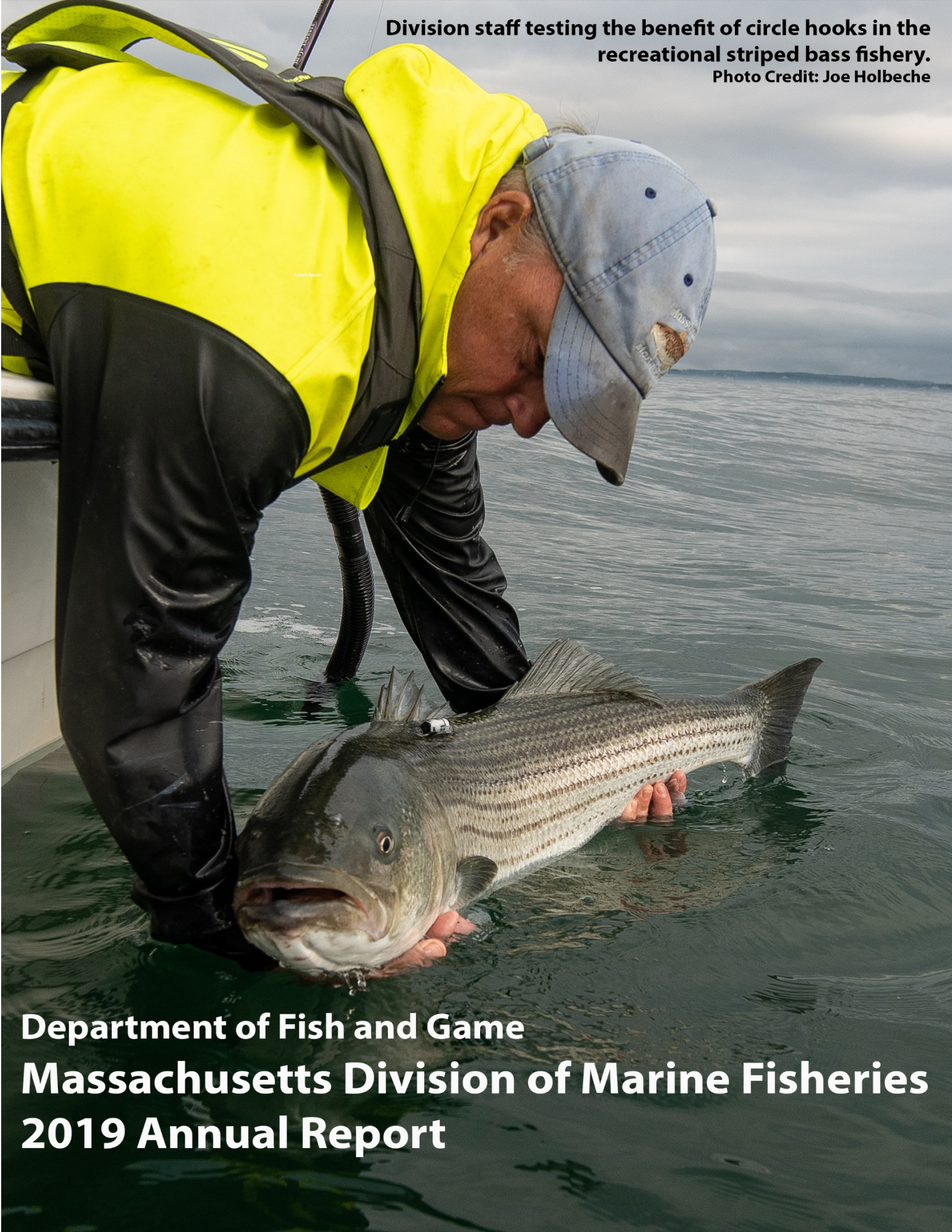

Division staff testing the benefit of circle hooks in the recreational striped bass fishery.
Photo Credit: Joe Holbeche

Department of Fish and Game

Massachusetts Division of Marine Fisheries 2019 Annual Report

Department of Fish and Game

Massachusetts Division of Marine Fisheries

2019 Annual Report

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

Executive Office of Energy and Environmental Affairs
Secretary Kathleen Theoharides

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, 2019

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Introduction

The Massachusetts Division of Marine Fisheries (DMF or Division) of the Department of Fish and Game is the Commonwealth's marine fisheries management agency. DMF 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

USACE	US Army Corps of Engineers
ACCSP	Atlantic Coastal Cooperative Statistics Program
ALWTRP	Atlantic Large Whale Take Reduction Plan
ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management (Federal)
CCB	Cape Cod Bay
DMF	Division of Marine Fisheries (Massachusetts)
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
IBS	Industry-Based Survey
ILF	In-lieu Fee
ISSC	Interstate Shellfish Sanitation Conference
LCMA	Lobster Conservation Management Area
MassBays	Massachusetts Bays National Estuarine Program
*Mass*CZM	Massachusetts Office of Coastal Zone Management
*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
*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
NOAA	National Oceanic and Atmospheric Administration (and NOAA Fisheries)
NSSP	National Shellfish Sanitation Program
OCC	Outer Cape Cod
OLE	Office of Law Enforcement (Massachusetts)
PCCS	Provincetown Center for Coastal Studies
PSP	Paralytic Shellfish Poisoning
RHL	Recreational Harvest Limit
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

Personnel

Dr. David Pierce, Director (retired November 1)
Daniel McKiernan, Deputy Director (January–October)/Acting Director (November–December)
Melanie Griffin, Fisheries Policy Analyst
Nichola Meserve, Fisheries Policy Analyst
Dr. Catherine O'Keefe, Marine Science and Policy Analyst
Jared Silva, Policy Analyst & Administrative Law Clerk

Overview

DMF 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 DMF proposes in order for them to be implemented.

Advisory Groups

Following below is a summary of 2019 proceedings by groups advising DMF 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 10 monthly business meetings during 2019. Regulatory revisions and fishery specifications that were approved by the Commission or became effective during 2019 are included in the summary of fisheries management actions beginning on page 10. An MFAC Law Enforcement Subcommittee composed of several Commission members and Massachusetts environmental police officers also met once to discuss various enforcement and non-compliance issues. There were no changes to the membership of the MFAC in 2019.

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 May 2019 to review spending of the Fiscal Year (FY) 2019 fund appropriation and make recommendations for spending of the expected FY2020 fund appropriation of roughly $1.7 million. The approved spending plan included, but was not limited to: construction of the Deer Island Fishing Pier in Boston Harbor; the Small Grants Program through which municipalities can compete for funds to finance public access improvement projects; enhanced sampling and assessment of the recreational fishery; public informational and educational materials and programs; monitoring diadromous fish populations; monitoring fish populations at artificial reefs; and research into striped bass catch and release mortality rates.

Seafood Marketing Steering Committee

On August 13, 2014, "An Act Promoting Economic Growth across the Commonwealth" established a Seafood Marketing Program within DMF. The legislation laid out initial objectives of the program, required the appointment of a 19-member steering committee to guide DMF 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 DMF, met twice during the year. See Seafood Marketing (page 111) for more information.

Shellfish Advisory Panel

DMF 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 during May to provide industry input on a range of issues including, for example, state aquaculture and *Vibrio* management, federal and interstate shellfish management revisions, and the ongoing efforts of the Massachusetts Shellfish Initiative, which is a cooperative effort to develop a strategic plan aimed at optimizing the economic, environmental, and social benefits of the Commonwealth's shellfish resources.

The Public

Input from commercial and recreational fishery participants and other stakeholder types is integral to the Division's initiation, development, implementation, and monitoring of fisheries management initiatives. Stakeholder engagement is achieved through various informal and structured processes.

DMF Public Hearings: During 2019, DMF held 12 state public hearings to collect stakeholder input on proposed revisions to Massachusetts marine fishery regulations (see below). These comment periods included the collection of written comments.

- January 9 & 10 (Gloucester, Plymouth): groundfish state-waters commercial management.
- January 19 & 23 (Hyannis, Plymouth): rights whale protections; whelk commercial gauge increases.
- January 30 & 31 (Plymouth, Gloucester): shellfish recodification and reorganization; municipal contaminated shellfish relay and transplant fee.
- February 25 & 27 (Bourne, Gloucester): striped bass conservation; striped bass commercial management; measures to improve for-hire compliance; scup commercial bycatch limit during small mesh squid fishery; commercial trip limit and quota management.
- June 13 (Westborough): black sea bass, scup, cod, and haddock recreational fishing limits.
- September 10 & 11 (Gloucester, Bourne): tautog commercial permitting and tagging program; lobster control date for LCMA1; coastal sharks; fluke commercial Period I management; ocean quahog trip limit; retail farmers market permit; northern shrimp commercial harvest moratorium; horseshoe crab commercial bait harvest closure in Pleasant Bay; spiny dogfish commercial trip limit.
- October 17 (Westborough): lobster processing.

Formal public comment and informal public input was collected on numerous other issues through written submissions only: recreational scup and black sea bass management; a petition to decrease the ocean quahog trip limit; suspending the April groundfish closure between Marblehead and Plymouth; in-season adjustments to commercial fluke and striped bass limits to facilitate harvest of the state's quotas; strategic planning for the management of shellfish in the state; special permit requests for open-water aquaculture projects; management of the commercial summer flounder Period II fishery; and the commercial scup winter period trip limits.

ASMFC Public Hearings: During 2019, DMF hosted two ASMFC public hearings to collect stakeholder input on proposed revisions to interstate fishery management plans.

- April 1 (Gloucester): Atlantic Herring Draft Addendum II to Amendment 3 of the Interstate FMP.
- October 2 & 3 (Woburn, Bourne): Striped Bass Draft Addendum VI to Amendment 6 of the Interstate FMP.

Stakeholder Meetings: Policy and management staff participated in countless additional informal meetings with commercial, recreational, and non-traditional fisheries stakeholders at their request to discuss items of interest.

Fisheries Management Actions

American Lobster

Processing Rules: During the summer of 2019, state law at G.L. c. 130 §44 was amended to expand allowances for the processing of lobster and the possession of processed lobster parts beyond frozen shell-on lobster tails weighing three ounces or greater (e.g., to shell-on claws). The revised law allows for the in-state possession and sale of these shell-on lobster parts, and for seafood dealers to import these shell-on lobster parts for processing and to process whole live lobsters into these shell-on lobster parts. Accordingly, DMF amended its lobster processing regulations to reflect these changes in state law. The revisions were made effective September 27.

Atlantic Herring

Inshore Gulf of Maine Spawning Protection: Protections on Atlantic herring spawning activity in Area 1A were strengthened in 2019 through Addendum II to Amendment 3 of the Interstate FMP (i.e., when and how the three spawning area closure are implemented). The changes were made in response to the results of the 2018 Benchmark Stock Assessment, which showed reduced levels of recruitment and spawning stock biomass over the prior five years, with 2016 recruitment levels the lowest on record. Under the new protocols in 2019, the MA-NH Spawning Area within Area 1A was closed to the directed fishery from September 23–November 3. DMF expected to amend its regulations in early 2020 to align with the FMP's language.

Inshore Gulf of Maine Quota Management: DMF implemented the days out schedule for the directed herring fishery in Area 1A consistent with ASMFC Herring Management Board decisions. Permit conditions were issued to vessels declared into the directed fishery through DMF's opt-in process. The Area 1A quota was managed in bi-monthly periods set for June (1), July/August (2), September/October (3), and November/December (4). Due to the low 2019 Annual Catch Limit, the fishery remained closed until July 15 with the Period I quota rolled into Period 2. The directed fishery included a four-day, 160,000-pound per week limit from the start of the fishery through August 18 when the period's quota was exhausted. The fishery reopened on September 1 under the same catch measures and closed on September 11 for the rest of Period 3. The fishery opened for Period 4 on November 4 and operated under one landing day per week until the directed fishery closed on November 27.

Acceptable Biological Catch and Localized Depletion: DMF submitted two comment letters to NOAA Fisheries related to the NEFMC's Amendment 8 to the Atlantic Herring FMP. Amendment 8 included the development of a long-term Acceptable Biological Catch (ABC) control rule based on Management Strategy Evaluation (MSE) to specifically account for herring's role as forage in the ecosystem. DMF submitted a letter in support of reduced herring catch limits for the 2019 fishing year based on the long-term control rule. Additionally, Amendment 8 included measures to restrict the use of mid-water trawl gear in inshore waters to prevent localized depletion of herring and minimize user conflict among various stakeholders. DMF submitted a comment letter in support of the inshore buffer zones.

Atlantic Menhaden

Commercial Permitting Guidelines: DMF issued a new policy document that provides guidelines for the state's commercial menhaden fishery permitting rules. The policy did not alter the existing menhaden permitting or management structure, but instead succinctly describes the various permit classes and the tiers of fishing opportunities permit holders are authorized to engage in based on the permit endorsements held. This step was taken in response to increased interest in the fishery stemming primarily from concerns regarding potential baitfish shortages (i.e., herring) and a need to provide greater clarity on the different access levels to the menhaden fishery.

Quota Transfers: Massachusetts requested and received four transfers of commercial menhaden quota totaling 1.3 million pounds, two in August and two in September. These transfers from Rhode Island (1), Connecticut (2), and New York (1) were made in response to persistent high inshore availability of menhaden and enabled the fleet to continue harvesting at a higher trip limit. With these transfers, the total annual harvest approached 7 million pounds, the highest level since 2008.

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 Period I Management: DMF adopted regulations to increase the fluke commercial Period I (January 1–April 22) trip limit from 500 pounds to 1,000 pounds and eliminate the closed fishing period occurring throughout January. These rule changes were effective November 29 and will thus first affect the 2020 fishery. This action responded to both a significant increase in fluke quota beginning in 2019 and decreased landings by the offshore wintertime fishing fleet in Massachusetts in recent years.

Fluke Commercial Period II Management: DMF made several in-season adjustments to the 2019 Period II (April 23–December 31) commercial fluke limits to facilitate further utilization of the available 2019 commercial quota. Through Director's Declarations, Saturday was added to the normal Sunday–Thursday open fishing days for September 21–October 31, followed by the addition of Friday and a trip limit increase to 1,000 pounds for all gear types for November 1–December 31. Additionally, through the conditioning of permits, DMF initiated a pilot program on August 27 that allowed trawlers fishing for fluke to possess and land two daily limits lawfully caught and retained over consecutive open commercial fishing days provided the first day's catch was segregated in a sealed container. The industry-proposed program sought to increase the nearshore fleet's effectiveness and efficiency in targeting the quota; it ended on October 31.

Scup Commercial Bycatch Limit during the Small Mesh Squid Fishery: DMF implemented a seasonal increase to the scup bycatch limit for trawl vessels with net mesh measuring less than 5" diamond in the cod end. These vessels became authorized to possess and land up to 2,000 pounds of scup during April 15–June 15. This change in the bycatch limit was consistent with a revision to federal regulations requested by DMF and Rhode Island (through the MAFMC) to increase the retention of market sized scup caught during the spring small mesh trawl fishery for squid, taking into consideration the underutilized quota for scup. The prior limits allowed for

1,000 pounds of scup to be retained during October 1–April 30 and 200 pounds during May 1–September 30. This regulation took effect April 19.

Scup Commercial Trip Limits: Two Director's declarations set the 2019 Winter II and 2020 Winter I trip limits at 27,000 pounds and 50,000 pounds, respectively, to complement the federal measures.

Scup Recreational Management: Through the interstate management process, the northern region of Massachusetts through New York was afforded additional harvest opportunities to achieve the coastwide recreational harvest limit. Our region selected to eliminate the closed season of January–April (providing for year-round access) and increase the possession limit aboard for-hire vessels during the "bonus season" (May–June in Massachusetts) from 45 fish to 50 fish (complementing the federal waters limit). The minimum size and regular season bag limit remained status quo at 9" and 30 fish. This rule took effect on April 16.

Black Sea Bass Recreational Management: While the ASMFC approved status quo regulations along the coast to not exceed the 2020 recreational harvest limit, DMF requested and received permission to adjust the timing of our recreational black sea bass fishing season such that it continued to open on a Saturday in May, provided our projected harvest remained the same. The 2019 season occurred over May 18–September 8, whereas the 2018 season spanned May 19–September 12. The bag limit and size limit were held constant at 5 fish and 15". This regulation was effective on April 16.

Quota Transfers: Massachusetts received a transfer of commercial fluke quota (3,875 pounds) from North Carolina in May to account for landings made by a vessel bound for that state but granted safe harbor in Massachusetts after experiencing a mechanical issue. In August, Massachusetts agreed to transfer 100,000 pounds of scup Summer Period commercial quota to Connecticut. Since the quota was never reached, the transfer did not impact the length of our scup fishery.

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. DMF also includes monkfish in its definition of multispecies groundfish. Any management actions affecting these species are thus grouped.

State-waters Commercial Groundfish Management: Effective March 22, DMF adopted two regulations intent on better aligning state-waters commercial groundfish landings with the state-waters sub-components (i.e., harvest allowances assigned through the federal FMP). The first regulation established a new April commercial groundfish fishing closure in those state-waters between 42°30' N latitude (Marblehead) and 42°00' N latitude (Plymouth) that are west of 70°30' W longitude; however, the regulation includes a provision allowing the Director to annually suspend the closure—with the approval of the MFAC—if it is deemed unnecessary based on available state landings data. For 2019, the Director suspended the April closure. Available landings data indicated that the state-waters fishery was well under the state-waters subcomponents for the 2018 fishing year (May 1, 2018–April 30, 2019) for all relevant groundfish stocks, with the exception of GOM winter flounder for which the available federal quota was underutilized providing a sufficient buffer against exceeding the overall annual catch limit for this stock. The second regulation established a December 31, 2018 control date for the state-waters groundfish permit endorsement. Subject to future rulemaking, this control date

could be used to limit participation in the state-waters groundfish fishery based on prior history. DMF had also proposed an owner-operator requirement for these permit endorsements to address latent effort, but was compelled against taking this action in response to public comment.

Recreational Groundfish Management: Effective July 10, DMF took emergency action to implement recreational fishing limits for GOM cod, GOM haddock, and Georges Bank cod for fishing year 2019 (May 1, 2019–April 30, 2020). For GOM haddock, the fall closure (September 17–October 30) was eliminated and the bag limit was increased from 12 fish to 15 fish. The minimum size remained status quo at 17". For GOM cod, the moratorium on harvest was lifted for two weeks in the fall (September 15–September 30), during which time the limit was one fish measuring at least 21". The retention of GOM cod during any other time of year remained prohibited. While the NEFMC had recommended an additional two-week opening in April, NOAA Fisheries did not authorize a spring season, and DMF did not pursue this open fishing period for state-waters either. For Georges Bank cod, the minimum size was reduced from 23" to 21"; the 10-fish bag limit and year-round open season remained status quo.

Horseshoe Crab

Bait Harvest Closure in Pleasant Bay: Effective November 29, a new regulation codified the long-standing prohibition on the bait harvest of horseshoe crabs within the Pleasant Bay complex. This restriction had been implemented by Director's Declarations since 2006 to avoid depletion of the localized horseshoe crab population within this shallow, intertidal body of water along Eastern Cape Cod. The area remains open to bio-medical harvest; however, horseshoe crabs captured for bio-medical purposes are returned to the harvest area after bleeding and marked to prevent recapture.

Northern Shrimp

Harvest Moratorium: DMF codified the long-standing moratorium on the commercial harvest of northern shrimp into regulation, effective November 29. The moratorium was first implemented in 2014 in response to resource depletion driven by the adverse impacts warming water temperature has had on recruitment and spawning stock biomass. With no improvement to the stock or environmental conditions since (or projected in the near-term), regulations formalizing the moratorium replaced the Director's Declaration process previously used to establish the moratorium on an annual basis.

Protected Species

Right Whale Protections: To reduce the risk of mortality to right whales by ship-strikes, DMF established a 10-knot speed limit for vessels operating during March 1–April 30 within Cape Cod Bay (waters south of 42°08' N latitude and west of 70°10' W longitude). This state rule applies to all vessels with an overall length of less than 65'. Vessels measuring 65' and greater are subject to a similar federal speed limit regulation. The regulation includes a provision to adjust the timing of the speed limit restriction as well as the Large Whale Seasonal Trap Gear Haul-Out (March 1–April 30 default) in response to the presence or absence of right whales in the Bay. This rule change was effective March 22. For 2019, the speed limit was extended through May 9 to account for the continued presence of right whales in the area, as was the large whale trap gear haul-out period for certain waters of Cape Cod Bay and the Outer Cape. This included those

waters under the jurisdiction of the Commonwealth within Cape Cod Bay south of 42°8.42' N latitude, as well as those waters under the jurisdiction of the Commonwealth east of Cape Cod and north of 41°51.5' N latitude.

Sharks

Commercial Spiny Dogfish Trip Limit: Consistent with ASMFC action, DMF declared a 6,000-pound possession and landing limit for the 2019/2020 commercial spiny dogfish fishery, effective May 1, 2019. In addition, DMF formally adopted the 6,000-pound limit into the spiny dogfish regulations, effective November 29, given this limit is expected to remain in place for the next several years. This action reduces the need for annual declarations by the Director. The trip limit can still be amended from 6,000 pounds via declaration if needed.

Shellfish

Whelk Commercial Gauge Size Increases: DMF adopted a 10-year schedule of increases to the minimum gauge width for knobbed and channeled whelk to enhance protection of the spawning stock biomass. The first gauge width increase occurred in 2019, with a move from 2 7/8" to 3", effective March 22 with the rule change. The minimum gauge width will increase by 1/8" on a biennial basis until reaching the terminal size of 3 5/8", representing the size at which 50% of female whelks are mature. DMF's recent stock assessment for channeled whelk found they are overfished with overfishing occurring in Nantucket Sound, the principal harvest area.

Shellfish Recodification: The state's shellfish regulations were re-codified to ensure explicit compliance with the National Shellfish Sanitation Program's Model Ordinance. These new regulations describe shellfish growing area classifications; explain how growing areas are classified and harvest statutes are published and amended; establish rules governing the sanitary harvest, handling, and transport of shellstock; explicitly allow for bulk tagging by grower/dealers; and set forth the shellfish relay program and statutorily mandated relay fee. Technical corrections were also made to the Vibrio management regulations. These regulatory changes took effect on March 22**.**

Commercial Ocean Quahog Trip Limit: Effective November 29, the commercial state-waters ocean quahog trip limit was reduced from 26 cages (832 bushels) to 8 cages (256 bushels). This action was taken in response to an industry-based petition. Ocean quahog populations in state-waters are limited and can likely only sustain a relatively low level of fishing activity. In addition to allowing the existing ocean quahog populations to be fished over a longer period of time by the inshore day-boat fishery, the lower limit was anticipated to help mitigate against potential gear conflicts with fixed gear fishermen.

Squid

Small Mesh Trawl Seasonal Extension: On June 7, DMF declared a one-week extension to the season during which trawlers may fish for squid using small mesh trawls in the waters south and west of Cape Cod. Rather than closing on June 10, the 2019 fishery remained open through June 16 to provide additional access to the large, market-sized squid that remained in the area. At-sea observer data on catch composition were reviewed in making this decision.

Striped Bass

Conservation Measures: DMF adopted two new striped bass conservation measures aimed at improving the survival rate of fish that are caught and released. Effective May 17, 2019 (the date of the regulations' adoption), all fishermen were prohibited from gaffing any undersized striped bass or releasing any fish that had been gaffed. The second regulation established that beginning on January 1, 2020, all private recreational anglers fishing with natural baits would be required to use (inline) circle hooks. In addition to not applying to anglers aboard for-hire vessels, the circle hook mandate would not apply to fishermen fishing with natural baits affixed to artificial lures (e.g., tube and worm) or using the snag and drop technique. The delayed implementation was meant to allow bait and tackle shops and anglers a transition period to liquidate inventory.

Striped Bass Importation: Effective May 17, DMF rescinded a rule prohibiting the importation of non-conforming sized striped bass during Massachusetts' commercial striped bass season. Provided they are properly tagged and were lawfully caught in the jurisdiction of origin, non-conforming sized striped bass (i.e., less than 34" in length for 2019) became legal for importation into Massachusetts year-round. The original prohibition during our commercial season pre-dated the rigorous commercial tagging program established coastwide through the interstate plan and was deemed no longer necessary. This issue gained traction when the Massachusetts commercial fishery did not close in 2018, preventing the import of fish from states further south during late fall. An emergency action was taken to temporarily rescind the rule for the remainder of 2018, and this action in 2019 made that permanent.

Conservation License Plate: Massachusetts motorists will soon be able to display their passion for striped bass and river herring with a new specialty license plate created by DMF and the Massachusetts Environmental Trust (MET) issued by the Registry of Motor Vehicles. DMF and the MET collected pre-orders for the striped bass license plate during the latter half of 2019, reaching the threshold of 750 pre-orders by the end of the year. It is expected that it will take an additional 6 to 8 months in 2020 to manufacture and distribute the plates to the RMV. Once ready, applicants will be contacted by the RMV and instructed to go to their chosen RMV office to pick-up their pre-ordered license plate. Funds generated from the sale of the Striped Bass Conservation Plate are dedicated to striped bass studies, fish passage improvement projects, and angler education. DMF anticipates the plate will be distributed by late fall 2020.

Tautog

Commercial Tagging Program: DMF implemented a commercial tautog tagging program commencing in 2020 to address poaching, as mandated by Amendment 1 to the interstate FMP for tautog. Prior to the annual start of the commercial fishery (currently September 1), DMF will issue tautog tags directly to commercial fishermen, who will be required to tag their tautog catch through the operculum before offloading the fish. At the end of the commercial season, commercial fishermen will be required to return all unused tags and submit a tag accounting report within two weeks of notification. Dealers and seafood purveyors will be prohibited from receiving any untagged tautog. Dealers will be required to liquidate their supply of MA-tagged tautog within two weeks of the end of the state's commercial fishing season. Dealers are not allowed to acquire any fish with tags from a prior calendar year; any fish retained on January 1 with a tag from a prior year may only be sold to an end consumer, and this product must be liquidated by the last day of February.

Commercial Permitting: DMF established the commercial tautog fishery as limited entry beginning in 2020 in order to effectively administer the tagging program. The issuance of tautog permit endorsement will be restricted to renewals, and only for those fishermen who held one in 2018 or 2019 and sold at least 120 pounds of tautog in any year during 2010–2016. DMF anticipated that there would be approximately 200 potential harvesters in 2020 (commensurate with recent activity levels), in contrast to the 2,000 or so tautog permits that DMF issued per year in 2018 and 2019 (of which about 90% did not report selling any fish). These criteria made use of a previously established control date, which had served to alert fishery participants to the likelihood of future access restrictions. Tautog permit endorsements will be transferable, provided the permit was actively fished in four out of the past five years. The rule changes for tautog tagging and permitting were effective November 29.

General Matters

Mobile Gear Regulations: Effective March 22, the state's mobile gear fishery regulations were amended by modernizing the mobile gear closure boundaries into latitudinal and longitudinal coordinates (rather than antiquated references). This rule change also specified that chafing gear may be used on the bottom of trawl nets and net strengtheners may be used in exempted small mesh fisheries. Additionally, the mobile gear night closure was extended to include purse seine fishing, which was previously established through permit conditions.

At-sea Transfer of Fish and Use of Transport Vessels: Effective May 17, regulations were established prohibiting the at-sea transfer of fish with an exemption for fish sold over the rail under the authority of a bait dealer permit, and allowing for authorized dealer transport vessels to exceed trip limits to bring fish from multiple commercial fishermen to port. These rule-changes clarified existing regulations and ensured ongoing compliance with interstate FMPs.

Conducting Commercial Fishing Activity on Recreational For-Hire Trips: Effective May 17, a regulation was adopted to clarify that for-hire operations may not fish under commercial fishing limits while patrons are onboard. This rule was meant to close a loophole by which some captains were allowing their patrons to fish as "crew" to retain higher commercial catch limits for "personal use."

Sale of Fish to a Primary Buyer: Effective May 17, DMF established a regulation requiring the initial sale of all fish from a commercial fisherman to be to a primary buyer. This complemented an existing rule that all entities purchasing fish directly from fishermen be primary buyers.

Retail Farmer's Market Permit: DMF established a new "Retail Farmer's Market" dealer permit category for issuance in 2020 and beyond to better accommodate the emerging activity of retail sale of seafood at farmer's markets and allow for a more streamlined public health inspection. This was adopted into the regulations on November 29.

Adjudicatory Proceedings

Under state law, DMF may sanction commercial and recreational fishing permits for violations of the state's marine fishery laws and regulations subject to a due process adjudicatory proceeding. These adjudicatory proceedings are held before a magistrate. They may be initiated by the agency, the Environmental Police, or municipal officials authorized to enforce the marine fishery laws of the Commonwealth.

In 2019, DMF initiated three adjudicatory proceedings. One hearing was based on incident reports alleging violations of local shellfish bylaws, improper tagging of shellfish, unlawful harvest of shellfish from an aquaculture grant, and failure to report. Another hearing was based on incident reports alleging trap tag violations and trap limit violations in the conch pot fishery. The last hearing addressed the denial of a coastal lobster permit transfer by DMF.

Twelve adjudicatory proceedings were concluded in 2019. This included final decisions in 11 of the 12 matters continued from 2018 and one of the three matters initiated in 2019; the remaining three matters continue into 2020. Six of the 12 proceedings that concluded in 2019 resulted in a final decision to revoke the permit. Violations in support of revocation included: the abandoning of lobster trap gear in the seasonal large whale trap gear closure area; the harvest of shellfish from contaminated waters, improper tagging of shellfish, and conducting unauthorized shellfish culture activities; possession of non-conforming lobsters; possession of undersized whelks; and violations of local shellfish bylaws, improper tagging of shellfish, the unlawful harvest of shellfish from an aquaculture grant, and failure to report. One of the 12 proceedings that concluded in 2019 was resolved by a three-year suspension of the commercial permit. This action was taken in response to violations regarding the harvest of contaminated shellfish and improper shellfish tagging.

Five of the 12 proceedings that concluded in 2019 were resolved by a settlement agreement between the parties. One individual had their commercial and recreational fishing permit suspended for one year for violations of the striped bass recreational bag limit. Two individuals had their commercial permits suspended for one year for violating the state's commercial striped bass rules. One individual had their for-hire permit conditioned for a period of three years for possessing non-conforming quantities of tautog during a charter; these conditions restrict access to the recreational tautog fishery during the fall and subject the permit holder to a three-year probationary period. One individual had their permit conditioned to be subject to a two-year probationary period in response to the unlawful possession of bay quahogs while conducting surf clam dredging activities.

Other Activities

Committee Work and Leadership Positions

During 2019, staff represented Massachusetts at five NEFMC meetings, served on the Groundfish, Scallop, Herring, Monkfish, Skate, and Ecosystem-Based Fishery Management Oversight Committees, provided technical expertise to the Groundfish, Scallop, Herring and Habitat Plan Development Teams and the Northeast Trawl Advisory Panels, and participated in over 100 Council related meetings, hearings, and workshops. In recognition of these cooperative activities and their benefit to the successful management of fisheries, the Council granted the Commonwealth $80,000 in assistance to be divided between two state Fiscal Years (SFY2018 and SFY2019). Per the final contract between DMF and the Council, DMF submitted a SFY2019 Annual Summary Report of Technical Assistance and Support for Performance Period 2 (July 1, 2018–June 30, 2019).

