Gloucester Marina
Photography by: Thomas Hoopes

Department of Fish and Game

Massachusetts Division of Marine Fisheries

2020 Annual Report

Department of Fish and Game

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Commonwealth of Massachusetts
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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 Daniel J. McKiernan

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January 1–December 31, 2020

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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

Daniel J. McKiernan, Director, Section Leader

Fisheries Policy and Management Program

Personnel

Daniel McKiernan, Director (appointed from Acting Director on May 21)
Melanie Griffin, Federal Fisheries Policy Analyst
Nichola Meserve, Interstate Fisheries Policy Analyst
Dr. Catherine O'Keefe, Fisheries Policy Analyst (through February 28)
Jared Silva, State/Local Fisheries Policy Analyst
Kelly Whitmore, Federal Fisheries Policy Analyst (beginning June 7)
Julia Kaplan, Communications Specialist (beginning May 11)

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 2020 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. Extensive staff preparation occurs for these meeting including the development of recommendation memoranda on proposed regulatory changes that summarize public comment and review the biological and socio-economic impacts of alternatives; and preparation of informational presentations and written briefing on state, interstate, and federal fisheries management issues to keep the MFAC apprised of recent developments.

The MFAC was convened for eight business meetings during 2020, seven of which were held virtually due to safety precautions related to the Covid-19 global pandemic. Regulatory revisions and fishery specifications approved by the Commission during 2020 are included in the summary of fisheries management actions beginning on page 13. Two subcommittees of the MFAC also met during the year: one to review various enforcement and non-compliance issues, and the other to discuss future improvements to the commercial striped bass fishery. Changes to MFAC membership in 2020 included the appointments of Orleans-based commercial fisherman Bill Amaru and Tisbury's Dr. Shelley Edmundson, Executive Director of the Martha's Vineyard Fishermen's Preservation Trust (to fill seats vacated by Andrew Walsh and Charles Quinn).

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 engage with the Division on 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 twice during 2020. Both meetings were held virtually due to the Covid-19 global pandemic. The first meeting focused on the Division's recommended spending plan for the expected FY2021 fund appropriation of roughly $1.7 million, while the second meeting was convened to discuss prioritization metrics for public access projects and the recreational permit fee structure. The panel endorsed the Division's FY2021 spending plan, which included: continued 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. The Panel also developed initial recommendations for how the recreational permit fee structure could be revised.

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 the DMF Director, met three times during the year (all in a virtual setting due to the global pandemic). See Seafood Marketing (page 102) 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 did not meet during 2020, although the Division and many of the panel's members were heavily engaged in 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.

Public Input & Stakeholder Engagement

Input from commercial and recreational fishery participants and other stakeholder groups is integral to the Division's initiation, development, implementation, and monitoring of fisheries management initiatives. Stakeholder engagement is achieved through various structured processes including public hearings and comment periods; scoping and informational meetings; and the distribution of Advisories, the Division's newsletters, annual reports, and other publications. Such activities for 2020 are described below. Policy and Management staff also routinely participate in informal meetings with commercial, recreational, and non-traditional fisheries stakeholders at their request to discuss items of interest; and respond to constituent inquiries about fisheries management issues in the Commonwealth.

DMF Public Hearings & Comment Periods

State law requires DMF to conduct a public comment period and hold a public hearing(s) on most types of proposed amendments to the state's marine fisheries regulations. During 2020, three such comment periods were held including a total of five public hearings:

- February 7–March 18 comment period, with hearings on March 10 & 12 (Reading & Tisbury): recreational striped bass and bluefish limits; commercial striped bass, summer flounder, black sea bass, horseshoe crab, menhaden, and sand lance limits; regulatory clarifications and corrections. A third hearing on these topics scheduled for March 12 in Buzzards Bay was canceled due to Covid-19 safety measures; the written comment period was extended in response.
- July 8–August 14 comment period, with a hearing on August 3 (virtual): Cape Cod Canal commercial striped bass fishing closure.
- November 13–December 18 comment period, with hearings on December 8 & 9 (virtual): protected species regulations affecting trap and gillnet fishing.

Certain other actions, such as Director's Declaration to adjust commercial fishery limits for quota managed species, require a public comment period only. During 2020, written public comment was accepted on the following proposed actions:

- February 12–February 26: in-season adjustment to commercial fluke Period I trip limit.
- February 14–February 28: temporary suspension of the April commercial groundfish closure between Marblehead and Plymouth.
- August 10–August 24: in-season adjustments to commercial striped bass, fluke Period II, and black sea bass trip limits and/or open fishing days.
- September 11–September 25: establishment of commercial scup Winter II trip limit.
- October 22–November 5: in-season adjustment to commercial fluke Period II trip limit.
- November 23–December 5: in-season adjustment to 2021 commercial fluke Period I trip limit.
- November 24–December 8: establishment of 2021 commercial scup Winter I trip limit.

DMF Scoping Meetings & Input Periods

DMF occasionally holds additional ad hoc meetings to inform the industry of and/or accept informal scoping comment on upcoming issues. During 2020, the following industry meetings were held:

- February 18 & 19 (Bourne & Gloucester): anticipated changes to federal Atlantic Large Whale Take Reduction Plan affecting trap fisheries.

Publications

Advisories: DMF released 102 electronic notices to our subscriber list on various rule changes, public hearings, quota closures, and other important information. The agency replaced its antiquated listserv technology for the distribution of these Advisories in early 2020 with a new subscription service (Granicus' GovDelivery platform), greatly improving the quality and expanding the reach of our electronic communications with stakeholders. Advisories are also posted to the Division's social media platforms.

DMF News: DMF published its newsletter twice in 2020 (Figure 1). These publications serve to inform and educate our constituents on major management, science, and administrative happenings at the Division. In contrast with prior years, the 2020 editions of "DMF News" were made available through the Division's website in electronic format only. With the ongoing transition to more digital communications, the mailing of paper copies to constituents was terminated. Printing of copies for distribution at trade shows and other events was expected to continue; however, this was suspended for 2020 given the cancellation of all events due to the Covid-19 pandemic.

Annual Report: DMF published its *2019 Annual Report*.

Figure 1. The covers of the two 2020 editions of the DMF News.

Regional Councils and Interstate Commissions

New England Fishery Management Council

Some fisheries go beyond state level and are managed regionally in collaboration with the federal government. The Director of the Commonwealth's Division of Marine Fisheries serves as one of 18 voting members on the New England Fishery Management Council (NEFMC). One of eight regional fishery councils established in 1976 under the Magnuson-Stevens Fishery Conservation and Management Act, the NEFMC supports management of the living marine resources within the United States exclusive economic zone (EEZ), spanning from 3 to 200 miles offshore, from Maine through Connecticut. The regional councils develop federal fishery management plans (FMPs), which are implemented by NOAA Fisheries after it ensures that 10 National Standards within the Magnuson-Stevens Act have been met. The NEFMC has federal FMPs for: Northeast Multispecies (13 groundfish stocks), Atlantic Sea Scallop, Monkfish, Atlantic Herring, Northeast Skate Complex (seven species), Small-Mesh Multispecies (five groundfish stocks), Red Crab, Spiny Dogfish, Atlantic Salmon, and Habitat. Since regional fisheries don't recognize jurisdictional boundaries, the Division also seeks to balance state waters management of regional fisheries in a manner consistent with and in support of federal FMPs, in some cases this is done with the ASMFC to coordinate management plans between federal and state waters.

Meetings: During 2020, staff represented Massachusetts at six NEFMC meetings; served on the Atlantic Herring, Atlantic Sea Scallop, Executive, Groundfish, Monkfish, Skate, and Spiny Dogfish Committees; provided technical expertise to the Groundfish, Scallop, Atlantic Herring, and Habitat Plan Development Teams, the Northeast Trawl Advisory Panel, and Research Set-Aside (RSA) programs for Atlantic herring and Atlantic sea scallops; 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 once again granted the Commonwealth funds to support management and technical assistance (see Grants section, page 97, for further details). Due to public health circumstances surrounding the COVID pandemic, all meetings were held virtually with limited exceptions.

Actions: Working through the COVID pandemic brought challenges common to various fishery management bodies such as advancing virtual meeting capabilities and addressing data gaps (e.g., loss of observer and fishery independent survey information) but also unique regional challenges as the Council sought to finalize action on two controversial amendments for scallops (Amendment 21: Northern Gulf of Maine access and IFQ trip limits) and groundfish (Amendment 23: at-sea monitoring). The NEFMC finalized both amendments in September. Throughout 2020 the Council advanced its ecosystem-based fishery management work, provided recommendations on recreational groundfish measures (see Fishery Management Actions for further detail), updated multi-year specifications for most FMPs, continued efforts to consider Atlantic herring spawning protections on Georges Bank, and set 2021 management priorities. June 2020 also saw NOAA Fisheries approve the NEFMC's Omnibus Deep-Sea Coral Amendment, which was expected to become effective later in the summer. Staff continued to contribute to technical analyses (see Fishery Dependent Investigations) and policy decisions at the NEFMC in support of 2020 work on Atlantic Herring FMP Framework 8 (2021-2023 catch limits and mackerel optimization) and Framework 7 (spawning protection on Georges Bank).

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. Ms. Elizabeth Etrie and Mr. John Pappalardo were both re-appointed by the Secretary of Commerce to third terms.

Request for Atlantic Herring Fishery Disaster Declaration: Staff provided analysis and support for Governor Baker's August 18 request to the Secretary of Commerce to declare a fishery failure in the Atlantic herring fishery. While not a NEFMC action, this effort is grouped here because fishery disaster declarations are also

authorized under the Council's founding legislation (the Magnuson-Stevens Fishery Conservation and Management Act). Record low recruitment has driven the resource to historically low levels, resulting in significant herring quota decreases. Severe economic hardship has resulted, with herring fishery revenue more than halved from the recent 5-year average, and further quota reductions imminent. Staff anticipated quota cuts will not just exacerbate impacts in the directed herring fishery but cause run-on economic problems for the American lobster, Atlantic mackerel and Silver hake (whiting) fisheries. As of the end of CY2020, the Massachusetts request, along with similar declarations from other New England states, remained under review with NOAA Fisheries.

Atlantic States Marine Fisheries Commission

The Atlantic States Marine Fisheries Commission (ASMFC) coordinates the conservation and management of 27 nearshore, migratory fish and shellfish species along the Atlantic coast. The Commission was formed through an Interstate Compact, ratified by the states and approved by the U.S. Congress in 1942. Each member state from Maine through Florida is represented by three Commissioners—the director of the state's marine fisheries management agency, a state legislator, and an individual appointed by the state's governor to represent stakeholder interests—who collectively have one combined ballot on votes taken by the Commission's species management boards. These species management boards develop and adopt interstate FMPs, which are then implemented at the state level. Failure to implement interstate FMP requirements can result in a non-compliance determination triggering the U.S. Department of Commerce to close a state's fisheries until regulatory compliance occurs. In addition to interstate fisheries management, Commission deliberations also address fisheries science, habitat conservation, and law enforcement.

Meetings: During 2020, Massachusetts had a declared interest and served on 16 species management boards, including American Eel, American Lobster/Jonah Crab, Atlantic Herring, Atlantic Menhaden, Atlantic Striped Bass, Atlantic Sturgeon, Bluefish, Coastal Sharks, Horseshoe Crab, Northern Shrimp, Shad/River Herring, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, Tautog, Weakfish, and Winter Flounder. DMF represented Massachusetts at the four routine quarterly meetings of the ASMFC (Winter, Spring, Summer and Fall), plus two additional Board-specific meetings (Policy and Tautog), four additional meetings held jointly with the Mid-Atlantic Fishery Management Council on co-managed species (Summer Flounder/Scup/Black Sea Bass and Bluefish), and five Atlantic herring days out meetings. All of these meetings, except the Winter Meeting, were held virtually due to the Covid-19 pandemic. Staff chaired the ASMFC management boards (for at least part of the year) for American Lobster/Jonah Crab, Shad/River Herring, and Atlantic Menhaden.

State representation was also provided on the ASMFC Executive Committee and Interstate Fisheries Management Program Policy Board. The Executive Committee met remotely with unprecedented frequency to address the coordination and distribution of CARES Act Fisheries Relief (see page 96), along with other shared management challenges wrought by the Covid-19 pandemic. Management and Policy staff also served on various committees that were active in 2020 including a Striped Bass Work Group (early development of Amendment 7 issues); the Striped Bass Plan Development Team (for Amendment 7); a Recreational Mode Split Working Group; and the Tautog Plan Review Team (reviewing state management proposals and compliance reports); and also attended the meetings of various other technical, scientific, and monitoring committees to stay informed of the latest developments in interstate management issues.

Public Hearings: States are afforded the opportunity of a public hearing for any draft addendum or amendment to the ASMFC's interstate fishery management plans. DMF assists ASMFC in the scheduling and moderation of such hearings. During 2020, DMF hosted four ASMFC public hearings to collect stakeholder input on the following management actions: the Summer Flounder, Scup, and Black Sea Bass Commercial/Recreational Allocation Amendment (February 13 in Bourne); the Bluefish Allocation and Rebuilding Amendment (February 13 in Bourne); Atlantic Herring Draft Addendum III addressing management of the inshore Gulf of Maine fishery

(March 2 in Gloucester); and Black Sea Bass Draft Addendum XXXIII addressing the commercial state allocations and quota management (virtually on October 29). The hearings addressing summer flounder, scup, black sea bass, and bluefish management were held as joint hearings for the Mid-Atlantic Fishery Management Council's complimentary federal FMP actions.

Actions: Several of the more remarkable fishery management actions that DMF staff played an integral role in 2020 included: the Striped Bass Management Board's approval of the states' Addendum VI implementation plans (measures to reduce fishing mortality by 18% and reduce recreational discard mortality) and initiation of Amendment 7; the Atlantic Menhaden Management Board's adoption of ecological reference points (ERPs) and the selection of a TAC for 2021 that quantitatively accounts for predator forage demands; the Summer Flounder, Scup and Black Sea Bass and Bluefish Boards' ongoing development of amendments addressing commercial/recreational sector re-allocation in response to recalibrated recreational catch estimates and commercial state quota re-allocation in response to changing species and fishery dynamics; and the Policy Board's approval of a process for states to amend recreational fishing measures in response to Covid-19 impacts (and subsequent approval of MA's for-hire black sea bass season).

Fisheries Management Actions

Described below are the fishery management actions enacted by DMF during 2020. Actions fall into several categories: permanent regulatory changes to 322 CMR (Code of Massachusetts Regulations) which can occur only after a public hearing and comment period on the proposals and are subject to the MFAC and Commissioner of DFG's approval of the Director's recommendation; temporary (90-day) regulatory changes to 322 CMR under the Director's Emergency Authority for the preservation of the public health, safety or general welfare; annual specifications and adjustments under the Director's Declaration Authority as established in pertinent regulations, some of which require public comment periods; time-specific authorizations or restrictions per Letters of Authorization, Permit Conditions, Pilot Programs, and Quota Transfers.

Atlantic Herring

Commercial Regulations: DMF adopted a 2,000-lb. incidental catch and small-scale fishery limit for non-federal permit holders to streamline the Commonwealth's specification process by only requiring issuance of permit conditions to federal category permit holders. Additionally, DMF updated language and terminology regarding the MA/NH Spawning Area Closure to better conform to the IFMP. This included refining the definition for the gonadal somatic index, expanding the closure duration from four to six weeks, eliminating the 5-day advance notification requirement for the closure, and reducing the threshold for spawn herring in sample catch to extend the closure from 25% to 20%.

Area 1A Effort Control Permit Conditions: DMF implemented weekly landing limits, days out, and seasonal closures for the directed herring fishery in Area 1A (inshore Gulf of Maine) consistent with ASMFC Herring Management Board decisions. Permit conditions were issued to vessels which had declared into the directed fishery through DMF's opt-in process and according to their federal category permit. The Massachusetts/New Hampshire spawning closure was also implemented per the FMP's default closure dates (September 23–November 3) by permit conditions.

Atlantic Menhaden

Commercial Regulations: Several regulatory amendments were adopted effective May 1 for the state's commercial menhaden fishery. The 95% quota-use trigger that formerly dropped the limited entry fishery's trip limit to 6,000 pounds was rescinded because it had been preventing the state from harvesting 100% of its

available menhaden quota; this results in a 25,000-pound trip limit being in effect for 85–100% quota use. With the increased likelihood that the state's commercial fishery will take 100% of the available commercial quota, DMF also adopted regulations to allow the state to apply to participate in the Episodic Event Set-Aside (EESA) program, as allowed under the interstate FMP. The EESA is a set-aside of 1% of the coastwide quota for the northeast states (ME–NY) if they take their state allocated commercial quota by September 1. Under the regulations, if Massachusetts were to participate in the EESA fishery, limited entry commercial menhaden permit holders would be allowed to continue to fish in state-waters under a 120,000-pound trip limit until the cumulative effort of all participating states exhausts the set-aside. DMF also amended its allowance for harvest after the state's allocated quota is used, consistent with the interstate plan. A new incidental catch and small scale fishery allowance permits commercial fishermen to fish at a 6,000-pound trip limit once 100% of the quota is taken, provided any purse seines used do not measure 150 fathoms in length and 8 fathoms in depth or greater. This replaced DMF's prior bycatch allowance, which was more restrictive and allowed for only an incidental catch of up to 1,000 pounds of menhaden provided the menhaden catch did not exceed 5% the weight of the entire catch. Lastly, DMF established the limited entry commercial menhaden fishery as an owner-operator fishery, requiring the individual named on the commercial permit to be onboard the vessel when any commercial menhaden fishing activity is occurring. This action was designed to enhance compliance and address concerns regarding the activation of latent effort.

Episodic Event Set-aside Permit Conditions: For the first year, Massachusetts participated in the Episodic Event Set-aside Fishery, as authorized under the interstate FMP and the state's new regulations (above). DMF closed the state's quota managed fishery effective August 7, and subsequently enrolled in the program through a request to ASMFC. The menhaden fishery re-opened under the EESA effective August 17, and closed August 27. Because less than 10% of the set-aside quota remained upon our enrollment, DMF issued permit conditions restricting participants to a 25,000-pound trip limit (rather than the regulation's 120,000-pound trip limit), consistent with the management of the last 15% of the state's quota.

Commercial Quota Transfers: Massachusetts received four transfers of commercial menhaden quota totaling 2.35 million pounds, bringing the state's quota to just under 8.4 million pounds. These transfers from North Carolina (2), South Carolina (1), and Rhode Island (1) were made in response to persistent high inshore availability of menhaden and enabled the fleet to continue harvesting at a 25,000-pound trip limit accountable to the quota, rather than under the 6,000-pound small scale/incidental catch limit which is not accountable to the quota. Two of the transfers occurred in July and preceded the state's participation in the EESA Fishery, and two occurred in August, providing for additional harvester access after the closure of the EESA fishery. Menhaden quota transfers require multi-state agreement and ASMFC approval per FMP requirements.

Bluefish

Recreational Regulations: Massachusetts' recreational bluefish possession limits were revised effective May 1 consistent with coastwide action by the ASMFC to not exceed the 2020 recreational harvest limit. The universal 10-fish limit was replaced with a 5-fish limit for anglers aboard for-hire vessels and a 3-fish limit for anglers fishing from shore or private vessels. The season remained open year-round, with no restriction on the size of bluefish that may be retained.

Commercial Quota Transfers: DMF transferred a total of 70,000 pounds of the state's annual bluefish commercial quota to other states in 2020. These transfers to North Carolina (55,000 pounds) and Rhode Island (15,000 pounds) were made in early November after the Massachusetts' fishery had effectively concluded and had no impact on the state's landings. Bluefish quota transfers require multi-state agreement and ASMFC and NOAA Fisheries approval per FMP requirements.

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 Pilot Program: In cooperation with neighboring states, DMF implemented a pilot program for the Fluke Period I fishery (January 1–April 22) to provide additional flexibility and efficiency to the fleet. The pilot program allows vessels which are also permitted to land summer flounder in adjacent states (e.g., Connecticut and Rhode Island) to possess non-conforming quantities of summer flounder when landing in Massachusetts. This allowance is contingent on the vessel properly labeling the catch destined for each state, not exceeding the aggregate trip limit for the participating states where they are permitted, and not offloading more than the state's applicable landing limit. Additionally, participating vessels must be equipped with a Vessel Monitoring System authorized by NOAA Fisheries. Midway through its inaugural season, DMF expanded the scope of the pilot program to similarly allow the possession of multiple state limits of black sea bass. Participation in the pilot program was granted through Letters of Authorization issued to eligible harvesters.

Fluke Commercial Period I Declarations: DMF made a temporary adjustment to the Fluke Period I (January 1–April 22) commercial trip limit to increase the fleet's access to the state's available quota, 30% of which is targeted for harvest by the Period I fishery. Effective February 23, the trip limit was increased from 1,000 pounds to 2,000 pounds by a Director's Declaration for the rest of Period I.

Fluke Commercial Period II Regulations: DMF revised the state's regulations for the Period II (April 23–December 31) directed commercial fluke fishery in response to an elevated quota level and underperformance with the quota in 2019. For the inshore summertime fishery (June 10–October 31), the commercial trawl trip limit was increased from 300 pounds to 400 pounds and the commercial hook and line trip limit was increased from 200 pounds to 250 pounds (still Sundays–Thursdays). For the offshore fall fishery (November 1–December 31), the closed fishing days of Fridays and Saturdays were eliminated. Additionally, the trip limit was adjusted to allow vessels to possess and land 1,000 pounds of summer flounder if 5% or more of the quota remains available on November 1; otherwise a 500-pound limit is in place.

Fluke Commercial Period II Pilot Program: Via Letters of Authorization, DMF renewed the pilot program begun in 2019 allowing trawlers during the summertime fishery (June 10–October 31) to retain and land two consecutive days' limits of fluke. The program contains provisions that require the vessel operator to segregate the first day's catch into a sealed container and provide documentation regarding each day's fishing activity in a DMF issued logbook. This program was designed to provide small-scale trawlers increased flexibility, safety, and efficiency in targeting the available fluke quota. Effective July 22, DMF modified the pilot program to similarly allow participating vessels the possession and landing of two consecutive days' trip limits of horseshoe crab and black sea bass to avoid unnecessary discarding in the mixed-species trawl fishery.

Fluke Commercial Period II Declarations: DMF made several temporary adjustments to the Period II commercial summer flounder limits in 2020 via a Director's Declaration. Effective August 23, the trip limit for trawlers was increased from 400 pounds to 600 pounds. Then effective October 4, the trip limit was increased to 1,000 pounds for all gear types and the closed fishing days (Fridays and Saturdays) were eliminated. Lastly, effective November 1, the trip limit was increased to 2,000 pounds for all gear types.

Scup Commercial Winter I & II Declarations: Two Director's Declarations set the 2020 Winter I and II trip limits at 50,000 pounds and 24,000 pounds, respectively, to complement the federal measures. A Statement of Permit Conditions was issued for each declaration.

Black Sea Bass Commercial Regulations: Given a 59% increase to the state's 2020 commercial quota for black sea bass, DMF increased the limits for the directed fishery (July 9–quota) by about 30%. The trip limit for pot fishermen was increased from 300 pounds to 400 pounds and the limit for commercial anglers was increased

from 150 pounds to 200 pounds (still Sundays, Tuesdays, and Thursdays). The seasonal set-aside for the weir fishery was also increased from 15,000 pound to 24,000 pounds. The incidental catch limits for trawlers were also adjusted to enhance the retention of marketable fish and reduce regulatory discarding. The possession limit for trawlers during the springtime small mesh trawl squid fishery (April 23–June 9) was increased from 50 pounds to 100 pounds (still with a 50,000-pound aggregate cap). Additionally, during the summertime large mesh mixed trawl fishery (June 10–October 31), trawlers became authorized to retain and land up to 100 pounds of black sea bass during the open fishing days in the commercial fluke fishery, rather than the prior allowance of 150 pounds but only on open black sea bass days during the summertime directed black sea bass fishery (July 9–Quota).

Black Sea Bass Commercial Declarations: DMF made several temporary adjustments via Director's Declaration to the 2020 commercial black sea bass limits in response to fishery performance and quota utilization. Effective August 30, the daily trip limit for both pot and hook and line fishermen were increased by 25%, from 400 pounds to 500 pounds for pot fishermen and from 200 pounds to 250 pounds for hook and line fishermen. In addition, Mondays and Wednesdays were added as open commercial fishing days effective August 31, providing five open days per week (Sundays–Thursdays), followed by the addition of Fridays and Saturdays effective October 2.

Black Sea Bass For-Hire Permit Conditions: DMF issued permit conditions to extend the recreational black sea bass season for anglers aboard for-hire trips into the fall in response to a Covid-19 based for-hire fishing closure affecting the start of the season. This season, which would have ended on September 9, was extended through October 9 for the for-hire fishery. DMF requested and was granted approval for this action by the ASMFC through a conservation equivalency proposal. As such, the 31 days added to the end of the for-hire season were projected to result in the same amount of harvest that likely would have occurred aboard for-hire vessels during the seven days that the fleet was prohibited from fishing for black sea bass during the spring (May 18–May 24).

Commercial Quota Transfers: In March, DMF agreed to transfer 200,000 pounds of scup Summer Period commercial quota to Connecticut based on prior years' fishery performance indicating that this would not impact the Massachusetts scup fishery while assisting the Connecticut fishery with their low allocation. DMF accepted transfers of commercial fluke quota (6,965 pounds) and commercial black sea bass quota (3,165 pounds) from North Carolina in June to account for landings made by three vessels bound for that state but granted safe harbor in Massachusetts after experiencing mechanical issues. An additional 9,185 pounds of summer flounder commercial quota was transferred from North Carolina to Massachusetts for landings made in December after a similar mechanically-based safe harbor situation. In November, Massachusetts received requested transfers of commercial black sea bass quota from New Hampshire (10,000 pounds) and Maine (5,000 pounds) to ensure that the state's pot harvesters would be able to retain the fish within their gear upon final retrieval for the season. All such transfers require multi-state agreement and ASMFC and/or NOAA Fisheries approval per FMP requirements.

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 Declaration: DMF lifted the April Groundfish Closure in Massachusetts Bay from Plymouth to Marblehead for 2020. As specified in regulation, this closure may be annually rescinded with a Director's Declaration when it is determined that doing so will not result in an exceedance of the annual federally allocated state-waters sub-components for regulated groundfish stocks or will not compromise federal conservation objectives.

Gulf of Maine Cod For-Hire Permit Conditions: DMF issued permit conditions to extend the recreational Gulf of Maine cod season for anglers aboard for-hire trips from September 15–September 30 to September 8–October 7. This action was consistent with that taken by NOAA Fisheries to provide the for-hire fleet with these additional 14 days in the fall season to make up for lost access to the groundfish fishery in the spring due to Covid-related restrictions.

Horseshoe Crab

Commercial Regulations: DMF established a 75-crab open access trip limit for trawlers fishing for summer flounder who do not hold the limited entry horseshoe crab bait permit endorsement. This regulatory limit was meant to replace the issuance of Letters of Authorization as done in prior years allowing such vessels to take the same 300-crab limit that the limited entry permit endorsement allows. This change responded to 2019's earlier-than-usual closure of the horseshoe crab quota (on September 1), which forced trawlers fishing in the large mesh mixed trawl fishery to discard any horseshoe crabs incidentally caught during September and October.

