429	45
Total	**6,852**	**690**

Coastal Lobster Permit allows the taking, landing, and sale of lobsters and edible crabs (to a licensed dealer) harvested from within the coastal waters of the Commonwealth. There is a maximum pot limit per vessel that is based on Lobster Management Areas and individual allocations. The permit may be endorsed to take and sell shellfish and finfish at no additional cost. In the case of skin or scuba divers, only the licensee is covered.

Offshore Lobster Permit allows the landing and sale of lobsters and edible crabs (to a licensed dealer) taken outside of the coastal waters of the Commonwealth pursuant to appropriate federal permit(s). If the permit is endorsed for the use of pots to harvest lobster, there is a maximum pot limit per vessel that is based on Lobster Management Areas and individual allocations. The permit may be endorsed to take and sell shellfish and finfish at no additional cost.

Seasonal Lobster Permit is issued to full-time students only (verification required), and allows the licensee only to take and sell lobsters and edible crabs (to a licensed dealer) from June 15–September 15. A maximum of 25 pots may be used. Diving is not permitted; sale of fish and/or shellfish is not permitted.

Boat Permit allows the taking, landing, and sale of finfish (to a licensed dealer) and may be endorsed for shellfish. The permit covers everyone aboard the vessel. Price varies with vessel size (0–59', 60–99', and 100+'). No lobsters or edible crabs may be taken.

Individual Permit allows the holder only to take, land, and sell finfish (to a licensed dealer) and may be endorsed for shellfish. No lobster or edible crabs may be taken.

Shellfish Permit allows an individual to take, land, and sell (to a licensed dealer) shellfish and seaworms. A shellfish ID card from *MarineFisheries* and a town permit are also required.

(A Shellfish Transaction Card allows the named individual holding a commercial permit endorsed for shellfish and seaworms to sell shellfish and seaworms when used in conjunction with a Registry of Motor Vehicles identification card. In 2017, *MarineFisheries* issued 3,275 shellfish transaction cards; of which, 252 were issued as employee shellfish transaction cards to 128 shellfish businesses.)

Rod & Reel Permit allows the holder only, to catch and sell finfish (to a licensed dealer) caught by Rod & Reel only. No other gear types may be used.

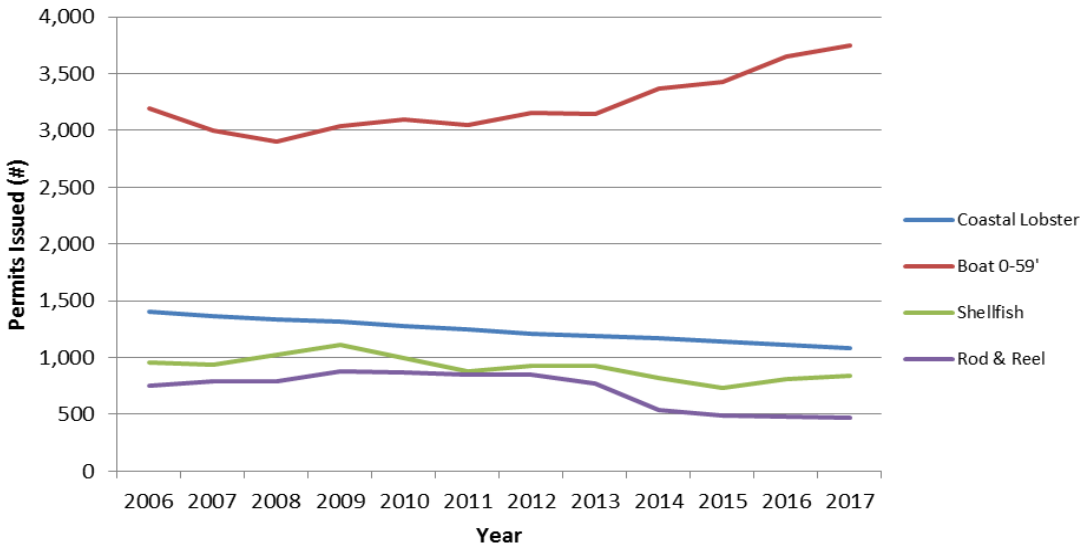

Figure 2. Trend in sales of four frequently issued commercial fisherman permits, 2006–2017.

Dealer Permits

Anyone engaged in the wholesale or retail trade of raw fish, shellfish, lobsters, or bait, whether frozen or fresh, must have a *MarineFisheries* Dealer Permit and may be subject to inspection from the Massachusetts Department of Public Health (*Mass*DPH). Shellfish dealers must abide by *Mass*DPH regulations for tagging and record keeping. Massachusetts seafood dealers who purchase seafood products, even if for bait purposes, directly from fishermen are considered primary buyers, and must be so endorsed on their dealer permits. *MarineFisheries* issued a total of 1,861 commercial dealer permits in 2017 (Table 2).

Table 2. 2017 dealer permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Wholesale Dealer	391	7
Wholesale Truck	88	128
Wholesale Broker	29	12
Retail Dealer	837	79
Retail Truck	34	3
Retail Boat	104	0
Bait Dealer	137	12
Total	**1,620**	**241**

Wholesale Seafood Dealer Permit allows the holder to acquire, handle, store, distribute, process, fillet, ship, or sell raw fish and/or shellfish, whether frozen or unfrozen, in bulk or for resale. It also allows retail sales from the same single, fixed location. An approved inspection from the Division of Food and Drugs is required. A copy of the inspection report must be submitted with the application to *MarineFisheries*. The name and address must be the same on the inspection report and permit. This permit may be endorsed for bait (excluding shellfish), with an inspection specifically stating, “Approved for retail and bait license”. A Hazard Analysis and Critical Control Points (HACCP) plan is required.

Wholesale Seafood Truck Dealer Permit allows the holder to acquire, handle, distribute, ship, or sell raw fish, whether frozen or unfrozen, in bulk or for resale from a truck only. It does not allow the holder to process raw fish, whether frozen or unfrozen, lobster, or shellfish. Nor does it allow the holder to purchase shellfish or shuck, re-label, or repack shellfish. An approved inspection from the Division of Food and Drugs is required. A copy of the inspection report must be submitted with the application to *MarineFisheries*.

Wholesale Seafood Broker Permit allows the holder to act as an agent who negotiates contracts of purchase and sale of seafood. The brokerage activities will not involve the actual handling, processing or reshipping of finfish, shellfish or other marine resources. A "broker only" waiver must be filed in lieu of a health inspection.

Retail Seafood Dealer Permit allows the holder to sell raw fish, whether frozen or unfrozen, shellfish, and lobsters at one retail location. The holder must purchase shellfish only from a holder of a wholesale dealer or wholesale truck permit, or from a certified out-of state wholesale dealer. Shellfish CANNOT be purchased directly from a harvester. It does not allow the holder to shuck, relabel, or repack shellfish. An approved inspection from the Division of Food and Drugs must be submitted to *MarineFisheries*. The name and address must be the same on the inspection report and permit. This permit may be endorsed for bait (excluding shellfish). The inspection must specifically state "Approved for retail and bait license".

Retail Seafood Truck Dealer Permit allows the holder to sell fish or lobsters at retail from a mobile unit (does not include shellfish). It does not allow the holder to process, fillet, shuck, cook, etc. An inspection is required from a town or county Board of Health. A copy of the inspection must be submitted with the application. The name and address must be the same on the inspection report and permit. A Hawkers and Peddlers permit may also be required.

Retail Boat Seafood Dealer Permit allows the holder to sell "whole" fish and lobsters from his/her boat only (does not include shellfish). A commercial fisherman's permit is required in addition to this permit. A boat waiver must be filed in lieu of a health inspection.

Bait Dealer Permit allows the holder to take and sell marine bait. No inspection is required. Local regulations (i.e., on worms, eels, etc.) may apply.

Special Permits

Special Permits are required for certain activities in the marine environment, as described below. *MarineFisheries* issued a total of 19,154 special permits in 2017 (Table 3). Of the Special Permits issued, the Non-commercial Lobster Permit has had the largest percent decline in sales over the past 10 years (40%).

Table 3. 2017 special permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Non-commercial Lobster	6,420	117
Regulated Fishery Endorsements	11,289	787
Master Digger	5	1
Subordinate Digger	37	0
Scientific Collection	68	15
"Other" Special Permits	415	0
Total	**18,234**	**920**

Non-commercial Lobster Permit is required to fish for or take lobsters and edible crabs for personal use. This authorizes the holder and members of the holders' immediate family, residing in the same residence, to

fish for and take lobsters using 10 pots only. The immediate family is defined as the spouse, parents, children, grandparents, brothers, and sisters of the holder. This permit may be endorsed for diving by the permit holder only. Other family members may purchase additional permits for diving only.

Regulated Fishery Endorsement is required for certain commercial fishing activities in addition to a commercial fisherman permit. Regulated Fishery Endorsements are required for dragging, gillnetting, netting in inshore net areas, and setting fish pots in waters under the jurisdiction of the Commonwealth. Regulated Fishery Endorsements are also required for the commercial harvest of northern shrimp, surf clams, ocean quahogs, sea herring, sea urchins, fluke, black sea bass, scup, striped bass, dogfish, American eel, horseshoe crabs, groundfish, and menhaden.

Master Digger Permit is required for an individual who wants to harvest contaminated clams from areas classified as "restricted". Shellfish are depurated at the Shellfish Purification Plant in Newburyport in accordance with regulations and established procedures. In addition to this application form, applicants must also include a $1,000 surety bond, sign a master digger affidavit, have their vehicle inspected and approved by *Mass*DPH Division of Food and Drugs, must be at least 18 years of age, and may not possess an "open" area commercial shellfish license at the same time as a Master Digger Permit.

Subordinate Digger Permit is required for the harvest of contaminated clams from areas classified as "restricted". Shellfish are depurated at the Shellfish Purification Plant in Newburyport in accordance with regulations and established procedures. Subordinate diggers must work for a Master Digger, be at least 18 years of age, and may not possess an "open" area commercial shellfish license at the same time as a Subordinate Digger Permit.

Other Special Permits are required for activities including aquaculture, scientific collection, shellfish propagation, and shellfish relay.

Recreational Saltwater Fishing Permits

MarineFisheries began issuing recreational saltwater fishing permits in 2011 for the first year of the recreational saltwater fishing permit program. *MarineFisheries* issued a total of 184,753 recreational saltwater fishing permits in 2017 (Table 4). Issuance rose 2–3% per year from 2012–2015 and 4% in 2016. In 2017, *MarineFisheries* saw the largest increase in permits issued of about 5%.

Table 4. 2017 recreational saltwater fishing permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Recreational Saltwater, Age 16–59	113,364	16,889
Recreational Saltwater, Age 60+	47,431	6,232
Charter Boat	745	45
Head Boat	41	6
Total	**161,581**	**23,172**

Recreational Saltwater Fishing Permit is required of all fishermen age 16 and over. Exceptions have been made for anglers fishing aboard legally permitted for-hire vessels, individuals that are disabled, and for those fishermen with a valid recreational saltwater fishing permit from another coastal state that has entered into a reciprocity agreement with Massachusetts. The permit is free for fishermen aged 60 and over.

Charter Boat Permit is required for a vessel that can carry up to six persons fishing as passengers from the for-hire vessel.

Head Boat Permit is required for a vessel that can carry seven or more persons fishing as passengers from the for-hire vessel.

Limited Entry Permit Transfer Program

State regulations prohibit the transfer, loan, lease, exchange, barter or sale of any permit without permission of *MarineFisheries*. Limited entry permits (commercial permits and permit endorsements that are restricted in distribution to renewals) are transferable according to criteria established by regulation. Transfer criteria include two key components: the permit's activity and the transferee's experience. Limited entry permits include, but are not limited to, coastal lobster, fish pot (scup, conch, and black sea bass), gillnetting, surf clam, ocean quahog, mobile gear coastal access, fluke, horseshoe crab, groundfish, black sea bass, and menhaden.

The transfer process begins with pre-application forms through which the permit holder and potential transfer recipient can determine their eligibility to participate in a transfer. Pre-approval is followed by the completion of a transfer packet, and final approval. See Table 5 for a summary of transfers administered by *MarineFisheries* during the year.

Table 5. 2017 limited entry permit transfer statistics.

Permit/Endorsement Type	Permits Transferred (#)	
	Resident	Non-resident
Coastal Lobster	33	0
Mobile Gear Coastal Access	6	2
Fish Pot	5	0
Fluke	10	2
Black Sea Bass	6	1
Groundfish	2	0
Surf Clam	0	2
Ocean Quahog	0	1
Quahog Dredge	1	1
Horseshoe Crab	3	0

Fisheries Statistics Project

Dealer Landings Data Collection

Landings or purchases of all marine species by seafood buyers from commercial fishermen were collected as part of the dealer reporting program. Since 2005, all primary buyers not already required by federal law to report electronically have been required to report under state regulations. All data from these state-reporting dealers were submitted to *MarineFisheries* via paper forms and entered into the ACCSP Standard Atlantic Fisheries Information System (SAFIS) database by project personnel or entered directly into SAFIS electronically by the dealers. All quota-based fisheries were monitored using these dealer data stored in the SAFIS database.

In 2017, 1,861 businesses obtained a Massachusetts seafood dealer permit. Of those, 476 (or 26%) were categorized as primary buyers, which meant they intended to purchase marine species directly from fishermen. These dealers were required to report their primary purchases, including products retailed

themselves. Of the 476 dealers, 229 had a federal dealer's permit which required reporting electronically either to the SAFIS database or to another federal reporting system. These dealers were categorized as "federal-reporting" and the remaining 247 dealers were categorized as "state-reporting."

Even though many of the primary buyers in 2017 had been primary buyers in years past, all were required to complete paperwork to confirm their buying intentions and their commitment to the dealer reporting requirements. This registration process not only provided a signed statement for enforcement purposes, if necessary, but also provided the means to monitor reporting compliance and track quotas.

Throughout the year, 157,035 trips were entered into the SAFIS database, an increase of approximately 1,000 trips compared to 2016. Federal-reporting dealers electronically submitted 71% of these transactions. Of the remaining transactions submitted by state-reporting dealers, slightly more than one-third were entered electronically by dealers, and the rest were submitted on paper-based forms.

Total landings (in whole pounds), as reported through the SAFIS database or other federal reporting programs, amounted to 688 million pounds, valued at $605 million (ex-vessel). The top five species in order of value were sea scallop, American lobster, Eastern oyster, Atlantic surf clam, and goosefish totaling $471 million, or 78% of the total value. Offshore shellfish (sea scallop, Atlantic surf clam, and ocean quahog) made up more than half of the total value landed in Massachusetts, whereas inshore and intertidal landings of shellfish, such as soft shell clam, northern quahog, blue mussel, and oyster amounted to less than 10% of total value landed. Landings of invertebrate species (lobster, crabs, and whelk) amounted to 33 million pounds, valued at $101 million, or 17% of the total value landed. Cumulative finfish landings, including both pelagic and benthic species, made up 16% of the total value with groundfish species amounting to 11% of the total value. Landed species with an individual gross value over $2 million are shown in Table 6; in aggregate, these species accounted for approximately 97% of the total value of all species landed.

Certain species are managed by quota in Massachusetts and were monitored in 2017 using the dealer reported landings in the SAFIS database. Automated analyses ran on a nightly basis and the results were displayed on both the *MarineFisheries* internet website (Figure 3) and the internal Statistics Project intranet website. On a weekly basis during the open season, staff reviewed compliance and estimated projections separately for each quota-managed species. Data from dealers that had already purchased during the year or had in past years were included in order to account for potential landings if a dealer had not yet reported purchases. An estimated closure date was calculated based on a regression analysis run at least once per week for each open fishery.

QUOTA MANAGED SPECIES
2017 Landings and Quota Information
as of Feb 07, 2018 - 07:10 A.M.

Species	2017 MA Landings	2017 Quota	Quota Type	Percent Landed
Black Sea Bass	542,383	535,982	MA	101.2%
Bluefish	364,770	573,755	MA	63.6%
Dogfish	9,526,469	22,677,836	CW	to NMFS
Fluke	419,147	389,573	MA	107.6%
Horseshoe Crab*	120,954	165,000	MA	73.3%
Menhaden	3,570,913	3,660,454	MA	97.6%
Scup *(Winter I)*	1,220,210	8,291,190	CW	to NMFS
Scup *(Summer)*	1,312,071	1,520,289	MA	86.3%
Scup *(Winter II)*	45,920	5,160,914	CW	to NMFS
Striped Bass	822,936	800,885	MA	102.8%
Tautog	66,451	64,643	MA	102.8%

MA = Massachusetts-specific quota
CW = Coast-wide quota shared between MA and other Atlantic states prompt
*Horseshoe Crab quota and landings reported as count of individual crabs harvested for non-biomedical purposes.

Figure 3. Example of quota monitoring data available on *MarineFisheries'* website.

Table 6. 2017 Massachusetts landed species with value greater than $2 million.

Species	Landings (whole pounds)	Value
Sea Scallop	269,846,842	$330,247,259
American Lobster	16,686,109	$82,290,976
Eastern Oyster	8,346,667	$28,377,781
Atlantic Surf Clam	97,919,285	$18,316,265
Goosefish	17,192,196	$11,837,902
Jonah Crab	11,650,912	$11,400,575
Haddock	11,712,479	$11,371,728
Ocean Quahog	117,067,677	$10,718,872
Atlantic Herring	30,705,711	$6,718,520
Soft Shell Clam	3,715,113	$6,254,156
Acadian Redfish	11,193,999	$6,183,841
Winter Flounder	1,924,735	$5,752,756
American Plaice (Dab)	2,277,439	$5,316,484
Silver Hake (Whiting)	5,598,276	$4,838,429
Pollock	6,208,296	$4,782,296
Northern Quahog	4,219,990	$4,548,717
Bluefin Tuna	792,434	$4,120,583
White Hake	4,100,163	$4,101,492
Striped Bass	823,436	$3,979,531
Atlantic Cod	1,583,103	$3,774,367
Channeled Whelk	1,103,345	$3,120,142
Winter Skate	11,805,718	$2,873,724
Atlantic Mackerel	10,169,987	$2,756,435
Deep-sea Red Crab	2,722,775	$2,722,716
Atlantic Razor Clam	547,096	$2,365,107
Witch Flounder (Gray Sole)	919,444	$2,317,235
Blue Mussel	12,140,356	$2,305,508
Yellowtail Flounder	1,720,959	$2,233,168
Longfin Squid	1,414,637	$2,200,277
Bay Scallop	949,776	$2,111,331

Source: ACCSP Data Warehouse, as of April 20, 2018.

Fisherman Catch and Effort Data Collection

Since 2010, all commercial fishermen have submitted, on a monthly basis, comprehensive, standardized trip-level data for all commercial trips conducted under the authority of a Massachusetts commercial fisherman permit. Those individuals holding a federal permit with reporting requirements to NMFS (e.g., Vessel Trip Report or VTR), were exempt from reporting to *MarineFisheries* for those activities occurring on their federally-permitted vessel. In 2017, *MarineFisheries* also exempted those vessels commercially fishing solely for bluefin tuna who were already required to report landings to the NMFS Highly Migratory Species (HMS) Division. All other individuals were required to report to *MarineFisheries*.

Standardized trip-level reporting eliminated the suite of species- and gear-specific annual catch reports that were collected for years, some since the late 1960s, and has greatly enhanced the agency's capabilities to monitor catch and effort information in all commercial fisheries conducted by Massachusetts commercial fishermen. It also meets the interstate standards promoted by ASMFC through ACCSP.

Fishermen either submitted their trip-level reports in paper form or online using the SAFIS eTRIPS application, a web-based program developed jointly by ACCSP staff and program partners, or the eTRIPS mobile application. Project staff used the same application or a bulk upload process called eTRIPS upload to enter data submitted on paper forms. Thus, the primary repository for all trip-level data, except those reported to NMFS, was the SAFIS database. Data were easily downloaded from the SAFIS database and used for compliance and fisheries analyses.

In 2017, *MarineFisheries* issued 7,542 commercial harvester permits, of which 17% were for federal reporting vessels, and the remaining 6,300 commercial permits were designated as "state-reporting." Thirty-four percent of the permit holders reported electronically using the SAFIS eTRIPS application, representing a 1% increase in electronic reporting participation since 2016. This left slightly less than 50% of all harvesters submitting paper reports to *MarineFisheries*. Of the 109,666 commercial trips that were entered in the SAFIS database to date for 2017, approximately 30% were entered by commercial permit holders using the SAFIS eTRIPS applications, with the remaining trips entered by *MarineFisheries* staff.

Data Analysis and Dissemination

Project staff provided a wide variety of data and technical support during 2017. Significant time was dedicated to ensuring correct harvester reporting methods and compliance during the permit renewal period. Maintaining critical functions given ongoing reduced staff members remained a priority. Compliance metrics were maintained for harvester and dealer reporting, and work was distributed to continue to accommodate more real time data entry. Additionally, significant time was spent updating previous analyses of individual fishery performance, particularly striped bass, cod, winter flounder, and black sea bass in order to assess management successes. Program staff also worked to more efficiently document data requests and data audits in 2017 which resulted in a modified workflow and improved communication among staff members. A number of projects are highlighted below.

Electronically-submitted Harvester Data Audit: In 2017, project staff completed an in-depth audit of all data submitted directly by harvesters to SAFIS via eTRIPS applications for 2016. This involved analysis of the data as well as trends in data entry errors. Approximately 900 harvesters were contacted with questions or requests for corrections, and updates were tracked as users responded. Harvesters who did not set up "favorites" in the application were found to have the most error prone data. Results of this analysis will be brought to ACCSP in 2018 and subsequent website validations and changes will prevent many errors from repeating in the future.

Black Sea Bass Bycatch Analysis: With a 50% increase in the 2017 commercial black sea bass quota, a bycatch allowance for trawl vessels operating in the spring squid and fluke fisheries was considered. An analysis of sea sampler data was conducted to measure the incidence of black sea bass in observed catches. Data from trawl trips in NMFS statistical area 538 that occurred during the months of May–July were examined.

Data Supplied for Standardizing Biological Measurements in Lobster Fishery: The American Lobster Technical Committee discussed the need to standardize biological compliance measures including the v-notch definition and maximum size limits for entire stock units. An analysis was completed to estimate what impact enforcing the 1/8" v-notch definition and 6.75" or 6.5" maximum size would have on the Outer Cape Cod lobster fleet. Staff supplied the harvester data submitted by Outer Cape Cod coastal lobster permit holders between 2014 and 2016 parsed by permit type (federal versus state-only) used in the analysis.

Analysis of Mobile Gear in Waters Surrounding Nantucket: In response to a proposal to prohibit mobile gear in all waters within three miles of Nantucket, the Project spent a significant amount of time analyzing the scope of the various trawl and dredge fisheries currently occurring in these waters. Of particular interest

was the impact of trawling on spawning squid potentially reducing the abundance available as forage for other critical species such as striped bass. The analysis was presented to the proposing entities, and ultimately, no management action resulted.

Striped Bass Tagging Program: 2017 was the fourth year of a commercial fishery tagging program mandated by ASMFC. Program staff estimated the 2017 tag requirements for individual dealers and distributed tags prior to the season and throughout as needed (Figure 4). At the end of the season, unused tags and an accounting report were required to be submitted to the agency. Program staff were responsible for identifying any discrepancies and following up with dealers as needed. The compliance rate was high (Table 7).

Figure 4. 2017 commercial striped bass tags.

Table 7. 2017 striped bass tagging statistics (as of April 2018)**.**

# of Dealers Receiving Tags	# of Tags Purchased	# of Tags Distributed	# of Tags Returned	# of Tags Used	# of Tags Missing
111	80,000	65,500	24,049	41,222	229

ACCSP Participation and Planning

MarineFisheries staff continued to participate on all partner-based committees within ACCSP, particularly as *MarineFisheries* relied heavily on the services provided. S. Reed was a member of the Operations Committee. A. Webb continued as the chair of the Information Systems committee in 2017. Staff worked with programmers to address program bugs and long-term solutions to ongoing issues as well as provided technical advice in areas such as data quality and standards, application design, outreach, and policies. In 2016, ACCSP initiated the planning stage of a SAFIS redesign as a result of committee and partner specific discussions and the Independent Program Review (IPR) conducted in 2012, which ultimately will require a strong commitment from partners to successfully implement this project in the coming years. The advent of this project resulted in additional committee meeting attendance by staff in 2017, as well as identifying the need to determine how future Project goals fit with the redesign plan and ever advancing technology.

In 2017, NMFS also certified eTRIPS/mobile, an ACCSP application, as a method for electronically submitting VTRs. This increased the application's visibility in the industry, and required input from state partners regarding design changes in both the online and mobile environments. A few state users began to test and use the application in 2017, but this certification and launch for NMFS provides a starting point for implementing the application as an option for all state harvesters in the coming years.

Swipe Card Pilot Project: The SAFIS eDR/mobile application was launched into production in Massachusetts (and Maine) in August 2016. The free application runs on Windows, iOS, and Android platforms and utilizes a harvester's shellfish transaction card to consummate a point-of-sale transaction between the harvester and dealer. This technology promotes a single-ticket commercial data collection system in Massachusetts for inshore shellfish dealers and harvesters, where dealers collect and submit all information about the commercial trip. *MarineFisheries* had two dealers using the application in 2017, and by the end of the year, several others were queued for setup. Also in 2017, project staff focused on finding a resolution to issues preventing the application from being used by federal dealers. Discussions between state and federal partners of ACCSP began in late 2017 to codify the requirements necessary to expand the use of the product. Pending successful implementation for federal dealers, this, or similar, technology could potentially be expanded to other fisheries in Massachusetts in the future.

Local IT Management

Information systems/technology is primarily conducted through the Executive Office of Energy and Environmental Affairs' Information Technology Group (EOEEA-IT). During 2017, Project staff provided assistance to EOEEA-IT on local information systems issues when needed and worked on several specific tasks outlined below.

Website Maintenance: The *MarineFisheries* website continued to be an extremely useful means of distributing public information. The Quota Monitoring webpage is one of the agencies top visited pages. A Statistics Project intranet site was also maintained for the display of quota information, reporting compliance, and both harvester and dealer reporting information. Updating data displayed on all sites was automated, but maintaining that automated process and accommodating changing requirements is an ongoing task.

Oracle Database / Application Development & Maintenance: *MarineFisheries* continued to use four production databases and associated applications during 2017: Commercial Permits and Statistics; Lobster Sampling; Shellfish Sampling & Area Management; and Time Tracking for Federal Grants. This was the last year of maintenance on the Time Tracking database as that project was moved to a different program. Minor updates were made to the Commercial Permits and Statistics application during the year, and further development and testing occurred on the addition of Oracle-based aquaculture permits and associated applications to this database. After completion of testing, these new elements were anticipated to go live in 2018.

SHELLFISH AND HABITAT SECTION

J. Michael Hickey, Assistant Director, Section Leader

Shellfish Sanitation and Management Program

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Overview

The Shellfish Sanitation and Management Program (Shellfish Program) focuses on public health protection, as well as the direct and indirect management of the Commonwealth's molluscan shellfish resources. Public health protection is ensured through the sanitary classification and the monitoring of marine biotoxins within state waters, including Nantucket Sound.

Nationally, the harvest and handling of all bivalve molluscan shellfish is regulated by the National Shellfish Sanitation Program (NSSP). The NSSP was established in 1925 by the United States Public Health Service for the harvest and handling of shellfish in interstate commerce for human consumption. The NSSP "Guide" is developed and administered today by the United States Food and Drug Administration (USFDA) and the Interstate Shellfish Sanitation Conference (ISSC), a federal/state cooperative. The Commonwealth of Massachusetts is a voting member of the ISSC.

Shellfisheries management is accomplished by direct *MarineFisheries* regulation of the commercial surf clam, ocean quahog, and quahog dredge boat fisheries. In addition, regulations cover the harvest of contaminated shellfish for depuration and relay, and establish size, trip limit, and season for many shellfish species. *MarineFisheries* regulates commercial shellfish aquaculture and is required to certify that operation of private shellfish aquaculture projects at sites licensed by coastal municipalities will not have an adverse impact on shellfish or other natural resources of the city or town. Indirectly, *MarineFisheries* manages shellfish resources through a partnership with coastal communities by providing technical assistance to local management authorities in the development of management plans and local regulations for control and conservation.

Shellfish Sanitation and Public Health Protection Project

Shellfish Growing Area Classification

Surveys: Public health protection is accomplished with the use of sanitary surveys to determine a shellfish growing area's suitability as a source of shellfish for human consumption. Sanitary surveys include: 1) identification and evaluation of all actual and potential pollution sources which may affect a shellfish growing area; 2) evaluation of hydrographic and meteorological characteristics that may affect distribution of pollutants; and 3) assessment of overlying water quality. Each shellfish growing area must have a complete sanitary survey every 12 years, a triennial evaluation, and an annual evaluation report to maintain a classification allowing shellfish harvesting. Minimum requirements are set by the *NSSP Guide for the Control of Molluscan Shellfish*.

To satisfy NSSP requirements in 2017, staff biologists in the Gloucester and New Bedford offices completed 319 annual evaluation reports, 47 triennial evaluations, and 19 sanitary survey reports (Table 8). Thirty-two conditional area management plans were re-evaluated. A total of 10,108 water samples were collected and analyzed for fecal coliform bacteria from 301 shellfish growing areas, in 65 cities and towns of the Commonwealth. All samples were tested at either of *MarineFisheries'* shellfish laboratories in Gloucester and New Bedford using the mTEC method. Of these, 9,709 samples were taken at classification stations, 348 were pollution source samples, while an additional 51 ad-hoc samples were collected.

USFDA evaluates Massachusetts annually for compliance with the NSSP. Shellfish growing area files are reviewed for compliance with the NSSP standards for minimum sampling frequency, completion of required growing area reports, conditional area management plan updates, and conformity with appropriate classification area water quality criteria requirements. The USFDA determined Massachusetts remained in compliance with the NSSP during 2017.

Table 8. Summary of 2017 shellfish growing area report and sampling activity.

	North Section	South Section	Total
Annual Evaluation Reports	38	281	319
Triennial Evaluations	10	37	47
Sanitary Surveys	2	17	19
Management Plans/MOUs Reviewed	20	12	32
Total Water Samples	3,265	6,843	10,108
Classification Station Water Samples	3,112	6,597	9,709
Pollution Source Water Samples	125	223	348
Ad-hoc Water Samples	28	23	51
Shellfish Growing Areas Sampled	20	281	301
Classification Sub-Areas sampled	103	592	695
Cities/Towns Sampled	21	44	65
Vp Shellfish Samples	0	33	33

Shellfish Classification: The NSSP defines five area classification schemes:

1. APPROVED: Open to shellfish harvesting for direct human consumption subject to local rules and regulations. Closed only during major coast-wide events (e.g., hurricane, oil spill, red tide event).
2. CONDITIONALLY APPROVED: Closed some of the time due to rainfall or seasonally poor water quality or other predictable events. When open, it is treated as an Approved area.
3. RESTRICTED: Contains a limited degree of contamination at all times. When open, shellfish can be relayed to a less contaminated area or harvested for depuration.
4. CONDITIONALLY RESTRICTED: Contains a limited degree of contamination at all times, subject to intermittent pollution events and may be closed some of the time due to rainfall or seasonally poor water quality. In Massachusetts, when open, only softshell clams may be harvested by Master/Subordinate Diggers for depuration at the *MarineFisheries* Shellfish Purification Plant.
5. PROHIBITED: Closed to the harvest of shellfish under all conditions, except the gathering of seed for municipal propagation programs under a *MarineFisheries* permit.

Massachusetts utilizes all five classifications throughout 1,743,909 acres (Figure 5, Table 9). During 2017, the Shellfish Program was involved in a number of initiatives to increase shellfish harvesting opportunities. Major reclassifications included:

- In June, *MarineFisheries* changed the classification of the 11-acre area known as Bella Vista Cove Area (BB18.5) in Fairhaven, from Prohibited to Approved. The area had been classified as Prohibited since 2010.
- In October, a 2.5-acre portion of the Pamet River (CCB7.3) classified as Prohibited since 1986 was upgraded to a Conditionally Approved classification with a seasonal opening window of November 1–April 30. The reclassified portion, at the western end of the Pamet River, was absorbed into the Pamet Harbor growing area CCB7.1. The Pamet River supports recreational harvest of quahog, softshell clam, and oyster.
- In December, a 91-acre portion of the West Branch of the Westport River (BB3.31), in the Town of Westport, was reclassified from Approved to Prohibited due to unacceptable water quality.