DMF staff also represented Massachusetts at four ASMFC meetings, plus three additional species-specific meetings of the ASMFC with the Mid-Atlantic Fishery Management Council. Staff chaired the ASMFC management boards for winter flounder, tautog, striped bass, menhaden, and shad/river herring, and served on numerous other boards, committees, and teams throughout the year.

Staff co-chaired the Massachusetts Marine Fisheries Institute (MFI), served as MFI Policy Director and was a member of the MFI Executive Committee. Staff also served as the state's representative to the Stellwagen Bank Advisory Council.

Marine Fisheries Institute

The Massachusetts Marine Fisheries Institute (MFI) is a cooperative venture between DMF 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 secured $450,000 in earmarked state funds for the 2020 fiscal year in the Division's appropriation for collaborative research that applies innovative technology to assess the biomass of fish in the region. Specifically, the funds supported: 1) continued development and application of the open cod-end video trawl survey system to estimate stock size for Gulf of Maine cod; 2) research to discriminate between sub-populations of Gulf of Maine cod based on otolith morphology; 3) teaching and advising on stock assessment methods; and 4) continuation of the MFI Advisory Council efforts.

Researchers continued and expanded the river herring/shad bycatch avoidance program for the Atlantic herring fishery. DMF and SMAST received a 2019 Herring Research Set-Aside award, "Maintaining and expanding bycatch avoidance strategies in the mid-water trawl Atlantic herring fishery," for $134,979 to support the program through 2021. In 2017, the MFI received its first external, competitive research grant through NOAA Fisheries' Bycatch Reduction Engineering Program. During 2019, DMF and SMAST researchers continued efforts on the two-year project, "Developing and testing a pelagic species distribution model to forecast river herring bycatch hotspots." The grant for $116,789 supports the evaluation of the impact of fisheries-dependent data on river herring, Atlantic herring, and Atlantic mackerel habitat forecasts, and compares predicted bycatch hotspots to observed river herring bycatch to determine utility in predicting bycatch. The project completed analysis of forecasting models to predict bycatch hotspots and was expected to be finalized in early 2020.

The MFI submitted its 2019 Annual Report in July, highlighting collaborative research on Atlantic cod. The report documented the 20-year history of MFI efforts related to understanding the spatial structure of U.S. cod stocks, including tagging programs, genetic studies, otolith research, and spatial modeling. Results from this research were synthesized in 2019 to support the Northeast Fisheries Science Center's Atlantic Cod Stock Structure Working Group. The working group was formed to determine the most appropriate representation of stock structure for use in regional stock assessments based on currently available information. MFI scientists have played a large role in the group, including DMF staff members leading reviews of early life history and Fishermen's Ecological Knowledge.

The MFI Advisory Council met in November to receive updates on MFI research and wind energy activities, as well as provide input to MFI's Strategic Planning initiative. The Advisory Council offered guidance about MFI's future direction under new leadership and ways to expand the impact of MFI efforts in the region.

Coordination of NEFMC Nominations

DMF 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. Dr. Michael Sissenwine of Falmouth was re-appointed by the Secretary of Commerce to a third term as a Massachusetts at-large member.

Publications

Strategic Plan: DMF released the *Massachusetts Division of Marine Fisheries Strategic Plan for 2019–2023*. The new plan replaces the 2010–2014 strategic plan while maintaining DMF's mission statement. DMF revised its vision and goals to reflect future objectives and initiatives, including an emphasis on stewardship of marine resources, enhancing regional partnerships, and maintaining staff professionalism. DMF policy, science, and administrative staff participated in drafting the new strategic plan, which was published in August.

Annual Report: DMF published its *2018 Annual Report*.

Advisories: DMF released 81 electronic Marine Fisheries Advisories to subscribers of our listserv on various rule changes, public hearings, quota closures, and other important information.

DMF News: DMF published its newsletter twice in 2019 (Figure 1). These editions of "DMF News" were mailed to subscribers and made available through the Division's website. The publication serves to inform and educate our constituents on major management, science, and administrative happenings at the Division.

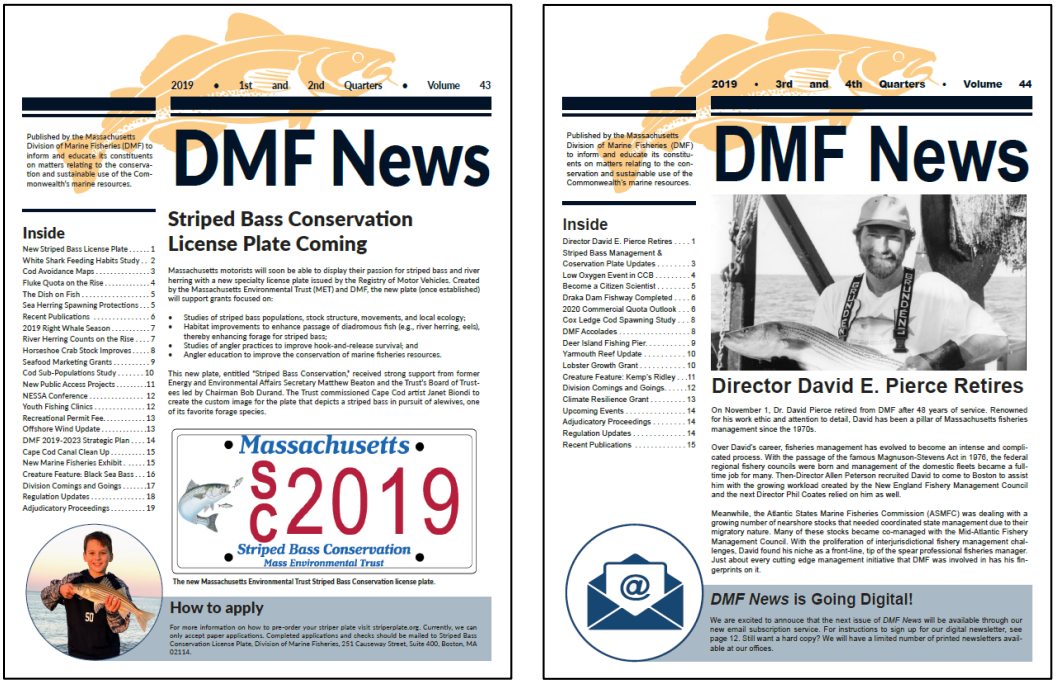


Figure 1. The covers of the two 2019 editions of the DMF News.

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
Nicholas Buchan, Harvester Reporting Coordination (June–December)
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
George Davis, Permitting & Support for Fisheries Reporting
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 and fish 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 involved in the initial sale of food and shellfish, and 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 DMF and to fulfill requests made from outside the agency. Project personnel also participate in the planning and development of the 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 Division and 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 DMF commercial fishing permit and must sell only to permitted Massachusetts dealers. DMF issued a total of 8,113 commercial fisherman permits in 2019 (Table 1). Over the past decade, DMF has seen an increase in commercial fisherman permit sales, particularly for small Boat, 0–59' in length, and Rod & Reel permits (Figure 2). Generally, this change can be attributed to more restrictive regulations and the increasing cost of operation within the fisheries.

Table 1. 2019 commercial fisherman permit issuance.

Permit Type	Permits Issued (#)	
	Residents	Non-residents
Coastal Lobster	1,056	6
Offshore Lobster	295	95
Seasonal Lobster	105	2
Boat 99+'	12	18
Boat 60-99'	70	201
Boat 0-59'	3,549	398
Individual	206	4
Shellfish and Seaworm	880	0
Shellfish and Rod & Reel	406	0
Rod & Reel	756	54
Total	**7,335**	**778**

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

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

Shellfish Permit allows an individual to take, land, and sell shellfish and seaworms. A Shellfish Transaction Card from DMF 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 2019, DMF issued 3,578 shellfish transaction cards; of which, 242 were issued as employee shellfish transaction cards to 44 shellfish businesses.)

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

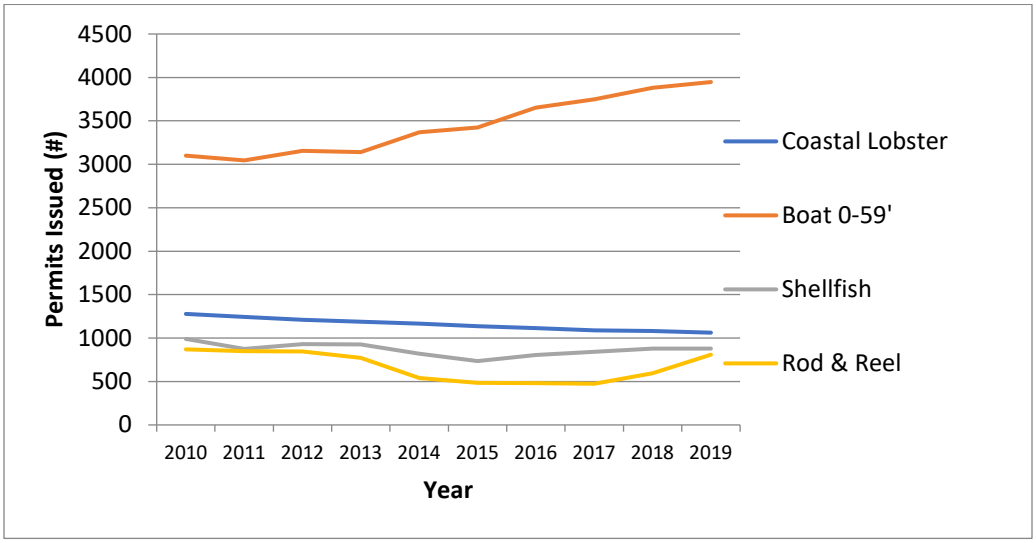


Figure 2. Trend in sales of four frequently issued commercial fisherman permits, 2010–2019.

Dealer Permits

Anyone engaged in the wholesale or retail trade of raw fish, shellfish, lobsters, or bait, whether frozen or fresh, must have a DMF 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. A new seafood dealer permit type was created in 2019 to accommodate the retail sale of seafood at farmer's markets. DMF issued a total of 1,870 seafood dealer permits in 2019 (Table 2). The number of seafood dealer permits issued has been relatively unchanged over the past ten years.

Table 2. 2019 dealer permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Wholesale Dealer	385	7
Wholesale Truck	83	131
Wholesale Broker	24	11
Retail Dealer	840	98
Retail Truck	31	4
Retail Boat	104	0
Bait Dealer	141	9
Retail Farmer's Market	2	0
Total	**1,610**	**260**

Wholesale Seafood Dealer Permit allows the holder to acquire, handle, store, distribute, process, fillet, ship, or sell raw fish and 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 MassDPH must be submitted with the application to DMF. 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 plan is also 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, relabel, or repack shellfish. An approved inspection from the Division of Food and Drugs must be submitted with the application to DMF.

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. 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 DMF. 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 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) may apply.

Retail Seafood Farmer's Market Dealer Permit allows the holder to sell certain raw fish and fish products at a farmer's market subject to written approval by the Department of Public Health, or the municipal or county board of health. This permit was established by regulation in 2019 in order to make the permitting process for farmer's markets more intuitive.

Special Permits

Special Permits are required for certain activities in the marine environment, as described below. DMF issued a total of 21,246 special permits in 2019 (Table 3). 2019 Special Permit issuance is nearly consistent with 2018. Overall, the ongoing decline in non-commercial lobster permits was offset by an increase in regulated fishery endorsements.

Table 3. 2019 special permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Non-commercial Lobster	6,003	113
Regulated Fishery Endorsements	13,662	937
Master Digger	4	1
Subordinate Digger	29	0
Scientific Collection	62	15
Shellfish Propagation & Aquaculture	419	1
Total	**20,179**	**1,067**

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 holder's 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 clam/ocean quahog, sea herring, sea urchins, fluke, black sea bass, scup, striped bass, dogfish, American eel, horseshoe crab, groundfish, tautog, 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 the application form, applicants must 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

DMF began issuing recreational saltwater fishing permits in 2011. DMF issued a total of 195,517 recreational saltwater fishing permits in 2019 (Table 4). Issuance rose 3.8% for the year, which is similar to growth annually since the first year of issuance.

Table 4. 2019 recreational saltwater fishing permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Recreational Saltwater, Age 16–59	116,401	18,367
Recreational Saltwater, Age 60+	52,753	7,133
Charter Boat	766	54
Head Boat	37	6
Total	**169,957**	**25,560**

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 DMF permission. Limited entry permits (commercial permits and endorsements that are restricted in distribution to renewals) may be 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 DMF during the year.

Table 5. 2019 limited entry permit transfer statistics.

Permit/Endorsement Type	Permits Transferred (#)	
	Resident	Non-resident
Coastal Lobster	42	0
Mobile Gear Coastal Access	2	3
Fish Pot	6	1
Fluke	9	4
Black Sea Bass	3	3
Groundfish	0	1
Surf Clam/ Ocean Quahog	1	1
Quahog Dredge	1	1
Horseshoe Crab	0	1

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 DMF 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.

In 2019, 1,870 businesses obtained a Massachusetts seafood dealer permit. Of those, 470 (or 25%) 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 470 dealers, 235 had a federal dealer 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 235 dealers were categorized as "state-reporting."

Even though many of the primary buyers in 2019 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, 162,986 dealer reports were entered into the SAFIS database, an increase of approximately 2,600 reports compared to 2018. Federal-reporting dealers electronically submitted 78% of these transactions. Of the remaining transactions submitted by state-reporting dealers, 69% were entered electronically by dealers either through SAFIS eDR online, file upload, or eDR mobile; the remainder was submitted on paper-based forms that were either keypunched by program staff or uploaded through the SAFIS file upload module. The percentage of federal landings is unchanged compared to 2018, but the percentage of state reports entered electronically increased dramatically. In early 2019, DMF adopted a requirement for all dealers to report electronically beginning January 1, 2020. Project staff migrated many of the remaining paper reporting dealers to electronic reporting before the January deadline, which likely contributed to the rise in electronically submitted data.

Total landings (in whole pounds), as reported through the SAFIS database or other federal reporting programs, amounted to 706 million pounds, valued at $679 million (ex-vessel). The five most valuable species were sea scallop, lobster, eastern oyster, haddock, and Atlantic surf clam totaling $555 million, or 82% of the total value. Offshore shellfish (sea scallop, Atlantic surf clam, and ocean quahog) made up 62% 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 about 7% of total value landed. Landings of invertebrate species (lobster, crabs, and whelk) amounted to 33 million pounds, valued at $110 million, or 16% of the total value landed. Cumulative finfish landings, including both pelagic and benthic species, made up 15% of the total value with groundfish species amounting to 9% 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 98% of the total value of all species landed.

Table 6. 2019 MA-landed species with value greater than $2 million.* Source: ACCSP Data Warehouse, 4/17/20.

Species	Landings (whole pounds)	Value
Sea scallop	348,474,301	$397,097,791
American lobster	16,688,233	$93,122,838
Eastern oyster	9,079,916	$30,140,622
Haddock	18,728,143	$18,258,987
Atlantic surf clam	82,678,098	$16,616,040
Ocean quahog	91,328,531	$8,233,267
Jonah crab	9,697,607	$8,137,653
Monkfish	14,024,887	$8,100,894
Northern shortfin squid (*Illex*)	17,906,382	$7,200,085
Soft shell clam	3,430,426	$6,542,633
Acadian redfish	11,624,678	$6,151,012
Northern quahog	4,729,020	$5,492,526
Bluefin tuna	1,206,428	$5,282,704
Pollock	6,316,874	$4,945,496
Atlantic cod	2,032,533	$4,540,043
Longfin squid (*Loligo*)	2,619,798	$4,505,408
White hake	3,885,886	$3,978,752
Channeled whelk	990,800	$3,759,914
American plaice (dab)	1,712,092	$3,353,202
Winter flounder	1,132,326	$3,132,192
Striped bass	586,128	$3,116,800
Silver hake (whiting)	3,238,572	$2,992,210
Witch flounder (gray sole)	1,615,776	$2,831,292
Winter skate	10,046,012	$2,813,319
Atlantic sea herring	9,873,088	$2,685,091
Atlantic razor clam	505,321	$2,539,070

*Deep-sea red crab and hagfishes are also in this list, but the data are confidential.

Species managed by quota in Massachusetts were monitored using the dealer reported landings in the SAFIS database. Automated analyses ran on a nightly basis and the results were displayed on both the DMF internet website (Figure 3) and the Statistics Project intranet website. On a weekly basis during the open season, staff reviewed compliance and estimated projections for each quota-managed species. An estimated closure date was calculated based on a regression analysis run at least once per week for each open fishery.

QUOTA MANAGED SPECIES
2019 Landings and Quota Information
as of Mar 09, 2020 - 12:12 P.M.

Species	2019 MA Landings	2019 Quota	Quota Type	Percent Landed
Black Sea Bass	530,814	532,600	MA	99.7%
Bluefish	184,171	517,828	MA	35.6%
Dogfish	6,568,744	11,903,243	CW	to NMFS
Fluke	551,300	741,532	MA	74.3%
Horseshoe Crab*	177,252	165,000	MA	107.4%
Menhaden	6,964,323	7,345,252	MA	94.8%
Scup *(Winter I)*	374,653	10,820,000	CW	to NMFS
Scup *(Summer)*	685,329	2,016,280	MA	34.0%
Scup *(Winter II)*	187,897	9,090,487	CW	to NMFS
Striped_Bass	586,128	869,813	MA	67.4%
Tautog	67,021	64,753	MA	103.5%

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 DMF's website.

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 DMF for those activities occurring on their federally-permitted vessel as were 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 DMF.

Fishermen either submitted their trip-level reports in paper form or entered their fishing activities themselves using a SAFIS eTRIPS application. SAFIS eTRIPS Online is a web-based program developed jointly by ACCSP staff and program partners that has been available to users since 2010. In June 2019, Massachusetts began promoting the use of the SAFIS eTRIPS Mobile application available on all major platforms for phones and tablets, as well as Windows. Project staff used the online 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 2019, DMF issued 8,113 commercial harvester permits, of which 18% were for federal reporting vessels, and the remaining 6,657 commercial permits were designated as "state-reporting." Thirty-seven percent of all permit holders reported electronically using the SAFIS eTRIPS Online or Mobile applications, a 2% increase in electronic reporting participation since 2018. This left 45% of all harvesters submitting paper reports to DMF. Of the 107,491 commercial trips that were entered in the SAFIS database by mid-July 2020 for the 2019 calendar year, approximately 30% were entered by commercial permit holders using the SAFIS eTRIPS applications, with the remaining trips entered by DMF staff.

Project staff are in the process of auditing and merging these data with federal data to finalize the full Massachusetts harvester dataset at the time of publication, so the values are subject to change.

Data Analysis and Dissemination

Project staff provided a wide variety of data and technical support during 2019. Significant time was dedicated to routine activities such as ensuring correct harvester reporting methods and maintaining compliance metrics for harvester and dealer reporting. DMF reduced the impact of some bottlenecks in state data entry during busier times of the year with the addition of a full-time employee who came on board in June 2019. As of early April 2020, state harvester data for 2019 received through January 2020 were entered into the SAFIS database; the state harvester dataset was considered complete by the end of June 2020. Additionally, significant time was spent working with ACCSP to validate landings for a variety of species. A few projects are highlighted below.

Broad scope analysis of state waters fisheries: DMF provided 2013–2018 landings, value, and activity level data for gear types identified as "small-scale fisheries," which included a wide range of coastal targeted species, to a team of researchers at the University of Maine and Duke University. This study is part of a larger international project by the FAO called "Illuminating Hidden Harvests," which is attempting to ensure that these "small-scale fisheries" are considered in all policy-making processes.

Inshore shellfish analysis: DMF provided the results of a comprehensive analysis of the state's shellfish fisheries to the Massachusetts Shellfish Initiative (MSI) Taskforce. The MSI will use these data to help provide overarching guidelines, goals, and a strategic plan for the state to maximize the economic, environmental, and social benefits of Massachusetts' shellfish resources, built with input from shellfish stakeholders across the state.

Port Profile Analysis: DMF, in collaboration with the Urban Harbors Institute, launched a state-wide project focused on commercial fishing activity and infrastructure in each port of landing within the Commonwealth. Project staff established methods and began analyses in 2019 that continued into 2020. The Urban Harbors Institute plans to release a final report highlighting infrastructure needs, levels of fishing efforts, and value of landings on both a municipal and regional level in late-2020.

Striped Bass Tagging Program: 2019 was the sixth year of a commercial fishery tagging program mandated by ASMFC. Program staff estimated the 2019 tags required for individual dealers and distributed tags prior to the season and throughout as needed. 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).

Table 7. 2019 striped bass tagging statistics (as of April 2020)**.**

# of Dealers Receiving Tags	# of Tags Purchased	# of Tags Distributed	# of Tags Returned	# of Tags Used	# of Tags Missing
79	80,000	51,180	20,799	29,564	817

ACCSP Participation and Planning

DMF staff continued to participate in all partner-based committees within ACCSP. Staff served on the Operations, Information Systems (chair), and Commercial Technical committees. 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. ACCSP's SAFIS redesign project continued in 2019; however, a project focusing on the development and release of an updated eTRIPS Mobile application that would allow the Southeast for-hire industry to report electronic VTRs was the priority. ACCSP did maintain all existing applications during 2019 though, and Project staff continued to provide feedback to ACCSP regarding eTRIPS Mobile development and enhancement to ensure changes were appropriate and successful. The redesign is a priority for 2020 and will likely have a direct impact on Massachusetts harvesters and dealers in 2021. This project will continue to require significant input from project staff to ensure all applications meet Massachusetts reporting requirements.

Tracking Projects: Work began on two ACCSP-funded pilot projects in 2019 investigating cell-based vessel monitoring systems (VMS), which carry lower costs and may be just as effective in inshore waters as compared to satellite-based systems. One project focused on the lobster industry and being done in collaboration with Maine, proved that cell-based vessel tracking would work for data analysis needs in the Gulf of Maine; further testing was planned for 2020 on a variety of device types. The second project focused on the integration of VMS data with eTRIPS Mobile reporting and being done in collaboration with Rhode Island, went through early testing that was promising, with more work planned for 2020. If successful in either or both studies, cell-based tracking devices may help fill a critical spatial data gap, allow for more fine-tuned spatial management, and provide law enforcement with the potential to utilize hail out measures or location-based metrics as enforcement tools.

Swipe Card Pilot Project: Discussions between state and federal partners of ACCSP to codify the requirements necessary to expand the use of the SAFIS eDR/Mobile application to federal dealers were still in progress at the end of 2019. This free application was launched into production in Massachusetts (and Maine) in August 2016, and utilizes a harvester's shellfish transaction card to consummate a point-of-sale transaction between the harvester and dealer, promoting a single-ticket commercial data collection system. This reporting option works well for small dealers who buy from a handful of harvesters. DMF had four dealers using the application in 2019. 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 2019, 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 Quota Monitoring webpage is one of the agencies top-visited pages. Quota information is also displayed on a Statistics Project intranet site, along with reporting compliance and both harvester and dealer reporting information. Maintaining the automated process that updates the data displayed on both sites and accommodating changing requirements was an ongoing task.

Oracle Database / Application Development & Maintenance: DMF continued to use three production databases and associated applications during 2019: Commercial Permits and Statistics; Lobster Sampling; and Shellfish Sampling & Area Management. The Aquaculture Permits application remained in development. EOEEA-IT initiated a project to redesign the current Oracle system and associated applications in late 2018, and project staff spent a significant amount of time in 2019 documenting the current system. EOEEA-IT hired a business analyst to work closely with project staff to conduct this discovery process, which was completed in August. Funding and time limitations from EOEEA-IT paused the project for the remainder of the year; it was expected to resume in mid to late 2020.

Gloucester Facility Server Retirement: In the fall of 2018, the Executive Office of Technology Services and Security (EOTSS) notified staff that both servers residing in Gloucester were to be retired and began work to migrate all data to Boston based servers. One of the two servers was officially retired in 2018, and the second required extensive documentation and creative solutions be conducted by staff prior to its retirement in the spring of 2019. Ultimately, the redesign of the Oracle-based databases and associated applications will also include further updates to these tasks to improve efficiency and incorporate best practices.

PC Replacements: EOEEA-IT initiated a project in 2019 to replace all PCs in the Commonwealth, thus providing a somewhat uniform platform for all state employees that includes Windows 10 and Microsoft Office 365. This process, involving a significant amount of discovery, documentation including inventory and licenses, and migration, was overseen by project staff for the Gloucester and Boston offices. The first wave of deployments happened in late 2019.

SHELLFISH AND HABITAT SECTION

J. Michael Hickey, Assistant Director, Section Leader

Shellfish Sanitation and Management Program

Personnel

J. Michael Hickey, Program Manager

Gloucester
Jeff Kennedy, Gloucester Regional Shellfish Supervisor, Shellfish Purification Plant Manager
Florence Cenci, Shellfish Lab Supervisor
Gregory Bettencourt, Biologist II
Ryan Joyce, Biologist II
Devon Winkler, Biologist II
Melissa Campbell, Biologist II
Ashley Lawson, Bacteriologist I
Jennifer Poniatowski, Bacteriologist I (through November 2019)

New Bedford
Thomas Shields, New Bedford Regional Shellfish Supervisor, Hughes Hatchery Manager
Gregory Sawyer, Biologist III
Susan Boehler, Bacteriologist III, Shellfish Lab Supervisor
Christopher Schillaci, Biologist III, Aquaculture & Vibrio Specialist (through November 2019)
Neil Churchill, Biologist II (retired November 22)
John Mendes, Biologist II
Terry O'Neil, Biologist II
Christian Petitpas, Biologist II
Gabriel Lundgren, Biologist I
Harriet Booth, Biologist I (through November 2019)

Newburyport
Diane Regan, Shellfish Lab Supervisor
Kevin Magowan, Depuration Coordinator I (through October 2019)
Richard Hardy, Wildlife Technician II
Peter Kimball, Wildlife Technician II

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 U.S. Public Health Service and is administered today by the United States Food and Drug Administration (USFDA) and the Interstate Shellfish Sanitation Conference (ISSC), a federal/state cooperative. Massachusetts is a voting member of ISSC.

Shellfisheries management is accomplished by direct DMF 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. DMF 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. Indirectly, DMF manages shellfish resources through partnerships 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 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 2019, staff biologists completed 310 annual reports, 85 triennial evaluations, and 20 sanitary surveys (Table 8). Thirty-one conditional area management plans were re-evaluated. A total of 9,398 water samples were collected and analyzed for fecal coliform bacteria from 310 shellfish growing areas in 65 cities and towns of the Commonwealth. All samples were tested at one of the Division's shellfish laboratories using the mTEC method.

USFDA evaluates Massachusetts annually for compliance with the NSSP. Shellfish growing area files are reviewed with regards to NSSP standards for minimum sampling frequency, completion of required reports, conditional area management plan updates, and conformity with appropriate water quality criteria requirements. The USFDA's 2018 Program Element Evaluation Report determined that there are programmatic deficiencies. DMF is working on a corrective action plan based on the report's recommendations to strengthen the program. The USFDA did not perform a new Program Element Evaluation in 2019.

Table 8. Summary of 2019 shellfish growing area report and sampling activity.

	North Section	South Section	Total
Annual Reports	33	277	310
Triennial Evaluations	13	72	85
Sanitary Surveys	4	16	20
Management Plans/MOUs Reviewed	20	11	31
Total Water Samples	3,209	6,189	9,398
Classification Station Water Samples	2,595	6,018	8,613
Pollution Source Water Samples	568	156	724
Ad-hoc Water Samples	46	15	61
Shellfish Growing Areas Sampled	21	277	298
Classification Sub-Areas sampled	104	577	681
Cities/Towns Sampled	21	44	65

Classification and Status: The Shellfish Program uses two methods to control harvesting access to shellfish growing areas. Classification is assigned according to the NSSP's five definitions: Approved, Conditionally Approved, Restricted, Conditionally Restricted, and Prohibited (defined below; Figure 4). If water quality within a growing area trends towards permanent improvement or impairment, its Classification is upgraded or downgraded depending on the circumstances. The Status of a growing area (Open/Closed) is separate and distinct from its Classification. If water quality within a growing area suddenly demonstrates degradation from emergency or unexpected conditions, the growing area can be temporarily closed until water quality improves and the source of contamination no longer exists. All Classifications except Prohibited may be in the Open status or placed in the Closed status for cause.

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 DMF 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 DMF permit.

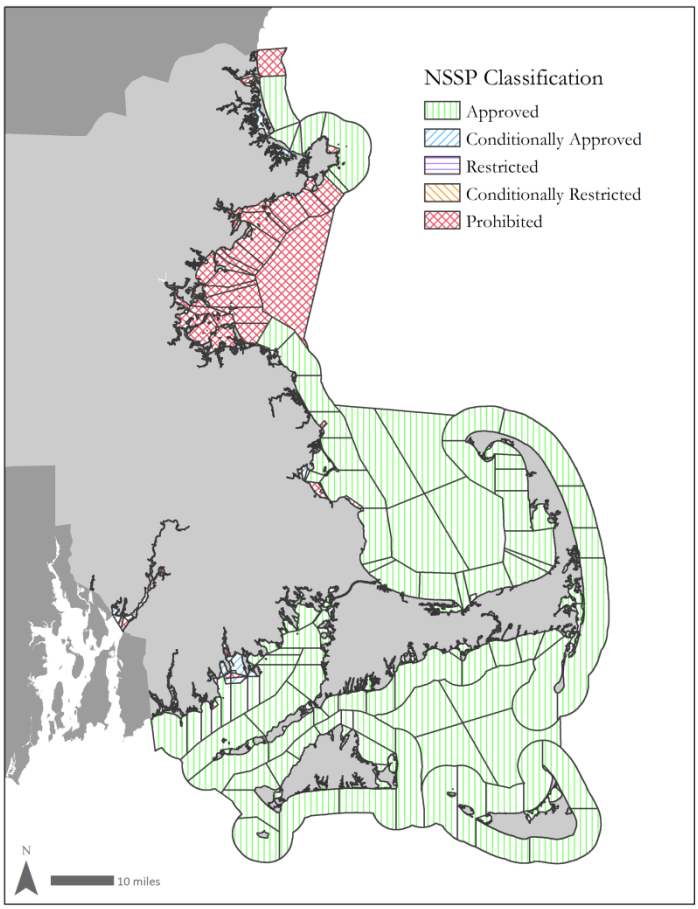


Figure 4. 2019 NSSP classification map of MA waters.

In 2019, a total of 1,743,992 acres were assigned a Classification (Table 9). Overall, Approved, Restricted, and Conditionally Restricted acreage decreased; Conditionally Approved acreage remained roughly the same; and Prohibited acreage increased. These changes are primarily due to stricter NSSP requirements and guidelines that will soon be defined in the upcoming 2019 revision of the NSSP Guide for the Control of Molluscan Shellfish due for publication by September 2020.

Table 9. Change in Massachusetts shellfish growing area classification, 2018 to 2019.

Area Classification	Acreage		
	2018	2019	Change
Approved	1,475,756	1,475,514	-242
Conditionally Approved	24, 665	24,639	-27
Restricted	3,261	2,962	-299
Conditionally Restricted	4,610	4,509	-101
Prohibited	235,699	236,369	669
Total	1,743,992	1,743,992	

Notification: A legal notice is required 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 2019, staff generated 423 legal notices which were distributed for sanitary reclassification, rainfall closures and re-openings, paralytic shellfish poisoning events, oil spills, and more typical emergency closures (e.g., extreme rainfall, flooding, sewage discharge).

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. Staff collects shellfish from 13 primary stations weekly from March through October. Samples are analyzed at the DMF 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 420 shellfish samples from state waters were processed for PSP during 2019, plus nine mussel samples collected by Salem State University in federal waters.

