Department of Fish and Game

Massachusetts Marine Fisheries

2013 Annual Report

Department of Fish and Game

Massachusetts Division of Marine Fisheries

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Commonwealth of Massachusetts
Governor Deval Patrick

Executive Office of Energy and Environmental Affairs
Secretary Richard K. Sullivan, Jr.

Department of Fish and Game
Commissioner Mary B. Griffin

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Introduction

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

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

Mission

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

Vision

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

Goals

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

Promote and support our commercial and recreational fisheries.

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

Foster partnerships that help accomplish the Division's mission.

Support continued development of an ecologically sustainable marine aquaculture industry.

Promote a high level of staff commitment and professionalism.

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

Frequently Used Acronyms and Abbreviations

Army Corps	US Army Corps of Engineers
ACCSP	Atlantic Coastal Cooperative Statistics Program
ACE	Annual Catch Entitlement
ACL	Annual Catch Limit
AM	Accountability Measure
ASMFC	Atlantic States Marine Fisheries Commission
CCB	Cape Cod Bay
CE	Conservation Engineering
DAS	Days-at-sea
EOEEA	Executive Office of Energy and Environmental Affairs
EPA	Unites States Environmental Protection Agency
FMP	Fishery Management Plan
GIS	Geospatial Information System
ICCAT	International Commission on the Conservation of Atlantic Tunas
ILF	In-lieu Fee
ISSC	Interstate Shellfish Sanitation Conference
LMA	Lobster Management Area
*Mass*DAR	Massachusetts Department of Agricultural Resources
*Mass*DCR	Massachusetts Department of Conservation and Recreation
*Mass*DEP	Massachusetts Department of Environmental Protection
*Mass*DOT	Massachusetts Department of Transportation
*Mass*DPH	Massachusetts Department of Public Health
Massport	Massachusetts Port Authority
Mass*Wildlife*	Massachusetts Division of Fisheries and Wildlife
MAFMC	Mid-Atlantic Fishery Management Council
MFAC	Marine Fisheries Advisory Commission
MRIP	Marine Recreational Information Program
NEFMC	New England Fishery Management Council
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NSSP	National Shellfish Sanitation Program
PCCS	Provincetown Center for Coastal Studies
PDT	Plan Development Team
PSP	Paralytic Shellfish Poisoning
SAFIS	Standard Atlantic Fisheries Information System
SMAST	School for Marine Science and Technology (at UMass Dartmouth)
SNE	Southern New England
TAC	Total Allowable Catch
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-year

FISHERIES MANAGEMENT AND POLICY SECTION

Policy and Fisheries Management Program

Personnel

Paul Diodati, Director
Dr. David Pierce, Deputy Director
Daniel McKiernan, Deputy Director
Steve Correia, Senior Marine Fisheries Biologist
Melanie Griffin, Fisheries Management Specialist
Nichola Meserve, Fisheries Policy Analyst
Story Reed, Permit Program Administrator
Jared Silva, Regulatory Coordinator

Conservation Engineering Project
Michael Pol, Project Leader
David Chosid, Marine Fisheries Biologist
Mark Szymanski, Assistant Marine Fisheries Biologist

Overview

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

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

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

State Fisheries Management

Following below are actions taken and issues confronted by *MarineFisheries* in 2013, unilateral of interstate or federal fisheries management actions.

Marine Fisheries Advisory Commission

The Marine Fisheries Advisory Commission (MFAC) held eight business meetings during 2013. The Commission approved regulatory revisions that: established weight equivalencies for the commercial possession of monkfish parts (322 CMR 6.03(10)); prohibited the possession of ocean pout and windowpane flounder by recreational anglers (322 CMR 6.03(13)); clarified the lobster management area declaration requirements (322 CMR 7.01(2)); amended the commercial and recreational Gulf of Maine winter flounder regulations (322 CMR 6.03 (11)); revised the commercial scup and black sea bass regulations (322 CMR 6.28); extended the lunar closure for horseshoe crab harvest (322 CMR 6.34(7)); increased the minimum size for lobsters in Management Area 3 (322 CMR 6.01(1)); eliminated seven regulations identified as being unduly constraining on small businesses or outdated; exempted charter boats from posting recreational fishing rules (322 CMR 7.10(5)); amended the conch pot fishery rules (322 CMR 6.12 and 6.21); implemented gear requirements for scallop dredges and additional rules to sustain the state waters' resource (322 CMR 4.10 and 6.05); clarified the river herring bycatch tolerance (322 CMR 6.17); prohibited the harvest of American shad throughout the Commonwealth except where sustainability could be demonstrated (322 CMR 6.17); established a striped bass permit endorsement application/renewal deadline (322 CMR 6.07(3) and 7.01(4)); amended the recreational fluke, scup, and black sea bass rules (322 CMR 6.22 and 6.28); established a commercial menhaden limited entry permit and quota management system (322 CMR 6.43 and 7.01(4)); revised the minimum sizes for seven groundfish species (322 CMR 6.03(2)); and allowed the possession and sale of shell-on lobster tails (322 CMR 6.32). The MFAC also approved annual specifications and/or mid-season adjustments for spiny dogfish trip limits, Atlantic herring days out, and commercial scup fishery trip limits.

MarineFisheries and the MFAC conducted a total of nine public hearings on the above changes, and one public hearing on proposals that would be considered for approval in 2014. *MarineFisheries* also hosted four public hearings for the ASMFC on the interstate management of fluke, American eel, Atlantic herring, and American lobster.

Marine Recreational Fisheries Development Panel

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

The Panel met during June 2013 to make recommendations for spending of the expected FY14 fund appropriation of roughly $1 million. The approved spending plan included, but was not limited to: design and permitting for the construction of several possible future fishing piers; infrastructure improvement projects in Mashpee, Aquinnah, Westport, and Marshfield;

expanded and enhanced sampling and assessment of the recreational fishery; additional public informational and educational materials and programs, including the production of a video promoting recreational angling in Massachusetts; stocking and monitoring diadromous fish populations; and monitoring fish populations at artificial reefs.