Commercial Letters of Authorization: While the intent of the above regulation to establish an open access trip limit was to avoid an early closure of the horseshoe crab quota, its result in 2020 was to slow landings more than necessary, thus impacting the supply of horseshoe crabs for the biomedical market. Accordingly, in late August letters of authorization were issued to interested trawlers to again retain the 300-crab limit throughout the end of September or until the quota was caught.

Permit Conditions: DMF issued permit conditions effective October 9 that adjusted the commercial horseshoe crab open fishing days for mobile gear fishermen in response to in-season adjustments that increased the number of open commercial fishing days in the fluke trawl fishery. In order to reduce regulatory discarding, properly permitted fluke draggers were exempt from the no-fishing days for horseshoe crabs while quota remained.

Protected Species

Right Whale Protection Declarations: An April 25 aerial survey by the Provincetown Center for Coastal Studies estimated five right whales feeding at or near the surface in southern Cape Cod Bay, including two mother/calf pairs. Accordingly, on April 27, DMF announced extensions of the seasonal speed limit restriction and fixed gear closure in the Bay (which were set to expire on May 1) through May 7. However, a subsequent aerial survey on April 29 indicted that the whales had migrated out of the Bay, and the extensions were rescinded. This situation demonstrated the utility and effectiveness of DMF's declaration authority to protect rights whales when present in state waters.

Sharks

Spiny Dogfish Commercial Quota Transfers: Between January and March, the Northern Region states of Maine–Connecticut transferred a total of 3.7 million pounds of their shared Fishing Year (FY) 2019 commercial spiny dogfish quota. These quota transfers were to Virginia (three transfers totaling 3.2 million pounds) and New Jersey (one transfer of 500,000 pounds). Given the seasonality of the Northern Region fishery, which occurs predominantly during the summer and fall months, these transfers were not expected to impact the region's fishery, while assisting these southern states to avoid premature closures of their fisheries which last later into the fishing year. Spiny dogfish quota transfers require multi-state agreement and ASMFC approval per FMP requirements.

Coastal Sharks: Effective March 20, DMF implemented a suite of regulations largely intended to conform with recent revisions to the interstate requirements and federal regulations. This included adopting sex specific recreational minimum size limits for shortfin mako sharks ; mandating the use of inline corrodible circle hooks when recreationally fishing with natural baits; requiring that shortfin mako sharks caught in commercial fishing gear be immediately released if alive at haul-back; allowing coastal sharks legally caught by longlines outside of state-waters to be landed in Massachusetts ports; and implementing federal rules regarding the retention of certain coastal shark species while in possession of tunas, swordfish, and billfish.

Striped Bass

Recreational Regulations: Three revisions were made to the recreational fishing regulations in time for the 2020 season. First, DMF adopted the interstate plan's new 28" to less than 35" slot limit as required for 2020. When implemented coastwide, Addendum VI projected that this measure would end overfishing by cutting recreational removals by 18%. Addendum VI also adopted a circle hook mandate for recreational bait fishing for striped bass to improve catch and release survival, but with a one-year delay in the implementation deadline (2021). In advance of this, DMF adopted for 2020 a requirement for all anglers fishing from shore or a private vessel (but not aboard for-hire vessels) to use a circle hook when recreationally fishing for striped bass with whole or cut natural bait, except when used in conjunction with an artificial lure. DMF sought but was not granted an allowance to maintain these exemptions under Addendum VI's circle hook mandate for 2021. Additional rulemaking was anticipated to occur in early 2021 for compliance with the circle hook requirement. Lastly for 2020, DMF required all recreational anglers to use a non-lethal device when using a device to remove striped bass from the water (e.g., a net) to reduce discard mortality. This effectively prohibited gaffing of striped bass by recreational anglers. These rule changes took effect on May 1.

Commercial Regulations: The commercial striped bass minimum size limit was increased from 34" to 35" for the 2020 season. DMF's principal reason for adopting this change was to improve enforcement and compliance by segregating the commercial and recreational fisheries based on the size of fish they may retain. This modification had a minor effect on the state's quota provided in the interstate plan. All states' commercial quotas were reduced by 18% to end overfishing on the resource, assuming no change to their size limit. The one-inch increase modified MA's newly reduced quota from 713,247 pounds to 735,240 pounds. DMF also rescinded two regulatory provisions that became unnecessary with the change in the size limit: 1) the fin-clipping requirement for commercially permitted fishermen fishing recreationally on a closed commercial fishing day; and 2) the allowance for dual for-hire and commercial permit holders to sell unwanted striped bass taken by their for-hire clients during a recreational fishing trip. These rule changes were implemented on May 1.

In addition, effective June 3, DMF closed the Cape Cod Canal to commercial striped bass fishing. Under the rule, all striped bass retained from the Cape Cod Canal or possessed within 1,000 feet of the Canal's shoreline must adhere to the recreational fishing limits. An exception was made for the possession of striped bass 35" or greater legally caught elsewhere for commercial purposes and being actively transported through the 1,000-foot buffer area to a primary dealer. This action was taken to address numerous and worsening public nuisance and safety problems arising from increased fishing activity along the Canal. These problems, including anglers conducting themselves in threatening and unruly manners, parking illegally on adjacent roads, trespassing over private property, and interfering with other recreational activities, had been especially acute on open commercial striped bass fishing days. Although the primary mission of the Canal is navigation, a secondary objective of the U.S. Army Corp of Engineers' management of the surrounding area is to provide recreational opportunities for the public. This regulation was also expected to greatly enhance compliance and enforcement with the new recreational striped bass conservation rules at one of the most productive fishing locations for large bass. Given the Canal's great popularity as a shore fishing location for striped bass, the Massachusetts Environmental Police and local police departments rely heavily on public tips of illegal fishing activity; however,

these tips have previously been hindered by the virtual indistinguishability of recreational and commercial striped bass fishermen. The closure of the Canal to commercial striped bass fishing (in combination with the new 35" commercial minimum size) should enhance the ability of anglers to see and accurately report illegal striped bass fishing activity. This rule was initially implemented via emergency action, and subsequently adopted as a permanent final regulation.

Commercial In-Season Adjustment: DMF temporarily added Tuesday as an opening commercial fishing day beginning on September 1 for the 2020 season, by Director's Declaration. This increased the number of fishing days per week from two (Mondays and Wednesdays) to three (Mondays–Wednesdays). This action responded to fishery performance and quota utilization, and also accommodated commercial fishermen interest to conduct fishing activity over consecutive days to take advantage of night fishing opportunities that may otherwise be limited by having non-consecutive open fishing days.

General Matters and Other Species

For-hire Fishing Permit Conditions: Consistent with guidance from the Executive Office of Energy and Environmental Affairs regarding the conduct of boating and marine related activities during the Covid-19 pandemic, DMF issued permit conditions that prohibited all for-hire fishing activity in Massachusetts during the period of April 27–May 24, 2020, and continued to limit the capacity of nearly all permitted Head Boats throughout the year. Upon the initial re-opening on May 25 (Phase I), Charter and Head Boats were restricted to no more than 10 people, including captain and crew (note that Charter Boats are capped at six fishing passengers). Under Phase II, effective June 9, the restriction was changed to no more than ten customers, excluding captain and crew. Under Phase III, Step 1 (as amended August 12), the restriction applicable to Head boat was increased to 50% capacity or 10 passengers, whichever is greater, but not to exceed 50 passengers (plus captain and crew). Effective December 13, this restriction was modified from 50% to 40%. Extensive social distancing, hygiene, cleaning/disinfecting, and various operational safety measures also applied.

Purse Seine Permit Conditions: DMF issued routine permit conditions setting forth restrictions on the use of purse seines in order to properly conservation and manage inshore bait fisheries. Two sets of permit conditions were issued specific to Inshore Net permits (which allow the use of purse seines in the Inshore Restricted Waters) and Coastal Access Permit Purse Seine endorsements (that do not). These conditions include such items as reporting requirements, maximum net size, spotter plane limitations, prohibited areas, and closed days.

Sand Lance: Effective May 1, DMF adopted a 200-pound trip limit for sand lance. Sand lance had been an unregulated species in Massachusetts. The new limit was designed to prevent the proliferation of an industrial scale bait or reduction fishery on this important nearshore forage species, while continuing to accommodate small-scale commercial or personal bait harvesting activity with beach seines or other similar artisanal gear.

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 2020, DMF initiated three adjudicatory proceedings based on violations that occurred during 2019. One hearing was based on incident reports alleging violations of whelk minimum size rules. Another hearing was based on incident reports alleging violations of egg-bearing lobster rules. The last hearing addressed incident reports alleging violations of the state's commercial black sea bass open fishing days and trip limits, harvester and dealer reporting requirements, and primary buyer regulations. Each of these matters carried on into 2021.

Three adjudicatory proceedings that were initiated prior to 2020 were concluded in 2020. The first matter addressed trap tag and trap limit violations in the conch pot fishery and resulted in a three-year suspension (2021–2023) of the commercial fisherman's regulated conch pot fishery permit endorsement. The second matter addressed the transferability of a coastal lobster permit and was resolved by having DMF allow the transfer of this permit. The last matter was initiated in 2017 and addressed alleged mobile gear fishing violations. This matter was continued until a final disposition was made in the parallel criminal case, which occurred in late February 2020. For a number of reasons, DMF withdrew its claim in this matter in September 2020 and no actions were taken against the permit.

Other Activities

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. DMF's Director and SMAST's Dean co-chair the MFI.

In 2020, the MFI continued its record of providing independent scientific research applied to regional, national, and international marine fisheries with an emphasis on cooperative research between scientists and fishermen. MFI researchers have been highly productive in a variety of areas, including bycatch reduction, conservation engineering, population dynamics, stock assessment, survey methodology, and management research. In addition to MFI contributions to research, MFI has also been a vehicle for advancing graduate education in fisheries-related fields. This includes direct involvement by and support for students in MFI research and workshop activities, participation by DMF scientists in graduate and post-doctoral advising and development of courses, enrollment of DMF personnel in graduate programs, as well as other educational efforts. Additional details can be found in the MFI Annual Report.

Striped Bass Conservation License Plate

During 2019, DMF and the Massachusetts Environmental Trust (MET) collaborated to develop a new Striped Bass Conservation Plate; funds generated from its sale would be dedicated to striped bass studies, fish passage improvement projects, and angler education. By early 2020, the minimum number of orders to launch a new license plate was met and the plate went into production with the expectation that they would be distributed to Registry of Motor Vehicle offices for pickup by pre-applicants within 8 months. However, the Covid-19 pandemic interrupted this schedule, and at year's end distribution of the new plates was still on hold. DMF and MET provided regular updates to pre-applicants throughout the year and remained committed to see the plate come to fruition in 2021.

Additional Committee Work

Staff served as the state's representative to the Stellwagen Bank Sanctuary Advisory Council (SAC), which included attendance at seven (virtual) Council or sub-committee meetings in 2020. The SAC is a community-based body, established by the Secretary of Commerce per the National Marine Sanctuaries Act, that advises the sanctuary superintendent on issues relevant to the effective implementation of the Sanctuary management plan. In 2020, the SAC began work on a revision to the Sanctuary's management plan, last updated in 2010.

Permitting and Statistics Program

Personnel

Story Reed, Program Manager
Anna Webb, Fisheries Statistics Project Leader
Kerry Allard, Permitting Project Coordinator
Kim Lundy, Dealer Reporting Coordination & Quota Monitoring
Erich Druskat, Fisheries Data Analyst
Nicholas Buchan, Harvester Reporting Coordination
Mary Ann Fletcher, Fisheries Statistics Support
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
Amanda Meli, Seasonal Receiving Teller
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 7,184 commercial fisherman permits in 2020 (Table 1). Over the past decade, DMF has seen a general increase in commercial fisherman permit sales, particularly for small Boat, 0–59' in length,

and Rod & Reel permits (Figure 2).

Table 1. 2020 commercial fisherman permit issuance.

Permit Type	Permits Issued (#)	
	Residents	Non-residents
Coastal Lobster	1,040	7
Offshore Lobster	285	99
Seasonal Lobster	104	1
Boat 99+'	12	18
Boat 60-99'	74	208
Boat 0-59'	3,452	378
Individual	212	6
Shellfish and Seaworm	818	0
Shellfish and Rod & Reel	397	0
Rod & Reel	790	57
Total	**7,184**	**774**

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.

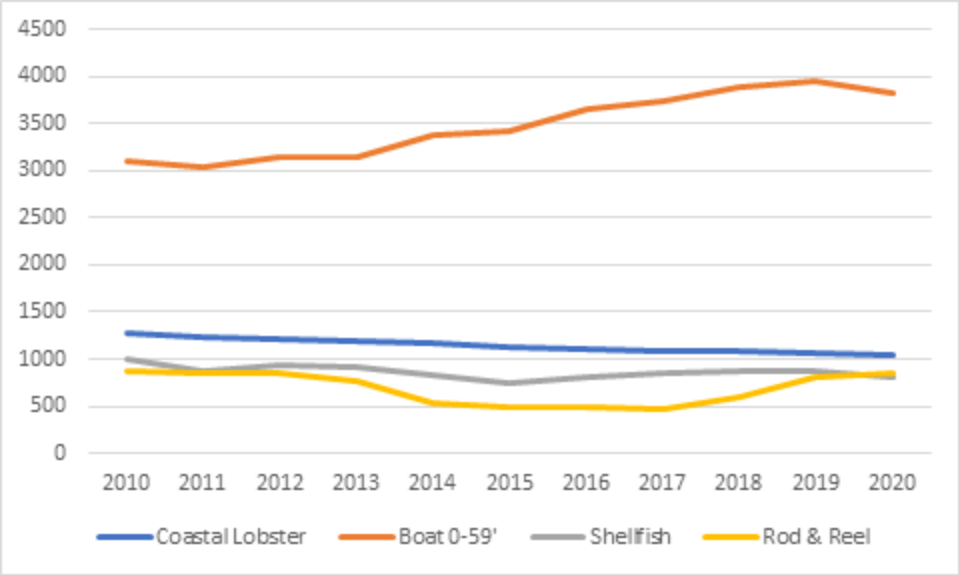

Figure 2. Trend in sales of four frequently issued commercial fisherman permits, 2010–2020.

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. DMF issued a total of 2,050 seafood dealer permits in 2020 (Table 2), a number relatively unchanged over the past ten years.

Table 2. 2020 dealer permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Wholesale Dealer	379	7
Wholesale Truck	83	125
Wholesale Broker	32	12
Retail Dealer	824	98
Retail Truck	36	3
Retail Boat	301	2
Bait Dealer	132	12
Retail Farmer's Market	4	0
Total	**1,791**	**259**

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 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. For 2020, the fee for this permit was waived after the COVID-19 public health emergency was declared on March 10, 2020. This action was taken in recognition of the need to get Retail Boat permits issued quickly to fishermen who were struggling to sell their lobsters, fish, and sea scallops to traditional wholesale markets.

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 & Regulated Fishery Endorsements

Special Permits are required for certain activities in the marine environment, as described below. DMF issued a total of 19,474 special permits in 2020 (Table 3). 2020 Special Permit issuance is nearly consistent with 2019.

Table 3. 2020 special permit & regulated fishery endorsement issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Non-commercial Lobster	6,379	107
Regulated Fishery Endorsements	11,627	833
Master Digger	4	0
Subordinate Digger	33	0
Scientific Collection	59	11
Shellfish Propagation & Aquaculture	420	1
Total	**18,522**	**952**

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 214,568 recreational saltwater fishing permits in 2020 (Table 4). Issuance rose over 9% for the year, due to increased interest in outdoor activities during the pandemic.

Table 4. 2020 recreational saltwater fishing permit issuance.

Permit Type	Permits Issued (#)	
	Resident	Non-resident
Recreational Saltwater, Age 16–59	139,434	15,809
Recreational Saltwater, Age 60+	53,499	4,995
Charter Boat	724	54
Head Boat	46	7
Total	**193,703**	**20,865**

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 for-hire vessel that can carry up to six persons fishing as passengers.

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

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. 2020 Limited Entry Permit Transfer Statistics.

Permit/Endorsement Type	Permits Transferred (#)	
	Resident	Non-resident
Coastal Lobster	23	0
Mobile Gear Coastal Access	4	4
Fish Pot	2	1
Fluke	14	4
Black Sea Bass	18	5
Groundfish	2	1
Surf Clam/ Ocean Quahog	0	0
Quahog Dredge	0	0
Horseshoe Crab	1	0
Menhaden	0	2
Tautog	2	0
Inshore Net	0	0

Fisheries Statistics Project

Dealer Landings Data Collection

Landings or purchases of all marine species by seafood buyers from commercial fishermen were collected as part of the dealer reporting program. Since 2005, all primary buyers not already required by federal law to report electronically have been required to report under state regulations. Through 2019, all data from these state-reporting dealers were submitted to DMF via paper forms and entered into the Atlantic Coastal Cooperative Statistic Program's (ACCSP) Standard Atlantic Fisheries Information System (SAFIS) database by project personnel or entered directly into SAFIS electronically by the dealers. Beginning January 1, 2020, all state-reporting dealers were required to submit data electronically via SAFIS applications, the file upload method, and/or a certified third-party vendor. Project staff spent a significant amount of time creating outreach documents and training dealers making the transition to electronic reporting in 2020.

In 2020, 2,046 businesses obtained a Massachusetts seafood dealer permit. Of those, 656 (or 32%) 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 656 dealers, 309 had a federal dealer permit and the remaining 235 dealers were categorized as "state-reporting." Due primarily to the COVID-19 pandemic, there were 28% more primary buyers in 2020 as many businesses pivoted to selling product direct to consumers via boat retail sales to mitigate some of the losses. DMF offered the retail boat seafood dealer permit free of charge to any permit holder interested in this business plan and as a result, issued close to 200 more permits than in previous years, all of which were primary buyers.

As is the case every year, all primary buyers 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. The extra workload from the increase in issued permits caused some delays in processing this primary buyer paperwork.

Throughout the year, 122,582 dealer reports were entered into the SAFIS database, a decrease of approximately 40,000 reports compared to 2019 due to the COVID-19 pandemic. Federal-reporting dealers electronically submitted 76% of these transactions. The percentage of federal landings is unchanged compared to 2019.

Total landings (in whole pounds), as reported through the SAFIS database or other federal reporting programs, amounted to 599 million pounds, valued at $557 million (ex-vessel; calculated from price paid to fishermen). This represents a decrease of about 18% in overall landed pounds and value as compared to 2019, which highlights the significant COVID-19 impact on Massachusetts fisheries. More specifically, ex-vessel value was down approximately 19.5% between March and December compared to the same time in 2019 (Figure 3). January and February were strong months though, thus the overall losses were slightly reduced. The top five species landed in 2020 in order of value were sea scallop, American lobster, haddock, Eastern oyster, and Atlantic surf clam totaling $446 million, or 80% of the total value. Haddock was one of the few species to show an increase in landings in 2020 while oysters lost the third highest valued rank for the first time in several years as the fishery had the greatest overall losses in value at over 40% as compared to 2019. Offshore shellfish (sea scallop, Atlantic surf clam, and ocean quahog) made up 60% of the total value landed in Massachusetts, whereas inshore and intertidal landings of shellfish, such as soft shell clam, northern quahog, blue mussel, and oyster amounted to less than 6% of total value landed. Landings of invertebrate species (lobster, crabs, and whelk) amounted to 30 million pounds, valued at $94 million, or 17% of the total value landed. Cumulative finfish landings, including both pelagic and benthic species, made up 17% of the total value with groundfish species amounting to 11% of the total value. Landed species with an individual gross value over $2 million are shown in Table 6; in aggregate, these species accounted for approximately 97% of the total value of all species landed.

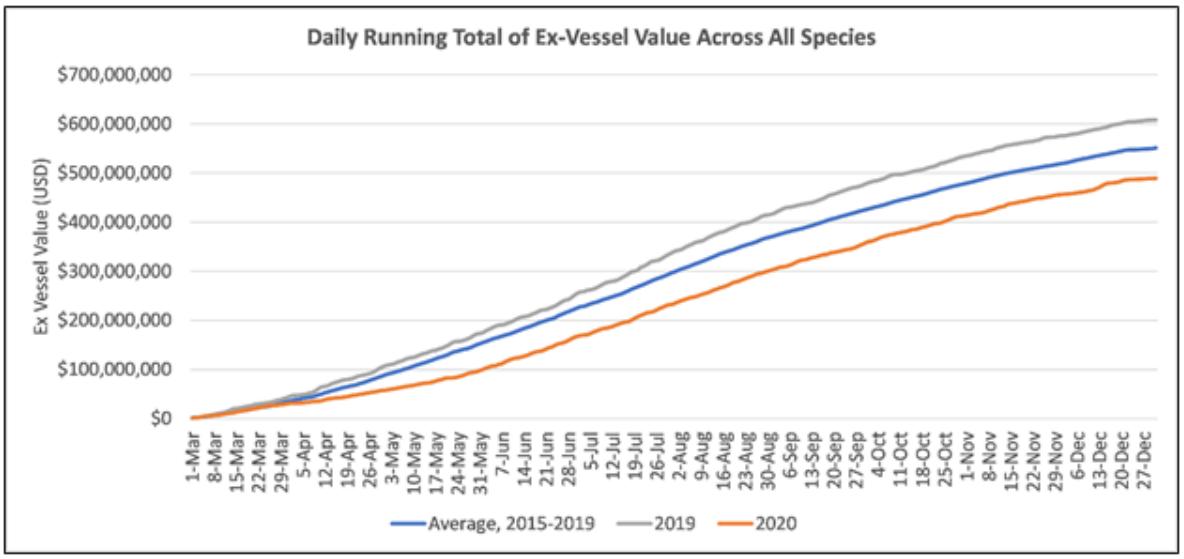

Figure 3. 2020 daily running total ex-vessel value from March 1–December 31, 2020 as compared to the same time period over the previous 5-year average and to 2019. Source: ACCSP Data Warehouse; 4/22/2021.

Table 6. 2020 MA-landed species with ex-vessel value over $2 million.* Source: ACCSP Data Warehouse, 4/22/21.

Species	Landings (whole pounds)	Ex-Vessel Value
Sea scallop	264,092,545	$314,194,865
American lobster	15,763,212	$78,604,366
Haddock	21,876,728	$21,736,453
Eastern oyster	5,560,863	$17,779,874
Atlantic surf clam	67,173,719	$14,054,743
Jonah crab	8,649,738	$7,059,428
Soft shell clam	3,252,085	$7,056,969
Acadian redfish	12,878,774	$7,055,782
Ocean quahog	79,841,618	$6,958,555
Northern shortfin squid (*Illex*)	19,123,638	$6,721,935
Monkfish	12,273,549	$6,032,788
Pollock	7,125,699	$5,659,006
Silver hake (whiting)	4,049,493	$4,635,020
Bluefin tuna	1,072,070	$4,351,171
Northern quahog	3,285,544	$3,918,564
White hake	3,891,995	$3,491,336
Winter skate	13,656,580	$3,483,155
Atlantic cod	1,468,781	$3,184,807
Menhaden	8,827,142	$3,136,550
Channeled whelk	943,579	$3,136,331
Witch flounder (gray sole)	1,773,513	$2,878,047
Atlantic sea herring	8,629,455	$2,437,318
Atlantic Mackerel	8,798,640	$2,366,313
American plaice (dab)	1,368,566	$2,229,933

*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 4) 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
2020 Landings and Quota Information
as of Apr 15, 2021 - 07:45 A.M.

Species	2020 MA Landings	2020 Quota	Quota Type	Percent Landed
Black Sea Bass	722,101	743,565	MA	97.1%
Bluefish	112,667	115,838	MA	97.3%
Dogfish	6,574,604	13,153,004	CW	to NMFS
Fluke	700,390	795,584	MA	88.0%
Horseshoe Crab*	163,295	165,000	MA	99.0%
Menhaden	8,360,307	8,417,582	MA	99.3%
Scup (Winter I)	101,395	10,027,953	CW	to NMFS
Scup (Summer)	616,920	1,668,915	MA	37.0%
Scup (Winter II)	68,672	8,394,299	CW	to NMFS
Striped_Bass	386,924	735,240	MA	52.6%
Tautog	63,405	62,797	MA	101.0%

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 4. 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 (available since 2010), while SAFIS eTRIPS Mobile is a newer 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 by project staff; fishermen also have easy access to their own landings within SAFIS.

Following a redesign of the administrative interface in SAFIS that made possible a more flexible data collection program, eTRIPS Online underwent a significant redesign in 2020 which went live on January 1, 2021. Project staff were integral to that project, meeting weekly with ACCSP during the latter stages of development to discuss testing results and partner needs. DMF also provided insight into end-user needs as well as basic requirements for the expanded fixed gear data collection that began at the launch for 2021.

Project staff spent much of 2020 preparing for mandatory changes to harvester reporting requirements within the lobster and Jonah crab interstate FMP. Addendum XXVI to Amendment 3 requires increased spatial

resolution in data collection programs for federal waters activity by requiring ten-minute squares be reported in addition to the statistical area typically reported. Large scale management issues such as ocean planning and protected species interactions drove this need for finer spatial resolution of commercial activity in addition to the other newly required trip level elements including but not limited to numbers of buoy lines. Eight new elements were added to the MA data collection program, of which 5 were implemented for fixed gear fisheries only (e.g., sink gillnet and pot/trap fisheries). Simultaneously with the redesign of eTRIPS which made possible such changes, partner states and federal representatives met frequently throughout 2020 to define and standardize these new data collection elements for a 2021 data collection launch. Additionally, significant time was spent redesigning the 2021 paper reporting form to accommodate the new fields, creating outreach materials for the new paper form including regional maps of ten-minute squares, and detailed instructions for data entry.

Additionally, a new field was added to the reports for tautog reporting in 2020 as mandated by ASMFC. This field captured number of fish landed in addition to the weight of the landing. This data element was expected to be used to assist validation of the tag requirements implemented for the first time in 2020. Due to the timeline of the SAFIS redesign effort, DMF accepted all tautog reports on paper for 2020 and will be entering them into SAFIS later.

In 2020, DMF issued 7,952 commercial harvester permits, of which 18% were for federal reporting vessels, and the remaining 6,498 commercial permits were designated as “state-reporting.” Thirty-nine percent of all permit holders reported electronically using the SAFIS eTRIPS Online or Mobile applications, a 2% increase in electronic reporting participation since 2019. This left 43% of all harvesters submitting paper reports to DMF. Of the 83,288 commercial trips that were entered into the SAFIS database for state reporting harvesters for the 2020 calendar year, approximately 31% were entered by commercial permit holders using one of the SAFIS eTRIPS applications, with the remaining trips entered by DMF staff. This percentage of electronically entered trips is similar to previous years. Compared to 2019, and as a result of the pandemic, the total number of trips reported for 2020 was down approximately 19%.

Data Analysis and Dissemination

On March 10, 2020, the governor of Massachusetts declared a state of emergency, and all personnel began working from home on March 18, 2020. The pandemic not only impacted the day-to-day operations of the Project, but also the industry it serves and supports, as described above. Landings and reporting were not a priority for many as they pivoted business models or closed temporarily.