Closure of the Nauset system is a nearly annual event, whereas PSP closures elsewhere occur more sporadically. The Nauset system closure was enacted on April 24, one day earlier than 2018, and rescinded on June 7, one day later than 2018 (Figures 5 and 6).

North shore and particularly South shore closures are less frequent. 2019 was a particularly unusual year for the North and South shores as the bloom arrived in June with toxicity persisting into and through July in certain locations (Figures 5 and 6). A closure in area N7 Essex Bay was instituted on June 10, then lifted for all species except ocean quahogs and carnivorous snails on June 13. A new closure was applied on June 17 in Essex Bay for all shellfish except scallop adductor muscle. This was followed by a new PSP closure for all species, except scallops, on June 19 for areas Mass. Bay 1 (MB1) through Mass. Bay 14 (MB14) on the South Shore. On June 20, closures for mussels, ocean quahogs, and carnivorous snails were applied to shellfish areas N1–N6, N8, and N10–14; followed on June 26 with closures for all bivalve shellfish and carnivorous snails. Area N9 in Gloucester also closed for all bivalve shellfish and carnivorous snails on June 20. On July 20, areas MB1–MB14 reopened for all shellfish, and on July 31, areas N1–N14 reopened for the harvest of softshell clams followed by mussels and razor clams on August 8. Closures for all shellfish except whole sea scallops and carnivorous snails were not lifted until October 10.

There were no reported illnesses due to PSP from Massachusetts shellfish in 2019 as typical.

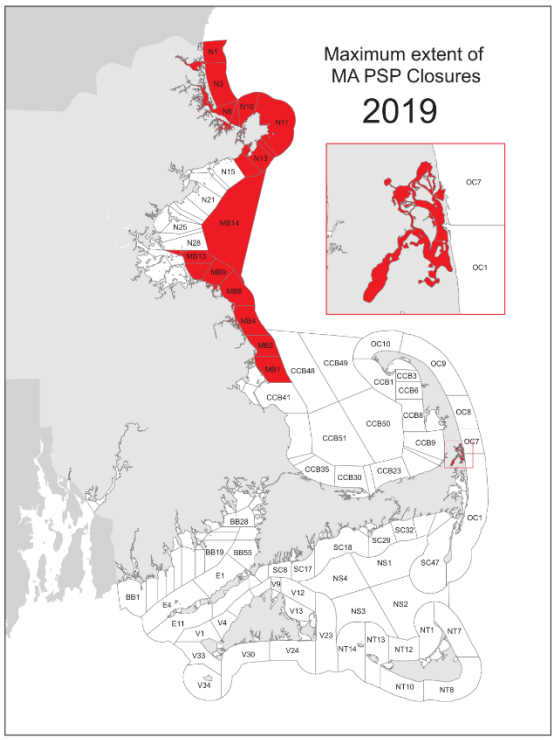


Figure 5. 2019 PSP closures.

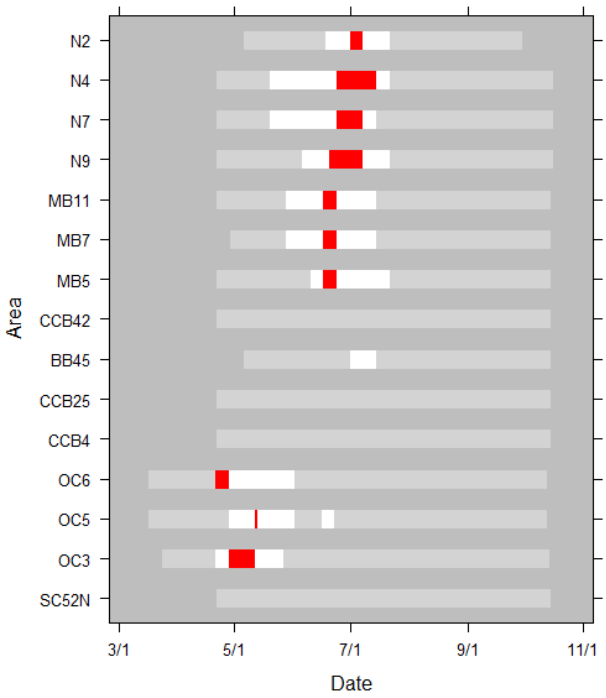


Figure 6. 2019 PSP closure dates by growing area.

Phytoplankton Monitoring: There are many kinds of microscopic algae that potentially pose a public health risk due to biotoxin production. Though PSP has historically been the primary threat in the northeast, DMF monitors the phytoplankton community for the presence of the many other potentially toxic algae species. Phytoplankton monitoring occurred year-round on the North Shore, with 171 samples collected from the four primary regional stations located in Newburyport, Ipswich, Essex, and Gloucester. *Alexandrium*, which causes PSP, were first seen in early May; however, the bloom occurred later than usual with cell counts peaking between June 27 and July 3. Once again, *Karenia mikimoitoi* was identified in Massachusetts waters at the end of July. On September 6, reports of brown water were received caused by an unidentified algal bloom in Boston Harbor, primarily off Constitution Beach in East Boston and off the Boston Harbor Islands. Samples identified large numbers of *Karenia mikimoitoi*. Karenia has been identified annually since 2017 from July to the end of September. The maximum cell count in 2019 exceeded that of 2018. While the presence of *Karenia mikimoitoi* is generally not considered a public health risk, it is noted due to its association with fish kills.

The South Shore office launched a new quantitative Phytoplankton Monitoring Program in January 2019. Eight routine monitoring stations are monitored along the South Coast year-round. This year, 244 individual samples were collected and brought to the New Bedford office for analysis. All phytoplankton observed were identified and cell counts were completed for any harmful algal bloom species.

High cell counts of *Pseudo-nitzschia* spp. which is known to produce the biotoxin domoic acid (which causes Amnesic Shellfish Poison toxicity in shellfish) were observed in Hyannis Harbor during October/November 2019. No toxicity was observed, and no closures enacted.

DSP Closure: Additional sampling/analysis was conducted during July 2019 to monitor an observed bloom of *Dinophysis sp.*, in the Nauset Estuary. *Dinophysis* is known to produce okadaic acid, the causative agent of

Diarrhetic Shellfish Poison (DSP) toxicity in shellfish. A precautionary closure was enacted on July 10 for areas OC2–OC6. Shellfish tissue samples from several species were sent to the FDA lab in Maryland for toxicity analysis. No meat samples exceeded the established action level and the closure was lifted as cell counts declined. The closure affected approximately 1,540 acres, lasting 9 days.

In addition to monitoring of primary stations for biotoxins and potentially toxic algae, Shellfish staff responded to multiple reports of discolored water and/or fish kills throughout the region including Boston Harbor, Cape Cod Bay, Chatham, Buzzards Bay, and Martha's Vineyard. In all cases non-toxic algal blooms were identified and no shellfish closures were enacted.

Shellfisheries Management Project

Contaminated Shellfish Resources

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

Commercial Bait Harvest: Dredge boat permits were issued for the contaminated surf clam bait fishery off Nantasket Beach in Hull; however, because fewer than three vessels participated in this small fishery, landings cannot be reported.

Contaminated Relay: DMF permits municipalities to relocate (between and within communities) bacterially contaminated shellfish to Approved and Conditionally Approved waters for natural purification and propagation (termed Spring Relays; Table 10 and Table 11). Quahogs are the most frequently transplanted species followed by oysters. All activities are conducted under strict NSSP guidelines and are heavily supervised by state and local enforcement authorities. No shellfish can be harvested until bacterial testing of the meats has been completed on each lot. After transplant, the Division requires that shellfish remain in the water through at least one spawning season: if relocated by June 15, contaminated shellfish must remain unharvested at the transplant site until at least September 15; if relocated after June 15, they must remain unharvested until September 15 of the following year.

Westport and Provincetown both conducted oyster transplants from within their own town waters. Westport, in conjunction with UMass Dartmouth, grew oysters in Cockeast Pond in the West Branch as part of a nitrogen remediation study. Eight bushels of oysters were transplanted to Halfmoon Flat in the East Branch in December 2019. Provincetown harvested oysters from a bathing beach area located south of McMillan Pier to an area in the Inner Harbor north of the pier (Table 11).

Two dredge boats contracted by towns permitted for contaminated quahog relay activities typically commence relay harvesting in the Taunton River in late April. Most of the spring transplants were completed by June 15 except for Westport. The two boats moved a total of 3,851 bushels of quahogs to 11 coastal communities during the spring season (Table 10). An additional 10,270 bushels of quahogs were delivered to eight Buzzard Bay towns between June and early-November as part of the B-120 and New Bedford Commerce Terminal Shellfish Restoration Programs (Table 12, see page 39). Prior to transplant operations, disease monitoring was conducted on shellfish collected from several donor sites in the Taunton River. Shellfish samples were sent to Kennebec Marine Biosciences in Maine for analysis. Pathology tests determined the quahogs from the donor site were disease free.

Table 10. 2019 Municipal Spring Relays of contaminated quahogs.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
Taunton River	Truro	Pamet Harbor	CCB7.1	294	9-May
Taunton River	Yarmouth	Lewis Bay	SC28.7	950	10-Jun
Taunton River	Oak Bluffs	Sengekontacket (1,4 & 5)	V16.23, .27, & .28	181	30-Apr
Taunton River	Dennis	Bass River Center	SC34.22	161	11-Jun
Taunton River	Eastham	Salt Pond and Town Cove	OC4.25 & 6.23	300	15-May
Taunton River	Provincetown	Inner Harbor	CCB4.20 & .21	176	16-May
Taunton River	Westport	East Branch	BB4.21	444	6-Aug
Taunton River	Swansea	Lee River	MHB3.25	145	14-Jun
Taunton River	Sandwich	Sandwich Harbor	CCB37.0	400	10-Jun
Taunton River	Fairhaven	North Cove	BB21.20	400	12-Jun
Taunton River	Wellfleet	Inner Harbor & Harbor	CCB13.21, .22 &	400	30-May

Table 11. 2019 contaminated oyster transplants.

Harvest Site	Transplant Site	Area	Bushels	Last Day Planted
Provincetown, Inner Harbor	Provincetown, Inner Harbor	CCB4.21	100	June 14
Falmouth, Little Pond	Falmouth, Green Pond	SC12.20	162	Nov 5

Table 12. 2019 B-120 and Marine Commerce Terminal contaminated quahog transplants

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
B_120 Contaminated Quahog Transplants					
Taunton River	Westport	East Branch	BB4.31	800	26-Jun
Taunton River	Dartmouth	Apponagansett Bay	BB12.22	800	17-Jul
Taunton River	New Bedford	Clark Cove	BB13.27	800	Aug. 16
Taunton River	Fairhaven	North Cove	BB21.21	800	9-Jul
Taunton River	Mattapoisett	Mattapoisett Harbor	BB25.20	800	30-Jul
Taunton River	Marion	Planting Island Cove	BB32.27	61	1-Nov
Taunton River	Wareham	Wareham River	BB36.20 & .21	800	29-Jun
Taunton River	Bourne	Red Brook Harbor	BB49.20	800	29-Jul
New Bedford Marine Commerce Terminal Quahog Mitigation Transplants					
Taunton River	New Bedford	N.B. Outer Harbor	BB15.21	4,609	6-Nov

Depuration: DMF 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 the Division.

Clams are harvested from Conditionally Restricted areas in Boston Harbor, the Pines River in Revere and Saugus, and the Merrimack River in Newburyport and Salisbury, as well as out-of-state in Maine, 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 then sold into commerce.

During 2019, the plant received shellfish for depuration on 128 days, up from 80 in 2018. Regardless, soft shell clams processed for depuration were down 15% overall due to a 25% reduction in production from out-of-state areas. Digging in Quincy returned in August with Revere starting in October. There was a reduction from a 5-day/week digging schedule to 4 days/week (Mon/Tue/Thu/Fri) beginning in November to alleviate the need for weekend coverage. Five individuals purchased Master Digger permits in 2019 up from three the year prior, yet only four permits were active in 2019. The issuance of Subordinate Digger permits also increased from 25 in 2018 to 29 in 2019.

Wet Storage

2019 marked the seventh year 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 MassDPH and USFDA, and must comply with strict controls as well as traceability standards.

In 2019, wet storage processing increased by 21% with an additional three runs from the previous year. Shellfish Plant combined production was down slightly by 9% from 2018. Fees per rack remained at $6 for both depuration and wet storage.

Shellfish Purification Plant and Laboratory

The Shellfish Purification Plant's laboratory analyzed 410 shellfish samples from 163 lots 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, 486 UV effluent sea water samples, 197 raw seawater samples, and 400 tap water and control samples were bacteriologically tested for the more stringent drinking water standard of total coliform.

In addition, the laboratory tested 142 shellfish and water samples for the presence of Male Specific Coliphage (MSC). MSC is a virus of *E. coli*, 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 2019, DMF commenced a partnership with Gloucester Marine Genomics Institute of Gloucester, MA to further examine the relationship of MSC and associated environmental viral risk within Massachusetts shellfisheries.

For the fourth year, the laboratory participated in DMF *Vibrio parahaemolyticus (Vibrio)* assessments. This included analyzing environmental and experimental samples including the resubmergence and transplant pilot program on Martha's Vineyard. Forty-four oyster samples were processed by MPN and 85 total samples were analyzed by qPCR for total and pathogenic *Vibrio.*

Staff attended the Northeast Shellfish Sanitation Association Annual Meeting, participated in ISSC monthly Laboratory Committee and Laboratory subcommittee conference calls, examined and proposed laboratory quality systems documentation, and attended the ISSC Biennial meeting.

The Plant was inspected on a monthly basis by MassDPH and reviewed by USFDA in September. General improvements and extensive maintenance continued throughout the year. Due to beach erosion of northern Plum Island, saltwater well #2 failed in early June, limiting plant operations to the remaining saltwater well. A feasibility study for a replacement was begun.

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

Shellfish Restoration and Mitigation in Buzzards Bay

Since 2014, Shellfish Program staff in New Bedford have 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, such as overfishing, poor recruitment, disease, natural predation, and natural changes in habitat features. Shellfish mitigation refers to replacement of shellfish that have been permanently lost due to direct human actions, including shoreline alteration projects, dredging activities, and placement of pipelines and electric cables.

New Bedford Marine Commerce Terminal Quahog Mitigation: The New Bedford Marine Commerce Terminal 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 9.8 million shellfish were lost as a result of the filling and dredging activities involved with the project. In fulfillment of an agreement between the Massachusetts Clean Energy Center and DMF to oversee and execute certain requirements of the Final Mitigation Plan for the terminal, the Division developed 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 10 years. Planting would target shallow sub-tidal areas in Approved and Conditionally Approved areas only, such that after a maximum of three years (to allow the seed to grow, spawn, and reach legal size), the areas could be opened to harvest.

Planting activities began in 2015 under the plan of selecting one of 10 subareas around the South End peninsula for seeding with 2 million juvenile quahogs (20–25mm size range) in pre-identified optimal habitat areas each year. Between 2015 and 2017, Division staff broadcast seeded more than 3.2 million seed quahogs over 16.6 acres within three subareas, including two experimental plots used to monitor quahog growth and survival. Due to annual planting numbers that were well below target (because of poor supply of commercial hatchery reared seed quahogs) plus annual survival rates of planted quahogs that were proving insufficient to reach target levels for future harvest and spawning, no seed quahogs were planted in 2018.

Consequently, beginning in 2019, DMF modified the NBMCT mitigation strategy from planting small hatchery seed quahogs to transplanting adult contaminated quahogs from the Mount Hope Bay/Taunton River complex to New Bedford waters. Working collaboratively with commercial fishermen and New Bedford Shellfish Department staff, a total of 4,609 bushels of mildly contaminated adult quahogs from the Taunton River were planted in a 21-acre mitigation site off Fort Tabor in New Bedford Outer Harbor

between August 22 and November 6 (Figure 7). It is estimated that roughly 834,000 thousand quahogs were planted at the mitigation site. These quahogs are expected to spawn during the summer of 2020 and beyond, hopefully resulting in significant recruitment to the quahog population in surrounding waters within New Bedford and Fairhaven.

Figure 7. Map of the 21-acre mitigation site for adult contaminated quahog relays in 2019.

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 resources and mitigating 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, DMF was selected by the Trustees to implement specified restoration strategies.

As a result, DMF is overseeing a six-year program to restore shellfish resources and benefit public recreational shellfishing through the three activities below. DMF works collaboratively with the Trustees and town shellfish departments on all aspects of these projects. Out planting of quahogs and oysters under the B-120 shellfish restoration project will be completed in 2020.

- Contaminated Quahog Relays: 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 Bourne, Dartmouth, Fairhaven, Gosnold, Marion, Mattapoisett, New Bedford, Wareham, and

Westport. Shellfish Program staff assist shellfish officials in each town with mapping relay sites and conducting pre- and post-relay assessments of the quahog population and surrounding habitat. Planted sites remain closed to recreational fishing for one to three years. In 2019, relays were successfully completed in eight towns, with a total of 5,561 bushels of quahogs transplanted into the specified Buzzards Bay sites.

- Quahog Upwellers and Seed Planting: In 2016 and 2017, DMF oversaw a program whereby the towns of Wareham, Dartmouth, and Fairhaven operated and maintained upwellers purchased with B-120 funds to grow small quahog seed (3–5mm) for subsequent out-planting at larger sizes (15–20 mm) for the restoration of town-managed recreational shellfishing areas. Due to a poor growth year for quahog seed at the New Jersey hatchery and time constraints for adequate field grow-out, quahog seed was not purchased in 2018. In 2019, Fairhaven agreed to expand their grow-out capacity, adding a second town-built upweller and receiving 846,000 1.5-mm quahog seed purchased from Muscongus Bay Aquaculture in Maine. From late June through mid-November, DMF biologists worked closely with town personnel to monitor growth and survival of the seed, with bi-weekly size sampling. Because the quahog seed did not reach the field plant size of 15–20 mm in shell length, DMF and Fairhaven decided to over-winter the quahogs in grow-out bags secured in suitable subtidal habitat for retrieval by DMF-certified divers and return into Fairhaven's upwellers in early spring 2020 for further grow-out. Following a second growing season in the upwellers, the quahogs were expected to be broadcasted into a DMF-approved site managed for sustainable recreational shellfishing in the fall of 2020.
- Single Oyster Purchases and Out-planting: The B-120 oyster project began in 2017 in Bourne (Figure 8), Marion, and Wareham. In response to a request from the three participating towns for additional single oysters and following discussions with the Trustees, an additional year was added to the B-120 oyster project for 2019. Generally, each municipality purchases small-sized oyster seed to be placed in upwellers and/or larger-sized oysters for placement in nursery grow-out systems. These nursery systems are located in designated areas and consist of floating rack and bag systems with bags held within large cages, or single bags strung together in lines and secured with buoys and anchors on either end. The participating towns and DMF work together closely to ensure these efforts support the B-120 goal to create and maintain sustainable, recreationally available oyster resources at each of the oyster planting sites. Through monitoring of the oyster seed within the upwellers and nursery systems, and monitoring the growth, survival, and density of out-planted oysters, DMF intends to document the success of the B-120 oyster restoration program.

Figure 8. Small oyster seed in Bourne's upweller (right) and larger oyster seed in floating bags at Bourne's nursery grow-out site off Toby's Island (left).

Environmental Protection Activities

Shellfish Program personnel respond to pollution events in coastal waters in order to assess damage to shellfish populations and 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. Nine pollution-related events in 2019 are detailed below.

- There was a 300,000-gallon sanitary sewer discharge into the Taunton River (MHB:2) on April 15. As these waters are classified as Prohibited, no shellfish closure was required.
- An ongoing investigation into elevated fecal coliform levels in stormwater draining into the Jones River, Gloucester uncovered failing septic systems upstream. Weekly sample collection allowed for the reopening of classification area N9.8 on December 1. Summertime impact of the discharges on the Annisquam River led to the closing and redefinition of portions of classification area N9.7.
- The discharge of untreated sewage to the Monatiquot River in Braintree, feeding the Weymouth Fore River, resulted in multiple area closures from April 23, reopening on May 14.
- Due to a heavy rainfall event in the Plymouth, Kingston, and Duxbury region on July 12, surrounding shellfish growing areas (CCB:42–47) were closed to shellfishing for five days.
- On August 28, shellfish growing areas in the vicinity of New Bedford (BB:13–15) were closed for eight days due to a pump failure at the New Bedford Waste Water Treatment Plant which resulted in the release of an estimated 650,000 gallons of partially treated sewage.
- A boat fire and sinking of the vessel resulted in a 17-day closure of the South River (MB:6) in Marshfield and Scituate. The river was closed to shellfishing from November 1–18.
- The entire Massachusetts coastline was closed to shellfishing on October 10 due to a Nor'easter Storm. Strong winds, storm surge, and coastal flooding resulted in a three-day closure for most areas. In areas with established rainfall policies routine action levels/closure durations were followed.
- An untreated sewage discharge through a storm drain into Plymouth Harbor resulted in the closure of CCB:42 on December 30.

The Shellfish Program also contributed to the review of proposed coastal alteration projects for impacts on water quality, shellfish resources, and habitat. Recommendations were provided to DMF's Habitat Program Technical Review Project, as well as the review of NPDES permits.

Aquaculture and Propagation Project

The management of marine aquaculture and shellfish propagation activities is a major responsibility of DMF. 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. DMF's duties 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, DMF 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 that 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 2019, Project staff certified 33 new shellfish aquaculture license sites and inspected 37 acres of tidelands (Table 13).

Town	License Sites	Acres
Barnstable	1	2
Bourne	4	6
Brewster	1	1
Eastham	12	12
Falmouth	6	9
Ipswich	1	1
Mashpee	1	1
Orleans	3	1
Provincetown	4	4
Total	**33**	**37**

Table 13. New License Certifications in 2019

Permitting

DMF issues permits for all marine aquaculture activities in the Commonwealth. Permits require holders to manage their culture activities in a manner that prevents impacts to the environment and other user groups and 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 conducting shellfish planting activities. The permit allows the possession, transplant, and grow-out of seed shellfish from approved sources. In 2019, DMF issued shellfish propagation permits to 395 private aquaculture license site holders (Table 14), and 25 municipalities (for public propagation activities) operating shellfish aquaculture projects in over 30 coastal municipalities throughout the Commonwealth.

In 2019, DMF also issued commercial aquaculture permits for the culture of sugar kelp and horseshoe crabs (solely for the purpose of wild population enhancement) and a short-term experimental Integrated Multi-Trophic Aquaculture (IMTA) project involving the production of steelhead trout.

Table 14. 2019 private shellfish propagation permits and acreage under cultivation, by municipality.

Municipality	# Growers	Total Acres	Species Grown
Aquinnah	1	1.6	Quahog
Barnstable	49	158	Oyster, Quahog, Soft Shell Clam, Surf Clam
Bourne	8	15	Oyster, Quahog, Soft Shell Clam
Brewster	11	11.5	Oyster, Quahog
Chatham	2	7	Oyster, Quahog, Soft Shell Clam, Sugar Kelp
Chilmark	9	23	Oyster, Blue Mussel, Sugar Kelp
Dartmouth	2	1	Oyster
Dennis	26	32	Oyster, Surf Clam
Duxbury	28	77.5	Oyster, Quahog, Surf Clam
Eastham	27	39.6	Oyster, Quahog
Edgartown	13	17	Oyster
Essex	1	8.5	Oyster
Fairhaven	2	38	Oyster, Quahog
Falmouth	9	54	Oyster, Quahog, Surf Clam, Sugar Kelp, Steelhead Trout, Bay Scallop
Gosnold	1	32	Oyster
Harwich	1	0	Oyster, Sugar Kelp
Ipswich	3	3	Soft Shell Clam
Kingston	3	8.5	Oyster
Marion	4	2.5	Oyster, Quahog
Mashpee	5	19	Oyster, Quahog
Mattapoisett	2	7	Oyster, Bay Scallop
Nantucket	8	73	Oyster, Quahog
Oak Bluffs	2	2	Oyster, Sugar Kelp
Orleans	15	18.5	Oyster, Quahog, Blue Mussel, Surf Clam
Plymouth	30	81.5	Oyster, Quahog, Surf Clam, Bay Scallop
Provincetown	16	34	Oyster, Quahog, Soft Shell Clam
Rowley	3	4	Oyster, Soft Shell Clam
Truro	5	20	Oyster
Wareham	7	83	Oyster, Quahog
Wellfleet	93	261	Oyster, Quahog, Soft Shell, Surf Clam, Blood Arc
Westport	5	80	Oyster, Quahog
Yarmouth	4	27	Oyster, Quahog
Grand Total	**395**	**1240**	

Aquaculture Landings

Aquaculture landings and value for oysters and quahogs are presented in Table 15. With a total value over $29 million, American oyster culture continues to dominate the aquaculture industry in the state. There is growing

interest in expanding aquaculture in the state's north shore municipalities. It is noteworthy that Essex contributed to oyster aquaculture landings in 2019. 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 attributable 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.

Table 15. 2019 Aquaculture Landings and Value for Oysters and Quahogs.

American Oyster		
Town or Region	Pieces	Reported Value
Barnstable	13,388,943	$7,358,572
Bourne/Falmouth	1,024,211	$563,867
Brewster	586,945	$336,143
Chatham	830,078	$490,699
Dennis	2,328,009	$1,278,132
Duxbury	10,191,839	$5,736,938
Eastham	952,324	$505,712
Edgartown	2,705,510	$1,679,617
Essex	*	*
Kingston	183,543	$99,392
Marion	87,934	$44,881
Mashpee	326,051	$187,631
Nantucket	475,925	$375,572
Orleans	1,128,850	$648,828
Other Island Towns	244,781	$202,482
Other South Coast Towns	2,189,888	$1,144,951
Plymouth	3,173,940	$1,680,423
Provincetown/Truro	146,783	$88,321
Wareham	1,117,200	$677,450
Wellfleet	10,089,940	$5,437,374
Yarmouth	907,110	$498,202
Total	**52,079,804**	**$29,035,187**
Quahog		
Town or Region	Pieces	Reported Value
Barnstable	645,803	$190,989
Eastham/Orleans	95,283	$25,196
Other Towns	31,737	$7,641
Wellfleet	2,035,557	$599,270
Total	**2,808,380**	**$823,094**
Total Aquaculture Landings Value		**$29,858,281**

* Confidential Data; Totals reflect only displayed values.

Source: SAFIS Dealer Reports on April 21, 2020 and staff edits.

John T. Hughes Hatchery & Research Station

The Martha's Vineyard Shellfish Group (MVSG), a consortium of the Shellfish Departments of the six towns of Martha's Vineyard, continued to use portions of the Division's John T. Hughes Hatchery and Research Station to spawn and culture shellfish for eventual transplant to harvestable shellfish beds throughout Martha's Vineyard. This activity supports several of the Division's strategic goals, including improving fisheries sustainability, supporting the state's commercial and recreational fisheries, and providing technical support to municipal shellfish departments.

In 2019, MVSG continued bivalve culture activities at three facilities: DMF's Hughes Hatchery, the MVSG hatchery in Vineyard Haven, and the shellfish nursery facility on Chappaquiddick Island. Culture activities in the main building and two greenhouses at Hughes Hatchery continue to include nursery grow-out of quahogs, and oysters in upweller silos, tanks, and tables utilizing fresh seawater from Lagoon Pond and aeration (Figure 9).

Figure 9. Larval tanks (right) and Kalwall tubes (background) for algae culture in the new greenhouse. Photo courtesy of MVSG.

In addition, bay scallop and oyster eggs and larvae were cultured and released to various salt ponds on the island. Various species of phytoplankton were continuously cultured and used to provide additional food for larvae, and setting quahogs, scallops, and spat-on-oyster shells. Shellfish production at Hughes Hatchery relative to total production at the three facilities that MVSG uses is presented in Table 16.

Table 16. 2019 Shellfish Production at Hughes Hatchery.

Shellfish Species by Developmental Stage	From Hughes Hatchery	Total MVGG Production	% From Hughes Hatchery
1 mm Quahog Seed	6,408,500	13,500,000	52.90%
Scallop Larvae Set	25,418,000	39,047,000	37.90%
Oyster Larvae Set	8,150,000	17,582,500	50.60%

MVSG also continued 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. The Martha's Vineyard Fishermen's Preservation Trust also continued whelk aging research at Hughes Hatchery. Live whelks were tagged using a variety of methods and held to determine efficacy of the tags and to determine post-tagging survival.

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 to *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. DMF is also responsible for the closure of harvest areas following the notification of a *Vibrio* outbreak from *Mass*DPH.

No changes were made to the *Vibrio* regulations for 2019. 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. DMF*,* in cooperation with local Shellfish Constables and the Massachusetts Environmental Police, work with harvesters and growers to educate and verify compliance with the *Vibrio* Control Plan through routine compliance monitoring and training workshops. DMF 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. Ongoing monitoring included environmental data collection and oyster tissue sampling for *Vibrio* levels. Several research efforts continued in 2019 which aim to fine-tune existing *Vibrio* controls, explore additional illness reduction options, and where possible reduce the regulatory burden *Vibrio* has placed on the Massachusetts oyster industry.

Table 17. Sole source *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
2018	10
2019	8

Despite the substantial efforts made in Massachusetts to curb *Vibrio* illness, certain harvest areas have continued to experience elevated levels of *Vibrio* cases, specifically Duxbury, Plymouth and Kingston Bays, and Katama Bay on Martha's Vineyard. The number of cases linked to Massachusetts harvested shellfish continued to decrease in 2019 as compared to baseline years (Table 17). As a result, DMF did not propose any changes to the *Vibrio* regulations for the 2020 *Vibrio* season.

Other Activities

Professional Organizations: Staff participated in numerous professional organizations such as the ISSC, Northeast Shellfish Sanitation Association, Massachusetts Shellfish Officers Association, and New England Estuarine Research Society.

2019 NESSA Meeting: On April 9–10, DMF and the MA DPH hosted the 2019 conference for the Northeast Shellfish Sanitation Association (NESSA). Over 100 participants representing state and federal regulatory bodies, the shellfish industry, scientific research institutions, and NGOs from the six northeastern states from Maine to New Jersey attended the event in Plymouth. This regional meeting is held every year by a member state and is an important tool providing regional stakeholders the opportunity to discuss shellfish sanitation issues and develop consensus on issues of mutual interest. Such regional collaboration is particularly important when the states attend the Interstate Shellfish Sanitation Conference (ISSC) every two years. At these meetings, members take up proposals to amend and update the National Shellfish Sanitation Program's Guide to meet emerging public health challenges and changing industry needs, thus setting the regulatory framework and guidelines to which states must adhere in order to control and manage the harvest, handling, and sale of molluscan shellfish in a manner that ensures product is suitable for public consumption and interstate commerce. An ISSC biennial meeting was held in San Diego in October 2019 with DMF in attendance.