American Lobster

Declaration of Fishing Area: Following a public hearing in January 2013, *MarineFisheries* moved the requirement of lobster permit holders to declare the Lobster Management Area(s) they intend to fish in a calendar year from the trap tag regulations to the permitting regulations so that it is clear that this requirement applies to all commercial lobster permit holders, not just trap fishermen.

Sale of Shell-on Lobster Tails: As part of the FY2014 budget, Governor Patrick legalized the in-state sale of shell-on lobster tails weighing in excess of three ounces. *MarineFisheries* amended its lobster processing rules to conform to the law, including labeling requirements that allow enforcement officers and public health inspectors to determine if lobster tails at a dealer's establishment came from a legally processed lobster. These changes were promulgated by emergency action, then final action following a public hearing in October 2013. Industry support for additional processing allowances was wide-spread. These rules brought Massachusetts industry up to speed with common practice in neighboring states (Figure 1).

Photo Credit: Orion Seafood

Figure 1. Consumers can now enjoy the convenience of shell-on lobster tails in Massachusetts

Recreational V-Notch Possession Rule: Massachusetts has three different v-notch possession rules for recreational fishermen depending on the area fished: Gulf of Maine, Outer Cape Cod, and Southern New England. These varying possession rules are difficult to enforce because the agency does not issue area-specific recreational lobster permits. Moreover, the rationale for the different rules is obtuse, reducing compliance. Accordingly, *MarineFisheries* recommended to the MFAC the creation of a single state-wide recreational v-notch possession standard of ⅛ inch with or without setal hairs. A public hearing was expected in early 2014.

Lobster Gear Marking: To avoid confusion over lobster gear marking requirements, *MarineFisheries* proposed at a public hearing in December 2013 to remove all referencing to "branding" gear in the regulations. Consistent with the so-called "buoy branding bill", signed into law by Governor Patrick in 2011, lobster traps and buoys must only be marked with the

permit holder's identification number, a reflection of changes in trap construction from wood to plastic and wire. A final rule was expected in early 2014.

Aquaculture Raised Finfish

Sale of Non-Conforming Fish: With a growing market for aquaculture raised finfish and no loss in conservation from allowing these fish to be harvested at times and sizes prohibited in the wild fishery, *MarineFisheries* proposed in 2013 to authorize the sale of non-conforming aquaculture raised finfish product provided proper labeling occurred. Existing state regulations do not differentiate between wild caught and aquaculture raised finfish, and thus prohibit the possession of these products. A public hearing was held in December 2013 with final regulations expected in 2014.

Fluke, Scup, and Black Sea Bass

Annual Commercial Measures: Following a public hearing in February 2013, *MarineFisheries* amended the commercial measures for scup (*Stenotomus chrysops*) and black sea bass (*Centropristis striata*). The commercial fluke (*Paralichthys dentatus*) measures were unchanged from 2012.

Given an under-harvest of the Commonwealth's Summer Period scup quota in recent years, *MarineFisheries* liberalized the season, trip limit, and open fishing days for pot and hook and line fishermen in 2013. Specifically, the scup trip limit was doubled to 800 pounds and the open days increased from three to five (Sunday – Thursday) during the May fishery; the month of June was also newly opened to harvest at 400 pounds scup per trip, three days per week (Sunday, Tuesday, and Wednesday); and lastly, the trip limit was raised from 800 pounds to 1,500 pounds for the scup season beginning July 1. In addition, the Summer Period start date for mobile gear was shifted from April 23 to May 1 to conform to the federal period date.

Figure 2. The average daily price paid to harvesters for black sea bass remained more stable throughout the season with the postponement of the fishery's start date to early August.

Regarding black sea bass, the increased inshore availability of this species amidst a static commercial quota rendered the fishery increasingly difficult to manage, particularly a timely closure of the spring fishery. Unprecedented catch rates in May had relegated little-to-no quota for the summer fishery intended to start on August 1. The majority of harvested fish were from pre-spawning aggregations and those commercial fishermen fishing waters off Martha's Vineyard and Nantucket Sound (where the fish arrive later) were effectively shut out of the fishery. Consumers were denied a local black sea bass market, and non-compliance with possession limits appeared to increase. To address these issues, the spring fishery was eliminated in 2013 in favor of a season beginning on the first Tuesday of August (Figure 2). Three open days were

established per week (Sunday, Tuesday, and Wednesday) and the trip limits were raised from 200 pounds to 300 pounds for fish pots and from 80 pounds to 150 pounds for mobile gear and hook and line.

Commercial Winter Fluke Pilot Program: As done in 2011 and 2012, *MarineFisheries* offered letters of authorization (LOAs) to interested fluke permit endorsement holders to land a weekly limit of fluke rather than the standard daily limit (500 pounds) during the 2013 Period I Fishery. The pilot program was created at the request of offshore trawl vessel fishermen to assist the fleet in achieving its seasonal allocation (30%) of the annual quota while also reducing regulatory discards. The 2013 pilot program began with a 1,000-pound weekly limit, which was increased to 2,000 pounds in late March due to the amount of Period I quota remaining. To ensure timely monitoring of the quota, participants were required to sell their fluke to designated dealers who report their transactions daily.

MarineFisheries issued 56 LOAs to participate in the 2013 program. The program ended on April 22, 2013, when 25% of the annual quota (197,809 lbs) was projected to be caught; the possession limit then dropped to 100 pounds. In total, 45 vessels landed fluke during the pilot program. Under the program, the Period I Fishery landed 29.6% of the 2013 quota, within its 30% allocation. Due to the success of the program, *MarineFisheries* planned to reauthorize the pilot program in 2014.

Scup Commercial Trip Limits: With the approval of the MFAC, *MarineFisheries* made several in-season adjustments to the commercial trip limits for scup to facilitate full use of the quota. For the period of October 11 through October 31, the daily trip limit was raised to 2,500 pounds for all gear types and Fridays and Saturdays were opened to landings. Consistent with federal action, the daily trip limit was also set at 8,000 pounds for the November 1 through December 31 Winter II fishery.