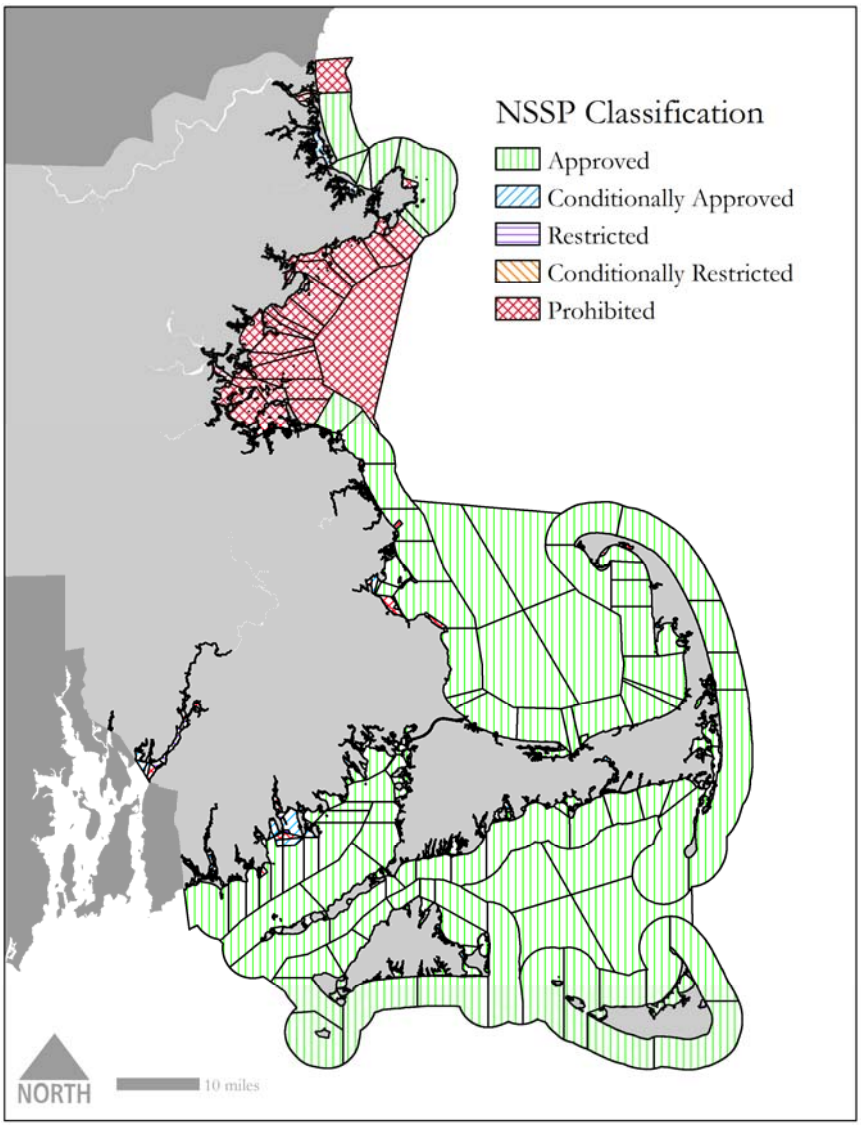

Figure 5. 2017 NSSP classification map of Massachusetts shellfish growing areas.

Table 9. Change in Massachusetts shellfish growing area classification, 2016 to 2017.

Area Classification	Acreage		
	2016	2017	Change
Approved	1,476,357	1,476,268	-89
Conditionally Approved	25,080	25,082	2
Restricted	3,320	3,263	-57
Conditionally Restricted	4,653	4,653	0
Prohibited	234,499	234,643	144
Total	1,743,909	1,743,909	

Notification: A legal notice is required by *MarineFisheries* for each change in a shellfish growing area's classification or status. These notices reflect the type of opening or closure, the dates, the reason, and other pertinent descriptive information. Copies are sent to municipal managers, the state Office of Law Enforcement, *Mass*DPH, USFDA, and other interested parties. In 2017, 421 legal notices were generated by

Shellfish Program staff and distributed for sanitary reclassification, rainfall closures and re-openings, paralytic shellfish poisoning events, Vibrio closures, oil spills, and more typical emergency closures (e.g., extreme rainfall, flooding, raw sewage discharge).

Pollution Discharge and Contaminant Assessment

Program biologists comment and make recommendations regarding United States Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) Permits. In 2017, seven permits required review, including three industrial discharges, one onsite wastewater facility, and three waste water treatment plants, one of which included consultation with USFDA for a dye study. Another NPDES permit involved direct discharge of boiler condenser rinse fluid to the Cape Cod Canal that was quickly remediated. Direct consultation with EPA and the Massachusetts Department of Environmental Protection (*Mass*DEP) was provided to address shellfish staff concerns before issuance of final NPDES permits.

Staff also participated in a multi-agency, multi-state review of an environmental impact statement for a desalination plant in Swansea, and commented on fish and ichthyoplankton impact mitigation at a desalination plant in Dighton. Consultation was provided to *Mass*DEP and *Mass*CZM to prevent a discharge of fuel oil into the waters of Woods Hole that are protected under the Ocean Sanctuaries Act. Shellfish biologists collected samples in Massachusetts to support NOAA's nationwide monitoring program for contaminants of emerging concern in blue mussels.

Biotoxin Monitoring

Paralytic Shellfish Poisoning Monitoring: A major aspect of the Shellfish Program is monitoring for naturally occurring marine biotoxins produced by microscopic algae that can cause paralytic shellfish poisoning (PSP) or "red tide". Consumption of shellfish containing certain levels of PSP toxin can cause severe illness and even death. Shellfish Program personnel collect shellfish from 13 primary stations weekly from March through October. Samples are analyzed at the *MarineFisheries* Gloucester lab where bioassays determine the levels of toxin in shellfish. If toxin is found, both the frequency of sampling and the number of sample sites are increased. Shellfish areas are closed if toxin levels exceed safe limits.

A total of 451 shellfish samples were processed for PSP during 2017. The majority (411) were the indicator species, blue mussel, although softshell clam (26), surf clam (7), quahog (6), and American oyster (1) were included.

Toxicity and closures occurred in the Nauset system and on the upper North Shore in 2017 (Figure 6). Closure of the Nauset system is a nearly every year event, whereas North Shore closures occur more sporadically (most recently in 2014). 2012 marks the

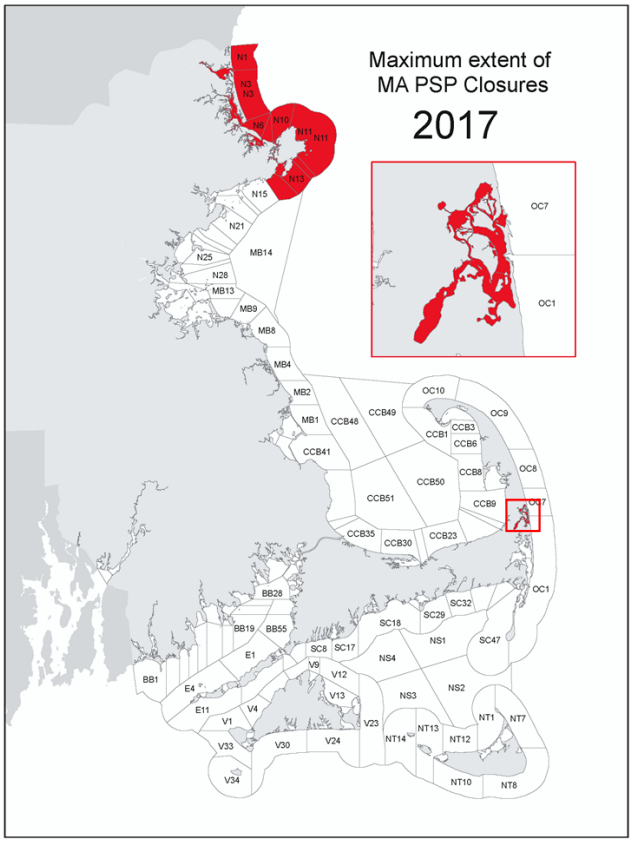

Figure 6. Geographical limit of PSP shellfish area closures in 2017.

last year that an area outside of Nauset or the North Shore was closed. The Nauset system closure of 1,540 acres was enacted on May 3; most areas were reopened on June 10 (31 Days), although Salt Pond (OC6) remained closed until June 27. Essex Bay (N7) closed on June 23 for the harvest of blue mussels, followed by blue mussel closures in surrounding areas from N1 through N14. The harvest of all shellfish in Essex Bay (N7) was closed on July 9 with a partial reopening for softshell and razor clams July 17. All other shellfish and North Shore Areas were reopened on September 22. The North Shore closure was atypical with onset approximately 4–5 weeks later than normal at impacted stations. Once again in 2017, there were no reported illnesses due to PSP from Massachusetts shellfish.

Amnesic Shellfish Poisoning Monitoring: An emerging challenge for *MarineFisheries*, and the Northeast region in general, has been monitoring for Amnesic Shellfish Poisoning (ASP) toxicity in shellfish. Massachusetts experienced its first-ever ASP closure in 2016. The consumption of seafood—whether frozen, raw, or cooked— with an accumulation of domoic acid can cause the life-threatening ASP. Domoic acid is a neurotoxin produced by certain species of naturally occurring planktonic diatoms called *Pseudo-nitzchia*.

There are several complications to monitoring and timely management responses. While *MarineFisheries* can quickly test shellfish for the presence and quantity of total *Pseudo-nitzchia,* identification by species (to tell toxic from non-toxic) requires electron microscopy or genetic analysis not available at our facilities. Additionally, the presence of toxic species does not necessarily mean that domoic acid is actively being produced. *MarineFisheries* has invested in the purchase of Scotia Rapid Test kits that test for the presence or absence of toxicity, but do not quantify toxin concentration. The USFDA guidance on domoic acid levels requires regulatory action at 20 ppm.

In 2017, *MarineFisheries'* phytoplankton monitoring identified elevated levels of *Pseudo-nitzchia* in several south shore locations beginning in February. Plankton samples were subsequently collected at four stations in Buzzards Bay, microscopically analyzed to quantify *Pseudo-nitzchia* abundance and screened for domoic acid toxin presence in-house, and sent to Florida Fish and Wildlife Conservation Commission for species composition and quantitative toxin analyses. Plankton in three of the four stations tested positive for domoic acid, prompting the collection and testing of shellfish meats. The results of the outsourced testing would later reveal extremely low levels of domoic acid in the phytoplankton and a predominance of *Pseudo-nitzchia* species not generally highly toxic; however, the species *P. australis*, which is known to be highly toxigenic, was identified for the first time in Massachusetts waters.

Oysters or quahogs were collected at five locations in Buzzards Bay in late February. All shellfish samples tested negative for the presence of domoic acid. An additional 16 shellfish meat samples (oysters, blue mussels and softshell clam) were tested throughout March, of which two blue mussel samples from the Town of Chilmark on Martha's Vineyard tested positive for the presence of domoic acid. Subsequent quantitative analyses performed by Rhode Island State Health Laboratories showed domoic acid levels in these mussels were 5.6 and 5.7 ppm, well below the established regulatory standard for closure of 20 ppm. Mussels from the Town of Chilmark were collected again in early April, testing negative for domoic acid.

Pseudo-nitzschia continued to be present and actively screened for the entire 2017 calendar year. Monitoring resulted in no closures for ASP in Massachusetts in 2017 and no illnesses were reported.

Phytoplankton Monitoring: Due to emerging harmful algae threats, the Shellfish Program began modifying its phytoplankton monitoring efforts in several ways in 2017. On the north shore, qualitative monitoring continued to co-occur with weekly PSP sampling but with an expansion from the typical April–November sampling season to year-round. Sampling in 2017 consequently increased, with a total of 172 phytoplankton samples collected from the four primary regional stations in Newburyport, Ipswich, Essex, and Gloucester. An additional 17 samples were taken at various times and locations in response to elevated *Pseudo-nitzschia* counts and PSP toxicity. A dinoflagellate, later identified as *Karenia mikimotoi*, was found at the four

northern primary stations as well as in waters around Cape Ann in September, but by the beginning of October had completely disappeared.

On the south shore, it was determined that quantitative monitoring needs to replace the qualitative monitoring that has regularly co-occurred with PSP monitoring. During 2017, *MarineFisheries* kept regular and frequent contact with external groups quantitatively monitoring for potentially harmful phytoplankton on the south shore, and purchased a high-power microscope for our South Shore Field Station in order to develop our own quantitative monitoring procedure. Heightened interest in learning about harmful phytoplankton and the closures they can cause also led staff to plan and present a Plankton Identification In-Service Training Workshop for the Massachusetts Shellfish Officers Association.

Shellfisheries Management Project

Contaminated Shellfish Resources

MarineFisheries directly manages the contaminated shellfish resources for commercial bait harvest, relay, and depuration.

Commercial Bait Harvest: In 2017, 20 dredge boat permits were issued for the contaminated surf clam bait fishery off Nantasket Beach in Hull, an increase of three permits from 2016. Due to confidentiality restrictions, landing statistics for this small fishery cannot be reported for this period.

Contaminated Relay: *MarineFisheries* permits municipalities to relocate, between and within communities, bacterially contaminated shellfish to Approved and Conditionally Approved waters for natural purification and propagation. All activities are conducted under strict NSSP guidelines and are heavily supervised by state and local enforcement authorities. The Division requires that shellfish remain in the water through at least one spawning season: contaminated shellfish must remain at the transplant site until at least September 15 if relocated by June 15; if the shellfish are transplanted after June 15, the shellfish must remain in the transplant site until September 15 of the following year. No shellfish can be harvested until bacterial testing has been completed on each lot. Quahogs are the most frequently transplanted species followed by oysters.

Prior to transplant operations, disease monitoring was conducted on shellfish collected from donor sites, including quahogs from the Taunton River and oysters from the Pocasset River and Bourne's Pond in the Town of Bourne and Little Harbor and Little Pond in the Town of Falmouth. Shellfish samples were sent to Kennebec Marine Biosciences in Maine for analysis. Pathology tests indicated that quahogs and oysters from all donor sites were disease free.

Two dredge boats contracted by the towns were permitted to commence relay harvesting in the Taunton River in mid-April. The majority of shellfish transplanting was completed by June 15 except for Westport. The two boats moved a total of 10,422 bushels of quahog to 16 coastal communities.

The Town of Falmouth transplanted seed oysters to Orleans and six areas within the Town of Falmouth, while Bourne conducted three in-town relays. A total of 1,773 bushels of oysters were relocated.

See Tables 10 and 11.

Table 10. 2017 contaminated quahog relays.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
Taunton River	Truro	Pamet Harbor	CCB7.1, 7.2	300	Apr 18
Taunton River	Yarmouth	Lewis Bay	SC28.7	975	May 16
Taunton River	Oak Bluffs	Sengekontacket (1, 4 and 5)	V16.23, .27, .28	500	Apr 28
Taunton River	Dennis	Bass River Center	SC34.20	175	Jun 8
Taunton River	Bourne	Phinney's Harbor	BB46.23	300	May 7
Taunton River	Eastham	Salt Pond	OC6.21	150	May 4
Taunton River	Eastham	Town Cove	OC4.25	150	May 3
Taunton River	Tisbury	Lake Tashmoo	V8.26	78	May 18
Taunton River	Tisbury	Lagoon Pond	V11.27	372	May 17
Taunton River	Barnstable	Cotuit Bay (Bluff Pt.)	SC21.20	300	May 24
Taunton River	Westport	East Branch (Halfmoon)	BB4.21	1,442	Jun 9
Taunton River	Westport	East Branch (David Rd.)	BB4.22	1,486	Jul 11
Taunton River	Westport	East Branch (Pettey Lane)	BB4.26	2,071	Aug 22
Taunton River	Provincetown	The Breakwater	CCB5	85	May 2
Taunton River	Sandwich	Sandwich Harbor	CCB7.20, 7.21	300	Jun 14
Taunton River	Fairhaven	Nasketucket Bay (North Cove)	BB21.20	858	Jun 3
Taunton River	Plymouth	Plymouth Harbor (Long Point)	CCB42.22	100	Jun 23
Taunton River	Wareham	East River/Broad Cove	BB42.25	500	Jul 28
Taunton River	Edgartown	Sengekontacket Pond	V16.22	150	Sep 28
Little Pond	Falmouth	W. Falmouth Harbor	BB54.25	34	Oct 12
Taunton River	Swansea	Coles River	MHB4.26	200	Jun 15

Table 11. 2017 contaminated oyster relays.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
Fisherman's Cove	Bourne	Fisherman's Cove	BB43.31	9	Apr 13
Fisherman's Cove	Bourne	Buttermilk Bay	BB44.24	13	Apr 13
Pocasset River	Bourne	Megansett Harbor	BB50.20	24	Jun 23
Bourne's Pond	Orleans	Namequoit R. (Lonnies Pond)	SC63.20	194	Jun 22
Little Harbor	Falmouth	Bournes Pond	SC13.25	188	May 30
Little Pond	Falmouth	West Fal. Harbor (Assoc.)	BB54.25	283	Nov 4
Little Pond	Falmouth	West Fal. Harbor (Middle)	BB54.24	616	Oct 20
Little Pond	Falmouth	Green Pond (SE corner)	SC12.22	330	Oct 21
Little Pond	Falmouth	Great Pond (Massasoit)	SC11.25	116	Nov 4

Depuration: *MarineFisheries* has operated the Shellfish Purification Plant in Newburyport since 1961. The commercial harvest of mildly contaminated soft-shell clam (*Mya arenaria*) is made possible through depuration at the plant. During the purification process, seawater pumped from a saltwater well is used to flush pathogens (disease-causing bacteria) out of the shellfish, making them safe for market. The management and oversight of this process is a sizeable and critical activity for *MarineFisheries*.

Clams are harvested from Conditionally Restricted areas in Boston Harbor, the Pines River in Revere and Saugus, and the Merrimack River in Newbury, Newburyport and Salisbury, and then transported by licensed and bonded Master Diggers under strict enforcement to the Shellfish Purification Plant. The plant has nine depuration tanks which are filled with seawater from two 130-feet deep wells; the water is maintained at a constant temperature and salinity and is continuously disinfected with ultraviolet light. Each tank can hold 108 dealer bushels/racks of clams. The depuration process is typically three days, during which analysis of shellfish and tank water is accomplished by daily testing in the on-site certified laboratory. Upon completion, the clams are returned to the harvesters who pay a depuration fee. The purified clams are them sold into commerce.

During 2017, the plant received shellfish on 62 days, down from 106 days in 2016. Due to confidentiality restrictions, landings cannot be reported for this period. All lots met release criteria with no product recalls. Three Master Diggers delivered clams to the Purification Plant in 2017, down from eight the previous year. The issuance of Subordinate Digger permits decreased from 76 to 37. With the addition of a seasonal laborer in October the plant was able to return to a depuration harvest schedule of five days per week. This was up from a three day per week schedule caused by the loss of two plant laborers in 2016.

Wet Storage

2017 marked the fifth year that the Shellfish Purification Plant has offered wet storage processing to wholesale shellfish dealers. Wet storage processing at Newburyport utilizes the same tanks, seawater, ultraviolet sterilizers, and biological flushing as the depuration process to flush sand, mud, and grit out of shellfish harvested from NSSP-classified Approved areas. As these shellfish are already at safe bacterial levels, the focus of wet storage is on enhancing them for market and extending shelf-life. While there is no mandatory process time or microbiological testing like for depurated shellfish, wet stored shellfish are also regulated by the NSSP, overseen by *Mass*DPH and USFDA, and must comply with strict controls and standards, like traceability. In 2017, wet storage decreased 18% from the prior year. Fees per rack remained at $6 for both depuration and wet storage.

Shellfish Purification Plant and Laboratory

Laboratory Activities: The Shellfish Purification Plant's laboratory analyzed 134 shellfish samples from 62 runs for fecal coliform in compliance with Federal and state depuration standards. To validate the seawater used in the depuration process, tank and raw seawaters were examined for dissolved oxygen and temperature daily and for turbidity, salinity, and pH monthly. In addition, 219 effluent water samples, 92 raw seawater samples, and 12 tap water samples were bacteriologically tested for the more stringent drinking water standard of total coliform.

An additional 400 shellfish samples were tested for the presence of Male Specific Coliphage (MSC). MSC is a virus of E. coli Famp, and its presence has been correlated with the presence of Norovirus and other human viral pathogens found in shellfish and shellfish waters. The laboratory continued its partnership with the New Hampshire Department of Environmental Services analyzing for MSC in shellfish, environmental waters, and wastewater treatment plant influent and effluent. In May, the Laboratory Supervisor assisted USFDA for two days in the laboratory for MSC analysis during the Durham, NH Dye Study.

The laboratory assisted in the assessment of *Vibrio parahaemolyticus (Vibrio)*, analyzing samples for the resubmergence and tidal study projects in Duxbury and Katama. 102 oyster samples were analyzed by MPN, producing 972 boil preps for the *tlh* gene of *Vibrio,* and 327 boil preps for *trh*/*tdh* genes.

Staff of the Shellfish Purification Plant Laboratory successfully participated in the FDA's Shellfish Proficiency Test for depuration water, growing area water, shellfish and Vibrio assessment.

Education and Outreach: Numerous scheduled tours were provided throughout the year for school groups and the general public as well as impromptu tours. Support and outreach to the educational community also continued by supplying seawater to local educators for classroom saltwater cultures, displays, and aquaria.

Facility Maintenance: The Plant was inspected on a monthly basis by *Mass*DPH and was reviewed by USFDA in September. All sanitation and maintenance records were kept current. A portable seawater chiller/heater was purchased and will be used in the near future to comply with holding temperature requirements for wet storage, and will also be used to control water temperature in tanks for research projects.

Shellfish Restoration and Mitigation in Buzzards Bay

Since 2014, Shellfish Program staff in New Bedford has been involved in two major shellfish restoration and mitigation activities in Buzzards Bay. Shellfish restoration refers to enhancing or augmenting shellfish stocks that have waned or been lost due to a myriad of possible factors, some of which include overfishing, poor recruitment, disease, natural predation, and natural changes in habitat features. Shellfish mitigation, on the other hand, refers to replacement of shellfish that have been permanently lost due to direct human actions, including shoreline alteration projects, dredging activities, and placement of pipe lines and electric cables.

New Bedford Marine Commerce Terminal Quahog Mitigation: The New Bedford Marine Commerce Terminal (NBMCT) was created to develop a multi-purpose marine terminal capable of supporting offshore renewable energy facilities, international shipping, and other industries within New Bedford. It is estimated that approximately 9.8 million shellfish were lost as a result of the filing and dredging activities involved with the project. In fulfillment of an agreement between the Massachusetts Clean Energy Center (CEC) and *MarineFisheries* to fulfill certain requirements of the Final Mitigation Plan for the NBMCT, the Division has implemented a program to plant 2.5 quahog seed for every one quahog impacted, for a total of 24.5 million seed quahogs to be planted within New Bedford waters over the next 10 years.

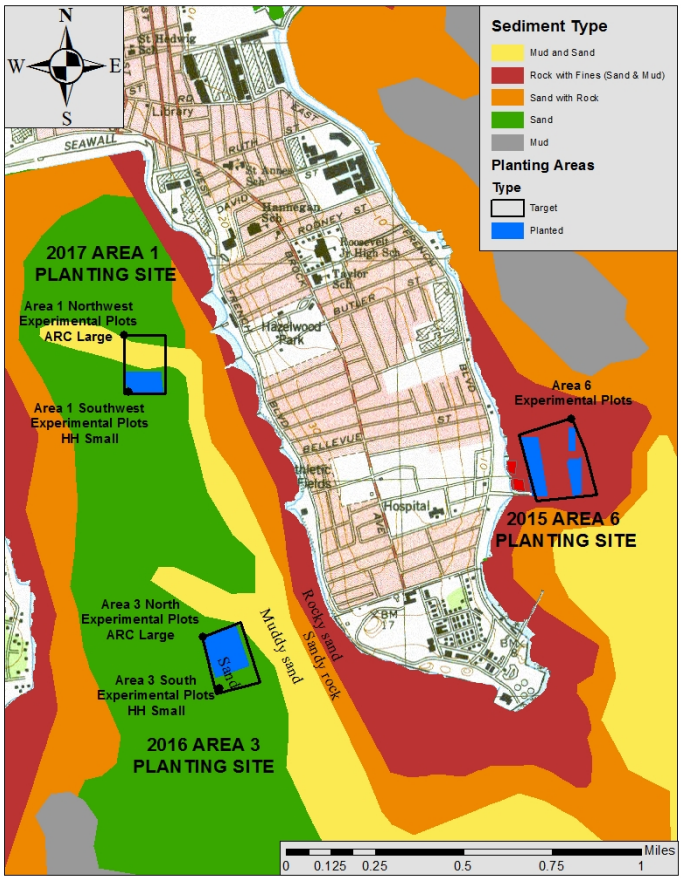

Figure 7. Areas planted with quahogs in 2015, 2016, and 2017. Bottom sediment types are included.

Planting activities target shallow sub-tidal areas in New Bedford municipal waters, in Approved and Conditionally Approved areas only. Each year, seeding takes place in a portion of one of 10 subareas around the South End peninsula. The planted area is closed to shellfishing for a maximum of three years to allow the seed to grow, spawn, and reach legal harvest size. The annual objective of the seeding program is to plant 2 million juvenile quahogs (in the 20–25mm size range).

For 2017, a 10-acre planting site was selected within Area 1 (Figure 7). Prior to site selection, the Shellfish Program collaborated with the Division's Habitat Program to identify optimal quahog habitat: sand and sand/mud mixtures. Divers were deployed to verify ground conditions previously estimated by side-scan sonar.

Over six field days, Division staff planted a total of 804,760 seed quahogs over 3.8 acres within Area 1. Quahogs were broadcast seeded from one of the Division's 21-foot vessels, mostly along established transects. Fourteen predetermined transects, each approximately 10,800 ft^2, were marked with anchored buoys. Approximately 54,000 quahogs were seeded within each transect in order to obtain the target seeding density of 5 quahogs per square foot.

Most of the quahogs were purchased from two commercial hatcheries—the Aquacultural Research Corporation (ARC) in Dennis, MA and Bill Avery's Quality Bay Clams in Galloway, NJ. Smaller seed quahogs were produced at the Division's Hughes Hatchery in Oak Bluffs, MA and grown out in floating sand nursery trays in Edgartown and Chilmark town waters. On three occasions, Seawatch International Ltd. kindly transported quahogs from the New Jersey hatchery to New Bedford within their refrigerated trucks free of charge, resulting in tremendous savings of resources and labor.

Planting activity also included placement of quahogs in experimental plots for future monitoring of quahog growth and survival. These quahogs were placed into meshed bags and hand planted by divers. The number and density of planted quahogs within each plot varied depending on the size of the quahogs (smaller quahogs at higher density). All experimental plots (including those planted in 2016) will be sampled annually by divers to monitor growth and survival of the planted quahogs.

B-120 Buzzards Bay Shellfish Restoration Project: In April of 2003 the grounding of the B-120 oil barge, owned and operated by the Bouchard Transportation Company, resulted in an estimated 98,000-gallon oil spill in Buzzards Bay. Federal and state Trustee representatives were tasked, through the Natural Resource Damage Assessment process, with managing and supporting restoration of natural resource and resource use injuries. Restoration planning was completed in 2014 and injuries to shellfish resources and the recreational shellfishery were among those addressed. In partnership with nine Buzzards Bay communities, *MarineFisheries* was selected by the Trustees to implement specified restoration strategies.

MarineFisheries is overseeing a five-year program to restore shellfish resources and benefit public recreational shellfishing, including four activities (see below).*MarineFisheries* works collaboratively with the Trustees on all aspects of these projects and provides technical oversight on all TNC B-120 shellfish restoration work via participation on a Technical Advisory Committee.

- Contaminated Quahog Transplants: This project involves the relocation of quahog broodstock harvested from bacterially contaminated waters in the Taunton River to designated transplant sites within the municipal waters of Westport, Dartmouth, New Bedford, Fairhaven, Mattapoisett, Marion, Wareham, Bourne, and Gosnold. Shellfish Program staff assist shellfish officials in each town with mapping transplant sites and conducting pre- and post-relay assessments of the quahog population. Planted sites remain closed to recreational fishing for one to three years. Transplant activity was suspended in 2017 to facilitate completion of 2015 and 2016 post-planting surveys, and was scheduled to resume in 2018.
- Quahog Upwellers and Seed Releases: Under this project, Wareham, Dartmouth, and Fairhaven are growing small quahog seed (3–5mm) using municipally-managed upwellers for subsequent out-planting once they reach at least 20mm (Figure 8). One planted site per town in each of three years is the goal. Shellfish Program staff work collaboratively with municipal shellfish officials in each town to select appropriate seeding sites and conduct pre- and post- seeding assessments of the quahog population. The three towns received their first year of seed orders in 2017, and in November, Program staff assisted town staff and volunteers out-plant the quahogs from the upwellers to the selected sites. Wareham and Fairhaven opted to plant their quahogs under predator control nets (Figure 9) which were provided by *MarineFisheries*, whereas Dartmouth decided to broadcast seed their quahogs.

Figure 8. Quahog seed in a Wareham upweller. An upweller is a moored, floating, flow-through nursery system.

Figure 9. Crews prepare predator control netting in Fairhaven.

- Single Oyster Purchases and Out-planting: This oyster planting project involving Bourne, Marion, and Wareham is intended to create and maintain a sustainable oyster resource at six sites within Buzzards Bay. 2017 marked the first of two years in which each town is purchasing small oyster seed and/or larger field plant sized oysters. Shellfish Program staff assisted the towns in determining the size and quantity of oyster seed best suited to each town, depending on the availability of upweller space and oyster habitat. During 2017, just over 1.9 million oysters were purchased by the three communities. Shellfish Program staff are working collaboratively with the towns to monitor oyster growth, survival, and density.
- TNC Oyster and Bay Scallop Restoration: The Nature Conservancy is implementing three oyster placement projects under a four-year plan. One oyster project occurred in Fairhaven (Nasketucket Bay) in 2016. Two oyster projects in Bourne and Wareham are planned for 2018, each a one-acre site in Buttermilk Bay. TNC will also be using bay scallop spawner cages in an attempt to restore a spawning bay scallop population inside Squeteague Harbor in Bourne. The Shellfish Program is playing a lead role in these projects by advising on implementation techniques, site selection, monitoring protocols, and performance measures. The Shellfish Program is also providing regulatory oversight for the project in conjunction with other state and local regulatory processes.

Environmental Protection Activities

Shellfish Program personnel respond to pollution events in coastal waters in order to assess damage to shellfish populations and to determine the need for public health closures. Types of events include sewage discharges, boat sinkings, torrential rainfall, petrochemical spills, and other discharges of hazardous chemicals. Several pollution-related events in 2017 are detailed below.

- On July 5, a boat fire involving two vessels occurred in Lagoon Pond (V11). Town officials in Tisbury and Oak Bluffs were concerned about foam used by the fire department to extinguish the fire and a debris field floating around in the pond. There was also concern about a small 10-gallon fuel spill associated with the vessel sinkings. The area was closed to shellfishing for four days.
- On August 11, there was an accidental release of 100,000–150,000 gallons of partially treated sewage from the Scituate Wastewater Treatment Plant. The North River (MB5.1) and South River (MB6.1) were already under a seasonal closure. The Scituate South Coastal (MB4.0) was closed to shellfishing for seven days.