Habitat Program

Personnel

Dr. Kathryn Ford, Program Manager

Gloucester
Mark Rousseau, Marine Fisheries Biologist
Tay Evans, Marine Fisheries Biologist
Jillian Carr, Assistant Marine Fisheries Biologist (January–July)
Katelyn Frew, Assistant Marine Fisheries Biologist
Alex Boeri, Contract Technician (January–June)
Kristin Schmicker, Contract Technician (June–August)
Iris Seto, Student Intern (June–December)
Simonetta Harrison, Student Intern (June–December)

New Bedford
Eileen Feeney, Marine Fisheries Biologist
Dr. John Logan, Marine Fisheries Biologist
Steve Voss, Marine Fisheries Biologist
Ryan Nuttall, Contract Assistant

Overview

The goal of the Habitat Program is to protect and enhance marine fisheries resources. The Habitat Program includes two projects. The Technical Review Project reviews permits submitted to municipalities, the Commonwealth, and the federal government for construction projects occurring in waters with fisheries and habitats under DMF jurisdiction. The reviewers provide

recommendations to avoid and minimize impacts on marine fisheries resources. In addition, staff participates in various working groups to provide technical analysis and policy input on a variety of topics, including ocean planning and offshore wind development. The Fisheries Habitat Research Project conducts state- and grant-funded research related to marine fisheries habitats. Research varies year to year with studies focused on marshes, artificial reefs, eelgrass, and food webs.

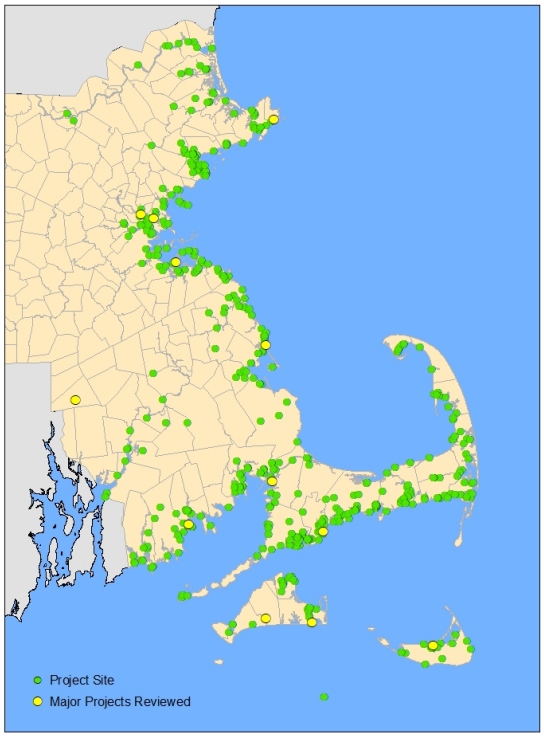
Technical Review Project

Technical Review

DMF reviews coastal construction projects and recommends changes that avoid, minimize, or mitigate potential impacts. Our recommendations include time-of-year recommendations that prevent impacts on critical life stages of marine fisheries resources, proposing soft shoreline solutions instead of rip rap or steel pile bulkhead to avoid habitat loss, technical guidance to improve monitoring of construction impacts (e.g., wind farms, docks, and piers), and changes to dock and pier designs to minimize impacts to eelgrass and saltmarsh.

In 2019, staff reviewed 550 projects in 84 municipalities (Figure 10). Of these, 359 were new applications, while 191 had been previously reviewed. The project types were dominated by docks, hard shoreline, and dredge projects. About 200 projects were replacements or repairs of existing infrastructure. Approximately 45% of all reviewed projects have the potential to directly impact habitat (n=245), including 134 projects in or near salt marsh and 48 in or near eelgrass.

Some major projects reviewed this year included shoreline stabilization for municipalities such as Barnstable, Dennis, Duxbury, Haverhill, Hull, New Bedford, and Quincy; Vineyard Wind; Amitie Submarine Cable; dredging projects including Annisquam River Federal Navigation Project, the Town of Bourne 10-year dredge plan, Popponesset Bay in Mashpee, Cuttyhunk entrance channel in Gosnold, Clam Beach in West Tisbury, Boston Harbor Deep Draft Navigation Improvement Project, and the Town of Plymouth's Federal Navigation Channel. Additional major projects reviewed in 2019 included the Town of Plymouth's Foothills Preserve and West Beaver Dam Brook Restoration Project, the Martha's Vineyard Shipyard Tisbury marina proposal, MassDOT's culvert replacement project along the South Coast Rail, the Northeastern University Expansion in Nahant, and the Salem Sewer Line Relocation.



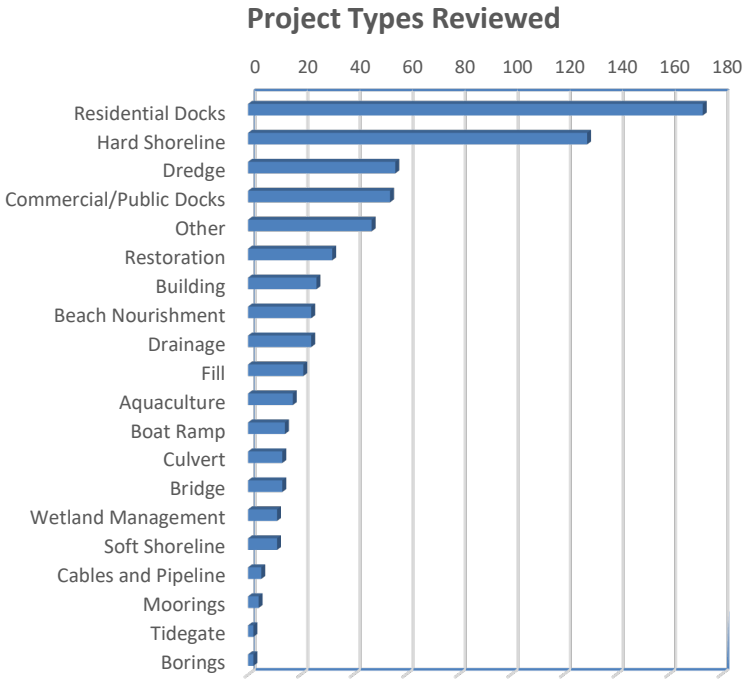


Figure 10. Coastal alteration projects reviewed by Program staff in 2019 by location (left) and type (right). Note that a single project can include multiple project types. "Other" includes boat lifts, energy (e.g. utility, wind) groin repair, dam removal or improvement, boardwalks, and road repairs.

Efforts to improve efficiency and standardization of reviews continued. Staff completed an extensive update to the Technical Review Manual, which contains the Project's standard operating procedures. A new draft guidance document summarizing potential impacts to marine resources and best management practices for the design of docks, piers, and floats was developed in 2019 with plans to publish the final report in a peer-reviewed journal in 2020.

In Lieu Fee Program

The In Lieu Fee (ILF) Program is the mechanism by which the U.S. Army Corps of Engineers (USACE) can mitigate for unavoidable impacts on natural resources from the construction activities they regulate. From 2009–2014, DMF was the sponsor for the first ILF program in Massachusetts, the Coastal ILF Program, which 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 USACE General Permit and Individual Permit.

Coastal ILF Program: The Coastal ILF Program funded four projects. Three projects were completed (including five years of required monitoring) in 2017: two *Phragmites* removal projects at Rough Meadows, Rowley and Great Marsh, Newbury, and one stream connectivity project at Off Billington Street Dam, Plymouth. Work on the fourth project, the installation of a fishway at Draka Dam, Taunton, was completed in 2019 with additional support from Save the Bay, the Massachusetts Environmental Trust, and USFWS.

***Mass*DFG ILF Program:** In 2019, *Mass*DFG initiated a selection process for identifying coastal restoration projects to submit to USACE for funding approval. Two DMF projects, a fishway installation at the Willowdale Dam, Ipswich River, and expansion of an artificial reef in Nantucket Sound off Yarmouth, were selected for funding by USACE after review and consultation with the Interagency Review Team.

Staff contributed to the ILF Program's tracking of payments received and credits sold and the development of the Department's 2018 annual report on the program, which was submitted to USACE and approved in August. Staff also participated in the selection process for a new Aquatic Mitigation Specialist position for the program, conducted proposal review for projects submitted for funding consideration, and attended a USACE sponsored summit about the challenges and triumphs of ILF programs.

Offshore Wind

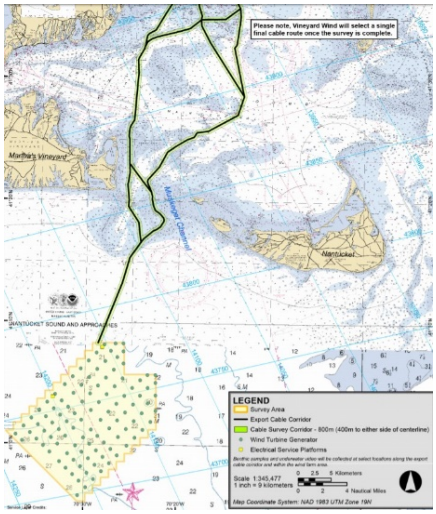


Figure 11. Vineyard Wind 800 MW project with offshore export cable.

Two Wind Energy Areas (WEAs) are offshore of Massachusetts: the Massachusetts WEA and the Rhode Island–Massachusetts WEA. These WEAs are divided into six leases that are held by four companies: Orsted, Vineyard Wind, Equinor Wind, and Mayflower Wind Energy. Planning for possible offshore wind development in the Gulf of Maine also commenced in 2019.

Throughout the year, DMF participated in multiple wind-energy activities, including reviewing permits for Vineyard Wind's offshore export cable through Massachusetts waters (Figure 11); reviewing Vineyard Wind mitigation plans; attending the State of the Science workshop on Long Island regarding advancements and needs in science and monitoring for offshore wind; attending a workshop in Philadelphia to initiate the Regional Offshore Science Alliance; participating in the Massachusetts Offshore Wind Fisheries Working Group, the New York Fisheries Technical Working Group, and the newly-launched Gulf of Maine Renewable Energy Task Force; scoping out and reviewing proposals being funded by the Massachusetts Clean Energy Center for fisheries research, and provided technical advice for state efforts related to offshore wind development in the Gulf of Maine.

Ocean Planning

The Massachusetts Ocean Management Plan serves as the Commonwealth's blueprint for the protection and sustainable use of state ocean waters. In 2019, staff participated in joint meetings of the Ocean Advisory Commission and Science Advisory Council as part of the Ocean Plan review process for 2019–2020. DMF also reconstituted the Ocean Plan Fisheries Working Group to assist with the update of protective measures for fish and fisheries under the Ocean Plan.

One of the goals of the Ocean Plan is to better coordinate on aquaculture activities. For the past two years, Habitat Program staff have partnered with the Shellfish Program to develop the Massachusetts Aquaculture Permitting Plan (MAPP). The draft MAPP was completed in June 2019 with funding from ASMFC. Continued funding from ASMFC was awarded in 2019 for a partner website designed to assist growers with the permitting process in Massachusetts. Staff continued to meet with partner agencies to establish the permitting process for aquaculture projects in Massachusetts, identify project types that can receive standard conditions, and conduct an environmental assessment of the major aquaculture activities in Massachusetts.

DMF continued to participate in the Northeast Regional Ocean Council, particularly the Ocean Planning Committee, which replaced the Northeast Regional Planning Body when it disbanded in 2018.

DMF also participated in the Northeast Habitat Assessment team. The assessment is characterizing estuarine, coastal, and offshore fish habitat within state waters from Maine to North Carolina. The goal of the project is to develop information and tools to support the National Fish Habitat Assessment, provide spatial products that describe fish habitat for the New England and the Mid-Atlantic Fishery Management Councils' essential fish habitat (EFH) and habitat area of particular concern (HAPC) descriptions, and provide tools and information to the region to support state or regional habitat protection and restoration initiatives. The habitat maps will be valuable in addressing coastal zone development impacts on fish habitats.

Fisheries Habitat Research Project

Artificial Reefs

Massachusetts has five permitted artificial reefs in its waters. Staff performs surveys to identify new reef sites for permitting, conducts compliance and biological monitoring, coordinates materials acquisitions and deployments, and provides technical guidance to advance artificial reef development and uses in state coastal waters.

Reef Monitoring: In 2019, all reef sites were monitored for community composition, biomass, invasive species presence, permit compliance, and temperature data. Acoustic receivers were utilized year-round to assess the patterns of tagged fish. Work continued on the development of protocols to guide future reef monitoring efforts.

DMF conducted a study using Baited Remote Underwater Video Stations (BRUVS) to compare reef productivity of artificial reefs in Nantucket Sound (Figure 12). Species richness, diversity, abundance, and the age structure of black sea bass and scup were compared to fish aggregations on nearby natural reefs and sand bottom habitats. The study identified an increase in the abundance of reef-associated species with increases in artificial reef age. The voluntary service of several members of the Cape Cod Salties recreational sportfishing club who donated vessel time and one Northeastern University (NEU) Three Seas Program graduate intern were critical to the study. Future research on reefs in Nantucket Sound will utilize BRUVS to assess structured habitat connectivity to determine appropriate spacing of new artificial reefs.

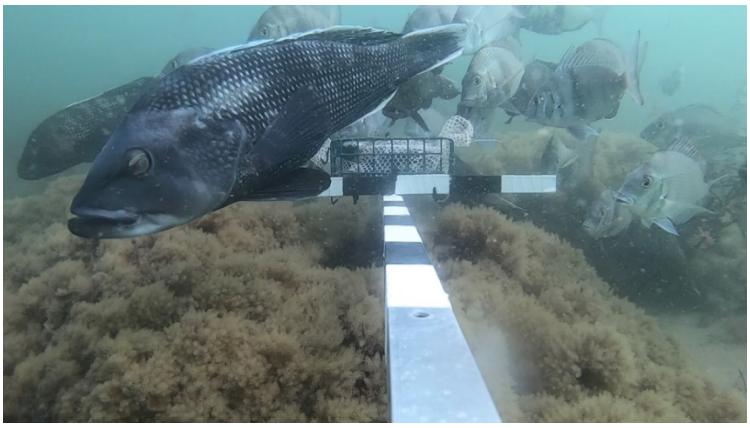


Figure 12. (Left) NEU graduate intern Simi Harrison and Cape Cod Salties volunteer Robert Dyka prepare to depart from the Bass River in Yarmouth for BRUVS field data collection. (Right) Video image of black sea bass and scup from BRUVS deployed on the Yarmouth artificial reef.

Material Storage and Procurement: In 2018, Project staff secured a two-year lease with the Massachusetts Clean Energy Center for a one-acre artificial reef material staging area at the New Bedford Commerce Terminal. Fifteen hundred cubic yards of material from the Massachusetts Department of Transportation's (*Mass*DOT) South Coast Railway Redevelopment Project was stored at the site. An effort to obtain surplus materials from *Mass*DOT maintenance depots was ongoing at year's end. Efforts continued to arrange future direct material deployments to reef sites from large coastal construction projects.

Deployments: On October 1, the first of several planned material deployments on undeveloped sections of the Yarmouth artificial reef site occurred. Two US Coast Guard vessels deposited 140,000 pounds of retired concrete buoy sinkers to an area within the southern portion of the permitted site (Figure 13). This occurred at no cost to the Commonwealth as part of the USCG maritime stewardship efforts in support of local coastal communities. Additional sinkers were scheduled to be delivered to the site again in mid-January 2020. DMF also worked with the Robert B. Our Company, the Town of Yarmouth, and the Cape Cod Salties to identify and secure over 2,000 cubic yards of clean construction debris to create 1-2 acres of structured habitat. *Mass*DFG's ILF Program provided funding in November 2019 for two deployments of this material, scheduled to occur in early January 2020. These deployments marked the first time in more than two decades that new materials were added to the Yarmouth reef site. Recreational species such as black sea bass and scup were expected to populate the newly deployed structures in the spring of 2020.

Figure 13: Deployment of retired buoy sinkers to the Yarmouth reef site on October 1.

Cape Cod Bay Site Selection: In 2018, DMF began exploring the potential for four to five new artificial reef locations in lower Cape Cod Bay between Sandwich and Barnstable. In 2018 and 2019, a combination of SCUBA surveys, photo ground-truthing, and side-scan sonar surveys were conducted to determine if sites matched suitable artificial reef siting criteria. In 2019, the final proposed reef sites were chosen within each town.

Climate Change

Climate change is an area of active research and policy development in New England. DMF's primary focus is on harnessing existing research efforts and ensuring that data relevant to climate change are being collected in a standardized way and made accessible to all research entities.

Temperature: Project staff compiles all marine and coastal continuous bottom temperature monitoring records collected by DMF. The database contains over 7 million records from 1986 to present, inventorying more than 30 seafloor stations and over 40 estuarine and riverine sites where bottom temperature data are collected seasonally, typically March to October. Approximately 200,000 temperature records statewide are collected annually. In 2019, DMF continued efforts to test a new SQL server platform for housing and archiving the database with a focus on improving database maintenance and enabling access to near real-time information. Efforts to advance the database to a publicly accessible platform were ongoing.

Ocean Acidification Commission: The first meeting of the Special Legislative Commission Relative to Ocean Acidification was held on December 7, 2019. The Commission was created by legislation with membership including Massachusetts legislators, coastal and ocean acidification scientists, commercial fishermen and aquaculturists, and representatives from environmental agencies and organizations, including DMF (with Program staff serving as a proxy for the DMF Director). An additional four meetings of the Commission were expected for 2020, to review relevant scientific data and information related to coastal and ocean acidification, conduct public hearings, and create a report of findings and policy recommendations for the legislature by year's end.

Food Webs: Project staff have been researching the processes by which ocean warming and other physiological changes from climate change may alter food webs. Analysis performed in collaboration with other researchers in 2019 resulted in staff submitting two journal articles based on a global dataset of tuna stable isotope records to assess changes in pelagic food webs in relation to ocean warming. The first of these two studies used time series analysis to examine trends in tuna carbon isotope records to reveal global declines in carbon isotope values most likely due to changes in the productivity and/or composition of phytoplankton communities. The second study demonstrated that the expansion of warmer, less productive waters worldwide would impact the structure of marine food webs and the corresponding foraging habitats of marine predators.

Two studies examining the interplay between eutrophication and transfer of contaminants into the food web were also underway during the year. The first showed a possible linkage between macroalgae blooms caused by elevated nutrient levels and polychlorinated biphenyls getting into food webs in New Bedford Harbor. Results from this study, conducted in collaboration with Northeastern University, the University of New Hampshire, and Roger Williams University (RWU), were published in 2019 in Marine Ecology Progress Series. The second study explores how eutrophication affects the bioavailability of mercury in coastal food webs within several

Cape Cod estuaries. It has been ongoing since 2012 with partners from Harvard University, RWU, University of California Santa Cruz, and Dauphin Island Sea Lab with partial funding from Woods Hole Sea Grant.

Eelgrass Monitoring and Restoration

Eelgrass is a critical marine fisheries habitat. DMF focuses on research, monitoring, and restoration of eelgrass in Massachusetts.

Seagrass Monitoring: The eelgrass team completed its twelfth year of monitoring a site off West Beach, Beverly in Salem Sound as part of the international SeagrassNet monitoring program and Mass CZM's Marine Invader Monitoring and Information Collaborative (MIMIC). SeagrassNet tracks short- and long-term trends in eelgrass meadow characteristics at 136 sites globally, including two sites in Massachusetts. Our Seagrass Net station data show a consistently stable meadow with little annual variation in percent cover, shoot density or biomass. We have recorded invasive tunicates on the subsurface lines and buoys marking the site but not on the grass itself. In 2019, staff continued to collaborate with other SeagrassNet participants in the northeast and mid-Atlantic on a peer-reviewed regional synthesis. Work also continued on a collaboration started in 2017 with scientists from NEU to digitally scan high-resolution images of eelgrass samples from West Beach for a wasting disease assessment. The West Beach SeagrassNet station is also a reference site for our ILF restoration project.

DMF annually monitors an additional five reference beds in Salem, Marblehead, Boston, Broad Sound, and Nahant. These areas were established during 2013–2014 to track trends in natural beds compared to transplanted sites. Reference beds are stable overall. Some sites are consistently lower density than others. We also see changes in density over time, driven by storm events and direct impacts from lobster gear, but there have been no alarming declines or indications of increased stress.

Salem Sound Eelgrass Restoration: The eelgrass team initiated a five-year ILF-funded project in 2017 to restore a half-acre of eelgrass at Middle Ground in Salem Sound to mitigate for construction impacts to coastal ecosystems. As part of the project, annual monitoring is required at four sites planted during 2017–2018. The annual monitoring was conducted in July 2019 (Figure 14). Planted plots at three sites were on a trajectory of expansion and growth and on target to meet the success criteria. We concluded that the fourth site, which is particularly vulnerable to nor'easters and showed almost no remaining eelgrass in 2019, was no longer a viable restoration site.

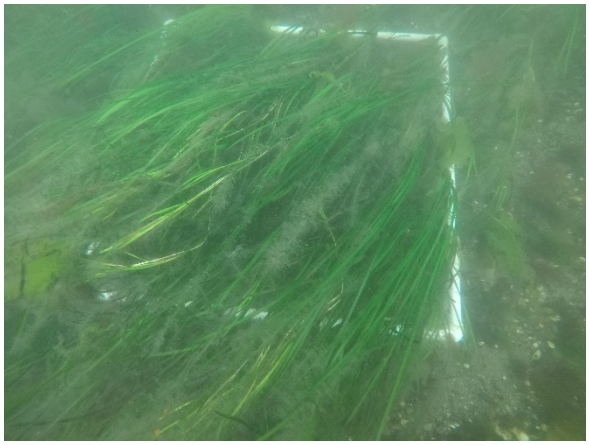


Figure 14. Monitored quadrat at ILF West Beach restoration site, July 2019

Eelgrass Restoration Method Evaluation: Eelgrass seeding has been an effective restoration method in other parts of the world. Staff seed-planted eelgrass in 2018 to evaluate whether this method could be used successfully in Massachusetts. Monitoring in 2019 did not find any surviving plants. We concluded that the planted sites were too deep and too dynamic for successful seed planting, whereas other methods, including burlap disc planting have been successful at the same site. No seed planting was planned for 2020.

Figure 15. Conservation mooring with float rode and helical anchor in eelgrass in Manchester harbor. August 2019

Conservation Moorings: Some mooring systems are termed "conservation moorings" because they use flexible rode technology to float the mooring rode, thereby eliminating chain drag and reducing scarring in eelgrass meadows (Figure 15). DMF has been studying these systems since 2010. Proper sizing, design, installation, and maintenance are critical to reducing impact on eelgrass. Our guidance document on the use of these systems was updated in 2019 and provided to harbormasters and mooring maintainers.

We also concluded our monitoring for the Massachusetts Port Authority's (Massport) Conservation Mooring Program that it funds to offset eelgrass impacts caused by a Logan Airport runway safety area expansion. DMF monitored 39 moorings in Wareham, Boston, Gloucester, Manchester-by-the-Sea, Quissett, and West Falmouth that were installed in 2014 and 2015. The conservation moorings at West Falmouth Harbor were the most successful, where a net of 440 square meters of eelgrass habitat has recovered. Installation of conservation moorings in Quissett Outer Harbor, Manchester Outer Harbor, Gloucester, and Onset Harbor also led to positive net recoveries, though shoot densities were still considerably below target. The monitoring at Camp Harborview, Boston, showed that the early recoveries documented between 2015 and 2017 were erased by the unauthorized replacement of conservation moorings with chain moorings in 2018. A final report was expected to be sent to Massport in January 2020.

Staff also provided technical guidance on the use of conservation moorings to mitigate for eelgrass losses caused by the Bouchard B-120 oil spill in Buzzards Bay in 2003 through the ongoing settlement process from the Natural Resources Damage Assessment. The 2019 grant was awarded to the Buzzards Bay Program; DMF expected to provide continued technical assistance through the installation and monitoring process.

Duxbury-Kingston-Plymouth Bays Study: Since 2014, DMF has been engaged in partnerships with the Massachusetts Bays National Estuarine Program (MassBays), EPA, and the North and South Rivers Watershed Association (NSRWA) to monitor and investigate potential causes for the severe declines in eelgrass beds that have been occurring in the Duxbury-Kingston-Plymouth embayment over several decades. In 2019 with funding from Veolia, NSRWA took the lead on a rapid assessment protocol developed with DMF in 2018. NSRWA recruited volunteers and completed all 119 stations during an Eelgrass Blitz week in August (Figure 16), with plans to continue the monitoring next summer. Conduct of these surveys each summer will provide important insights into the overall health of the Duxbury-Kingston-Plymouth

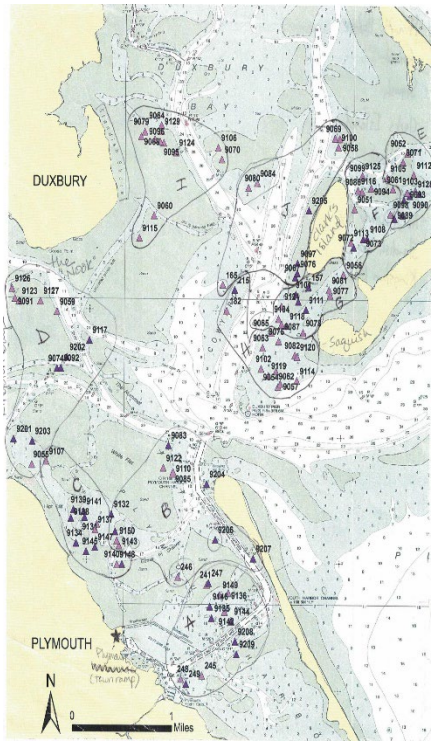


Figure 16. Eelgrass monitoring stations completed by citizen scientists.

embayment through monitoring changes in eelgrass coverage and disease prevalence. Expanding the surveys into other embayments will provide more high-resolution mapping data on eelgrass distribution and condition in Massachusetts. Other citizen science groups have also shown interest in our volunteer monitoring protocol including Salem Sound Coastwatch.

Bay Scalloping Impacts to Eelgrass

DMF continued two studies initiated in 2018 to better understand eelgrass response to scallop dragging. Certain characteristics of the fishery (such as its timing outside of the eelgrass growing season and prohibitions on the use of toothed dredges) plus anecdotal evidence suggest that bay scalloping does not impact eelgrass. At the same time, no studies have been performed in New England and there have been reports of damaged meadows after the fishing season.

Assessment of Eelgrass Meadow After Dragging: The Westport River supported a large and prolonged bay scallop harvest in 2017 for the first time in decades, presenting a unique opportunity to characterize eelgrass meadows during the growing season following a single season of scalloping. In summer 2018 and 2019, DMF surveyed an eelgrass meadow that was the site of intensive scallop dragging as well as several nearby unfished beds that served as references for comparison. All beds were surveyed using drop camera and side-scan sonar. Preliminary image analyses have not demonstrated any clear declines in eelgrass for the meadow targetted by the scalloping fleet.

Controlled Impact: To better understand potential impacts of scallop dragging on eelgrass meadows in a more controlled manner, DMF established an experimental scallop dragging site in an eelgrass meadow in Nasketucket Bay in Fairhaven in 2018. The site was selected due to minimal prior scalloping pressure while being proximate to previously fished beds. During the commercial and recreational bay scalloping season (November–December 2018 and 2019), DMF performed both high- and low-intensity dragging using a pan dredge and surveyed both the fished sites, as well as adjacent unfished reference sites, using drop cameras and side-scan sonar to assess any potential short-term impacts. DMF planned to repeat the experimental dragging with associated monitoring for a third and final season in 2020. Preliminary results were presented at the EPA's annual eelgrass meeting in March 2019 and the spring 2019 meeting of the New England Estuarine Research Society (NEERS).

DMF expanded its controlled impact study in 2019 by establishing a second experimental dragging site in the West Branch of the Westport River. DMF contracted and worked with a commercial scalloper to perform the same experimental dragging treatments applied previously to the Nasketucket Bay site, then performed side-scan sonar and drop camera surveys to assess any short-term impacts of scallop dragging. Both dragging and survey work were done in December 2019. DMF planned to continue controlled dragging at this second experimental site for two additional field seasons.

Salt Marsh

Private docks are frequently constructed over salt marsh, potentially impacting this important habitat through shading impacts. DMF conducted two field studies from 2013–2015 to improve understanding of how shading and associated marsh impacts varied with different dock designs. Results from the two complementary studies showed that the existing dock design guideline recommending dock height be set equivalent to dock width was inadequate for minimizing shading impacts. In 2019, DMF continued outreach efforts to convey these findings to regulatory

agencies. Outreach included meetings with MA DEP and a presentation to the Town of Hingham's Conservation Commission.

Winter Flounder

Figure 17. Sampling winter flounder.

Winter flounder spawn in winter months and early spring in New England embayments and coastal waters; however, more detailed information regarding preferred spawning habitat and timing of peak spawning activity within embayments is needed. Broad time-of-year spawning restrictions are placed on coastal alteration projects. This included dredging project overseers frequently seek a waiver. Our lack of more detailed knowledge limits our ability to determine when and where dredging projects are least likely to negatively impact winter flounder spawning success. Whereas previous efforts to evaluate spawning have been hindered by the methods (e.g., too costly, too invasive), environmental DNA (eDNA) offers a new tool that would enable us to frequently sample a greater number of stations to establish when and where winter flounder are located. eDNA is genetic material from an organism that enters the aquatic environment and can be used to trace presence and potentially relative abundance through identification of eDNA in water samples collecting in the field. To better understand the spatial distribution of winter flounder in Boston Harbor, DMF partnered with UMass Amherst (Figure 17). in the summer of 2019. To better understand winter flounder south of the Cape, DMF collected water samples in partnership with Rhode Island Department of Environmental Management's winter flounder fyke net survey in the winter of 2019–2020. Water samples were to be analyzed for eDNA by geneticists at UMass and the Gloucester Marine Genomics Institute (GMGI) in 2020.

Other Activities

Technical Committees: Program 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 (ACFHP), the ACFHP Science and Data Committee, the NEFMC Habitat Plan Development Team, the NROC Habitat Classification and Ocean Mapping Subcommittee, NEFMC/MAFMC Northeast Regional Habitat Assessment Team, MA Climate Change Vulnerability Assessment Team, 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, the Marine Dissolved Oxygen Technical Advisory Committee, the NEERS Executive Committee, and the Northeast Regional Habitat Assessment Inshore Habitat Team.

Support Activities: Staff reviewed proposals for NOAA, MIT Sea Grant, Mass Clean Energy Center, ACFHP, and the Bouchard grant and performed peer review for ten academic journals. Staff also participated in thesis committees for two Master's candidates at the University of Maine. Two project staff participated in Northeastern University Three Seas Program Career Night and advised two NEU graduate student interns from June to December.

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
Nicholas Buchan, Biologist
Brad Schondelmeier, Biologist
Kimberly Trull, Assistant Biologist
Nicole Ward, Assistant Biologist
Elise Koob, Ageing Technician
Christy Draghetti, Ageing Technician
Joe Holbeche, 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, 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. These activities are organized under four projects: Age and Growth Project, Fisheries Dependent Sampling Project, Fisheries Research Project, and Striped Bass Project.

Age and Growth Project

In 2019, staff aged hard-part structures from many species important to Massachusetts recreational and commercial fisheries. Table 18 shows the number of samples processed and aged. Several focus areas for 2019 are highlighted below.

River herring: In 2019, work began to reassess the ages assigned to river herring captured between 2006 and 2009. In recent years, all river herring ageing has been accomplished using otoliths. Ages derived from otoliths are more precise and accurate than those derived from scales. Trends in current population metrics lead to some uncertainty in historic ages, so it was deemed necessary to reassess those ages.

Black sea bass: Work continued in 2019 on a project to validate the otolith ageing methodology for black sea bass. Marginal increment analysis has demonstrated that one annulus is laid down each year and that the presumed first annulus is formed at one year of age. Work continued on the analysis of the

microchemical study to elucidate the natal origins of the population that is expanding into the Gulf of Maine.