While every effort was made to adapt to this new reality, there were significant impacts on progress during this time. Delays in typical workflows were frequently encountered and were compounded by unexpected additional workloads. The primary task added to the project during 2020 was assisting in the management of the distribution of Coronavirus Aid, Relief, and Economic Security Act Fisheries Relief Program (CARES) funds to Massachusetts permit holders. This work was prioritized and required several months of work to finalize and complete. Related to this, project staff were continuously asked to provide updates on documented COVID-related losses to the commercial and aquaculture industries. Other, more routine tasks generally took longer to complete. Significant time was dedicated to routine activities such as ensuring correct harvester reporting methods, but maintaining compliance metrics for harvester and dealer reporting was not a priority until the fall. Additionally, significant time was spent working with ACCSP to validate landings for a variety of species throughout this time as stock assessments and other data heavy projects continued. A few projects are highlighted below.

CARES: Project staff heavily participated in the CARES Program. In order to pre-qualify permit holders into sector specific income-based tiers, project staff conducted extensive analyses of total annual landings for individual

permit holders. Additionally, permit holders were able to appeal their pre-qualification status, and project staff worked closely with the sector leads to verify submissions. See the CARES Act Fisheries Relief section (page 96) for more information.

Port Profile Analysis: DMF, in collaboration with the Urban Harbors Institute, continued 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, with an expected release date of spring 2021. This work required detailed review of landings data from 2014 through 2018 and required a significant amount of time from project staff to meet deadlines.

Striped Bass Tagging Program: 2020 was the seventh year of a commercial striped bass fishery tagging program mandated by ASMFC to reduce poaching coast-wide. This program is conducted at the dealer level in Massachusetts (Table 7). Program staff estimated the 2020 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.

Table 7. 2020 striped bass tagging statistics (as of July 2021)**.**

# of Dealers Receiving Tags	# of Tags Purchased by DMF	# of Tags Distributed	# of Tags Returned	# of Tags Used	# of Tags Missing
170	65,000	46,520	25,527	19,605	1,388

Tautog Tagging Program: 2020 was the first year of a commercial tautog fishery tagging program mandated by ASMFC to reduce poaching coast-wide. Per the FMP, this program is conducted at the harvester level in all states (Table 8). Commercial fishermen must tag their commercial tautog catch through the operculum prior to offloading the fish from the fishing vessel and selling the fish into commerce. The tautog tags are single use metal tags inscribed with the calendar year, state of issuance, and sequential tag number.

Table 8. 2020 tautog tagging statistics (as of July 2021)**.**

# of Eligible Fishermen	# of Fishermen Receiving Tags	# of Tags Purchased by DMF	# of Tags Distributed	# of Tags Returned	# of Tags Used
218	160	35,000	34,775	13,502	21,273

ACCSP Participation and Planning

DMF staff continued to participate in all partner-based committees within ACCSP. Staff served on the Operations, Information Systems, Commercial Technical, and Standard Codes committees, while staff from the recreational program served on the Recreational Technical committee. 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, policies, and the eTRIPS redesign project as described above. ACCSP tasks demanded even more time from project staff throughout the year, and this is expected to continue moving forward as their applications continue to expand.

Tracking Projects: Work continued on two ACCSP-funded pilot projects investigating cellular-based vessel monitoring systems (VMS), which carry lower costs and may be just as effective in inshore waters, or even offshore 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 conducted in early 2020 and a report was released in summer 2020. The second project focused on the integration of VMS data with eTRIPS Mobile reporting and done in collaboration

with Rhode Island, began in earnest in 2020; however, the pandemic influenced the project plan dramatically. Commercial fisheries ground to a virtual halt in March as the Commonwealth, along with most other states and countries, closed the restaurant industry to slow the spread of the virus. International markets shut down, and seafood dealers advised their harvesters to stay home as well. While some fisheries began to recover by the fall, obtaining volunteers to field test anything was difficult as staff did not feel it was appropriate to ask anything extra of industry members during this trying time.

Staff and partners instead focused on app development and API testing. App development was able to move forward, and the integration of Faria Beede, Pelagic Data Systems, CLS America, and Succorfish devices was finalized. The developers were able to successfully connect to the device APIs and transmit track data to ACCSP. Continued testing of the built-in mobile device GPS also succeeded in Apple devices and some Android devices. Further testing of eTRIPS mobile 2 via DMF vessels and staff cars showed success in tracking trips with all devices. This testing led to numerous bug fixes and iterative development, and the application was considered ready for field testing near the end of 2020.

The eTRIPS mobile 2 Map View was also completed. This allows harvesters to view their tracked trips on a dynamic map from within the application while connected to WiFi. Additional work by ACCSP on an administrative interface for the project showing the VMS locations of vessels in a jurisdiction is in progress as well as additional items such as testing GeoFencing capabilities of the devices and tablet GPS. The project was expected to complete in fall 2021 with an application for future funding to continue development later.

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 2020. This free application, launched into production in Massachusetts (and Maine) in August 2016, 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 a few dealers using the application in 2020. 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) under the larger direction of the Executive Office of Technology Services and Security (EOTSS). During 2020, 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, made more time consuming due to remote work.

Oracle Database/Application Development & Maintenance: DMF continued to use three production databases and associated applications during 2020: Commercial Permits and Statistics; Lobster Sampling; and Shellfish Sampling & Area Management. The Aquaculture Permits application remained paused during 2020. EOEEA-IT initiated a project to redesign the current Oracle system and associated applications in late 2018; however, the project was paused throughout 2020 due to funding and time limitations from EOEEA-IT. The project was expected to resume in early 2021.

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 second wave of deployments in Gloucester happened in early 2020, right before the pandemic began. The pandemic shifted the process dramatically, and combined with supply chain issues, resulted in some DMF staff still without new mobile assets well into 2021.

Remote Work: The abrupt shift to telework due to the pandemic resulted in a significant amount of unexpected work on IT liaison staff. Getting all DMF staff up and running remotely required coordination of assets, VPNs, and other tools. Additionally, EOEEA-IT and EOTSS continuously pushed out new software to aid employees in telework. By the end of 2020, all staff were using new Microsoft tools such as OneDrive, SharePoint, and Teams to work collaboratively and remotely. While not available to everyone by the end of 2020, the speed at which these tools were released helped most staff better transition to remote work.

SHELLFISH AND HABITAT SECTION

Shellfish Sanitation and Management Program

Personnel

Kevin Creighton, Interim Program Manager (January–April)
Jeff Kennedy, Program Manager (starting May)

Gloucester
Florence Cenci, Bacteriologist III, 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

New Bedford
Thomas Shields, New Bedford Regional Shellfish Supervisor, Hughes Hatchery Manager
Gregory Sawyer, Biologist III
Susan Boehler, Bacteriologist III, Shellfish Lab Supervisor
Dr. Christian Petitpas, Biologist III, Aquaculture & Vibrio Specialist
John Mendes, Biologist II
Terry O'Neil, Biologist II
Simone Wright, Biologist II
Holly Williams, Biologist II
Kaley Towns, Biologist II
Gabriel Lundgren, Biologist I
Brianne Shanks, Bacteriologist I
Einat Sandbank, Biologist I
Audrey White, Seasonal Technician

Newburyport
Diane Regan, Bacteriologist III, Shellfish Lab Supervisor
Conor Byrne, Depuration Coordinator I
Richard Hardy, Wildlife Technician II
Peter Kimball, Wildlife Technician II

Overview

The Shellfish Sanitation and Management Program focuses on public health protection, as well as the management of the Commonwealth's molluscan shellfish resources. Public health protection is ensured through sanitary classification and 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 a multipronged approach including direct DMF regulation of the commercial surf clam, ocean quahog, and quahog dredge boat fisheries; and indirectly managing other 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. In addition, DMF 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.

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 harvest. Minimum requirements are set by the NSSP Guide for the Control of Molluscan Shellfish.

To satisfy NSSP requirements in 2020, staff biologists completed 285 annual reports, 71 triennial evaluations, and 15 sanitary surveys (Table 9). Thirty-one conditional area management plans were re-evaluated. A total of 8,077 water samples were collected and analyzed for fecal coliform bacteria from 249 shellfish growing areas in 63 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 sampling frequency, completion of required reports, conditional area management plan updates, and conformity with appropriate water quality criteria requirements. The USFDA's 2020 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.

Table 9. Summary of 2020 shellfish growing area report and sampling activity.

	North Shore	South Shore	Total
Annual Reports	27	258	285
Triennial Evaluations	21	50	71
Sanitary Surveys	5	10	15
Management Plans/MOUs Reviewed	20	11	31
Total Water Samples	1,806	6,271	8,077
Classification Station Water Samples	1,704	6,185	7,889
Pollution Source Water Samples	68	86	154
Ad-hoc Water Samples	34	0	34
Shellfish Growing Areas Sampled	20	229	249
Classification Sub-Areas sampled	103	402	505
Cities/Towns Sampled	19	44	63

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 5). 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 and culture of seed for commercial shellfish aquaculture and municipal propagation programs under a DMF permit.

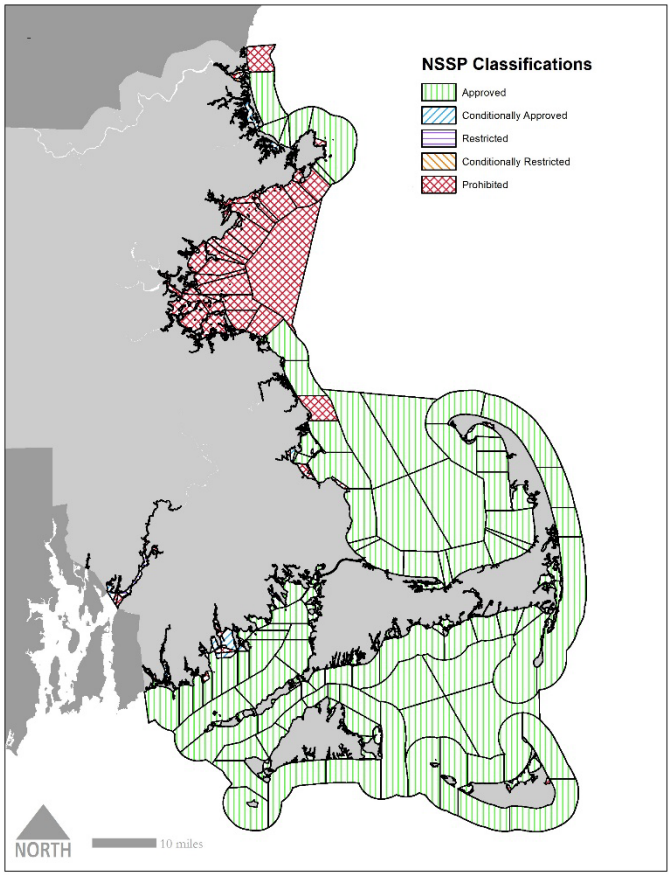

Figure 5. 2020 NSSP classification map of MA waters.

In 2020, a total of 1,743,992 acres were assigned a Classification (Table 10). The total acreage of Prohibited areas increased in 2020, while the acreage of all other areas decreased. These changes were primarily due to stricter NSSP requirements and guidelines that were defined in the 2019 revision of the NSSP Guide for the Control of Molluscan Shellfish that was published in October 2020.

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 2020, staff generated 447 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).

Table 10. Change in Massachusetts shellfish growing area classification, 2019 to 2020.

Area Classification	Acreage		
	2019	2020	Change
Approved	1,475,515	1,456,151	-19,364
Conditionally Approved	24,638	24,618	-20
Restricted	2,962	2,525	-437
Conditionally Restricted	4,509	4,430	-79
Prohibited	236,369	256,267	19,899
Total	1,743,992	1,743,992	

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 349 shellfish samples from state waters were processed for PSP during 2020, plus 18 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. In 2020, the Nauset system closure was enacted on March 19, over a month earlier than 2019, but toxin levels never rose beyond that date and the closure for all species, other than blue mussels, was lifted on April 30. The blue mussel closure remained in place out of an abundance of caution and was lifted on May 28 (Figures 6).

North shore and particularly South shore closures are less frequent. 2020 was a very quiet year for the North and South shores as the coastal bloom never really arrived. No toxicity was detected in any samples from these coastal areas during the entire 2020 sampling season.

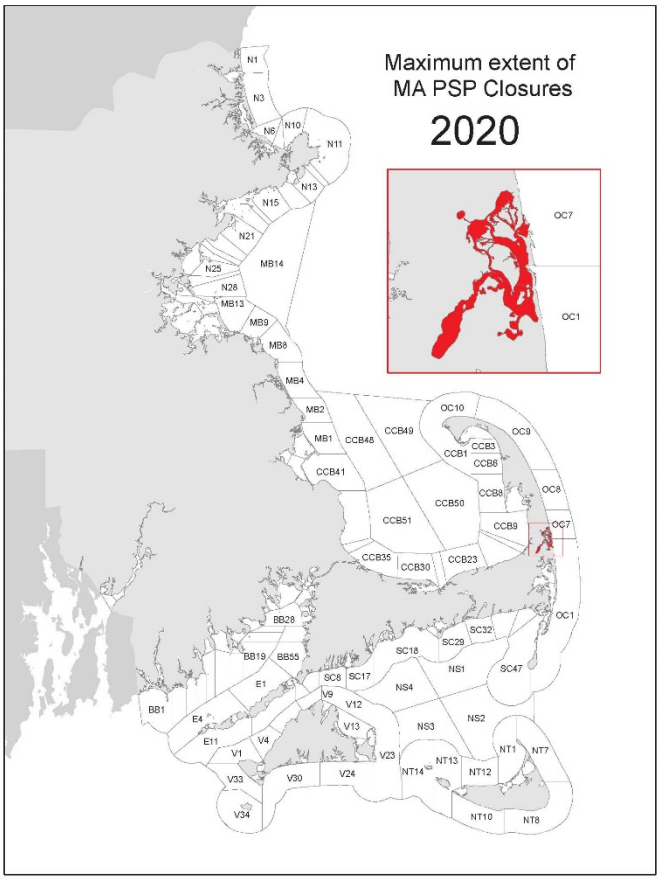

Figure 6. 2020 PSP closure.

There were no reported illnesses due to PSP from Massachusetts shellfish in 2020, as is typical.

Phytoplankton Monitoring: There are many kinds of microscopic algae that potentially pose a public health risk due to biotoxin production. Though PSP, caused by the dinoflagellate *Alexandrium*, 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. Overall, 2020 was a quiet year for harmful algal blooms. Phytoplankton monitoring occurred year-round on the North Shore, with 199 samples collected from the four primary regional stations in Newburyport, Ipswich, Essex, and Gloucester. We began seeing cells of *Alexandrium* in late March but counts stayed low and only hit a high of 122 cells/liter in late May. There were varying abundances of both small and large cell *Pseudo-nitzschia* throughout the year. In the beginning of June there was a bloom of small *Pseudo-nitzschia* at our northernmost site in Newburyport. As a precaution, we ran Scotia rapid test strips—these were all negative. Once again, we found *Karenia mikimotoi* in Massachusetts waters. We began seeing cells in the middle of July, hit a peak in August, and cells were once again gone by the end of September. We have seen *Karenia mikimotoi* every year since 2017 from the end of July until the end of September. While the presence of *Karenia mikimoitoi* is generally not considered a public health risk, it is noted due to its association with fish kills and potential role in the recent hypoxic events in Southern Cape Cod Bay.

Along the South Coast, eight routine monitoring stations are sampled year-round, in a biweekly manner, alternating between Duxbury, Barnstable (Cape Cod Bay side), Wellfleet and Westport one week and Barnstable (Hyannis Harbor), Eastham (Nauset), Mattapoisett, and Swansea the following week. In 2020, 286 individual samples were collected and brought to the New Bedford office for analysis. Maximum *Alexandrium* cell concentration during the Nauset closure was 550 cells/liter. Varying abundances of small and large *Pseudo-nitzschia* were observed at all South shore monitoring stations. On two occasions abundances of *Pseudo-nitzschia* approached or exceeded 50,000 cells/liter: Mattapoisett in February and Cape Cod Bay side of Barnstable in November. In both cases, replicate Scotia rapid screening kits for ASP were run and results were negative for domoic acid. Follow-up sampling showed concentrations decreased in the subsequent weeks and no further toxin testing was necessary.

In addition to monitoring of primary stations for biotoxins and potentially toxic algae, Shellfish staff responded to multiple reports of discolored water and potential cyanobacteria blooms throughout the region. In most cases non-toxic algal blooms were identified and no further action was necessary. One such sample collected on September 8 in response to rust-colored water observed in Sandwich Basin revealed a dense bloom of *Karenia mikimotoi.* Also in early September, DMF staff examined samples from three great ponds on Martha's Vineyard (Chilmark Pond, Squibnocket Pond, and Tisbury Great Pond). Tisbury Great Pond was experiencing a non-toxic diatom algal bloom, but potentially toxic cyanobacteria blooms of the genus *Dolichospermum* were observed in Squibnocket and Chilmark Ponds. Since Chilmark Pond and the affected area of Squibnocket Pond have Prohibited classifications, no additional shellfish harvest closures were necessary.

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 coastal communities, bacterially contaminated shellfish to Approved and Conditionally Approved waters for natural purification and propagation. All activities are conducted under strict NSSP guidelines and are heavily supervised by state and local enforcement authorities. The Division has a policy that requires shellfish remain in the water through at least one spawning season: contaminated shellfish must remain in the transplant site until at least September 15 if relocated by June 15 of the same year; if the shellfish are transplanted after June 15, the shellfish must remain in the transplant site until at least September 15 of the following year. No shellfish can be harvested until

bacterial testing has been completed on each lot. Quahogs are the most frequently transplanted species followed by oysters. Prior to transplant operations, disease testing is 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.

Two dredge boats were initially contracted by nine towns and were permitted to commence transplant harvesting in the Taunton River in late June. The start date is generally in mid-April when the water temperatures reach a minimum of 45°F but was delayed in 2020 due to COVID-19 issues. One of the boats dropped out of the program in August due to mechanical issues leaving one boat to complete the transplants. Most of the spring transplants were started in late-June and completed by mid-October. The two boats moved a total of 4,637 bushels of quahogs to nine coastal communities during the "spring" transplant season (Table 11). An additional 3,225 bushels of quahogs were delivered to five Buzzard Bay towns between July and mid-October as part of the B-120 Shellfish Restoration Program (Table 12). Due to a Status change from Open to Closed in New Bedford Shellfish Growing Areas BB13 and BB15, no contaminated quahogs from the Taunton River were relayed to the City of New Bedford as part of the New Bedford Commerce Terminal Quahog Mitigation Project during 2020.

As part of the B-120 Shellfish Restoration Program, two oyster reef planting projects were conducted in Buttermilk Bay, in the Towns of Wareham and Bourne. Under the authority of a DMF contaminated shellfish relay permit, 175,000 seed oysters were planted by DMF and town staff at the two oyster reefs.

Three in-town contaminated shellfish transplants occurred in Provincetown, Barnstable, and Falmouth during 2020 (Table 13). The Provincetown transplant moved 200 bushels of oysters from the east side of the pier to the western end of the harbor. Barnstable transplanted 172 bushels of quahogs from the Bumps River to East Bay and Falmouth moved 70 bushels of oysters to two areas in West Falmouth Harbor from their overwintering site at the DPW building.

Table 11. 2020 Municipal Spring Relays of contaminated quahogs.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
Taunton River	Truro	Pamet Harbor	CCB7.1	266	Jul 6
Taunton River	Yarmouth	Lewis Pond	SC31.20	500	Oct 1
Taunton River	Wareham	Broad Cove	BB42.2	449	Jul 30
Taunton River	Dennis	Bass River Center	SC34.23	65	Jul 20
Taunton River	Westport	East Branch	BB4.26	1,757	Nov 17
Taunton River	Swansea	Coles River	MHB4.26	300	Jul 10
Taunton River	Sandwich	Sandwich Harbor	CCB37.0	300	Jul 29
Taunton River	Fairhaven	Round Cove	BB18.20	500	Aug 28
Taunton River	Wellfleet	Inner Harbor & Harbor	CCB13.21, .22 & 11.20	500	Jul 25

Table 12. 2020 B-120 contaminated quahog transplants from the Taunton River.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Last Day Planted
Taunton River	Gosnold	Cuttyhunk Pond	E11.2	25	Oct 12
Taunton River	Dartmouth	Apponagansett Bay	BB12.23	800	Oct 19
Taunton River	Fairhaven	Round Cove	BB18.20	800	Aug 28
Taunton River	Wareham	Onset Bay	BB40.20	800	Sept 22
Taunton River	Bourne	Phinney's Harbor	BB46.20	800	Aug 25

Table 13. 2020 Contaminated oyster and quahog transplants.

Harvest Site	Transplant Town	Transplant Site	Area	Bushels	Species
Provincetown Inner Harbor	Province-town	Provincetown Inner Harbor	CCB4.21	200	Oyster
East Bay	Barnstable	East Bay	SC24.0	172	Quahog
Overwintering Site	Falmouth	W. Falmouth Harbor	BB54.24 & BB54.25	70	Oyster

Depuration: DMF has operated the Shellfish Purification Plant in Newburyport since 1961. The commercial harvest of mildly contaminated soft shell clams 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.

Throughout 2020 the Purification Plant received clams on 129 days out of the year. The plant allowed harvesters to dig five days per week, up one day a week from 2019. Although the frequency of days increased, the total number of days harvested increased only by one. The Purification Plant experienced a 39% decrease in racks processed for depuration. Four Master Digger Permits were active throughout 2020, in addition to an out-of-state harvester who transported product from Maine to be processed and released for instate consumption. The plant saw an increase in areas frequented by harvesters in 2020. Digging resumed in GBH 5.2, Logan Airport, as well as various areas throughout the Weymouth area.

Digging came to a halt in early March of 2020 due to the COVID-19 pandemic. Harvesting resumed in May, and although the rack quantities recovered to pre-COVID numbers, the total number of racks for the year suffered a loss. 2020 saw an incredible price increase for soft shell clams. As the summer wore on, harvesters migrated to digging open areas as opposed to contaminated areas, chasing a higher price rather than larger quantities.

Wet Storage

2020 marked the eighth 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.

2020 saw a 64% decrease in racks processed for wet storage. The demand for wet storage services ground to a halt in early March due to the mandatory COVID-19 shutdown. Processing of shellfish was deemed an essential service, and like many other food related programs, operations began again in early May. As demand for clams over the summer months increased, the digging of areas resumed and production recovered to pre-COVID harvest levels. Wet storage services, however, did not recover, primarily due to unprecedented demand that the industry encountered in the summer months. Dealer operations simply did not have the supply on hand, or the lead time required.

During COVID-19 restrictions, the plant continued to operate as a food facility. While the plant was closed to the public, maintenance and staffing schedules were adjusted to accommodate COVID-19 guidelines. In July, the single 125-foot salt water well failed, necessitating an emergency purchase and installation of a new pump. During this downtime, plant staff painted concrete and metal surfaces in the dry plant and cabinets in the laboratory. Staff also acquired HACCP training and researched options for saltwater backup sources.

Shellfish Purification Plant Laboratory

The Shellfish Purification Plant's laboratory analyzed 233 shellfish samples from 129 lots for fecal coliform in compliance with federal and state depuration standards. In addition, 230 UV effluent sea water samples, 157 raw seawater well samples, and 320 tap water and control samples were bacteriologically tested for the more stringent drinking water standard of total coliform. The laboratory also tested 88 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 NH shellfish and environmental waters.

The laboratory also continued the FY20 partnership with Gloucester Marine Genomics Institute. The laboratories were assessing the relationship between MSC and associated environmental viral risk factors within Massachusetts shellfisheries. Due to COVID-19 restrictions, limited field sampling and testing was conducted in the spring of 2020. The partnership commitment extended to the end of CY20 as funding sources to continue the study were explored.

For the fifth year, the Purification Plant laboratory participated in DMF *Vibrio parahaemolyticus* (*Vibrio*) assessments used to determine *Vibrio* management plan protocols. For two weeks in 2020 the DMF study compared intertidal and subtidal oyster response when challenged with a two-day heat abuse treatment and then resubmerged. The Newburyport laboratory analyzed 66 samples by qPCR for total and pathogenic *Vibrio*.

The Plant laboratory staff successfully participated in FDA proficiencies for regulatory tests and *Vibrio*, and helped secure FDA sponsored grants for DMF shellfish equipment and DMF shellfish personnel training. Laboratory staff virtually attended the 2020 IAFP conference. During the pandemic shutdown while the plant was closed to the public, the Shellfish Plant Laboratory remained open processing depuration, *Vibrio*, MSC and MSC/GMGI study samples. Staff continued to participate in monthly ISSC Laboratory Committee and Laboratory subcommittee conference calls, perform upkeep and laboratory maintenance, and prepare laboratory supporting documentation.

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. During this 3-year period, annual planting numbers were far below the targeted 2 million seed quahogs per year due to a shortage in supply from commercial hatcheries. This shortage of available seed combined with lower than predicted annual survival rates of planted quahogs indicated that our mitigation approach was insufficient to reach the program objectives. As a result, no seed quahogs were planted in 2018.

Consequently, beginning in 2019, DMF modified the 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 13-acre mitigation site off Fort Tabor in New Bedford Outer Harbor. In November 2020, DMF conducted a two-day dive survey of the Fort Tabor mitigation site to assess survival of planted quahogs and success of the previous year's work (Figure 7). DMF divers found 374 quahogs in the 18 square meters surveyed, resulting in a site-wide estimate of 710,168 quahogs present in the area and a 90% survival of planted quahogs.

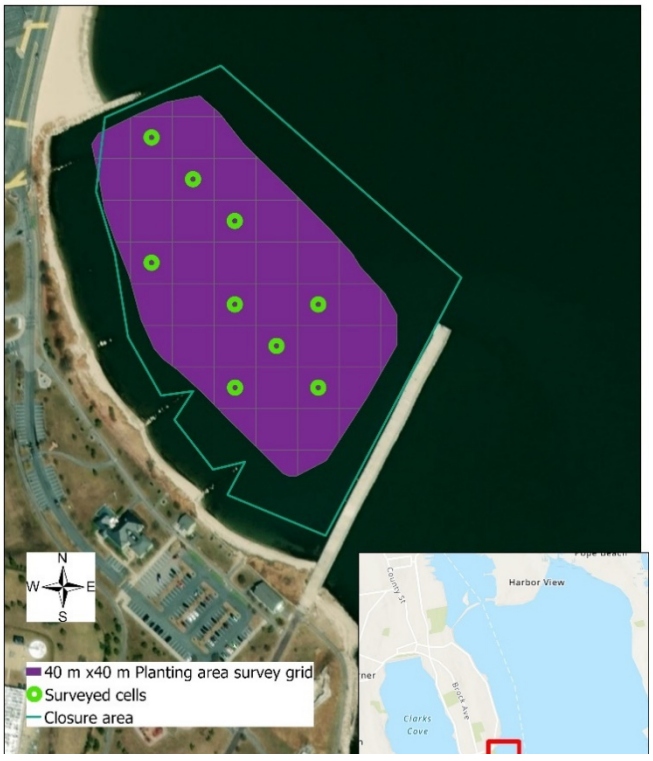

Figure 7. Map displaying the planting area within the Fort Tabor mitigation site with digital grid constructed for selecting post-planting survey sample locations. Selected cells surveyed in 2020 are marked in green.