- On August 15, a 60’ fishing boat (FV Challenger) sank at the EPA dock in New Bedford Harbor with 6,300 gallons of diesel fuel onboard. Emergency response teams placed a boom around the vessel at dock and retrieved most of the spilled fuel. New Bedford Outer Harbor (BB15.4) was closed to shellfishing through August 29 (13 days).
- On August 19, portions of Cape Cod and most towns on Martha’s Vineyard experienced torrential downpours in a very short time period. Four to five inches of rain fell in most towns affected by shellfish closure. The National Weather Service reported that Wellfleet received 6-7" in a 2-hour period. Torrential rains caused flash flooding throughout Barnstable County. In Wellfleet, erosion caused a dune to collapse trapping a vehicle in a sinkhole. Shellfish growing areas in Sandwich, Yarmouth, Chatham, Harwich, Brewster, Wellfleet, Dennis, Eastham, Orleans, Barnstable, and all of Martha’s Vineyard were closed for four days.
- On September 22, six inches of rain fell in Nantucket. Shellfish growing areas in Nantucket Harbor (NT2- NT6) and Madaket Harbor (NT11) were closed to shellfishing for five days. The storm was associated with Tropical Storm Jose, which resulted in heavy rain, flooding, and the sinking of an estimated twelve sail boats. Total rainfall was estimated to be six inches over the course of two days, with 3" falling over a 2-hour period.
- Shellfish growing areas in Barnstable, Yarmouth, Dennis, and Mashpee were closed for four days following extremely heavy rainfall that occurred on October 25 and 26.
- Hydrographic dye studies were conducted in Lynn Harbor and Broad Sound in Lynn, Nahant, and Revere on September 9 and October 27. These limited, follow-up studies were to determine and document repairs to the Lynn Wastewater Treatment Plant outfall pipe. Breaks were first identified in the original August 2016 hydrographic dye study with preliminary repairs completed shortly thereafter. Conditionally Restricted shellfish growing areas in N26 remain closed.
- Staff continued weekly rotation to monitor and institute rainfall and emergency closures weekdays, weekends, and all holidays for Conditionally Restricted areas of greater Boston Harbor, Pines River, and Merrimack River. The Shellfish Area Information System was updated on 69 occasions with email notifications sent to local constables, environmental police, and state and federal contacts.

The Shellfish Program also contributes to the review of proposed coastal alteration projects for impacts on water quality, shellfish resources, and habitat. Recommendations are provided through *MarineFisheries* environmental review process to the permitting agencies concerning the effects of proposed structures, filling, and discharge to marine waters. In 2017, staff biologists reviewed a combined 183 project proposals.

Aquaculture Project

Figure 10. An oyster aquaculture licensed site in the intertidal zone, Wellfleet.

The management of marine aquaculture is a major responsibility of *MarineFisheries*. This includes managing the introduction, culture, and harvest of all marine species in the Commonwealth. Currently the vast majority of marine aquaculture in Massachusetts consists of municipally licensed molluscan shellfish aquaculture (Figure 10). *MarineFisheries* shellfish aquaculture responsibilities involve two major areas of concern: certifying the issuance of aquaculture licenses by municipalities, and the permitting of aquaculturists, towns and hatcheries to obtain, possess and sell sub-legal shellfish (seed) for transplant and grow-out to legal size.

Shellfish License Certification

Under state statute, *MarineFisheries* is required to certify that municipally issued aquaculture licenses and associated culture activities will cause no substantial adverse effects on the shellfish or other natural marine resources of the city or town where they are located. Project staff review proposed aquaculture projects and survey sites to determine a project's potential to impact important or protected marine resources. Staff also review projects to evaluate potential conflicts with existing recreational and commercial fisheries and other public uses. If it is determined a project presents a risk to marine resources or may limit public access, the agency may deny certification or require the town to condition the license to minimize such impacts.

In 2017, Project staff certified 15 new shellfish aquaculture license sites and inspected 38.5 acres of tidelands (Table 12).

Table 12. New License Certifications in 2017.

Town	License Sites	Acres
Bourne	2	2
Eastham	1	0.5
Marion	1	0.5
Mattapoisett	2	2
Orleans	2	1
Plymouth	1	1.5
Provincetown	4	4
Wareham	1	2
Westport	1	25
Total	**15**	**38.5**

Permitting

MarineFisheries issues permits for all marine aquaculture activities in the Commonwealth. Permits require holders to manage their culture activities in a manner that prevents the introduction of diseases, non-native species, and other pests or predators that could decimate natural populations and harm both aquaculture and wild commercial fisheries. Additionally, permits may be conditioned to ensure food safety standards are met.

In the case of shellfish, a propagation permit is issued annually to both private growers and municipalities. The permit allows the possession, transplant, and grow-out of seed shellfish from approved sources. In 2017, *MarineFisheries* issued shellfish propagation permits to 390 private aquaculture license site holders (Table 13) and 24 municipalities (for public propagation activities) operating shellfish aquaculture projects in 30 coastal municipalities throughout the Commonwealth.

In 2017, *MarineFisheries* also issued two commercial kelp aquaculture permits in the state. The permits authorize kelp aquaculture on existing licensed shellfish aquaculture sites and the sale of kelp to wholesale seafood dealers for distribution. *MarineFisheries* staff began and will continue working closely with partner agencies, the aquaculture industry, and researchers to foster the sustainable development of this new aquaculture sector in Massachusetts (Figure 11).

Figure 11. Interest in sugar kelp aquaculture is growing; uses include a variety of products like food, fertilizers, cosmetics, pharmaceuticals, and biofuel. (Photo courtesy of Martino's Seafood, LLC.)

Table 13. 2017 private shellfish propagation permits and acreage under cultivation, by municipality.

Municipality	# Growers	Total Acres	Species Grown
Aquinnah	1	1.6	Quahog
Barnstable	52	156	Oyster, Quahog, Soft Shell Clam, Surf Clam
Bourne	7	9	Oyster, Quahog, Soft Shell Clam
Brewster	11	10.5	Oyster, Quahog
Chatham	2	7	Oyster, Quahog, Soft Shell Clam, Razor Clam
Chilmark	8	23	Oyster, Blue Mussel, Sugar Kelp
Dartmouth	1	0.5	Oyster
Dennis	28	32	Oyster
Duxbury	27	77.5	Oyster, Quahog, Surf Clam
Eastham	26	27.6	Oyster, Quahog
Edgartown	13	17	Oyster
Fairhaven	2	38	Oyster, Quahog
Falmouth	10	45	Oyster, Quahog
Gosnold	1	32	Oyster
Ipswich	2	2	Soft Shell Clam
Kingston	3	8.5	Oyster
Marion	4	2.5	Oyster
Mashpee	4	18	Oyster, Quahog
Mattapoisett	2	113	Oyster, Bay Scallop
Nantucket	8	73	Oyster, Quahog
Oak Bluffs	2	2	Oyster, Sugar Kelp
Orleans	14	17.5	Oyster, Quahog, Blue Mussel, Surf Clam
Plymouth	31	81.5	Oyster, Quahog, Surf Clam, Bay Scallop
Provincetown	12	30	Oyster, Quahog, Soft Shell Clam, Razor Clam
Rowley	3	4	Oyster, Soft Shell Clam, Razor Clam
Truro	7	20	Oyster
Wareham	7	83	Oyster, Quahog
Wellfleet	93	261	Oyster, Quahog, Soft Shell, Surf Clam, Razor Clam, Blood Arc
Westport	5	80	Oyster, Quahog
Yarmouth	4	27	Oyster, Quahog
Total	**390**	**1,299.7**	

Aquaculture Landings

Aquaculture landings, as derived from SAFIS dealer reports, are presented in Table 14. Confidentiality of an individual or corporation's data is protected by only displaying summarized values and quantities that could not be used to identify data attributed to a single permitted entity. Units for quantity are converted for reporting purposes using standardized conversion factors developed by the Fisheries Statistics Project. Value is calculated from the unit prices reported by dealers with the average unit price used to fill in missing data. While interest is growing in the culture of species such as sugar kelp, mussel, soft shell clam, razor clam, surf clam, blood arc clam, and bay scallop, their limited production does not allow for reporting due to confidentiality rules.

Table 14. 2017 aquaculture landings and value.

American Oyster		
Town or Region	Pieces	Reported Value
Barnstable	10,660,314	$6,070,790
Brewster	445,177	$258,472
Chilmark/Oak Bluffs/Gosnold	302,760	$251,309
Dennis	2,599,293	$1,510,097
Duxbury	12,339,545	$6,804,473
Eastham	387,054	$218,547
Edgartown	2,299,579	$1,450,800
Falmouth	313,937	$189,035
Kingston	260,915	$145,472
Marion	94,414	$46,851
Mashpee/Yarmouth/Chatham	1,138,450	$665,002
Nantucket	391,037	$240,401
Orleans	1,208,761	$695,890
Plymouth	2,366,015	$1,292,389
Provincetown/Truro	323,789	$192,758
South Coast	1,786,475	$1,002,404
Wareham	1,555,606	$904,963
Wellfleet	9,376,577	$5,075,455
Total	47,849,698	$27,015,107

Quahog		
Town or Region	Pieces	Reported Value
Barnstable	494,914	$122,271
Eastham/Orleans	327,787	$64,737
Other areas	18,272	$3,832
Wellfleet	3,588,212	$864,900
Total	4,429,184	$1,055,740

Total Aquaculture Value	**$28,070,846**

John T. Hughes Hatchery & Research Station

Figure 12. Culture tanks at the Hughes Hatchery.

Infrastructure investments in *MarineFisheries*' John T. Hughes Hatchery and Research Station continue to pay off in the form of enhanced public shellfish beds through its partnership with the Martha's Vineyard Shellfish Group (MVSG). The MVSG, a consortium of the Shellfish Departments of the six towns of Martha's Vineyard, continues to use portions of this Division-owned facility to spawn and culture shellfish for eventual transplant to harvestable shellfish beds throughout the waters of Martha's Vineyard. Access to the hatchery greatly expanded MVSG's hatchery and nursery capacity (Figure 12). This activity supports several of the Division's strategic goals, including improving fisheries sustainability, supporting the Commonwealth's commercial and recreational fisheries, and providing technical support to Martha's Vineyard Town Shellfish Departments.

In 2017, MVSG continued to repurpose the facility for bivalve culture by building new larval and algal culture systems to increase its functionality and efficiency. Culture activities in the main building and two greenhouses continue to include nursery grow-out of quahogs and oysters in upweller silos, tanks, and tables utilizing fresh seawater from Lagoon Pond and aeration. In addition, bay scallop and oyster eggs and larvae are cultured and released to various salt ponds on the island.

MVSG also continues to diversify activities at Hughes Hatchery by expanding their remote setting of spat-on-oyster shells. These oysters are intended to support expanded efforts by Martha's Vineyard communities to utilize cultured shellfish to improve water quality and marine habitats in compromised nearshore waters that are plagued by eutrophic conditions caused primarily by excess nutrients.

Shellfish production at Hughes Hatchery continued to increase in 2017 (Table 15).Oyster and scallop eggs, larvae, and seed were produced; phytoplankton tanks provided additional food for setting quahogs, scallops, and spat-on-oyster shells. In early December, 140,000 seed quahogs reared at Hughes Hatchery were planted in New Bedford waters as part of the New Bedford Marine Commerce Terminal Shellfish Mitigation Project. Bay scallop production was down this year due to a bloom of *Cochlodinium* algae (aka Rust Tide) in Lagoon Pond that caused low survival of MVSG's August batch of scallops.

Table 15. Estimated 2017 shellfish seed production at the Hughes Hatchery.

Shellfish	Quantity (million)
Quahog Seed	6.4
Oysters (singles, spat-on shell, and larval releases)	154
Scallops (singles, spat-on shell, and larval releases)	106

During 2017, MVSG continued their EPA-funded *Phragmites* Project at Hughes Hatchery. *Phragmites australis* are the tall reeds commonly seen along highway drainage areas and other wetlands. They grow around many Vineyard salt ponds where they are extremely invasive and exclude native species. The study is focusing on providing scientifically sound evidence supporting *Phragmites* harvest for nitrogen removal, it also looks at ways to use the harvested reeds as a sustainable fuel source and feed for livestock.

Vibrio Management

A major component of the Shellfish Program's public health protection responsibilities is the implementation of control measures intended to limit the human health risks associated with the exposure of *Vibrio parahaemolyticus* bacteria (*Vibrio*) from the consumption of raw oysters. Exposure to *Vibrio* can cause severe gastrointestinal illness and in rare cases can be lethal. As a result, the USFDA requires NSSP member states with a history of *Vibrio* illness to monitor conditions in oyster harvest areas, implement *Vibrio* control measures, and respond in the event of a *Vibrio* illness outbreak associated with shellfish consumption. *MarineFisheries* is also responsible for the closure of harvest areas following the notification of a *Vibrio* outbreak from *Mass*DPH.

The Vibrio Control Season in Massachusetts runs from May to October, when the risk of *Vibrio* infection is highest. During this period, commercial oyster harvesters are required to ice oysters to prevent the post-harvest growth of *Vibrio;* tag containers of oysters with the time of harvest and time of icing; shade oysters during harvest and transportation; and maintain a harvest logbook. Additionally, certain aquaculture activities related to the culling and processing of oysters are subject to *Vibrio* related restrictions. *MarineFisheries,* in cooperation with local Shellfish Constables and the Massachusetts Office of Law Enforcement, work with harvesters and growers to educate and verify compliance with the *Vibrio* Control Plan through routine compliance monitoring and training workshops.

MarineFisheries and *Mass*DPH continually evaluate the effectiveness of *Vibrio* controls and work with industry and other stakeholders to make improvements and incorporate state-specific data where possible. New research efforts initiated in 2015 continued through 2017. These efforts aim to fine-tune existing *Vibrio* controls, explore additional illness reduction options, and where possible reduce the growing regulatory burden *Vibrio* has placed on the Massachusetts oyster industry. Ongoing monitoring included environmental data collection and oyster tissue sampling for *Vibrio* levels.

MarineFisheries entered the second year of a pilot program in cooperation with the Town of Edgartown and aquaculturists on Martha's Vineyard to evaluate the efficacy of transplanting oysters from Katama Bay to Vineyard Sound prior to harvest. In the first year this program showed promising results with an over 80% reduction in *Vibrio* illnesses reported from Katama Bay in 2016 as compared to 2015. The trend in illness reduction continued in 2017 and the program is expected to continue into 2018.

No changes were made to the *Vibrio* regulations for 2017. There was one growing area closure associated with *Vibrio* illness. The number of cases linked to Massachusetts harvested shellfish remained similar to 2016, and well below peak years (Table 16). As a result, *MarineFisheries* did not propose any changes to the *Vibrio* regulations for the 2018 *Vibrio* season. *MarineFisheries* continued its research efforts to further fine tune *Vibrio* controls and where possible reduce the regulatory burden associated with *Vibrio*.

Table 16. *Vibrio* cases related to the consumption of MA-harvested shellfish.

Year	# of Cases
2011	2
2012	9
2013	33
2014	11
2015	28
2016	10
2017	14

Other Activities

Technical Assistance: In Massachusetts, cities and towns manage the shellfisheries in all waters within their boundaries not closed by *MarineFisheries* for public health reasons. This includes all shellfisheries with the exception of commercial harvest of surf clams and ocean quahogs which remain under state control. The Shellfish Program assists municipalities on a wide variety of shellfisheries management issues providing technical and regulatory information as well as recommendations on numerous subjects to local shellfish

managers. Assistance includes: shellfish propagation; predator control; survey methods; management openings and closures; habitat improvement; shellfish management plans; aquaculture development and regulation; water quality; public health and sanitation; and permitting. Shellfish staff provided technical assistance to municipal managers and boards, state and federal agencies, academia and non-governmental research and management organizations, and individuals.

Professional Organizations: Program staff participated in numerous professional organizations such as the ISSC, Northeast Shellfish Sanitation Association, Massachusetts Shellfish Officers Association, and New England Estuarine Research Society. In 2017, four Program staff participated on ISSC committees throughout the year.

Neoplasia Monitoring: Staff continued sampling softshell clams as part of a long-term study with a West Chester University researcher to track the prevalence and extent of incidence of hemic neoplasia in these shellfish throughout Massachusetts coastal waters. Neoplasia has been implicated in clam die-offs in Cape Cod, Boston Harbor, and the North Shore as well as other regions of the east coast.

Habitat Program

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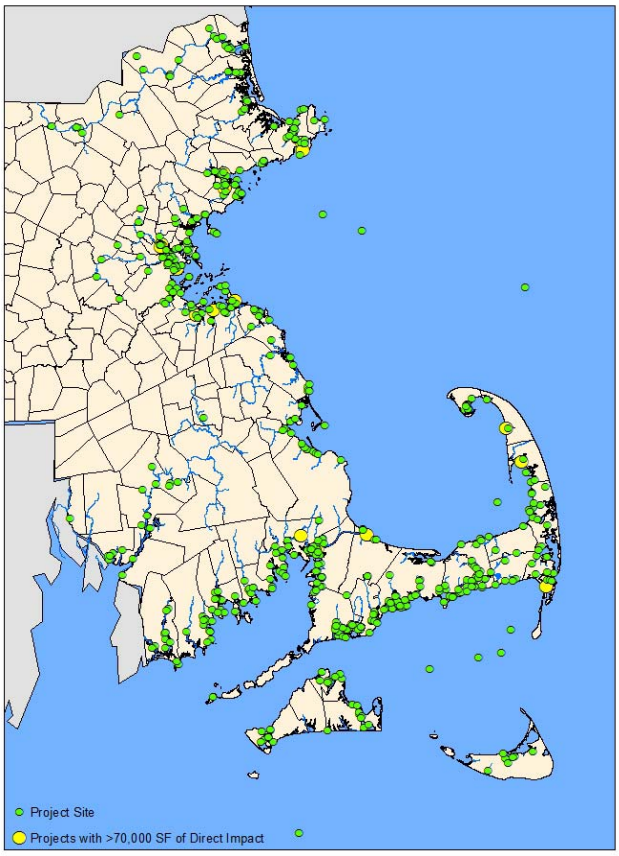
Overview

The goal of the Habitat Program is to protect and enhance marine fisheries resources. The Habitat Program includes three projects. The **Technical Review Project** reviews permits submitted to municipalities, the state, and the federal government for construction projects occurring in waters with fisheries and habitats under *MarineFisheries* jurisdiction. The reviewers provide recommendations to avoid and minimize impacts to marine fisheries resources. The **Fisheries Habitat Research Project** conducts state and grant-funded research related to marine fisheries habitats. Research varies year to year but focuses on monitoring and restoration of marshes, artificial reefs, eelgrass, and food webs. The **Ocean Planning** provides technical assistance and policy input to state and regional ocean planning activities.

Technical Review Project

Technical Review

In 2017, staff reviewed 629 projects in 101 municipalities (Figure 13). Of these projects, 405 were new projects. The project types were dominated by docks, piers, and floats. Some of the major projects that were reviewed this year included shoreline stabilization for municipalities including Chelmsford, Charlestown, Weymouth, Hull, Haverhill, Quincy, Freetown, and Plymouth; Vineyard Wind; Atlantic Link Cable; several Boston Harbor projects including ACOE Federal Navigation Channel Dredge Project, MWRA HEEC Cable, ACOE MSC CAD Cell excavation and dredge disposal, and Conley Container Terminal dredging and wharf construction; dredging of marinas and yacht clubs such as Palmers Cove Yacht Club, Hingham Shipyard Marina, Neponset Wharf Marina, and Brewers Hawthorne Cove Marina; Sandwich sand by-passing from Scusset Beach to Town Neck Beach; MassDOT Bridge Repairs; and the temporary expansion of the Massachusetts Bay Ocean Dredged Material Disposal Site (ODMDS).



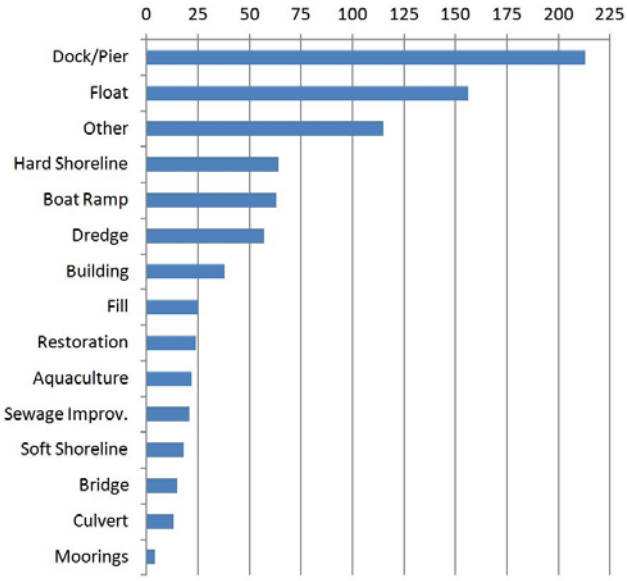


Figure 13. Coastal alteration projects reviewed by Program staff in 2017 by location (left) and type (right). Note: a single project can include multiple project types.

Our reviews resulted in improvements to these projects that will avoid and minimize environmental impacts. Some examples of how our comments minimized impacts include the use of time of year restrictions on projects to protect vulnerable life history activities, the reduction of project sizes to avoid critical resource areas, and the use of new materials or methods to lessen impact.

Efforts to improve efficiency and standardization of reviews are ongoing and significant progress was made in 2017 to overhaul our standard operating procedures document for the Technical Review Project.

In Lieu Fee Program

The In Lieu Fee (ILF) Program is the mechanism by which the Army Corps of Engineers can mitigate for unavoidable impacts on natural resources from the construction activities they regulate. From 2009–2014, *MarineFisheries* was the sponsor for the first ILF program in Massachusetts, the Coastal ILF Program. The Coastal ILF Program addressed authorized impacts of less than one acre in extent to coastal aquatic resources. In 2014, a new Massachusetts-wide ILF program sponsored by *Mass*DFG was developed to include unavoidable resource impacts statewide under both the Corps General Permit and Individual Permit.

Coastal ILF Program: Under the Coastal ILF Program, 27 construction projects impacting 18,980 square feet (0.44 acres) of aquatic habitat contributed nearly $230,000. Following a competitive selection process, two *Phragmites* removal projects were funded at Rough Meadows, Rowley and Great Marsh, Newbury and one stream connectivity project was funded at Off Billington Street Dam, Plymouth. Restoration work on all three projects was completed in 2013. Staff completed the fifth and final year of required monitoring in 2017. The results are as follows:

- Rough Meadows, Rowley: *Phragmites* cover was reduced by applying an approved chemical treatment to 27 individual *Phragmites* stands ranging in size from 0.01 to 2.91 acres. After five years of monitoring, 11.49 acres of the 15.05 acres treated remain free of *Phragmites*. Follow-up treatments on areas experiencing regrowth are expected in 2018 and beyond (Figure 14).
- Upper Great Marsh, Newbury: *Phragmites* stands were removed in both high and low salt marsh areas and regrowth of salt marsh grass (*Spartina* sp.) was documented. Monitoring in 2017 found only small, low density *Phragmites australis* stands, which can be easily treated via backpack spray equipment. Funding will be sought in 2018 for additional treatments.
- Off Billington Street Dam, Plymouth: In 2013, this dam on Town Brook was removed and the impoundment behind the dam drained. ILF funds were used to vegetate the banks of a restored stream upstream of the dam removal. Monitoring has documented a substantial improvement and diversification of the vegetation community in the former Off Billington Street Dam impoundment over the last four years. Species composition has continued to shift, incorporating local seed sources as well as those provided by the contractor. A number of insect species were found using the area.

Figure 14. Signage installed for the Rough Meadows *Phragmites* removal project.

A fourth project, the installation of a fishway at Draka Dam, Taunton was partially funded through the Coastal ILF Program. Permitting and design was completed in 2017, and installation was targeted to occur in 2018. For the Draka Dam project, monitoring will continue for five years from the date of installation of the fishway.

Mass ILF Program: In 2016, *Mass*DFG selected the first project to receive funding under the new statewide ILF program. The selection process included review and approval by the Army Corps and the multi-agency ILF steering committee. A Division-led eelgrass restoration project to transplant 0.5 acres of eelgrass in state waters was initiated in 2017. DMF is uniquely qualified to conduct this restoration because of its unparalleled success restoring eelgrass in Massachusetts. Restoration work and five years of required monitoring is expected to be completed in 2021. The ILF eelgrass restoration project is described in more detail in the Eelgrass section of this report (page 56).

Offshore Wind

The generation of energy via offshore wind farms is a new industry off the coast of the U.S. Eastern Seaboard. There are two Wind Energy Areas (WEAs) proximal to Massachusetts for leasing by wind farm developers: the Massachusetts WEA and the Massachusetts-Rhode Island WEA (Figure 15). The two WEAs have five lease areas, three of which have been leased to Deepwater Wind, Orsted, and Offshore MW (the other two are projected to be leased in the summer of 2018). These companies conducted site assessment surveys in 2017, and there was a considerable increase in activity pertaining to the development of these projects. At year's end, Offshore MW was developing state permitting documents for a cable access route through Muskeget Channel and landing in Hyannis.

For several years our primary involvement has been as a member of the Massachusetts Renewable Energy Task Force and the Joint RI-MA Renewable Energy Task Force. Additionally, staff has participated in meetings of the Habitat and Fisheries Workgroups for the Massachusetts WEA. In 2017, we began to participate more directly in permit-related review and meetings, including study protocols for Deepwater Wind and Orsted projects and two meetings with the Massachusetts Ocean Planning Team and Vineyard Wind. Also in 2017, New York released a planning document for their development of offshore wind, and a lease in federal waters adjacent to New York was granted to Statoil. Since the wind development areas off of New York have the potential to affect fisheries that are either based in or land product in Massachusetts, we stayed apprised of the New York wind energy development efforts.

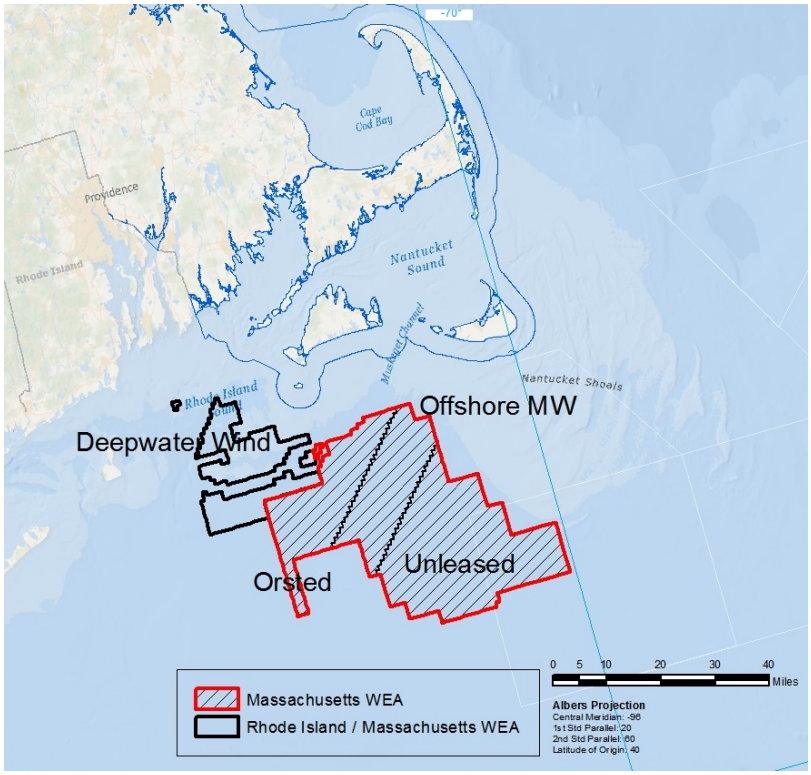


Figure 15. Offshore wind energy areas adjacent to MA.

Staff efforts focused on addressing permitting concerns, reviewing documents, and preparing recommendations for regional and site-specific fisheries studies to assess siting and impact of offshore wind farms. Four meetings were held in the fall of 2017 to address concerns related to offshore wind and fisheries resources and the fishing industry. Staff (K. Ford) gave a presentation on the Massachusetts WEA and chaired one panel discussion at these meetings.

Fisheries Habitat Research Project

Artificial Reefs

Massachusetts has five permitted artificial reefs in its waters. The first reef was installed in 1978 in Yarmouth, and the most recent installation was in Harwich in 2016. Staff perform surveys to identify new reef sites to permit in MA coastal waters, conduct compliance and biological monitoring, and provide technical guidance to advance artificial reef development and uses in MA coastal waters.

Reef Monitoring: The five reef sites were monitored for community composition, biomass, invasive species presence, and permit compliance. An artificial reef monitoring protocol was drafted as guidance for future reef monitoring efforts. Acoustic receivers were deployed to all reef sites for the first time. Receivers will be utilized year-round at all sites to track the patterns of tagged migratory fish species. Time-series temperature data and invasive species presence data were collected at all permitted reef sites. To evaluate the use of video as a tool to supplement species presence data collected at reef sites, staff piloted the use of an unmanned camera at a georeferenced station on the Harwich reef site (Figure 16). Staff (M. Rousseau and K. Ford) gave a presentation on the development and monitoring of the Harwich reef at the Coastal and Estuarine Research Federation's Biennial Meeting.

Figure 16. Black sea bass on the artificial reef in Nantucket Sound, off Harwich.

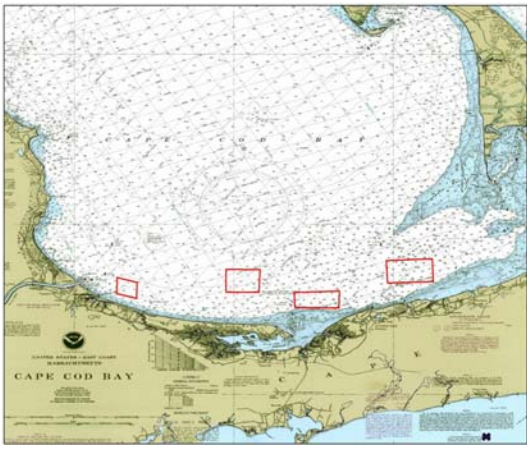


Figure 17. Areas of lower Cape Cod Bay (red boxes) surveyed in 2017 for identifying potential new artificial reef locations.

Cape Cod Bay Site Selection: In order to identify four to five new locations to site future artificial reefs, staff conducted an acoustic survey of four discrete areas in lower Cape Cod Bay, mapping over 12,000 acres of seafloor at depths between 25 and 70 feet (Figure 17). The survey work was a collaborative effort between *MarineFisheries* and the Cape Cod Charter Boat Association. Ground-truthing specific areas within the survey sites was expected to occur in 2018, in order to select several 10-acre locations for reef site permitting.

Material Storage and Procurement: Project staff continued efforts with the Commissioner of *Mass*DFG and the Secretary of EOEEA to locate and secure a staging area suitable for temporarily storing reef materials for future deployments. Deployment of materials from coastal construction project sites directly to permitted reef areas also continued to be developed.

Boston Harbor Beneficial Use Reef: In partnership with Northeastern University, the City of Boston, *Mass*CZM, the Nature Conservancy, and the Army Corps of Engineers, we continued our project exploring how to beneficially reuse dredged rock material coming from the Army Corps' Boston Harbor Deepening Project. The siting and conceptual design stages of this project, funded by the National Fish and Wildlife Foundation's Hurricane Sandy Coastal Resiliency Competitive Grants Program, concluded in 2017 with a report identifying and characterizing two sites where nearshore artificial reefs could be sited for the purpose of shoreline protection and fisheries habitat enhancement: Gallops Island, Boston and Devereux Beach, Marblehead. One of the key conclusions was that meaningful shoreline protection would require the construction of a nearshore berm tall enough that using the Boston Harbor dredge material was impractical. Therefore, in the fall of 2017 efforts shifted to focus exclusively on fisheries habitat enhancement as a project goal. At the request of *Mass*DCR, Sheep Island, Weymouth was assessed as a potential alternative site and *MarineFisheries* conducted field assessment work at the island. Several meetings with the project's partners were convened to plan and discuss moving the project into the permitting stages. Permitting discussions were expected to continue into 2018. Staff (K. Ford and M. Rousseau) presented on the project at the Coastal and Estuarine Research Federation's Biennial Meeting.