Tautog: Staff has been spearheading a movement toward using the non-lethal method of ageing tautog with pelvic spines. In 2019, DMF hosted an ASMFC tautog ageing workshop to train tautog agers from other states on using pelvic spines. Staff then compiled a collection of otoliths, opercula, and pelvic spines from 75 fish representing samples from states throughout the population's range. This collection will be used as an exchange collection to assess precision between structures and states. This is an important step in the acceptance of pelvic spine derived ages being used in the stock assessment.

Table 18. Samples processed for ageing in 2019

Species	Structure	Process	Number
American shad	Otoliths and scales	Otoliths aged, scales checked for repeat spawning	423
Atlantic Halibut	Otoliths	Sectioned, aged	337
Atlantic Menhaden	Scales	Cleaned, mounted	120
Black sea bass	Otoliths and scales	Cleaned, mounted, aged	810
Bluefish	Otoliths	Baked, sectioned, aged	97
Fluke	Scales	Cleaned, pressed	51
Rainbow Smelt	Scales	Mounted	561
River herring	Otoliths and scales	Cleaned, mounted, aged	4,669
Scup	Scales	Cleaned, pressed	24
Striped bass	Otoliths	Sectioned, aged	133
Striped bass	Scales	Cleaned, pressed	1,678
Tautog	Otoliths and opercula	Cleaned, sectioned, aged	259
Winter flounder	Otoliths	Sectioned, aged	725

Other Activities: 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 was 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 the Gulf States Marine Fisheries Commission to construct an age determination manual.

The Age and Growth Lab continued to be a resource for researchers involved in fish ageing. Researchers from a variety of universities, state agencies, and NOAA Fisheries consulted with staff on ageing of several fish species.

Staff organized and installed hardware and software in the wet-lab to allow for digital data collection. A digital measuring board, digital calipers, balance, and computer with software customized to the sampling protocols used by the Division are all part of this package. This upgrade allows for faster and more accurate data collection.

Fisheries Dependent Sampling Project

Project staff are responsible for the at-sea and shore-side sampling of commercial fisheries that occur in and adjacent to Massachusetts territorial waters. The Project also conducts fish biology research

studies, provides field and vessel support to other projects, and conducts data analysis and summarization.

Commercial Fisheries Sampling

Project 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 strengthen DMFs' participation in and contributions to the regional fishery management councils and the ASMFC.

Shore-side Sampling: Due to staffing constraints and reduced landings in some cases, port sampling of commercial catch was carried out for only the highest priority species in 2019. The striped bass and menhaden fisheries were sampled per interstate plan requirements (Table 19). The Atlantic herring fishery was sampled for catch characterization and the bycatch avoidance program (page 64). Sampling efforts for Northern shrimp were suspended in 2019 due to cessation of the research fishery (in addition to the ongoing commercial fishery closure).

Project staff worked with members of the Age and Growth Project to develop a method for removing striped bass age structures (otoliths) without compromising the condition of the fish for wholesale. Using this supplemental age structure will improve the ability to age the larger older fish that are routinely landed in the commercial fishery, improving catch at age estimates, and ultimately improving the striped bass assessment.

Table 19. Number of port sampling events, or trips, made to intercept commercial vessels or seafood dealers where information was collected in 2019.

Species	Intercepts	Number individuals	Number age samples
Menhaden	12	120	120
Striped Bass	24	481	481

At-sea Sampling: Project staff contributed extensively to numerous at-sea sampling activities. Conduct of the Industry-based Survey for Gulf of Maine Cod remained the dominant activity for project staff (78 sea days). Staff provided gear maintenance, field support, and data management for validation trips of newly-developed cod avoidance maps (66 sea days) and acoustic telemetry studies to better understand the migration patterns of striped bass, shad, and white shark (28 sea days). Field support was provided for the routine annual monitoring of the state's coastal lobster fishery between May and November (26 sea days) and the Division's biannual resource assessment trawl survey (24 sea days). Vessel support (12 sea days) was provided for numerous external projects, including: collecting biological samples for UMass-Boston/New England Aquarium (NEAQ), Gloucester Marine Genomics Institute, and Maritime Gloucester; assisting University of New England satellite tag porbeagle sharks in Ipswich Bay and on Jefferies Ledge; and collecting microplastic samples from Boston Harbor for the NEAQ, EPA, and Draper Labs. Through an effort funded by National Fish and Wildlife Foundation staff collaborated with the Center for Coastal Studies, commercial lobstermen, and the Massachusetts Environmental Police to

Figure 18. DMF's Brad Schondelmeier displaying catch of longfin squid during an at-sea sampling trip.

remove fixed gear from the Massachusetts large whale seasonal trap closure (3 sea days). Lastly, in order to provide accurate, timely data regarding the spring longfin squid trawl fishery operating in and adjacent to Nantucket Sound, staff conducted two sea sampling trips (Figure 18) and coordinated an additional trip which was completed by a contracted sampler.

Commercial Fisheries Data Analysis

Project staff possess the required data access and skills to query, summarize, and sea sampling analyses to aid DMF staff from other projects. During 2019, basic data queries and summaries were provided to support efforts by the Conservation Engineering Project, Diadromous Fisheries Project, Invertebrate Fisheries Project, and other agency initiatives. Extensive effort was invested in developing a report characterizing the longfin squid fishery in and adjacent to Nantucket Sound for the Massachusetts state legislature. All appropriate state and federal harvester, dealer, catch, and biological data were thoroughly analyzed and a draft report completed in 2019. The final report, due in 2020, will provide in-depth detail regarding the biological impacts and economic benefit of the spring inshore squid fishery to the Commonwealth, the relative levels of bycatch occurring in the commercial fishery, and possible areas of concern. This document will answer numerous questions about the fishery and could inform future management discussions and deliberations.

Atlantic Herring Fishery Portside Sampling and River Herring Bycatch Avoidance

Project staff completed the 12th year of portside sampling of the Atlantic herring and mackerel mid-water trawl (MWT) fishery in collaboration with industry and SMAST. Funding for portside sampling continued under a no-cost extension of the NOAA-issued Atlantic Herring Research Set-Aside (RSA) of 2016–2018. Administration of the River Herring Bycatch Avoidance program was funded by the newly awarded 2019–2021 Atlantic herring RSA.

Due to a string of poor recruitment events in the past decade, the biomass of Atlantic herring has decreased drastically causing severely reduced quotas in 2019. As a result, far less fishery effort occurred and far fewer trips were sampled than in previous years. With the aid of contracted biologists, DMF sampled 14 trips in 2019, and incorporated data from an additional nine trips sampled by other programs, most often the NOAA Northeast Fisheries Observer Program (NEFOP). From landings in MA ports, 2,342 metric tons of herring or mackerel from 20 MWT trips were sampled. Over 5,500 lengths were collected on target species, and over 1,100 river herring and American shad bycatch lengths were recorded. DMF staff continued to edit, enter and upload sampling data to NOAA's Greater Atlantic Regional Fisheries Office (GARFO) within a week of landing in order to bolster NOAA's monitoring of river herring/shad catch limits in the herring and mackerel fisheries.

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 MWT fishery for Atlantic herring and mackerel. Under the bycatch avoidance program, portside sampling and NEFOP sea sampling data are aggregated, and bycatch rates are communicated back to participating vessels, allowing them to make better-informed decisions about where to fish. In the winter/spring of 2019, more frequent real-time communications were utilized in response to the fast-paced fishing seasons associated with the reduced quotas. In total, three preseason advisories, four sampling summaries, three bycatch alerts, and seven bycatch cap updates were sent to industry collaborators over the course of 2019. An email chain with vessel managers was initiated on multiple occasions to help build consensus across the fleet.

Operating in the first year of the 2019–2021 Herring Research Set-Aside, DMF and SMAST allocated 451.5 metric tons (995,377 lb) of RSA herring quota to eligible participating vessels. This value,

representing the standard 3% of each herring management area's quota, was down 85% from 2018. Unfortunately, due to circumstances within the fishery, zero metric tons of 2019 herring RSA quota was harvested. Herring RSA quota distribution and funding mechanisms will be reconsidered for 2020 in order to provide more funding certainty to Project staff. Despite these shortfalls, the River Herring Bycatch Avoidance program was able to add four additional vessels to the participating fleet and will be operating in 2020.

In anticipation of the NOAA Industry-Funded Monitoring Amendment (IFM), whereby Atlantic herring vessels will fund a portion of their monitoring and the portside sampling program will become federally-operated, DMF hosted NEFOP and GARFO staff for multiple portside samples and conducted tours of sampling sites in Massachusetts ports. DMF continued to assist NEFOP in developing sampling protocols and data standards to be used in the federal portside sampling program. DMF also worked to identify portside sampling sites in Massachusetts in need of upgrades to comply with IFM standards. Upgrades to ensure safe access were designed with industry collaborators and federal funds were acquired in order to reimburse for work completed. These efforts will help ensure a smooth transition from a voluntary state-run portside sampling program to a federally-operated portside sampling program.

Staff assisted with numerous federal and state fisheries management actions for Atlantic herring, mackerel, and river herring in 2019. Staff served on the ACCSP's Biological Review Panel and Bycatch Prioritization Committee (chair) and helped prioritize species for funding consideration. Staff made major contributions to the ASMFC's Atlantic Herring Plan Development Team (PDT) that was tasked with developing new options for herring management in the inshore Gulf of Maine, and supplied pertinent information for ongoing Atlantic herring, mackerel, river herring, and menhaden management actions. DMF collaboration with external agencies continues to broaden the scope of research and utility of fisheries sampling data. For example, over ten years of DMF herring gonad somatic index (GSI) data was used to help profile the extent and duration of spawning events on Georges Bank and Nantucket Shoals for a NEFMC discussion paper.

A 2017 NOAA Bycatch Reduction Engineering Program (BREP) grant was completed after a second winter of environmental and catch data collection on mid-water trawl vessels fishing in southern New England waters. In the two winter fishing seasons (2018, 2019), eight vessels were outfitted with data loggers affixed to the net's headrope sensor. Temperature, depth, and salinity data was collected for 143 hauls on 71 unique trips, and these data were paired with available catch sampling data. Unfortunately, due to reduced fishery sampling, only 13 hauls had catch observations available. This low sample size inhibited some planned analysis; however, retrospective comparisons of the previous decade's observer bycatch data to the project's fisheries-independent habitat model forecasts yielded positive results. Reliable predictions of separate target catch and bycatch areas were revealed for December, January, and February (in some years). Future funding is being sought to enable integration of these findings with the ongoing bycatch avoidance program.

Finally, in order to further describe spawning characteristics of Georges Bank and Nantucket Shoals herring, two GSIs were conducted on landings from east of Cape Cod, where most of the autumn fishing effort occurred. Catch of spawning herring from this area is relatively rare. Due to minimal landings of herring in Massachusetts ports from Management Area 1A (inshore Gulf of Maine), only one GSI was taken after the re-opening of the Massachusetts/New Hampshire spawning area. This sample was collected in early November and showed that 99% of the herring had already spawned.

Fisheries Research Projects

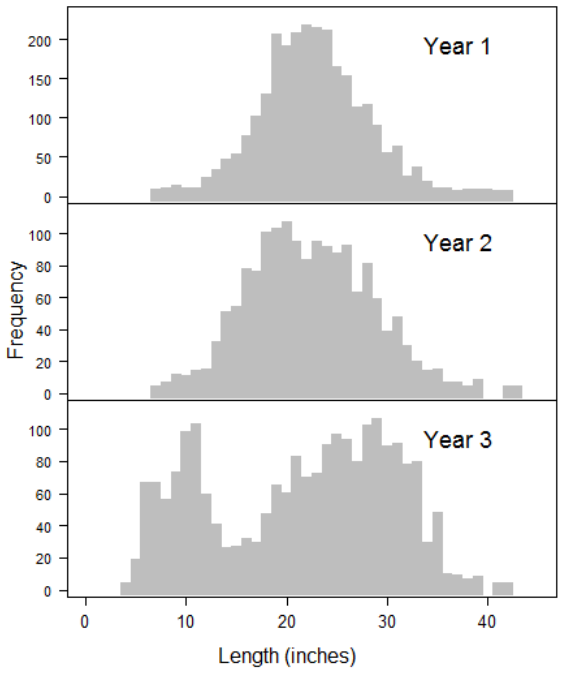
DMF continued its commitment to applied fisheries research to improve the management and assessment of the Commonwealth's marine resources through various collaborations with university, non-profit, state, and federal organizations.

Industry-Based Survey of 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, DMF conducted an industry-based trawl survey (IBS) from 2016–2019 in a portion of the GOM that encompasses the core area of the cod population as well as the ground fishery.

Eight monthly survey cruises that attempted 50 tows per cruise and covered the two peaks in cod spawning activity were conducted in each of the last three years: "Spring" spawning of April, May, June, and July; and "Winter" spawning of October, November, December, and January. The F/V Miss Emily, a Scituate-based 55' commercial stern trawler, acted as the survey vessel throughout the entire project, and made its final survey cruise in January 2019. During this final month, DMF staff completed 45 representative tows over 10 days, with a tow-completion rate of 90%. Over its full duration (2016–2019), the IBS completed a total of 1,004 tows over 262 survey days, for an overall completion rate of 90%.

Figure 19. Length frequency of Atlantic cod captured during the IBS.



In addition to standard survey operations, DMF continued two complementary studies to estimate the efficiency of the cod IBS trawl. The studies examined: 1) the herding effect of the trawl net ground cable, and 2) the escapement of groundfish species under the sweep of the trawl net. Data from these studies will be used to increase the accuracy of swept area biomass estimates generated from the cod IBS. This experimental work began in December 2016 and was completed in June 2019. In total, 144 experimental tows were completed over 21 additional survey days.

Over the course of the survey, haddock was the most abundant species observed out of 82 different fish and invertebrate species collected (Table 20). For Atlantic cod, the most prevalent size class was "Markets" (16–30 inches), with notably fewer smaller and larger fish (Figure 19). However, in the final year of the survey, juvenile cod under 16 inches were the most abundant size class encountered. Such positive signs of new recruitment provide some measure of hope for the future of the stock.

Although the survey was designed to study cod, all organisms caught were weighed, and all groundfish,

river herring, and lobsters were measured. Biological data collected from cod throughout the survey included: length (n=6,066), sex and maturity (n=4,286), otoliths (n=2,784), and genetic samples (2,103). Data and specimen requests were also collected for numerous government agencies, scientific organizations, and universities.

Table 20. Total catch weights and raw catch-per-unit effort (pounds/hr) for the top 20 species captured by the IBS. (Year 1=Apr 2016–Jan 2017; Year 2= Apr 2017–Jan 2018; Year 3= Apr 2018–Jan 2019)

		CPUE (lb/hour)		
Species	**Pounds**	**Year 1**	**Year 2**	**Year 3**
Haddock	291,318	639.1	536.7	648.0
Spiny dogfish	186,338	553.5	319.8	306.0
Acadian redfish	100,364	181.9	184.7	257.5
Silver Hake	31,636	80.1	60.2	59.2
Atlantic cod	30,753	86.7	50.9	56.3
Atlantic herring	29,464	40.8	109.9	38.3
Red hake	28,788	91.0	47.2	44.3
American plaice	28,590	78.3	64.9	39.1
American Lobster	26,273	51.2	49.5	63.2
Winter flounder	14,979	37.0	33.7	24.2
Yellowtail flounder	13,780	32.7	30.2	24.2
Monkfish	12,389	29.7	27.2	21.5
Alewife	10,832	21.7	27.1	19.7
White hake	10,087	29.1	17.9	16.8
Atlantic mackerel	9,615	10.4	39.5	11.9
Longhorn sculpin	7,202	15.4	14.6	15.2
Thorny skate	6,980	14.0	14.6	15.2
Witch flounder	6,665	12.4	15.4	14.1
Pollock	6,145	12.7	11.6	14.1

In 2019, DMF staff published a peer reviewed scientific article on the relative importance of sub-populations to the Gulf of Maine stock of Atlantic cod. This paper relied heavily on the IBS dataset and describes a novel otolith-based technique to discriminate between the two primary spawning groups of cod in the Gulf of Maine. This analysis revealed that spring-spawning cod are more concentrated within closed fishing areas and therefore experience a lower mortality rate. However, despite dominating older age classes and comprising a large fraction of the spawning stock, these spring cod currently contribute little to recruitment. The results from this work are currently being incorporated in the ongoing review of cod stock structure (see Atlantic Cod Stock Structure, page 69).

Minimizing Recreational Discard Mortality

Haddock: As part of our continued work on estimating and minimizing the discard mortality of important groundfish species, DMF scientists published an article in 2019 on a f*ishery-scale discard mortality rate estimate for haddock in the Gulf of Maine recreational fishery.* This paper made use of a large-scale and long-term acoustic telemetry experiment, as well as extensive fishery observations. Across the entire recreational fishery, 63% of haddock were estimated to die shortly after release, with

the highest mortality occurring on smaller individuals during the autumn. A set of best handling practices for recreational haddock anglers were developed from this work and incorporated in the new "Recreational Haddock Fishing Guide" to be distributed for the 2020 season. The discard mortality rate estimate produced by this project has already been incorporated in the 2017 and 2019 stock assessment updates for Gulf of Maine haddock.

Atlantic Cod: During 2019, DMF furthered its work to create practical guidance for the recreational fishery to reduce cod bycatch while targeting haddock, with the goal of preventing further measures restricting recreational anglers' access to the abundant haddock resource. Previously, DMF created seasonal geostatistical models, fit to IBS trawl survey data, which account for the non-linear relationship between abundance and habitat (depth, temperature, seafloor rugosity). After translating the predicted density of each species into an expected catch rate for baited hooks, DMF classified the resulting maps into areas to target and to avoid. During the summer of 2019, these guidance maps were validated through standardized charter fishing trips. A total of 54 validation fishing trips were conducted aboard four different vessels, which resulted in 138 volunteer anglers catching more than 8,000 fish at over 400 different locations. Over the entire dataset, fishing in the target areas resulted in a 12% higher haddock catch rate and a 33% lower cod bycatch rate.

To increase angler interest and promote outreach, the guidance maps were combined with a high-resolution bathymetric map and incorporated into a new "Recreational Haddock Fishing Guide" for distribution in 2020 (Figure 20). These guides will be made freely available at tackle shops, sportsman's shows, permit offices, and via our website. In addition, the guidance maps will also be available via a free location-aware smartphone app (Avenza Maps), which allows offline tracking and navigation. Because cod and haddock populations are always in flux and their distribution in the Gulf of Maine can vary over time, DMF developed (with funding from NOAA Fisheries) a "citizen science" program where volunteer anglers will be recruited to collect standardized catch information. The data collected will be electronically reported to DMF throughout the season and incorporated into new maps for 2021.

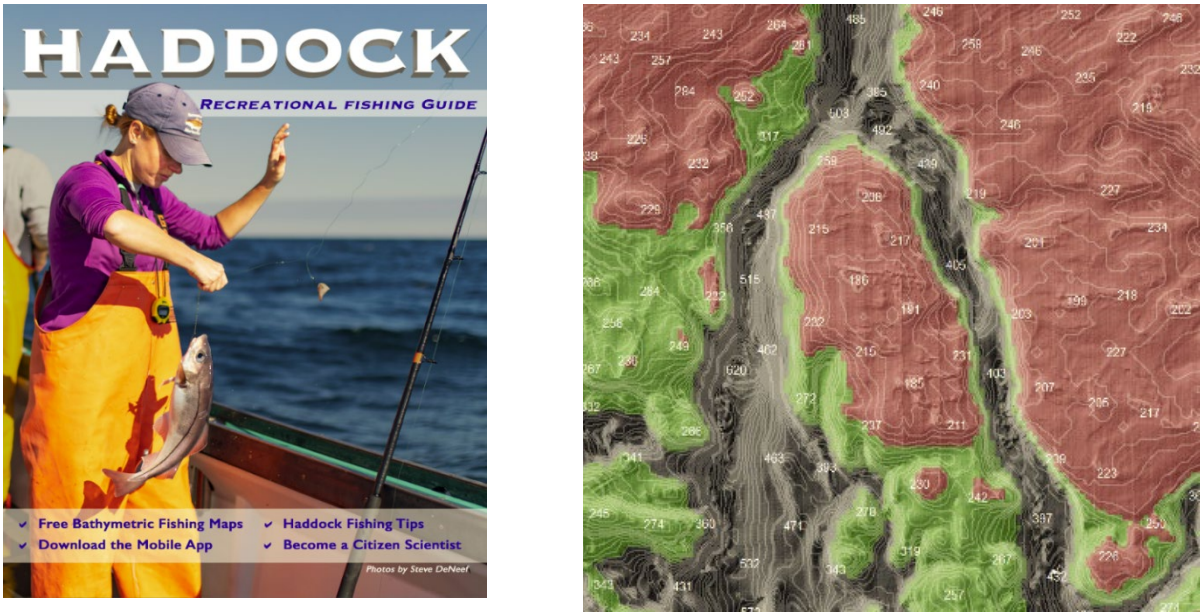


Figure 20. Recreational haddock fishing guide cover (left) and an example guidance map (right) showing areas to target in green (high haddock catch, low cod bycatch), areas to avoid (low haddock, high cod), as well as bathymetric features.

Winter Spawning Cod in Massachusetts Bay

Staff co-authored a scientific article describing their prior research project to identify the distribution of winter spawning cod in Massachusetts Bay. This research used multiple fixed and glider-mounted acoustic technologies to track the movements of cod during the spawning season over multiple years. Prior to this project, which received funding from the Saltonstall-Kennedy Grant Program, relatively little was known about the spawning time and location for this group of fish. In addition, the team of collaborators (DMF, The Nature Conservancy, SMAST, Northeast Fisheries Science Center, and the Stellwagen Bank National Marine Sanctuary) extended this analysis to a broader dataset that encompasses more than a decade of passive acoustic data, and submitted a second scientific journal article for publication in 2020.

Atlantic Cod Stock Structure

In February of 2018, a group of scientists from the US and Canada formed the Atlantic Cod Stock Structure Working Group, with the objective of determining the most appropriate representation of Atlantic cod stock structure for use in regional stock assessments. This group is following a two-year process to broadly review all available scientific information and consider potential implications for fishery management. DMF scientists have played a key role in the group, including leading sub-groups on early life history and fishermen ecological knowledge. Preliminary conclusions were shared at a symposium in Durham, NH in June 2019 to gather input from fishing industry representatives as well as the broader scientific community. This feedback was then incorporated into a final report that will be reviewed by the Scientific and Statistical Committee of the NEFMC in 2020. This work will be instrumental in re-defining the way in which Atlantic cod stocks in the United States are managed and assessed.

Alewife and Blueback Herring Life History Models

Staff continued work on an alewife life history simulation model, including testing, calibrating, validating and conducting sensitivity analyses. A manuscript demonstrating the model's utility for ecological modeling was written and accepted for publication in 2020. In collaboration with Emerson College, staff developed a spatially-explicit, agent-based life history model for blueback herring in the Shawsheen River system. Considerable testing of model assumptions occurred in 2019. The work was expected to be completed by the summer of 2020.

Striped Bass Research Project

Without a doubt, Atlantic striped bass are the backbone of the Massachusetts recreational fishing industry and provide enjoyment to hundreds of thousands of recreational anglers each year. The Commonwealth is also home to one of the largest commercial fisheries for striped bass in the country. 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

DMF 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 2019, Striped Bass Research Project staff conducted 10 trips aboard contracted vessels, tagging a total of 416 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. Length, weight, and age structures (scales) are collected during market sampling trips, in accordance with ASMFC target sampling levels. Sample size for 2019 is shown in Table 19.

Acoustic Tagging Study

In 2019, DMF continued an acoustic telemetry study of striped bass in Massachusetts waters which is examining how striped bass mortality is influenced by their 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. DMF biologists are also collaborating with researchers from the University of Massachusetts Amherst, University of Montana, and University of New Brunswick St. John to develop genomic tools and analyze collected data. The creation of a genomic population baseline for striped bass will allow DMF to establish spawning-population-specific mortality rates for striped bass harvested by Massachusetts anglers. Since 2015, over 7,000 genetic samples have been collected from striped bass caught in state waters. In 2019, this project also used $50,000 from the Marine Recreational Fisheries Development Fund to process genetic samples and advance the development of a cost-efficient genomic stock identification method.

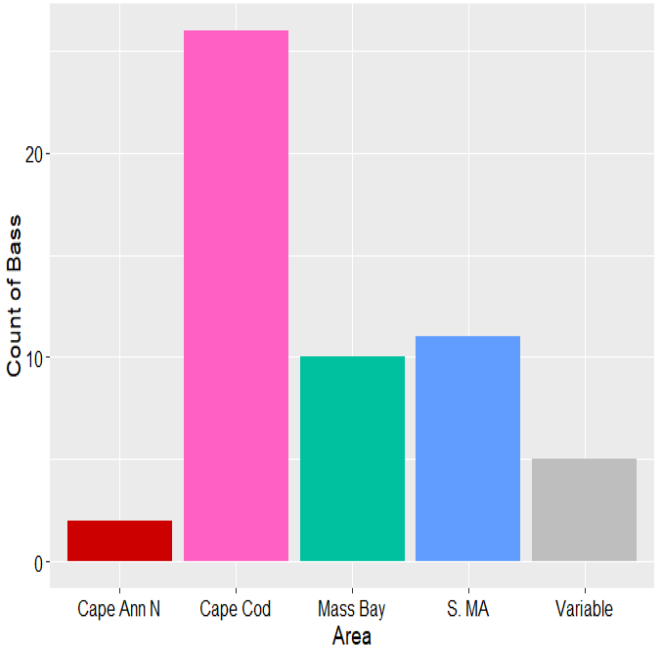


Figure 21. Bar plot showing areas of residence over 4 years by striped bass tagged in 2015 and detected through the end of 2018. 90% of striped bass detected over those 4 years showed fidelity to one area while 10% of bass moved among different areas from year to year.

During 2019, acoustic receivers were deployed for a final year 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. Initial analysis of tagged bass detections from 2015 through 2018 illustrates that striped bass returned to the same greater areas of the Massachusetts coast annually (Figure 21), although they used different migratory corridors depending on their final destination. Nearly all of the striped bass that resided in waters north of the Cape Cod Canal used the canal to migrate in spring and fall while those that resided in waters around

Cape Cod often used the canal during the spring migration but departed through Nantucket Sound or around the island in the fall.

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 2019, 53 participating anglers collected over 1,498 paired length/age samples from striped bass. The size composition of striped bass reported by participating anglers is shown in Figure 22. Participating anglers also collected 101 black sea bass samples, 51 fluke samples, and 24 scup samples, species which the program was expanded to include in 2013. The striped bass carcass collection program also continued in 2019 and obtained 133 otolith samples from volunteer anglers.

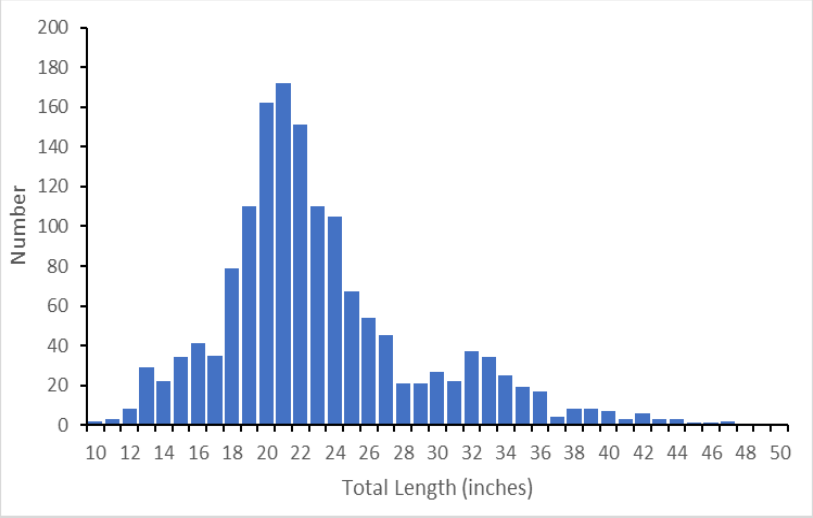


Figure 22. Size composition of striped bass collected by SADCT anglers in 2019.

Striped Bass Stock Assessment

Staff conducted analyses to determine the size limits and quota needed to meet the 18% reduction required by the ASMFC management plan in 2020; and compiled the 2018 Massachusetts striped bass monitoring report for the Division's Technical Report Series.

Other Activities

Assessment and Management Support: 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 2019, staff served on ASMFC's Striped Bass Technical, Tagging, and Stock Assessment Committees, Menhaden Technical Committee, Multispecies Committee, and Age and Growth Committee; the NEFMC's Atlantic Herring Plan Development Team; the ACCSP's Bycatch and Biological Sampling Priorities Committees. Many presentations were given by staff to other governmental organizations and private groups. Staff also served as the ASMFC member to the Assessment Operation Panel in Woods Hole, MA, and as a panel reviewer for the ICES Atlantic mackerel benchmark stock assessment in Ijmuiden, Netherlands.

Publications: Staff authored an article on the effects of multistage cluster sampling on the bias of mortality rates produced through catch curve analysis.

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 (January–April)
Alex Boeri, Assistant Marine Fisheries Biologist (July–December)
Crystal Cano, Seasonal Fisheries Technician (June–November)

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
Dr. Tiffany Cunningham, Senior Marine Fisheries Biologist (January–March)
Dr. Sam Truesdell, Senior Marine Fisheries Biologist (September–December)
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. The production of peer-reviewed publications and participation in 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, whelk, Jonah crab, and northern shrimp. Fishery-dependent and -independent surveys, as well as 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 writing and administration, and participation in ASMFC technical meetings.

The **Protected Species Project** is involved in various activities related to the conservation and management of protected species in Massachusetts waters. This covers all efforts of the Large Whale Conservation

Program, including oversight of the right whale surveillance program, acoustic monitoring of right whales, and large whale disentanglement. Project staff oversees and participates in work on other protected species, such as harbor porpoise and sea turtles. Issues include sea turtle disentanglement, federal Take Reduction Teams, grant management, and 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

Small Channeled Whelk Excluder for Pots in Massachusetts

Staff collaborated with the Invertebrate Fisheries Project to begin development of a small whelk excluder for the inshore channeled whelk pot fishery in Massachusetts. The first objective was to observe whelk movement and behavior; e.g., frequency and speed of movement, climbing ability, response to temperature, ability to turn over when disturbed. To that end, 35 sublegal whelks were obtained from the fishery and held in a tank in the SMAST wet lab. Staff developed a camera recording and mounting system that captured most of the tank floor on a 24-hour basis using a low-light camera. Whelk were recorded for approximately 168 hours in sum. Other activities included video management and whelk and tank maintenance. Work was expected to continue into 2020 to examine response to baits in a linear flow tank and pot exit and entrance behavior and testing possible exit shapes and locations, with the eventual goal of design and testing of a prototype modification in the laboratory and then in commercial trials.

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

Haddock separator trawls in the Georges Bank fishery take advantage of haddock being higher in the water column than Atlantic cod and flatfish. One step further is to try to capture haddock with nets and doors completely off-bottom, also reducing impacts to habitat and bottom dwelling fish. This project, funded by the NMFS Saltonstall-Kennedy Program, tests the effectiveness of two different off-bottom, mid-water trawls to target Georges Bank haddock and redfish. Staff partnered with Mark Phillips (F/V Illusion), Mike Hillers (SIMRAD), and Pingguo He (SMAST). Despite unavoidable delays to the fieldwork for this project, staff were able to make modifications as needed, obtain grant extensions and permits, and complete three sampling trips in 2019 to test the two different off-bottom trawls. Specifically, one tuning trip and two comparative testing trips were completed during 21 days at sea. These three trips required a great deal of planning, especially acquiring electronic sensors to monitor the shape of the nets and their height off bottom when fishing. Reasonable amounts of haddock and net geometry data were collected and entered into the database; data QA/QC and analysis was initiated. A final report was expected in March 2020.