In early 2020 three new mitigation sites were chosen for adult contaminated quahog relays in the summer of 2020. Due to required closures of shellfish growing areas in Clarks Cove and New Bedford Outer Harbor, DMF and the New Bedford Shellfish Constable agreed to postpone the relay of quahogs until the classification issues could be resolved in 2021.

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 oversaw 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 was 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 2020, relays were successfully completed in five towns (Dartmouth, Fairhaven, Bourne, Wareham, Cuttyhunk) with a total of 3,225 bushels of quahogs transplanted among all 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 received 846,000 1.5-mm quahog seed purchased from Muscongus Bay Aquaculture in Maine. Seed was grown and monitored from late June through mid-November but did not reach the target field plant size of 15–20 mm in shell length at the end of the growing season. DMF and Fairhaven personnel decided to overwinter the quahogs in grow-out bags secured in suitable subtidal habitat. In June of 2020, DMF-certified divers retrieved the overwintered quahogs and returned them to Fairhaven's upwellers for further grow-out. In October, the surviving 210,000 seed quahogs ranging from 4–28mm in length were planted (Figure 8). The quahog seed was planted in the same closed area that was planted with adult contaminated quahogs earlier in the year.

Figure 8. Largest quahogs planted in Fairhaven on October 9 (up to 28 mm in length).

- Single Oyster Purchases and Out-planting: The B-120 oyster project began in 2017 in Bourne, 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. In 2020, DMF conducted surveys of the five previously planted oyster restoration sites to measure the success of restoration efforts. DMF also partnered with Bourne and Wareham shellfish departments to plant single oysters on two previously constructed oyster reefs in Buttermilk Bay. A total of 150,000 oyster seed ranging from 25–40 mm in length were planted over the two sites.

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 three major areas of concern: 1) certifying the issuance of aquaculture licenses by municipalities, 2) permitting of aquaculturists, towns, and hatcheries to obtain, possess and sell sub-legal shellfish (seed) for transplant and grow-out to legal size; and 3) reviewing shellfish pathology reports to add hatcheries to DMF's list of approved seed sources and prevent new introductions and spread of shellfish diseases in Massachusetts waters.

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.

Table 14. New License Certifications in 2020.

Town	License Sites	Acres
Bourne	1	1.8
Eastham	3	3
Mattapoisett	2	53
Provincetown	5	5
Rowley	1	4
Tisbury	1	1
Yarmouth	1	3
Total	**14**	**70.8**

In 2020, Project staff certified 14 new shellfish aquaculture license sites which involved surveying 70.8 acres of tidelands (Table 14). An additional two site surveys were conducted that resulted in denial of certification due to the presence of eelgrass within the proposed license site in one case and the presence of quahog quantities considered a significant public resource in the other.

Staff also contributed to the completion of the online Massachusetts Aquaculture Permitting tool (page 53).

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 2020, DMF issued shellfish propagation permits to 386 private aquaculture license site holders (Table 15), and 28 municipalities (for public propagation activities) operating shellfish aquaculture projects in over 30 coastal municipalities throughout the Commonwealth.

In 2020, DMF also issued aquaculture permits for the culture of sugar kelp and horseshoe crabs (solely for the purpose of wild population enhancement).

Table 15. 2020 private shellfish propagation permits and acreage under cultivation by municipality.

Municipality	# Growers	Acres	Species Grown
Aquinnah	1	1.6	Quahog
Barnstable	48	158	Oyster, Quahog, Soft Shell Clam, Surf Clam
Bourne	7	16.8	Oyster, Quahog, Soft Shell Clam
Brewster	11	11.5	Oyster, Quahog
Chatham	2	7	Oyster, Quahog, Soft Shell Clam, Sugar Kelp
Chilmark	11	23	Oyster, Blue Mussel, Sugar Kelp
Dartmouth	2	1	Oyster
Dennis	27	32	Oyster, Surf Clam
Duxbury	28	77.5	Oyster, Quahog, Surf Clam
Eastham	28	42.6	Oyster, Quahog
Edgartown	11	17	Oyster
Essex	1	8.5	Oyster
Fairhaven	3	38	Oyster, Quahog
Falmouth	8	54	Oyster, Quahog, Surf Clam, Sugar Kelp, Steelhead Trout, Bay Scallop
Gosnold	1	32	Oyster
Harwich	1	0	Oyster, Sugar Kelp
Ipswich	1	1	Soft Shell Clam
Kingston	3	8.5	Oyster
Marion	4	2.5	Oyster, Quahog
Mashpee	4	19	Oyster, Quahog
Mattapoisett	2	60	Oyster, Bay Scallop
Nantucket	7	73	Oyster, Quahog
Oak Bluffs	1	2	Oyster, Sugar Kelp
Orleans	13	18.5	Oyster, Quahog, Blue Mussel, Surf Clam
Plymouth	30	81.5	Oyster, Quahog, Surf Clam, Bay Scallop
Provincetown	16	39	Oyster, Quahog, Soft Shell Clam
Rowley	1	4	Oyster, Soft Shell Clam
Tisbury	1	1	Oyster, Bay Scallop
Truro	6	20	Oyster
Wareham	8	83	Oyster, Quahog
Wellfleet	90	261	Oyster, Quahog, Soft Shell, Surf Clam, Blood Arc
Westport	6	80	Oyster, Quahog
Yarmouth	5	30	Oyster, Quahog
Grand Total	**386**	**1304.5**	

Aquaculture Landings

Aquaculture landings and value for oysters and quahogs are presented in Table 16. The COVID-19 pandemic created much hardship throughout the seafood industry in 2020, but impacted the oyster aquaculture fishery the hardest. Because the restaurant industry absorbs the lion's share of the raw oyster market, restaurant closures to on-site dining caused an immediate collapse of the oyster market in March and seafood dealers had an abundance of cultured oyster product that could not be sold. For about a week after the restaurant closures DMF staff managed requests from oyster growers to return (resubmerge) landed and sold oysters to their farms when the primary buyers could not sell the oysters and wanted to return the product. Oyster culture continues to

dominate the aquaculture industry in Massachusetts. However, with a total value of $17,052,029 in 2020, the cultured oyster industry suffered greater than 41% loss compared to the industry's value in 2019. Quahog aquaculture revenue increased substantially to $1,026,209 in 2020. This increase was driven primarily by quahog growers in the Town of Wellfleet. However, it is not clear whether this apparent increase in cultured quahog value can be attributed to an actual increase in cultured harvest, or the improved propagation permit annual reporting for 2020 that allowed DMF to capture and correct more quahog landings incorrectly attributed as wild harvest, or some combination of the two. Any future analyses of such data will include a caveat for the change in methodology for 2020 and beyond. The value of other cultured shellfish species and kelp does not substantially add to aquaculture landings value and are not reported here due to confidentiality issues.

Table 16. 2020 Aquaculture Landings and Value for Oysters and Quahogs.

American Oyster		
Town or Region	**Pieces**	**Reported Value**
BARNSTABLE	8,902,926	$4,682,035
BOURNE	41,600	$22,778
BREWSTER/CHATHAM	1,039,224	$581,008
DENNIS	908,186	$473,082
DUXBURY	8,195,177	$4,382,935
EASTHAM	676,726	$340,117
EDGARTOWN	1,087,156	$630,260
FALMOUTH	465,389	$251,677
MARION	35,800	$17,023
MASHPEE	48,150	$23,959
NANTUCKET	422,845	$325,796
ORLEANS	624,760	$347,650
OTHER ISLAND TOWNS	234,305	$191,097
OTHER SOUTH COAST TOWNS	882,386	$467,068
PLYMOUTH/KINGSTON	1,583,000	$804,049
PROVINCETOWN	95,382	$54,351
TRURO	61,749	$36,533
WAREHAM	355,700	$202,368
WELLFLEET	5,610,660	$2,844,693
YARMOUTH	715,134	$373,551
TOTAL	**31,986,255**	**$17,052,029**
Quahog		
Town or Region	**Pieces**	**Reported Value**
BARNSTABLE	717,052	$195,524
CHATHAM/EASTHAM/ORLEANS	35,221	$8,290
WELLFLEET	3,031,757	$822,395
TOTAL	**3,784,031**	**$1,026,209**
Total Aquaculture Landings Value		**$18,078,238**

Source: SAFIS Dealer Reports on April 2, 2021 and staff edits.

Throughout most of 2020, a substantial amount of DMF staff time was dedicated to fielding calls/inquiries from growers desperate to find alternative markets for their cultured oyster product since their primary market had collapsed. With a much-diminished market, unharvested oysters continued to grow on aquaculture sites and many growers were faced with an abundance of product that outgrew the optimal size for the raw half-shell market. DMF provided support to several external projects that created alternative markets for cultured oysters, particularly oversized oysters (See Other Activities Section).

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 2020, 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 continued to include nursery grow-out of quahogs, and oysters in upweller silos, tanks, and tables utilizing fresh seawater from Lagoon Pond and aeration.

In 2020, MVSG set 1.3 million oyster larvae onto shell at the Hughes Hatchery for an ongoing, pilot-scale project in Sengekontacket Pond. The spat on shell will be kept in bags and cages (safe from predators) until September of 2021, at which point it will be planted onto small beds of shells and oysters which were established in 2018. The goal is to increase microbial denitrification in Sengekontacket by promoting on-bottom oyster beds. This project is funded by the Friends of Sengekontacket.

MVSG continued with its aquaculture research in 2020 by developing methods to culture ''southern'' surf clams (*Spisula solidissima similis*). This inshore species of surf clams is more tolerant to higher water temperatures than their offshore deeper-water counterparts. Considered an alternative species among aquaculturists in the northeast, surf clams may offer the capacity of oyster growers to diversify their crop. When young surf clams reach 2 inches, they can be marketed as clams for pasta and raw bars; thus, the affectionate name of *butter clams*. During summer 2020, MVSG grew 100,000 seed surf clams for the Southeastern Massachusetts Aquaculture Center, which are now on several shellfish farms on Cape Cod and two on the Vineyard (Figure 9).

Figure 9. Southern surf clam seed produced at Hughes Hatchery. 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.

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 (*Vp*; *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 MassDPH.

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
2020	11

No changes were made to the *Vibrio* regulations for 2020. The *Vibrio* Control Season in Massachusetts runs from May 19 to October 19, 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* bacteria; 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.

There were 11 sole-source (traced to a single shellfish growing area) *Vibrio* illnesses in 2020 (Table 17). Despite the substantial efforts made in Massachusetts to curb *Vibrio* illness, certain harvest areas have continued to experience elevated levels of *Vibrio* cases, specifically Plymouth, Kingston and Duxbury Bays (CCB42, 43, 45), and Katama Bay (V20) on Martha's Vineyard. Eight of the 11 source-source illnesses traced back to oysters harvested in Katama Bay. There were another five multi-source illnesses that couldn't be traced back to a single growing area (e.g., oyster brand medley consumed), two traced to out-of-state growing areas, and one illness that was lost to follow-up.

DMF conducted *Vibrio* research in August 2020 involving a temperature-abuse experiment on cultured oysters in Plymouth Harbor. To assess the impact of 48 hours of exposure to ambient air temperatures (typical of air drying practices for anti-fouling purposes) on the abundances of total and potentially pathogenic *Vp*, oysters from both sub-tidal and inter-tidal "treatments" were exposed (abused) for two days then resubmerged at their respective source locations. *Vp* genes indicative of total and pathogenic *Vibrio* were measured in oysters in initial, abused (day 0) and after 2, 4, 6 and 8 days of resubmergence. Total *Vp* increased in abused oysters by three orders of magnitude and returned to environmental concentrations on Day 8 of resubmergence in the sub-tidal treatment and Day 6 of resubmergence in the inter-tidal treatment. Genes indicative of pathogenicity increased 2–3 orders of magnitude in the temperature abuse treatment and returned to environmental concentrations on Day 6 of resubmergence in the sub-tidal treatment and Day 4 of resubmergence in the inter-tidal treatment. Inter-tidal oysters purged their accumulated *Vibrio* burdens faster than the sub-tidal oysters. Given these results DMF concluded that the current 10-day resubmergence requirement in the *Vibrio* Control Plan is sufficiently protective of public health.

Other Activities

Staff participated in numerous professional organizations such as the Massachusetts Shellfish Officers Association and New England Estuarine Research Society.

Shellfish Program staff worked with the Cape Cod Cooperative Extension (CCCE) that administered the Woods Hole Sea Grant Rapid COVID Relief program. The program funded the purchase of oysters from commercial growers for outplanting in recreational shellfishing areas within four Cape towns. All activities were authorized by DMF via the issuance of Letters of Authorization (LOAs) to aquaculturists and municipalities for the sale and purchase of market-sized shellfish.

Shellfish Program staff also worked with the Nature Conservancy (TNC) and Pew Charitable Trusts on a program termed the SOAR program (Supporting Oyster Aquaculture and Restoration) to purchase oysters from growers for the purposes of shellfish restoration. DMF permitted the planting of oysters at three identified sites in Nasketucket and Buttermilk Bays via amendments to Bourne's, Wareham's and Fairhaven's Municipal Shellfish Propagation Permits, and issuance of LOAs to growers and TNC for the purchase and sale of market-sized oysters. Shellfish Program staff assisted with monitoring oyster deliveries, pathology sample collection and data compilation.

In 2020, DMF applied for and was awarded our second FDA Milk and Shellfish Grant to purchase shellfish program equipment. DMF used the $12,500 received to purchase needed supplies and equipment for the laboratory and for enhancing field studies, including an ice maker, dataloggers, a pH meter, binoculars, GPS units, and ASP toxin kits. DMF also received our first FDA Milk and Shellfish Grant for shellfish program training. This award of $12,880 was to support 14 DMF employees to attend the Northeast Shellfish Sanitation Conference Meeting in Rhode Island and four DMF bacteriologists to attend the Northeast Laboratory Evaluation Officers and Managers meeting in Long Island, NY. However, due to COVID-19 restrictions, these onsite meetings were cancelled. FDA restructured the grant conditions to permit states to use the money for virtual shellfish training opportunities. DMF had a total of 10 employees participate in attending five different conferences and training classes. DMF was also able to purchase two laboratory references books for each of the three DMF laboratories. DMF is grateful for the support of the FDA State Cooperative Shellfish Grant Programs that provided over $25,000 in capital and educational funding.

Habitat Program

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Overview

The Habitat Program protects and enhances marine fisheries resources through its Technical Review and Fisheries Habitat Research 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 to marine fisheries resources. In addition, staff participates on 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 studies focus on marshes, artificial reefs, eelgrass, and food webs.

Technical Review Project

Technical Review

DMF reviews coastal construction projects and provides information to municipal, state, and federal agencies to ensure projects avoid, minimize, or mitigate potential impacts to marine fisheries resources and habitats. Each project is included in an Access database with pertinent information about the type of project, the potential habitat impacts, and the size of impacts. In 2020, staff reviewed 566 projects in 87 municipalities (Figure 10). Of these, 367 were new applications (199 had been previously reviewed) which is consistent with the average of 391 new projects per year over the past 10 years. The dominant project type was residential docks, as it was in 2019.

Not all projects represent new construction or new impacts; 144 projects were replacements or repairs of existing infrastructure. Approximately 45% of all reviewed projects had the potential to directly impact habitat (n=252), including 118 projects in or near salt marsh and 43 in or near eelgrass (Figure 11). In 2020, DMF recommended time of year restrictions (TOYs) for 114 of the 566 projects reviewed (20%).

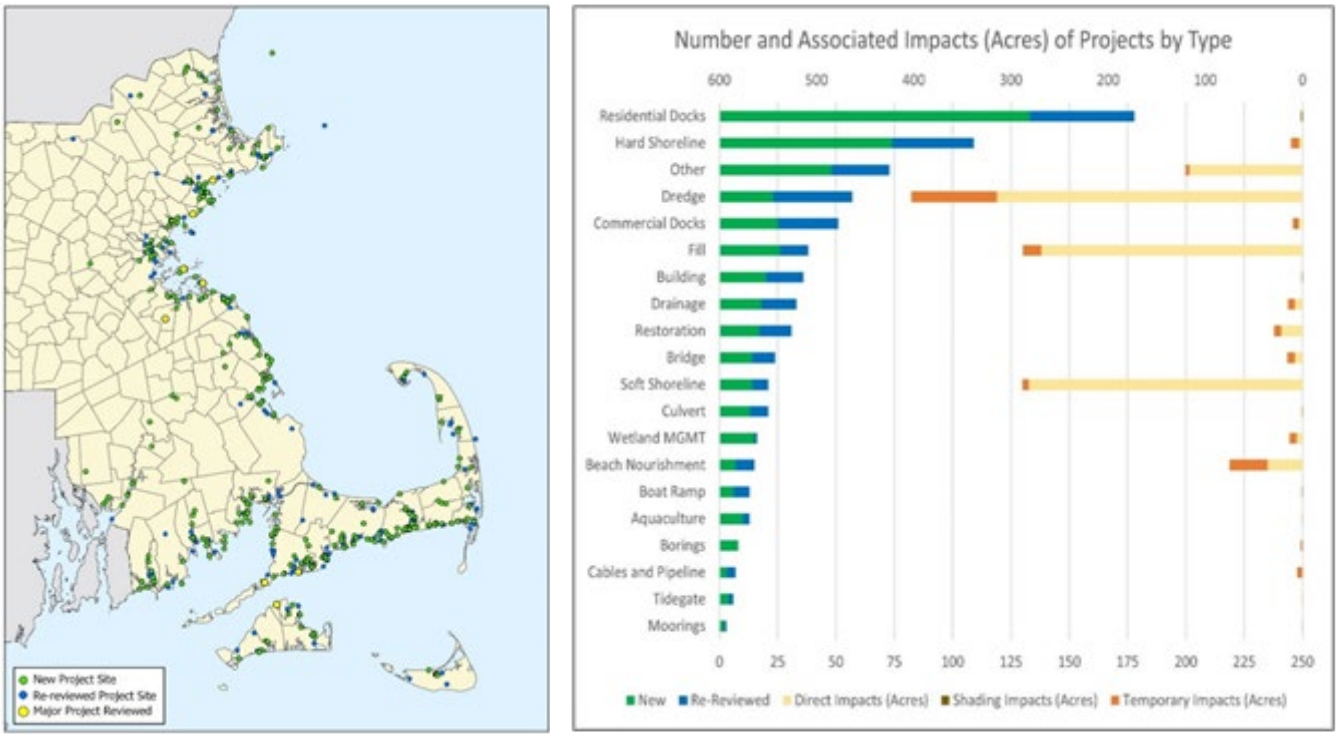

Figure 10. Coastal alteration projects reviewed by Program staff in 2020 by location (left), and number and cumulative impact size (right). A single project can include multiple project types. "Other" includes boat lifts, energy (e.g., utility, wind), groin repair, dam removal or improvement, boardwalks, and road repairs.

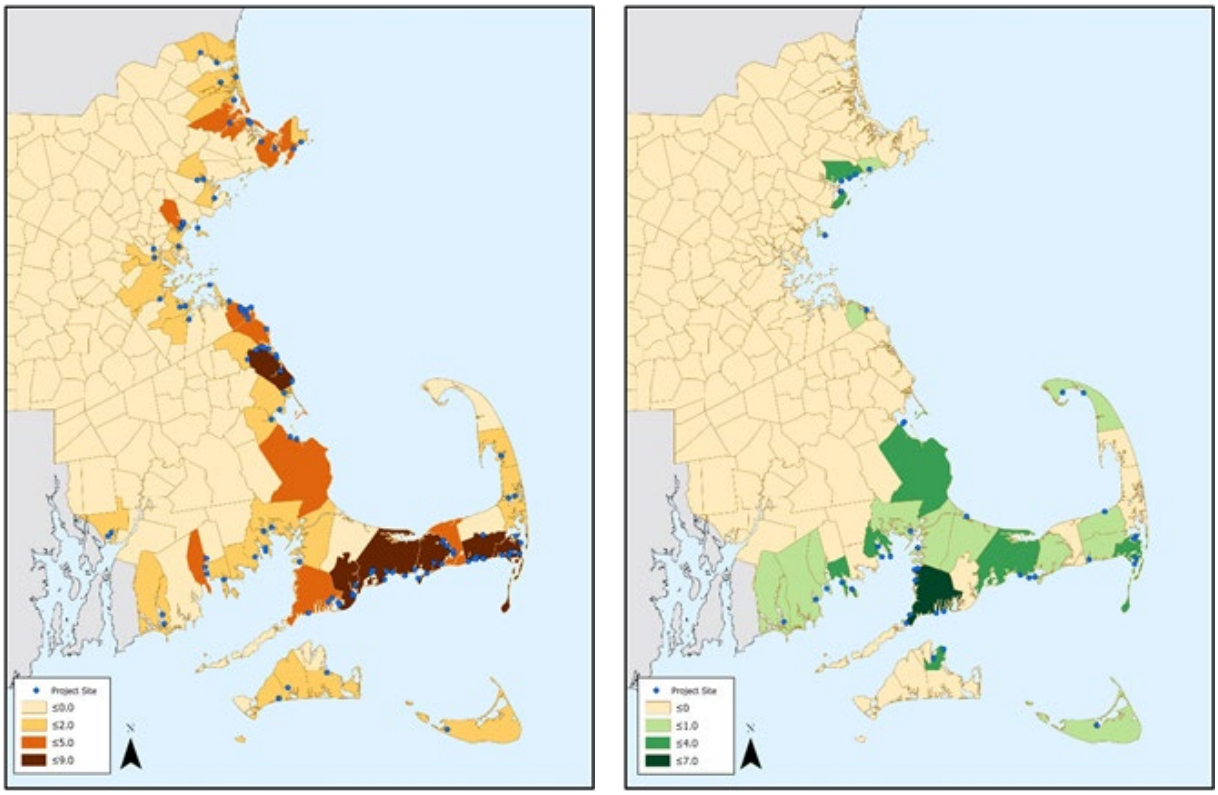

Figure 11. Projects with potential impacts to salt marsh (left) and eelgrass (right).

Some of the notable projects reviewed this year included the Vineyard Wind 1 offshore wind project; Amitié submarine cable; the Armstrong dam removal in the Monatiquot River in Braintree; WHOI Iselin dock and waterfront access in Falmouth; the Saugus drawbridge replacement; Gallops Island remediation and restoration; and several docks over eelgrass including in Nahant at 211 Willow Road, and in Marblehead at 61 Naugus Ave. Major dredging projects included Halls Creek in Barnstable, Chilmark Pond, Lake Tashmoo in Tisbury, and Harthaven Inlet Channel in Oak Bluffs. Reviewers noted there were no new major shoreline stabilization projects proposed by municipalities this year, but smaller private shoreline stabilization projects were proposed in Beverly and Barnstable.

The north shore office reviews projects from the Town of Hull and north to the New Hampshire border and the south shore office reviews projects from the Town of Cohasset and south to the Rhode Island border, including the Islands. The north shore office reviews approximately 35% of these projects while the south shore office reviews 65%. The north shore office generally has fewer but more complex, urban projects, while the south coast office generally has more projects that are smaller in size.

During 2020, Habitat Staff undertook a large project to consolidate files and make many reports available on our website. Other efforts to improve efficiency and standardization of reviews included the development of a template letter for dock projects and the submission of a dock impact review paper to a peer-reviewed journal.

Staff presented at the Massachusetts Association of Conservation Commissions (MACC) 2020 Annual Environmental Conference about private dock and pier impacts on important marine fisheries resources and habitats.

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: Under the Coastal ILF Program, two *Phragmites* removal projects were funded at Rough Meadows, Rowley and Great Marsh, Newbury and one stream connectivity project was funded at Off Billington Street Dam, Plymouth. These projects and five years of required monitoring ended in 2017. A fourth project, the installation of a fishway at Draka Dam, Taunton was partially funded through the Coastal ILF Program with additional support from Save the Bay, the Massachusetts Environmental Trust, and USFWS. Construction was completed on the project in 2019. DMF returned to the site spring 2020 to remove downstream debris in the channel, stock 1,000 alewife to boost the spawning run, and monitor fishway performance. No river herring were observed in 2020. Annual stocking and weekly seasonal monitoring will continue through 2024.

***Mass*DFG ILF Program:** In 2020, *Mass*DFG initiated a selection process for identifying coastal restoration projects to submit to the USACE for funding approval. One DMF proposal, the Eelgrass Site Selection Model and Targeted Planting Study, was selected for funding by the USACE after review and consultation with the Interagency Review Team. The goal of this project is to identify suitable sites to restore eelgrass (*Zostera marina*) across coastal Massachusetts.

Staff contributed to the ILF Program's tracking of payments received and credits sold and the development of the Department's 2019 annual report on the program. Staff also conducted proposal review for projects submitted for funding consideration and attended a USACE sponsored ILF summit convening participants from

all of the New England ILF Programs to share information about the challenges and successes of individual programs.

Offshore Wind

South of Marth's Vineyard and Nantucket are two Wind Energy Areas (WEAs) which are divided into six leases that are held by four companies: Orsted (Baystate Wind, Deepwater Wind), Vineyard Wind, Equinor Wind, and Mayflower Wind (Figure 12). In 2020, DMF continued its participation in multiple wind-energy activities, including reviewing permits for Vineyard Wind's offshore export cable through Massachusetts waters, developing the Vineyard Wind Fisheries Innovation Fund, attending workshops and meetings focused on learning about offshore wind and potential impacts, and being a member of the Regional Offshore Science Alliance (ROSA). Five projects being funded by the Massachusetts Clean Energy Center for fisheries research were launched, and DMF participates in several steering committees associated with those studies.

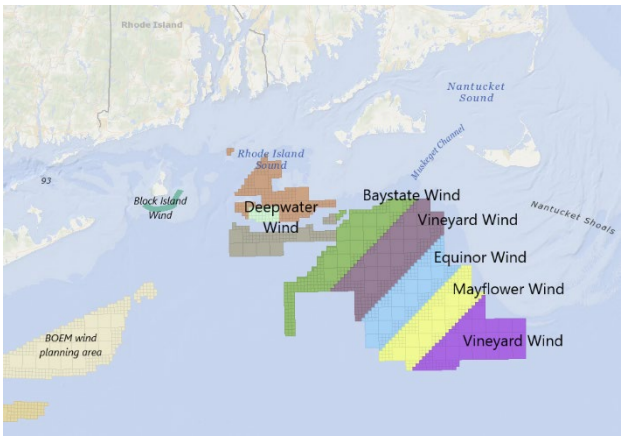

Figure 12. Offshore wind energy areas adjacent to MA.

Participating in conversations surrounding the development of floating offshore wind in the Gulf of Maine was continued, including participation in meetings regarding the State of Maine Offshore Wind Research Array.

Ocean Planning

In 2020, the Massachusetts Ocean Management Plan (the Commonwealth's blueprint for the protection and sustainable use of state ocean waters) completed its workgroup reports for the plan's five-year review. DMF chairs the Fisheries Working Group.