Climate Change

Climate change is an area of active research and policy focus in New England. *MarineFisheries'* primary focus is on harnessing existing research efforts and ensuring that data relevant to climate change (in particular

temperature) are being collected in a standardized way and made accessible to internal and external research entities.

Temperature: The Fisheries Habitat Program compiles all marine and coastal continuous bottom temperature monitoring records collected by *MarineFisheries*. The database contains over 7 million records from 1986 to present. The database inventories more than 30 seafloor stations plus more than 40 estuarine and riverine sites where bottom temperature data are collected seasonally, typically March to October. Approximately 200,000 temperature records are collected annually. In 2017, a directed effort was undertaken to quality control the database and ensure data accuracy. As part of this process, each temperature monitoring site was examined for duplicate or errant records and new data were added to bring the database up to date. Staff also initiated efforts with EOEEA-IT and tested a new SQL server platform for housing and archiving the database. The long-term goal for this effort is to establish a secure, accessible platform that allows the database to be easily updated and for near real-time data updates to be accessible for end-users. This effort was ongoing at year's end.

Climate Change Vulnerability: In 2017, Executive Branch agencies were required to complete a climate change vulnerability assessment in order to comply with Governor Baker's *Executive Order No. 569 – Establishing an Integrated Climate Change Strategy for the Commonwealth*. This survey was designed to assist agencies in identifying key assets, functions, missions and services/programs that may be affected by natural hazards, now and as they may exist in the future, and to assist in assessing the degree of exposure, sensitivity, and adaptive capacity to climate change and natural hazards. Habitat Program staff coordinated agency survey response efforts, incorporating input from all relevant staff and projects.

Food Webs: Ocean warming and other physical changes associated with climate change may alter marine food webs and impact top predators supporting commercial and recreational fisheries. To better understand potential impacts of climate change for several economically important tuna species, staff participated in a series of workshops to compile and analyze tuna diet data in relation to environmental variables. Study results found that the expansion of warmer, less productive waters worldwide may have regional impacts on prey abundances and composition and consequently on foraging opportunities for these tuna species. Staff (J. Logan) was co-author to a manuscript published in the journal *Deep Sea Research Part II: Topical Studies in Oceanography* summarizing the results.

Ocean warming is also expected to increase the impacts of nutrient enrichment and the bioavailability of previously unavailable contaminants in coastal waters. Staff has been examining the interplay between eutrophication and contaminants transfer in New Bedford Harbor and several Cape Cod estuaries. In New Bedford Harbor, large blooms of the green macroalgae *Ulva* occur seasonally due to elevated nutrient levels. Within the Superfund site in the inner harbor, these blooms were found to contain high concentrations of PCBs that increased in relation to underlying sediment concentrations. Additional studies identified *Ulva* as an important energy pathway in the New Bedford Harbor food web suggesting that these macroalgal blooms, or "green tides" facilitated by excess nutrients may present a previously overlooked pathway of contaminants transfer in urban estuaries. In several estuaries on the Cape, the Habitat Program is examining how eutrophication affects the bioavailability of mercury in coastal food webs. In estuaries with different nitrogen loading levels, the mercury content in sentinel estuarine fish and invertebrates is being analyzed. The New Bedford Harbor study is in collaboration with researchers from Northeastern University, the University of New Hampshire, and Roger Williams University (RWU) while the mercury study includes partners from RWU, University of California Santa Cruz, and Dauphin Island Sea Lab. Results from both studies were presented by staff (J. Logan, J. Fleming) at the Coastal and Estuarine Research Federation's Biennial Meeting.

Eelgrass Monitoring and Restoration

Eelgrass is a critical marine fisheries habitat and has been the center of many studies and restoration efforts at *MarineFisheries* for over a decade. The eelgrass team focuses on research, monitoring, and restoration of eelgrass in Massachusetts.

Seagrass Monitoring: The eelgrass team completed its eleventh year of monitoring a site off of West Beach, Beverly in Salem Sound as part of the international SeagrassNet monitoring program. This program tracks short- and long-term trends in seagrass condition globally. The site is also monitored for invasive species as part of a partnership with *Mass*CZM's Marine Invader Monitoring and Information Collaborative. Monitoring data were collected by Division divers according to SeagassNet's established sampling protocol. In 2017, staff (J. Carr and T. Evans) also collaborated with other SeagrassNet stations in the northeast and mid-Atlantic for the preparation of a regional synthesis, which was presented at the Coastal and Estuarine Research Federation's Biennial Meeting. We also conducted our annual monitoring of four other reference beds in Marblehead, Boston, Broad Sound, and Nahant. These areas were established as reference beds between 2013 and 2014 to track trends in natural beds compared to restoration site success.

HubLine Eelgrass Restoration: The final report for the HUB3 Hubline eelgrass restoration project neared completion in 2017. Staff (T. Evans) gave a presentation on the Division's Boston Harbor eelgrass restoration work at the Coastal and Estuarine Research Federation's Biennual Meeting.

Salem Sound Eelgrass Restoration: In 2017, the eelgrass team initiated a five-year project, funded by the Massachusetts In Lieu Fee Program, to restore half an acre of eelgrass to mitigate for construction impacts to coastal ecosystems. In collaboration with Northeastern University, staff planted two ¼ acre sites at Middle Ground in Salem Sound; one on the west side during April and May, and one on the east side in August and September (Figure 18). The effort also includes gene testing the five different eelgrass donor beds to better understand the effect of genetic diversity on transplant success.

Figure 18. A diver plants eelgrass in a burlap disc within Salem Sound.

Conservation moorings: Since 2010, the eelgrass team has been studying the effectiveness of "conservation mooring" systems designed to minimize impact of moorings in eelgrass beds. By floating the mooring rode, these systems are expected to reduce scarring associated with chain drag. Study sites in Gloucester, Boston, Manchester, Wareham, and Falmouth have indicated that proper design and installation are critical to effectiveness. In 2017, staff met with several harbormaster groups in March to present a summary of findings along with guidelines and recommendations with respect to conservation moorings.

Blue Carbon Studies: The eelgrass team continued to assist the EPA with a study investigating the carbon stored in seagrass ecosystems (called blue carbon since it represents carbon stored in aquatic ecosystems). The Division provided a boat and two divers for two field days to collect samples of eelgrass and sediment in Gloucester and West Falmouth. Since 2015 this work has resulted in the first estimates of eelgrass' role in the coastal carbon cycle in Massachusetts. The findings confirmed that seagrasses do sequester carbon at a rate higher than unvegetated areas and carbon content in seagrass meadows is similar in New England to other parts of the world. Stable isotope analysis found that carbon stored in the sediments came from both within the meadow and from outside sources. Knowing this capacity for carbon storage supports efforts for restoration and protection of established eelgrass meadows.

Tunicates in Eelgrass: The eelgrass team also monitored a transect in Salem Sound for tunicate presence as part of a study conducted by Woods Hole Oceanographic Institute Scientists. Data collected by two Division divers during one field day were incorporated into the larger study to determine the effect of tunicates on eelgrass in Massachusetts. Invasive tunicates can lead to reduced light reaching the leaves and may be indicative of water quality issues.

Habitat Characterization

Knowing where fish are carrying out key life history activities such as breeding, feeding, and growth is the foundation of habitat charaterization. Habitat information allows *MarineFisheries* to better manage fish resources and potential impacts to those fish resources from human activities. In 2017, efforts at characterizing fish habitat were focused on tuna and groundfish.

Tuna: Having successfully applied for NOAA funding in 2016, *MarineFisheries* initiatiated a study, in collaboration with other researchers, to better understand the connectivity between western Atlantic bluefish tuna spawning grounds in the Gulf of Mexico and seasonal feeding grounds in New England and elsewhere in the North Atlantic. During 2017, samples previously collected and archived by NOAA fisheries observers were prepared for chemical analyses to determine natal origin and feeding location. Analysis was underway at year's end with an anticipated completion date of September 2018.

Massachusetts groundfish: In 2017, staff began exploring ways to use data from the Division's research trawl survey to best characterize the spatial distribution of fish species and potentially vulnerable habitat types in Massachusetts coastal waters. The first analysis examined relationships between individual species and various environmental variables, including sediment type, temperature, and depth. Bubble plots of spatial distribution were generated indicating the abundance of a given species by decade and over the 40-year time series.

Salt Marsh

Across the Massachusetts coastline, more than 2,500 docks and piers are currently constructed over salt marsh. New dock construction projects are required to follow a height to width ratio standard of 1:1 to minimize the impacts of dock shading on marsh vegetation; however, this standard had not been tested with respect to its efficacy at avoiding impacts to marsh grasses. With partial funding from MassBays, staff conducted field studies from 2013 to 2015 to evaluate the impact of docks on marsh vegetation and abiotic conditions. Staff (J. Logan, K. Ford, and S. Voss) were co-authors on manuscripts published in the journal *Estuaries and Coasts* in 2017, as well as a presentation given at the New England Estuarine Research Society's Spring Meeting. The research found that increased light penetration under docks is a function of height. Docks up to a 1:1.5 height ratio continued to reduce impact on the underlying marsh. Grated decking designed to enhance light penetration did not provide any detectable increase in light availability (relative to docks with traditional plank decking) or clearly reduce impacts to marsh production.

Seafloor Mapping

Our habitat characterization research primarily focuses on seafloor mapping and identifying community and spatial patterns in the Division's trawl survey data. Using single-beam sonar, sidescan sonar, and video equipment, the team maps shallow coastal areas not covered by other seafloor mapping studies in each year. In 2017, we also used this technology to image fishing gear.

Sidescan and Video Mapping: In partnership with the Massachusetts Bays Program, staff completed a study launched in 2016 that assessed temporal trends in eelgrass spatial distribution in Salem Sound along the

coastlines of Marblehead, Salem, Danvers, Beverly, and Manchester over the last several decades. Other meadows were mapped in Broad Sound, Nahant Cove, Swampscott Harbor, and Sandwich. Overall, the study found more eelgrass than was previously mapped with aerial imagery, in part due to increased ability to see deeper meadows and discriminate optically difficult areas (e.g., rocks, channels) from eelgrass areas using acoustics (Figure 19). Staff prepared a final report on the project (J. Carr and K. Ford), and presented results at the Coastal and Estuarine Research Federation's Biennial Meeting (J. Carr, K. Ford, and S. Voss), as well as to two other interested government and public groups (J. Carr).

Trawl Net Dimensions Study: Sidescan sonar was used to image actively fishing trawl nets to determine the distances between doors and wing spread (Figure 20). Four separate nets were surveyed including two Lowrise experimental nets, the Division's net used in the GOM Cod Industry Based Survey (IBS) , and the Division's net used in the inshore trawl survey aboard the NOAA vessel Gloria Michelle. Data will be compared to Notus net mensuration sensor data in an attempt to verify our readings. Preliminary findings for the IBS net study show good agreement for the door spread but poor Notus calculated wing spreads.

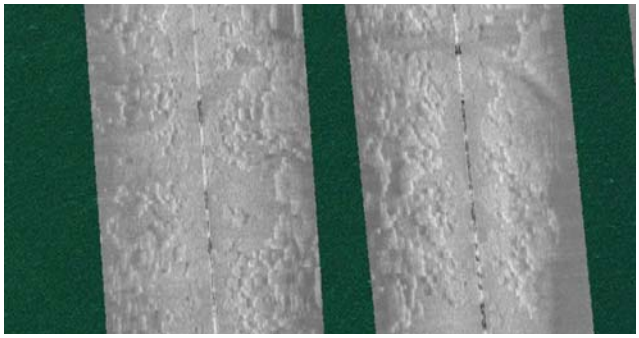


Figure 19. Sidescan sonar images of an eel grass bed (mottled area)

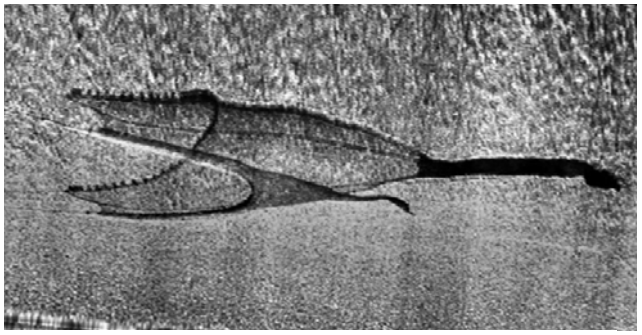


Figure 20. Sidescan sonar image of the IBS net.

Impacts of Hydraulic Clam Dredging: For the past several years, there have been concerns over the impact of hydraulic clamming in eelgrass habitat, particularly in the Herring Cove region of the Provincetown coast and the Ellisville region of the Plymouth coast. The Habitat Program continued to participate in the review of research related to this topic as well as meetings regarding the potential for impact from this gear type.

Other Activities

Technical Committees: Project staff continued to serve on a variety of habitat-related committees, including the ASMFC Habitat and Artificial Reef Committees, the Atlantic Coastal Fish Habitat Partnership, the NEFMC Habitat Plan Development Team, the NROC Habitat Classification and Ocean Mapping Subcommittee, the Massachusetts Bay Management Committee, the Buzzards Bay National Estuary Program, the Boston Harbor Habitat Coalition, the Gulf of Maine Climate Network's Sentinel Monitoring Project, the Marine Invader Monitoring and Information Collaborative, and the NEERS Executive Committee. Staff reviewed proposals for NOAA and MIT SeaGrant Programs, and participated in running the international Coastal and Estuarine Research Federation Biennial Conference in Providence, RI.

Education/Outreach: Project staff provided numerous presentations and technical assistance related to education and outreach. Staff represented the agency at the Boston Boat Show, Women in Science and Engineering Fair, the Salem Sound Coastwatch high school marine science summer program, and the Topsfield Fair. Habitat staff also assisted other agency projects including resource assessment trawl and shrimp cruises, benthic suction and ventless surveys for lobsters, shellfish sanitation surveys, Cape Cod Canal ghost gear removal dives, and acoustic telemetry receiver dives.

Ocean Planning

The Northeast Regional Ocean Plan was certified in December 2016, and implementation began in 2017. Support to ongoing initiatives under the ocean plan was provided through meeting attendance and document review for the Northeast Regional Planning Body (NERPB) and the Important Ecological Areas subcommittee (including reviews of the Ocean Health Index). The Northeast Regional Ocean Council (NROC) is another cooperative communication and planning organization in the northeast and *MarineFisheries* is a member. Staff (K. Ford) represented the Division at two NROC meetings in 2017, and gave a presentation on the Division's concerns about nature-based infrastructure at one of them.

The Massachusetts Ocean Plan was updated in 2015. In 2017, staff participated in joint meetings of the Ocean Advisory Commission and Science Advisory Council. An initiative recommended by the Ocean Plan was to organize an Aquaculture Working Group. To this end, multiple interagency meetings were held to consider how best to approach the development of a working group, pursue permitting efficiencies under MEPA, and prepare a request to the Secretary of EOEEA for a Special Review Procedure for aquaculture permitting.

FISHERIES BIOLOGY SECTION

Dr. Michael Armstrong, Assistant Director, Section Leader

Fish Biology Program

Personnel

Dr. Gary Nelson, Program Manager
Micah Dean, Senior Biologist
William Hoffman, Senior Biologist
Scott Elzey, Biologist
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Brad Schondelmeier, Assistant Biologist
Kimberly Trull, Assistant Biologist
Nicole Ward, Assistant Biologist
Elise Koob, Ageing Technician
Collin Farrell, Ageing Technician

Overview

The objectives of the Fish Biology Program are to collect, process, and analyze biological data on recreationally- and commercially-important fishes needed for effective, science-based management of Massachusetts' fishery resources. Biological data collected from harvested and released fish include age structures (i.e., scales, otoliths, and vertebrae), length frequencies, maturity stages, and bycatch levels. All data are used in stock assessments to determine the status of those resources. In addition, information on catch and effort of recreational anglers are collected via volunteer surveys. Special research projects are also conducted to address specific management needs.

Age and Growth Project

In 2017, staff aged hard-part structures from many species important to the recreational and commercial fisheries. Table 17 shows the number of samples processed. Several focus areas for 2017 are highlighted below.

River herring: River herring (n=692) were sampled from the Cod Industry Based Survey. These samples were targeted to fill in samples from times of year that had not been previously sampled. Future plans include conducting a marginal increment study to validate the annual periodicity of the marks on the otoliths once sufficient samples are collected from each month of the year.

Atlantic cod: Otoliths were removed from juvenile Atlantic cod (n=624) captured on the resource assessment trawl survey. Counts of daily growth rings were made to determine hatch date. The processing of these data was ongoing at year's end.

Black sea bass: Black sea bass samples were again collected from the ventless trap survey. This has been a valuable source of samples from a species that is potentially under-sampled by the bottom trawl survey. Also in 2017 a project was initiated to validate the annual patterns of marks seen on black sea bass otoliths

using marginal increment analysis and microchemical analysis. This work was being done as part of a master's degree being pursued by a staff member.

Tautog: Tautog were collected through the ventless trap survey, the bottom trawl survey, and from the tautog rod and reel survey. Collecting samples from three different projects with three different gears will allow for evaluation of gear selectivity among lengths and ages.

Table 17. Samples processed for age in 2017; all samples were collected in 2017.

Species	Structure	Process	Number
American shad	Otoliths and scales	Otoliths aged, scales checked for repeat spawning	466
Atlantic cod	Otoliths	Daily ring counts	624
Black sea bass	Otoliths and scales	Cleaned, mounted, aged	997
Bluefish	Otoliths	Baked, sectioned, aged	112
Fluke	Scales	Cleaned, pressed	413
River herring	Otoliths and scales	Cleaned, mounted, aged	4,575
Scup	Scales	Cleaned, pressed	98
Striped bass	Otoliths	Sectioned, aged	662
Striped bass	Scales	Cleaned, pressed	2,171
Tautog	Otoliths and opercula	Cleaned, sectioned, aged	642
Winter flounder	Otoliths	Sectioned, aged	971
Wolffish	Otoliths	Aged whole	251

Other Activities: Within the lab, regular maintenance and expansion of reference collections was performed. In 2017, reference collections were started for black sea bass otoliths, tautog otoliths, and tautog pelvic spines. In addition, staff began the process of cataloging and properly archiving all past and present samples. Although the Age and Growth lab wasn't constructed until 2009, samples of ageing structures have been collected by the state for decades. These samples had been boxed and stored somewhat haphazardly. Reorganizing of archived samples was expected to conclude in early 2018.

Staff participated in an ASMFC-hosted ageing quality assurance and quality control meeting. During this meeting, representatives from state agencies along the east coast met and compared ages on a representative set of samples. This is an important step to ensure that all age data are as precise and accurate as possible. Staff also participated in the continued joint effort by the ASMFC and Gulf States Marine Fisheries Commission to construct an age determination manual. The document was expected to be finalized in early 2018.

The Age and Growth Lab continued to be a resource for researchers involved in fish ageing. Staff consulted with researchers from University of Massachusetts, University of New Hampshire, and Northeastern University as well as several state agencies. Staff contributed to the collection of ageing structures from wolfish and Atlantic halibut for two external projects funded by the Saltonstall-Kennedy grant program. Ageing of the collected samples was scheduled to occur early in 2018.

Staff participated in the Marine Science Symposium for high school students. Two sessions at both Salem State College and Northeastern University were attended.

Fisheries Dependent Sampling Project

The Fisheries Dependent Sampling Project is responsible for at-sea and shore-side catch sampling and performance assessment of the commercial fisheries that occur in and adjacent to Massachusetts territorial waters. The Project also conducts fish biology research studies and provides support to other *MarineFisheries* projects and senior staff.

Commercial Fisheries Sampling

Staff collected data and biological samples from commercial fisheries to document and characterize fishery performance, support stock assessments and research, and address specific management questions. These data also strengthened *MarineFisheries*' participation on, and contributions to, the regional fishery management councils and the ASMFC.

Shore-side Sampling: Port sampling of commercial catch was conducted for three species in collaboration with Recreational Fisheries Project and Invertebrate Fisheries Project staff (Table 18). Numerous fisheries, primarily based out of the southern part of the state, were not sampled due to staff limitations. Samplers based out of the Gloucester field station were able to collect the required high-priority south shore striped bass samples at a Boston fish processing facility. Northern shrimp samples represent those from the sentinel experimental fishery that exists using research set-aside quota due to the ongoing harvest moratorium.

Table 18. Number of port sampling events, or trips, made to intercept commercial vessels or seafood dealers where information was collected in 2017.

Species	Intercepts	Number individuals	Number age samples
Menhaden	5	50	50
Striped bass	22	458	458
Northern shrimp	2	-	-

At-sea Sampling: Project staff contributed extensively to numerous at-sea sampling activities (Table 19). Planning and implementation of the Industry-Based Survey for Gulf of Maine Atlantic Cod remained the dominant activity for project staff, both in terms of sea days and time on land. The survey is conducted ten days per month, 8 months a year (April–July and October–January). Consistent with past years, monitoring of the state's coastal lobster fishery was also a major undertaking. Sampling occurred between May and November and was conducted out of five ports: Rockport, Gloucester, Beverly, Quincy, and Boston.

Reliance on Project staff for field support (and data management) for grant-funded acoustic telemetry studies was slightly reduced in comparison to past years. Project staff supported research efforts, which included finalizing estimates of the post-release mortality of rod and reel caught cusk; evaluating the efficacy of release mechanisms for rod and reel caught cusk; enhancing the understanding of striped bass migration patterns and identifying the proportion of sub-stock contingencies by region in Massachusetts; and defining American shad migrations in the Charles River and coastal Massachusetts.

In 2017, an internally funded study was initiated to improve general knowledge of a local black sea bass aggregation in Boston Harbor. Boston is on the northern extent of the range for black sea bass and recently numbers have been high enough to support a small recreational fishery. Staff caught and released 49 black sea bass that were tagged with acoustic transmitters. Biological samples (age structures and DNA tissue) were collected for demographics and genetic analyses. This study capitalized on the presence of *MarineFisheries* state-wide acoustic array that is maintained by the Fish Biology Program and the Large Pelagics Research Project (Figure 21).

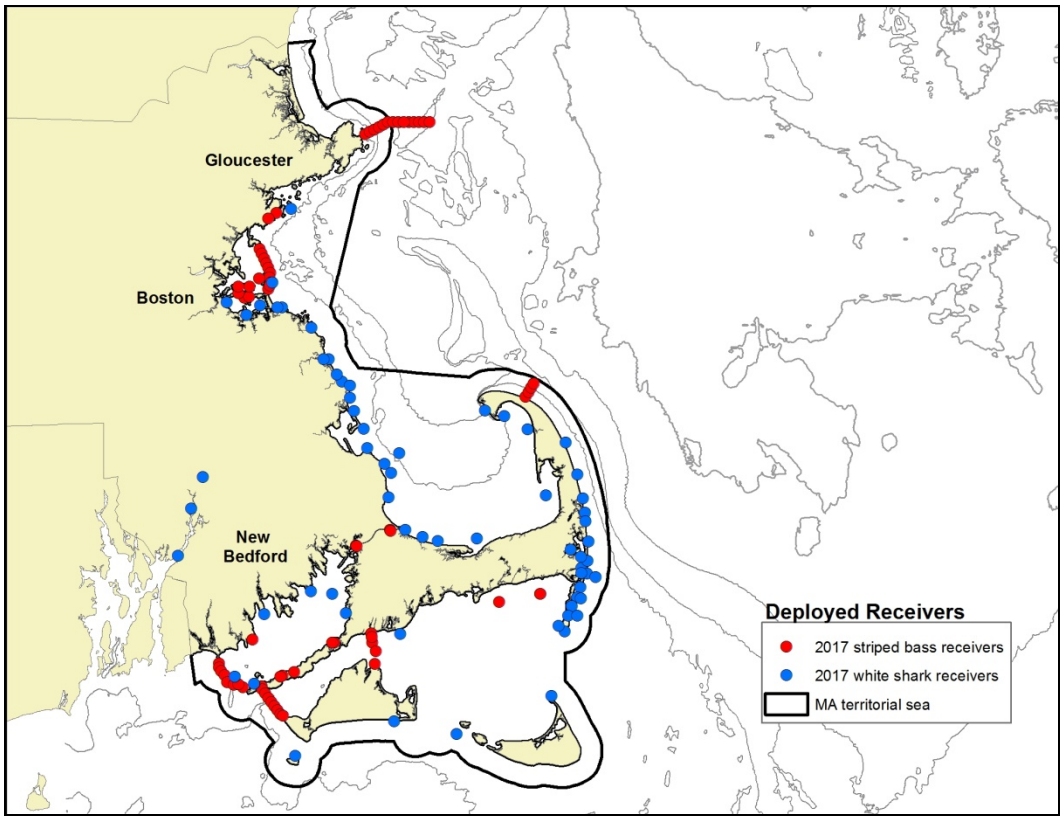

Figure 21. Massachusetts state-wide acoustic telemetry array. *MarineFisheries* maintains one of the largest and most comprehensive acoustic arrays along the Atlantic coast. Located on a marine frontal boundary, Massachusetts is ideally located for the conducting of acoustic telemetry studies.

In the summer of 2017, Project staff again contributed to the experimental whiting fishery off Ipswich Bay (see Conservation Engineering Project, page 72). Project staff designed the sampling protocols, trained six contracted sea samplers, deployed samplers on every trip, conducted one sea sampling trip, edited, audited and entered all 26 completed trips into relational databases, and assisted in data analysis.

Multiple sea days were spent aboard R/V *Michael Craven* and R/V *Alosa* to support other *MarineFisheries* projects or external collaborations. These efforts included: collecting biological samples for UMass-Boston/New England Aquarium, Gloucester Marine Genomics Institute, and Maritime Gloucester; conducting side-scan sonar work for Resource Assessment, Cod IBS and Conservation Engineering projects; hauling gear for NOAA Acoustic Research for Atlantic Cod; and assisting MA OLE with lobster gear removal.

Table 19. Summary of at-sea sampling efforts by Project staff in 2017.

Sea Days (#)	Project
84	Cod IBS
33	Coastal lobster
36	Acoustic telemetry - striped Bass
3	Acoustic telemetry - cusk
7	Resource assessment
1	Experimental whiting fishery
13	Vessel support for external projects

Atlantic Herring Fishery Portside Sampling and River Herring Bycatch Avoidance

Project staff continued into the tenth year of portside sampling of the Atlantic herring and mackerel mid-water trawl (MWT) fishery, and into the seventh year of administering the River Herring Bycatch Avoidance program, in collaboration with industry and SMAST. Funding for sampling and bycatch avoidance was provided through the NOAA-issued Atlantic Herring Research Set-Aside (RSA).

In 2017, with the aid of contracted biologists, *MarineFisheries* sampled 41 trips portside, and incorporated data from an additional 37 trips sampled by other programs—most often the NMFS Northeast Fisheries Observer Program (NEFOP). From landings in MA ports, 62 MWT trips totaling 10,976 metric tons of herring or mackerel were sampled. This sampling represents over 60% of state landings by MWT vessels participating in the Atlantic herring and mackerel fishery. From these sampled landings, over 6,000 Atlantic herring and mackerel lengths were collected.

The goal of the bycatch avoidance program is to reduce the incidental catch of river herring (alewife and blueback herring) and American shad in the pelagic mid-water trawl fishery. Under the bycatch avoidance program, portside sampling and sea sampling (NEFOP) data are aggregated and bycatch rates are reported back to the industry, allowing vessels to make more informed decisions about where to fish in order to reduce river herring and shad bycatch. For example, despite reaching 80% of their Cape Cod Area river herring and shad catch cap in mid-January 2017, the MWT fishery was able to continue fishing there until the end of the year, without exceeding the cap, because of their adherence to bycatch avoidance program communications. Staff (B. Schondelmeier and W. Hoffman) co-authored a paper evaluating the program's impacts that was published in the journal *Marine Policy* in 2017.

Shown to be a cost-effective and accurate method for collecting catch composition data in this fishery, portside sampling (paired with electronic monitoring) may soon be a fishery monitoring option. At the desires of the MWT industry and the NEFMC, *MarineFisheries* and NOAA's Greater Atlantic Regional Fisheries Office (GARFO) continued to work on integrating portside sampling data into river herring and shad catch cap monitoring. Also, *MarineFisheries* assisted NEFOP and GARFO with the implementation phase of the NOAA Omnibus Industry-Funded Monitoring Amendment.

Project staff conducted extensive outreach with industry, fisheries managers, and stakeholders during the year. Talks and presentations were provided to the Massachusetts Marine Fisheries Advisory Commission, the Stellwagen Bank Sanctuary's Advisory Committee, the MAFMC's River Herring/Shad Committee, the River Herring Technical Expert Working Group, a Massachusetts Marine Fisheries Institute workshop on accountability measures and multiple herring industry and stakeholder groups. Informational documents were published through the new *MarineFisheries* website and social media, the SMAST bycatch avoidance website, and Massachusetts Lobstermen's Association publications. A text message notification system was again used to inform commercial fixed-gear fishermen about potential RSA fishing activity.

MarineFisheries' collaboration with external agencies continues to broaden the scope of research and utility of fisheries sampling data. Multiple NEFMC fisheries monitoring and river herring conservation issues are being directly informed by findings from past and ongoing work. Collaboration with NOAA Cooperative Research's Study Fleet program helps implement tow-level electronic Vessel Trip Reports via onboard laptops. This system allows for real-time data collection which aids *MarineFisheries*, NOAA and fishermen alike. In a continuation of an ASMFC project, genetic stock identification of river herring caught as bycatch at sea, paired with bycatch expansions, is contributing to ongoing research, with the goal of further describing the origin, scale and relative impact of this bycatch.

Operating under the 2016–2018 Herring Research Set-Aside, *MarineFisheries* and SMAST allocated 2,136 metric tons of RSA herring quota to eligible participating vessels in 2017. Unfortunately the conditions for RSA harvest did not arise this year (area-specific quotas were not achieved), and none of the RSA quota was

harvested. However, due to their strong level of support for the program, the nine participating vessels donated $67,000 in order to continue the portside sampling and bycatch avoidance work in 2018.

Additionally under the RSA, SMAST and *MarineFisheries* are evaluating a pelagic species distribution model for possible integration into the bycatch avoidance program. Further, this same group began work on a NOAA Bycatch Reduction Engineering Program grant to mount data loggers on MWT nets in order to record environmental conditions during commercial hauls. These data will be matched with fishery sampling data and will also refine a pelagic species distribution forecast, with the hopes of identifying specific habitats with increased chances of bycatch.

Finally, in order to inform the timing of the Massachusetts/New Hampshire (MA/NH) Spawning Area closure, *MarineFisheries* sampled the gonad somatic index (GSI) of commercial landings from Herring Management Area 1A. This season marked the second year using a new spawning forecast model to determine closure dates. Maturity data collected to date have revealed a greatly improved alignment with the reproductive biology of the herring population. Between Maine Department of Marine Resources and *MarineFisheries*, a record 29 fishery samples were collected and processed in 2017, providing an unprecedented description of the spawning season. The spawning forecast from the model resulted in a closure starting October 1. Comparison to full-season maturity data collected after the closure revealed the forecast to be within two days of the target spawning level (Figure 22). Fishery samples during the final week of the initial 4-week MA/NH spawning closure indicated the continued presence of herring in spawning condition, resulting in an additional 2-week closure. *MarineFisheries* also obtained two GSI samples on landings from Georges Bank. While there are currently no regulations that address harvest of spawning herring on Georges Bank, collection of spawning data from these offshore areas is a continued priority.