Bycatch Reduction of Red Hake in the Southern New England Silver Hake Trawl Fishery

The NMFS Bycatch Reduction Engineering Program (BREP) awarded DMF this project in 2019 to test a large mesh belly panel as a bycatch reduction method for red hake in the whiting/silver hake fishery in southern New England. Red hake populations in southern New England continue to decline despite effort reduction measures. Collaborators include Pingguo He (SMAST), Danny Farnham (Gabby G Fisheries), and others. Initial stages of the project were underway at year's end.

Revision of Existing Whiting Special Access Areas

DMF has worked with the whiting (silver hake) fishing fleet since 2016 to sample their catches in hopes of supporting an earlier opening of the small-mesh exemption area off Cape Ann. During 2019, staff supported the Gloucester Fisheries Commission in successfully applying for an experimental fishing permit for July from NMFS. Our efforts included assisting with the permit application and measuring nets before fishing and were expected to continue with data analysis and report writing. Approximately 13 fishing trips on three vessels were completed under the permit. A report on the 2016–2017 experimental fishery was also published in DMF's Technical Report Series.

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

This Saltonstall-Kennedy Grant-funded cooperative research project successfully developed a trawl with a very low headline height that reduces cod catch while fishing for flatfish. Although the project is concluded, free testing of this net was made available to fishermen in the region, with different sizes available for different sizes of vessels. A scientific manuscript on this project has been accepted but not published yet. A 2019 NOAA Bycatch Reduction Engineering Project proposal to test a modification of this net was funded, to be led by the Gulf of Maine Research Institute with CE staff advising.

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

This National Fish and Wildlife Foundation funded project demonstrated that reliable detection of derelict lobster pots using side-scan sonar requires improvement of identification methods. Even with improvements, using sonar to accurately count pots may only be useful in simple seafloor types (e.g., flat, sandy). Development of a scientific manuscript continued. The project was presented at the 2019 Annual Meeting of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour.

Other Activities

Committee Work: Staff served on the ICES-FAO Working Group on Fishing Technology and Fish Behaviour, collaborated on a feature article for the ICES Newsletter on the foci of the Working Group, and participated in the annual meeting as a presenter and a co-convener. Staff also served on the NEFMC/MAFMC Northeast Trawl Advisory Panel, and as editor or advisor on four academic journals. Staff continued contributing to the Massachusetts Wind Energy Fisheries Working Group, and New York Fisheries Technical Working Group. Staff presented during the wind energy development symposium at the International Conference in Fisheries Engineering in Nagasaki, Japan, also co-convening a session on gear technology and speaking about outreach and engagement efforts with fishermen. Staff was appointed to the adjunct faculty at SMAST.

Support Activities: Staff participated on the DMF dive team, assisting on other project's field work. An informational YouTube video on whelk measurements was updated by staff. Staff collaborated with outside organizations on recycling of fishing gear.

Invertebrate Fisheries Project

American Lobster Research and Monitoring

Commercial Lobster Trap Sampling: DMF has worked cooperatively with Massachusetts commercial lobster trap fishermen to sample their catch since 1981. In 2019, the 39th year of operation, a total of 60 trips were conducted by staff members of the Invertebrate Fisheries Project (14 trips) and the Fisheries Dependent Investigations Project (46 trips), during which 31,184 lobsters were sampled from 12,379 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 conservation discards (including sublegal-sized lobsters, egg-bearing females, and v-notched females). This effort also includes shell disease monitoring, which tracks the prevalence of shell disease symptoms on lobsters in Massachusetts coastal waters (Figure 23). In 2019, a total of 5,950 lobsters were sampled for shell disease. All commercial trap sampling program data are provided annually to the ASMFC and ACCSP.

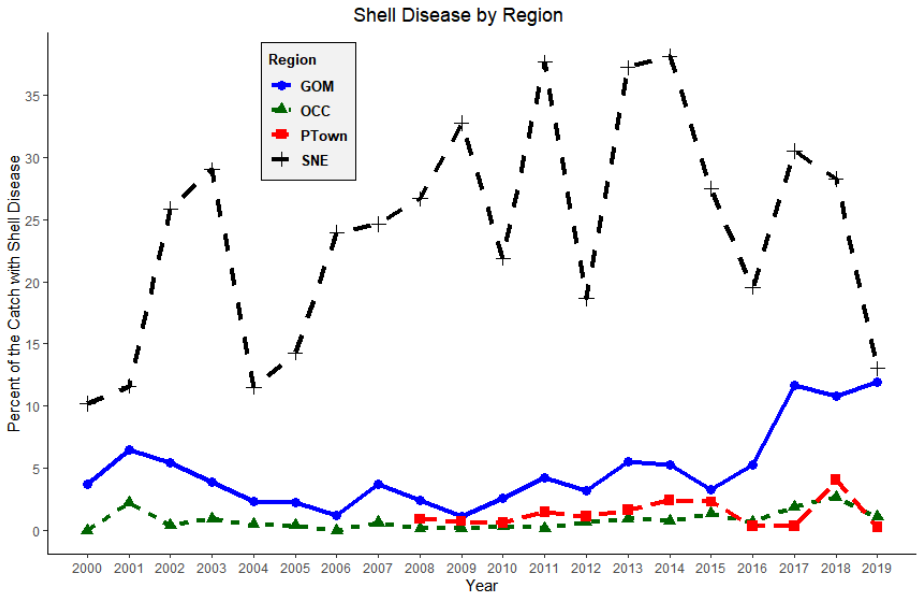


Figure 23. Percent of the observed lobster catch with shell disease during commercial trap sampling in the inshore Gulf of Maine (GOM), Outer Cape Cod (OCC), Provincetown (PTown), and nearshore Southern New England (SNE) regions.

Staff continued to conduct bycatch sampling during the commercial lobster trap sampling program to better characterize the incidental catch of several commercially important finfish species in lobster gear. 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 2019 Ventless Trap Survey took place from June through September with seven contracted vessels. Project staff completed a total of 55 sea days. This survey is a cooperative effort between DMF 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. 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 24). 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 2019 a total of 10,406 lobsters were sampled from 2,666 trap hauls in the northern survey area (MA territorial waters from Cape Cod Bay to the NH border). In the southern survey area (MA territorial waters including Buzzards Bay and south of the Elizabeth Islands), a total of 2,479 lobsters were sampled from 1,102 trap hauls.

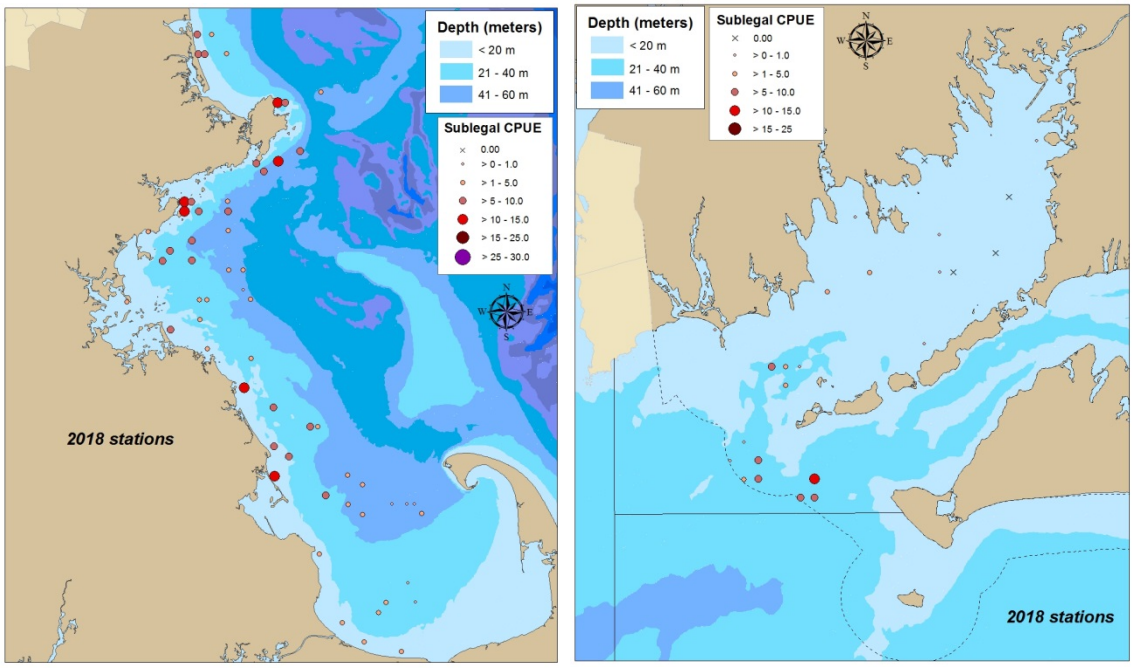


Figure 24. Average catch per trap haul (CPUE) of sublegal-sized lobsters at the 2018 ventless trap survey stations in the northern (left) and southern (right) survey areas.

Additional biological sampling of bycatch species was continued in 2019, 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.

A detailed report summarizing and interpreting ten years of the Ventless Trap Survey (2006–2016) was finalized with an anticipated publication date in the MA DMF Technical Report Series of early 2020.

Annual Early-Benthic-Phase Lobster Suction Sampling: Project staff completed the 25th year of this sampling program in 2019. The program is conducted to track year-class strength of newly settled post-larval American lobsters (Figure 25) and to delineate coastal habitat important to the settlement of these juveniles. Project staff conducted the SCUBA-based survey over seven field days in August and September, sampling 14 coastal sites spanning Cape Ann to Buzzards Bay. Suction sampling of Cape Cod Bay and Vineyard Sound was suspended in 2019 due to heightened presence of white sharks. Mean densities of YOY lobsters were above the time series mean in the South Shore region, but below the time series mean in all other regions of coastal Massachusetts (Table 21). Data from this program contribute annually to the American Lobster Settlement Index, an international research collaborative that tracks changes in the recruitment of American lobsters.

Figure 25. A young-of-the-year lobster observed by DMF biologists during lobster suction sampling in Salem Sound.

Table 21. Comparison of 2019 YOY lobster densities to time series means, by region.

Region (# years)	2019 YOY Mean (#/m^2)	Time Series Mean (#/m^2)
Cape Ann (10)	0.08	0.40
Salem Sound (24)	0.11	0.58
Boston (23)	0	0.13
South Shore (8)	0.17	0.07
Cape Cod Bay (24)	N/A	0.26
Buzzards Bay (25)	0	0.07
Vineyard Sound (9)	N/A	0.01

Assessment and Management Support: Staff served as the vice-chair for the ASMFC American Lobster Technical Committee and served on the ASMFC American Lobster Stock Assessment Subcommittee. Work focused on data contributions and analyses in support of the 2020 Benchmark Assessment. This included the processing of offshore female lobster samples to update existing size-at-maturity estimates. Staff also assisted with training and consulted on an ASMFC-supported maturity study focused on updating data for offshore SNE and the Georges Bank region.

Staff also participated on the ASMFC Lobster Bait Working Group to review and address potential biosecurity risks associated with bait use in the American lobster and Jonah crab trap fisheries. While traditional lobster trap baits such as Atlantic herring, menhaden, redfish, and skate are generally sourced locally, interest in low-cost alternatives from further abroad has increased due to changes in traditional bait availability. The working group drafted a resolution, under review by ASMFC at year's end, to mitigate the pathogenic risks associated with non-native bait types through a coordinated state and regional effort.

Staff attended the 2019 Massachusetts Lobstermen's Association Annual Weekend, which serves to build relationships with industry members and engage with them on the various research and monitoring programs we conduct. Staff gave a presentation regarding the decline of the SNE lobster stock at the ICES Shellfish Symposium Shellfish – Resources and Invaders of the North in Tromsø, Norway. Information on lobster biology and regulations was also presented to the Massachusetts Shellfish Officers Association.

A characterization of fishing activity and trap loss in the Massachusetts recreational lobster fishery was completed in 2019 and entered into the DMF Technical Report Series.

Applied Research: Work continued on 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. Working in collaboration with University of New Hampshire, Wells National Estuarine Research Reserve, and Department of Fisheries and Oceans Canada, staff applied for and received an extension in order to finalize image processing and analyses for the histological components of the study. All project participants were in the final phases of analyses and beginning report and manuscript preparation at years end. Staff served on the dissertation committee for a graduate student at UNH who incorporated a portion of this study into his successfully-defended doctoral dissertation.

Project staff continued to participate in a collaborative research project funded by NOAA's Saltonstall-Kennedy program to examine how early-stage lobster recruitment is impacted by warming ocean waters. Staff served on the thesis committee for a SMAST graduate student who successfully defended his master's thesis based on this work.

Staff successfully applied for funding from the 2019 National Sea Grant American Lobster Research Initiative to conduct a growth study on large offshore lobsters, with work scheduled to begin in January 2020.

Staff co-authored a 2019 journal article on possible consequences of skewed sex ratios in American lobster populations.

Horseshoe Crab Monitoring

Commercial Fishery Sampling: Monitoring of the commercial bait and biomedical harvests of horseshoe crab continued in accordance with the interstate FMP. DMF has collected prosomal width measurements from horseshoe crabs in bait and biomedical facilities since 2008. Widths were obtained from 1,058 crabs from the bait fishery and 1,420 crabs from the biomedical fishery in 2019. The size distributions of male crabs from both fisheries and female crabs from the biomedical fishery have been relatively consistent over the entire time series, whereas the median size of female crabs observed in the bait fishery has been decreasing slightly since 2014.

Fisheries-Independent Surveys: DMF and numerous volunteer organizations conducted spawning beach surveys at 17 beaches along the South Coast, Cape Cod, and the Islands (Figure 26). This included a new survey site that was added on Long Beach in Plymouth. Surveys were conducted at high tide two days prior, the day of, and two days after the new and full moons from mid-April through the end of June. DMF staff conducted 30 surveys at Swift's Beach in Wareham, and compiled all MA survey results for analysis.

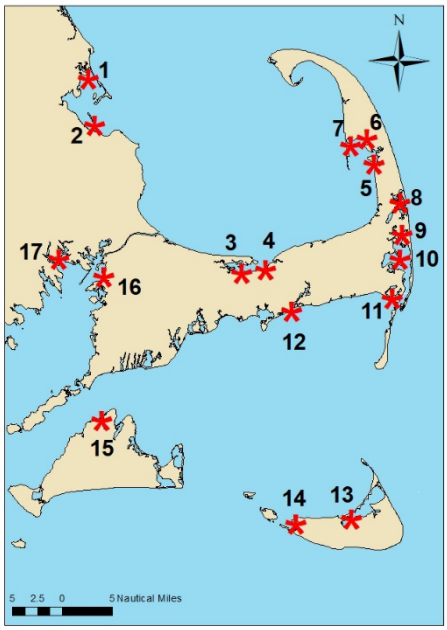


Figure 26. Map of Massachusetts horseshoe crab spawning beaches surveyed in 2019.

Assessment and Management Support: Staff served on the ASMFC Horseshoe Crab Technical Committee, contributing to the development of the 2019 Horseshoe Crab Benchmark Stock Assessment and presenting the assessment results to the MFAC. Staff hosted an annual meeting of regional horseshoe crab biologists and enthusiasts and met with the Massachusetts Shellfish Officers Association, giving presentations on the status of horseshoe crab management and assessment at both events.

Jonah Crab Research and Monitoring

Commercial Fishery Sampling: Monitoring of the commercial Jonah crab catch has been required by the ASMFC FMP since 2015. Project biologists conducted 10 port sampling trips to collect length frequency and sex ratio data from the commercial fishery in 2019. These trips sampled a total of 6,840 crabs from

NMFS statistical areas (SA) 537, 562, 525, and 526. Most crabs are harvested in SA 537, from which the average size was roughly 5.5 inches in 2019.

Assessment and Management Support: Staff served as chair of the ASMFC Jonah Crab Technical Committee, which focused on data collection for a forthcoming stock assessment, and as a member of the ASMFC Jonah Crab Plan Review Team, evaluating state compliance with FMP requirements. Staff met with the Massachusetts Shellfish Officers Association to provide information on the biology and regulation of edible crabs (Jonah, rock, and blue crabs) in Massachusetts.

Applied Research: Project staff completed a Jonah crab tagging study in 2019. Through funding provided by ASMFC and the NOAA Saltonstall-Kennedy Grant Program, DMF and industry partners tagged over 32,000 Jonah crabs with assistance from the Maine Department of Marine Resources and the New Hampshire Department of Fish & Game. Tagging efforts ended in November of 2018, though the collection of recapture information continues. Through the end of 2019, most of the 834 crabs recaptured by the end of 2019 were found less than 3 miles from their release location (Figure 27). The data generated from both funding sources was pooled into a singular final project report, and was submitted to NOAA in February of 2019, summarizing the data from January 1, 2017 through June 30, 2018.

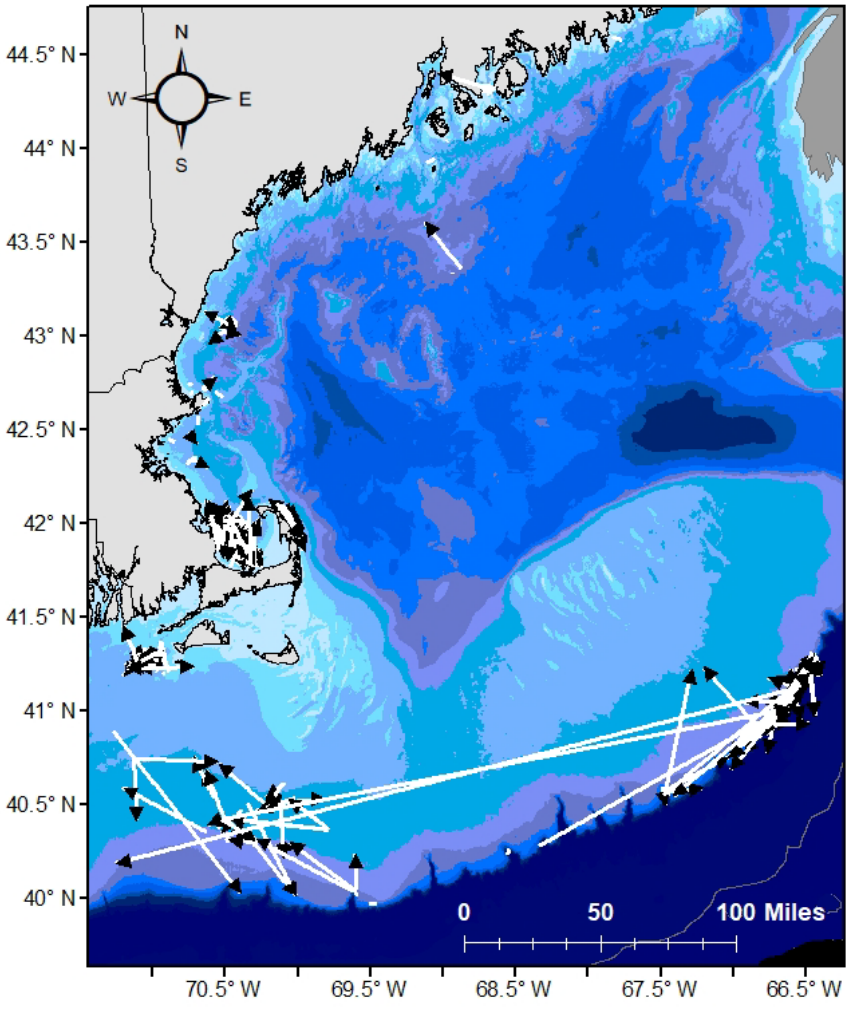


Figure 27. Map of Jonah crab movement from 834 recaptured crabs with release and recapture location information (most crabs were recaptured within a short distance of release location). White line originates at tag release location, black arrow is the recapture location.

Whelk Research and Monitoring

Commercial Fishery Sampling: Staff conducted six commercial sampling trips aboard commercial vessels fishing whelk pots in 2019, measuring over 9,500 whelks. Four trips were conducted in Nantucket Sound (two in the spring and two in the fall) and two in Buzzards Bay (one in the spring and one in the fall). Fishery-dependent sampling trips have been conducted opportunistically in Nantucket Sound and Buzzards Bay since 2003. Over this timeframe, there has been a ¼ to ⅜ inch decrease in the average size of channeled whelk observed, and fewer whelk observed above the size at which females reach maturity, despite minimum legal size increases in 2014, 2015, 2017, and 2019.

Assessment and Management Support: Staff generated updated whelk fisheries status information in support of DMF's proposed (and adopted) schedule of whelk commercial gauge increases. Information provided regarded size at maturity, life history, catch and effort trends, and fisheries independent trends. Staff also met with the Massachusetts Shellfish Officers Association to provide information on the biology, fishery, and management of whelk in Massachusetts.

Applied Research: Staff collected and processed knobbed whelk captured during DMF's spring trawl survey to further examine size-at-maturity for this species. Over 40 whelks were measured and dissected to determine maturity status. Maturity information was used to help monitor the population and provide management advice.

Northern Shrimp Research and Monitoring

Northern Shrimp Assessment Survey: In July, staff participated in the 36th annual northern shrimp assessment survey conducted offshore throughout the Gulf of Maine aboard NOAA NEFSC's R/V *Gloria Michelle*. A total of 83 out the 84 planned survey stations were completed. DMF staff processed shrimp samples from the For the eighth consecutive year, the survey indicated an exceptionally low abundance and biomass of northern shrimp and poor recruitment of the newest year class.

Assessment and Management Support: Staff served on the ASMFC Northern Shrimp Technical Committee to prepare the 2019 Gulf of Maine Northern Shrimp Stock Assessment Update Report. In response to the continued depleted condition of the resource, the ASMFC Northern Shrimp Section maintained the three-year harvest moratorium on commercial fishing set through 2021.

Staff served on the ASMFC Northern Shrimp Summer Survey Work Group to review and improve operational aspects of the assessment survey. Work Group findings were presented to the ASMFC Northern Shrimp Section in the fall.

Green Crab

In 2019, DMF staff administered a program to remove invasive European green crabs from the Great Marsh, a large stretch of salt marsh located along the North Shore of Massachusetts. This program was developed in 2014 to address local concern that fisheries resources were being threatened due to recent expansions of the green crab population. Green crabs are known predators of soft shell clams and other shellfish, and can also degrade habitats such as eelgrass beds and salt marsh due to extensive burrowing activity (Figure 28). To reduce green crab numbers, North Shore municipalities were offered reimbursement for the

Figure 28. Green crab observed by staff surveying eelgrass in Salem Sound.

removal of green crabs from estuaries and nearshore shallow waters. In 2019, the Towns of Essex, Ipswich, and Newbury, and the City of Gloucester participated in the depletion program. Fishermen trapped over 130,000 pounds of green crabs. Around 75% of the green crabs collected through this program were sold to seafood dealers (primarily as bait); the remaining crabs were composted locally.

Other Activities

Cape Cod Bay Mortality Event: In late September, Project staff responded to reports of dead lobsters and finfish observed in lobster traps in southern Cape Cod Bay and conducted an extensive investigation into the causes behind these deaths. With assistance from the Center for Coastal Studies, water quality sampling was conducted, which enabled staff to determine that the southern portion of Cape Cod Bay had experienced a severe hypoxic event, with those animals caught in traps and unable to move away succumbing to the extremely low dissolved oxygen. A complete report of the investigation and findings was prepared and shared with the Massachusetts Lobstermen's Association, and a presentation of the findings was given to affected fishers. Plans were underway at year's end to increase monitoring resolution and the Division's ability to detect deteriorating conditions in the future.

Enforcement: Staff responded to two enforcement cases of suspected egg removal from female lobsters. Staff collected and analyzed pleopods and other details from the female lobsters, providing detailed reports to the arresting officers. As a result of these cases, it was decided to re-examine the technique for detecting bleached egg-bearing females. Staff members conducted a small study to determine the length of time over which it was possible to detect whether an egg-bearing lobster had had its eggs removed chemically (via bleach). Staff also started work with MA Environmental Police to schedule training opportunities for officers on how to identify potential cases of mechanical or chemical egg removal.

Wind Energy Development: Staff contributed to DMF's review of regional offshore wind energy development plans and provided comments on invertebrate fishery resources in and around project and lease areas. Staff reviewed fisheries monitoring plans and contributed to the formulation of internal guidance documents on fisheries' research priorities relevant to offshore wind development in and around Massachusetts.

Other: Staff acted as a reviewer for three peer-reviewed journals.

Protected Species Project

Cape Cod Bay Right Whale Surveillance Program

In 2019, DMF partnered with the Provincetown Center for Coastal Studies (PCCS) and NOAA Fisheries to carry out the 21st 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.

Although the North Atlantic right whale population has been in decline since 2010, the proportion of the population that visits Cape Cod Bay continues to be high. This trend of high abundance continued in 2019, with at least 65% (n=270) of the known right whale population being documented in Cape Cod Bay and adjacent waters (Figure 29). This is the second-highest abundance observed in the study's history, surpassed only by 2011 (66%). The prevalence of right whale surface feeding behavior was less than previous years, owing to lower *Calanus* (copepods) abundance and limited vertical rise of other species in the water column. Peak right whale abundance occurred in mid-April, although

aggregations continued to be observed into May. For this reason, DMF extended the fixed gear closure and vessel speed limit until May 9 when right whales finally left the Bay.

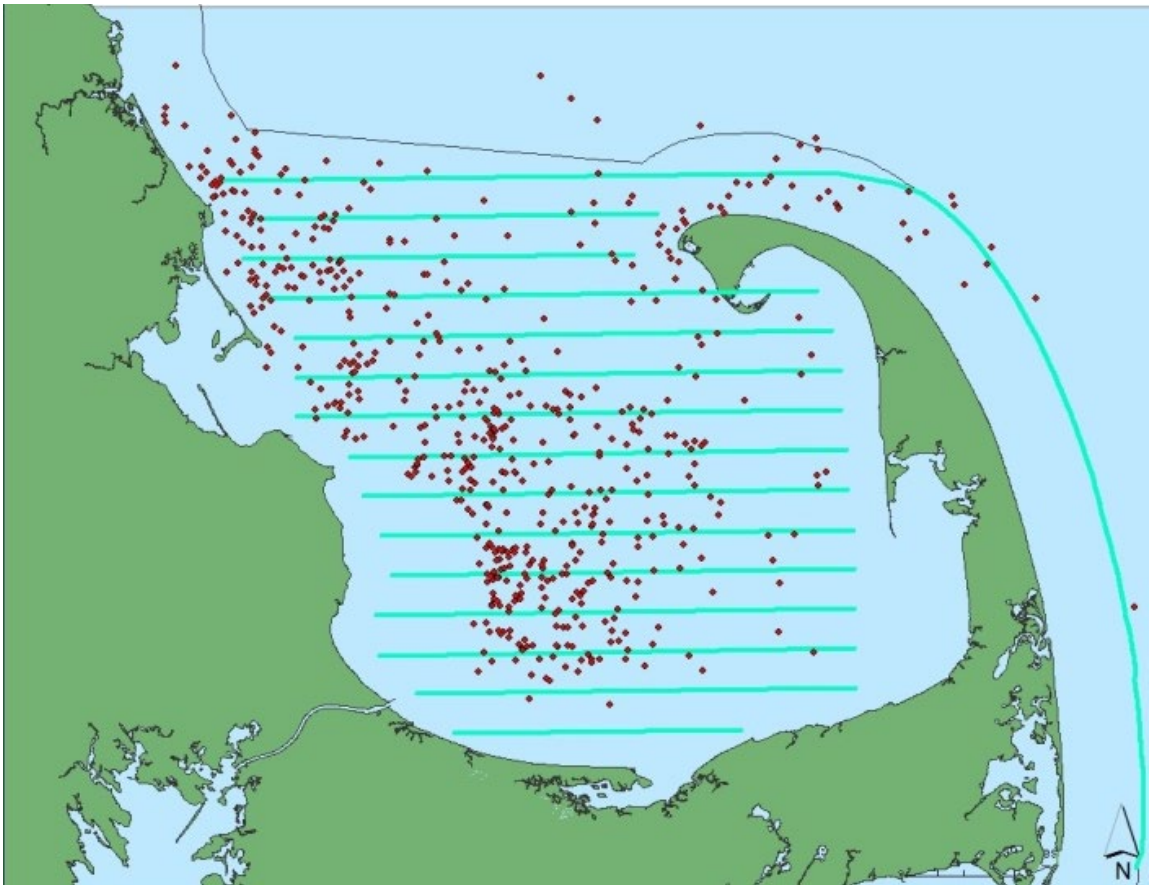


Figure 29. Map of PCCS 2019 right whale aerial sightings with aerial survey tack lines depicted.

The Right Whale Unusual Mortality Event continued in 2019 with 9 moralities observed in Canadian waters and one in US waters. Seven calves were born in 2019, compared to zero in 2018. However, the high levels of mortality and low reproductive rates are unsustainable for the population. The high abundance of right whales visiting Cape Cod Bay demonstrates how critical Massachusetts waters are to the North Atlantic population and the importance of protecting them.

Project staff administered the grants from NOAA Fisheries and the Massachusetts Environmental Trust that supports aerial surveillance and habitat monitoring and assisted in the coordination of large whale conservation activities. In 2019, project staff worked with the lobster fishing industry and NOAA Fisheries to develop a suite of new conservation measures to achieve a 60% reduction in entanglement risk of right whales in the Massachusetts lobster fishery. This new plan was expected to be finalized and submitted to NOAA Fisheries in early 2020 to amend the Atlantic Large Whale Take Reduction Plan beginning in 2021.

Large Whale and Sea Turtle Disentanglement

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

Of the 33 whale entanglement cases documented in 2019 along the United States and Canadian coasts, 23 of those were observed off the coast of Massachusetts: three right whale, 14 humpback whales, and six minke whales. Four humpback whales were disentangled, along with six minke whales, and one right whale was partially disentangled. The location of the entangled whale is not necessarily the site of the encounter with the gear.

In 2019, there were 15 confirmed leatherback sea turtle entanglement cases, which is consistent with the past season averages. Eleven of these cases were disentangled by network members. The remaining cases were either discovered as carcasses or could not be relocated by network members.

Other Activities

Staff participated as a member of the Massachusetts Habitat Working Groupon on Offshore Wind Energy, continuing to advise EOEEA, BOEM, and MassCEC on the potential impact of wind energy development on whales, marine turtles, and other potential protected species.

Staff also participated in various working groups and meetings related to the potential development and operation of rope-less fishing methods in the US and Canadian trap/pot fisheries. Through these efforts, DMF continued to work closely with federal regulators, scientists, and fishermen to evaluate the risks and potential of rope-less systems.

Resource Assessment Project

2019 Trawl Survey

The 42nd annual spring and fall surveys were accomplished aboard NOAA's R/V Gloria Michelle. The spring survey completed 102 stations from May 6–23; the fall survey completed 90 stations from September 3–25 (Figure 30).