Groundfish

State Waters Winter Flounder Trip Limit: In mid-2013, a number of commercial and recreational fishermen reached out to *MarineFisheries* with concerns about increasing fishing effort by commercial federal vessels targeting winter flounder (*Pseudopleuronectes americanus*) in the state waters portion of the Gulf of Maine and the potential effect this could be having on the local availability of winter flounder. Under existing state rules, these federal groundfish permit holders may fish for and retain winter flounder in excess of the state waters trip limit; for all other groundfish species, federal vessels are held to the state water trip limit when fishing in state waters.

MarineFisheries agreed that because winter flounder tend to aggregate when in inshore waters, a growing directed fishery unconstrained by trip limits, driven by recent changes in the groundfish fishery (e.g., reduced abundance of the foremost economically important stocks) would be detrimental to local winter flounder stocks. Consequently, a public hearing was held in December 2013 on a proposal that would eliminate the state waters winter flounder trip limit exemption for federal groundfish vessels. A final rule was expected in 2014.

Horseshoe Crab

Lunar Closure Amendment: In February 2013, *MarineFisheries* took to public comment a proposal to extend the May through June horseshoe crab (*Limulus polyphemus*) lunar closures

into April. This proposal originated as part of a petition from the Town of Wellfleet, citing changing environmental conditions and their influence on the timing of spawning. Our data supported this observation; in warm years, like 2012, early spawning can (and did) occur in mid-to-late April. Recognizing that horseshoe crabs warrant aggressive local conservation due to life history factors (no planktonic larval stage and limited adult movement) and believing the lunar closure strategy to be a sound conservation measure, *MarineFisheries* revised the lunar closure to begin on April 16.

Recreational Fishing Issues

Posting Rules on Charter Boats: Following a hearing in February 2013, *MarineFisheries* adopted an exemption for charter boats to post fishing rules in a conspicuous place. Some charter boat operators successfully argued that their space to post rules was limited, particularly on center console vessels, and that as they only carried six patrons, they could announce the rules and monitor their customers catch to ensure compliance with recreational fishing regulations. Posting of rules on party boats remained a requirement.

Filleting of Recreational Catch: Other than for groundfish and striped bass, the Commonwealth's marine fishing regulations do not address the legality of filleting at sea or govern the disposition of fillets. This lack of a universal rule, be it an allowance or a prohibition, has reportedly complicated enforcement of recreational fishing limits when the catch is filleted, as is commonly done on many for-hire vessels as well as some private vessels. *MarineFisheries* and the MFAC had numerous discussions in 2013 on how to accommodate current practices with practical rules that would not undermine the conservation objectives of recreational species' bag and size limits. Public hearings were expected to be held in early 2014 on proposed rules that would allow for species identification (a skin-on rule) and enforcement of bag limits (a number of fillets rule).

For-Hire Vessel Responsibility: With law enforcement officials continuing to encounter possession, bag limit, and minimum size infractions onboard for-hire vessels, *MarineFisheries* decided to reconsider who is held responsible for these violations. Under existing rules, the individual is held accountable, which does not seem to deter non-compliance, particularly as these individuals often do not hold recreational fishing permits which could be revoked for violations. Compliance was further compounded by a recent trend whereby for-hire patrons would comingle their catch or abandon their coolers to avoid responsibility. *MarineFisheries* determined that because it is the for-hire vessel permit that exempts patrons from holding their own fishing permit, it should also be – by default – the for-hire permit holder and/or operator who is responsible for everyone onboard with regard to the state's fishing laws and regulations. Moreover, staff observations indicated that some for-hire operations do the bare minimum to ensure their patrons fish in compliance with rules. *MarineFisheries* planned to hold a public hearing in 2014 to propose that both the individual and the for-hire permit holder are responsible for fishing violations onboard a for-hire vessel.

River Herring

Bycatch Tolerance: Having received a number of inquiries from law enforcement and industry regarding the applicability of the Commonwealth's river herring bycatch tolerance, *MarineFisheries* amended the applicable regulation to clarify that the 5% tolerance applies only

to bait fisheries occurring in federal waters. Prior to this action, a public hearing was held in April 2013.

Sea Scallop

Response to Increased Inshore Participation: In response to a substantial increase in participation, effort, and landings of sea scallops (*Placopecten magellanicus*) in state waters, the Division held scoping meetings in 2011 to consider additional restrictions to the state waters scallop fishery. Based on public input and with the support of the MFAC, the Division made effective by permit condition, a 200-pound state waters sea scallop (shucked) trip limit (or 2,000 pounds whole), a 10 inch twine top minimum mesh size, and a 4 inch minimum dredge ring diameter. Federally permitted scallop vessels could transit state waters and land larger amounts of scallops in state ports, provided they complied with the federal plan and their gear was stowed. In April 2013, the Division held public hearings on codifying these permit conditions in the regulations, plus two additional proposed rules aimed at further constraining illegal fishing activity: 1) prohibiting the harvest or attempted harvest of sea scallops by state-permitted vessels from federal waters without a federal sea scallop permit, and 2) prohibiting the retention and eventual release of live sea scallops within coastal harbors and estuaries. All proposed rules were adopted (Figure 3).

Photo credit: Cape Cod Commercial Fishermen's Alliance

Figure 3. New regulations adopted in 2013 aim to prevent the overfishing of sea scallop beds in state waters.

Spiny Dogfish

Experimental Short-soak Gillnet Fishery: *MarineFisheries* re-authorized, for a second year, the experimental short-soak gillnet spiny dogfish (*Squalus acanthias*) fishery in the October – November groundfish closure in state waters (Plymouth north to Marblehead). The spiny dogfish fishery has been unable to land its quota in recent years and the Division already allows longlining for spiny dogfish during this time-area closure. Four letters of authorization were issued to participate in the experimental fishery with conditions including net tending and monitoring requirements. Access to the area was subject to revision if regulatory discards became problematic. Even with this additional access to the spiny dogfish resource, the 2013/2014 commercial spiny dogfish fishery in Massachusetts remained open at the end of 2013, due to limited market demand.