One of the goals of the Ocean Plan is to better coordinate on aquaculture activities. In 2020, DMF concluded a three-year project that included development of the Massachusetts Aquaculture Permitting Plan (MAPP) and a companion website designed to assist growers with the permitting process in Massachusetts. In developing the website, we met with eight partner agencies and had growers test the website for usability. The website was finalized in the early summer: www.massaquaculturepermitting.org.

DMF continued to participate on the Northeast Regional Ocean Council and the Northeast Habitat Assessment team. Both of these regional entities are doing important work to improve regional coordination of the management and permitting of offshore activities.

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 MA coastal waters.

Reef Monitoring: In 2020, 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. Most fish documented through the acoustic receiver data were striped bass. We also documented fish visiting multiple reef sites and returning to the same reef site over multiple years. Work continued on the development of protocols to guide future reef monitoring efforts.

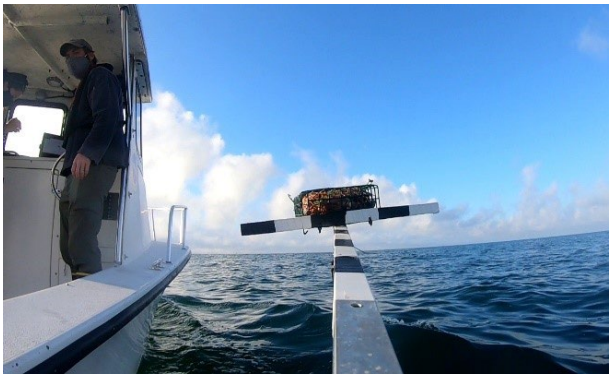

Figure 13. Habitat Project staff conducting BRUV sampling in 2020.

DMF continued a study using Baited Remote Underwater Video Stations (BRUVS) to compare reef productivity of artificial reefs in Nantucket Sound (Figure 13). The BRUVS were used to measure species richness, diversity, abundance, and age structure of black sea bass and scup and compare fish aggregations on artificial reefs to those on nearby natural reefs and sand bottom habitats. The study identified an increase in abundance of reef-associated species with increases in artificial reef age. Staff continues utilizing BRUVS to assess structured habitat connectivity to determine appropriate spacing of new artificial reefs.

Material Storage and Procurement: 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. Over 2,000 cubic yards of material from the Massachusetts Department of Transportation's (*Mass*DOT) South Coast Railway Redevelopment Project have been stored at the site (Figure 14). An effort to obtain surplus materials from *Mass*DOT maintenance depots was ongoing at year's end. Efforts were also continued to orchestrate future direct material deployments to reef sites from large coastal construction projects.

Figure 14. Reef materials stored at the CEC Marine Commerce Terminal in New Bedford.

Deployments: In January 2020, two material deployments occurred on undeveloped sections of the Yarmouth artificial reef site. DMF, DFG, the Town of Yarmouth, and the Cape Cod Salties worked together to create more than two acres of structured habitat in Nantucket Sound. The suite of deployments (which began in late 2019) marked the first time in more than two decades that new materials were added to the Yarmouth reef site. Additionally, the US Coast Guard deployed approximately 70 retired concrete buoy sinkers to the Yarmouth reef at no cost to the Commonwealth as part of the USCG maritime stewardship efforts in support of local coastal communities. Recreational species including black sea bass and scup were observed on newly deployed structures in the spring of 2020.

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 2020, project staff met with MEPA representatives to discuss the appropriate permitting pathway for these sites. Proposed sites in Brewster and Dennis were selected for permitting.

Habitat staff presented updates on DMF artificial reef activities to various groups, including: DMF's Marine Recreational Fisheries Development Panel, the Cape Cod Commercial Charter Boat Association, the Cape Cod Salties, and the ASMFC Artificial Reef Committee.

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. Efforts to advance the database to a publicly accessible platform were ongoing.

Ocean Acidification (OA) Commission: The OA Commission was created in 2018 by legislation and is comprised of Massachusetts legislators, coastal and ocean acidification scientists, commercial fishermen and aquaculturists, and representatives from environmental agencies and organizations, including DMF. In 2020, the Commission reviewed relevant scientific data and information related to coastal and ocean acidification, conducted public hearings, and released *The Report on The Ocean Acidification Crisis in Massachusetts* to the public at the end of the Year. Recommendations made in the report were expected to be used to draft OA Legislation in 2021.

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 publishing two journal articles in 2020 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 used carbon stable isotopes to identify differences in habitat use and movement patterns of tunas worldwide.

A study initiated in 2012 to examine the interplay between eutrophication and transfer of contaminants into Cape Cod estuarine food webs continued in 2020. Through a new partnership with researchers from the Harvard School of Public Health, analysis of archived samples for total mercury content continued while new samples collected in 2020 were analyzed for per- and polyfluoroalkyl substances (PFAS).

Eelgrass Monitoring and Restoration

Eelgrass is a critical marine fisheries habitat (Figure 15). The DMF Habitat team conducts research, monitoring, and restoration of eelgrass in Massachusetts. The eelgrass experts at DMF also play an important role advising other groups studying eelgrass and protecting eelgrass through technical review of construction projects.

Seagrass Monitoring: The eelgrass team completed its 13th year of monitoring a site off of West Beach, Beverly in Salem Sound as part of the international SeagrassNet monitoring program and Mass CZM's Marine Invader Monitoring and Information Collaborative. Due to COVID-19 restrictions, monitoring did not take place in April,

but was completed in July and October. In 2020, we continued to collaborate with other SeagrassNet participants in the northeast and mid-Atlantic on a peer-reviewed regional synthesis and we continued 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 at our monitoring site. Our SeagrassNet station data show a consistently stable eelgrass 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. To better understand tunicate prevalence on eelgrass regionwide, we are collaborating with scientists at WHOI, EPA, DFO, USGS, NPS, and state representatives along the East Coast. Due to COVID-19, no sampling was conducted in 2020 but sampling will resume in the 2021 season.

Figure 15. An eelgrass meadow.

Five reference meadows in Salem, Marblehead, Boston, Broad Sound, and Nahant (in addition to the SeagrassNet site) were established during 2013–2014 for annual monitoring of baseline trends in shoot density, percent cover, leaf area index, wasting disease, light, and temperature in natural eelgrass meadows. We have measured eelgrass density ranges from 150 and 350 shoots/m^2 across different sites. Some sites are consistently lower density than others. We also have recorded episodic changes in density due to storm events and direct impacts from lobster gear, but there have been no notable long-term eelgrass declines or indications of increased stress at these sites.

The Habitat team also regularly uses acoustic side scan sonar monitoring of selected study sites and other targeted areas of interest. In 2020 we surveyed floats in Marblehead as part of the dock and eelgrass study with Salem Sound Coast Watch. Acoustic monitoring of meadows in Wareham and Bourne continued in 2020 in support of the Wareham Wastewater Treatment Plant potential relocation, and in Sandwich at Town Neck Beach, in relation to ongoing beach management.

Salem Sound Eelgrass Restoration: A half-acre site was planted with eelgrass in 2018 and 2019. Required annual monitoring continued as planned in July 2020. The planted plots are on target to meet success criteria by 2022, as planned. Of the originally planted plots, 74-88% remained and had expanded at each set. Shoot density increased since the previous monitoring in 2019 as did planted square area, at all sets. Monitoring will continue annually for a total of 5 years. This restoration work is funded by the *Mass*DFG ILF Program.

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. The Habitat team has been studying these systems since 2010 at sites throughout the Commonwealth. In 2020, staff provided technical support to the Buzzards Bay Program in development of their installation and monitoring program of additional conservation moorings in West Falmouth.

Duxbury-Kingston-Plymouth Bays Study: Eelgrass beds have experienced severe declines over several decades in the Duxbury-Kingston-Plymouth embayment, and these changes are being monitored in the hopes of preventing more loss and restoring eelgrass. Since 2014, DMF engaged in partnerships with the Massachusetts Bays National Estuarine Program (MassBays), EPA, and the North South River Watershed Association (NSRWA) to investigate potential causes for eelgrass loss and to monitor eelgrass extent. In 2020, because of COVID-19 restrictions, the annual Citizens Science eelgrass rapid assessment run by NSRWA was postponed for a year.

However, Habitat staff were able to complete the eelgrass rapid assessment at 119 locations in August of 2020. All stations are at sites where eelgrass used to persist, but we are finding it is no longer present. Eelgrass was absent at 89 stations. Eelgrass was lost from twelve stations where it was present in 2019 but we did find eelgrass at three stations where it was absent in 2019. DMF, with assistance from Department GIS staff, developed and tested an app that will enable the use of phones and tablets to collect the rapid assessment data. NSRWA will take the lead on the monitoring for the summer of 2021 and many volunteers expressed interest and excitement in returning to do the survey. This work is funded by mitigation funds from Mass DEP and Veolia. Other citizen science groups have also shown interest in our volunteer monitoring protocol including Salem Sound Coastwatch. Continuing to conduct these surveys each summer will provide important insights into the overall health of eelgrass in the embayment. Expanding the surveys into other embayments will provide more high-resolution mapping data on eelgrass distribution and condition in Massachusetts.

Eelgrass Site Selection Model (IL08): With funding from the MassDFG ILF Program, a study to identify suitable sites for future eelgrass restoration was launched in 2020. The first phase of the project, using available data layers in a GIS to determine potential suitable planting sites, was started in 2020. Staff are working collaboratively with DFG GIS staff to develop a model using applicable data. In summer 2020 staff tested field methods to collect light attenuation and percent of surface irradiance at sites that rate well in the model.

Bay Scalloping Impacts to Eelgrass

Bay scallops are found predominantly in eelgrass meadows. To better understand if the wintertime bay scallop fishery was impacting eelgrass, DMF started studying the impact of draggin for bay scallops on eelgrass in 2018 and has conducted field work multiple times per year since then. The first study relies on a natural experiment. In 2017, the Westport River supported a large and prolonged bay scallop harvest 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 2018, 2019, and 2020, the Habitat team 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. Data was still being analyzed at year's end, but preliminary work has not demonstrated any declines in eelgrass clearly linked to scalloping activity.

The second study is a controlled impact assessment whereby DMF established experimental scallop dragging sites in an eelgrass meadow in Nasketucket Bay in Fairhaven and in the West Branch of the Westport River. During the bay scalloping season (November–December) in Fairhaven, the Habitat team performed both high and low intensity dragging and measured eelgrass density in both the fished sites and adjacent unfished reference sites in 2018, 2019, and 2020. DMF completed experimental dragging in winter 2020 and will conduct final site monitoring during summer 2021. In Westport, the Habitat team worked with a commercial scalloper to perform the experimental dragging treatments in December 2019 and 2020. In Westport, a third and final season of experimental dragging is planned for fall 2021.

Salt Marsh

Private docks are frequently constructed over salt marsh, potentially impacting this important habitat through shading impacts. In quantitative research studies from 2013–2015, DMF showed that current dock design guidelines recommending dock height be set equivalent to dock width (i.e., 1:1 ratio) was inadequate for minimizing shading impacts. In 2020, DMF continued outreach efforts to convey these findings to regulatory agencies by presenting findings at the Massachusetts Association of Conservation Commissions (MACC) annual meeting. Also in 2020, a comprehensive assessment of dock impacts and associated best management practices were documented in a paper submitted for peer review in a scientific journal.

Winter Flounder

Figure 16. RI DEM staff hauling fyke net after eDNA water sample collection.

Winter flounder spawn demersal, adhesive eggs in winter months. These eggs are sensitive to turbidity and burial so dredging projects in all Massachusetts embayments are limited by time of year (TOY) restrictions during the spawning and larval development periods as an impact minimization strategy. Since detailed information regarding the timing and location of spawning within embayments is currently lacking, the winter flounder TOY spawning recommendation is broad and long. When combined with user conflicts during summer months, this generally restricts the dredging window to the fall and early winter. There is great interest in better understanding how to adequately protect winter flounder while providing more flexibility for dredge projects in time and space.

In 2019, the Habitat team began a sampling program to assess the feasibility of using environmental DNA (eDNA) to establish when and where winter flounder are located. South of the Cape, the Habitat team collected water samples in partnership with the Rhode Island Department of Environmental Management's (RI DEM) winter flounder fyke net survey in the winters of 2019 and 2020 (Figure 16). These samples will allow eDNA data to be compared with traditional survey assessments of winter flounder presence and abundance during winter months. Additional field validation samples were collected in summer 2020 in association with our young-of-year winter flounder seine survey on Cape Cod to provide similar summer month comparisons to traditional survey results. Grants and additional partnerships to support this work were also fostered in 2020. Water samples will be analyzed for eDNA by geneticists at the Gloucester Marine Genomics Institute in 2021.

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 Ocean Planning Committee and Habitat Classification and Ocean Mapping Subcommittee, the MA State Interagency Aerial Spraying Technical Committee, the MA Ocean Acidification Commission, 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 MA DFG ILF Steering Committee and Project Proposal Review Team, the New England Estuarine Research Society (NEERS) Executive Committee, the PEW National Coastal Habitat Report review team, the TNC Offshore Wind Siting Tool steering committee, and the PNNL Marine Hydrokinetic Working Group.

Support Activities: Staff reviewed proposals for NOAA, MIT Sea Grant, Mass CEC, ACFHP, and performed peer review for eight academic journals. Staff represented the agency at the EEA Summer Internship Speaker series and DMF weekly seminar series. Staff also participated on thesis committees for PhD and Master's candidates at the University of Maine, UMass Boston, and UNH.

FISHERIES BIOLOGY SECTION

Dr. Michael Armstrong, Assistant Director, Section Leader

Fish Biology Program

Personnel

Dr. Gary Nelson, Program Manager
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William Hoffman, Senior Biologist
Scott Elzey, Biologist
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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 2020, 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 2020 are highlighted below.

The COVID-19 pandemic brought many challenges to the daily activities of the Age and Growth staff. Collection of samples conducted normally by other projects within the Division was impacted, so there were fewer samples to age. Fish normally processed fresh for age structures had to be frozen to facilitate easier planning of staff schedules. Fish processing was slightly modified by adding a barrier between persons handling samples and recording the data (Figure 17). Staff adapted to teleworking, with age samples and microscopes being regularly transported between homes and the laboratory. Consensus ageing was

Figure 17. Barrier constructed to allow for social distancing while fish processing in the wet lab during the 2020 COVID pandemic.

performed at the office with social distancing in effect. Despite these challenges, the data output from the lab remained of high quality.

River herring: In 2020, work to re-determine scale ages of river herring sampled during 2004-2009 was conducted. Trends in current population metrics lead to some uncertainty in historic ages, so it was deemed necessary to reassess those ages. Overall, 6,690 samples were re-evaluated.

Black sea bass: A project to validate the otolith ageing methodology for black sea bass was conducted in 2020. Marginal increment analysis demonstrated that one annulus is laid down each year and that the presumed first annulus is formed at 1 year of age. In addition, a microchemical study of black sea bass otoliths to elucidate the natal origins of the black sea bass population in the Gulf of Maine was completed. Staff are in the process of writing manuscripts for publication.

Table 18. Samples processed for ageing in 2020

Species	Structure	Process	Number
American shad	Otoliths and scales	Scales aged and checked for repeat spawning	215
Black sea bass	Otoliths and scales	Cleaned, mounted, aged	649
Bluefish	Otoliths	Baked, sectioned, aged	119
Fluke	Scales	Cleaned, pressed	46
River herring	Otoliths and scales	Cleaned, mounted, aged	10364
Scup	Scales	Cleaned, pressed	150
Striped bass	Otoliths	Sectioned, aged	50
Striped bass	Scales	Cleaned, pressed	1469
Tautog	Otoliths and opercula	Cleaned, sectioned, aged	234
Winter flounder	Otoliths	Sectioned, aged	257

Other Activities: Work was concluded on a joint effort by the ASMFC and Gulf States Marine Fisheries Commission to construct an age determination manual. The Age and Growth staff played a major role in the writing and editing of the document. The result of the work was the completion of a 294-page ageing manual for fishes from the Gulf of Mexico and Atlantic Coast that will serve as an important reference for anybody interested in ageing fish. The document can be found on the ASMFC website.

Due to the pandemic, age and growth exchanges with staff of other state, educational, and research entities were reduced because most collaborators were restricted to working remotely.

The first full test of the new wet-lab digital data collection system occurred during the spring. After bugs were fixed, the system performed well and considerably reduced processing time.

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 DMF's participation on, and contributions to, the regional fishery management councils and the ASMFC.

The COVID-19 pandemic greatly reduced our ability to visit fish dealers and processors, sail aboard commercial vessels and meet with fishermen and stakeholders in person. However, Project staff remained in close contact with industry members, stakeholders, and fisheries managers during the year. These communications that leverage the existing rapport between Project staff and commercial harvesters have become more pertinent in a year when sea sampling was not conducted for nearly 6 months.

Port sampling of commercial catch (Table 19) was conducted in collaboration with Recreational Fisheries Project staff. With a reduction in staff, decreased landings, and the COVID-19 pandemic, only the highest-priority species were sampled. While the commercial striped bass season was open for an extended period allowing more time to collect biological samples, the light and variable landings required extra effort to obtain sample targets. Samplers based out of Gloucester were again able to collect the required high-priority south shore/Chatham striped bass samples at a Boston fish processing facility, in addition to sampling fish landed in Gloucester and Boston.

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 wholesale fish. The new technique uses a hole saw attached to a portable drill to open the otic capsule through the gill cavity. The new method will improve the ability to sample the larger, older fish that are routinely landed in the commercial fishery.

Samples were collected from the commercial menhaden fishery to help inform ASMFC coast-wide stock assessments. The required sample number is based on the volume of landings, which was increased in 2020 through interstate quota transfers to Massachusetts as well as entry into the Episodic Event Set Aside. Eleven commercial samples of 10 random menhaden were collected, analyzed, and sent to NOAA ageing staff.

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	11	110	110
Striped Bass	23	426	547

At-sea sampling activities by Project staff were reduced compared to past years; however, monitoring of the state's coastal lobster fishery was able to be conducted and remained a major undertaking. Despite the COVID-19 pandemic, sampling occurred between June and November and was conducted out of five ports: Rockport, Gloucester, Beverly, Quincy, and Boston (Table 20). A summary of 2020 commercial sampling efforts is covered under Invertebrate Fisheries Project (page 71).

Sampling of the April commercial groundfish fishery in state waters was planned, but it was eventually discontinued due to uncertainty around the emerging pandemic and difficult commercial markets for fishermen. However, staff communicated frequently with fishery participants to gauge catch and bycatch levels, fish markets and observed trends.

Gear preparation, maintenance of receivers, field support and data management for grant-funded acoustic telemetry studies was performed by staff in 2020. Project staff supported research efforts, which included enhancing the understanding of striped bass migration patterns and identifying the proportion of sub-stock contingencies by region in Massachusetts; defining American shad migrations in the Charles River and coastal Massachusetts, and improving the understanding of white sharks in Massachusetts state waters.

Due to the COVID-19 pandemic, no sea sampling occurred during the spring inshore longfin squid fishery. To inform in-season management of the Nantucket Sound spring fishery, staff stayed in close communication with several commercial squid fishermen and dealers, while monitoring effort, environmental, and market trends. The lack of a restaurant seafood market impacted the demand for squid, reducing vessel effort by nearly half and cutting dock prices by about 30% from prior years. These realities, combined with lukewarm desire for a fishery extension, prompted DMF to close the fishery on the default date of June 10.

Through an effort funded by National Fish and Wildlife Fund, staff from multiple projects collaborated with Center for Coastal Studies, commercial lobstermen, and the Massachusetts Environmental Police to remove fixed gear from the Massachusetts large whale seasonal area closure. This closure was created to protect seasonal aggregations of endangered right whales. The closure runs from February 1 through April 30 and it is illegal for lobster gear to be inside the closure area due to the risk of whale entanglement. Project staff spent three days removing gear using *the R/V Michael Craven* and numerous hours transporting and storing unlawful lobster gear.

Table 20. Summary of at-sea sampling efforts by Project staff in 2020.

Sea Days (#)	Project
36	Acoustic telemetry- Striped Bass
10	BREP – Cod Avoidance
22	Coastal lobster
30	Vessel Support for external projects

Commercial Fisheries Data Analysis

Project staff possess the required data access and skills to query, summarize and provide data to aid DMF managers and staff from other projects. Basic data queries and summaries were provided to support efforts by the Conservation Engineering Project, Diadromous Project, Invertebrate Project and other agency initiatives.

In 2020, Project staff completed a report characterizing the longfin squid fishery in and adjacent to Nantucket Sound that was requested by the Massachusetts state legislature. The report was published as a DMF Technical Report and presented to the Massachusetts MFAC and state legislators in mid-May. The report presents an overview of the biology, fishery, and management of longfin squid in Massachusetts and Northeast US waters, as well as ongoing sampling efforts and conservation concerns. A comprehensive dataset of landings and sea sampling data was summarized to create profiles of the vessel participation in the inshore spring fishery (Figure 18), recent trends in landings and revenues, and catch and bycatch observations in the fishery. Catch of species with ecological, forage or recreational fishery importance were discussed in the context of potential detrimental fishery impacts. A further need to address some regulatory discards and research on potential impacts on spawning adults was identified. Ultimately, staff concluded that the longfin squid fishery is managed responsibly on federal and state levels, maintaining input from a diverse group of stakeholders, and remaining flexible and responsive to both industry and public.

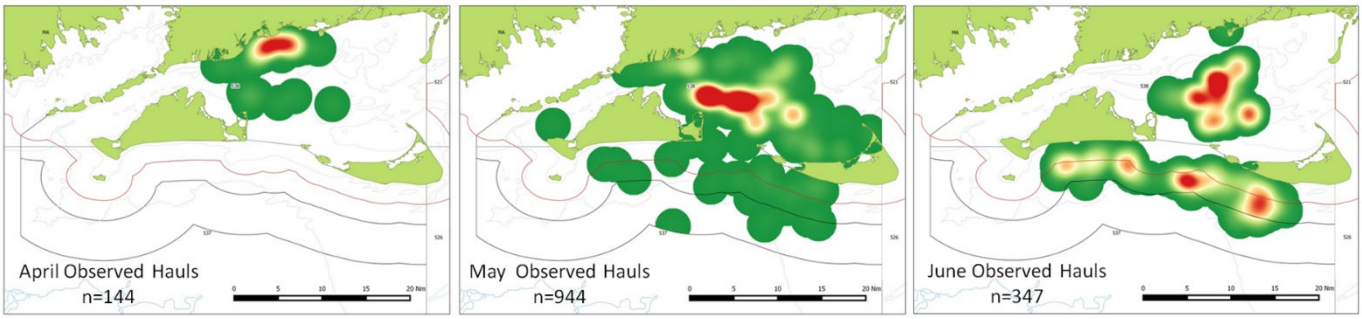

Figure 18. Distribution of starting locations of observed hauls targeting longfin squid. Source: unpublished NEFOP data.

Atlantic Herring Fishery Portside Sampling and River Herring Bycatch Avoidance

Due to the expiration of funding for portside sampling, staff discontinued the large-scale portside sampling program of the mid-water trawl fisheries for Atlantic herring and Atlantic mackerel in 2020. The Atlantic Herring Research Set-Aside (RSA) continued to fund the River Herring Bycatch Avoidance Program, a collaboration with SMAST and mid-water trawl industry partners.

The 2020 bycatch avoidance program, which aggregates real-time catch sampling data in the fishery and communicates these observations to fishermen as necessary, sent two seasonal bycatch projections, two immediate bycatch alerts and three catch sampling summaries. Additionally, the program moderated multiple bycatch and catch cap-related industry discussions. Ultimately, the industry was able to fish for herring and mackerel in 2020 without the direct threat of river-herring catch caps shutting down areas. The final 2020 mid-water trawl herring catch caps were 39% (Gulf of Maine), 11% (Cape Cod), 4% (Southern New England) and 18% in the coast-wide mackerel fishery.

The future of the River Herring Bycatch Avoidance program, as funded by the Research Set-Aside remains uncertain. Only 32% of the RSA quota allocated to vessels in 2020 was harvested, although vessels paid for extra quota that was not landed. However, with herring quotas (and thus RSA allocations) continuing to decline, the feasibility of running a program based on a percentage of the quota is in question.

Additionally, in 2020, FDS Project staff aided NOAA Fisheries Sampling Branch in the development of and transition to a federal portside sampling program. Infrastructure improvements were made that ensure safe access to portside offloads of herring and mackerel. These improvements were made possible with funding from the ASMFC. Project staff continued to assist with the development of sampling protocols and training materials in anticipation of federal portside sampler trainings. This program, enacted under the Industry-Funded Monitoring Amendment (IFM) whereby vessels will fund sampling coverage on up to 50% of trips, will be implemented in mid-2021. DMF facilitated NOAA communications to participating and interested vessels and hosted an outreach meeting for NOAA and fishermen in March 2020.

Staff assisted with numerous federal and state fisheries management actions for Atlantic herring, mackerel, and river herring in 2020. Staff served on the ACCSP Biological Review Panel and Bycatch Reduction Committee, helping prioritize species for funding consideration. Staff again made contributions to the ASMFC Atlantic Herring Plan Development Team that was tasked with developing new options for herring management in the inshore Gulf of Maine. DMFs' collaboration with external agencies continued to broaden the scope of research and utility of fisheries sampling data.

A 2017 NOAA Bycatch Reduction Engineering Program (BREP) grant aiming to determine if updated habitat forecasts could accurately predict river herring, Atlantic herring, and mackerel presence was finalized after a no-cost extension allowed for final analysis of winter 2018 and 2019 data. While a large amount of environmental

data were collected during commercial mid-water trawl herring fishing activities, few catch observations were available to be linked to these efforts, reducing the strength of the project's findings. In the end, reliable predictions of separate target catch and bycatch areas were revealed in retrospective analysis for December, January, and February (in some years). In late 2020, the project team began developing a manuscript for publication.

Finally, staff conducted one GSI sample on herring landed from the Gulf of Maine in November 2020. Lower herring quotas and truncated fishing seasons reduced the availability of herring from times and areas where they were expected to be in spawning condition. While this issue of access to spawning fish may persist as quotas remain low, staff will continue to collect and sample herring for spawning maturity to inform monitoring and future management decisions.

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.

Eight monthly survey cruises that attempted 50 tows per cruise and covered the two peaks in cod spawning activity were conducted in each year: "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, which encompassed 24 cruises and 1001 tows.

The spatially and seasonally-intensive sampling of this survey has created a unique dataset that will inform stock assessments and fisheries management for years to come. DMF staff published their second peer-reviewed scientific article in 2020, which used the IBS dataset to independently estimate the size selectivity of the GOM cod fishery. Several regulations (e.g., closed areas, minimum mesh size) have led to a "dome-shaped" fishery selectivity curve, wherein medium-sized cod are removed from the population at a faster rate than all other sizes. This finding, which is at odds with the current stock assessment, may have caused significant inaccuracies in previous stock reference points and harvest limits. At year's end, staff were preparing two additional scientific papers using the IBS data.

Minimizing Discard Mortality

Building on DMF's previous work to estimate and mitigate the recreational discard mortality of several groundfish species, a new *Recreational Haddock Fishing Guide* was published in 2020 with funding from NOAA's Bycatch Reduction and Engineering Program. This guide contains detailed monthly maps of areas to target (good haddock fishing with little cod bycatch), and areas to avoid (not as good haddock fishing, with high cod bycatch). These maps were developed using geostatistical models fit to IBS trawl survey data and were rigorously tested during 2019 to validate their usefulness. 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.