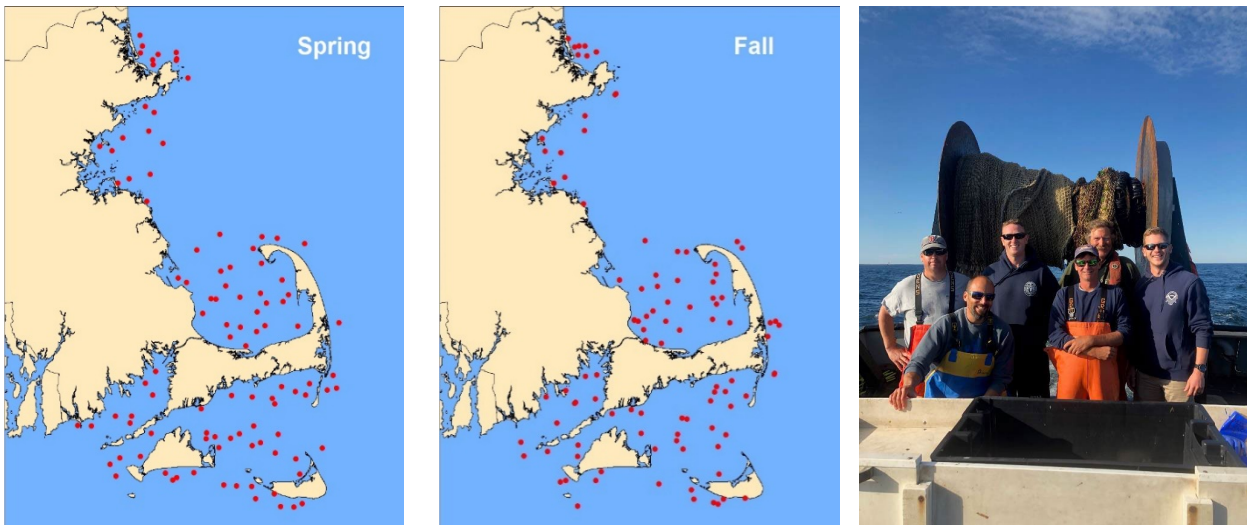


Figure 30. 2019 spring and fall trawl survey station locations, and a typical crew.

The 2019 trawl surveys provided weights, counts, and measurements for 100 different species of fish and invertebrates. To aid cooperative fisheries assessments, survey crew collected over 1,740 age structures and sex and maturity observations from cod, haddock, summer flounder, yellowtail flounder, winter flounder, black sea bass, scup, tautog, 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, age and growth of tautog and black sea bass, longfin squid genetics, and the Ocean Genome Project.

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

2019 Seine Survey

The 44th Nantucket Sound Estuarine Winter Flounder Young-of-Year (YOY) Seine Survey was completed from June 24–July 11. This survey provides an index of abundance for YOY winter flounder in the Southern New England/Mid-Atlantic stock. Additionally, we count all commercially and recreationally important finfish and invertebrates, and record presence/absence for all other species. Forty-five species occurred in 2019 seine survey hauls. The 2019 stratified mean index for YOY winter flounder abundance increased slightly. While three of the last ten years are above the time series median, the overall trend is one of decline for the Southern New England winter flounder stock since the survey's inception.

Groundfish Assessment and Management Support

Staff served as an active member on the NEFMC Groundfish Plan Development Team, providing analysis for assessment and management support during the development of Framework 59 and the continued development of Amendment 23. In addition, staff served as a member on the NEFMC Monkfish Plan Development Team and NEFSC Atlantic Cod Stock Structure Working Group. Staff participated in the NEFSC operational assessment updates for 14 groundfish stocks in the fall of 2019, and the Transboundary Resource Assessment Committee stock assessments for Eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder in the summer of 2019. Staff served as a member of the ASMFC Winter Flounder Technical Committee.

Staff collaborated with researchers from the University of Massachusetts Dartmouth, Woods Hole Oceanographic Institution, the Northeast Fisheries Science Center, Rutgers University, and The Nature Conservancy to initiate a multi-year study to better understand the distribution and timing of cod spawning in Southern New England. Outcomes from the multidisciplinary research will be a characterization of spawning dynamics and thermal habitats of cod in Southern New England, and assessment of their connectivity with other cod populations. The anticipated benefits include an understanding of seasonal habitat usage to help evaluate the potential impacts of offshore wind development.

Staff collaborated with researchers at the Northeast Fisheries Science Center to solicit fishermen's ecological knowledge related to changes in the distribution and migration of flatfish in New England. Staff utilized four decades of data from fisheries-independent trawl surveys to evaluate long-term changes in the growth and maturation of yellowtail flounder in the Gulf of Maine, culminating in a manuscript submitted for publication in 2020. Staff also collaborated with researchers from the University of Massachusetts Dartmouth and the Maine Department of Marine Resources to help develop a standardized catch-per-unit-effort time series for Atlantic halibut in the Gulf of Maine.

Staff served as an adjunct faculty member at the University of Massachusetts Dartmouth, co-teaching a class entitled “Field Methods for Fisheries Research”. Staff also served as the New England District Director for the American Institute of Fisheries Research Biologists.

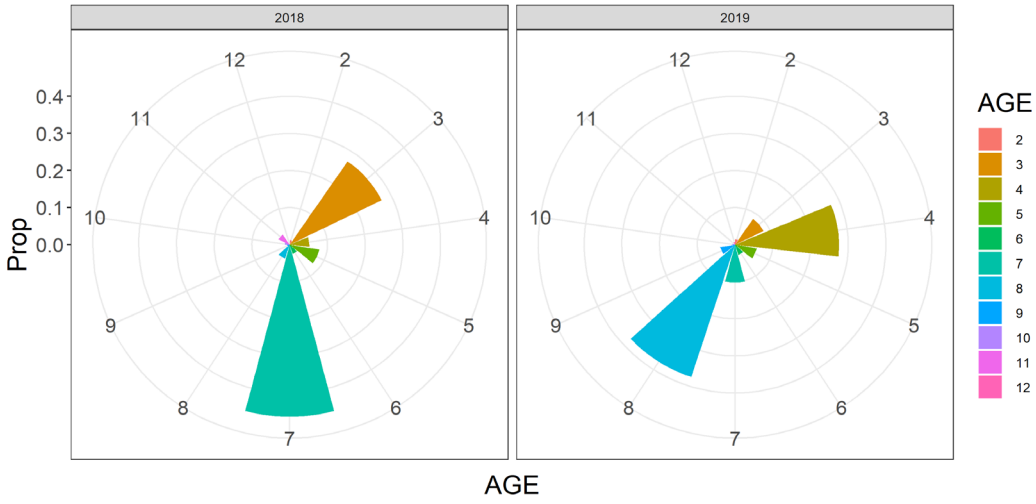
Recreational Fish Assessment and Management Support

2019 marked a year of transition in Recreational Fish Assessment and Management Support, with the departure of staff in March and subsequent onboarding of new staff in September. The position will continue to represent DMF on ASMFC technical committees for black sea bass, fluke, scup, tautog, and bluefish.

Figure 31. DMF’s Dr. Sam Truesdell with a tautog sampled during the 2019 spawning season.

Despite the gap in dedicated staff, DMF continued its focus on black sea bass research to better characterize spawning behavior and habitat use during the spawning season. We conducted 13 directed rod and reel sampling trips between May 23–August 28 (Figure 31). In addition to collecting length data on every captured fish, a sample was sacrificed on each trip to determine sex, maturity stage, and to remove otoliths for aging analysis by the DMF age and growth lab. Age analysis revealed that the majority of fish available in 2019 were still from the very strong 2011 year class and the moderately strong 2015 year-class (Figure 32). In both 2018 and 2019, the 2011 and 2015 year-classes supported the majority of the catch in the recreational fishery. All other year classes detectable by this survey (2007 through 2016) contributed very little to the total catch. This suggests that black sea bass abundance could be prone to moderate to substantial annual shifts related to year-class strength. DMF will continue to monitor population characteristics of black sea bass in our waters to help insure robust management of this valuable resource.

Figure 32. Proportion of observed ages from the 2018 and 2019 spawning grounds sampling of black sea bass. These data revealed that the age composition in both 2018 and 2019 were consistently dominated by the age classes born in 2011 and 2015.



Recreational and Diadromous Fisheries Program

Personnel

Dr. Gregory Skomal, Program Manager

Recreational Fisheries Project
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

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, Fishway Crew
James Rossignol, Fishway Crew

Overview

The Recreational and Diadromous Fisheries Program includes three Projects.

The **Recreational Fisheries Project** works to preserve, enhance, and promote the Commonwealth's marine recreational fisheries. The goals of the Project 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 on 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; promote and enhance recreational fishing access through the purchase and maintenance of access sites, much of which is funded by recreational fishing permit sales; and disseminate information on all aspects of recreational species and fisheries to the public.

The **Large Pelagics Research Project** conducts research 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; participate in the state, regional, federal, and international management processes; and 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 DMF staff, state and federal agencies, municipalities, and private groups to facilitate, design, and execute restoration projects to

enhance 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, harvest, and restoration potential. The 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

Since 1983, recreational fisheries catch and effort data have been collected along the Atlantic Coast through NOAA Fisheries' Marine Recreational Information Program (MRIP). DMF 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 2019, DMF 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 (ACCSP administers the program for NOAA Fisheries). During 2019, 60 headboat sea sampling trips were completed for a total of 1,229 angler intercepts. For shore-side sampling, our MRIP field interviewers completed 1,140 assignments for a total of 5,375 angler intercepts: 3,651 from private vessels, 849 from charter vessels, and 875 from shore anglers.

DMF recognizes the social, economic, and cultural importance of recreational fishing to members of our Commonwealth. MRIP is vitally important to both fisheries scientists and managers who use the information to assess how catch levels affect fish population size and to develop measures for sustainable recreational fisheries.

Recreational Fishing Derby

Project staff administered the state's Saltwater Fishing Derby. Formally known as the Governor's Cup and hosted by the Division of Tourism, the derby was moved to DMF in 1983. In 2019, there were more than 150 entries in the derby, including 43 winners with two Skillful Skippers and two Anglers of the Year. No new state records were set. Other activities in 2019 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. 2019 Derby winners were recognized with awards at the annual New England Boat Show in February of 2020 (Figure 33).

Figure 33. DMF's Dan McKiernan and Mike Armstrong, along with DFG Commissioner Amidon, recognize John Clark for his Junior Angler of the Year achievement.

Public Access

The Public Access Coordinator position, which is funded from the Marine Recreational Fisheries Development Fund, manages all DMF 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 projects that will enhance 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.

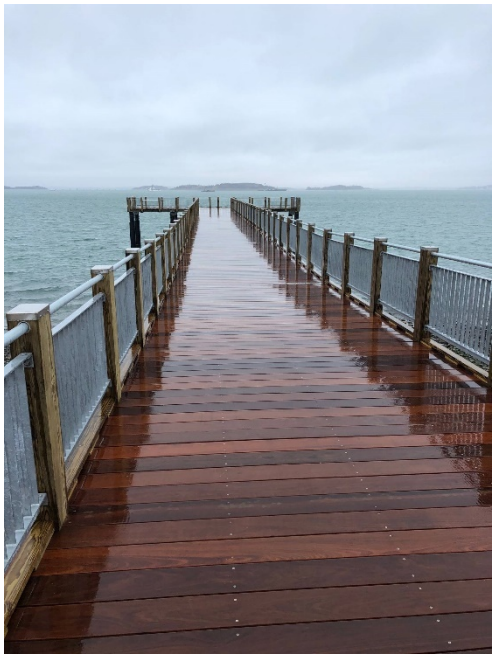


Figure 34. The Deer Island public access fishing pier.

In 2019, DMF worked with OFBA to build a fishing pier on Boston Harbor's Deer Island (Figure 34). This project, initiated in 2012, was expected to be open for use in 2020. DMF also completed another year of the small grants program providing $50,000 to assist municipalities with projects that promote or support local recreational fishing activities and access. In 2019, three projects were approved for funding: the addition of lighting and security cameras at the famed Sandwich boardwalk in Sandwich; two cartop (canoe and kayak) launches at The Buzzards Bay Coalition's Weweantic River Reserve at Horseshoe Mill Pond in Wareham; and a digital pay kiosk at Fall River's Bicentennial Park Boat Launch.

At the DMF 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. Every year, DMF staff works closely with official plover monitors 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.

In addition, staff continued to collaborate 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

During 2019, staff worked with various entities to develop proposals for public access sites; responded to numerous inquiries from user groups and private individuals regarding shore-side fishing sites, public access rights, and future access projects; and represented the agency at multiple fishing and boating trade shows.

Outreach

Figure 35. The cover of the 2019 sportfishing guide.

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 35) 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, important recreational fishing news was distributed to recreational permit holders through an email alert referred to as *The Broadcast*.

Large Pelagics Research Project

Shark Research

DMF 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 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.

White Sharks: The aggregation of white sharks off the coast of Massachusetts is one of only a handful of "hotspots" in the world and unique along the east coast of the US. As such, the state of Massachusetts, and in particular, the towns on Cape Cod are faced with a growing potential for negative interactions between this species and people utilizing our coastal waters. As a result, DMF staff intensified their research on the fine-scale predatory behavior of white sharks off the coast of Massachusetts using a variety of methods. First, the existing acoustic receiver array was expanded to fill gaps around Cape Cod and to include the majority of towns along the Massachusetts coastline. Second, tagging efforts were expanded into Cape Cod Bay, where four sharks were acoustically tagged in 2019. Third, a gridded acoustic array was deployed off Head of the Meadow Beach (Truro) with the Center for Coastal Studies to examine fine-scale movements of sharks as they relate to the habitat. Fourth, real-time acoustic receiver technology was tested off Newcomb Hollow Beach (Wellfleet) and Head of the Meadow Beach. The receivers provided beach managers and lifeguards with immediate notifications when acoustically-tagged white sharks were detected close to these beaches. Fifth, acceleration data logging tags (ADLs) were deployed on white sharks to record very fine-scale movements at sub-

second intervals, including tailbeat frequency, amplitude, body posture, and swimming depth. These data will be used to examine swimming patterns (e.g., traveling, resting, hunting, foraging, mating), bioenergetics, and, ultimately, provide estimates of the intensity of white shark predation on gray seals.

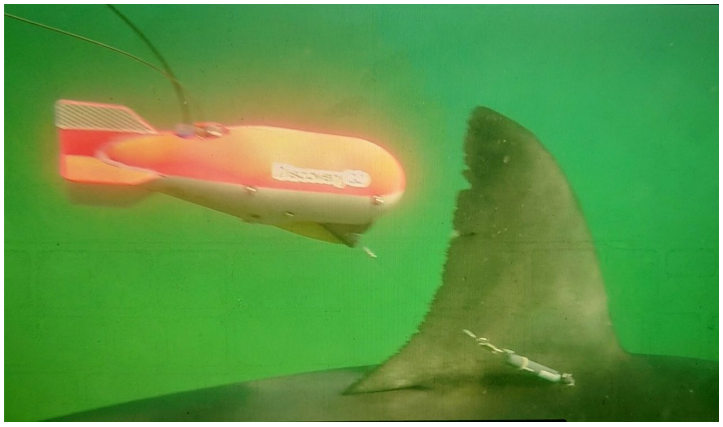


Figure 36. A white shark carries an acoustic tag (grey) and an Acceleration Data Logger (orange).

As a result, 50 white sharks were tagged with acoustic transmitters off the Outer Cape (46) and in Cape Cod Bay (4) in 2019; six of these also carried acceleration data logging tags for up to two days (Figure 36). This brings the total to 203 individuals tagged since 2009. These efforts were conducted with funding and logistical support from local nonprofits, including the Atlantic White Shark Conservancy. Data collected in 2019 will be used to better understand the behavior of white sharks in these areas of high shark-human overlap to better inform public safety practices.

Shark Management: Staff participated in the development and the amendment of state, interstate, federal, and international shark management plans. During 2019, staff served on the following committees: ASMFC Coastal Sharks Technical Committee and 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, staff co-advised and served on the committees of nine graduate students who are working with DMF to study the relative abundance, life history, movements, and physiology of sharks.

Publications: Staff co-authored six articles published in scholarly journals in 2019. Topics included: advancing research for the management of long-lived Greenland sharks; assimilating electronic tagging, oceanographic modeling, and fisheries data to estimate movements and connectivity of swordfish in the North Atlantic; the use of mesoscale eddies by pelagic sharks for foraging; a global spatial risk assessment of sharks under the footprint of fisheries; the multi-method assessment of whale shark residency, distribution, and dispersal behavior in the Red Sea; and white shark use of Gray's Reef National Marine Sanctuary.

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 wildlife and were formerly important for traditional small-scale fisheries in coastal towns. DMF is responsible for the management of diadromous fish populations in coastal rivers of Massachusetts, and 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, DMF has increased monitoring efforts over the past decade to meet management goals. Current monitoring coverage includes at least one station targeting spawning run counts and biological data for each of the major coastal drainage areas. Additionally, DMF and local partners now use electronic or video technologies to record spawning run counts at 22 river systems (Table 22).

Table 22. River herring monitoring sites where biological samples and/or census counts are collected.

River	Biological	Counts
Merrimack River, Lawrence	Yes	Fish Lift
Concord River, North Billerica	No	Video
Parker River, Newbury	Yes	Video
Essex River, Essex	No	Electronic
Mystic River, Medford	Yes	Video
Aberjona River, Winchester	No	Video
Back River, Weymouth	Yes	Electronic
Herring Brook, Pembroke	No	Electronic
Town Brook, Plymouth	Yes	Video
Town River, West Bridgewater	No	Electronic
Nemasket River, Middleboro	Yes	Visual *(Volunteer)*
Sippican River, Rochester	No	Electronic
Mattapoisett River, Mattapoisett	No	Electronic
Acushnet River, Acushnet	No	Electronic
Agawam River, Wareham	No	Electronic
Wankinco River, Wareham	No	Electronic
Monument River, Bournedale	Yes	Electronic
Mill Creek, Sandwich	No	Electronic
Cedar Lake, Falmouth	No	Electronic
Stony Brook, Brewster	No	Electronic
Herring River, Harwich	Yes	Electronic
Pilgrim Lake, Orleans	No	Electronic *(new)*
Herring Creek, Aquinnah	No	Video

In 2019, river herring counts ranged from 7,924 fish in the Town River, West Bridgewater to 1,223,263 in the Herring River, Harwich. River herring counts showed increases at most herring runs in 2019. Substantial improvements in run counts occurred at a few locations with recent restoration activity: Mystic River, Medford; Herring Brook, Pembroke; Herring River, Harwich; and Town Brook, Plymouth.

Project staff also provided technical assistance to local groups conducting volunteer visual counts at herring runs. In 2019, a total of 47 rivers in 35 towns were monitored in Massachusetts. Many of these local groups participate in the MA River Herring Network. At the Network's annual meeting, DMF staff presented information about management updates, population status, and the potential accuracy of different counting methods and technologies.

Propagation

DMF 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. Approximately 2,000 pre-spawning adult river herring were trapped and transported in 2019 via our stocking truck (Table 23). In cooperative efforts, an additional 2,000 river herring were collected from two Massachusetts donor systems and released into Rhode Island rivers, and large numbers of river herring were distributed within the Merrimack River watershed.

In 2019, DMF continued efforts to restore American shad to Massachusetts watersheds in conjunction with USFWS. Approximately 323,000 young-of-year shad from the USFWS Nashua hatchery were hatched from Merrimack River broodstock and released into the Nashua River. Approximately 271,000 young-of-year shad were released into the Merrimack River.

Table 23. River herring stocking results for 2019.

Donor System	Recipient System	Adults (#)
Parker River	Pentucket Pond, Parker River, Georgetown, MA	356
	Ipswich River	250
Nemasket River	Ten Mile River, Turner Reservoir, East Providence, RI	1,000
	Kickemuit Reservoir, Warren, RI	1,000
Nemasket River	Three Mile River, Dighton	500
Monument River	Mill Pond, Boat Cove Creek, Barnstable	750
Merrimack River	Sudbury River, MA	2,150
	Merrimack River, NH	990
	Nashua River, NH	2,465
	Nissitissit River, NH	2,965
	Winnipesaukee River, NH	16,475
	Cohas Brook, NH	1,550

Technical Assistance

Project staff provided technical assistance to local authorities, private organizations, the DMF Habitat Program on environmental permit review, 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 required a sustained effort in 2019 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. Efforts on field assessments were reduced in 2019 in order to focus on an update of the project's quality assurance program plan (QAPP). The QAPP update, after review and approval by MassDEP, was submitted to the DMF Technical Report Series for publication. One assessment was initiated in 2019 at the New Bedford Reservoir (Acushnet River). Habitat assessment datafiles were finalized for James Pond, West Tisbury; Grassy Pond, Harwich; and Lovells Pond, Barnstable; and documented with summary reports.

Diadromous Fish Restoration Priority List/*Mass*DOT Diadromous Fish GIS Datalayer: Ongoing efforts continued to update a GIS datalayer 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 over 450 fishways, impediments, and potential restoration sites, ranked by restoration potential within the four major coastal regions of Massachusetts. The GIS datalayer was designed to support transportation infrastructure planning and environmental review activities conducted by *Mass*DOT and DMF, and DMF and MassDEP restoration planning. Efforts began in 2019 on the fourth update to revise the datafile that supports DMF's recommendations on construction time-of-year impacts to diadromous and marine resources.

Mystic River Video and Counting: Project staff continued to provide technical assistance to the Mystic River Watershed Association on a web-based counting program for fish passage at the Mystic Lakes Dam. Staff installed the physical counting structure and assisted with videography and system maintenance to ensure footage was of suitable quality.

Concord River Video and Counting: Project staff continued to provide technical assistance to the Lowell Parks and Conservation Trust on a video counting program for fish passage at the Centennial Dam on the Concord River in North Billerica. Staff installed the physical counting structure and assisted with videography and system maintenance to ensure footage was of suitable quality. This counter has confirmed that river herring ascend the ladder at Centennial Dam, highlighting the need for restoration efforts at Talbot Mills Dam.

Diadromous Fish Research Studies

Blueback Herring Tagging, Mystic River (Medford): In 2019, project biologists collaborated with MIT researchers to pilot a habitat use project in the Mystic River watershed by spawning river herring. DMF trapped 30 blueback herring at the Mystic Lake Dam fish ladder and implanted acoustic tags. Fish were released above the dam in Upper Mystic Lake. Acoustic receivers were placed throughout the watershed to monitor tagged fish spawning activity and emigration.

River Herring Tagging, Mill River (Taunton): Project staff monitored migrations of multiple diadromous species at the Lake Sabbatia dam and fishway, as part of a cooperative restoration effort in the Mill River watershed. An underwater video camera at the top of the fishway records fish passage, a trap at the top of the eel ramp is checked daily from spring through summer, and in 2019, a pilot season of passive integrated technology (PIT) tagging was conducted on river herring. Antennas to detect PIT tags were placed at all outlets to the lake to detect tagged river herring and American eels. The eel population in the lake is surveyed annually in the summer using eel traps to estimate the number of eels, while PIT tags are used to identify individuals and track growth over time.

American Shad Monitoring

Charles River Monitoring: In 2019, project staff worked with colleagues at USFWS to collect adult American shad from the Charles River to characterize the population and identify fish marked with oxytetracycline (OTC) in year-specific patterns. These marks will help validate otolith ageing for American shad and provide important information for coast-wide population assessments.

Merrimack River Monitoring: American shad are monitored in cooperation with *MassWildlife* each spring/summer at the Essex Dam fish lift on the Merrimack River in Lawrence, per ASMFC's Fishery Management Plan requirements. The count of American shad in 2019 decreased in comparison to 2018. Striped bass, river herring, and sea lamprey were also lifted above the Essex Dam in 2019.

American Shad Electrofishing Survey: In the spring of 2019, project staff completed the fourth season of a pilot study to monitor the presence and abundance of American shad in the South River in Marshfield, and Indianhead River in Scituate. Monitoring was conducted in each river from the head of tide to the first obstruction using stream electroshocking surveys to detect the presence of spawning adult shad. During 19 sampling trips in the South River and 18 sampling trips in the Indianhead River between April and June, 85 and 124 shad were captured, respectively, for size, age, and genetic sampling. Scale-based aging indicated that these shad ranged from 3–9 years with some fish having spawned up to four times previously. Catch-per-unit-effort indices of abundance were calculated for each river. Monitoring is expected to continue in 2020 with interest to develop biological and catch-per-unit-effort indices of population abundance.

American Eel Young-of-the-Year Monitoring

All U.S. east coast states conduct standardized monitoring of YOY American eels under mandatory ASMFC protocols. DMF has monitored the spring migration of YOY eels in the Jones River (Kingston) using a Sheldon trap since 2001 and in the Essex River (Essex) with a fyke net since 2014 to contribute to a coast-wide index of eel population relative abundance. The Jones River trap catch in 2019 declined to 34 eels per haul, the lowest catch per haul in the 19-year time series. The Essex River eel fyke net repeated the high catches of 2018 in 2019 with 444 eels per haul.

Project staff has fabricated and installed 11 eel ramps in coastal rivers since 2007 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. The eel ramp at the Wankinco River in Wareham repeated the high catches seen in 2018, and a new eel ramp at the Jenney Grist Mill Dam on Town Brook, Plymouth, also had high catches in 2019. The two recent YOY catches at Wareham, and the 2019 catch in Plymouth are the highest recorded during 13 years of DMF eel ramp monitoring.

Rainbow Smelt Population and Habitat Monitoring

Rainbow smelt population declines since the 1980s prompted DMF 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 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 recent trend of higher than average smelt catches in the Fore River continued in 2019. The Weweantic River and the Parker River continued to have catches that depict very low spawning run populations. Collectively, the fyke nets have caught over 40 species of fish, including 10 species of diadromous fish, with potential indices of abundance for eel, white perch, and tomcod.

Fish Passage and Habitat Restoration Projects

Numerous projects to improve and maintain diadromous fish passage, habitats, and populations are conducted each year. In 2019, project staff devoted time to approximately 25 individual projects in various stages of development and implementation. The following list includes completed projects and larger ongoing projects of regional significance. Project highlights for 2019 include the completion of a new fishway at the Draka Dam on the Three Mile River in Taunton, a new fish ladder at Forge Pond Dam on the Jones River in Kingston, and fish passage improvements made by the DMF Fishway Crew at the historic Herring Brook Park in Pembroke.

Figure 37. Completed fishway at the Draka Dam, Three Mile River, Taunton.

Three Mile River, Taunton: The project to construct a fishway at the impassable Draka Dam on the Three Mile River was completed in 2019 (Figure 37), with a large effort of staff time to manage the construction contract with SumCo Ecoengineering and to monitor construction activity during October and November. The project provides fish passage at the Draka Dam for the first time in over a century and access for migratory fish to the 45-acre impoundment above the dam and for several miles of the Three Mile River. The fishway design process originated in 1997 and depended on cooperative efforts from property owners and partners to bring the project to successful completion in 2019.

Herring Brook Park, Pembroke: The DMF Fishway Crew worked cooperatively with the Town of Pembroke to rehabilitate a fishway at the historic Herring Brook Park (Figure 38). The location has been known for several decades to impede river herring passage due to the elevation change at a former mill structure that includes irregular channel substrate and degraded channel walls that caused annual fish mortality, as well as impeding the path for some fish attempting to pass. The crew worked closely with the Town of Pembroke Herring Fisheries Commission to repair the channel walls and install four in-stream weirs with granite blocks, install a concrete weir to manage fishway flows, and flows to a water wheel, and repair components of the mill race culvert. Our crew put in nine weeks of hard labor, crafting an improved fishway that is integrated with the historic look of the park. This site should be appreciated by the public, and possibly migrating fish, for many years.

Figure 38. Fishway rehabilitation at Herring Brook Park, Pembroke.

Forge Pond Dam, Kingston: Several years of discussions with the City of Brockton and the owner of the Forge Pond Dam on the Jones River in Kingston concluded with the DMF Fishway Crew fabricating and installing a custom, wood fish ladder at the dam in March 2019 (Figure 39). A fishway design was prepared by project staff and reviewed by the City of Brockton, resulting in a Memorandum of Understanding between Brockton and DMF. The fishway at the impassible dam provided passage for migratory fish for the first time in over a century from the Jones River to Silver Lake.

Figure 39. DMF Fishway Crew at Forge Pond Dam, Jones River, Kingston.

Fore River Watershed: Efforts continued on a multi-site project to restore diadromous fish to the Fore River Watershed in the Boston Harbor region. The project partners, led by the MA DFG Division of Ecological Restoration, secured funding and contracted an engineering firm to complete design and permitting for the Armstrong Dam removal and Natural Falls fish passage improvements, due to be prepared in 2020. Specific to the Natural Falls component, project staff submitted a grant proposal to fund construction to the In-Lieu-Fee Program, and DMF funded a USFWS Fish Passage Engineering Team review of the Natural Falls design.

Smelt Brook, Weymouth: A project to daylight a 150-foot section of an underground culvert that conveyed Smelt Brook flows in Weymouth Landing was completed in 2019. The project originated from Greenbush Train Line mitigation requirements nearly 25 years ago. The Town of Weymouth led the effort to revisit the project with funding secured for design and construction. The design included hydraulic modeling to create spawning riffles and resting pools that align with rainbow smelt spawning requirements. Project staff conducted weekly monitoring of the new spawning channel in the spring of 2019 and documented smelt egg deposition.

Horn Pond, Woburn: Recent efforts by DMF and local partners resulted in river herring entering Horn Pond in the Mystic River Watershed for the first time in over a century in 2017. This work continued in 2019 as project staff worked with the Mystic River Watershed Association and Town of Woburn to manage flows and fish passage at the Scalley Dam. The modified spillway passed about 10,000 adult river herring, thereby granting spawning fish access to more than 100 acres of habitat. Research by UMass Amherst documented successful spawning and juvenile growth within Horn Pond. Planning continued in 2019 through environmental mitigation processes to create a nature-like fishway to further improve passage at this site.

Town River, Bridgewater: DMF is partner to cooperative efforts to improve fish passage in the Town River tributary to the Taunton River. In 2019, progress on project design to remove the High Street Dam continued. Project staff is also working with the Town of West Bridgewater to conduct a feasibility study for redesigning the antiquated fish ladder at the next dam upstream at War Memorial Park.

Parker River, Newbury: The DMF Fishway Crew repaired several fishway weirs and wall sections in the Woolen Dam fishway on the Parker River in Newbury. Concrete forms were set up and poured during August. This work was part of an ongoing effort to improve fish passage at this

location and others in the Parker River watershed in recent years. Site monitoring has shown steady improvements in the counts of spawning river herring in response to this work.

Ipswich River, Ipswich: Efforts to improve fish passage at the Willowdale Dam on the Ipswich River continued. Funding was secured through the MA DFG In-Lieu-Fee Program, and designs for the new fishway and modifications to the old fishway for maximized eel passage were finalized. Construction was slated for the summer of 2020.

Baxter Grist Mill, Yarmouth: In 2019, the Town of Yarmouth completed a large-scale project to rehabilitate a historic grist mill. The project included grist mill improvements, dam reconstruction, and a new fishway. The National Resources Conservation Service was a principal partner on design and funding. Project staff were active in field data collections, early designs to replace the antiquated fish ladder, and construction-phase site visits.

Dam Removal Technical Assistance: Three dam removals occurred in 2019 with uncommon regional significance for coastal rivers in Massachusetts: Elm Street Dam, Jones River, Kingston; Horseshoe Mill Dam, Weweantic River, Wareham; and the Holmes Park Dam, Town Brook, Plymouth. These projects occur through remarkable, cooperative efforts that are driven by public funds. DMF's role is most focused on technical assistance to ensure the engineered designs meet migratory fish requirements. Substantial staff efforts were applied to the Elm Street Dam and Horseshoe Mill Dam removals in 2019 to assist designs with specific attention to rainbow smelt spawning and passage requirements and the creation of smelt spawning riffles. DMF staff also assisted in drafting post-construction monitoring plans for both sites.