Squid

Use of Small Mesh South of Nantucket and Martha's Vineyard: From April 23 through June 9, *MarineFisheries* allows draggers to tow small mesh (less than 6.5 in) for squid in all state waters south of the Massachusetts/Rhode Island boundary eastward to Chatham (except those areas closed to mobile gear fishing). Since 2010, *MarineFisheries* has been issuing letters of authorization to a small number of vessel operators to continue towing small mesh after June 9 in the waters south of Martha's Vineyard and Nantucket, as a small mesh squid fishery continues in the adjacent federal water to the south of Massachusetts during this period. Having reviewed the LOA fishery's operation for several years, *MarineFisheries* proposed to amend the regulations to permit this fishery. A public hearing was held in December 2013, with a final rule expected in 2014.

Striped Bass

Commercial Management Measures: In January 2013, at the request of the MFAC, the Division convened an industry focus group to discuss what, if any, regulatory changes should be proposed for the 2013 commercial striped bass (*Morone saxatilis*) fishery. With goals to reduce user conflict, extend the season, increase profit to harvesters, and maintain stock sustainability, the focus group reached consensus opinions regarding changes to the commercial open fishing days, season start date, and permitting requirements. The Director recommended taking several of these proposals to public hearing, but there was no consensus on whether to also propose a reduction to the commercial daily bag limit. Consequently, the only proposal taken to public hearing for implementation in 2013 was a March 15 striped bass endorsement application/renewal deadline, which would take effect in 2014. Following a public hearing in May 2013, this deadline was adopted.

Later in the year, after reviewing the 2013 commercial fishery's performance and receiving additional industry appeals for change, *MarineFisheries* revamped its suite of proposals, including an option to reduce the commercial bag limit. The MFAC agreed to take these proposals to public hearing early in the new year for possible implementation for the 2014 season.

Tautog

Applicability of Minimum Size: In 2013, law enforcement officers asked *MarineFisheries* to reconsider the regulatory language providing the Commonwealth's 16 inch minimum size limit for tautog (*Tautoga onitis*). Through this language, the minimum size applies only to commercial and recreational fishermen. Omitting persons involved in the post-harvester sale of tautog from the requirement reportedly helped enable the trade of illegally caught fish (i.e., a dealer in possession of undersized tautog was not violating a regulation). To further address the black market for live tautog, *MarineFisheries* also sought the MFAC's support to take to public hearing a proposal that would prohibit the possession of tautog by any dealer five days after the seasonal closure. A hearing was expected in early 2014.

Whelk

Spawning Stock Protection: In 2012, *MarineFisheries* completed a life history study on the channeled whelk (*Busycotypus canaliculatus*) to assess size and age at maturity. This study was

initiated to address concerns regarding the sustainability of the stock given increased fishing effort, declining catch per unit effort in the state's trawl survey, and anecdotal reports from fishermen of localized stock depletion particularly in Nantucket Sound and Buzzards Bay. The study indicated that female channeled whelks were not reaching sexual maturity at the existing 2 ¾" minimum shell width, and this could lead to eventual recruitment failure.

Following public scoping meetings and additional consultation with industry members in 2012, *MarineFisheries* held two public hearings in April 2013 on several proposed regulations aimed at increasing the sustainability of the stock. The final regulations increased the minimum size for channeled whelk by ⅛ of an inch in both 2014 and 2015; prohibited the baiting of all pot gear, other than conch pots and eel pots, with horseshoe crabs; and eliminated the undersized possession tolerance for both channeled and knobbed whelk (*Busycon carica*). In addition, the Division developed, manufactured, and distributed (free of charge to the industry and law enforcement officials) a gauge for measuring whelks against the minimum size, which was met with great support from fishery participants (Figure 4).

Figure 4. Channeled whelk being tested for minimum size compliance using the *MarineFisheries* issued slide gauge.

The Division also indicated its plans to: 1) commence a similar life history study for the knobbed whelk, to evaluate whether this species also needed additional protection, 2) closely monitor the effect of the channeled whelk size limit increase, to assess whether further size limit increases beyond 3 inches were warranted after 2015, and 3) propose a permit-holder onboard requirement and other permitting rules for all fish and conch pot fisheries to control effort, prevent permit leasing, and increase regulatory compliance in these fisheries.

Mobile Gear Fishery: The spring through fall mobile gear fishery in Nantucket and Vineyard Sounds has traditionally been dominated by small-scale, owner-operator vessels that primarily target fluke and take incidental limits of other species including horseshoe crab and whelk. At the request of several of these participants, *MarineFisheries* held an informal meeting in August 2013 to discuss fishery trends and bycatch issues, including the entry of new participants targeting horseshoe crab and whelk having been displaced from other mobile gear fisheries (e.g., groundfish). They viewed the trip limits for horseshoe crab and whelk as too large and argued that this provided incentive for these new entrants, whose targeting of horseshoe crab and whelk resulted in worrisome discards of fluke. Given concerns about the resource status of horseshoe crab and whelk, *MarineFisheries* developed proposals, expected to be aired at public hearings in early 2014, to reduce the mixed whelk and horseshoe crab trip limits for mobile gear.

Interstate and Federal Fisheries Management

Following below are actions taken and issues confronted by *MarineFisheries* in 2013 to address interstate or federal fisheries management actions.

American Eel

ASMFC Addendum III: Following ASMFC public hearings along the coast, including one in Massachusetts in April 2013, the interstate FMP for American eel (*Anguilla rostrata*) was adjusted in response to the 2012 stock assessment's finding that the stock is at or near historically low levels. The stock assessment calls for reductions to recreational and commercial fishing mortality across all life stages. Addendum III deals primarily with the yellow and silver eel stages, with a subsequent addendum expected to address mortality in the glass eel stage. It requires Massachusetts to increase the eel minimum size from 6 inches to 9 inches; decrease the recreational daily bag limit from 50 fish to 25 fish (with an exemption for for-hire vessels to possess 50 fish); prohibit the use of eel pots where mesh is not at least ½ inch by ½ inch; and prohibit the retention of eels from September 1 through December 31 if taken by any gear other than baited pots, rod and reel, and spears. A public hearing on these measures was expected in early 2014.