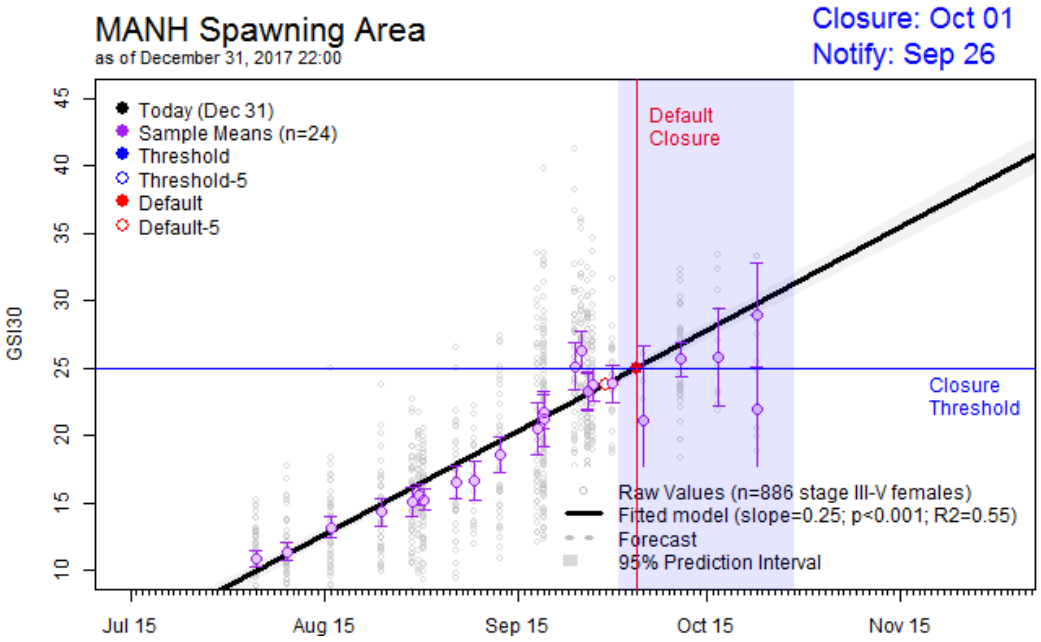

Figure 22. Comparison of sample GSI and forecast model predictions for Atlantic herring.

Special Fisheries Research Projects

Recreational Discard Mortality Studies

Haddock: In 2017, *MarineFisheries* and partners (SMAST, New England Aquarium, and University of New England) completed analysis of data collected utilizing acoustic telemetry to estimate the recreational discard mortality of haddock in the GOM. Funds from two NOAA grants allowed us to tag 156 haddock with acoustic transmitters in 2015, maintain an array of 32 receivers at the study site (central Jeffrey's Ledge) to monitor their fate, and record observations on an additional 2,422 haddock. Data were used to create a fishery-wide estimate of discard mortality, and model the influence of release condition on discard mortality. Results suggest that the mortality rate of discarded haddock is substantially greater than cod (~65% vs. ~15%), and is most influenced by size and season, with smaller haddock caught in summer being the most vulnerable. While a manuscript was under development for a peer-reviewed scientific journal at year's end, a preliminary estimate of discard mortality was made available to the NEFSC in 2017 and incorporated into the stock assessment.

Cusk: Nearly all cusk caught by the recreational fishery exhibit severe barotrauma symptoms and are unable to re-submerge to their natural benthic habitat. Our team of discard mortality collaborators designed a study to evaluate release devices as a tool to return cusk to the seafloor, allowing them to recompress their gas bladders. Acoustic telemetry was used to monitor the behavior and fate of fish post-release, revealing an unprecedented view of cusk movements. Although fieldwork primarily occurred in 2016 (447 cusk tagged over 18 trips; 76 with acoustic transmitters, monitored via a 43-receiver array), additional trips occurred in 2017 to confirm residency and survival of tagged cusk. Two cusk tagged more than a year earlier were recaptured on a single 2017 trip, demonstrating that release devices can result in post-release survival at some level. Analysis of the telemetry detection data was underway at year's end to produce a robust mortality estimate for use in stock assessments and fishery management plans.

Multiple Species: A common feature to each of our discard mortality studies has been to estimate the effect of release condition on discard mortality. Each acoustically tagged fish is examined for a series of physical attributes (e.g., hooking injury/location, barotrauma symptoms) and assigned a "condition" score upon release. Estimating discard mortality as a function of release condition allows us to determine which factors contribute to poor release condition, and ultimately to poor survival. Our team of collaborators was awarded a NOAA Bycatch Reduction Engineering Program grant in 2017 to gather comprehensive release condition data for several recreational groundfish species, including cod, haddock, cusk and pollock. Fieldwork (beginning April 2018) will include observing recreational groundfishing trips and recording release condition, along with various fishery (tackle configuration, handling time, etc.) and environmental (water temperature, air temperature, season) variables. This project will allow us to provide more accurate fishery-wide estimates of discard mortality, as well as establish a set of best practice recommendations for the capture and handling of groundfish to promote survival.

Geolocation of Groundfish from Archival Data Storage Tags

Two scientific journal articles on the geolocation of Atlantic cod via archival Data Storage Tags (DSTs) were published in 2017 by a team of scientists that included Division biologists. Both papers relied on data collected under a previous *MarineFisheries* cod tagging project in the Spring Cod Conservation Zone (SCCZ).

The first paper (with co-authors including M. Dean, W. Hoffman, and D. Martins and in the *ICES Journal of Marine Science*) compared observed temperature and depth records to a high-resolution oceanographic model to describe the annual movements of spring spawning cod throughout the Gulf of Maine. The second paper (with co-authors including M. Dean and in the *Canadian Journal of Fisheries and Aquatic Sciences*)

expanded upon this concept by applying a Hidden Markov Modeling framework that incorporates behavioral rules to achieve a more precise geolocation history. A key innovation for these studies was the ability to validate geolocation results with cod that were double-tagged with both acoustic transmitters and DSTs. The Division's acoustic tagging studies of 2010–2012 provided known positions against which the DST geolocation predictions could be compared.

Industry-Based Survey for Gulf of Maine Cod

Recent stock assessment updates for GOM cod have repeatedly found that the stock is overfished and that biomass continues to decline to unprecedented lows, despite repeated management actions to achieve rebuilding. At the same time, many fishermen have expressed concerns that the stock assessments do not reflect the true abundance of GOM cod. To better understand the population dynamics, improve our ability to assess and manage this stock, and address the issues that underlie industry disbelief in the scientific advice, *MarineFisheries* developed an industry-based trawl survey (cod IBS) in a portion of the GOM that encompasses 97% of the cod biomass and 93% of the commercial cod landings. The survey was launched in 2016.

In 2017, the F/V Miss Emily, a Scituate-based 55' stern trawler that is owned and operated by Kevin Norton, continued to act as the survey vessel. The vessel was outfitted with a new boom and net drum motor in 2017 to better handle large survey catches. The onboard electronic data collection system was improved to operate in the harsh working environment commonly endured on the deck of a commercial fishing vessel. These improvements led to a more reliable data collection system that is the backbone of the survey.

Eight monthly cruises, that attempted 50 tows per cruise, and covered the two peaks in cod spawning activity, were conducted in 2017: January, April, May, June, July, October, November, and December. *MarineFisheries* staff complete 65 days of survey work and 326 representative stations, resulting in a completion rate of 82%. In mid-November, a vessel breakdown occurred leading it to be unavailable for the rest of the month resulting in a 16% completion rate (Table 20).

The survey observed 61 different fish and invertebrate species. See Table 21 for total catch weights and catch per unit effort for groundfish species. Of the cod catch, fish between 15 and 24 inches were the most prevalent, while there was a notable absence of younger fish (<15 in) and large adults (>31 in). Haddock was the most abundant species caught.

Although the survey has been designed to study cod and is the priority species, all organisms caught were weighed and all groundfish, river herring, and lobsters were measured. Biological data collected from cod included: length, sex, maturity, genetics, and age structures (Table 22). Data and specimen requests were also collected for numerous government agencies, scientific organizations, and universities.

Division staff presented the results of the cod IBS at 12 different meetings during the year. Audiences included: Governor Charlie Baker and his cabinet, Northeast Fisheries Science Center staff, Massachusetts Marine Fisheries Institute Advisory Council, members of the American Fisheries Society, NEFMC Groundfish Plan Development Team, Northeast Fisheries Science Center, and members of the New England groundfish commercial fishing industry. Additionally a web application was developed that allows survey results to be viewed graphically over time. This web application also allows commercial fishing industry members to utilize survey results to guide them on the most efficient way to manage their species specific quotas (Annual Catch Entitlement).

Table 20. Tow completion rate by month.

Month	Rate (%)
January	82
April	96
May	96
June	98
July	100
October	78
November	16
December	76

Table 21. Total catch weights and CPUE of groundfish species.

Species	Kilograms	CPUE (kg/hr)
Haddock	39,389.51	257.11
Acadian redfish	12,328.93	80.48
American plaice	4,534.82	29.60
Atlantic cod	3,536.15	23.08
Winter flounder	2,535.30	16.55
Yellowtail flounder	2,152.90	14.05
White hake	1,295.61	8.46
Witch flounder	961.57	6.28
Pollock	803.52	5.24
Ocean pout	286.59	1.87
Atlantic wolffish	113.05	0.74
Atlantic halibut	90.53	0.59
Windowpane	76.07	0.50

Table 22. Biological data collected from Atlantic cod.

Data element	Quantity
Lengths	1,536
Sex & maturity	1,367
Otoliths	828
Dorsal fin clips	758
Caudal fins	96
Heads	17

In addition to standard survey operations, *MarineFisheries* continued a complementary study to estimate the catchability of the cod IBS trawl. Funding for the study was received through a NEFMC grant and administered by the Gulf of Maine Research Institute. In particular, this study quantified the escapement of groundfish species under the sweep of the trawl which will be used to increase the accuracy of swept area biomass estimates from the cod IBS. This work was completed in May and June of 2017, when 21 experimental tows were conducted over a three-day period. Results from the efficiency study were incorporated into a cod IBS working paper that was submitted to the NEFSC as part of the groundfish assessment update. It demonstrated how critical the experiment was for being able to interpret the results of the broader cod IBS dataset.

Year two of the survey will be completed in January 2018. Beginning in April 2018, year three of the survey will begin, and if funds allow, continue for a full third year.

Alewife Life History Modeling

As part of a collaborative grant with researchers from the University of Massachusetts Amherst, the Southwest Fisheries Science Center of NMFS, University of California Santa Cruz, and the Nature Conservancy to study impacts of bycatch on river herring production, G. Nelson developed an empirical-based alewife (*Alosa pseudoharengus*) life history model in 2016 that included all life stages and allows movement of individuals between ocean and freshwater systems. In 2017, significant time was spent refining empirical relationships as new field data became available and more detail (density-dependent growth and feeding models) was added to the model. A final report to the ASMFC was completed.

Striped Bass Research Project

Massachusetts is home to the one of the largest striped bass fisheries in the country. High population abundance of striped bass, the diversity of the Commonwealth's nearshore habitat, and many sources of food for striped bass are major factors contributing to the success of this fishery. Without a doubt, striped bass are the backbone of the Massachusetts recreational industry and provide enjoyment to hundreds of thousands of recreational anglers each year. Accordingly, this important resource is given a high level of attention by conducting many special investigations and monitoring programs designed to support the regional management process.

Survival Tagging Study

MarineFisheries has participated in the Striped Bass Cooperative State-Federal Coast-wide Tagging Study since 1991. The study's primary objective has been to develop an integrated database of tag releases and recoveries that will provide current information related to striped bass mortality and migration rates. During 2017, Striped Bass Research Project staff conducted 10 trips aboard contracted vessels, tagging a total of 380 striped bass.

Market Sampling

Monitoring of the age, size, and sex composition of the commercial harvest of striped bass is indispensable for identifying effective management and for substantiating estimates of mortality derived from fishery-independent sources. The objective of this project is to generate a time series database of biological characteristics of Massachusetts's commercial striped bass landings. During 2017, Striped Bass Research Project staff conducted 20 market sampling trips, collecting length, weight, and age structures (scales) from 493 commercially-caught fish.

Acoustic Tagging Study

In 2017, *MarineFisheries* continued an acoustic telemetry study of striped bass in Massachusetts waters. This study is a collaboration between staff in the Fish Biology Program and Diadromous Fisheries Project to examine how mortality is influenced by selection of habitat and migratory route to and from Massachusetts waters. The study design combines analysis of acoustically tagged fish with genetically derived population composition estimates of summering aggregations. *MarineFisheries* biologists are also collaborating with researchers from University of Massachusetts Amherst, University of Montana, and University of New Brunswick St. John to develop genetic tools and analyze collected data. The creation of a genetic population baseline for striped bass will allow *MarineFisheries* to establish spawning-population-specific mortality rates for striped bass harvested by Massachusetts anglers. Since 2015, over 4,500 genetic samples have been collected from striped bass caught in state waters.

During 2017, acoustic receivers were deployed between Nahant and Hull in Boston Harbor, off Provincetown and Monomoy on Cape Cod, and between East Chop and Falmouth as well as Gay Head and the Gooseberry Islands in Vineyard Sound and Buzzards Bay to monitor the movements of tagged striped bass. Acoustic monitoring will continue through at least 2019. Initial analysis of tagged bass detections in Massachusetts and coastal waters during 2015 and 2016 indicated that most fish tagged in 2015 were part of the Hudson River spawning population, especially fish that were below commercial size.

Volunteer Recreational Angler Data Collection Program

The Sportfish Angler Data Collection Team (SADCT) program was implemented in 2002 to generate a time series database of biological characteristics of Massachusetts' striped bass recreational catch. During 2017, 69 participating anglers collected over 2,000 paired length/age samples from striped bass. The size composition of striped bass reported by participating anglers and fishing mode (shore versus boat fishing) is shown in Figure 23.

In 2013, the SADCT program was expanded to include black sea bass, scup, and fluke. In 2017, SADCT anglers collected 258 samples from black sea bass, 53 samples from fluke, and 98 samples from scup.

The striped bass carcass collection program also continued in 2017 and obtained 242 otolith samples from volunteer anglers.

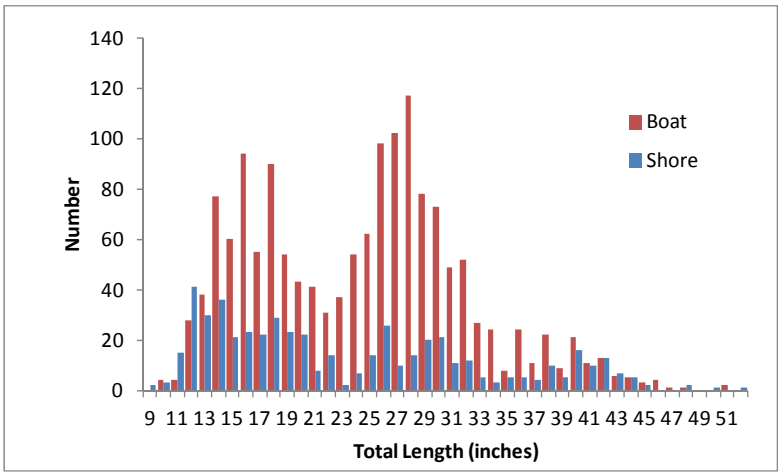

Figure 23. Size composition of striped bass collected by SADCT anglers in 2017.

Striped Bass Stock Assessment

As the developer of the ASMFC striped bass stock assessment model, G. Nelson conducted a continuity update of the striped bass stock assessment in 2017 for the 2018 benchmark. In addition, considerable time was spent developing new methods for estimating coast-wide commercial discards of striped bass for the 2018 benchmark assessment and reconstructing *MarineFisheries* striped bass commercial data back to 1982.

Other Activities

Sportfisheries Technical Assistance

Fish Biology Program staff provide technical expertise to other governmental organizations, private groups, and individuals with concerns about marine fisheries and serve on technical and advisory committees to support management efforts of important marine species. In 2017, G. Nelson served as the Massachusetts representative to the ASMFC's Striped Bass Tagging, Technical, and Stock Assessment Committees, and as a member of the NMFS operational assessment review panel. M. Dean served on the ASMFC Atlantic Menhaden Technical Committee and Multispecies Committee and the NEFMC Atlantic Herring Plan Development Team. W. Hoffman served on the ACCSP Bycatch and Biological Sampling Priorities Committees. S. Elzey served on the ASMFC age and growth QA/QC manual committee. Many presentations were given by staff to other governmental organizations and private groups.

Assessment and Survey Program

Personnel

Robert Glenn, Program Manager

Conservation Engineering Project
Dr. Michael Pol, Senior Marine Fisheries Biologist, Project Leader
David Chosid, Marine Fisheries Biologist

Invertebrate Fisheries Project
Dr. Tracy Pugh, Senior Marine Fisheries Biologist, Project Leader
Derek Perry, Marine Fisheries Biologist
Kelly Whitmore, Marine Fisheries Biologist
Steve Wilcox, Marine Fisheries Biologist
Mike Trainor, Assistant Marine Fisheries Biologist
Elizabeth Morrissey, Seasonal Fisheries Technician
Mike Walsh, Seasonal Fisheries Technician
Mike Auriemma, Seasonal Fisheries Technician

Protected Species Project
Erin Burke, Protected Species Specialist

Resource Assessment Project
Matthew Camisa, Senior Marine Fisheries Biologist, Project Leader
Vincent Manfredi, Marine Fisheries Biologist
Mark Szymanski, Marine Fisheries Biologist

Stock Assessment and Management Support Project
Dr. Greg Decelles, Senior Marine Fisheries Biologist/Stock Assessment Specialist
Dr. Tiffany Cunningham, Senior Marine Fisheries Biologist/Stock Assessment Specialist
Brendan Reilly, Seasonal Fisheries Technician

Overview

The Assessment and Survey Program includes five projects.

The **Conservation Engineering Project** (CE) collaborates with commercial fishing industry members and others to improve the design and performance of fishing gear and fishing practices. The Project focuses on reducing impacts of fishing gear on non-target species by understanding the behavior of fish around fishing gear. Producing peer-reviewed publications and participating on national and international organizations is integral to CE's work.

The **Invertebrate Fisheries Project** focuses on research and monitoring of commercially important marine invertebrates including American lobster, horseshoe crab, Jonah crab, whelk, and northern shrimp. Fishery-dependent and -independent surveys, plus applied research projects, are conducted to characterize the populations of, and the fisheries for, these valuable species and to inform their management. Additional tasks include research grant administration and participation on ASMFC technical committees.

The **Protected Species Project** is involved in various activities related to the conservation and management of protected species in Massachusetts waters. This includes oversight of the right whale surveillance program, acoustic monitoring of right whales, large whale and sea turtle disentanglement, participation on

federal Take Reduction Teams, grant management, and other activities, such as evaluating the potential risk of entanglement in subtidal aquaculture gear.

The **Resource Assessment Project** monitors the distribution, relative abundance, and size composition of marine fish and invertebrates in Massachusetts waters by conducting annual surveys utilizing consistent protocols. These include spring and fall statewide trawl surveys and a seine survey in certain south-facing Cape Cod estuaries. Survey data are used in assessments of numerous regional fish stocks, inform fishery management decisions, and contribute to evaluation of coastal alteration projects.

The **Stock Assessment and Management Support Project** provides dedicated staff to the task of contributing technical and analytical skills in support of regional stock assessments and management decisions in two areas: 1) key recreational species, including fluke, scup, black sea bass, tautog, and bluefish; and 2) groundfish. The recreational fisheries Marine Fisheries Biologist position is funded by saltwater fishing permit revenues through the Marine Recreational Fisheries Development Fund.

Conservation Engineering Project

Revision of Existing Whiting Special Access Areas

The second of a two-year study evaluating the possible earlier opening of the whiting fishery in Small Mesh Area 1 (SMA1, currently open July 15–November 15) was completed. No further effort was focused on the western Raised Footrope Exemption Area due to limited fishermen interest. Five trawlers from Gloucester participated in 25 experimental fishing trips in SMA1, off Ipswich Bay, between July 1–13 with sea samplers on board to weigh and measure the catch. Prior to start of the experimental fishery, CE surveyed fishermen for interest in participating, obtained an Experimental Fishing Permit from GARFO, and measured fishermen's nets to verify proper gear configurations. Video was also collected of one of the nets to document proper measurements of whiting gear. After fishing concluded, CE and other project staff conducted data analysis on both years' data.

Comparisons of catch data during the experimental fishery and the exempted SMA1 fishery indicate similar groundfish bycatch ratios. Haddock dominated the groundfish bycatch with American plaice and yellowtail flounder comprising a secondary component of groundfish bycatch. Excluding haddock, targeted whiting activity operated below the 0.05 groundfish bycatch ratio threshold during both the experimental and exempted time periods. There were indicators that operator performance impacted the ability of individual vessels to successfully take advantage of access to silver hake (whiting) while limiting bycatch of large-mesh groundfish. It appears therefore that outreach and education on proper configuration and use of required gear may be beneficial. CE produced an interim report for GARFO as part of the EFP process in 2017; a final report will be submitted and available for future management decisions.

Development of Side-scan Sonar Methodology to Survey Derelict Lobster Pots

During 2017, CE worked towards the conclusion of this National Fish & Wildlife Foundation funded project to establish the effectiveness of identifying ghost pots on the seafloor using sidescan sonar. Field work was completed in 2016 through a collaboration of multiple Division groups and fisherman Aaron Cebula. Overall, the results contraindicate the use of sidescan sonar to efficiently detect derelict lobster pots. CE submitted a final report to the funding entity, initiated a manuscript, provided an article for the DMF News, and submitted an abstract to present the project at a science conference in 2018.

Development of an Ultra-low-opening Groundfish Trawl to Avoid Cod

Figure 24. CE's M. Pol and Captain Ford field test the ultra-low-opening trawl.

Outreach and publication were the main foci in 2017 of this Saltonstall-Kennedy funded project to develop a trawl with a very low headline height to fish under cod for flatfish. Led by CE and Steve Earys (Gulf of Maine Research Institute), the project brought together a team of fishermen (Dan Murphy, Jim Ford), a gear maker (Jon Knight of Superior Trawl), and other researchers (Chris Glass of UNH, Pingguo He of SMAST, and Paul Winger of Memorial University of Newfoundland) to design, model, flume tank trial, and field test a new net design (Figure 24). Field testing in 2016 demonstrated that the selected net design was effective at reducing cod catches by about 50% compared to a standard trawl. Subsequent analysis suggested that use of the net could increase fishing time for flatfish by 80% and raise trip revenue by more than 30%. In 2017, nets were shared at no cost with fishermen in Green Harbor, Gloucester, and Newburyport. Study results and the opportunity for free trialing of the net were publicized via social media. Staff (M. Pol) presented the project's results at the annual meeting of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour.

Reducing Flatfish Bycatch in the Sea Scallop Fishery

This project, to evaluate the potential for a simple scallop dredge modification to reduce flatfish bycatch, advanced to sea trails in 2017. With funding awarded to the Provincetown Center for Coastal Studies by the NOAA Saltonstall-Kennedy grant program, the "tickle dredge" was field tested aboard the F/V Glutton (owned and operated by Beau Gribbin) on four days. CE assisted with gear preparation, dredge design, field testing, video collection, data analysis, and report writing. The dredge design was finalized during fieldwork based on live underwater video. Preliminary data analysis indicated the modifications did not reduce catches of flatfish; however, a final report was planned for early 2018.

Redeveloping a Sustainable Redfish Trawl Fishery in the Gulf of Maine

CE completed additional analysis of results from this NOAA-funded project which previously brought together a network of gear researchers, net makers, fishermen, management staff, fish processors and others working to re-establish the redfish trawl fishery in the Gulf of Maine. Pol's work on redfish bycatch, selectivity, escape timing, and possible impact on the redfish stock in the Gulf of Maine formed the basis for his PhD dissertation which was finalized and accepted during 2017 by UMass Dartmouth. A manuscript on catch and bycatch in an experimental redfish trawl fishery was also initiated.

Reducing Juvenile Haddock and Cod Catch in the Georges Bank Haddock Fishery

The goal of this Saltonstall-Kennedy funded project is to design and test a "dual-grid" system for eliminating small haddock from a trawl net before they reach the codend, as a means of reducing mortality. CE teamed with Chris Rillahan (SMAST) to test the system at sea in May 2017.

Complementary Testing of Off-Bottom Trawls to Target Georges Bank Haddock

Figure 25. Project participants inspect the twisted twine used on the off-bottom trawl. From left to right: Tor Bendiksen of Reidar's Manufacturing, Captain Phillips, and Professor He.

CE initiated a new project to demonstrate the effectiveness of off-bottom, mid-water trawls to target Georges Bank haddock and redfish. This project was funded by a NOAA Saltonstall-Kennedy grant and is a partnership with Steve Eayrs (GMRI), Jim Odlin (Atlantic Trawlers Fishing), Mark Phillips (F/V Illusion), and Pingguo He (SMAST). The project includes a comparison of an off-bottom trawl to a Ruhle trawl. CE organized two meetings with project partners to prepare for all aspects of the research (Figure 25).

Time at sea to allow familiarity with the net and adjustment for appropriate rigging was conducted on the F/V Illusion in late August–early September south of Nantucket and Martha's Vineyard with an open codend. CE collected and analyzed net geometry and video data, and presented results to partners. An interim report was submitted to the granting entity. Due to fishing schedules of industry partners, weather, resource availability, and other delays, the project partners postponed full sea trials until Spring 2018 and requested a one year no-cost extension.

Other Activities

Appointments: Michael Pol continued serving on the ICES-FAO Working Group on Fishing Technology and Fish Behaviour, and continued to co-chair a topic group examining hurdles to adoption of new fishing gears by the fishing fleet. He was also appointed co-chair of the Joint Workshop of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour and the Working Group on Fisheries Acoustics Science and Technology. He continued serving on the NEFMC Research Steering Committee and the ASMFC Fishing Gear Technology Workgroup, and the NEFMC/MAFMC Northeast Trawl Advisory Panel. Pol served on the Editorial Board of the journal *Fisheries Research*.

Video Digitization: CE has now digitized approximately 70% of its extensive collection of fishing gear video (nearly 1,400 individual recordings). Video hardware and software were also updated.

Other Publications: Staff (M. Pol) was co-author to two manuscripts published in 2017 on previous CE collaborations: one on a grid designed to reduce bycatch in the longfin inshore squid trawl fishery (*Journal of Applied Icthyology*), the other on a topless trawl designed to reduce cod bycatch in the groundfish fishery (in the journal *Fisheries Research*).

Invertebrate Fisheries Project

American Lobster Research and Monitoring

Commercial Lobster Trap Sampling: *MarineFisheries* has worked cooperatively with Massachusetts commercial lobster trap fishermen to sample their catch since 1981. In 2017, the 37th year of operation, a total of 76 trips were conducted by staff members of the Invertebrate Fisheries Project (42 trips) and the Fisheries Dependent Sampling Project (34 trips), during which 50,886 lobsters were sampled from 15,939 trap hauls. Data from the commercial trap sampling program are used to characterize the sex ratio and size

distribution of the commercial catch, as well as to track regulatory discards (including sublegal-sized lobsters, egg-bearing females, and v-notched females). This effort also tracks the prevalence of shell disease symptoms on lobsters in Massachusetts coastal waters (Figure 26). In 2017, a total of 7,881 lobsters were sampled for shell disease. All data are provided annually to the ASMFC and ACCSP.

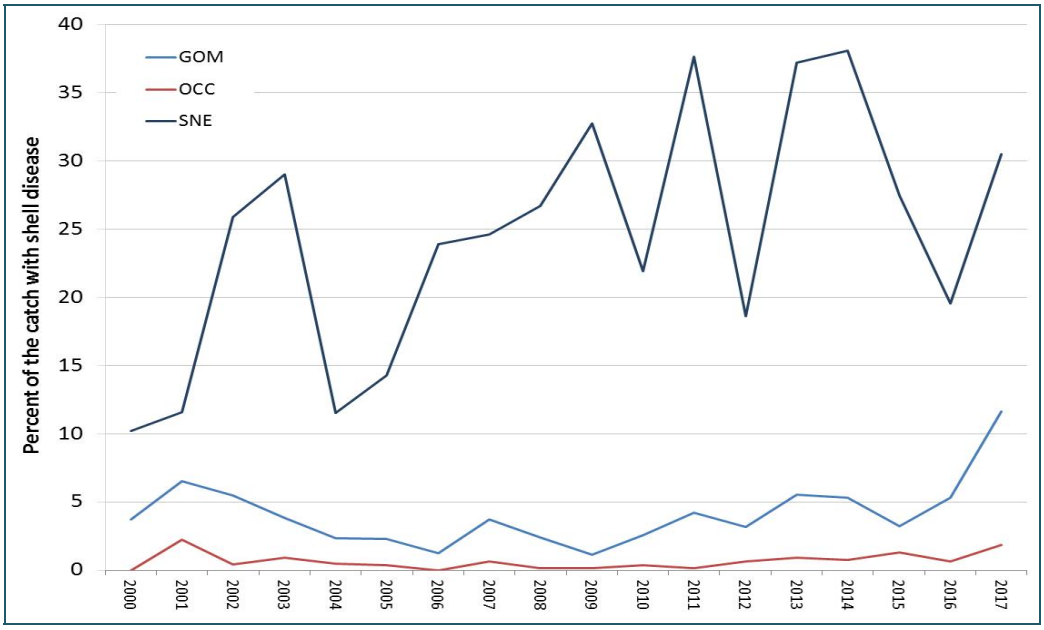

Figure 26. Percent of the observed lobster catch with shell disease from commercial trap sampling in the inshore Gulf of Maine (GOM), Outer Cape Cod (OCC) and nearshore Southern New England (SNE) regions.

Staff continued to conduct bycatch sampling during commercial lobster trap sampling to better characterize the incidental catch of several commercially important finfish species. For each sampled species (e.g., black sea bass, tautog, scup, cod, haddock, various flounders), samplers collect size and disposition information (including presence/absence of barotrauma wounds).

Ventless Lobster Trap Survey: The 2017 Ventless Trap Survey took place from June through September with seven contracted vessels. Project staff completed a total of 64 sea days. This survey is a cooperative effort between *MarineFisheries* and the lobster fishing industry to monitor the abundance of lobster and several bycatch species, and is funded by commercial and recreational lobster permit fees. The data from the Ventless Trap Survey are used to generate indices of lobster relative abundance, to monitor various population characteristics (such as sex ratio, abundance of egg-bearing females, and disease), and to examine spatial patterns in abundance (Figure 27). The ASMFC Lobster Technical Committee continually monitors the results of the various states' ventless trap surveys as indicators of stock status in both the GOM/GB and SNE stocks. In 2017 a total of 15,459 lobsters were sampled from 2,813 trap hauls in the northern survey area (Cape Cod Bay to the NH border). In the southern survey area (Buzzards Bay, south of the Elizabeth Islands, and portions of Rhode Island Sound), a total of 5,035 lobsters were sampled from 1,908 trap hauls.

Additional biological sampling of bycatch species was continued in 2017, which increases the available data on commercially important crab and finfish species. In both survey areas samplers collect length and sex for Cancer crabs (Jonah and rock crabs), and length information for various finfish species. Additionally, staff collected age structures for black sea bass and tautog captured in the southern survey area, which were analyzed by the Age and Growth Project in the Gloucester lab.