Despite the difficulty for conducting in-person outreach due to the global COVID-19 pandemic, more than 18,000 paper guidebooks were distributed to tackle shops, marinas, and permit offices in 2020. In addition, nearly 5,000 electronic versions were downloaded via a free location-aware smartphone app (Avenza Maps), which allows offline tracking and navigation. Additional funding from NOAA Fisheries also allowed for the creation of a "Citizen Science" program where volunteer anglers submitted standardized catch data to evaluate the ongoing relevance of the guidance maps. A total of 41 anglers contributed to the Citizen Science program, submitting 99 fishing reports between May and September. These data suggest that the recreational haddock guide maps continue to be relevant and useful, with fishing in target areas achieving +39% higher haddock catch rate and -24% lower cod bycatch rate. Participating anglers received fishing pliers after submitting their first report and a raffle entry to win a Yeti® cooler for each subsequent report (Figure 19).

DMF biologists also participated in a recent study to estimate the discard mortality of cod captured as bycatch in the lobster trap fishery. This study, led by the University of New England, used acoustic telemetry to estimate a 25% mortality rate for discarded cod captured in lobster traps. However, due to the low observed bycatch rate (110 cod caught in 18,853 trap hauls), the commercial lobster fishery may not be hindering the rebuilding of the cod stock. The findings were published in a scientific article.

Figure 19. (Left) Recreational haddock fishing guide cover and an example guidance map showing areas to target in green (high haddock catch, low cod bycatch), areas to avoid (low haddock, high cod). (Right) Peter Oldak, winner of the Citizen Science raffle prize is shown next to DMF biologist Micah Dean.

Spawning Cod in Massachusetts Bay

Many electronic tagging studies (including several conducted by DMF) have demonstrated that individual Atlantic cod return to the same precise seafloor feature each spawning season. These unique spawning sites support dense aggregations of cod for several months at a time and represent a highly vulnerable part of their life cycle. Once a spawning site becomes depleted through targeted fishing, there is little evidence that aggregations will form at that location in the future. For this reason, DMF has conducted extensive research over the past two decades to identify and describe cod spawning sites, in order to develop regulations that prevent their depletion and loss. However, an important question is how variable these spawning aggregations are in space and time, and whether regulations continue to be relevant years after they are enacted. To address this

issue, a team of collaborators including DMF, The Nature Conservancy, SMAST, and NOAA analyzed more than a decade of passive acoustic recordings from Massachusetts Bay to describe the trends and patterns of "grunts" produced by spawning cod. The findings, published in a scientific article in 2020, found remarkable consistency in the times and locations of spawning, but with higher activity at night and near full moons.

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 was reviewed by the Scientific and Statistical Committee of the NEFMC in May 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

In collaboration with Emerson College, staff developed a spatially-explicit, age-based life history model for blueback herring in the Shawsheen River system. A manuscript for publication was in development at year's end.

As part of an on-going modeling project to simulate Alewife population dynamics, a feeding model for Alewife post-larvae/young-of-the-year (YOY) residing temporally in lake, river, estuary and ocean regions was developed in an attempt to model growth in a more realistic manner (Figure 20). Individual models for six freshwater prey (rotifers, cladocerans (3) and copepods (2)) and eight marine prey (copepods) were created and linked to an Alewife foraging model that obtains the number and sizes of prey eaten. Those data are then inputted directly into a bioenergetics model to calculate growth. Preliminary results show good agreement between field observations of general diet composition, sizes of prey eaten, daily mean sizes of fish in the lake, daily mean sizes of emigrating fish, and daily growth rates and model predictions. This is an on-going project.

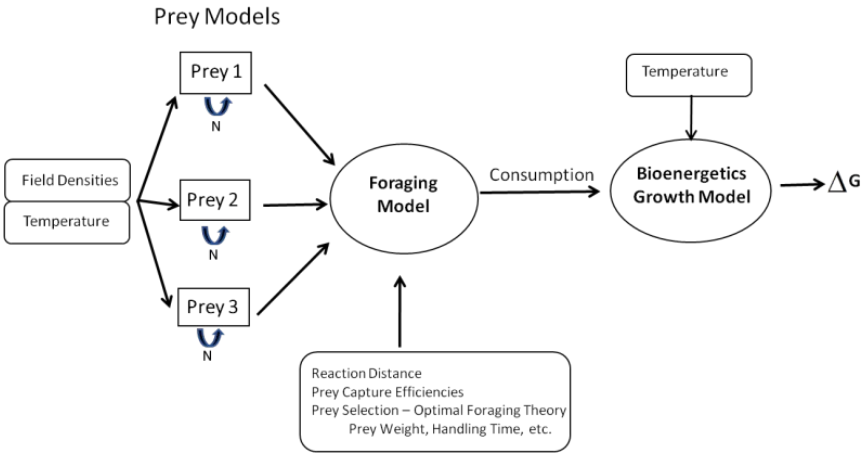

Figure 20. Conceptual diagram of young-of-the-year Alewife feeding simulation model.

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. Due to COVID-19 restrictions, no tagging trips were made in 2020.

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. In 2020, 426 individuals were sampled from commercial landings.

Acoustic Tagging Study

In 2020, DMF continued a 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 2020, this project obtained $60,000 in funding from the Marine Recreational Fisheries Development Fund and almost $100,000 from an ACCSP grant to process genetic samples and advance the development of a cost-efficient genomic stock identification method. Included in the grant product will be recommendations for coastal sampling protocols and effort requirements to provide population specific harvest data that can be used in future striped bass stock assessments.

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 2020, 46 participating anglers returned 1,248 paired length/age samples from striped bass. The size composition of striped bass reported by participating anglers is shown in Figure 21. Participating anglers also collected 202 black sea bass samples, 46 fluke samples, and 151 scup samples, species which the program was expanded to include in 2013. The striped bass carcass collection program also continued in 2020, but the COVID-19 pandemic appears to have impacted the number of anglers participating; only 38 fish were donated by volunteer anglers.

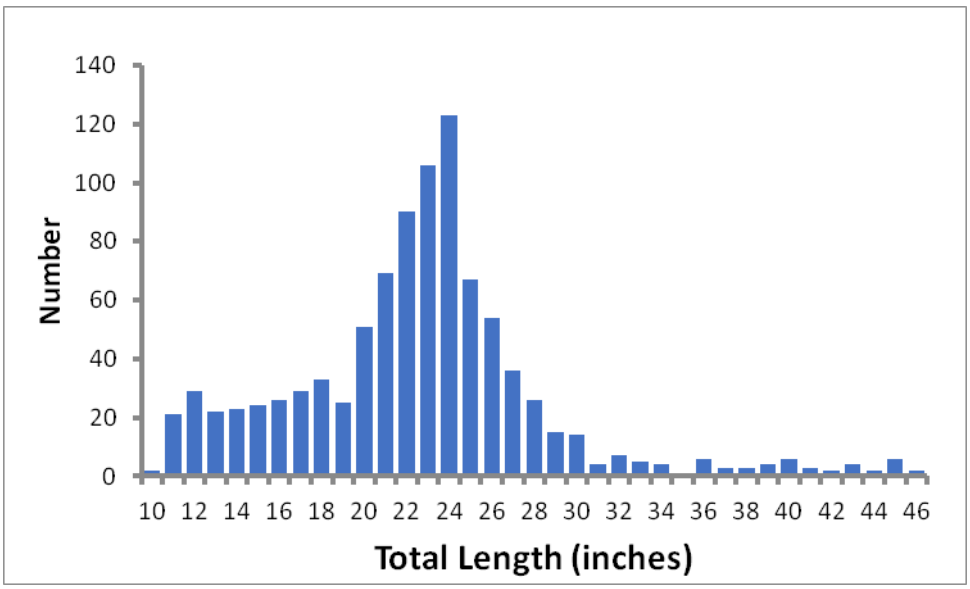

Figure 21. Size composition of striped bass collected by SADCT anglers in 2020.

Striped Bass Stock Assessment

Staff conducted analyses to examine impacts of changing the 9% release mortality rate on the 2018 stock assessment results for the ASMFC striped bass management board and compiled the 2019 Massachusetts striped bass monitoring report for the Division's Technical Report Series.

Other Activities

Assessment and Management Support: Program staff provided technical expertise to other governmental organizations, private groups, and individuals with concerns about marine fisheries via on-line meetings and served on technical and advisory committees to support management efforts of important marine species. In 2020, staff served on ASMFC's Striped Bass Technical 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. Several presentations were given by staff to other governmental organizations and private groups. Staff also served as a virtual ASMFC representative to the Assessment Operation Panel in Woods Hole, MA.

Publications: Staff authored two DMF TR series reports (characterization of the squid fishery and striped bass monitoring report) and published two peer-reviewed articles publication on a life cycle simulation model for exploring causes of population change in Alewife and estimating the discard mortality of Atlantic cod in the southern Gulf of Maine commercial lobster fishery.

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
Steve Wilcox, Marine Fisheries Biologist
Alex Boeri, Assistant Marine Fisheries Biologist
Brendan Reilly, Assistant Marine Fisheries Biologist
Nathalie Staiger, Contracted Scientist (starting in April)
Dawson Bathgate, Seasonal Fisheries Technician (May–October)

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 (through February)
Dr. Alex Hansell, Senior Marine Fisheries Biologist (starting June)
Dr. Sam Truesdell, Senior Marine Fisheries Biologist

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 Bycatch Reduction Device for Pots in Massachusetts

Staff continued to collaborate with the Invertebrate Fisheries Project to modify channeled whelk pots to reduce bycatch of undersized individuals. Our work in 2020 included observation using video of whelks and pots with and without vents or gaps in the side walls at the seawater lab at SMAST East. Summer trials focused on preliminary testing of whelks placed in pots. These tests were followed by 17 separate escape trials where whelks of a wide size range were placed in pots with bait outside in tanks. Three escape vent types were tried: a wood trap with multiple gaps in the sides; a wire trap with a vertical lobster vent; a wire trap with a lobster vent horizontally oriented. Over 1000 hours of video of whelks escaping and attempting to escape were collected. Escape data and video observations were being processed at year's end. Future work includes developing size-at-retention models, improving the wire trap design, and eventually field-testing of prototypes.

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

This project, funded by the NMFS Saltonstall-Kennedy Program and conducted cooperatively with industry and academic partners, tested the effectiveness of two different off-bottom, mid-water trawls (OBTs) to target Georges Bank haddock and redfish. Data collected in previous seasons were visualized and analyzed in 2020 and a final report prepared and delivered to NOAA Fisheries. Haddock catches in both nets successfully matched the catch of haddock in the Eliminator/Ruhle trawl in weight and in size, despite a smaller mesh codend on the OBTs. Generally, lower bycatch of bottom-oriented species was seen in the OBTs. Monitoring of the trawls was challenging, and adjustments to vessels speed and tow wire length during tows were often necessary. While the goal was to fish completely off-bottom at a height of 1 meter, the addition of heavy drop chains at the wing ends of the net were deemed necessary and displayed signs of frequent bottom contact. Nevertheless, the amount of bottom impact overall was likely reduced compared to the demersal Ruhle trawl, and the target height could be achieved. Overall, these nets show some promise for improving haddock fishing. Steps in 2021 include outreach to fishermen and scientists.

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. A kickoff meeting with the industry and academic collaborators was held and planning was conducted for fieldwork in May 2020, including equipment acquisition, upgrade, and repair, permit applications, budgeting, and contracting. Fieldwork was cancelled due to the pandemic, and rescheduled for May 2021.

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. Uptake appeared to be increasing, with two known users of this net. The results of this project were published in Fishery Bulletin. A manuscript on research needs for cod behavior in trawls was submitted to the ICES Journal of Marine Science. A follow-on NOAA Bycatch Reduction Engineering Project led by the Gulf of Maine Research Institute to test a modification of this net—a large mesh panel across the net mouth—was conducted with staff advising and analyzing data. Results showed that the modification did not decrease cod catch compared to the ultra-low-opening trawl.

Other Activities

Committee Work: Staff served on the ICES-FAO Working Group on Fishing Technology and Fish Behaviour and was appointed chair of the Working Group on Species and Size Selectivity Experiments. Staff served on the NEFMC/MAFMC Northeast Trawl Advisory Panel, and as editor or advisor on four academic journals. Staff continued contributing to the MA Wind Energy Fisheries Working Group, and New York Fisheries Technical Working Group. DMF Staff were appointed as the state representative to the Advisory Council of the Responsible Offshore Science Alliance, and were given an honorary Life Fellowship in the Society of Fisheries Technologists.

Support Activities: Staff began a worldwide assessment of commercial use of ropeless marking of fixed gear. Staff participated on the DMF dive team, assisting on other project's field work.

Invertebrate Fisheries Project

Impacts of the Covid-19 pandemic to the Invertebrate Fisheries Project sampling programs were relatively minimal. The lobster commercial trap sampling, ventless trap survey, Jonah crab port sampling, and horseshoe crab monitoring were completed with little disruption. However, the commercial whelk trap sampling program was negatively impacted; most trips were cancelled due to the necessity for prolonged close proximity between samplers and vessel captains on the typically smaller vessels characteristic of the participants. Additionally, the Gulf of Maine northern shrimp survey was cancelled this year.

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 2020, the 40th year of operation, a total of 52 trips were conducted by staff members of the Invertebrate Fisheries Project (12 trips) and the Fisheries Dependent Investigations Project (40 trips), during which 28,038 lobsters were sampled from 10,752 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. In 2020, a total of 5,418 lobsters were sampled for shell disease. All commercial trap sampling program data are provided annually to the ASMFC and ACCSP.

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).

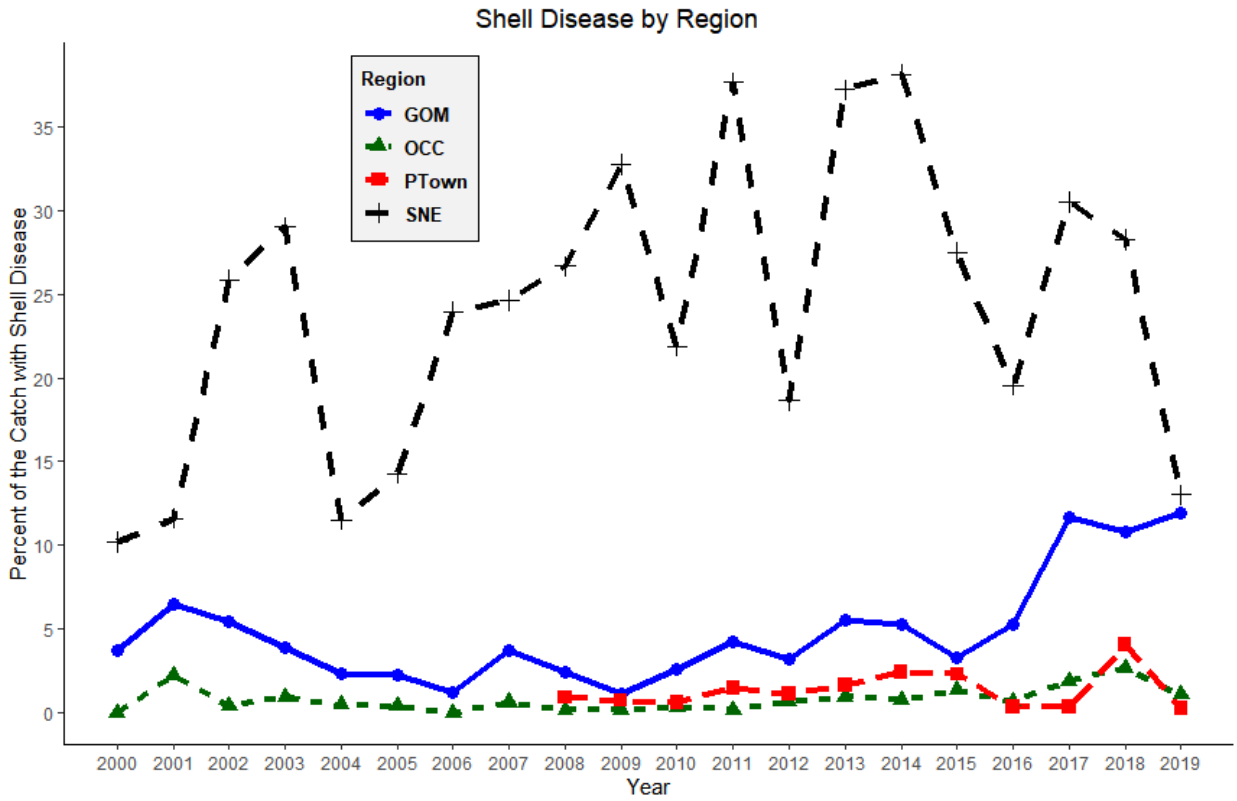

Figure 22. Percent of observed lobster catch with shell disease during commercial trap sampling in inshore Gulf of Maine, Outer Cape Cod, Provincetown, and nearshore Southern New England.

Ventless Lobster Trap Survey: The 2020 Ventless Trap Survey took place from June through September with six contracted vessels (one vessel covered both regions in SNE after the second contracted vessel declined participation due to Covid-19 related issues). Last minute changes in June added 1700-lb break-away contrivances to all of the survey gear's vertical lines, enhancing the precautions for protected species included in the survey gear rigging. 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 23). 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. Project staff completed a total of 57 sea days in 2020. In 2020 a total of 10,718 lobsters were sampled from 2,728 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 3,452 lobsters were sampled from 1,095 trap hauls.

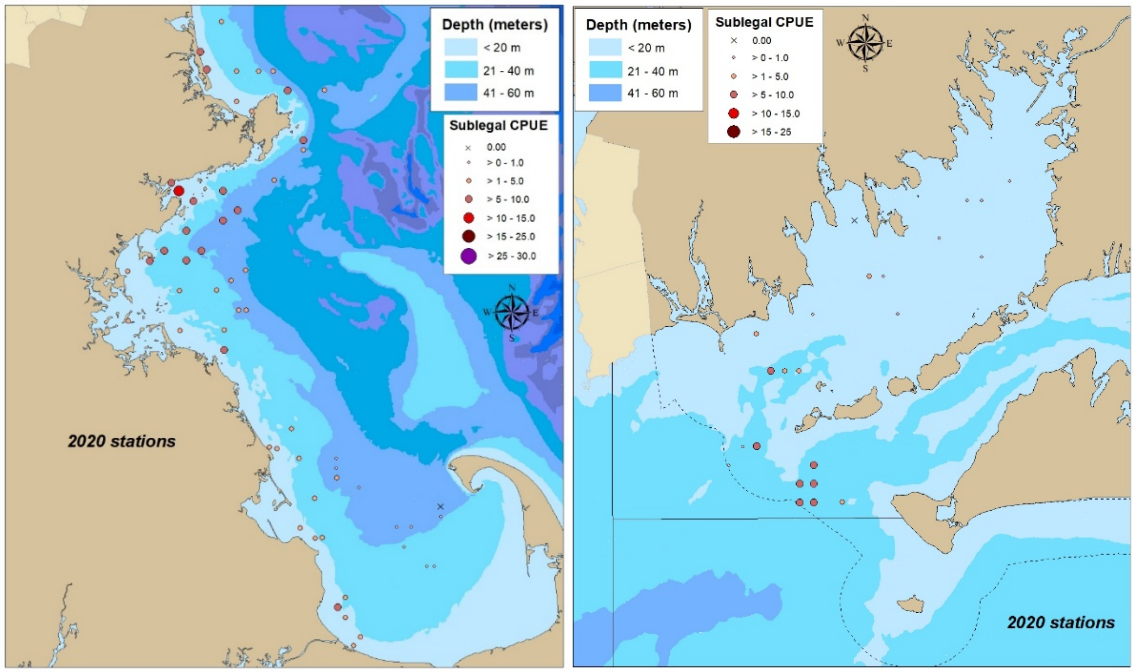

Figure 23. Average catch per trap haul (CPUE) of sublegal-sized lobsters at the 2020 ventless trap survey stations in the northern (left) and southern (right) survey areas.

Additional biological sampling of bycatch species was continued in 2020, 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.

Annual Early-Benthic-Phase Lobster Suction Sampling: Project staff completed the 26th year of this sampling program in 2020. The program is conducted to track year-class strength of newly settled post-larval American lobsters (Figure 24) and to delineate coastal habitat important to the settlement of these juveniles. Project staff conducted the SCUBA-based survey over eight field days in August and September, sampling 14 coastal sites spanning Cape Ann to Buzzards Bay. The Cape Cod Bay region and some South Shore sites were removed from the survey in 2019 due to frequent detection of tagged white sharks by nearby acoustic receivers during the time of the survey. Sampling intensity in Buzzards Bay was reduced and the Vineyard Sound region eliminated in 2019 because of the scarcity of lobsters in these areas. Average densities of YOY lobsters were above the time series averages in the Cape Ann and South Shore regions (Table 21). These two regions have relatively short time series. The three regions with a 20+ year time series were below their time series averages. Data from this program are contributed annually to the American Lobster Settlement Index, an international research collaborative that compiles data and tracks changes in the recruitment of American lobsters in US and Canadian waters.

Figure 24. A young-of-the-year lobster observed by DMF biologists during lobster suction sampling off Scituate.

Table 21 Comparison of 2020 YOY lobster densities to time series averages, by region.

Region	# years sampled	2020 YOY Average (#/m^2)	Time Series Average (#/m^2)
Cape Ann	11	0.42	0.40
Beverly/Salem	25	0.17	0.56
Boston Harbor	24	0.11	0.13
South Shore	9	0.25	0.09
Buzzards Bay	26	0.00	0.07

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 preparation in support of the 2020 Benchmark Stock Assessment, including participation in the week-long peer review workshop, conducted virtually in August. Staff also participated in weekly calls regarding implementation of new lobster data reporting elements.

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 worked to finalize analyses and begin report and manuscript preparation at year's end. One manuscript was successfully published describing a new technique for using DNA to quantify the number of sperm contained within a spermatophore.

Figure 25. DMF's Nathalie Staiger working with the molting cages in the SMAST wet lab during the lobster growth study.

In the summer of 2020 project staff conducted a laboratory-based growth study to collect data for large lobsters (>100 mm CL), addressing a data need for the lobster stock assessment. Large lobsters with old shells were collected from two commercial lobster fishers (one fishing Georges Bank, the other the Outer Cape Cod area) and brought back to the wet lab at SMAST. Using a pleopod staging technique, those lobsters that would molt within the next couple weeks were identified and kept for the study. Pre-molt lobsters were held individually in large cages until they molted, and measurements were taken before and after molting (Figure 25). The study, funded by the National Sea Grant American Lobster Research Initiative, will provide data on molt increment as well as an estimation of the annual probability of molting to update the stock assessment's growth matrix.

The 2019 hypoxic event in Cape Cod Bay led to several developments in 2020 which staff spent considerable time on. First, the MA Lobstermen's Association formed a Cape Cod Bay Study Fleet to implement a high-resolution water quality monitoring program. The five participating vessels each deployed five data loggers in their traps, recording water temperature and dissolved oxygen (DO) every 15 minutes. Data from these loggers were managed by DMF staff. Working with the agency's GIS team, a data dashboard was built to map results. Second, staff working in collaboration with Center for Coastal Studies and the Woods Hole Oceanographic Institution successfully applied for funding from the National Sea Grant American Lobster Research Initiative to initiate work to better understand the drivers of low DO in Cape Cod Bay, and to work towards predicting reoccurrences. Work on this project started in September, and included additional monitoring, leveraging the

Study Fleet's data for numerical modeling, the development of more publicly accessible visualization products (again working with the *Mass*DFG GIS team), and future implementation of fleet catch logs to track lobsters' responses to the changing environment. Hypoxic conditions were detected for the second year in a row in southern Cape Cod Bay in the late summer of 2020. This three-year project will continue through 2022.

Enforcement: Staff developed a training course for environmental police officers on methods to detect scrubbed or bleached egg-bearing female lobsters. Two classes were scheduled, one on the south shore and one on the north shore, to which Massachusetts environmental police, those from nearby states, and NOAA Fisheries law enforcement were invited. The south shore class was conducted March 6 with more than 30 participants (officers and students from Bristol Agricultural High School), but the second class scheduled later in March was cancelled due to Covid-19. Staff provided expertise on the detection of scrubbed or bleached eggers as needed.

Outreach and publications: Several media outlets interviewed staff concerning the Cape Cod Bay hypoxia situation, including WBUR, and the Cape Cod Times. Articles on the Study Fleet and DO work were provided to the MA Lobstermen's Association newsletter, the DMF newsletter, and a presentation was given to the MFAC.

Staff prepared and submitted four abstracts for presentation at the 12th International Conference and Workshop on Lobster Biology and Management, which was subsequently postponed due to Covid-19. Staff published a report in the DMF Technical Report Series summarizing data from 10 years of ventless trap survey work. Staff were co-authors on two manuscripts published in peer-reviewed journals.

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 1,055 crabs from the bait fishery and 814 crabs from the biomedical fishery in 2020. 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, while the average size of female crabs observed in the bait fishery has been decreasing since 2014. In 2020, the average size of a female bait crab was 10 mm smaller than the time series average.

Fisheries-Independent Surveys: DMF and numerous volunteer organizations conduct spawning beach surveys at 17 beaches along the South Coast, Cape Cod, and the islands (Figure 26), but only 12 beaches conducted surveys in 2020 due to Covid-19 restrictions. 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. Day and night high tides were surveyed at eight beaches in 2020; four beaches only surveyed day-time high tides. DMF staff conducted 30 surveys at Swift's Beach in Wareham. The 2020 index of spawning females was at or above time series medians for seven of eight beaches conducting night surveys, and eight of twelve beaches conducting day surveys.

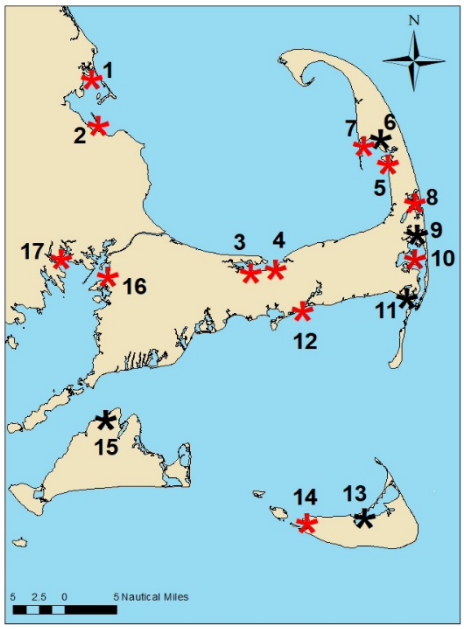

Figure 26. Map of horseshoe crab spawning beaches. Beaches that conducted surveys and reported data in 2020 are marked with red stars.

Assessment and Management Support: Staff continued to serve on the ASMFC Horseshoe Crab Technical Committee in 2020 and gave a virtual presentation to the Dennis Conservation Land Trust on the status of

horseshoe crabs in Massachusetts. The Horseshoe Crab Science Committee Meeting annually hosted by staff was canceled due to the pandemic.