American Lobster

ASMFC Addendum XVII: In November 2011, the ASMFC adopted Addendum XVII requiring a 10% reduction in exploitation on the depleted Southern New England (SNE) lobster (*Homarus americanus*) stock starting January 1, 2013. For Lobster Management Area (LMA) 3, the ASMFC approved a $3\ ^{17}/_{32}$ inch minimum size to achieve the required reduction. *MarineFisheries* implemented a $1/_{32}$ inch size limit increase by emergency action, effective December 31, 2012. A public hearing was held in February 2013, after which *MarineFisheries* adopted the new size limit as a final rule.

ASMFC Addendum XXI: In June 2013, *MarineFisheries* hosted an ASMFC public hearing on Draft Addendum XXI, later approved by the ASMFC in August 2013. The addendum changes the transferability program for LMAs 2 and 3 in an effort to allow for more flexibility in the movement of traps as the effort consolidation program for LMAs 2 and 3 occur.

Atlantic Large Whale Take Reduction Plan: In 2013, NOAA Fisheries issued a proposed rule for its management strategy to further reduce the risk of serious injury or mortality to North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), and finback (*Balaenoptera physalus*) whales resulting from entanglement in vertical lines associated with fixed gear fisheries off the U.S. Atlantic Coast. *MarineFisheries* submitted comment opposing this strategy, which would essentially eliminate the single trap fishery by forcing state waters fishermen to fish multiple pot trawls and create minimum trawl lengths for vessels already fishing trawls. The reasons for our opposition were many, including the significant unintended consequences that would place small vessel fishermen in jeopardy while achieving far less risk reduction than NOAA Fisheries estimated. *MarineFisheries* recommended the consideration of alternative strategies, such as enhanced buoy line marking requirements and a state-managed closure of the state waters portion of Cape Cod Bay Critical Habitat.

American Shad

Amendment 3 Compliance: To comply with Amendment 3 to the interstate FMP, *MarineFisheries* established shad (*Alosa sapidissima*) as a catch and release only fishery throughout the state, with the exception of the Merrimack and Connecticut Rivers (and their tributaries), where the bag limit was reduced from six fish per angler per day to three fish per angler per day. These regulatory revisions, implemented after a public hearing in April 2013, recognize the continued, depleted state of the Atlantic coast's shad resource. Massachusetts may be able to open additional river systems to limited recreational harvest in the future if monitoring can establish such harvest will not impact the population's sustainability.

Atlantic Herring

Annual Specifications: *MarineFisheries* set days-out of the Atlantic herring (*Clupea harengus*) fishery in accordance with ASMFC specifications and instituted a seasonal spawning closure based on catch monitoring. The selected landing days extended fishing throughout the summer and into fall in the inshore portion of the Gulf of Maine. Commercial catch sampling prompted a spawning closure in the Massachusetts/New Hampshire Atlantic Sea Herring Spawning Area from September 9 through October 6.

ASMFC Addendum VI: In July 2013, *MarineFisheries* hosted an ASMFC public hearing on Draft Addendum VI which proposed adding new management tools to the interstate plan to improve consistency between the species' four management areas. The addendum was approved in August 2013. Due to timing issues, *MarineFisheries* planned to implement the following revisions by emergency action early in 2014, to be followed by a public hearing: 1) the ability to seasonally split the sub-annual catch limits (sub-ACLs) for Management Areas 1B, 2, and 3; and 2) quota triggers for the sub-ACLs and the stock-wide ACL.

NEFMC Amendment 5 & Framework Adjustment 3: During 2013, *MarineFisheries,* as a member of the NEFMC, supported development of catch caps for river herring and shad in the Atlantic herring fishery (Amendment 5) and a process for setting catch caps (Framework 3). Proposed caps on river herring/shad incidental catch in the Atlantic herring fishery were developed based on 2008-2012 observer data. *MarineFisheries* focused on vetting data used to set catch caps and ensuring the careful extrapolation of catch rates to determine overall catch. Catch rates are highly variable in the Cape Cod area and moderately variable in the Southern New England/Mid-Atlantic area. Although finalized by the NEFMC in September 2013, measures awaited NOAA Fisheries final approval at year's end.

NOAA Fisheries disapproved several proposed measures in Amendment 5 addressing monitoring of herring mid-water trawl vessels, particularly with respect to groundfish bycatch. This precipitated a vigorous Council debate on emergency measures to ban mid-water trawl vessels, which did not result in any action.

Atlantic Menhaden

ASMFC Amendment 2: In December 2012, the ASMFC approved Amendment 2, establishing the first coastwide commercial total allowable catch (TAC) for menhaden (*Brevoortia tyrannus*). The TAC represents a 20% reduction from the average coastwide landings (bait and reduction) in 2009-2011. Based on harvest in these years, Massachusetts was allocated 0.84% of the TAC (3.16 million pounds for 2013). States were given until July 1, 2013 to implement regulations

compliant with the interstate requirements. Due to timing, *MarineFisheries* implemented emergency regulations effective June 26, 2013. A public hearing was held in July 2013 in order to implement final regulations.

In February 2013, *MarineFisheries* began what would be a series of conversations with the MFAC to develop proposed regulations for the state's menhaden fishery. Important to these discussions were recent landings data documenting the fishing fleet's ability to greatly exceed the Commonwealth's new quota, providing the impetus for *MarineFisheries* to develop a quota management system that could prevent early closure of the menhaden fishery and disruption of an important bait fishery (Figure 5).

MarineFisheries adopted a limited entry regulated fishery permit endorsement for menhaden to protect the harvest opportunities of traditional participants in the fishery. This permit endorsement is only required for those vessels intending to land more than 6,000 pounds per day, and is restricted to vessels that meet at least one of several eligibility criteria. The fishery remains open access for any operators landing less than 6,000 pounds per day.

Figure 5. Menhaden are an important bait species for both commercial and recreational fishermen.

In addition, a tiered system ratchets down the trip limits of the menhaden endorsement holders as the quota is consumed. These trip limits, and the landing levels that trigger, them changed between the emergency and final regulations based on comment during the public hearing. The final rules set a trip limit of 125,000 pounds until 75% of the quota is consumed, a 25,000-pound trip limit until 95% of the quota is consumed, and a 6,000-pound trip limit for the remaining 5% of the quota. The fishery closes to all participants (including the open access harvesters fishing under a season-long 6,000-pound trip limit) once 100% of the quota is taken, with the exception of a 1,000-pound bycatch limit, under which the weight of menhaden cannot exceed 5% the weight of the total catch being landed. For effective monitoring of the quota, all menhaden permit endorsement holders must also obtain a dealer permit and report their menhaden landings daily. Open access participants must report monthly on the standard harvester trip-level reporting forms.