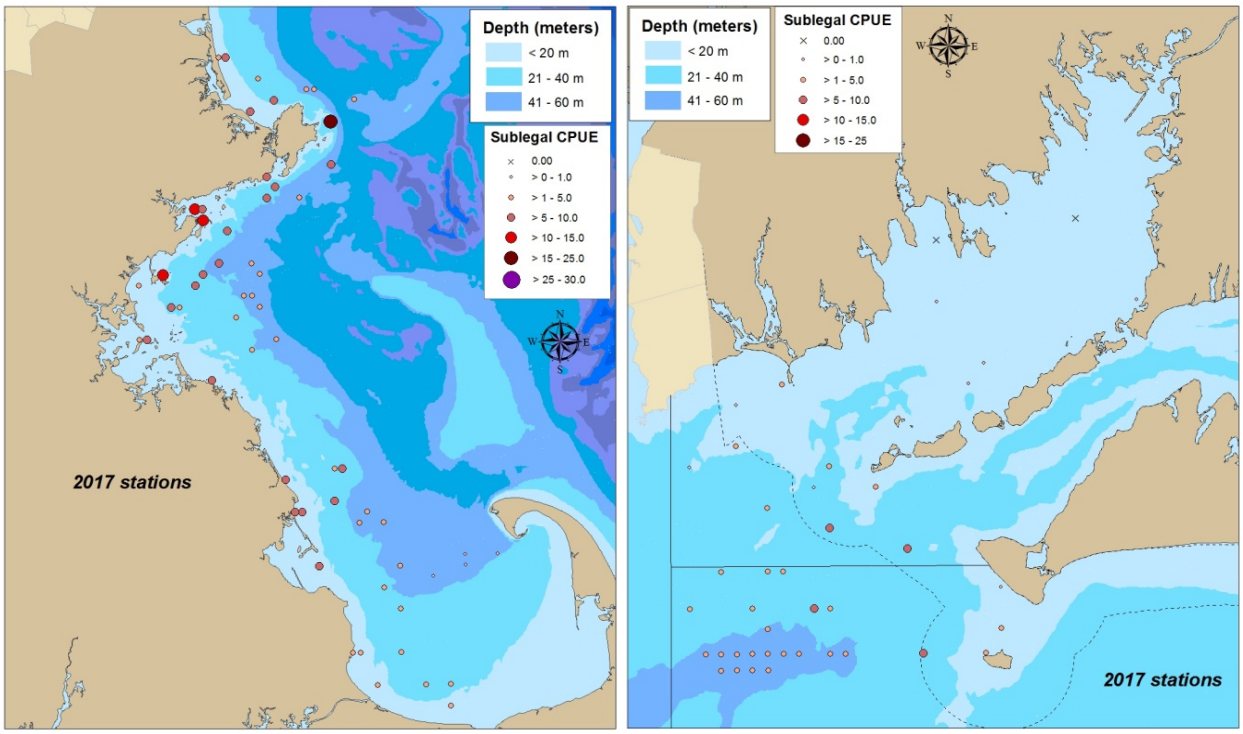

Figure 27. Average catch per trap haul (CPUE) of sublegal-sized lobsters at the 2017 ventless trap survey stations in the northern (left) and southern (right) survey areas.

Annual Early-Benthic-Phase Lobster Suction Sampling: Project staff completed the 23nd year of this sampling program in 2017. The program is conducted to track year class strength of newly settled post-larval American lobsters and to delineate coastal habitat important to the settlement of these juveniles. A total of 23 coastal sites were surveyed spanning Buzzards Bay, Cape Cod Bay, and Massachusetts Bay. Project staff conducted the SCUBA-based survey over 12 field days from August to mid-October. Mean densities of YOY lobsters were above the time series mean in the Cape Ann and South Shore regions, and below the time series mean in Salem Sound, Boston, Cape Cod Bay, Buzzards Bay and Vineyard Sound. Data from this program contribute annually to the American Lobster Settlement Index, an international research collaborative that tracks changes in recruitment of American lobsters.

Applied Research: Work intensified on all aspects of a NOAA Saltonstall-Kennedy grant funded project to examine potential sub-lethal impacts of stress to reproductive output in SNE lobsters and determine if shell disease can be used as an indicator of reproductive problems in all lobster stocks. Led by T. Pugh, this is a collaborative project involving researchers from University of New Hampshire, Wells National Estuarine Research Reserve, and Department of Fisheries and Oceans Canada. Invertebrate Project staff members made multiple collection trips in the Southern New England study area, gathering egg-bearing females for fecundity analyses (conducted by Wells NEER staff), males and pre-molt females for use in mating experiments (conducted by UNH), recently molted females for determination of mating success (conducted by *MarineFisheries*), and male lobsters for examination of spermatophore output (conducted by *MarineFisheries*). Staff processed 279 recently molted females and 56 males; female seminal receptacles and male spermatophores were prepared for histological analysis of sperm content. Data analyses as well as additional field and laboratory work will be conducted in 2018 to wrap up this project.

Invertebrate Project staff collaborated with a team of researchers working on another Saltonstall-Kennedy funded project to examine how early-stage lobster recruitment is impacted by warming ocean waters. Staff provided data on lobster distribution shifts and biological advice to the modeling team from WHOI and

SMAST, as well as at-sea observations on lobster egg hatch to inform the timing of a larval survey conducted by SMAST faculty and students.

Staff continued to work on updating maturity information for offshore lobsters, including finishing sample processing and conducting data analyses. These data will help to fill gaps in maturity information for the offshore components of the GOM/GB and the SNE lobster stocks.

Assessment and Management Support: T. Pugh served as the vice-chair for the ASMFC American Lobster Technical Committee. T. Pugh presented an update on the status of the Southern New England lobster stock to the MA Marine Fisheries Advisory Commission in May, prior to a vote on pending management measures by the ASMFC Lobster Management Board.

Presentations and publications: T. Pugh was co-author to an article published in the *Journal of Crustacean Biology* regarding mating by sexually immature female lobsters. Staff presented at the *International Conference & Workshop on Lobster Biology and Management* on ghost fishing by derelict traps in the lobster fishery (K. Whitmore) and image analysis to examine the composition of male lobster ejaculates (T. Pugh).

Other Activities: Invertebrate Fisheries Project staff members attended the 2017 Massachusetts Lobstermen's Association Annual Weekend, which serves to improve relations with industry members and provides an opportunity to engage with them on the various research and monitoring programs we conduct.

Staff members K. Whitmore, E. Morrissey, and E. Brewer completed a comprehensive report which reviewed trends in recreational lobster licenses, effort, and catch from 2000–2015. The report also summarized the results of a 2015 online survey of MA recreational permit holders on fishing patterns and gear loss. Findings included a 40% decline in the number of permits fished since 2000, with 3,900 permits fished in 2015. Over 1,400 online surveys were received and results indicated that recreational traps are lost at an average rate of 26%. The report was scheduled for addition to the *MarineFisheries* Technical Report series in 2018.

In August of 2017 staff members assisted the MA Environmental Police on a case involving potential lobster violations, examining lobsters and processing samples for evidence of illegal removal of eggs.

T. Pugh and K. Whitmore acted as reviewers for articles submitted to several scientific journals, and T. Pugh acted as a section editor for the *Bulletin of Marine Science*. T. Pugh acted as a proposal reviewer for the NOAA Saltonstall-Kennedy Grant Program.

Horseshoe Crab Monitoring

Commercial Fishery Sampling: Monitoring of the commercial bait and biomedical harvests continued in accordance with the interstate FMP. Prosomal width measurements were obtained from 405 crabs from the bait fishery and 705 crabs from the biomedical fishery. Female crabs from the bait market were slightly smaller compared to the rest of the time series, whereas male sizes remained consistent. The size distribution of biomedical crabs has been fairly consistent since sampling began in 2008.

Fisheries-Independent Surveys: Annual volunteer-based spawning beach surveys continued at 15 beaches along the South Coast, Cape Cod, and the islands. *MarineFisheries* staff conducted 30 surveys at Swift's Beach in Wareham, MA (Figure 28). Survey results were still being analyzed at year's end, but it appeared that poor spring weather conditions may have contributed to a reduced number of spawning crabs observed at many beaches.

Figure 28. Spawning horseshoe crabs at Swifts Beach, Wareham.

Assessment and Management Support: D. Perry participated as a member of the ASMFC Horseshoe Crab Technical Committee, and provided data for 2018 Benchmark Horseshoe Crab Stock Assessment.

Other Activities: D. Perry administered a mail survey to all commercial whelk pot fishermen regarding their baiting practices with an emphasis on the use of horseshoe crabs as bait. D. Perry and M. Trainor assisted the MA Environmental Police's investigation into reports of imported Asian horseshoe crabs (which are prohibited in Massachusetts). D. Perry gave a presentation at the Woods Hole Oceanographic Institution on horseshoe crab biology and the results of the 2016 spawning beach survey and resource assessment trawl survey.

Jonah Crab Research and Monitoring

Commercial Fishery Monitoring: Traditionally considered bycatch of the American lobster fishery, Jonah crab is now a targeted species and its fishery is one of the top ten most valuable in the state. Over 60% of all Jonah crabs commercially harvested in the United States are landed in Massachusetts.

Project biologists measured and sexed 11,219 Jonah crabs in 2017 as part of our port and market sampling programs. The sampled catch was comprised almost entirely of males (99.8%). The average crab was 5.5"; the largest, 6.8". Sampled crabs were landed by both inshore and offshore boats.

Applied Research: *MarineFisheries* continued to work on three Jonah crab studies in 2017.

The first project, a Jonah crab maturity study, was completed in 2017 in partnership with the Atlantic Offshore Lobstermen's Association with funding from the Commercial Fisheries Research Foundation's Saltonstall-Kennedy grant. Staff analyzed 2,356 crabs to determine male and female gonadal and morphometric maturity in five regions (Table 23). The male size at morphometric sexual maturity in all regions, including Southern New England where over 70% of Massachusetts Jonah crabs are landed, was determined to be below the current minimum legal size of 4.75" carapace width.

Field work for the second project, a tagging study with additional fisheries-dependent data collection, was completed in 2017. With ASMFC funding and again in partnership with the Atlantic Offshore Lobstermen's Association, Project biologists tagged 16,332 Jonah crabs in an effort to determine movement patterns, stock boundaries, and growth characteristics. Data analyses were ongoing at year's end; results thus far indicate that crabs have generally traveled short distances, moving a median distance of 2.7 miles from their original release location.

The third project, another tagging study, was begun in 2017 with funding provided by the Saltonstall-Kennedy grant program. In cooperation with the Atlantic Offshore Lobstermen's Association, New Hampshire Fish & Game, and Maine Department of Marine Resources, a total of 9,280 crabs were tagged during the year, nearly halfway to the goal of 20,000.

Table 23. Jonah crab male and female size at maturity estimates, by region. Sizes are carapace width in inches. NAs represent regions that could not be accurately estimated.

Region	Male size at morphometric maturity (chela height)	Female size at morphometric maturity (abdomen)	Female size at 50% gonadal maturity (physiological)
SNE offshore	4.61	3.46	3.50
SNE inshore	NA	NA	3.39
Georges Bank	4.29	3.70	3.66
GOM offshore	4.53	NA	3.86
GOM inshore	4.06	NA	NA

Assessment and Management Support: D. Perry served on and chaired the ASMFC Jonah Crab Technical Committee. Staff compiled an overview of the Jonah crab fishery and ongoing Division research for presentation to the MA Marine Fisheries Advisory Commission.

Other Activities: D. Perry gave two demonstrations to the MA Environmental Police showing officers how to measure a crab as well as providing information on crab biology and fishery statistics.

Whelk Research and Monitoring

Figure 29. Staff member M. Auriemma conducting sampling on a whelk vessel in Nantucket Sound.

Commercial Fishery Sampling: Project biologists conducted seven sampling trips aboard commercial vessels fishing conch pots for channeled whelk in 2017, measuring over 9,000 whelk (Figure 29). Fishery-dependent sampling trips have been conducted opportunistically in Nantucket Sound and Buzzards Bay since 2003. Over this timeframe, there has been a ⅜-inch decrease in the average size of channeled whelk observed. Despite minimum legal size increases that occurred in 2014, 2015, and 2017, the average size has decreased and there are fewer whelk above the size at which females reach maturity than in previous years.

Applied Research: Staff collected and processed knobbed whelk captured during the spring and fall trawl survey to further examine size-at-maturity. Over 150 samples were taken to the lab for external measurement and then dissected to determine maturity status. Maturity information is used to help monitor the populations and provide management advice for the knobbed whelk fishery. Understanding reproductive biology is an important component to ensuring there is adequate spawning stock to replenish the population and allow for sustainable harvest.

Fisheries Management Support: In 2017, there was a definition change regarding the appropriate use of the chute-style whelk gauge to determine whether a whelk is legal-sized. To understand the impacts of this change, project staff measured almost 1,500 whelk using specialized slide-style measuring boards. Each whelk was then passed through a series of gauges ranging in size from 2 ⅞" and 3 ¾" (in 1/16" increments) according to the newly defined measurement technique, to document how a whelk of known width passed or didn't pass through each gauge width. This provided information about what proportion of whelk at each size would be deemed legal using a variety of gauge sizes. Results were shared with industry and managers at several public meetings.

Public Outreach: S. Wilcox and D. Chosid (Conservation Engineering Project) partnered with MA Environmental Police Sergeant Matthew McClintock to produce a video demonstrating the proper way to measure whelk. The video is available via the Division's YouTube channel. This video served as a useful reference to fishermen, dealers, scientists, and enforcement to clarify and establish the correct measurement technique.

Northern Shrimp Research and Monitoring

Northern Shrimp Assessment Survey: In July and August, *MarineFisheries* staff participated on several one-week legs of the 34th annual northern shrimp (*Pandalus borealis*) assessment survey conducted throughout the Gulf of Maine aboard NOAA's R/V Gloria Michelle. For the sixth consecutive year, the survey indicated an exceptionally low abundance of shrimp would be available to the fishery in the upcoming

season, and low recruitment of the newest year class. The ASMFC Technical Committee recommended a 2017/2018 harvest moratorium based on the 2017 survey and assessment results, and noted that recently-observed unfavorable water temperatures may contribute further to poor recruitment.

Assessment and Management Support: K. Whitmore served on the ASMFC Northern Shrimp Technical Committee. In that role, she assisted in preparation of the annual ASMFC Northern Shrimp Stock Status Report and facilitated the development and implementation of a 2017 cooperative winter research sampling program, with participation by the MA trawler F/V Mystique Lady. *MarineFisheries* staff members processed shrimp samples from the cooperative winter research program (Figure 30) and provided biological and catch data to the Technical Committee.

K. Whitmore also served on the ASMFC Northern Shrimp Stock Assessment Subcommittee, which reviewed assessment data and models in preparation for a 2018 peer review. Whitmore also served on the ASMFC Northern Shrimp Plan Development Team to prepare Amendment 3 to the Interstate FMP.

Figure 30. Staff member E. Morrissey staging and measuring northern shrimp.

Green Crab

In February, *MarineFisheries* staff from the Invertebrate Fisheries, Fisheries Policy and Management, Shellfish, and Fisheries Statistics programs met formally with representatives from the nonprofit "Green Crab R&D Project" as requested by the group, to address questions and provide guidance relative to developing green crab (*Carcinus maenas*) as an edible seafood product in Massachusetts.

Protected Species Project

Cape Cod Bay Right Whale Surveillance Program

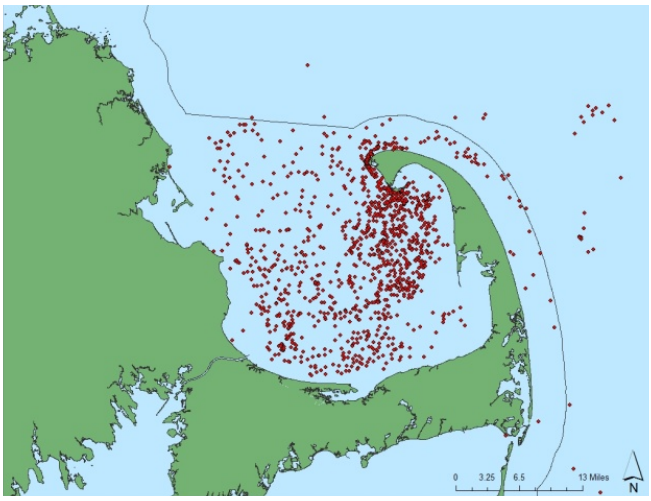

Figure 31. Map of 2017 right whale aerial sightings.

In 2017, *MarineFisheries* partnered with the Provincetown Center for Coastal Studies (PCCS) and NMFS to carry out the 19th year of the Cape Cod Bay Right Whale Surveillance Program. The program conducts aerial surveillance and habitat monitoring of right whales in the Cape Cod Bay portion of Right Whale Critical Habitat.

The trend of high abundance of right whales continued in 2017, with at least 55% (n=251) of the known right whale population being documented by the survey (Figure 31). A record-breaking 197 individual whales were observed during a single flight in April. The overall number of right whales visiting the bay in 2017 was higher than 2016 (n=182), though the seasonal pattern of arrival and departure was similar to previous years.

On April 13, a dead right whale was observed off Barnstable and necropsy results indicated the cause of death was vessel collision. 2017 was a bad year for the overall North Atlantic right whale population, with approximately 3% of the population dying due to vessel collision and entanglement. Most carcasses were observed in the Gulf of St. Lawrence (Canada). In light of this and the overall decline in the right whale population since 2010, the high abundance of right whales visiting Massachusetts waters demonstrates the importance of protecting right whales and how critical Cape Cod Bay is to the North Atlantic population.

Project Staff administered the grant from NMFS that supports aerial surveillance and habitat monitoring and assisted in coordination of large whale conservation activities. The Division issued advisories to mariners about the presence of high risk right whale aggregations.

Leatherback Sea Turtle Tagging

MarineFisheries continued its collaboration with Woods Hole Oceanographic Institution to study how sea turtle entanglement in fixed gear fisheries could be mitigated. The goal is to collect fine-scale data on turtle behavior in gear-dense areas in order to understand how they maneuver around gear and how they become entangled. In 2017, we tagged five leatherback sea turtles in Vineyard Sound with a REMUS-100 AUV and conducted concurrent habitat sampling with a second REMUS-100 AUV.

Large Whale and Sea Turtle Disentanglement

MarineFisheries and PCCS cooperatively administer the large whale and sea turtle disentanglement efforts around Massachusetts through grants from NMFS and the Massachusetts Environmental Trust. Project staff assisted in disentanglement efforts, gear analysis, and performed all grant management activities.

Of the 41 whale entanglement cases documented in 2017 along the United States and Canadian coasts, 19 of those were observed off the coast of Massachusetts: 1 right whale, 16 humpback whales, 1 fin whale, and 1 minke whale. Four humpback whales were disentangled. The remaining cases were either not life-threatening or were not in a position to be resolved due to the time of day and distance from responders.

In 2017, there were 23 confirmed leatherback sea turtle entanglement cases, higher than average over the last decade. Of these, 11 were resolved by network members and eight may have been aided by well-intentioned mariners. The remaining cases were either discovered as carcasses or could not be relocated by network members.

Other Activities

E. Burke participated as a member of the Massachusetts Habitat Working Group on Offshore Wind Energy, advising the group on monitoring for potential protected species in the Massachusetts Wind Energy Area.

E. Burke provided guidance to Division shellfish personnel and municipal and federal shellfish authorities on the potential impacts of subtidal aquaculture projects to protected species. The potential for subtidal aquaculture gear to increase entanglement risk should be carefully considered when developing and licensing these projects, especially if they fall within the boundaries of Right Whale Critical Habitat.

Resource Assessment Project

2017 Trawl Survey

The 40th annual spring and fall surveys were accomplished aboard NOAA's R/V Gloria Michelle. The spring survey completed 105 stations from May 8–26; the fall survey completed 99 stations from September 5–25 (Figure 32).

The 2017 trawl surveys provided weights, counts, and measurements for 101 different species of fish and invertebrates. To aid cooperative fisheries assessments, survey crew collected over 2,500 age structures and sex and maturity observations from cod, haddock, summer flounder, yellowtail flounder, winter flounder, windowpane flounder, black sea bass, scup, weakfish, tautog, American lobster, and Jonah crab. Additional collections supported studies on the spatial structure of cod and river herring populations, size at maturity and distribution of Jonah crab, ocean pout and smooth dogfish maturity, black sea bass age and growth, longfin squid genetics, gray seal diets, and the Ocean Genome Project.

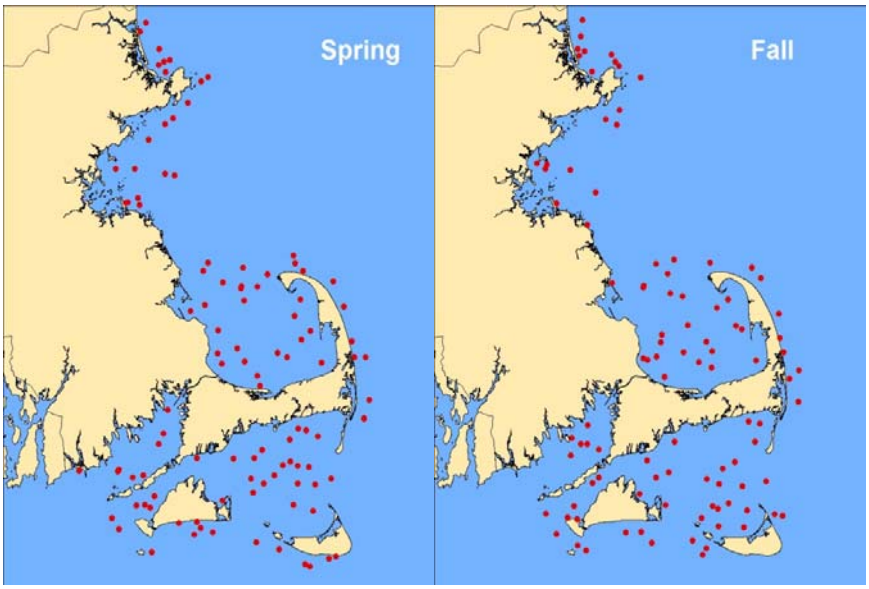

Figure 32. 2017 spring and fall trawl survey station locations.

Survey data provided by project personnel in 2017 were included in annual compliance reports for various ASMFC-managed species; supported regional management and assessment efforts for Atlantic cod, American lobster, yellowtail flounder, winter flounder, American plaice, summer flounder, scup, tautog, black sea bass and wolffish; and aided research efforts by outside institutions related to climate change, effects of temperature on fish distribution, effects of commercial fishing on forage fish distribution, and ocean planning. Project personnel also served on the following committees of the ASMFC's Northeast Area Monitoring and Assessment Program: Operations, Data Management, and Trawl Technical.

2017 Seine Survey

The 42nd Nantucket Sound Estuarine Winter Flounder Young-of-Year (YOY) Seine Survey was completed during June 19–July 6. The objective of this survey is to index winter flounder YOY abundance for the Southern New England stock; however, we count all commercially and recreationally-important finfish and invertebrates, and record presence/absence for all other species. The 2017 stratified mean index for YOY winter flounder abundance rose above the time series median for the first time since 2013. While three of the last seven years show some signs of recovery, the overall trend is one of decline for the Southern New England winter flounder stock. Forty-six species occurred in 2017 seine survey hauls.

Stock Assessment and Management Support Project

Groundfish Assessment and Management Support

G. DeCelles served on the NEFMC Groundfish Plan Development Team, where he provided analysis for assessment and management support during the development of Framework 57 and the drafting of Amendment 23. He participated in the NEFSC operational assessment updates for 19 groundfish stocks in the fall and the operational assessment for halibut in the winter. DeCelles participated during the Transboundary Resource Assessment Committee stock assessments for Eastern Georges Bank cod and

haddock and Georges Bank yellowtail flounder in the summer. DeCelles also served as a member of the ASMFC Winter Flounder Technical Committee and the NEFMC Monkfish Plan Development Team.

DeCelles collaborated with researchers from the Canadian Department of Fisheries and Oceans and the University of New Brunswick on a high-resolution genetic stock identification study for cod throughout the northwest Atlantic. He collected genetic samples from spawning and young-of-the-year cod from New England waters for genetic analysis.

Publications: DeCelles was co-author to five peer-reviewed journal articles published in 2017. One article, published in the *ICES Journal of Marine Science,* evaluates using fishermen's ecological knowledge to map cod spawning grounds on Georges Bank (co-authors also include staff member D. Martins). Two articles, one published in *Transactions of the American Fisheries Society* and the other in *Fisheries*, involve the development a new video trawl survey system for New England groundfish. A fourth article, published in the *Journal of Northwest Atlantic Fishery Science,* evaluates spatiotemporal patterns of flatfish bycatch in two scallop access areas on Georges Bank. The last article, published in the journal *Fish and Fisheries*, evaluates reproductive resilience as a means to understand connectivity and productivity in exploited marine fish.

Recreational Fish Assessment and Management Support

T. Cunningham served on the ASMFC technical committees for summer flounder, scup, black sea bass, tautog, bluefish, and weakfish, including the role of Vice-Chair for the Summer Flounder, Scup, and Black Sea Bass Technical Committee. She was also a member of the MAFMC bluefish, scup, summer flounder, and black sea bass monitoring committees. She was also appointed to the summer flounder stock assessment working group for the 2018 benchmark assessment.

Cunningham provided extensive analyses to support the stock assessment process and evaluate management strategies for recreational fisheries. Working with other New England states, proposals to advance regional management of black sea bass and tautog were developed, with the intention of providing greater equity in regulations among neighboring states. Cunningham took a lead role on ongoing technical committee work to develop improved and consistent methodologies for evaluating different management actions.

Cunningham led efforts for a NOAA Saltonstall-Kennedy grant funded project to evaluate the feasibility of a hook and line survey to assess the status of tautog in southern Massachusetts. Sampling was conducted in 2017 during the spring and fall months, concluding in November. In collaboration with local charter fisherman Captain Mel True and volunteer anglers, *MarineFisheries* collected 2,036 tautog over 47 days at 230 sampling locations (Figure 33). In addition to the valuable information collected to evaluate rod and reel sampling gear as a potential long-term monitoring tool, fish were sampled for lengths, weights, sex, maturity, and age to help inform future monitoring efforts and management measures for tautog.

Figure 33. Staff members R. Glenn and K. Creighton participating in field sampling for the tautog hook and line pilot study.

Recreational and Diadromous Fisheries Program

Personnel

Dr. Gregory Skomal, Program Manager

Recreational Fisheries Project
Dr. Gregory Skomal, Senior Marine Fisheries Biologist, Project Leader
John Boardman, Marine Fisheries Biologist
Matt Ayer, Marine Fisheries Biologist
Ross Kessler, Public Access Coordinator
David Martins, MRIP Coordinator

Large Pelagics Research Project
Dr. Gregory Skomal, Senior Marine Fisheries Biologist, Project Leader
John Chisholm, Marine Fisheries Biologist

Diadromous Fisheries Project
Brad Chase, Senior Marine Fisheries Biologist, Project Leader
John Sheppard, Marine Fisheries Biologist
Dr. Sarah Turner, Marine Fisheries Biologist
Ben Gahagan, Marine Fisheries Biologist
Edward Clark, Carpenter

Overview

The Recreational and Diadromous Fisheries Program includes three Projects.

The **Recreational Fisheries Project** works to preserve, enhance, and promote the marine recreational fisheries of the Commonwealth. Goals are to conserve key recreational species through science-based management; support the recreational fishing community, including local recreational fishing businesses; and educate the Commonwealth's citizens of the features and benefits of local recreational fisheries resources. Project personnel measure abundance, length frequency, and age classes of key finfish populations for input to stock assessments and to design and analyze management options; assess habitat and prey needs of key species; measure harvest and release of key species; and promote and enhance recreational fishing access through the purchase and maintenance of access sites; and disseminate information on all aspects of recreational species and fisheries to the public.

The **Large Pelagics Research Project** has been conducting research since 1987 to enhance our understanding of the ecology, life history, and relative abundance of sharks, tunas, and billfish off the coast of Massachusetts, where extensive recreational fisheries for these species occur. In addition to this research, the Project's goals are to foster cooperative research; to participate in the state, regional, federal, and international management process; and to provide public education and technical information on the biology, management, and utilization of highly migratory species.

The **Diadromous Fisheries Project** works to improve fish passage and restoration, as well as investigate fish biology and contribute to fisheries management. Fish passage and restoration is accomplished through coordinated efforts of *MarineFisheries* staff, state and federal agencies, municipalities, and private groups to facilitate, design, and execute restoration projects with the goal of enhancing diadromous fish populations and habitats. Technical assistance and monitoring are also provided as needed for individual restoration projects and coastal watersheds. The fish biology and management efforts cover 10 species of diadromous

fish stocks in Massachusetts, such as river herring, rainbow smelt, white perch, tomcod, American eel, and American shad. These species are monitored for run counts, indices of population abundance, size and age composition, local harvests, and restoration potential. Information generated by this project is necessary for the sustainable management of diadromous fish populations as required by state and federal laws.

Recreational Fisheries Project

MRIP Sampling Project

Figure 34. Biologist John Boardman interviews a fisherman on a head boat.

Since 1983, recreational fisheries catch and effort data have been collected along the Atlantic Coast through NMFS' Marine Recreational Information Program (MRIP). *MarineFisheries* has managed the at-sea head boat survey segment for Massachusetts waters since 2003, and assumed the shore-side sampling of charter vessels, shore anglers, and private/rental vessel anglers in 2013. The benefits of doing so include the ability to increase sample sizes and improve the precision of catch estimates.

In 2017, *MarineFisheries* continued its coordination of MRIP surveys—training 20 seasonal field interviewers, scheduling trips, logging data, maintaining equipment, attending data review meetings, and maintaining regular communication with ACCSP regarding survey performance and sampling. (The ACCSP administers the program for NMFS.) During 2017, 76 headboat sea sampling trips were completed for a total of 1,105 angler intercepts (Figure 34). For shore-side sampling, our MRIP field interviewers completed 1,216 assignments for a total of 3,501 angler intercepts: 2,460 from private vessels, 453 from charter vessels, and 588 from shore anglers.

Recreational Fishing Derby

Project staff administered *MarineFisheries'* Saltwater Fishing Derby. The derby, formally known as the Governor's Cup and hosted by the Division of Tourism, was moved to *MarineFisheries* in 1983. New changes were drafted in 2017 for implementation in 2018, which included the creation of three new divisions: inshore, groundfish, and large pelagic. In the catch and release portion of the derby, *MarineFisheries* established three categories (men, women, juniors) and some of the minimum entry lengths were lowered for junior anglers. Other activities in 2017 included creating, printing, and distributing rule pamphlets and entry forms. Project staff had regular communications with weigh stations, prepared press releases, distributed outreach materials, and tracked derby standings. 2017 Derby winners were scheduled for recognition with awards at the annual New England Boat Show in February of 2018.

Public Access

The Public Access Coordinator position is funded from the Marine Recreational Fisheries Development Fund. The Coordinator, R. Kessler, manages all *MarineFisheries* saltwater fishing access projects, working closely with the *Mass*DFG Office of Fishing and Boating Access (OFBA), NGOs, towns, and other state and federal agencies to identify, plan, and implement construction/renovation/improvement of new fishing piers and other structures for fishing access. The coordinator also serves as a liaison to the fishing public for all matters of saltwater fishing access including advocating for beach and shore access.

In 2017, Kessler worked with OFBA to complete the planning, permitting, design, and engineering for a fishing pier on Boston Harbor's Deer Island. In addition, he collaborated with the Massachusetts Natural Heritage Program and many other organizations to implement a Habitat Conservation Plan (HCP) for alternative management options in piping plover habitat. Kessler sits on the Science Advisory Group's Predator Management team in the HCP.

MarineFisheries completed another year of the small grants program providing $50,000 of recreational fishing permit funds to assist local towns with small public access projects. This program allows for municipalities to apply for grants that fund projects promoting or supporting recreational fishing activities and access in their towns. In 2017, four projects were approved for funding: improvements to the boat ramp in Sandwich at Sandwich Marina, including fixing potholes and adding overhead lighting; the addition of tie-up floats at state ramps in Fall River's Bicentennial Park and on the Pamet River in Truro (Figure 35); and the installation of fillet stations, kiosks, and safety ladders at six shore side fishing locations in Rockport.

Figure 35. Tie-up floats were added to the state ramp at the Pamet River, Truro, with a public access small grant awarded in 2017.

At the *MarineFisheries* Craven's Landing access site on Scorton Creek in Sandwich, periodic site monitoring and maintenance were required. Seasonal contractors were hired for site patrol and coordinated for weekly summer assignments. For the seventh consecutive year, a brief closure of Craven's Landing was necessary due to the presence of federally protected piping plovers. Fortunately, the closure in 2017 was limited to one day as the young plover chicks wandered away from the landing unlike most years. Every year, *MarineFisheries* staff works closely with Mass Audubon to comply with USFWS regulations. Access is limited at Craven's Landing after plover chicks are born and re-opens when young plovers fledge or migrate out of a federally established buffer zone.