Jonah Crab Research and Monitoring

Commercial Fishery Sampling: Monitoring of the commercial Jonah crab catch has been required by the interstate FMP since 2015. Project biologists conducted 14 port sampling trips from seven individual boats to collect length frequency and sex ratio data from the commercial fishery in 2020 (Figure 27). These trips sampled a total of 5,272 crabs from NMFS statistical areas (SA) 537, 562, 525, and 526. Most crabs are harvested in SA 537 and 526; the average size in these areas was similar to prior years.

Assessment and Management Support: Staff served as chair of the ASMFC Jonah Crab Technical Committee and worked on data collection and review for the first Jonah crab benchmark stock assessment scheduled for 2023. Staff also participated as a member of the ASMFC Jonah Crab Plan Review Team, evaluating state compliance with FMP requirements.

Figure 27. A tote of Jonah crabs.

Whelk Research and Monitoring

Commercial Fishery Sampling: Due to Covid-19 limitations, staff were only able to conduct one commercial sampling trip in Buzzards Bay aboard a commercial vessel fishing whelk pots in 2020, measuring over 1,300 whelks. Normal sampling targets are to conduct four trips 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 width 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 continued engagement with industry representatives to provide biological information related to concerns regarding the regulatory schedule for minimum size increases. There was one meeting with industry and several informational requests on this topic. Staff also responded to regulatory and management inquiries from other state agencies.

Northern Shrimp Research and Monitoring

Northern Shrimp Assessment Survey: The annual northern shrimp assessment survey, conducted offshore throughout the Gulf of Maine aboard NOAA's R/V *Gloria Michelle,* was canceled this year due to Covid-19.

Assessment and Management Support: Staff served on the ASMFC Northern Shrimp Technical Committee.

Other Activities

Wind Energy Development: Staff continued to contribute 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 reviewers for peer-reviewed journals. Staff served on the thesis committee for one SMAST graduate student.

Protected Species Project

Cape Cod Bay Right Whale Surveillance Program

In 2020, DMF partnered with the Provincetown Center for Coastal Studies (PCCS) and NOAA Fisheries to carry out the 22nd 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. Due to Covid-19 restrictions, aerial and vessel surveys were suspended in mid-March, but resumed in a limited capacity by the beginning of April. Despite the reduction in surveillance time, the team documented at least 47% (n=175) of the known right whale population in Cape Cod Bay and adjacent waters (Figure 28). This is likely an underestimate of the proportion of the population that visited the area. Cape Cod Bay and adjacent waters continue to be an important seasonal habitat for right whales, which is especially significant given that the population numbers less than 400 individuals.

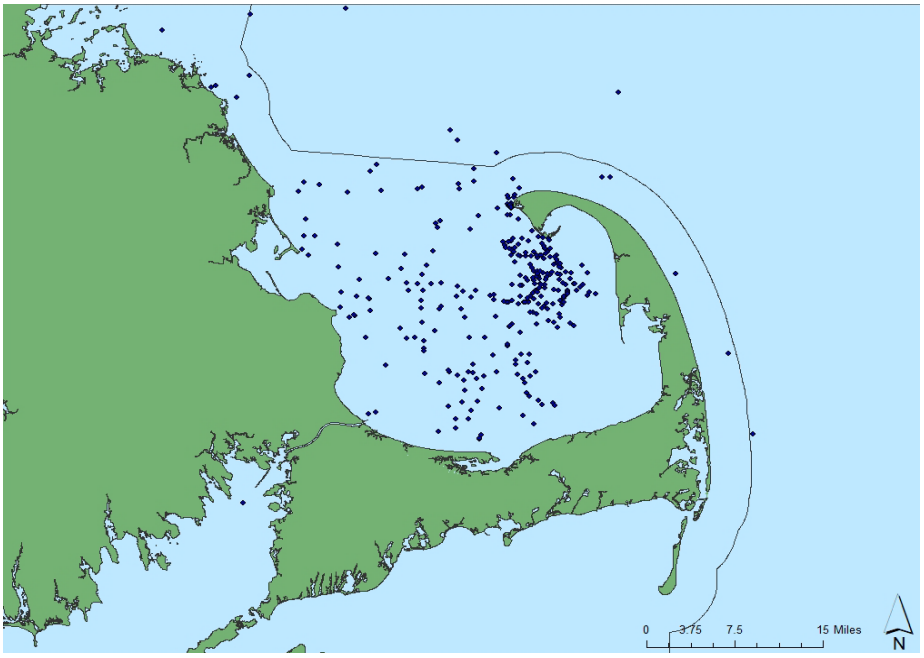

Figure 28. Map of PCCS 2020 right whale aerial sightings.

Right whale mortalities in 2020 were relatively low in comparison to the high mortality seen in 2017 and 2019. However, the two documented mortalities involved calves. Only 10 calves were born in 2020, which highlights the continued perilous state of the population. In light of this, 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.

In 2020, Project Staff administered the grant from NMFS that supports aerial surveillance and habitat monitoring and assisted in coordination of all large whale conservation activities.

Large Whale and Sea Turtle Disentanglement

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

Incidental Take Permit Application

As part of ongoing litigation regarding the federal Endangered Species Act, DMF initiated the process of applying for a federal Endangered Species Act Section 10 Incidental Take Permit (ITP) for fixed gear fisheries in state waters that might interact with endangered species. Project staff are part of DMF's ITP Task Force. In 2020, staff worked on the initial stages of the ITP application, including analysis of endangered species and fisheries data and the development of large whale conservation measures to mitigate impacts to endangered species.

Ropeless Fishing Scoping Project

Staff received funding to develop a framework for the implementation of ropeless fishing in New England. Staff worked with a contractor to initiate a scoping process through interviews with a variety of stakeholders to address the regulatory, logistical, technological, and financial challenges with this potential gear modification.

Weak Rope Implementation

Staff assisted DMF in the development and implementation of reduced breaking strength modifications for buoy lines in Massachusetts state waters. The broad scale use of reduced breaking strength (i.e., "weak") rope or inserts is an important component of DMF's Habitat Conservation Plan, which is a key element of the Incidental Take Permit application.

Other Activities

Staff participated as a member of the Massachusetts Habitat Working Group. This body assists EEOEA, the federal Bureau of Ocean Energy Management, and the Massachusetts Clean Energy Center with analysis of natural resource data as it relates to potential impacts in the Massachusetts Wind Energy Area (WEA). State and federal governments are assessing the potential impact of wind energy development on marine mammals that inhabit the area south of Martha's Vineyard and Nantucket. Staff participated in the development of a scientific framework to study the potential impact on marine mammals and continues to work with EEOEA and BOEM on monitoring and protecting whales, marine turtles, and other potential protected species in the WEA.

Resource Assessment Project

2020 Trawl Survey

What would have been the 43rd annual spring and fall surveys aboard NOAA's R/V Gloria Michelle were cancelled due to COVID-19 concerns. All survey preparations for the spring and fall surveys were complete on time, but the risk to scientists and crew was deemed too great to carry out the surveys. This marks the first time since the survey's inception in 1978 that an entire survey was cancelled.

Survey data for 1978–2019 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.

2020 Seine Survey

The 45th Nantucket Sound Estuarine Winter Flounder Young-of-Year (YOY) Seine Survey was completed from June 15–July 2. 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. Thirty-eight species occurred in 2020 seine survey hauls. The 2020 stratified mean index for YOY winter flounder abundance increased slightly. While four 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

2020 marked a year of transition in staffing for 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 Framework 61. In addition, staff served as a member on the NEFMC Monkfish Plan Development Team and as a member of the ASMFC Winter Flounder Technical Committee.

Staff participated in the NEFSC operational assessment updates for 12 groundfish stocks in the fall of 2020 and the Transboundary Resource Assessment Committee stock assessments for Eastern Georges Bank cod and haddock, and Georges Bank yellowtail flounder in the summer of 2020. Staff participated in the NEFSC Haddock and Index Based Methods research track assessments.

Staff collaborated with researchers from the University of Massachusetts Dartmouth, Woods Hole Oceanographic Institution, the NEFSC, Rutgers University, and The Nature Conservancy to continue 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 University of Massachusetts Dartmouth, NEFSC and Rhode Island Department of Environmental Management to develop standardized indices of abundance from fishery catch rates for upcoming groundfish assessments. The intent of these analyses is to contribute to the improvement of groundfish stock assessments in the Northeast US by providing fishery perceptions of relative abundance and potentially including fishery catch rates as indices of abundance in stock assessment models.

Staff utilized four decades of data from fisheries-independent trawl surveys to evaluate long-term changes in size, distribution, and abundance of groundfish. Staff also served as the New England District Director for the American Institute of Fisheries Research Biologists.

Recreational Fish Assessment and Management Support

Staff represented DMF on ASMFC and MAFMC Technical Committees and Monitoring Committees for bluefish (vice chair of Technical Committee), black sea bass, scup, summer flounder, tautog, and weakfish. These assignments include conducting analyses and bringing proposals to the groups in support of adjustments to MA fishery regulations as well as evaluating potential regulatory changes in other states or in federal waters.

DMF's black sea bass spawning survey continued during May–July 2020, marking the third year of this sampling program. The purpose of this rod-and-reel survey is to collect data on Buzzards Bay black sea bass as the spawning season progresses. Eight sampling trips were made during 2020. Total length was recorded on each fish caught and some fish, covering a range of size groups, were sampled to obtain data on weight, age, sex, and spawning condition.

Tautog are scheduled for a stock assessment update during 2021, and staff represented DMF on the Tautog Stock Assessment Committee. Since the last time this stock was assessed (2016), substantial adjustments have been made to the historical recreational fisheries catch data (i.e., the MRIP program estimates). This means that additional analyses are required for this update and work on the assessment began during 2020. Data from Massachusetts and Rhode Island are used together as the "MARI" region is assessed as its own stock unit. Assessment results are expected during the fall of 2021.

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
Kristen Thiebault, MRIP/FHTS Sampler

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; assess habitat and prey needs of key species; measure harvest and release of key species; facilitate 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). 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. DMF has managed the at-sea head boat survey segment for Massachusetts waters since 2003 and assumed the shore-side Access Point Angler Intercept Survey (APAIS) 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 2020, DMF began the implementation and administration of the For-Hire Telephone Survey (FHTS) in Massachusetts.

Despite the coronavirus pandemic, DMF continued its coordination of APAIS/MRIP surveys in 2020—training 20 seasonal field interviewers, scheduling trips, logging data, maintaining equipment, attending virtual data review meetings, and maintaining regular communication with the Atlantic Coastal Cooperative Statistics Program (ACCSP) regarding survey performance and sampling. (ACCSP administers the program for NOAA Fisheries.) Shoreside and headboat survey sampling were delayed altogether from March 1 through May 19 due to the pandemic. The former resumed May 20, just prior to the start of Memorial Day weekend, with special Coronavirus sampling guidelines in place to protect both DMF field interviewers and anglers alike. Headboat sea sampling trips were cancelled for most of the year due to difficulty with social distancing aboard vessels, except in the month of July (as a trial period) when 11 trips were completed for a total of 88 angler intercepts. Despite the late start and challenges related to shoreside sampling during a pandemic, our MRIP field interviewers completed 1,012 assignments out of 1,195 scheduled for a total of 5,403 angler intercepts (more than the year prior): 3,895 from private vessels, 588 from charter vessels, and 920 from shore anglers.

A new position was funded through the ACCSP to carry out the FHTS, through which effort information from charter and head boats is collected throughout the fishing season. During 2020, 1,740 calls were completed to vessel representatives from March through December. In the peak months of sampling, there were nearly 1,000 active vessels with 10% of those vessels being selected each week for surveys. The new biologist also worked to update and improve a federal vessel directory to ensure that future survey work will be more efficient.

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 2020, there were 70 entries in the derby, including 45 winners and two Anglers of the Year. One new state record was set. Other activities in 2020 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. Due to the Covid pandemic, the 2020 Derby Awards Ceremony was cancelled. Derby winners received their awards by mail (Figure 29).

Figure 29. Anna Jacobs, the 2020 Adult Angler of the Year.

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 30. The new Deer Island fishing pier.

In 2020, DMF completed the construction of a new fishing pier on Boston Harbor's Deer Island (Figure 30) with the OFBA and the Massachusetts Water Resources Authority. This project was initiated in 2012 and will serve Massachusetts anglers for decades to come. DMF also initiated work to rebuild the historic Salem Willows Park Fishing Pier. The permitting, planning, and engineering were underway at year's end.

Once again, DMF's small grants program provided $50,000 to assist municipalities with projects that promote or support local recreational fishing activities and access. In 2020, three projects were approved for funding: maintenance, including new deck planking and fillet station, of a fishing pier in Beverly; the refurbishing of a pier in Onset Bay, Wareham in collaboration with the Buzzards Bay Coalition; and a project in Danvers to perform engineering surveys, brush clearing, and signage at public ways to water that have been obscured over time. All of these projects serve to enhance public access for anglers in the Commonwealth.

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. Staff also 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 2020, staff worked with various entities to develop proposals for public access sites; responded to inquiries regarding shoreside fishing sites, public access rights, and future access projects; and represented the agency remotely at multiple monthly meetings of various sportsmen's gatherings.

Outreach

Staff routinely answered public inquiries regarding recreational fisheries and attended virtual meetings of the recreational fishing community. However, due to the pandemic, all fishing and boating trade shows were cancelled in 2020.

Figure 31. The cover of the 2020 Saltwater Fishing Guide.

The Massachusetts Saltwater Recreational Fishing Guide (Figure 31) was prepared and distributed to over 140 bait and tackle shops and to requesting anglers by mail and website downloads. In addition, important recreational fishing news was distributed to recreational permit holders through the Division's email distribution list.

Large Pelagics Research Project

Shark Research

DMF began shark research in 1987 to more fully elucidate the ecology, distribution, and relative abundance of sharks that are subject 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 and survey efforts were expanded into Cape Cod Bay. Third, two gridded acoustic arrays were deployed off Head of the Meadow Beach (Truro) and Nauset (Orleans) beaches with the Center for Coastal Studies to examine fine-scale movements of sharks as they relate to the habitat. Fourth, five real-time acoustic receivers were deployed off popular Outer Cape swimming beaches including: Newcomb Hollow and Lecounts (Wellfleet), Head of the Meadow (Truro), Nauset Trail (Orleans), and North Beach (Chatham). 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 camera tags 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. Sixth, a fixed aerial camera system was tested in Orleans as a potential tool to observe nearshore white shark behavior.

As a result, 38 white sharks were tagged with acoustic transmitters off the Outer Cape in 2020; eight of these also carried acceleration data logging camera tags for up to two days (Figure 32). This brings the total to 230 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 2020 will be used to enhance our understanding of white shark predatory behavior in these areas of high shark-human overlap to better inform public safety practices. Lastly, technical assistance and acoustic receivers were provided to the state of Maine in response to the fatal shark attack (June 2020).

Shark Management: Staff participated in the development and the amendment of state, interstate, federal, and international shark management plans. During 2020, staff served on the following committees: ASMFC Coastal Sharks Technical Committee and Plan Development Team; ASMFC Spiny Dogfish Technical Committee and Plan Development Team; ICCAT Advisory Committee, Swordfish and Shark Working Group; and NMFS Highly Migratory Species Advisory Panel.

Figure 32. A white shark carries an acceleration data logging camera tag (orange) while hunting a group of gray seals off the Outer Cape. (Photo credit: Wayne Davis)

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 three articles published in scholarly journals in 2020. Topics included: seasonal distribution and habitat use of the common thresher shark in the western North Atlantic; movements and residency of sharks within a Marine Protected Area off the coast of St. Croix, USVI; and broad-scale movements of blacktip and lemon sharks from a Caribbean nursery in St. John, USVI.

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 not only responsible for the management of diadromous fish populations in coastal rivers of Massachusetts, but also the restoration, improvement, and maintenance of their migratory pathways.

Biological Assessments for River Herring

The alewife (*Alosa pseudoharengus*) is the most abundant and well-known anadromous fish in Massachusetts. Along with the closely related blueback herring (*Alosa aestivalis*), both species are known commonly as "river herring." River herring have had high cultural and economic importance historically, but present populations are well below former levels and harvest has been banned since 2006. As a result, DMF has increased monitoring efforts over the past decade to meet management goals of restoring populations and harvest. 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 stations where biological samples and/or census counts are collected.

River	Biological	Counts
Merrimack River, Lawrence	No	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
Cedar Lake, Falmouth	No	Electronic
Stony Brook, Brewster	No	Electronic
Herring River, Harwich	Yes	Electronic
Pilgrim Lake, Orleans	No	Electronic
Herring Creek, Aquinnah	No	Video

In 2020, river herring counts ranged from 461 fish in Cedar Lake, Falmouth to 887,724 in the Herring River, Harwich. River herring counts decreased at most herring runs in 2020, although some locations posted high counts well above their time series average: Herring River, Harwich; Nemasket River, Middleboro; and Town Brook, Plymouth. Project staff provided technical assistance to local groups conducting volunteer visual counts at herring runs. In 2020, a total of 26 rivers in 25 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 restoration activities for diadromous fish in 2020.

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. The COVID-19 pandemic curtailed all scheduled stocking events in 2020 except for a single transport of approx. 1,000 pre-spawning adult river herring to the Three Mile River in Dighton.

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 2020 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 2020 in response to the COVID-19 pandemic. One assessment was completed in 2020 at the New Bedford Reservoir (Acushnet River), and two were started at Mill Pond in Yarmouth and Island Creek Pond in Duxbury.

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 also supports DMF and *Mass*DEP restoration planning. An update of the priority list (Version-4) was completed in 2020. Efforts in 2020 also focused on working with DFG's GIS staff to bring V-4 into the GIS datalayer and improve functionality.

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

Diadromous Fish Research Studies

Blueback Herring Tagging, Mystic River: In 2020, project biologists continued their collaboration with MIT researchers to study habitat use by spawning river herring in the Mystic River watershed. DMF deployed acoustic receivers above and below the Upper Mystic Lakes Dam to detect fish tagged in 2019 that may have survived to return and spawn again in 2020. However, no tagged fish were detected.

River Herring Monitoring, 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 fishway exit records fish passage and a collection tank at an eel ramp is checked daily from spring through summer. PIT (passive integrated technology) tagging of river herring was conducted in 2019, but not in 2020 due to COVID-19 safety concerns. Antennas to detect PIT tags were placed at all outlets to the lake to detect tagged river herring and American eel. The eel population in the lake is surveyed annually in the summer using eel pots 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 2020, the COVID-19 pandemic prevented any collaborative sampling of American shad on the Charles River. Project staff will work with colleagues at USFWS and *Mass*Wildlife to collect adult American shad from the Charles River to characterize the population and identify fish marked with oxytetracycline (OTC) in year-specific patterns in 2021. 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 *Mass*Wildlife 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 2020 increased in comparison to 2019. This monitoring also includes other diadromous fish species.

American Shad Electrofishing Survey: In the spring of 2020, project staff completed the fifth season of a pilot study to monitor the presence and abundance of American shad in the South River and Indian Head River. 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 2020, 18 sampling trips in the South River and 18 sampling trips in the Indian Head River were conducted between April and June; 86 and 137 shad were captured, respectively, for size, age, and genetic sampling. Scale-based aging indicated that these shad ranged from 4–9 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 2021 with the 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 2020 declined to 14 eels per haul, the lowest catch per haul in the 20-year time series. The Essex River eel fyke net repeated the high catches of 2019 again in 2020 with 416 eels per haul.

Project staff has fabricated and installed 12 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. Overall, eel ramp catches declined in 2020 at most locations. Two eel ramps at the Wankinco River in Wareham and the Jenney Grist Mill Dam on Town Brook, Plymouth, had substantially lower catches in 2020 than 2019. Data for the Saugus River eel ramp, the first ramp in coastal MA, was submitted to ASMFC in 2020 for consideration as a yellow eel index of abundance in their eel stock assessment.

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 2020. The Weweantic River and the Parker River continue to have catches that depict very low spawning run populations. Collectively, the fyke nets have caught over 40 species of fish in total, including 10 species of diadromous fish, with potential indices of abundance for eel, white perch, Atlantic tomcod, and lamprey.

Fish Passage and Habitat Restoration Projects

Numerous projects to improve and maintain diadromous fish passage, habitats, and populations are conducted each year. In 2020, project staff devoted time to approximately 20 individual projects in various stages of development and implementation. The following list includes completed projects and larger ongoing projects of regional significance. Project highlights for 2020 include the completion of the Weymouth Herring Passage and Smelt Habitat Restoration Project, and much needed improvements in the fishway at the Elm Street Dam on the Indian Head River in Pembroke and Hanover.

Back River, Weymouth: The Weymouth Herring Passage and Smelt Habitat Restoration Project in the Back River was completed by the Town of Weymouth in 2020. This large cooperative project originated from concerns over herring getting trapped behind the gate of a flood control tunnel at the Broad Street Dam over 20 years ago. The project design began over 10 years ago and included a diversion wall to keep fish out of the tunnel, a resting pool for fish, and specific channel designs to improve rainbow smelt spawning habitat. DMF contributed field measurements and technical assistance to the design, and pre-and-post construction monitoring to the project.

Indian Head River, Hanover/Pembroke: The fishway at the Elm Street Dam on the Indian Head River received a major tune-up with the replacement of 13 Denil baffles, concrete repairs, and the installation of new concrete stop log board slots and a trash rack. Questions had been raised over the aging condition of this important fishway for numerous diadromous and freshwater fish. The Fishway Crew dewatered the fishway and found it to be completely impassible with four collapsed baffles, large debris jams, and shrubs growing in the fishway.

Herring Brook Park, Pembroke: The Fishway Crew returned to the historic Herring Brook Park to modify the fishway at the former mill structure that was the site of one of DMF's larger fishway construction projects in 2019 (Figure 33). Operations of the fishway during the spring revealed that an additional weir was needed to safely pass herring around a water wheel and that weir and wall heights at several places needed to be raised to contain flow. This work was completed with granite blocks and river stones to add to the historic look of this popular public space.

Wareham Street Fishway, Middleborough: The DMF Fishway Crew made repairs to the board slots at this iconic Nemasket River fishway in 2020. The fishway was constructed by DMF in the 1980s. The concrete board slots had degraded causing irregular flow patterns. The slots were repaired with hydraulic cement during the late summer drought.

Bog Pond Fishway, Falmouth: In a cooperative project with the DMF Fishway Crew and the Town of Falmouth, a concrete entrance pool was added to the Bog Pond fishway in the Bourne Pond watershed in Falmouth. The fishway was constructed at an impassible dam in 2017. Three years of operations revealed that an entrance weir and pool were needed to allow easier access to the fishway in this shallow stream leading to Waquoit Bay.

Baxter Grist Mill Fishway, Yarmouth: A larger cooperative project to rebuild the historic Baxter Grist Mill on the Mill Creek in Yarmouth with associated new fishway and park improvements was completed in 2020 (Figure 34). The Town of Yarmouth was the lead with funding and technical assistance from the National Resources and Conservation Service. DMF was involved at all project stages and provided field assistance for early design.

Forge Pond Dam, Kingston: Work continued on the 20-year objective of restoring sea-run fish access to Silver Lake in the Jones River watershed in 2020. DMF reached an agreement with the City of Brockton in 2019 to install a temporary wood fishway at Forge Pond Dam in Kingston. With this installation, river herring passed from the Jones River to Silver Lake for the first time in over 100 years. The next step is to design a long-term fishway and to dredge Forge Pond. DMF funded the USFWS Fish Passage Engineering Program to design the next fishway. DMF is actively seeking funding now to advance the USFWS design

Figure 33. DMF Fishway Crew working on the fishway at Herring Brook Park, Pembroke.

Figure 34. Completed fishway at Baxter Grist Mill, Yarmouth.

to final designs and permitting. A working draft Fishway Operation and Maintenance Plan was written for the present fishway in coordination with the City of Brockton and implemented in the spring.

Fore River Watershed: Efforts continued in 2020 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 Division of Ecological Restoration, secured funding and contracted an engineering firm to complete design and permitting for the Armstrong Dam removal and Rock Falls fish passage improvements, with possible construction during summer and fall, 2021. DMF staff was active in the design review for the Rock Falls fishway and coordinated a large effort with stream maintenance in 2020 to ensure the path is open for the debut spawning run in 2022.

Town River, Bridgewater: DMF is partner to cooperative efforts to improve fish passage in the Town River tributary of the Taunton River. In 2020, project design to remove the High Street Dam was 90% completed with most permitting completed or underway. Project staff also worked 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.

Ipswich River, Ipswich: Efforts to improve fish passage at the Willowdale Dam on the Ipswich River continued. The project was fully designed, the Alaskan steeppass sections were purchased, and all permits were obtained in 2020. Construction was slated for the summer of 2020, but the COVID-19 pandemic prevented work. Construction was expected to occur in summer 2021.

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. These efforts continued in 2020 as project staff worked with the Mystic River Watershed Association and Town of Woburn to manage flows and fish passage at the Scalley Dam. Due to the COVID-19 pandemic, no visual count occurred but project staff observed many fish using the spillway and manually moved over 1000 river herring over the dam. New fishway construction was chosen as a preferred project as part of environmental mitigation processes and this work will occur over the next 3 to 5 years.

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 to the Director under Chapter 130, Section 19 of Massachusetts General Laws. Four working draft O&M plans were prepared in 2020 with plans finalized for the Bog Pond fishway in Falmouth and Forge Pond Dam in Kingston.

DMF issues Fishway Construction Permits following the review of final engineering plans to construct, rebuild, or alter fishways. During 2020, three Fishway Construction Permits were prepared for projects at: Herring Brook Park, Pembroke; the Elm Street Dam, Indian Head River, Pembroke/Hanover; and the Diversion Gate project at the Back River, Weymouth.

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. A single new plan was prepared in 2020 for the Stony Brook watershed and submitted to the Town of Brewster. A large increase in field efforts on stream maintenance occurred in 2020 as rivers with significant impediments were identified, but the COVID-19 pandemic limited other routine activities. Project staff worked in 18 rivers

with local partners in 2020 and made needed passage improvements in the Fore River, Braintree; Acushnet River, Acushnet; and Jones River, Kingston.

Other Activities

Technical Committee Participation: Staff actively participated on management and technical committees related to diadromous fish including the ASMFC technical committees for river herring, shad, American eel, sturgeon, and fish passage. Annual ASMFC compliance reports were prepared for American eel, river herring, American shad, and Atlantic sturgeon. Substantial effort was provided to the shad and river herring TC sub-committee related to updating the management plans and sustainable harvest plan metrics for those species.

Staff also served on the NMFS River Herring Technical Expert Working Group, 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 AFS Award Co-Chair.

Education/Outreach: Project staff provided numerous virtual presentations and technical assistance related to education, outreach, and constituency groups.

Additional Publications & Presentations: Staff contributed to two additional journal articles on adult run size and habitat availability limitations on juvenile river herring densities in lakes, and the surgical implantation of acoustic tags in American shad to resolve riverine and marine restoration challenges.