Fluke, Scup, and Black Sea Bass

Annual Recreational Measures: *MarineFisheries* revised the recreational regulations for the 2013 harvest of fluke, scup, and black sea bass pursuant to adjustments made by ASMFC. Changes were implemented by emergency regulation due to late breaking interstate management decisions. State public hearings occurred in June 2013. *MarineFisheries* also hosted an ASMFC public hearing on Draft Addendum XXIV in April 2013, which when finalized, established a mechanism to allow states access to the 2013 fluke recreational harvest limit that was projected to not be harvested.

With a 2012 fluke harvest below the 2013 target, *MarineFisheries* was able to liberalize the fluke regulations. Based on past comment from recreational fishermen, the minimum size was reduced from 16 ½ inches to 16 inches. Similarly with scup, the northern states had a 2012 harvest well below the 2013 target, allowing the states of Massachusetts through New York to liberalize rules. In response, the region developed an approach that increased the recreational bag limit from 20 to 30 fish and decreased the minimum size to 10 inches. In addition, the period when anglers on a for-hire vessel can possess 45 fish was extended by just over two weeks to cover all of May and June.

For black sea bass, the states from Massachusetts through New Jersey were required to reduce recreational harvest by 32% due to their 2012 harvest levels. *MarineFisheries* reduced the bag limit to four fish to meet the reduction while maintaining the same season as 2012. At the same time, because a certain segment of the for-hire industry would be severely disadvantaged by the late-breaking, low bag limits, the Division authorized interested for-hire vessels to reduce season length rather than bag limit for an equivalent estimated harvest reduction. The 76 vessels that actively participated in this special access fishery took approximately eight weeks out of the recreational black sea bass fishery and were held to additional conditions.

Groundfish

ASMFC Winter Flounder Addendum II: Consistent with the changes to the interstate FMP for winter flounder, and following a public hearing in January 2013, *MarineFisheries* finalized emergency regulations implemented in late 2012 that increased the commercial Gulf of Maine (GOM) winter flounder trip limit from 250 pounds to 500 pounds per trip or 24-hour period (whichever is longer), and eliminated the September 1 to October 31 recreational GOM winter flounder seasonal closure.

NEFMC Framework 48 Minimum Size Revisions: In order to reduce mortality in several groundfish fisheries, NOAA Fisheries, through Framework 48, increased the recreational minimum size for GOM haddock (from 18 in to 21 in) and reduced the commercial minimum sizes for six groundfish species including: Atlantic cod, *Gadus morhua* (from 22 in to 19 in); haddock, *Melanogrammus aeglefinus* (from 18 in to 16 in); gray sole, *Glyptocephalus cynoglossus* (from 14 in to 13 in); yellowtail flounder, *Limanda ferruginea* (from 13 in to 12 in) American plaice, *Hippoglossoides platessoides* (from 14 in to 12 in); and redfish, *Sebastes fasciatus* (from 9 in to 7 in, Figure 6). NOAA Fisheries strongly urged all states to match the federal rules, which would go into effect on July 1, 2013.

Figure 6. A 7 inch commercial size limit for redfish took effect on July 1.

MarineFisheries supported the recreational haddock size limit change as a needed measure to reduce the probability of exceeding the fishery's much reduced catch limit, but disagreed with the move to reduce the commercial minimum sizes. The NEFMC and NOAA Fisheries' rationale was to reduce regulatory discards and allow the fleet to recoup some revenue from fish that would otherwise be discarded. *MarineFisheries* argued that fishing mortality

would increase if fishermen changed their behavior to target these now legal smaller fish. However, inconsistent regulations between state and federal waters would be extremely disruptive to the fishery, leaving the Division little choice but to implement the size limit changes. *MarineFisheries* did so by emergency rules, effective July 1. A public hearing was held in July 2013 to accept comment and implement the changes as final rules. *MarineFisheries* urged NOAA Fisheries to follow through on its commitment to study the catch and see if a change in selectivity could be detected. The NEFMC also voted to ask that NOAA Fisheries monitor catch size composition for affected stocks and determine if fishermen are targeting smaller fish.

NEFMC Amendment 16 Measures: In accordance with changes made to the federal Northeast Multispecies FMP in Amendment 16, and following a public hearing in January 2013, *MarineFisheries* added a definition for monkfish tail, established a monkfish liver possession limit, and decreased the whole monkfish to monkfish tail weight conversion factor. In addition, *MarineFisheries* prohibited the recreational possession of ocean pout and windowpane flounder.

Horseshoe Crabs

Asian Horseshoe Crab Ban: In February 2013, the ASMFC approved a resolution encouraging all member states to ban the possession and distribution of imported Asian horseshoe crab species (*Carcinoscorpius rotundicauda* and *Tachypieus* spp.), due to environmental and human health concerns associated with the use of these species as bait. With a reduction in the availability of indigenous horseshoe crab in the U.S. whelk and eel pot bait markets, interest in the Asian horseshoe crab as an alternative bait had been increasing. A public hearing was held in December 2013 on a proposal to ban the importation, transportation, possession, sale, attempted sale, or release into state waters of three Asian horseshoe crab species. A final state regulation was expected in 2014.

Spiny Dogfish and Coastal Sharks

Spiny Dogfish Annual Specifications: With the resource continuing to be rebuilt and fished at a level well below the target, NOAA Fisheries and ASMFC raised the commercial quota for the 2013/2014 fishery to 40.8 million pounds, a 15% increase from the previous year, and ASMFC set a maximum commercial fisherman possession limit of 4,000 pounds per day (up from 3,000 pounds in recent years) for the Northern Region (Maine – Connecticut). *MarineFisheries* supported these measures. After a public comment period in Massachusetts on the trip limit, the MFAC voted in March to approve the 4,000 pound trip limit for the fishery starting May 1, 2013 until the Northern Region quota allocation (58% of the coastwide quota) was taken.