Kessler also worked with various entities to develop proposals for public access sites of interest. These included: USFWS, The Trustees of Reservations, Massachusetts Water Resource Authority, local municipalities, and multiple NGOs including Massachusetts Striped Bass Association, Mass Audubon, Barnstable County League of Sportsmen, Plymouth County League of Sportsmen, Cape Cod Charter Boat Association, Nantucket Anglers Club, Standish Sportsman's Club, Mass Sportsmen's Council, Osterville Angler's Club, Cape Cod Flyrodders, Trout Unlimited, and the Massachusetts Beach Buggy Association. In 2017, Kessler responded to numerous inquiries from user groups and private individuals regarding shore-side fishing sites, public access rights, and future access projects, and he represented the agency at multiple fishing and boating trade shows.

Outreach

Staff routinely answered public inquiries regarding recreational fisheries, attended meetings of the recreational fishing community, represented the agency at fishing and boating trade shows, and delivered presentations on fisheries management and research to organized groups such as local schools and fishing clubs.

The Massachusetts Saltwater Recreational Fishing Guide (Figure 36) was prepared and distributed at numerous trade shows, over 140 bait and tackle shops, similar locations along the coast, and to requesting anglers by mail and website downloads. In addition, an e-mail based newsletter—*The Broadcast*—was distributed electronically to permit holders.

Figure 36. The cover of the 2017 sport fishing guide.

Large Pelagics Research Project

Shark Research

MarineFisheries began shark research in 1987 to more fully elucidate the ecology, distribution, and relative abundance of sharks subjected to fisheries off the coast of Massachusetts. Staff conducts field research and opportunistically collects data from recreational and commercial fishermen's catch. Biological parameters including life history, ecology, and physiology are examined through the dissection and tagging of sharks. The goals are to foster cooperative shark research; participate in state, regional, federal, and international management processes; and provide public education and technical information on the biology, management, and utilization of sharks.

Movement and Habitat Studies: With external funding from private and federal grants, personnel continued to collaborate with federal and academic researchers on the study of broad and fine-scale movements of shark species. In 2017, the primary focus was on white shark.

Our efforts to study the movement ecology of white sharks off Massachusetts and the eastern US seaboard continued with an additional 27 white sharks being tagged, bringing the total to 132 individuals since 2009. These sharks were tagged with one or more of the following technologies: pop-up satellite tags (PSAT), real-time satellite tags (SPOT), coded acoustic transmitters, active acoustic transmitters, and NMFS conventional tags. The tagged sharks ranged from roughly 7.5 to 18.5 feet in total length.

Work continued on a five-year study initiated in 2014 to quantify the regional population size and relative abundance of white sharks in Massachusetts waters. With funding and logistical support from local non-profits, the Atlantic White Shark Conservancy and the John J. and Edith L. Sacco Charitable Foundation, aerial and vessel surveys were conducted from mid-June through October off the eastern coast of Cape Cod. As was the case in previous years of the study, the distribution of white sharks shifted throughout the season in 2017. Quantitative analysis is being conducted by SMAST student Megan Winton as part of her PhD research.

A paper analyzing and summarizing the broad-scale movements of white sharks in the North Atlantic was published in the journal *Marine Ecology Progress Series* (G. Skomal and J. Chisholm as co-authors). The movements of 32 PSAT and SPOT-tagged individuals, showed that white sharks are more broadly distributed, both horizontally and vertically, throughout the North Atlantic than previously understood (Figure 38), exhibiting an ontogenetic shift from near-coastal, shelf-oriented habitat in the summer to wide-ranging pelagic habitat with frequent excursions to mesopelagic depths the rest of the year. These findings

extend the known essential habitat for the white shark in the North Atlantic beyond existing protection, with implications for future conservation.

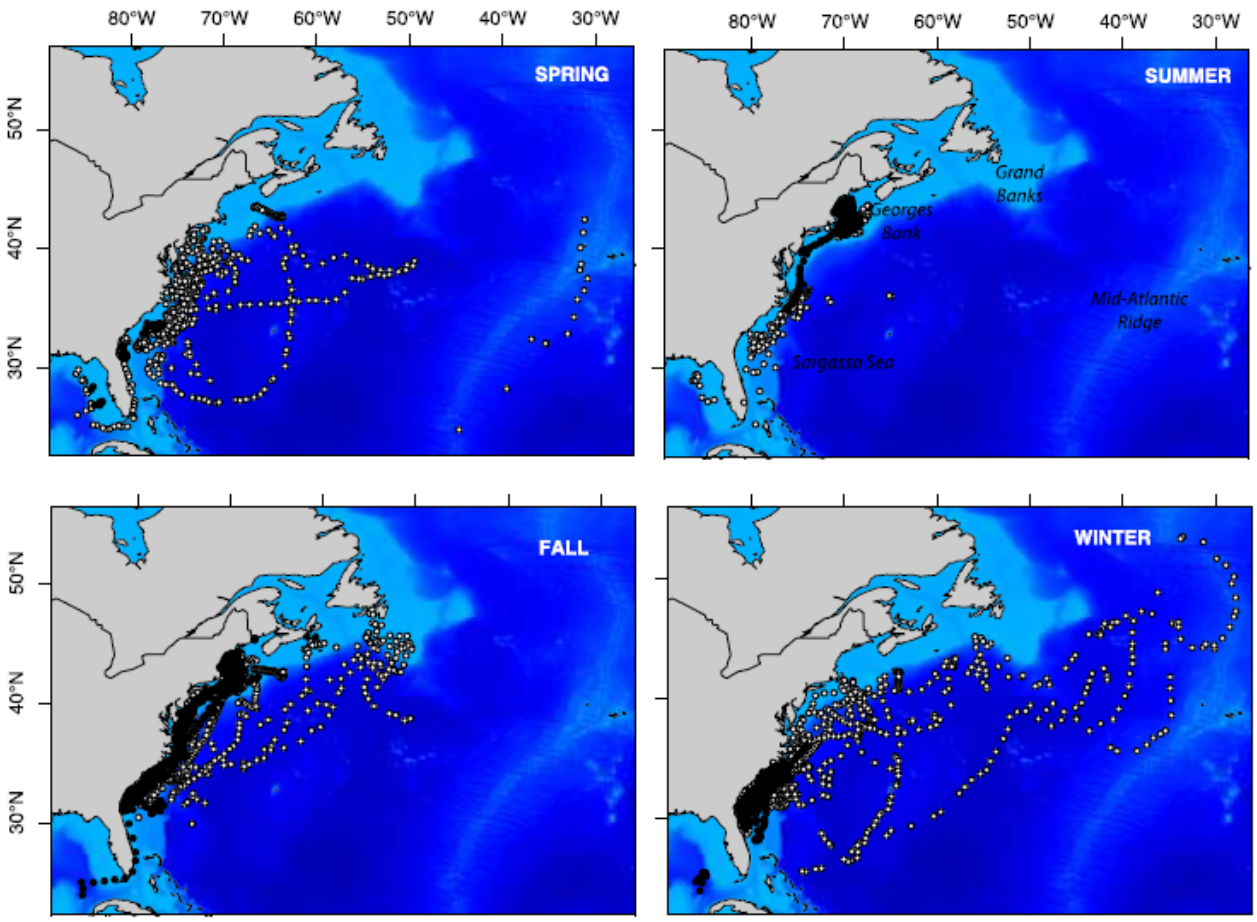

Figure 37. Broad-scale seasonal movements of white sharks in the North Atlantic with individuals showing coastal (black points) and pelagic (white points) behavior.

Shark Management: Staff participated in the development and/or amendment of state, interstate, federal, and international shark management plans. During 2017, G. Skomal served on the following committees: ASMFC Coastal Sharks Technical Committee, ASMFC Coastal Sharks Plan Development Team, ASMFC Spiny Dogfish Technical Committee, ICCAT Advisory Committee Swordfish and Shark Working Group, and NMFS Highly Migratory Species Advisory Panel.

Outreach and Media: To meet the public's constant and growing demand for information on sharks, especially white sharks, numerous presentations pertaining to sharks were delivered to the public. Technical information on sharks was also provided to several media outlets.

As adjunct faculty to SMAST, the UMass Biology Department, and the Woods Hole Oceanographic Institution, G. Skomal co-advised and/or served on the committees of 11 graduate students; 10 of which are investigating the relative abundance, life history, movements, and/or physiology of elasmobranch fishes.

Other Activities

Publications: Staff (G. Skomal) was co-author to two additional papers published in peer-reviewed journals in 2017. One, in the journal *Fisheries Research,* analyzed short-term movement patterns of striped bass in

the coastal embayment off Plymouth, Kingston, and Duxbury. The other, in the journal *Fisheries Bulletin*, evaluated physiological stress response, post-release behavior, and mortality of blacktip sharks caught on circle and J-hooks in the Florida recreational fishery.

Diadromous Fisheries Project

Diadromous fish migrate between fresh and marine waters to complete their life history. They are valued for the forage they provide to a wide range of fish and wildlife and were formerly important for traditional small-scale fisheries in coastal towns. *MarineFisheries* is not only responsible for the management of diadromous fish populations in coastal rivers of Massachusetts, but also the restoration, improvement, and maintenance of their migratory pathways.

Biological Assessments for River Herring

The alewife (*Alosa pseudoharengus*) is the most abundant and well-known anadromous fish in Massachusetts. Along with the closely related blueback herring (*Alosa aestivalis*), both species are known commonly as "river herring." River herring have had high cultural and economic importance historically, but present populations are well below former levels and harvest has been banned since 2006. As a result, management goals to restore river herring populations have warranted a ramping up of river herring monitoring over the last decade. While the interstate FMP requires monitoring and sampling at only one site (Merrimack River), the Division monitored river herring or worked with local partners to collect spawning run counts and/or conduct biological sampling in 15 river systems in 2017 (Table 24). This included Stony Brook in Brewster for the first time, following *MarineFisheries'* fabrication and installation of a new electronic counter system with funding from the Town of Brewster.

Table 24. River herring monitoring locations where biological samples and/or counts are collected.

River	Biological	Counts
Parker River, Newbury	Yes	Video
Essex River, Essex	No	Electronic
Mystic River, Medford	Yes	Visual (Volunteer)
Back River, Weymouth	Yes	Electronic
Herring Brook, Pembroke	No	Electronic
Town Brook, Plymouth	Yes	Electronic (Town)
Monument River, Bournedale	Yes	Electronic
Herring River, Harwich	Yes	Electronic
Acushnet River, Acushnet	Yes	Electronic
Nemasket River, Middleboro	Yes	Visual (Volunteer)
Merrimack River, Lawrence	Yes	Fish Lift
Agawam River, Wareham	No	Electronic
Wankinco River, Wareham	No	Electronic
Mattapoisett River, Mattapoisett	No	Electronic
Stony Brook, Brewster	No	Electronic

In 2017, river herring counts ranged from 8,365 fish in the Acushnet River to 630,098 in the Mystic River. While electronic monitoring showed declines in most Massachusetts herring runs in 2017 (following a general four-year increasing trend), there were improvements in specific runs with recent restoration activity: Mystic River, Medford; Herring Brook, Pembroke; and Pilgrim Lake, Orleans.

Project staff also provided technical assistance to local groups conducting volunteer visual counts at herring runs. In 2017, a total of 40 rivers in 29 towns were monitored in Massachusetts. Many of these local groups participate in the Massachusetts River Herring Network. Staff (B. Chase, B. Gahagan, J. Sheppard) presented on various river herring issues at the network's annual meeting, including management updates, counting methods, and population status.

American shad are also monitored each spring/summer at the Essex Dam fish lift on the Merrimack River in Lawrence, per an interstate FMP requirement. The count of American shad in 2017 decreased slightly when compared to 2016. Striped bass and sea lamprey were also lifted above the Essex Dam in 2017.

Propagation

MarineFisheries collects and transports live river herring to assist efforts to re-establish and enhance river herring runs, subject to the guidance of our Stocking Protocol Policy. To assist ongoing fishway improvement projects, a total of 3,447 pre-spawning adult river herring were trapped and transported in 2017 via our stocking truck or lifted above a barrier into six coastal systems in the Commonwealth (Table 25). In a cooperative effort, an additional 2,000 alewives were trapped from a Massachusetts donor system and released into two Rhode Island coastal systems. Also, 250 alewives were transferred to the USFWS North Attleboro hatchery for research purposes.

In 2017, *MarineFisheries*, in conjunction with USFWS, continued efforts to restore American shad to the Charles River watershed. Approximately 232,000 young-of-year shad from the USFWS Nashua hatchery were hatched from Connecticut River broodstock and released above the Moody Street dam in Waltham.

Table 25. Number of pre-spawning adult river herring trapped and transported in 2017.

Donor System	Recipient System	# of Adults
Town Brook	Billington Sea, Town Brook, Plymouth, MA	1,500
Parker River	Pentucket Pond, Parker River, Georgetown, MA	488
	Main Street, Parker River, Newbury, MA	230
Nemasket River	Three Mile River, Dighton, MA	500
	Ten Mile River, Turner Reservoir, East Providence, RI	1,000
	Kickemuit Reservoir, Warren, RI	1,000
	USFWS North Attleboro National Fish Hatchery	250
Merrimack River	Sudbury River, Bedford, MA	352
	Concord River, Billerica, MA	365
	Shawsheen River, Andover, MA	12

Technical Assistance

Project staff provided technical assistance to local authorities, private organizations, and other agencies on topics related to diadromous fish resources. Numerous requests are received each year, especially during the spring, requiring a wide range of responses. Technical assistance associated with larger requests that require a sustained effort are as follows.

River Herring Habitat Assessment: River herring habitat assessments are conducted for two years during May–September to assess the suitability of habitats for restoration potential and to contribute to habitat and water quality remediation efforts. In 2017, assessments were concluded at Fresh Pond, Plymouth, and Turners Reservoir, Dartmouth. Staff also assisted local partners in completing the following assessments: Shad Factory Pond, Rehoboth; Lovells Pond, Barnstable; Looks Pond and James Pond, West Tisbury; and Ipswich River, Ipswich. Two new assessments were initiated at Grassy Pond, Harwich and Kellys Pond, Dennis. The analysis of assessment data was completed for Whitman's Pond, Weymouth and Tom Matthews Pond, Yarmouth. Two habitat assessment reports were submitted for publication in the *MarineFisheries* Technical Report series: Tom Matthews Pond, Yarmouth; and Lake Sabbatia, Taunton.

Diadromous Fish Restoration Priority List/*Mass*DOT Diadromous Fish GIS Datalayer: Project staff maintain a list documenting the status of diadromous fish passageways and prioritizing restoration projects. The list

focuses on passageways for river herring, but also considers other diadromous fish species and watershed connectivity. It contains 450 fishways, impediments, and potential restoration sites, ranked by restoration potential within the four major coastal regions of Massachusetts: Buzzards Bay, Cape Cod, South Shore, and North Shore/Boston Harbor. A GIS datalayer of the restoration priority list supports transportation infrastructure planning and environmental review activities conducted by *Mass*DOT and *MarineFisheries*. The priority list was updated in 2017 and provided to *Mass*DEP to integrate with their Wetlands Protection Act and Clean Water Act processes, including a presentation by staff (B. Chase).

Mystic River Video and Counting: Project staff provided technical assistance to help the Mystic River Watershed Association implement a web-based counting program that raised awareness about river herring passage and abundance, as well as helped assess the efficacy of an ongoing volunteer count. Staff scoped, designed, fabricated, and implemented the physical counting structure placed at Upper Mystic Lakes Dam. During the season, staff provided technical assistance with videography and system maintenance to ensure footage was of suitable quality.

Concord River Video and Counting: Project staff provided technical assistance to help the Lowell Parks and Conservation Trust create a video count on the lower Concord River. Staff scoped, designed, fabricated, and implemented the physical counting structure placed at Centennial Dam in North Billerica. During the season, staff provided technical assistance with videography and system maintenance to ensure footage was of suitable quality. This effort should provide a record of fish presence and abundance in the lower river prior to restoration efforts at Talbot Mills Dam.

Diadromous Fish Research Studies

Alewife Tagging, Concord River: In 2017, project biologists began to assess potential habitat use in the Concord River watershed by spawning river herring. Following the completion of a feasibility study to provide passage or dam removal at the Talbot Mills Dam in North Billerica, *MarineFisheries* and the USFWS transported 90 alewife from the Essex Dam fish lift on the Merrimack River, implanted acoustic tags (Figure 38), and released them at several locations in the Sudbury-Assabet-Concord watershed. Acoustic receivers were placed throughout the watershed and lower Merrimack River to monitor tagged fish spawning activity and emigration. This project was scheduled to continue in 2018.

Figure 38. *MarineFisheries* and USFWS biologists tag alewife on the Sudbury River.

Charles River Shad Monitoring: In 2017, project biologists concluded a study on the movements of American shad with the goal of informing managers about migration habits and potential challenges to shad restoration in the Charles River. Five acoustic receivers were deployed at various locations in the river to monitor the presence and movements of returning shad tagged in 2016. During late May and early June, 10 shad returned to the Charles River to spawn; six migrated above the Watertown Dam and eight subsequently emigrated to saltwater after spawning. This project successfully demonstrated the utility of surgical tagging for shad and gained important information on impediments to restoration in the Charles River as well as some of the first detailed movements of this species in marine waters. Staff (B. Gahagan) co-presented on impediments to shad restoration in the Charles River at the annual meetings of the American Fisheries Society and the Southern New England Chapter of the American Fisheries Society.

American Shad Electrofishing Survey: In the spring of 2017, project staff completed the second season of a pilot study to monitor the presence and abundance of American shad in the South River and Indianhead River (Figure 39). Monitoring was conducted in each river from the head of tide to the first obstruction using a combination of visual and stream electroshocking surveys to detect the presence of spawning adult shad. During 14 sampling trips in the South River and 15 sampling trips in the Indianhead River between April and June, 78 and 111 shad were captured, respectively, for size, age, and genetic sampling. Scale-based aging indicated that these shad ranged from 3–8 years with some individuals having spawned up to three times previously. Catch-per-unit-effort indices of abundance were calculated for each river system. Monitoring will continue to obtain long-term indices of population abundance.

Figure 39. *MarineFisheries* biologists release an American shad on the Indianhead River.

Rainbow Smelt Population and Habitat Monitoring

Rainbow smelt population declines since the 1980s prompted *MarineFisheries* to initiate spawning run monitoring using in-stream fyke nets in 2004. This monitoring continues as an annual data series to provide a relative index of population abundance and size and age data. The project presently maintains four stations at the Parker River (Newbury), Fore River (Braintree), Jones River (Kingston), and Weweantic River (Wareham). The occurrence of larger/older smelt in Jones and Fore river catches seen in 2016 continued in 2017. Smelt catches at the Parker and Weweantic rivers continue to trend near the lowest numbers of the time series. A staff presentation (by B. Chase, S. Elzy, S. Turner, and M. Ayer) on the fecundity and reproductive life history of rainbow smelt was given at the *ICES International Science Conference.*

American Eel Young-of-the-Year Monitoring

All U.S. East Coast states conduct standardized monitoring of YOY American eels under mandatory ASMFC protocols for use in the coastwide stock assessment. *MarineFisheries* has monitored the spring migration of YOY eels in the Jones River (Kingston) using a Sheldon trap since 2001 to contribute to a coastwide index of eel population relative abundance. A new fyke net station was initiated on the North Shore in 2014 and has been continued for eventual inclusion as a site to monitor long-term abundance. Eel catch at the Jones River trap increased in 2017 after a four-year declining trend. However, the total catch of 5,218 eels in 2017 remains low and the catch per haul of 121 eels equals the data series' 25th percentile.

Project staff also monitors eight eel ramps installed in coastal rivers to provide eel passage over barriers. Most ramps are managed cooperatively with local groups and outfitted with a collection tank to evaluate the performance of the eel ramp and the potential to use the location as a monitoring station for census counts of YOY or older eels. Piped eel passes have been installed at an additional two fishways; these gravity flow systems have no collection tanks.

Fish Passage and Habitat Restoration Projects

Numerous projects to improve and maintain diadromous fish passage, habitats, and populations are conducted each year. In 2017, project staff devoted time to approximately 20 individual projects in various stages of development and implementation. The following list includes completed projects and larger ongoing projects of regional significance. Highlights in 2017 include substantial progress in the Fore River Watershed restoration project, and a larger than average number of small fishway construction jobs completed by the *MarineFisheries* Fishway Crew, including some that addressed long-standing river herring mortality problems.

Fore River Watershed: Efforts continued on a multi-site project to restore diadromous fish to the Fore River Watershed in the Boston Harbor region. Much progress was made in 2017. A new Alaskan steeppass fish ladder was installed at the previously impassable Great Pond Reservoir (Figure 40). *MarineFisheries* funded the scoping design and sections of the steeppass, and actively participated in the lengthy project development, design, and permitting process. *Mass*DER joined the partnership, and the project received funding awards in 2017 from the NOAA Restoration Center and MA EOEEA. The project began in 2008 with funding from *MarineFisheries* to conduct a fish passage improvement feasibility study with the property owners, Town of Braintree, and Fore River Watershed Association. The project ranks high among potential diadromous fish restoration projects in the region given the opportunity to create a large river herring run to the 180-acre Great Pond Reservoir with strong local support. In 2017, efforts were made to remediate the fish passage obstruction at the Natural Falls, and a stream maintenance plan for the entire watershed was prepared with the Fore River Watershed Association. These efforts in the Fore River watershed, as well as other fish restoration projects in the metro Boston region, were the subject of a staff (B. Chase) presentation given to the Boston Harbor Habitat Coalition in 2017.

Figure 40. An Alaskan steeppass fish ladder is installed at the Great Pond Reservoir in Braintree.

South River, Marshfield: With materials funded by the Town of Marshfield, the *MarineFisheries* Fishway Crew installed a new entrance pool and weir to the Veterans Memorial Park Dam fish ladder on the South River. The weir orientation at the lower fishway entrance had long been considered to cause poor conditions to attract and pass river herring. A concrete weir was reconstructed and a new concrete weir and pool added.

Marston Mills River, Barnstable: With materials funded by the Town of Barnstable, the *MarineFisheries* Fishway Crew fabricated and installed a custom wood weir and pool fish ladder at the auxiliary spillway of the Mill Pond Dam on the Marston Mills River. The existing ladder was degraded and of poor design for this location. The new ladder included an aluminum attachment frame designed to be adjustable for pond level fluctuations.

Town Brook, Plymouth: With materials funded by the Town of Plymouth, the *MarineFisheries* Fishway Crew made concrete improvements to the sleeve of Town Brook's existing Alaskan steeppass and constructed a new concrete plunge pool wall to aid downstream passage. This site had annual problems with mortality of exiting herring.

Parker River, Yarmouth: At the request of the Town of Yarmouth, the *MarineFisheries* Fishway Crew replaced the fishway at the Forest Road Culvert on the Parker River. An existing wood fish ladder downstream of the culvert had flow-range limitations. We removed the wood ladder and redesigned fish passage at the site to use stop log slots and weir boards in the culvert entrance flume. Large amounts of sediment had to be removed from the flume to install the fishway, further improving passage at the culvert.

Gorman Mill Pond Dam, Pembroke: The *MarineFisheries* Fishway Crew fabricated and installed a custom, aluminum fishway exit box for the Gorman Mill Pond Dam fishway on Herring Brook with assistance from the Town of Pembroke herring wardens (Figure 42). The prior exit had an adjustable low-flow gate with a support rod that caused physical damage to many herring as they exited the fishway.

Figure 41. Installation of the Gorman Mill Pond Dam fishway exit on the Herring Brook, Pembroke.

Little River, Gloucester: In cooperation with the Town of Gloucester and Sumco Eco-Contracting, the wood Denil fish ladder at Lily Pond in the Little River was replaced with a new Alaskan Steeppass fish ladder. *MarineFisheries* funded the 1.5 sections of steeppass and provided technical and field assistance with the installation. This effort contributed to larger, cooperative restoration efforts in the watershed.

Three Mile River, Taunton: The project to construct a fishway at the impassable Draka Dam on the Three Mile River continued in 2017. Ongoing plan revisions and permit renewals in 2016/2017 for this longstanding project prevented the goal for construction in the summer of 2017. In partnership with the Public Access Board, construction bid documents were prepared and the project was posted in December.

Horn Pond, Woburn: In a cooperative project with the City of Woburn and Town of Winchester, the overflow spillway at Horn Pond was modified during reconstruction of the Scalley Dam. The modified spillway should be more amenable to fish passage and allow herring that migrate through the Mystic Lakes and up the recently completed fishway at Center Falls in Winchester to access more than 100 acres of spawning habitat.

James Pond, West Tisbury: *MarineFisheries* prepared a channel maintenance plan in 2015 to allow local officials to manage diadromous fish passage through a natural beach channel that seasonally limits passage to James Pond. Assistance was provided to the Town in 2016/2017 on several iterations of the plan and the scoping of field assessments to aid this planning. Staff participated in the project Notice of Intent review by the West Tisbury Conservation Commission, with a conclusion expected early in 2018.

High Street Dam, Bridgewater: *MarineFisheries* staff participated in a cooperative feasibility study on the improvement of fish passage at the High Street Dam on the Town River, with the dam owner, Town River Herring Fishery Commission, *Mass*DER, and The Nature Conservancy. A project scope was prepared and assistance was provided to the project contractor as the study progressed in 2017.

Ipswich River, Ipswich: Efforts to improve fish passage at the Willowdale Dam on the Ipswich River continued. Following meetings and the preparation of an approved MOU with the dam owner in 2015, project staff convened a meeting of local stakeholders to plan for work and incorporate concerns of other parties. Final design and permitting occurred in 2017 with installation scheduled for late summer, 2018.

Concord River, Billerica: *MarineFisheries* completed a feasibility study to restore fish passage at Talbot Mills Dam. Efforts began to characterize downstream fish presence and plan for restoration options.

Mill River, Taunton: The removal of the Reed and Barton Dam on the Mill River was an example of a dam removal in 2017 where multi-year technical assistance and field monitoring was provided by *MarineFisheries*. *MarineFisheries'* role in dam removals is typically limited to providing technical assistance to *Mass*DER and other partners. Staff (S. Turner and B. Chase) also co-presented on the results of a mark-recapture study to evaluate the effect of dam removal in the Mill River on yellow eel abundance at the annual meeting of the *Southern New England Chapter of the American Fisheries Society.*

Fishway Permitting and Operation and Maintenance Plans

MarineFisheries issues Fishway Operation and Maintenance (O&M) Plans for all new and reconstructed fishways per the authority granted the Director under Chapter 130, Section 19 of Massachusetts General Laws. Four O&M Plans were finalized in 2017 for: Seymour Pond, Harwich; Tom Matthews Pond, Yarmouth; Long Pond, Yarmouth; and Mill Pond, West Tisbury. Several draft plans were under development in 2017.

MarineFisheries issues Fishway Construction Permits following the review of final engineering plans to construct, rebuild, or alter fishways. During 2017, four Fishway Construction Permits were prepared for projects at: Hunters Pond Dam, Scituate; Great Pond Reservoir, Braintree; Lily Pond, Gloucester; and Lower Bog Dam, Falmouth.

River Herring Stream Channel Maintenance

Project staff routinely fields requests to assist Towns to maintain passageways for river herring. The work can involve developing plans for removing debris jams and excessive plant growth in channels or responding quickly during the migration season to remove blockages that threaten sea-run fish survival. Our Stream Maintenance Protocol for Diadromous Fish Passage in 2016 guides both our field work and the towns'. Field work on stream maintenance in 2017 focused on three coastal river systems: South River, Marshfield; Acushnet River, Acushnet; and the Fore River, Braintree. The Fore River activity involved a large effort with local partners as a stream maintenance plan for this watershed was prepared and approved by the Braintree Conservation Commission in December, 2017.

Other Activities

Technical Committee Participation: Staff actively participated on ASMFC committees and other professional organizations related to diadromous fish. ASMFC compliance reports were prepared in 2017 for American eel (B. Chase), river herring/American shad (J. Sheppard), and Atlantic sturgeon (S. Turner). ASMFC committee work included: the River Herring and American Shad Technical Committee (TC, Chair), American Eel TC, American Eel Stock Assessment Sub-Committee, and Fish Passage Working Group (B. Chase); the Sturgeon TC (S. Turner); and River Herring Stock Assessment Sub-Committee (B. Gahagan). S. Turner served as the AFS Southern New England Chapter Secretary and President-elect and on the NMFS River Herring Technical Expert Working Group (TEWG). B. Gahagan also served on the TEWG and on committees for the Connecticut and Merrimack rivers (Connecticut River Atlantic Salmon Commission TC; and Technical Committee for Anadromous Fishery Management of the Merrimack River Basin).

Education/Outreach: Project staff provided numerous presentations and technical assistance related to education, outreach, and constituency groups. Staff also attended spring river herring festivals and events at the following locations: Nemasket River, Middleborough; Town Brook, Plymouth; Acushnet River, Acushnet; and the Back River, Weymouth.

Additional Publications & Presentations: B. Gahagan, M. Armstrong, and J. Sheppard were among the co-authors of a 2017 article evaluating the temporal patterns of migration and spawning of river herring in coastal Massachusetts published in the journal *Transactions of the American Fisheries Society.* S. Turner was co-author to a paper published in the journal *Marine and Coastal Fisheries* evaluating spatiotemporal trends in the overlap of river herring with Atlantic herring and Atlantic mackerel with implication for river herring bycatch in the pelagic commercial fisheries. Results were also presented at the American Fisheries Society annual meeting. J. Sheppard presented on Acushnet River restoration and monitoring at a training seminar for trustees of the *Mass*DEP Natural Resource Damages Program, and on incorporating climate science into resource management at the Northeast Climate Adaption Science Center's Regional Science Meeting.

ADMINISTRATION

Kevin Creighton, Chief Fiscal Operator, Section Leader

Personnel

Finance
Darlene Pari, Accounts Payable Coordinator
Eva Morales, Accountant III
Jeanne Hayes, Accounts Receivable Coordinator
Shannon Davis, Program Coordinator – Revenue
Samantha Andrews, Program Coordinator – Internal Control Officer

Administrative Support
Kim Trotto, Administrative Support
Lynne Besse, Administrative Support
Rosemary Mitchell, Administrative Support
Whitney Sargent, Administrative Support

Grants Management
Stephanie Cunningham, Federal Aid and Grants Coordinator
Cecil French, Project Leader – Clean Vessel Act and Boating Infrastructure Grant
Maren Budrow, Assistant Federal Aid and Grants Coordinator
Melanie Griffin, Project Leader – Revolving Loan Fund & Groundfish Disaster Economic Assistance

Outreach
Elaine Brewer, Information & Education Coordinator (January–February)
Christine Cassidy, Information & Education Coordinator (July–December)
Kimberly Trull, Angler Education Coordinator

Seafood Marketing
Wendy Mainardi, Marketing Coordinator

Scientific Diving
Vincent Malkoski, Diving Safety Officer

Capital Assets and Facilities Management
Brian Castonguay, Gloucester Office, Head of Facilities and Capital Assets
Vincent Malkoski, New Bedford Office, Facilities and Capital Assets
Kevin Magowan, Shellfish Purification Plant, Facilities

Overview

MarineFisheries Administration is responsible for the Division's fiscal functions, grants management, capital assets, diver training, outreach efforts, and seafood marketing. The program develops, analyzes, and manages the Division's financial planning and resource allocation activities including budget submissions to the Legislature. The Program is responsible for collecting fees and reconciling revenue. The Program also provides all fiscal oversight and reporting on grants, contracts, and mitigation projects. In addition, all capital assets are procured, inventoried, managed, and maintained. Outreach is conducted through the creation of educational media, event planning, and other activities. Seafood Marketing efforts support and promote

Massachusetts seafood and the commercial industry. Capital Assets and Facilities Management is conducted with the intent to provide a healthy and productive working environment.

Budget

Overall, state-appropriated funds increased 2.71% from FY2016 to FY2017 (Table 26).

Appropriated funds for the operating budget increased 3.42% in FY2017. The modest increase was approved to primarily cover increased annualized costs for payroll, and the replacement of lease vehicles in the *MarineFisheries* fleet. The increased costs were offset somewhat by an overall decrease in utilities resulting from a reduction in fuel costs for the third year in a row.