Fishway Permitting and Operation and Maintenance Plans

DMF 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. Seven working draft O&M Plans were revisited and finalized in 2019. New O&M Plans were prepared as working drafts for the Triphammer Pond fishway, Hingham, and the Baxter Grist Mill fishway, Yarmouth.

DMF issues Fishway Construction Permits following the review of final engineering plans to construct, rebuild, or alter fishways. During 2019, two Fishway Construction Permits were prepared for projects at the Baxter Grist Mill fishway, Yarmouth, and the Elm Street Dam removal project on the Jones River, Kingston.

River Herring Stream Channel Maintenance

Project staff routinely fields requests to assist Towns in maintaining passageways for river herring. The work can involve developing cooperative 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 provides coastwide guidance for these practices. Stream maintenance plans were drafted by project staff in 2019 and approved by Town Conservation Commissions for the Jones River, Kingston, and the Weir River, Hingham. Field work on stream maintenance in 2019 involved seven coastal river systems: Centerville River, Barnstable; Acushnet River, Acushnet; Jones River, Kingston; Island Creek, Duxbury; South River, Marshfield; Weir River, Hingham; and the Fore River, Braintree.

Other Activities

Technical Committee Participation: Staff actively participated on committees related to diadromous fish, including ASMFC's technical committees for river herring, shad, American eel, sturgeon, and fish passage; and stock-assessment subcommittees for river herring and American eel. Annual ASMFC compliance reports were prepared for American eel, river herring, American shad, and Atlantic sturgeon, as was an update to the MA American Shad Management Plan. Substantial effort was provided to a shad and river herring sub-committee related to updating the management plans and sustainable harvest plan metrics for those species.

Staff also served on NMFS's River Herring Technical Expert Working Group and River Herring Endangered Species Status Review Team; and technical committees for the Connecticut River Atlantic Salmon Commission and Anadromous Fishery Management of the Merrimack River Basin. Contributions to the American Fisheries Society (AFS) included staff serving as Program Committee Chair of the AFS Southern New England Chapter and Award Co-Chair for AFS.

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; World Fish Migration Day at Herring River, Harwich; Mystic River, Medford; and the Pembroke Herring Fisheries Commission's Fish Fry celebration.

Additional Publications & Presentations: Staff published a study on rainbow smelt fecundity and reproductive life history in Fishery Bulletin in 2019. Numerous presentations are made by project staff at various venues. College seminar series presentations were made on river herring and eel to MA Maritime Academy and SMAST. Conference presentations were made at: the AFS Annual Meeting on shifts in the phenology of spring spawning alewife due to impacts of climate change and the development of a river herring tracking and web-based simulation tool for evaluating passage efficiency through newly restored watersheds; and the AFS Southern New England Chapter Winter Meeting on rainbow smelt sampling methodology evaluation and modeling to link data on river herring life stages.

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 Kass, Program Coordinator – Internal Control Officer

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

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

Outreach
Christine Cassidy, Information & Education Coordinator
Kimberly Fine, 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 (through November 2019)

Overview

DMF Administration is responsible for the Division's fiscal functions, grants management, capital assets, diver training, outreach efforts, and seafood marketing. Staff develops, analyzes, and manages the Division's financial planning and resource allocation activities, including budget submission to the Legislature. The program is responsible for collecting fees and reconciling revenue. Staff also provide all fiscal oversight and reporting on grants, contracts, and mitigation projects. Facilities and capital assets are procured, inventoried, managed, and maintained with

the intent to provide a healthy and productive working environment. 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.

Budget

Overall, state-appropriated funds increased 3.43% from Fiscal Year (FY) 2018 to FY2019 (Table 24). Appropriated funds for the operating budget increased 2.79%. The modest increase was approved to primarily cover increased annualized costs for payroll, and for costs to complete research on the Cod IBS and for an analysis of the impacts of the squid trawl fishery in waters under the jurisdiction of the Commonwealth.

The Legislature has created three retained revenue accounts for DMF, whereby funds from a particular funding source may be retained by the Agency to expend for a particular purpose. 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 from shellfish depuration and de-sanding at the Division's Newburyport facility, 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 increased 5.7% in FY19.

Appropriations from special fund accounts increased by just over 5%. The Legislature slightly increased the appropriation on the Saltwater Sport Fish Licensing account to adjust for increased personnel and research costs. 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 25 provides the breakdown of costs by primary spending category for the DMF operating accounts.

Table 24. Fiscal Year 2018 and 2019 appropriations (available funds for operations).

Title	Acct. Number	FY2018	FY2019	Change
General Fund Accounts				
General Operating	2330-0100	[1]$5,791,632	[2]$5,939,289	+2.55%
Sportfish Program	2330-0120	$699,079	$732,307	+4.75%
General Fund Total		$6,490,711	$6,671,596	+2.79%
Retained Revenue Accounts				
Sportfish Retained Revenue	2330-0121	$217,989	$217,989	0.00%
Purification Retained Revenue	2330-0150	$19,194	$47,016	+144.95%
Ventless Trap Retained Revenue	2330-0199	$250,000	$250,000	0.00%
Retained Revenue Total		$487,092	$514,914	+5.71%
Special Fund Accounts				
Saltwater Sport Fish Licensing	2330-0300	$1,306,079	$1,389,837	+6.41%
Seafood Marketing	2330-0104	$250,000	$250,000	0.00%
Special Fund Total		$1,556,079	$1,639,837	+5.38%
Appropriations Grand Total		**$8,533,882**	**$8,826,347**	**+3.43%**

[1] The final budget for FY2018 in Chapter 47 of the Acts of 2017 was $6,511,649. DMF's general operating budget was affected by:
1) earmarks totaling $697,000 ($347,000 to SMAST; $50,000 for the Great Marsh Green Crab Trapping Program; $50,000 for the Fishing Academy, Inc.; $75,000 for Coastal Marsh Restoration; and $175,000 for shellfish propagation in Barnstable, Dukes, and Nantucket counties); 2) the Governor's reduction for debt payment totaling $57,888; and 3) $34,871 made available from a reserve draw account to cover employee buyout costs pertaining to the 2015 Early Retirement Incentive Program that carried into FY2018.

[2] The final budget for FY2019 in Chapter 154 of the Acts of 2018 was $6,989,289. DMF's general operating budget was affected by:
1) earmarks totaling $1,050,000 ($450,000 to SMAST; $50,000 for the Great Marsh Green Crab Trapping Program; $50,000 for the Fishing Academy, Inc.; $75,000 for Coastal Marsh Restoration; $100,000 for maintenance to Herring Run to Whitman's Pond in Weymouth; $150,000 for Gloucester Marine Genomics Institute; and $175,000 for shellfish propagation in Barnstable, Dukes, and Nantucket counties); 2) funds added for DMF to complete the Industry Based Survey ($142,946) and a squid trawl fishery study ($20,000).

Table 25. FY2019 expenditures by account type and primary spending category (rounded to whole dollars).

	General Fund	Retained Revenue	Special Fund	Total
Salaries	$5,904,088	$171,820	$602,492	$6,678,400
Employee Expenses	$26,092	$9,917	$7,520	$43,529
Contracted Employees	$25,000	$3,028	$126,650	$154,678
Contracts	$2,777	$59,004	$811,479	$873,260
Facility Maintenance	$33,285	$11,338	$4,401	$49,024
Field & Lab Supplies	$70,308	$18,025	$19,155	$107,488
Fringe Costs	$122,571	$3,025	$12,534	$138,130
Fuel	$85,343	$2,338	$2,000	$89,681
Utilities	$71,096	$3,473	$0	$74,569
Lease/Rent	$142,406	$10,719	$0	$153,125
Maintenance/Repair	$111,372	$6,382	$5,125	$122,879
Office & Administrative	$166,614	$67,596	$37,528	$271,738
Services/Equipment Lease	$1,767	$134,750	$0	$136,517
Outside Agencies	$194,999	$6,878	$3,954	$205,831
Grants	$1,048,776	$4,000	$99,550	$1,152,326
Total	**$8,006,494**	**$512,293**	**$1,732,387**	**$10,251,174**

Staffing

Staffing levels were down slightly by the end of calendar year (CY) 2019 primarily due to the timing of retirements; four long-term employees retired near the end of 2019 and those positions are expected to be backfilled early in 2020. Overall, staffing level dropped by five positions between CY2018 and CY2019 (Table 26).

Table 26. Calendar Year 2018 and 2019 Authorized Personnel Levels.

Title	Acct. Number	CY2018	CY2019
DMF General Operating	2330-0100	59	57
Sport Fish Program	2330-0120	10	10
Saltwater Sport Fish Licensing	2330-0300	8	8
Federal Grants and Trust Account	2330-xxxx*	23	20
Total Employees in All Appropriations		**100**	**95**

*Multiple account numbers

Revenue

General Fund Revenue

DMF collects fees primarily from permit issuance and processing racks of soft shell clams at the Shellfish Purification Plant. A total of 30,961 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 $2,261,790 in 2019 (Table 27). Overall, there was an increase in total number of permits issued and revenue collected by approximately 1%.

The Shellfish Purification Plant processed 6,507 racks of soft shell clams in 2019, resulting in General Fund revenues of $39,042. This represents a 17% decrease in revenue from 2018. Overall, there has been a declining trend in racks processed and resulting revenues since 2009.

Table 27. 2019 General Fund Permitting Revenue.

Permit Type		Permit Fee		Revenue
		Resident	Non-resident	
Commercial Fisherman	Coastal Lobster	$310	$570	$330,780
	Offshore Lobster	$310	$570	$145,600
	Seasonal Lobster	$80	$145	$8,690
	Boat 100'+	$260	$520	$12,480
	Boat 60-99'	$195	$310	$92,040
	Boat 0-59'	$130	$260	$564,850
	Individual	$65	$130	$13,910
	Shellfish & Seaworm	$40	$80	$35,200
	Shellfish & Rod & Reel	$55	$130	$22,330
	Rod & Reel	$35	$100	$31,860
Commercial Fisherman Permit Revenue Subtotal				**$1,257,740**
Seafood Dealer	Wholesale Dealer	$130	$260	$51,870
	Wholesale Truck	$130	$260	$44,850
	Wholesale Broker	$130	$260	$5,980
	Retail Dealer	$65	$130	$67,340
	Retail Truck	$65	$130	$2,535
	Retail Boat	$65	$130	$6,760
	Bait Dealer	$65	$130	$10,335
	Retail Farmer's Market	$65	$130	$130
Seafood Dealer Permit Revenue Subtotal				**$189,800**
Special	Non-Commercial Lobster	$55	$75	$338,640
	Regulated Fishery Endorsements	$30	$60	$466,080
	Master Digger	$250	$500	$1,500
	Subordinate Digger	$100	$200	$2,900
	Scientific Collection	$10	$20	$920
	"Other" Special Permits	$10	$20	$4,210
Special Permit Revenue Subtotal				**$814,250**
Total				**$2,261,790**

Dedicated Fund Revenue

In addition to General Fund revenue, DMF generated $1,463,450 in revenue for the Marine Recreational Fisheries Development Fund in 2019 (Table 28). 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 2019, the fund saw a slight increase in revenue (<1%) over that of the previous year.

Table 28. 2019 Marine Recreational Fisheries Development Fund Revenue.

Permit Type	Permit Fee		Revenue
	Resident	Non-Resident	
Recreational Saltwater, Age 16–59	$10	$10	$1,347,680
Recreational Saltwater, Age 60+	$0	$0	$0
Charter Boat	$65	$130	$56,810
Head Boat	$130	$260	$6,370
Recreational Fund Donations			$52,590
		Total	**$1,463,450**

Grants

In FY2019, DMF spent approximately $4 million on federal grants and mitigation projects operating out of the DMF Trust Account, a slight increase from FY2018 (Table 29). Decreased spending on several federal grants was largely offset by a major increase of large infrastructure projects in the Clean Vessel Act Program.

Table 29. Fiscal Year 2018 and 2019 Expenditures.

Title of Federal Grant or Trust	Account No.	FY2018	FY2019
Clean Vessel Act	2330-9222	$556,000	$1,369,000
Fisheries Statistics	2330-9712	$164,000	$179,000
Boating Infrastructure	2330-9725	$208,000	$26,000
Interstate Fisheries	2330-9730	$247,000	$248,000
ACCSP	2330-9732	$19,000	$12,000
Saltonstall-Kennedy	2330-9733	$275,000	$64,000
Turtle Disentanglement/Protected Species	2330-9739	$825,000	$624,000
Economic Relief	2330-9741	$257,000	$84,000
Fish Age & Growth	2330-9742	$247,000	$276,000
Sport Fish Coordination	2330-9743	$86,000	$129,000
MFI Grants	2330-9744	$28,000	$32,000
Marine Fisheries Research Trust	2330-0101	$1,020,000	$1,006,000
	Total	**$3,932,000**	**$4,049,000**

The Revolving Loan Fund

The Massachusetts Commercial Fisheries Revolving Loan Fund (RLF) Program, operating under a Memorandum of Agreement between NOAA Fisheries and DMF, seeks to promote the effective implementation of catch share management in New England while minimizing the potential adverse socio-economic impacts to fishing communities and small-scale fishing businesses sometimes attributed to them. Under the program, DMF has contracted with two financial institutions, Tremont Credit Union and Community Development Partnership, to provide approved loan services to eligible applicants throughout the Commonwealth, and with a third

organization, the Gloucester-based New England Fishery Sector (NEFS) II, to administer funds for groundfish quota leasing.

During CY2019, Tremont Credit Union and Community Development Partnership together continued administration of seven active loans (six total recipients) totaling $124,281 in RLF funds. One new loan was issued to an existing borrower during 2019. All borrowers except one remain compliant with their repayment terms; Community Development Partnership is working with the non-compliant borrower to modify repayment terms. The lenders also assisted borrowers with technical assistance and business planning. NEFS II did not utilize RLF funds to lease-in additional groundfish quota in 2019.

Over the years, DMF has implemented a variety of amendments to the Memorandum of Agreement in order to address fishermen concerns and receive a larger pool of applicants to better serve smaller groundfishermen adversely affected by the catch share management plan. However, despite continued modifications to the RLF and Revolving ACE Leasing Fund (RALF) program, there persists a significant underutilization of loan funds and lack of new participation. This continued lack of loan utilization demonstrates that the RLF and RALF programs are not having their intended impacts, especially at the intended scale of small vessel owners in the groundfish fishery. Therefore, at the end of CY2019, DMF recalled funds from its three RLF partners. DMF continues to work with industry to develop a final repurposing solution for these funds.

The Clean Vessel Act Program

DMF 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 2019, the 25th 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 9 million gallons of effluent from state coastal waters.

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 2019, 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 30, Figure 40). Total reimbursement for all new and replacement equipment was $247,956. An additional $615,509 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 (Figure 41).

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. Another widely-distributed brochure includes a "how-to" guide for pumpout station use.

Table 30. New and Replacement *Mass*CVA Infrastructure for 2019.

Recipient	Equipment
Barnstable	Replacement pumpout boat
Mattapoisett	New Pumpout boat
Duxbury	Replacement pumpout boat engine
Newburyport	Replacement pumpout boat
Salisbury	Replacement pumpout boat
Hingham	Replacement pumpout boat engine

Figure 40. *Mass*CVA infrastructure funded in 2019 included a replacement pumpout boat in Salisbury.

Figure 41. Traditional pumpout station in Scituate funded by operation and maintenance grant money in 2019.

Boating Infrastructure Grant Program

The Massachusetts Boating Infrastructure Grant Program (*Mass*BIG) is a two-tiered federal grant program, directed through the USFWS and administered by DMF. *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 2019 (Table 31). This was for the City of New Bedford to improve transient recreational boater access at Pope's Island Marina. The grant will help with the installation of three finger piers, three electric/water pedestals, six double pennants, and a transient mooring to accommodate a vessel up to 75'.

*Mass*BIG also extended Manchester-by-the-Sea's Tier II Transient Boater Infrastructure improvement project into 2019 to allow for completion (Figure 42).

Table 31. Massachusetts BIG Project Summary for the past five years.

Year	Project	Award	% Complete
2015	Solomon Jacobs Park Harbormaster Facility Project (Gloucester Harbor)	$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	100%
2016	Nantucket Transient Boater Navigational Project (Nantucket and Madaket Harbors)	$45,056	100%
2017	Mattapoisett Transient Boater Access Project (Mattapoisett Harbor)	$180,000	25%
2018	Boston Harbor Islands Transient Boater Access Project (Peddocks Island)	$180,623	15%
2019	New Bedford Transient Boater Improvements Popes Island Marina	$52,271	10%

Figure 42. Manchester-by-the-Sea installs the Tier II-funded Reed Park Transient Boater Improvement Project in 2019.

Outreach

DMF's 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.

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: Staff 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: The planning and ordering of a striped bass circle hook card promotion was completed in late winter (Figure 43). 6,000 size 8.0 Offshore Angler hooks were acquired and attached to informational cards to be handed out at trade shows and public events throughout the late winter and early spring fishing season. The goal of the promotion was to encourage anglers to try out and purchase circle hooks in advance of any regulations, easing the transition into their use throughout the state for striped bass.

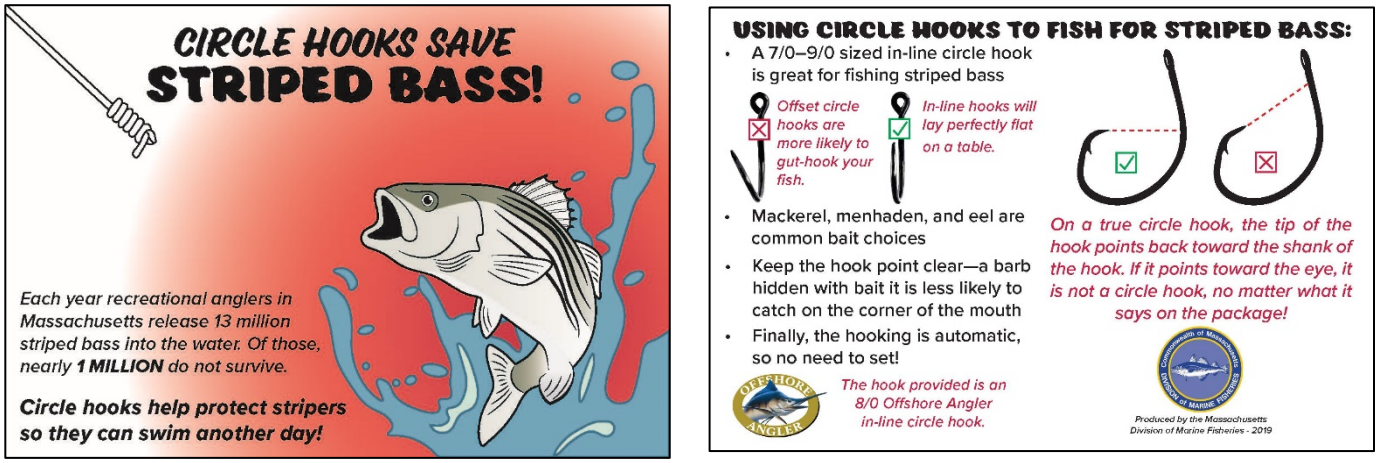


Figure 43. DMF's striped bass circle hook promotional card.

Museum Exhibition: In partnership with the US Army Corps of Engineers' Cape Cod Canal Visitor Center, a new saltwater fish and Massachusetts angler exhibit was opened in May. The exhibit, titled *The Cape Cod Canal: A Superhighway For Fish*, explores fish species biology, the Canal as a fish highway, responsible angler recreation, and recreational lobstering (Figure 44).
The roughly 300-square-foot exhibit introduces visitors to the canal with a large map and an overview of the physical pathway the canal provides to species traveling to the Gulf of Maine. A large, underwater cross section graphic of the Canal and six significant recreational species are highlighted just to the right of this introduction panel, engaging guests in a trivia-like game. An interactive fishing game affixed to the floor and panels along the back wall introduce various items of gear and strategies for saltwater fishing. An informational sign and tackle box highlighting responsible angler practices and a display on lobstering in the canal complete the

exhibit. The goal of the exhibit is to encourage and empower visitors to responsibly engage in saltwater fishing. Extension activites for the exhibit include fishing clinics and take away angler pamphlets.

Figure 44. New saltwater fish and Massachusetts angler exhibit at the Cape Cod Canal Visitor Center

Social Media: Communications with constituents through our social media platforms continued on Facebook, Twitter, YouTube, and Instagram. In 2019, both the DMF Facebook and Instagram accounts were verified as authentic (as a government agency), helping our constituents know that the content put out on these social media platforms is a trusted resource for fisheries information. Facebook and Twitter content was more focused on providing regulatory updates and near real time progress from field research; whereas Instagram continued to be used to highlight DMF research programs, survey work, recreational fisheries partnerships, and the Saltwater Derby. Overall, the Facebook page grew 29% in 2019, adding 1,942 new followers. Instagram grew 59% in 2019, adding 1,702 new followers. DMF also saw an increase in engagement rates with constituents on both platforms.

In the summer of 2019, I&E continued the "*What is it? Wednesday*" social media campaign on Facebook (Figure 45), targeting recreational anglers. In this informational game, photographs or videos of DMF research were posted to engage the community. Correct guesses were entered into an end of summer drawing for a spinning rod/reel combo, donated by Bass Pro Shops. Follow-up postings offered additional information and promoted various projects in addition to highlighting many of the species found in Massachusetts waters.

Figure 45. A typical "What Is It? Wednesday" social media campaign on Facebook.

Email Alerts: In 2019, DMF contracted with Granicus/Gov Delivery, to provide an email subscription service to constituents, replacing the legacy listserv system. This new communication cloud will allow for constituents to receive timely content that is tailored to their specific interests and reminders regarding the renewal of their recreational fishing permit. By the end of 2019, DMF completed build-out of the system, transferred data, and notified constituents on social media of the change to be implemented in early 2020.

R3 Initiatives: Every year, DMF works in conjunction with the Recreational Boating and Fishing Foundation (RBFF) to increase participation in recreational saltwater angling. In 2019, the Division's R3 initiatives focused on continued development of a plan to deliver effective angler recruitment, retention, and reactivation (R3) efforts and improving the communication with recreational anglers (see Email Alerts section).

Other: Staff 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

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 46) and a small grant program, which awards up to $500 per proposal for outside entities to create event(s) promoting saltwater angler education within Massachusetts.

In 2019, DMF hosted or participated in five youth fishing clinics for ages 7–15, nine events opened to all ages, and two adult surfcasting fishing seminars (Table 32). The 2019 events occurred from May through

Figure 46. DMF staff teaching fishing techniques and fish identification at a youth fishing clinic in 2019.

October, were free to the public, and included 340 youth participants under the age of 15. At these events, DMF biologists taught basic angling skills, how to responsibly handle fish, the importance of recycling monofilament, and other fun activities such as knot tying and fish identification. Educational handouts were distributed to registered youth, as were mini tackle kits which included circle hooks and a measuring tape. This year each fishing clinic was divided into two 2-hour events. At the end of each 2-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.

Also this year, DMF administered funding to Why Knot Fishing for sponsoring free fishing tournaments and clinics to Elevate Youth of Boston, a non-profit committed to empowering and mentoring youth through transformative outdoor experiences; and to The Fishing Academy, Inc., which works with inner-city children around the Boston area to engage them in saltwater fishing.

Table 32. 2019 Saltwater Angler Education Fishing Events.

Event	Partnering Organization(s)	Participants
Obear Park, Beverly	Why Knot Fishing-Kids Demo Day	6
Cashman Park Youth Fishing Clinic, Newburyport	City of Newburyport	34
Senior Center Fishing Clinic, Nauset Beach	City of Orleans & The Cape Cod Salties Association	20
Swain's Wharf, Nantucket	Nantucket Boat Basin 2nd Annual Father's Day Fishing Tournament	~30
Fort Taber Youth Fishing Clinic, New Bedford	City of New Bedford & Buzzards Bay Anglers Club	30
Fishing Tournament, Swampscott	Why Knot Fishing-Elevate Youth Fishing Derby/Fundraiser	60
Boating & Water Safety Day, Cape Cod Canal, Sandwich	Canal Visitor's Center	50
Salem Willows Youth Fishing Clinic, Salem	City of Salem	20
Family Fishing Night at Cape Cod Canal, Sandwich	Canal Visitor's Center (Family Fishing Seminar)	75
Surf casting clinic and Seining, Mattapoisett	YMCA	10
Phoenix School Youth Fishing Clinic, Beverly	City of Salem	10
5th Annual Fall Run Striper Classic Plum Island	Why Knot Fishing-Elevate Youth Fishing Derby/Fundraiser	10
Adult Surf Casting Clinic	South Yarmouth	50

Seafood Marketing

DMF's Seafood Marketing Program seeks to increase consumer awareness and preference for local seafood products. The program supports the state's commercial fishing and seafood industries and communities.

Marketing and Outreach

Massachusetts Avenue at the Seafood Expo North America: In its inaugural year, a

"Massachusetts Avenue" at Seafood Export North America (SENA) was organized by Massachusetts Department of Agricultural Resources and DMF with eight businesses that together showcased our local industry. MDAR facilitated USDA funds to offset 50% of eligible costs and DMF's Seafood Marketing Program to merchandise and promote the Avenue. To celebrate Mass Ave, there was a speaking program followed by a ceremonial ribbon cutting. The speakers were: DFG Commissioner Ron Amidon (MC), EEA Secretary Matt Beaton, MDAR Commissioner John Lebeaux, Senator Bruce Tarr, Representative Susan Gifford, and Charles Nagle (Owner, The John Nagle Company). Secretary Beaton announced the award of three research grants through the Division's Seafood Marketing Program at this event.

The Massachusetts Avenue businesses for 2019 included: Aquacultural Research Corporation Hatchery of Dennis; Cape Seafoods of Gloucester; Intershell International of Gloucester; John Nagle Company of Boston; North Atlantic Pacific Seafood of Gloucester; Pangea Shellfish Company of Boston; Plymouth Rock Oyster Company of Plymouth; and Red's Best of Boston.

Seafood Day & Other Initiatives: The second annual Seafood Day at the State House was co-organized with the Massachusetts Fishing Partnership Support Services and took place in October with the Seafood Marketing Program's Fall steering committee meeting taking place beforehand upstairs. The partnership with Eating with the Ecosystem continued to educate consumers by bringing a seafood boat to farmer's markets around the state to do eight chef demonstrations and tastings over the summer. Seafood consumption guidelines were added into the Recreational Fishing Guide for the first time. Our summer intern promoted retailers across the state by randomly selecting some to be photographed for Instagram.

Grant Program

The Seafood Marketing Grant Program distributed $116,034 in grants to three research projects in 2019. The Division specifically sought proposals that will provide information, insight, and the potential for a step forward for the Commonwealth's seafood sector through research. The end product will be a final report consisting of stakeholder involvement, original research, a review of existing literature or data, and conclusions that will be disseminated widely by the Seafood Marketing Program and awardees for the benefit of the commercial fishing and seafood industries, communities, and advocates. The awarded projects include:

- *Involving Massachusetts Fishermen in Seafood Traceability Programs;* $25,000 to the Fishing Partnership Support Services. The awardee will research current seafood traceability programs and present the information to fishermen and stakeholders across the Commonwealth to inform them of opportunities and technologies; and conduct roundtable discussions to gather feedback concerning the most effective ways to increase participation in traceability programs so that fishermen can receive a premium price for their catch, thus improving the economic security of Massachusetts fishing families.
- *Developing Port Profiles and a Commercial Fishing Infrastructure Assessment for Massachusetts Coastal Harbors;* $41,034 to the Urban Harbors Institute at University of Massachusetts Boston. The awardee will gather information for each fishing harbor in Massachusetts by conducting a survey, interviews, an analysis of existing data, and research to develop unique port profiles to ensure that the space, infrastructure, and amenity needs of the commercial fishing communities are met and that decision-makers are informed about existing inventory so that municipalities and communities can have a benchmark and improve upon current conditions.

- *Assessing Massachusetts Consumer Preferences to Purchase Local and Fully Traceable Seafood;* $50,000 to Michael T. Carroll and Josh Weirsma. The awardees will create a survey tool to assess consumer preferences for local, fully traceable seafood to better understand the purchasing decisions and attitudes towards Massachusetts seafood products and attributes; and administer the research to seafood shoppers at major supermarkets across different regions of the state to inform stakeholders about the New England groundfish market.

Scientific Diving

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

DMF scientific divers conducted over 400 research dives to support on-going research and monitoring programs, including artificial reef site surveys; 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. 2019 highlights included ghost lobster gear removal in the Cape Cod Canal, continued post-deployment monitoring of the new artificial reef off Harwich, and the successful completion of training for *Mass*Wildlife DMF, and SMAST biologists and students. Routine program management duties included diver training, equipment maintenance and repair, and maintenance of the air system.

Scientific Diving also maintains reciprocity agreements with the U.S. EPA, Boston University, the Marine Biological Laboratory, and Northeastern University, permitting cooperative diving research. In 2019, student divers participated in 108 DMF dives. In 2019, DMF also completed cooperative agreements with the MA Board of Underwater Archeological Resources and the Office of Coastal Zone Management to provide dive supervisions for divers from both agencies.

Educational and outreach efforts to dive clubs, schools, and local dive shows continued. Highlights included a DMF table at the Boston Sea Rovers Show, World Oceans Day at the New England Aquarium, and the Beneath the Sea Show in New Jersey. The Diving Safety Officer served on the Board of Directors of the Our World Underwater Scholarship Society and as President of the American Academy of Underwater Sciences Foundation.

Capital Assets and Facilities Management

Facilities

DMF maintains facilities at several coastal locations throughout the state. Headquarters are located in Boston, with the two primary field stations being 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 FY2019, DMF spent approximately $105,000 in facility planning, infrastructure maintenance, emergency repairs, and equipment throughout the agency. At the Gloucester Field Station, both

a boiler and HVAC controller were replaced, certain shellfish lab equipment was replaced, and the fisheries Age & Growth lab was fitted with a Fisheries Scientific Computer System. At the Shellfish Purification Plant, one of the two saltwater wells became exposed as a result of coastal erosion and had to be decommissioned; initial assessment on well replacement began in 2019. At the shellfish bacteriological laboratory in New Bedford, $41,000 was invested in the replacement of an autoclave.

Vehicles and Boats

DMF maintains a fleet of 40 vehicles and 16 boats. In 2019, $143,000 was paid to the Office of Vehicle Management for lease vehicles, and an additional $59,000 was spent on maintenance and repair for all stock. No vehicles were replaced in 2019. One outboard motor was replaced in the DMF vessel fleet for 2019, and the R/V Mya was repowered. Total maintenance of the vessels, engine replacements, and trailers cost just over $75,000.

Appendix A. 2019 Publications

DMF Technical Reports

David M Chosid, Michael Pol, B. Schondelmeier, M. Griffin. 2019. Early Opening Experimental Fishery for Silver Hake/Whiting in Small Mesh Area 1 and the Western Raised Footrope Exemption Area. DMF TR-67.

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DMF. 2019. DMF News, 2019 Q1&2 (43). 20 pp. www.mass.gov/info-details/dmf-news-1st-and-2nd-quarters-2019