Hammerhead Shark Recreational Size Limit: In October 2013, the ASMFC approved an increase to the hammerhead shark recreational size limit as part of Addendum III to the interstate FMP for Atlantic coastal sharks. This size limit increase from 54 inches to 78 inches fork length was based on new size-at-maturity research. To maintain compliance with interstate requirements, *MarineFisheries* planned to go to public hearing in early 2014 with a corresponding size limit increase.

Striped Bass

ASMFC Addendum III: In response to a multistate and federal investigation into illegal activity in the Chesapeake Bay commercial striped bass fishery, the ASMFC adopted Addendum III in 2012. The addendum requires each state with a commercial striped bass fishery to implement a tagging program for that fishery with the purpose of increasing accountability in the supply chain and thereby giving law enforcement a greater ability to detect poaching (Figure 7). Massachusetts was required to implement either a point-of-harvest or point-of-sale tagging program for 2014, with specific requirements relative to tag distribution, accountability, and monitoring.

In order to develop a compliant while practical program, the Division convened a panel of industry advisors in July 2013. Based on this input as well as the logistics of the Commonwealth's commercial striped bass fishery (e.g., open entry and roughly 4,000 permit holders per year), *MarineFisheries* developed a proposal for a point-of-sale (dealer) tagging program for implementation in 2014. Public hearings were expected in the first quarter of 2014.

Photo Credit: ASMFC

Figure 7. Under the interstate management plan, every striped bass harvested for commercial sale in Massachusetts in 2014 will need to be tagged for law enforcement purposes. Most states already have such a program in place; shown here is a striped bass harvested from the Chesapeake Bay with a tag locked in place through the mouth and gills.

Conservation Engineering Project

Overview

Conservation Engineering (CE) collaborates with industry and others to improve the design and performance of fishing gear and reduce impacts of fishing gear on non-target species. This program continues to lead regionally and internationally in vital gear research, particularly through several regional research programs. CE provided scientific leadership and overall

coordination including experimental design, fieldwork, data analysis, report writing, finances, oversight, and direction. Program personnel's strong relationships with industry members enhance the Program's position as a regional leader in gear research.

Activities

Redeveloping a Sustainable Redfish Trawl Fishery in the Gulf of Maine: This activity is a multi-year, NOAA Fisheries-funded network of gear researchers, net makers, fishermen, NOAA Fisheries Regional Office and Science Center members, Council staff, fish processors, and others working to re-establish the redfish trawl fishery in the Gulf of Maine. CE's leadership role in the network includes financial administration, contract management, equipment coordination, field work design, data collection and analysis, and report writing.

Project partners held a progress meeting in February in New Bedford, followed by multiple meetings in March to plan net selectivity trials. In late March and April, CE personnel led and staffed two six-day trips at sea on a commercial vessel to compare catches between trawl nets with codends of various mesh size: 2.5 in, 4.5 in, 5.5 in, and 6.5 in (Figure 12).

Figure 12. *MarineFisheries* and SMAST biologists at sea, comparing catches between trawl nets with codends of various mesh size.

CE personnel analyzed the data from these trips, in collaboration with Bent Herrmann of Denmark-based SINTEF Fisheries and Aquaculture Ltd., in FISHSELECT, and led the development of a report on this component of the project. Staff hosted a network meeting in Gloucester in August. A follow-up meeting was held in an attempt to reinvigorate industry engagement in the

project, at which it became clear that industry partners saw that recent requirements for 100% industry-funded observer coverage, in an exempted redfish fishery, invalidated their participation in the project. At this meeting, a plan was agreed to move forward with further investigation of redfish escape behavior and possible juvenile bycatch reduction in 2014.

Conservation Engineering Marine Fisheries Initiative: The intent of this initiative is to use a bottom-up approach to identify vital, immediate gear research that could assist groundfish fishermen in their continuing adjustment to sector management under new catch limits. As a network coordinator, CE arranged meetings, purchased equipment, contracted with vendors, and provided substantial budgetary and administrative leadership and oversight. As a scientific partner, CE met with sectors to develop and implement proposals and field research, analyze data, review other reports, and produce final reports.

Over 30 projects have been proposed and funded through this initiative. In 2013, this initiative completed several research projects, developed a new round of projects, and at year's end, began preparation for an outreach phase and project wrap-up. Proposals for new projects were reviewed in January. CE personnel had a major role in developing seven of the 17 new proposals and a contributing role to another three. Highlights of some projects follow:

- CE led the design, conduct, and analysis of an innovative flatfish escape window developed by Superior Trawl (of Narragansett, Rhode Island) and members of Sector 5.
- Working with members of Sector 6, and Reidar's Trawl Gear and Marine Supply (of New Bedford), another project was initiated to streamline stabilizers used on most trawl vessels, with the goal of improving fuel efficiency.
- CE personnel interviewed Sector X members regarding their results using highly selective codends; their impressions were generally positive.
- Two sectors tested the use of cod pots, based on prior research by CE. Testing of pots was conducted in collaboration with University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), using their large optic and acoustic test tank.
- CE staff engaged in two activities with Sustainable Harvest Sector members. Working with Willie Viola (F/V *Black Beauty*), the fuel-savings from using high tensile strength, smaller diameter twine in a trawl net was tested. The other activity, working with Terry Alexander (F/V *Jocka*), tested the ability of a "topless" net to avoid white hake while targeting grey sole.
- Staff continued outreach activities for a trawl net conceived by Gloucester draggerman, Dan Murphy, that is equipped with an inexpensive codend that, when filled with fish, is triggered to break away (and stop fishing) and release an integrated signaling device. CE and gear designer/builder Jon Knight (Superior Trawl, Rhode Island) demonstrated the net model at the New Bedford Working Waterfront Festival in September and educated spectators on the net's testing at a flume tank.

Other Activities

Appointments: Michael Pol continued serving as chair of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour. As such, he organized, conducted, and reported on the

2013 Annual Meeting in Bangkok, Thailand. A plan to host the 2014 meeting in New Bedford was initiated; Pol was selected to chair the organizing committee.