The Legislature has created three retained revenue accounts for *MarineFisheries*, whereby funds from a particular funding source may be retained by the Agency to expend for a particular purpose. The three retained revenue accounts include: Sportfish Restoration, Shellfish Purification Plant, and Ventless Trap. The Sportfish Restoration account allows for the deposit of federal Wallop-Breaux reimbursements (a sportfish restoration program), which may then be spent on other Wallop-Breaux reimbursable projects. The Shellfish Purification Plant account allows for the deposit of funds collected for the depuration and de-sanding of shellfish at the Division's Shellfish Purification Plant, which may then be spent on the maintenance and operation of the plant. The Ventless Trap account allows for the deposit of funds generated from the sale of lobster permits, which are then used to fund research on commercially important invertebrate species in the Commonwealth. Funding from retained revenue accounts decreased less than one percent in FY17.

Appropriations from special fund accounts increased 0.94% overall. The Legislature increased the appropriation on the Saltwater Sport Fish Licensing account to more closely align with projected spending in that account. This account is funded by recreational saltwater fishing permit sales and supports recreational fishery improvements. The Seafood Marketing Program, funded by revenue collected from the issuance of commercial fisherman and seafood dealer permits, remained level funded.

Table 27 provides the breakdown of overall costs by primary spending category for the *MarineFisheries* operating accounts.

Table 26. Fiscal Year 2016 and 2017 Appropriations (available funds for operations).

Title	Acct. Number	FY2016	FY2017	Change
General Fund Accounts				
General Operating	2330-0100	[1]$5,347,649	[2]$5,526,817	+3.35%
Sportfish Program	2330-0120	$638,635	$664,408	+4.04%
General Fund Total		$5,986,284	$6,191,225	+3.42%
Retained Revenue Accounts				
Sportfish Retained Revenue	2330-0121	$217,989	$217,989	0.00%
Purification Retained Revenue	2330-0150	$46,968	$50,254	+7.00%
Ventless Trap Retained Revenue	2330-0199	$180,990	$174,690	-3.48%
Retained Revenue Total		$445,947	$442,933	-0.68%
Special Fund Accounts				
Saltwater Sportfish Licensing	2330-0300	$1,305,519	$1,320,159	+1.12%
Seafood Marketing	2330-0104	$250,000	$250,000	0.00%
Special Fund Total		$1,555,519	$1,570,159	+0.94%
Appropriations Grand Total		**$7,987,750**	**$8,204,317**	**2.71%**

[1] The final budget for FY2016 in Chapter 46 of the Acts of 2015 was $6,387,596. *MarineFisheries'* general operating budget was affected by: 1) earmarks totaling $758,400 ($450,000 to the School of Marine Science and Technology; $83,400 for the Great Marsh Green Crab Trapping Program; $50,000 for the Fishing Academy, Inc.; and $175,000 for shellfish propagation in Barnstable, Dukes, and Nantucket counties); and 2) the Governor's mid-year 9c budget cuts and Early Retirement Incentive Program (in which four full time employees participating) totaling $281,547 in reductions.

2 The final budget for FY2017 in Chapter 133 of the Acts of 2016 was $6,298,094. *MarineFisheries'* general operating budget was affected by: 1) earmarks totaling $750,000 ($450,000 to the School of Marine Science and Technology; $50,000 for the Great Marsh Green Crab Trapping Program; $50,000 for the Fishing Academy, Inc.; $25,000 for Falmouth aeration; and $175,000 for shellfish propagation in Barnstable, Dukes, and Nantucket counties); 2) the Governor's 9c budget cuts and a debt payment totaling $55,148; and 3) $33,871 made available from a reserve draw account to cover employee buyout costs pertaining to the 2015 Early Retirement Incentive Program that carried into FY2017.

Table 27. FY 2017 costs by account type and primary spending category (rounded to whole dollars).

	General Fund	Retained Revenue	Special Fund	Total
Salaries	$5,234,060	$167,789	$543,566	$5,945,415
Employee Expenses	$24,978	$9,722	$7,765	$42,465
Contracted Employees	$24,754	$346	$65,117	$90,217
Contracts	$3,605	$62,666	$373,118	$439,388
Facility Maintenance	$27,561	$4,777	$0	$32,337
Field & Lab Supplies	$50,372	$10,377	$21,999	$82,748
Fringe Costs	$87,365	$2,785	$10,072	$100,222
Fuel	$57,316	$0	$729	$58,045
Utilities	$72,058	$0	$0	$72,058
Lease/Rent	$131,658	$0	$0	$131,658
Maintenance/Repair	$37,947	$13,578	$2,500	$54,025
Office & Administrative	$182,759	$33,014	$49,496	$265,269
Services/Equipment Lease	$2,053	$114,189	$0	$116,242
Outside Agencies	$168,155	$1,755	$2,262	$172,172
Grants	$407,000	$15,535	$124,607	$547,142
Total	**$6,511,641**	**$436,533**	**$1,201,231**	**$8,149,403**

Staffing

The overall staffing level remained the same between Calendar Year (CY) 2016 and CY2017 although there were several personnel changes and a shift within the spending accounts (Table 28).

Table 28. Calendar Year 2016 and 2017 Authorized Personnel Levels.

Title	Acct. Number	CY2016	CY2017
MarineFisheries General Operating	2330-0100	61	60
Sport Fish Program	2330-0120	10	10
Saltwater Sport Fish Licensing	2330-0300	7	7
Federal Grants and Trust Account	2330-xxxx*	23	24
Total Employees in All Appropriations		**101**	**101**

*Multiple account numbers

Revenue

General Fund Revenue

MarineFisheries collects fees primarily from permit issuance and from processing racks of soft-shelled clams at the Shellfish Purification Plant in Newburyport. A total of 28,557 permits and endorsements were issued by the Permitting Project for the categories of commercial fishing, seafood dealers, and special permit types, producing General Fund revenue of $2,157,810 in 2017 (Table 29). While there was a minimal decrease in total number of permits issued by approximately 0.3%, total revenue for commercial permits saw a slight increase of 0.1%. The Shellfish Purification Plant processed 6,354 racks of soft-shell clams in 2017. This includes both depuration and de-sanding activities. Operations resulted in General Fund revenues of $38,126, a decrease of approximately 11% as compared to the 2016 value of $42,648. This continued the overall declining trend in racks processed and resulting revenues since 2009.

Table 29. 2017 General Fund Permitting Revenue.

Permit Type		Permit Fee		Revenue
		Resident	Non-resident	
Commercial Fisherman	Coastal Lobster[1]	$310	$570	$338,580
	Offshore Lobster[1]	$310	$570	$152,690
	Seasonal Lobster[1]	$80	$145	$8,180
	Boat 100'+	$260	$520	$11,960
	Boat 60-99'	$195	$310	$77,025
	Boat 0-59'	$130	$260	$532,220
	Individual	$65	$130	$14,040
	Shellfish & Seaworm[2]	$40	$80	$33,760
	Shellfish & Rod & Reel	$55	$130	$22,735
	Rod & Reel	$35	$100	$19,515
Commercial Fisherman Permit Revenue Subtotal				**$1,210,705**
Seafood Dealer	Wholesale Dealer	$130	$260	$52,650
	Wholesale Truck	$130	$260	$44,720
	Wholesale Broker	$130	$260	$6,890
	Retail Dealer	$65	$130	$64,675
	Retail Truck	$65	$130	$2,600
	Retail Boat	$65	$130	$6,760
	Bait Dealer	$65	$130	$10,465
Seafood Dealer Permit Revenue Subtotal				**$188,760**
Special	Non-Commercial Lobster[1]	$55	$75	$361,875
	Regulated Fishery Endorsements	$30	$60	$385,890
	Master Digger	$250	$500	$1,750
	Subordinate Digger	$100	$200	$3,700
	Scientific Collection	$10	$20	$980
	"Other" Special Permits	$10	$20	$4,150
Special Permit Revenue Subtotal				**$758,345**
Total				**$2,157,810**

[1] In 2015, a new invertebrate species research fee was approved by the legislature; all lobster permits are assessed the research fee ($50 for commercial permits and $15 for non-commercial permits).

[2] All commercial permits, except Rod & Reel and Seasonal Lobster, may be endorsed for shellfish at no additional cost.

Dedicated Fund Revenue

In addition to General Fund revenue, *MarineFisheries* generated $1,405,889 in revenue for the Marine Recreational Fisheries Development Fund in 2017 (Table 30). Revenue is primarily from the issuance of recreational saltwater fishing permits, but also includes direct donations to the Fund. By law, all fees collected from the sale of recreational saltwater fishing permits, including permits issued to the for-hire fleet, are dedicated to the improvement of recreational saltwater fishing in Massachusetts. In 2017, *MarineFisheries* saw the largest increase in revenue, almost 5% over that of the previous year.

Table 30. 2017 Marine Recreational Fisheries Development Fund Revenue.

Permit Type	Permit Fee		Revenue
	Resident	Non-Resident	
Recreational Saltwater, Age 16–59	$10	$10	$1,302,350
Recreational Saltwater, Age 60+	$0	$0	$0
Charter Boat	$65	$130	$54,275
Head Boat	$130	$260	$6,890
Recreational Fund Donations			$42,194
		Total	**$1,405,889**

Grants

In FY2017, *MarineFisheries* expenditures on federal grants and mitigation projects returned to more typical levels (Table 31). Expenditures the two prior years were greatly elevated as a result of the federally funded Groundfish Disaster Economic Assistance Program.

Table 31. Fiscal Year 2016 and 2017 Expenditures.

Title of Federal Grant or Trust	Account Number	FY2016	FY2017
Clean Vessel Act	2330-9222	$1,104,000	$1,114,000
Fisheries Statistics	2330-9712	$135,000	$151,000
Boating Infrastructure	2330-9725	$25,000	$600,000
Interstate Fisheries	2330-9730	$175,000	$244,000
ACCSP	2330-9732	$600	$31,000
Saltonstall-Kennedy	2330-9733	$0	$157,000
Turtle Disentanglement/Protected Species	2330-9739	$587,000	$738,000
Economic Relief	2330-9741	$10,604,000	$614,000
Fish Age & Growth	2330-9742	$216,000	$266,000
Sport Fish Coordination	2330-9743	$75,000	$87,000
Marine Fisheries Research Trust	2330-0101	$1,600,000	$1,570,000
	Total	**$14,521,600**	**$5,572,000**

The Revolving Loan Fund (RLF)

The Massachusetts Commercial Fisheries RLF Program, operating under a Memorandum of Agreement (MOA) between NMFS and *MarineFisheries*, seeks to promote 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 are sometimes attributed to catch-share programs. Under the RLF, *MarineFisheries* contracted with two financial institutions to provide approved loan services to eligible applicants throughout the Commonwealth: (1) Tremont Credit Union, and (2) the Community Development Partnership. This year, *MarineFisheries* contracted with a third organization to operate the Revolving ACE Leasing Fund (RALF). Under the RALF, the Gloucester-based sector, New England Fishery Sector (NEFS) II, is allowed to administer funds for groundfish quota leasing.

During calendar year 2017, Tremont Credit Union and Community Development Partnership together continued administration of six active loans totaling $179,124 in RLF funds. No new loans were issued or closed during the year; all fishermen remain compliant with their repayment terms. Additionally, lenders assisted borrowers with technical assistance and business planning. NEFS II utilized $80,253 in RALF funds to lease-in additional groundfish quota. *MarineFisheries* continued working with a second Gloucester-based sector to develop a RALF program.

Groundfish Disaster Economic Assistance Program

Previously, *MarineFisheries* was awarded $21,715,292 in federal grants stemming from a September 2012 disaster declaration in the Northeast multispecies (groundfish) fishery by the Acting Secretary of Commerce. The Commonwealth's Groundfish Disaster Economic Assistance Program distributed $20,455,665 in direct aid payment to various commercial and recreational harvesters, crew members, shoreside businesses, and Sectors between August 2014 and June 2016. Remaining funds have been directed towards three initiatives.

Industry-Based Survey: In 2017, *MarineFisheries* completed the second year of the Gulf of Maine (GOM) Cod Industry-Based Survey. Details are provided under Special Fisheries Research Projects (page 66).

Whiting Experimental Fishery: Using a $50,000 set-aside, *MarineFisheries* completed the second of a two-year study to evaluate possible regulatory amendments to improve access for the small mesh whiting fishery. See Conservation Engineering Project (page 72) for more information.

Industry-funded Buyback Administration: With $200,000 dedicated to support development of an industry-funded buyback program, *MarineFisheries* established an Industry Outreach Group to develop a strawman proposal. The seven member group consisted of active fishermen, vessel owners and industry managers from Northeast Seafood Coalition and Sustainable Harvest sectors. The group held two in-person meetings in February and April and developed working papers through correspondence. Specifically, the group identified objectives for a buyback program, determined methods for valuation of the fishery and quota units, and detailed options for loan repayment. The group decided to suspend further development of a buyback program and indicated that any additional development would not be beneficial until conditions for the groundfish fishery change, including increased interest in permit buying and selling and stock status of key species. *MarineFisheries* has requested to NMFS a repurposing of these funds dedicated to the buyback administration.

The Clean Vessel Act Program

MarineFisheries administers the Clean Vessel Act Program (*Mass*CVA) to ensure that adequate, convenient pumpout facilities are provided to meet the needs of recreational boaters in Massachusetts coastal waters. This is achieved by monitoring the need for new or replacement coastal pumpout equipment and providing operation and maintenance funds to pumpout facilities offering free pumpout service to recreational boaters. Responsibilities include the identification of appropriate sites for needed pumpout equipment, providing technical assistance and information to boaters and others in need of *Mass*CVA information, and agency coordination with public and private parties.

In 2017, the 23rd year of our participation, *Mass*CVA continued to support Massachusetts' status as a No Discharge Zone (NDZ). With its hundreds of bays, coves, and inlets, it is challenging to provide adequate shore-side pumpout support along the Massachusetts coastline, especially with our short, intense New England boating season. Consequently, we have been a leader in the implementation of pumpout vessel use. Our matrix of pumpout vessels and shore-side pumpouts, along with dump stations, has created much wider boater access along the coast than twice the number of conventional shore-side facilities could have provided, and has been instrumental in Massachusetts' efforts to establish a statewide NDZ. To date, the *Mass*CVA Program has kept over 8.6 million gallons of effluent from state coastal waters.

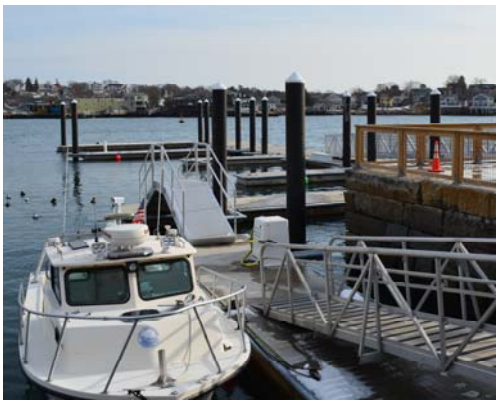

Figure 42. Shore-side pumpout station constructed in 2017 in Gloucester.

Our capital reinvestment program has enabled *Mass*CVA to expand with minimal cost to new pumpout operators that lack the capital for investment in new infrastructure. Through this program, when an operator replaces an existing *Mass*CVA pumpout boat or fixed-location station, the replaced equipment can be provided to another new or existing operator who can pay to have it refurbished at a fraction of the cost of new equipment.

In 2017, our CVA-funded pumpout facilities included 44 private marinas, one non-profit organization, and 49 cities and towns. *Mass*CVA staff stayed in close contact with all our pumpout operators, assessing programmatic needs and shortfalls. We addressed existing equipment concerns and facility growth requests as allowed by available Federal funds (Table 32). Total reimbursement for all new and replacement equipment was $374,123. An additional $544,569 was spent on facility operation and maintenance costs in support of 64 pumpout boats, 83 fixed-location pumpout stations, and 13 mobile pumpout carts available to the recreational boating public along the Massachusetts coastline.

Recreational boater outreach remained a critical component of *Mass*CVA. Over 8,000 pumpout location guides were distributed to the public at marinas and other boating or fishing-related outreach events (e.g., the New England Boat Show). Another widely-distributed brochure includes a "how to" guide for pumpout station use.

Table 32. New and Replacement CVA Infrastructure for 2017.

Recipient	Equipment
Charlestown Marina	Four new shore-side pumpout stations and heated lines
Constitution Marina	Replacement pumpout boat engine
Dockside Marina	New shore-side pumpout station
Falmouth	Replacement pumpout boat
Gloucester	New shore-side pumpout station with accompanying float (Figure 42)
Ipswich	Replacement pumpout boat
Provincetown Marina	New shore-side station
Sandwich Marina	Replacement of tight tank and shore-side pumpout station

Boating Infrastructure Grant Program

Figure 43. The City of Gloucester worked towards completion of the Tier II funded Solomon Jacobs Park Harbormaster Facility Project in 2017.

The Massachusetts Boating Infrastructure Grant Program (*Mass*BIG) is a two-tiered federal grant program, directed through the USFWS and administered by *MarineFisheries*. *Mass*BIG is funded by the Sport Fish Restoration Fund which in turn is funded by a small percentage of the Federal Gasoline Tax (an amount representing fuel purchased by boaters across the nation). *Mass*BIG is designed to provide grants to upgrade or install facilities for transient recreational boats 26 feet or more in length at public or partnered private facilities.

Under Tier I, *Mass*BIG may receive funding for eligible projects up to $200,000 annually. Proposed projects filed under Tier II can be much larger in scope. Unlike Tier I, Tier II proposals are judged in a nationally competitive process based on a strict point system. Both grant tiers are reimbursement grants, meaning that payments are made upon the submission of invoices for work accomplished. Selected applicants provide at least a 25% match for Federal funds received. All payments are based on 75% reimbursement of invoices from work completed.

One Tier I grant was awarded in 2017 (Table 33). Mattapoisett was awarded $180,000 for a project to construct a 100-ft long, 6-ft wide timber pier off the southeasterly end of Long Wharf in Mattapoisett Harbor, providing for five spaces for transient boats. A 10'x30' timber float and gangway will also be constructed and installed to provide enhanced pick up and drop off access for individuals wishing to access the wharf and town facilities.

During 2017, *Mass*BIG partnered with the Massachusetts Department of Conservation and Recreation and University of Massachusetts Boston to apply for a Tier I grant to enhance transient recreational boater access to the Boston Harbor Islands through the installation of 55 transient moorings off of Peddocks Island. This project, if funded, would enhance safe, reliable public access via recreational boat to Peddocks Island, and the Boston Harbor Islands as a whole.

Table 33. Massachusetts BIG Project Summary for the past four years.

Year	Project	Award	% Complete
2013	Wessagusset Yacht Club Transient Dockage Phase II & Phase III (Fore River, Weymouth)	$92,250	100%
	Seaport Landing Marina Transient Dockage (Lynn) *Extended in 2016*	$267,700	10%
2015	Solomon Jacobs Park Harbormaster Facility Project (Gloucester Harbor) (Figure 43)	$263,930	100%
	Newburyport Visiting Transient Boater Project (Merrimack River)	$448,059	100%
	Manchester by-the-Sea Transient Boater Infrastructure Improvement Project (Manchester Harbor)	$360,222	20%
2016	Nantucket Transient Boater Navigational Project (Nantucket and Madaket Harbors)	$45,056	15%
2017	Mattapoisett Transient Boater Access Project (Mattapoisett Harbor)	$180,000	10%

Outreach

MarineFisheries' Outreach efforts are focused on engaging and informing the Massachusetts saltwater fishing community and the general public. Activities are supported in large part by the sale of recreational saltwater fishing permits. 2017 marked the sixth year of this project.

Information & Education

The Information & Education Project (I&E) focuses specifically on establishing and maintaining meaningful connections with Massachusetts recreational saltwater anglers. Staff achieve this in a number of ways:

Public Events: I&E was present at various trade shows and events throughout the year, such as the New England Boat Show in Boston, the New England Saltwater Fishing Show, and the Topsfield Fair.

Publications: New publications for 2017 included an informational brochure on circle hook use, a promotional leaflet on *MarineFisheries'* saltwater fishing derby, and a *Marine Habitats* coloring book. The latter, along with the *Sharks of Massachusetts, Whales of Massachusetts,* and *Fish of Massachusetts* coloring books, continue to be a success, with 5,000 of each of the books printed for distribution in 2017.

Social Media: Communications with constituents through our social media platforms continued on: Facebook (user MaMarineFisheries), Twitter (handle @MassDMF), YouTube (channel MA MarineFisheries), and Flickr (user MA MarineFisheries). In 2017, *MarineFisheries* added a new social media platform, Instagram (user MassMarineFisheries).

MarineFisheries used these platforms to share information regarding policy and research as well as to cross promote with sister agencies within the Commonwealth. With the anticipation of the changing website platform, *MarineFisheries* altered the type of content it was presenting on social media to ensure constituents had multiple channels to receive important updates. In 2017, Facebook and Twitter content was more focused on providing regulatory updates and near real time progress from field research.

Overall, the Facebook page grew 60% in 2017, adding 1,242 new followers. Twitter grew nearly 30% in 2017 with 569 new followers. *MarineFisheries* also saw an increase in engagement rates with constituents on both platforms. By the end of the year, the new Instagram account had over 600 followers.

In the fall of 2017, I&E launched a new social media campaign targeting recreational anglers. An informational game, titled "*What is it? Wednesday,"* used photographs and videos of *MarineFisheries* research to engage the community (Figure 44). Correct guesses were entered into a monthly drawing for a Saltwater Angler Starter Kit, which included a mini tackle kit with circle hooks and sinkers, as well as *MarineFisheries* stickers and a measuring tape. Follow-up postings offered additional information and promoted various projects in addition to highlighting many of the species found in Massachusetts waters. Overall, the *What is it? Wednesday* promotion resulted in a 19% increase in engagement (through post "likes" and comments) in the November–December period.

Figure 44. *MarineFisheries'* December 6 *What is It? Wednesday* Facebook posting.

Website: In association with the Baker-Polito Administration's overhaul of the Commonwealth's Mass.gov website, I&E collaborated with *MarineFisheries*' webmasters to make things like buying a permit and looking up regulations a more user-friendly experience.

R3 Initiatives: Every year, *MarineFisheries* works in conjunction with the Recreational Boating and Fishing Foundation (RBFF) to increase participation in recreational saltwater angling. In 2017, *MarineFisheries* began developing a plan to deliver effective angler recruitment, retention, and reactivation (R3) efforts. Also in 2017, a representative from *MarineFisheries* attended the RBFF State Marketing Workshop in Phoenix, Arizona to learn about new and evolving marketing techniques and resources to provide to our saltwater permit holders.

Other: The Coordinator continued to represent the Division on Massachusetts Marine Educators, the National Marine Educators Association, and the New England Ocean Science Education Collaborative.

Saltwater Angler Education

Figure 45. Division staff teaching basic angling skills at a youth fishing clinic at Fort Taber.

Our Saltwater Angler Education initiative works to promote responsible recreational saltwater fishing in coastal Massachusetts waters, specifically reaching out to those who are new to the sport. Major components include fishing clinics (Figure 45) and a small grant program, which awards up to $500 per proposal for outside entities to create an event promoting saltwater angler education within Massachusetts.

In 2017, *MarineFisheries* hosted or participated in four youth fishing events and two events open to all ages, one of which was an evening family fishing clinic (Table 34). Events occurred from June through September, were free to the public, and included over 200 youth participants under the age of 15. At these events, *MarineFisheries* staff taught basic angling skills, how to responsibly handle fish, the importance of recycling monofilament, and other fun activities such as knot tying and painted fish prints. Educational handouts were distributed to registered youth, as were mini tackle kits which included circle hooks and a measuring tape. At the end of each 3-hour event, our goal is to have participants feel confident enough to saltwater fish on their own. Providing tackle to participants greatly increases those odds. We've received a lot of positive feedback from these fishing events with demand to host more.

Table 34. 2017 Saltwater Angler Education Fishing Events.

Event	Partnering Organization(s)	Participants
Salem Willows Youth Fishing Clinic, Salem	City of Salem	27
Boating & Water Safety Day, Cape Cod Canal, Sandwich	Canal Visitor's Center	25
Family Fishing Night at Cape Cod Canal, Sandwich	Canal Visitor's Center	90
Bass River Youth Fishing Clinic, South Yarmouth	Town of Yarmouth	34
Fort Taber Youth Fishing Clinic, New Bedford	City of New Bedford & Buzzards Bay Anglers Club	30
Fort Taber Youth Fishing Clinic, New Bedford	City of New Bedford	22

Seafood Marketing

The Seafood Marketing Program continued to promote and raise awareness for Massachusetts seafood in 2017. Formally launched in 2016, the program increased its activities in 2017.

The main summer outreach activity was participating in the full schedule of ten Boston 25 News Zip Trips. Zip Trips are Friday morning pop-up fairs in different communities throughout the Commonwealth that also serve as the setting for the Friday morning Boston 25 News edition. The Seafood Marketing Program sponsored the weekly "Taste of the Town" on-air segment that featured seafood prepared by local restaurants. These events provided a great way to engage with residents throughout the Commonwealth and education them on local seafood. The program also had a booth at the Boston Seafood Festival again.

The ongoing, two-year partnership with Massachusetts Farm to School resulted in seafood being featured as the "Harvest of the Month" in May at over 150 participating schools throughout the Commonwealth. This translated into up to 800,000 servings of local seafood being served during the month. The program also partnered with restaurants on a "Squid Week" in late May to promote delicious local squid. Staff also piloted a "Seafood Ambassador" program with local restaurants where Division staff met with restaurant staff to educate them on topics relevant to their menus. The early results were positive.

The first annual Seafood Marketing Grant Program wrapped up at the end of the fiscal year in June 2017. A total of $105,000 in grant funds was distributed for seven projects (below). In October, the Seafood Marketing Program began accepting applications for year two of the grant program.

- Cape Cod Commercial Fishermen's Alliance, Cape Cod: "Supporting the Local Economy: Demonstrating Skate and Dogfish" – $15,000 – Two boat-to-plate recipe demonstration videos on dogfish and skate for social media, in partnership with Buy Fresh Buy Local Cape Cod.
- Fishing Partnership Support Services Massachusetts, Burlington: "The Faces of Fishermen and their Families" – $10,000 – Five photo essays of fishermen and their families to increase public awareness by showing positive impact of our commercial fishing industry on our coastal communities.
- Red's Best, Boston: "Promoting Local Catch at the Boston Public Market" – $14,000 – Twelve free sample sessions for public tastings prepared by Red's Best kitchen staff with promotional material, and four seafood events at the Kitchen at the Boston Public Market.
- City of Gloucester/Gloucester Fishermen's Wives Association, Gloucester: "Collaborative Local Seafood Product Development for a New Audience" – $13,000 – Product development for various locally caught species such as Red Fish, Whiting, Pollock, Hake, and Yellowtail Flounder in order to market seafood better to buyers in restaurants, hotels, hospitals, and universities.
- Green Crab R & D Group, Ipswich: "The Nation's First Soft-Shell Green Crab Harvest" – $20,000 – Production of the country's first harvest of soft-shell green crabs, refine techniques and create market demand.
- New Bedford Harbor Development Commission, New Bedford: "Creating a Portal to New Bedford Seafood" – $13,000 – Creation of a New Bedford Seafood website that offers a central location for local, regional, and international buyers, and a Seafood Throwdown.
- Wellfleet SPAT, Wellfleet: "Taste the Merrior: An Educational Experience" – $20,500 – A pilot educational and tasting event in Boston this spring to reacquire and increase market share for Wellfleet oysters and clams after the damaging norovirus outbreak last fall.

The Seafood Marketing Steering Committee met twice, in June and November. The Steering Committee continued to provide valuable advice and direction to the program.

Scientific Diving

Figure 46. Advanced training for *MarineFisheries*, *Mass*DFW, and SMAST divers in Cape Cod Bay.

Scientific Diving is responsible for management of all scientific diving activities conducted by *MarineFisheries*. First organized in 1972, the program has evolved to meet the standards of the Occupational Safety and Health Administration's scientific diving exemption. This structure sets high standards for *MarineFisheries*' training and dive operations, affording *MarineFisheries* divers greater protection from accidental injury and helping to ensure the success of research performed by diving.

MarineFisheries scientific divers conducted over 640 research dives to support on-going research and monitoring programs, including artificial reef site surveys; coastwide benthic temperature monitoring; early-benthic-phase lobster suction surveys; eelgrass monitoring and restoration; shellfish abundance and habitat surveys; maintenance of acoustic telemetry receivers for numerous finfish species; PCB monitoring sample collection; and dive program training. 2017 highlights included continued post-deployment monitoring of the new artificial reef off Harwich and the successful completion of advanced and rescue training for *MarineFisheries*, Massachusetts Division of Fisheries and Wildlife, and SMAST biologists and students (Figure 46). *MarineFisheries* Scientific Diving Program also maintained reciprocity agreements with the U.S. EPA and Northeastern University, permitting cooperative diving research.

Routine program management duties included diver training, equipment maintenance and repair, and maintenance of the air system.

Educational and outreach efforts to dive clubs, schools, and local dive shows continued. Highlights included a *MarineFisheries* booth/table at the Boston Sea Rovers Show, World Oceans Day at the New England Aquarium, and the Beneath the Sea Show in New Jersey. *MarineFisheries* also hosted the 2017 Boston Sea Rovers Summer Intern during the summer field season. The Diving Safety Officer served on the Board of Directors of the Our World Underwater Scholarship Society and the American Academy of Underwater Sciences, and as President of the American Academy of Underwater Sciences Foundation.

Capital Assets and Facilities Management

Facilities

MarineFisheries maintains facilities at several coastal locations throughout the state. Headquarters are located in Boston, and the two primary field stations are located in Gloucester and New Bedford. Other facilities include the Shellfish Purification Plant in Newburyport, the Hughes Hatchery and Research Facility in Vineyard Haven, a storage and field support facility in New Bedford, and a subsidiary field office and storage facility in Sandwich.

In FY2017, *MarineFisheries* spent approximately $150,000 in facility planning, infrastructure maintenance, emergency repairs, and equipment throughout the Agency. This included several large projects in both the

Gloucester Field Station and the Shellfish Purification Plant, routine maintenance at the Hughes Hatchery and Research Facility, and a continued effort to develop the South Coast Field Station.

The Annisquam River Marine Fisheries Field Station in Gloucester upgraded or replaced several mechanical systems throughout the facility. A leaking roof over the Age and Growth Lab was repaired. The motorized overhead door to the wet lab was repaired and a new motorized overhead door was installed in the facilities storage building. The major project completed in FY2017 was the renovation and repair of a library/meeting room and a new design for cubed work stations in that same shared space.

The Shellfish Purification Plant in Newburyport focused much of its capital budget on the purchase and installation of a portable chiller to further enhance the wet storage and research capabilities of the tanks. Storm damage required the repair of the outfall pipe, and some electrical upgrades were made throughout the facility. In addition, lab and plant equipment were replaced using capital funds.

The New Bedford storage and field support facility received upgrades to its electrical service and had an industrial A/C unit installed in the workshop. Final plans were developed for the support building to be located at the Shawme Crowell State Forest, including the design of a septic system. The septic design was submitted to *Mass*DEP for permitting.

Construction of the new SMAST II facility continued throughout 2017, with a ribbon-cutting ceremony held in the fall. As substantial completion of the new facility was realized by November of 2017, the construction team switched focus to begin renovations of the original SMAST I building. Relocation of most of the south coast programs to the SMAST II facility was scheduled for early 2018. The Shellfish Program will be housed with the shellfish bacteriological lab in the SMAST I facility.

Vehicles and Boats

MarineFisheries maintains a fleet of 40 vehicles and 16 boats. In 2017, roughly $118,000 was paid to the Office of Vehicle Management for lease vehicles, and an additional $25,000 was spent on maintenance and repair for all stock. Two new 4WD pick-up trucks and a small SUV were received in 2017, replacing extremely worn and sidelined vehicles. No vessels, trailers, or outboards were replaced in the *MarineFisheries* fleet for 2017, but routine maintenance of the vessels and trailers cost just over $35,000.