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 (through May 2020)

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 and State Fishery Management & Technical Assistance
Maggie Nazarenus, Program Coordinator – Coronavirus Aid, Relief, and Economic Security Act and Revolving Loan Fund

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
Conor Byrne, Shellfish Purification Plant, Facilities and Capital Assets

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 11.24% from Fiscal Year (FY) 2019 to FY2020 (Table 23). Appropriated funds for the operating budget increased 10.45%. The increase in appropriated funds was approved to primarily cover increased annualized costs for payroll, continuation of a shark tagging program, shellfish research, and for full-year costs associated with the newly occupied field station in New Bedford.

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 decreased by less than 1% in FY20, primarily resulting from the continued decline of shellfish depuration at the Shellfish Purification Plant.

Appropriations from special fund accounts increased by just over 18%. The Legislature slightly increased the appropriation on the Saltwater Sport Fish Licensing account to adjust for increased personnel and research costs; and also approved a one-time bump up to cover construction costs on the Deer Island Fishing Pier out of this account. This account is funded by recreational saltwater fishing permit sales and supports recreational fishery improvements. The Seafood Marketing Program, funded by revenue collected from the issuance of commercial fisherman and seafood dealer permits, remained level-funded.

Table 24 provides the breakdown of costs by primary spending category for the DMF operating accounts.

Table 23. Fiscal Year 2019 and 2020 appropriations (available funds for operations).

Title	Acct. Number	FY2019	FY2020	Change
General Fund Accounts				
General Operating	2330-0100	[1]$5,939,289	[2]$6,611,146	+11.31%
Sportfish Program	2330-0120	$779,211	$809,121	+3.84%
General Fund Total		$6,718,500	$7,420,267	+10.45%
Retained Revenue Accounts				
Sportfish Retained Revenue	2330-0121	$217,989	$217,989	0.00%
Purification Retained Revenue	2330-0150	$47,016	$43,142	-8.24%
Ventless Trap Retained Revenue	2330-0199	$250,000	$250,000	0.00%
Retained Revenue Total		$514,914	$511,040	-0.75%
Special Fund Accounts				
Saltwater Sport Fish Licensing	2330-0300	$1,389,837	$1,688,993	+21.52%
Seafood Marketing	2330-0104	$250,000	$250,000	0.00%
Special Fund Total		$1,639,837	$1,983,993	+18.24%
Appropriations Grand Total		**$8,873,251**	**$9,870,300**	**+11.24%**

[1] 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).

[2] The final budget for FY2020 in Chapter 41 of the Acts of 2019 was $8,169,533. DMF's general operating budget was affected by: 1) earmarks totaling $1,585,000 ($450,000 to SMAST; $100,000 for the Great Marsh Green Crab Trapping Program; $50,000 for the Fishing Academy, Inc.; $175,000 for Coastal Marsh Restoration; $175,000 for shellfish propagation in Barnstable, Dukes, and Nantucket counties; $20,000 for shellfish propagation in the Town of Westport; $75,000 for a great white shark tagging program; $75,000 for ecosystem based study of great white shark presence in nearshore areas of Cape Cod; $40,000 for the Cape Cod Commercial Fishermen's Alliance for a youth program; $200,000 for shellfish research with the Gloucester Marine Genomics Institute; $25,000 for GMGI broadband; $100,000 for restoration to Town Pier and Historic Fish House in Swampscott; $100,000 maintenance of Herring Run in Weymouth); 2) $26,613 made available from a reserve draw account to cover employee longevity pay.

Table 24. FY2020 expenditures by account type and primary spending category (rounded to whole dollars).

	General Fund	Retained Revenue	Special Fund	Total
Salaries	$6,288,709	$121,491	$503,316	$6,913,516
Employee Expenses	$21,178	$337	$4,335	$25,850
Contracted Employees	$39,920	$16,148	$196,668	$252,737
Contracts	$2,828	$70,225	$140,466	$213,520
Facility Maintenance	$38,167	$8,881	$1,307,248	$1,354,296
Field & Lab Supplies	$188,710	$63,353	$106,351	$358,414
Fringe Costs	$162,566	$3,282	$15,812	$181,659
Fuel	$56,437	$0	$187	$56,624
Utilities	$65,165	$0	$0	$65,165
Lease/Rent	$207,608	$0	$0	$207,608
Maintenance/Repair	$107,536	$147,614	$0	$255,150
Office & Administrative	$198,048	$65,769	$53,836	$317,652
Services/Equipment Lease	$309	$0	$0	$309
Outside Agencies	$194,389	$5,828	$2,000	$202,217
Grants	$1,341,001	$0	$57,918	$1,398,919
Total	**$8,912,571**	**$502,927**	**$2,388,136**	**$11,803,635**

Staffing

Staffing levels were up just over 7% by the end of calendar year (CY) 2020 primarily due to the timing of backfills from the end of CY2019 and from the addition of new staff to the shellfish program. Overall, staffing level increased by seven positions between CY2019 and CY2020 (Table 25).

Table 25. Calendar Year 2019 and 2020 Authorized Personnel Levels.

Title	Acct. Number	CY2019	CY2020
DMF General Operating	2330-0100	57	65
Sport Fish Program	2330-0120	10	10
Saltwater Sport Fish Licensing	2330-0300	8	9
Federal Grants and Trust Account	2330-xxxx*	20	18
Total Employees in All Appropriations		**95**	**102**

*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 29,489 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 $2,191,530 in 2020 (Table 26). Overall, there was a drop in permit revenue collected by approximately 3% as compared to 2019.

The Shellfish Purification Plant processed 4,215 racks of soft shell clams in 2020, resulting in General Fund revenues of $25,288. This represents a 35% decrease in revenue from 2019 and is the lowest amount ever recorded. Overall, there has been a declining trend in racks processed and resulting revenues since 2009, but lack of market in 2020 due to COVID-19 restrictions further impacted all shellfish sales.

Table 26. Calendar Year 2019 and 2020 General Fund Permitting Revenue.

Permit Categories	CY2019	CY2020	Change
Commercial Fishing	$1,257,740	$1,237,970	-1.6%
Seafood Dealer	$189,800	$186,940	-1.5%
Special	$814,250	$766,620	-5.9%
Total General Fund Permit Revenue	**$2,261,790**	**$2,191,530**	**-3.1%**

Dedicated Fund Revenue

In addition to General Fund revenue, DMF generated $1,694,295 in revenue for the Marine Recreational Fisheries Development Fund in 2020 (Table 27). 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. The increase in outdoor recreational pursuits during COVID-19 was evident throughout the country, and in 2020, the fund saw a significant increase in revenue (~16%) over that of the previous year. Some activities, such as for-hire fishing, were negatively impacted during the pandemic because of social distancing requirements. As a result, permit sales in that category were slightly lower as compared to the previous year.

Table 27. CY2019 and CY2020 Marine Recreational Fisheries Development Fund Revenue.

Permit Categories	CY2019	CY2020	Change
Recreational Saltwater	$1,347,680	$1,552,430	+15.2%
For-Hire (charter & head boat)	$63,180	$61,880	-2.1%
Recreational Fund Donations	$52,590	$79,985	+52.1%
Total Rec. Fisheries Fund Revenue	**$1,463,450**	**$1,694,295**	**+15.8%**

Grants

In FY2020, DMF spent approximately $3.5 million on federal grants and mitigation projects operating out of the DMF Trust Account. This was a decrease of almost 17% as compared to FY2019 (Table 28). Most of the decreased spending can be attributed to large infrastructure projects in the Clean Vessel Act Program that were completed in FY2019, and decreased personnel costs coming out of the DMF Trust Account. There was a significant increase in spending on Protected Species in FY2020, and that is expected to continue in FY2021.

Table 28. Fiscal Year 2019 and 2020 Expenditures.

Title of Federal Grant or Trust	Account No.	FY2019	FY2020
Clean Vessel Act	2330-9222	$1,369,000	$803,000
Fisheries Statistics	2330-9712	$179,000	$187,000
Boating Infrastructure	2330-9725	$26,000	$177,000
Interstate Fisheries	2330-9730	$248,000	$293,000
ACCSP	2330-9732	$12,000	$18,000
Saltonstall-Kennedy	2330-9733	$64,000	$148,000
Turtle Disentanglement/Protected Species	2330-9739	$624,000	$761,000
Economic Relief	2330-9741	$84,000	$4,000
Fish Age & Growth	2330-9742	$276,000	$271,000
Sport Fish Coordination	2330-9743	$129,000	$130,000
MFI Grants	2330-9744	$32,000	$54,000
Marine Fisheries Research Trust	2330-0101	$1,006,000	$625,000
	Total	**$4,049,000**	**$3,471,000**

Coronavirus Aid, Relief, and Economic Security Act Fisheries Relief

During CY 2020, the Coronavirus Disease 2019 (COVID-19) crisis brought significant challenges to the fishing industry in Massachusetts. On March 10, 2020, Governor Charlie Baker declared a state of emergency in response to COVID-19. Stay-at-home and other social distancing orders required many businesses to temporarily close and businesses allowed to remain open were required to operate at reduced capacity.

On May 7, 2020, the Secretary of Commerce announced the allocation of $300 million in fisheries assistance funding provided by Section 12005 of the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) for those seafood and fishing industry sectors negatively affected by the COVID-19 pandemic. Approximately $28 million of this funding was allocated by NOAA Fisheries to the Commonwealth of Massachusetts, the third highest allocation in the country. The allocation to states was based on past revenues from four identified fishing sectors: seafood processing, commercial fishing, aquaculture, and recreational for-hire fishing. In Massachusetts, the contribution from each sector was estimated as 51.2% seafood processing, 45.2% commercial fishing, 2.1% aquaculture, and 1.5% for-hire fishing.

DMF set an ambitious goal of distributing the CARES Act relief to all sectors within a matter of months, forming an internal team of DMF employees to develop and implement a relief program for an industry with over 9,000 participants. The first step was to craft a spending plan for submittal to the ASMFC for approval by NOAA Fisheries. This process was deeply aided by the input of an overarching industry-based advisory panel and four sector-specific working groups formed by DMF and populated with industry representatives. Within five weeks of the announcement by the Secretary of Commerce, DMF submitted a spending plan to the federal government and in July, Massachusetts became the first state with an approved spending plan for this critical program.

To be eligible for participation in the CARES Act relief program, applicants were required to self-certify to several stipulations: that they had suffered a 35% revenue loss caused by COVID-19 relative to a previous five-year period specified for each sector, and that relief from this program plus other forms of COVID-19 pandemic-related aid and traditional fishing revenue in 2020 would not total more than their normal revenue. In addition, DMF implemented residency and age restrictions as required by the Act. Criteria were developed for each sector to further refine the pool of eligible permit holders and to tier payments based on such elements as vessel activity and size in the for-hire fleet, ex-vessel sales for the commercial and aquaculture sectors, and minimum seafood sales and number of employees for seafood processors.

Applications were developed based on the specific criteria approved for each sector and all permit holders were direct mailed an application packet that indicated their potential eligibility. Initial eligibility determinations were based on data submitted to DMF by the permit holders, through either normal reporting processes or pre-application surveys. Applicants were given a deadline for applying, followed by an appeals period. At the conclusion of the appeal period, once the final pool of eligible applicants was known, payment values were determined according to the tiering metrics. Across all four sectors, DMF approved more than 950 applications for this relief program (Table 29). Massachusetts was the first state in the nation to distribute CARES relief funding to fishermen and seafood processors, with all payments issued by mid-November.

Table 29. CARES Act Payment Distribution

Sector	Allocation	No. of Recipients	Minimum Payment	Maximum Payment
For-Hire Head Boats	$416,000	34	$1,432	$22,912
For-Hire Charter Boats	$584,000	72	$4,672	$9,344
Aquaculture	$1,152,000	170	$495	$15,830
Seafood Processors/Wholesale Dealers	$13,779,788	113	$44,740	$357,917
Commercial Fishing	$11,822,468	566	$6,360	$38,157

The Massachusetts fishing industry attributable to these four sectors is valued at approximately $1.4 billion annually. Although the $28 million of CARES Act fisheries relief allocated to the state only covered a portion of the total losses faced by local fisheries as a result of the COVID-19 pandemic, the Commonwealth was fortunate to receive the funds and is proud to have been able to provide relief to local businesses in an expedient manner. A second round of funding was anticipated for completion in 2021 following the enacting of the Coronavirus Response and Relief Supplemental Appropriations Act on December 27.

State Fishery Management & Technical Assistance

Staff provide technical assistance and support to the New England Fishery Management Council in the development, implementation, and monitoring of FMPs and Amendments. These cooperative activities enhance the management of fisheries occurring in the Territorial Sea and Exclusive Economic Zone. Since 2018, the Council has provided the Commonwealth with $80,000 biennially, split evenly between the two years. The $40,000 allocated to fishing year 2020 supported the Commonwealth's participation in Council meetings and other Committee meetings as well as in working groups, technical groups, and plan development teams. Some of this work is summarized in the policy section and DMF submitted a summary report of the State's technical assistance activities to the Council in August.

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 (CDP), 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.

Over the years, DMF 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) programs, a significant underutilization of loan funds and lack of new participation persisted. This continued lack of loan utilization demonstrated that the RLF and RALF programs did not have their intended impacts, especially at the envisioned scale of small vessel owners in the groundfish fishery. Therefore, at the end of CY2019, DMF recalled funds from its three RLF partners.

During CY2020, DMF worked with RLF partners to submit final reports, return unused funds and provide repayment plans for any remaining loans. DMF received unused funds from the CDP, the RLF partner servicing Cape Cod & the Islands, and established a contract through 2023 to allow for the continued administration of five existing CDP loans to eligible commercial groundfish fishermen through the RLF program totaling over $144,000. As the five existing loans are repaid, CDP shall make repayment to DMF on an annual basis. DMF continued to work through the end of 2020 with two other RLF partners, NEFS II and the Tremont Credit Union, to close out operation of their RLF programs.

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 2020, the 26th year of our participation, *Mass*CVA continued to support Massachusetts' status as a No Discharge Zone (NDZ). With 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 (Figure 35), 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.

Figure 35. Scituate's pumpout station funded for operation and maintenance in 2020.

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 2020, 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 36). Total reimbursement for all new and replacement equipment was $277,284.49. An additional $650,388.12 was spent on facility operation and maintenance costs in support of 64 pumpout boats, 83 fixed-location pumpout stations, and 13 mobile pumpout carts available to the recreational boating public along the Massachusetts coastline.

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

Table 30. New and Replacement *Mass*CVA Infrastructure, 2020.

Recipient	Equipment
Charlestown Marina	Replacement pumpout boat
Mattapoisett	Replacement pumpout boat engine
Quincy	Replacement pumpout boat
Quissett Harbor Boat Yard, Falmouth	Replacement pumpout boat engine
Safe Harbor Green Harbor Marina, Marshfield	New pumpout station
Salisbury	Replacement pumpout boat

Figure 36. *Mass*CVA infrastructure funded in 2020 included the replacement of Quincy's pumpout boat.

Boating Infrastructure Grant Program

The Massachusetts Boating Infrastructure Grant Program (*Mass*BIG) is a two-tiered federal grant program, directed through the U.S. Fish and Wildlife Service 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

Figure 37. Three recreational vessels tied up at Manchester-by-the-Sea's Tier II funded Reed Park Transient Boater Improvement Project, completed in 2020.

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.

*Mass*BIG discussed a number of possible BIG projects with Cities and Towns but no projects were applied for or awarded in 2020. Progress on several previously awarded projects continued during the year, including the completion of two (Table 31, Figure 37).

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) – *Completed 2020*	$360,222	100%
2016	Nantucket Transient Boater Navigational Project (Nantucket and Madaket Harbors)	$45,056	100%
2018	Boston Harbor Islands Transient Boater Access Project (Peddocks Island)	$180,623	25%
2019	New Bedford Transient Boater Improvements Popes Island Marina – *Completed 2020*	$52,271	100%

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 the following ways:

Public Events: Staff were present at various trade shows and events early in the year, including the 2020 New England Boat show in Boston and the New England Saltwater Fishing Show. Event materials included new gunnel stickers with a striped bass slot marker and updated striped bass circle hook cards. Roughly 3,000 circle hooks were distributed between the two shows. Expected participation at events later in the year was disrupted by the COVID-19 pandemic.

Publications and Design: The pilot year of the "Take Me Saltwater Fishing" initiative was moved to spring of 2021 due to the pandemic. Planning, design, and completion of program materials and promotional items was met throughout the spring season and into the summer of 2020. The design and purchase of two new outdoor promotional/education tents was completed in June. Unfortunately, due to restrictions for in-person gatherings, the planned circle hook promotions at various boat ramps throughout the state were canceled, as were in-person striped bass educational outreach activities. Activity switched to social media postings and updated webpages, hosting information on striped bass regulation changes and conservation practices. The goal of the striped bass promotions was to raise awareness of proper striped bass tackle and regulatory lengths.

Social Media: Communications with constituents through our social media platforms continued on Facebook, Twitter, YouTube, and Instagram. In 2020, Facebook and Twitter content continued to focus on providing regulatory updates and progress from field research, whereas Instagram focused on seafood marketing programs, recreational fishing, and the saltwater derby. Overall, the Facebook page grew 25% in 2020, adding

1,759 new followers. Instagram grew 23% in 2020, adding 920 new followers. DMF also saw an increase in engagement rates with constituents on both platforms.

In the summer of 2020, I&E continued the "*What is it? Wednesday"* social media campaign on Facebook (Figure 38), 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 pair of spinning rod/reel combos. Follow-up postings offered additional information and promoted various projects in addition to highlighting many of the species found in Massachusetts waters. Engagement insights on post clicks and reactions were among some of the year's highest, routinely breaking 500 post clicks and were among some of the most shared content on Facebook for the year.

Figure 38. 2020's first "What is it? Wednesday" post, featuring a sea raven.

Email Alerts: In 2019, DMF contracted with Granicus/Gov Delivery, to provide an email subscription service to constituents, replacing the legacy listserv system. Continuing into 2020, the listserv provided an easy way to update the constituency on commercial and recreational permitting and regulation changes during the ongoing pandemic.

R3 Initiatives: Every year, DMF works in conjunction with the Recreational Boating and Fishing Foundation (RBFF) to increase participation in recreational saltwater angling. In 2020, 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 through social media and email delivery.

Other: Staff, in collaboration with the MA Environmental Trust (MET), developed a specialty Striped Bass License plate to support new programs to research, protect, and preserve striped bass populations (see page 20 for more information).

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 39) and a small grant program, which awards up to $500 per proposal for outside entities to create an event promoting saltwater angler education within Massachusetts. In 2020, DMF administered funding to a non-profit group, The Fishing Academy, Inc., which works with inner-city children around the Boston area to engage them in saltwater fishing.

In 2020, DMF had planned to host or participate in five youth fishing clinics for ages 7-15, and seven events open to all ages, during the months of May through October, all free to the public. However, due to COVID-19 all clinics had to be cancelled. Typical events include DMF biologists teaching 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 are distributed to registered youth, as are mini tackle kits—including circle hooks and measuring tapes. Our goal is to have participants feel confident enough to saltwater fish on their own. Providing them with tackle to do so greatly increases those odds.

Planning was undertaken to safely resume the operation of fishing clinics in 2021. Staff hoped to offer pop-up clinics to pass out educational materials, circle hooks, and allow safely-distanced fishing as long as safety protocols allow. Clinics would be 2-4 hour in durations with rods being rotated out for sanitation purposes, and fishing limited to 30-minute increments.

Figure 39. DMF staff at fishing clinics in 2019 (all 2020 clinics were cancelled due to the pandemic): (right) Matt Ayer at Cashman Park Fishing Pier, Newburyport, teaching fishing techniques; (left) Lynne Besse at Cape Cod Canal Visitors Center, Sandwich, teaching fish identification.

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

The Seafood Marketing Program was going to start off 2020 with a new and exciting buyers' event at the Seafood Expo in March. "Navigating Massachusetts Seafood" was planned to bring together buyers and sellers for a breakfast and presentations at Legal Seafoods, a tour of the Fish Pier, a ribbon cutting, and networking on the floor of the Expo at our Massachusetts Avenue. Then COVID-19 hit and all seafood marketing event plans changed. The program reacted to the needs of the industry and pivoted to various forms of media promotion.

In early April, DMF contacted all seafood wholesale and retailers to make a comprehensive list of businesses that were open. The retail list was successful since DMF was already seeing a rise in retail demand due to restaurant closures. During this time, fishermen were organizing to set up direct-to-consumer markets powered mostly by social media. Wholesalers had taken a huge hit with restaurant closures, and were changing their

sales strategy to meet the new demands for the home cooks, contactless pick-up and delivery, as well as trying to adhere to social distance recommendations on their processing floors.

The Seafood Marketing Program addressed some of these new realities by issuing a video message from DMF's Director in late April. This video had over 6,000 views and implored people to buy Massachusetts Seafood. Radio advertising was purchased for the summer of 2020 with similar messaging. Audio and digital promotion via iHeartRadio family was recorded by local radio personality Billy Costa, and $72,000 was spent to reach the entire state with over 6 million impressions.

During the Summer of 2020, DMF also launched a Massachusetts Seafood Chef Series to encourage people to prepare seafood at home. The Seafood Marketing Program created six videos featuring Mac Hay of Wellfleet engaged in oyster shucking, shellfish preparing, lobster shucking, lobster purchasing, cleaning whole fish, and filleting whole fish. These videos were shared on social media, live on the DMF YouTube page, and can be used by any individual or business to promote seafood. For weekly content all summer, DMF collected 30 recipes with photos from chefs across the Commonwealth. These were posted to our Instagram and shared via Facebook. A new website was also created to house these recipes.

Grant Program

The 2020 Seafood Marketing Grant Program awarded over $50,000 in funding three projects to help the Commonwealth's local seafood industry sell fresh, locally-caught products to Massachusetts consumers through promotion and awareness campaigns:

$13,376 – Eating with the Ecosystem: *Real-Time Seafood Marketing, Synchronizing Supply and Demand in a Dynamic Environment.* The project is supporting Massachusetts' fishing and seafood communities by developing a crowdsourcing and consumer mobilization platform to test methods for real-time seafood purchasing advice, with the goal of making the state's retail marketplace rapidly adaptable to variation in supply of local species.

$31,240 – Our Wicked Fish, Inc.: *A Blueprint for Marketing Local Seafood at Colleges & Universities.* Our Wicked Fish and UMass Dining conducted a month-long campaign for New England-caught seafood at UMass Amherst in October (National Seafood Month). In-person components planned for the campaign (e.g., on-campus contests) were successfully replaced with virtual events (e.g., a cooking competition over Instagram).

$6,000 - New Bedford Port Authority: *Marketing New Bedford Seafood Internationally & Locally.* New Bedford Port Authority is updating its website and developing additional features that (1) market the New Bedford-based businesses to international buyers, and (2) further educate local and regional residents about locally landed species. This website will also support the Commonwealth by highlighting and sharing content about species that are landed throughout New England.

Other work with partnerships included helping MDAR launch the MassGrown Exchange with seafood businesses, and EEA as readers of the Food Security Infrastructure Grants.

Scientific Diving

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

Despite the many limitations and complications caused by the COVID-19 pandemic, DMF's scientific divers conducted over 240 research dives to support on-going research and monitoring programs, including artificial reef

site surveys, coast-wide 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, polychlorinated biphenyl monitoring sample collection, and dive program training (Figure 40). 2020 highlights include pre-removal surveys of ghost nets in Massachusetts Bay, the deployment of a new acoustic receiver mooring on the wreck of the *Mars*, continued post-deployment monitoring of the new artificial reef off Harwich, and the successful completion of training for DMF biologists.

Figure 40. DMF and Northeastern University scientific divers performing eel grass restoration monitoring in Salem Sound.

The Scientific Diving Program also maintains reciprocity agreements with the U.S. Environmental Protection Agency (EPA), Boston University, the Marine Biological Laboratory, Northeastern University, and Woods Hole Oceanographic Institution, permitting cooperative diving research. Routine program management duties included diver training, equipment maintenance and repair, and maintenance of the air system.

Educational and outreach efforts to dive clubs, schools, and local dive shows were greatly limited due to the restrictions on travel and public gatherings. Several educational sessions were conducted for local dive clubs using videoconference platforms. The Diving Safety Officer continued to serve on the boards of the American Academy of Underwater Sciences Foundation, Bay State Council of Divers, the Foundation for Underwater Research and Education, and the Our World Underwater Scholarship Society.

Capital Assets and Facilities Management

Facilities

DMF maintains facilities at several locations throughout the state. Headquarters are located in Boston, with the two primary field stations 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 response to the pandemic, COVID-19 safety protocols were developed in coordination with EEA guidelines and instituted for all DMF facilities, vehicles, and vessels. Similarly, operational protocols were developed and instituted for DMF field studies and the diving program.

In FY2020, DMF spent approximately $87,000 in facility planning, infrastructure maintenance, and emergency repairs. At the Gloucester Field Station, plans were developed and permitted for the construction of a retaining wall and expansion of the storage building. 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 and continued in 2020. Construction of the Shawme storage facility remained on hold pending resolution of permitting issues.

Vehicles and Boats

DMF maintains a fleet of 40 vehicles and 16 boats. In 2020, $143,000 was paid to the Office of Vehicle Management for lease vehicles, and an additional $61,000 was spent on maintenance and repair for all stock. 10 vehicles were scheduled for replacement in 2020; however, lack of available stock caused by the pandemic have pushed all vehicle orders off until 2021.

Figure 41. DMF trailered fleet in New Bedford

DMF was able to take advantage of agency down-time and the availability of CAP money to upgrade small vessels (Figure 41). VHF radios, chart plotters, sounders, and, as appropriate, radar units were replaced on six boats. All of the new VHF radios are AIS compatible and AIS units were installed on the R/V *Alosa* and R/V *Mya*. The total cost of these upgrades was $45,000. The preventive maintenance program begun in 2019 for the New Bedford boats and trailers continued at a cost of approximately $8,000. One Maritime Skiff and the North Coast were repowered at a cost of $26,000.

Routine maintenance and replacement of DMF diving equipment continued in 2020 at a cost of $6,500. Sixty air cylinders were inspected in-house, resulting in savings of $1,500.

Other Projects: Efforts continued on the multi-year effort to collect marine life in and around New Bedford Harbor in partnership with the DEP to support EPA's Superfund monitoring efforts. Personnel were assigned to the EEA Health and Safety Team, the Pilgrim Nuclear Power Station Decommissioning Committee, and as a DFG representative to EEA's MA Ingestion Pathway Team for responses to potential releases from Seabrook Station in NH.

In November, DMF Dive Safety Officer was inducted into the National Association of Underwater Instructors' Hall of Honor for outstanding contributions to the development of diving education.

Appendix A. 2020 Publications

DMF Technical Reports

Pugh, T. L., and **R. P. Glenn**. 2020. Random Stratified Ventless Trap Survey for American Lobster 2006-2016. DMF TR-71.

Livermore, J., **B. C. Chase**, M. Bednarski, and **S. Turner**. 2020. River Herring Spawning and Nursery Habitat Assessment: Mill River Watershed, 2012-2014. DMF TR-72.

Schondelmeier, B. P., **W. S. Hoffman**. 2020. Characterization of the Massachusetts Spring Longfin Squid Fishery. DMF TR-74.

Nelson, G. A. 2020. Massachusetts striped bass monitoring report for 2019. DMF TR-75

Contributions

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