Pol also continued serving on the NEFMC Research Steering Committee, and the ASMFC Fishing Gear Technology Workgroup.

Publications: Michael Pol and David Chosid co-authored (along with S.M. Bayse and P. He) an article in the journal *Fisheries Research*, entitled "Quantitative analysis of the behavior of longfin inshore squid (*Doryteuthis pealeii*) in reaction to a species separation grid of an otter trawl."

Four videos previously produced by CE, and previously only available by request, were posted to *MarineFisheries'* YouTube channel.

Outreach

Project personnel organized *MarineFisheries* booth for the 10th annual New Bedford Working Waterfront Festival.

Other Activities

Publications

DMF News: *MarineFisheries'* newsletter was published twice in 2013. Two editions covering the 1st & 2nd Quarters and the 3rd & 4th Quarters were mailed to subscribers and made available through the Division's website.

Annual Report: *MarineFisheries* 2012 Annual Report was published.

Coordination of NEFMC Nominations

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

Leadership Positions

Director Paul Diodati completed the second year of his ASMFC Chairmanship, and continued to serve as co-director of the Massachusetts Marine Fisheries Institute. Deputy Director Pierce was vice chair of the NEFMC's Groundfish Committee and Risk Policy Working Group, chair of the Joint NEFMC-MAFMC Spiny Dogfish Committee, and served on the NEFMC's Executive Committee.

Management Information Systems and Fisheries Statistics Program

Personnel

Thomas Hoopes, Program Coordination
Story Reed, Fisheries Data Collection Lead, Web Site Coordination
Kim Lundy, Dealer Reporting Coordination & Quota Monitoring
Brant McAfee, Fisheries Data & GIS Analysis
Mary Ann Fletcher, Fisheries Data Entry
Rosemary Mitchell, Permitting & Support for Fisheries Reporting
Whitney Sargent, Permitting & Support for Fisheries Reporting

Overview

The **Management Information Systems (MIS) Project** provides many services to *MarineFisheries* under the umbrella of information systems/technology including: local area network maintenance; PC and server maintenance; Internet and Intranet website development and maintenance; Oracle database development and maintenance; and geographic information systems (GIS) data development and assistance.

The **Fisheries Statistics Project** collects fisheries dependent data from both commercial harvesters and dealers designated as primary buyers. Both data sets are collected in a standardized trip-level format from all commercial permit holders. These data are used in many ways, both within *MarineFisheries* and to fulfill requests 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 law enforcement purposes, as well as permitting staff to issue permits from the Gloucester facility.

Management Information Systems Project

Website Development & Maintenance

The *MarineFisheries* website (www.mass.gov/marinefisheries) continued to be an extremely useful means of distributing information as does an internal Intranet site using Wiki technology, which provides both agency-wide and project-specific functionality to agency personnel. A Statistics Project Intranet site is also maintained for display of quota information, reporting compliance, and harvester and dealer reporting information. Migrating the Division's Internet website to the mass.gov portal format continued from the previous year, and was completed during 2013. New tools were and will continue to be explored to enhance Division content. Enhancements in 2013 included displaying a Google calendar and Google maps through Division pages, as well as implementing a rotating interactive slideshow on the homepage.

Oracle Database / Application Development & Maintenance

MarineFisheries continued to use and enhance four production databases during 2013: Commercial Permits and Statistics; Lobster Sampling; Shellfish Sampling and Area Management; and Time Tracking for Federal Grants. Some significant updates were made to the Commercial

Permits and Statistics application during the year, mainly to accommodate the collection of both an individual as well as a business name for commercial permit holders, starting in 2014.

GIS Technical Assistance & Data Development

Individual programs and projects continued to develop and maintain their own GIS data layers, and support was provided in specific cases.

Fisheries Statistics Project

Dealer Landings Data Collection

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

In 2013, 1,756 businesses obtained a Massachusetts dealer permit. Of those, 461 (26%) were categorized as primary buyers, purchasing marine species directly from fishermen. These dealers were required to report their primary purchases, including products retailed themselves. Of the 461 dealers, 222 had a federal dealer permit which required reporting electronically either to the SAFIS database or to another federal reporting system. These dealers were categorized as "federal-reporting." The remaining 239 dealers were categorized as "state-reporting."

Even though many of the primary buyers in 2013 had been primary buyers in years past, all were required to complete paperwork to confirm their buying intentions and their commitment to the dealer reporting requirements. This registration process not only provided a signed statement for enforcement purposes, if necessary, but also the means to monitor reporting compliance and track quotas.

Throughout the year, 154,822 transactions were entered into the SAFIS database, covering over 333,924 individual species landings. Federal-reporting dealers submitted just under 75% of these transactions electronically. Of the remaining transactions submitted by state-reporting dealers, one-third was entered electronically by dealers, and two-thirds were submitted on paper-based forms. The latter were either keypunched by project staff or uploaded through the SAFIS file upload module.

Total landings (in whole pounds), as reported through both the SAFIS database and other federal reporting programs, amounted to 695 million pounds, valued at $564 million. The top five species in order of value were sea scallop, American lobster, Atlantic surf clam (*Spisula solidissima*), Eastern oyster (*Crassostrea virginica*), and Atlantic sea herring, totaling $436 million, or 77% of the total. When grouped together, offshore shellfish (sea scallop, surf clam, and ocean quahog, *Arctica islandica*) make up 64% of the total value landed in Massachusetts, whereas inshore and intertidal landings of shellfish, such as soft-shell clam (*Mya arenaria*), northern quahog (*Mercenaria mercenaria*), blue mussel (*Mytilus edulis*), and oyster amounted to just under 6% of total value landed. Landings of crustaceans (lobster, crabs, and shrimp)

amounted to 28.1 million pounds, valued at $73.2 million, or 13%. All finfish landings, including both pelagic and benthic species, make up 17% of the total value, with groundfish species amounting to 11% of the total value. Landed species each with a total gross value over $1 million are shown in Table 1.

Table 1. 2013 Massachusetts Landed Species with Value Greater than $1 Million

Species	Landings (whole pounds)	Value ($)
Sea Scallop	243,880,838	334,551,782
American Lobster	15,218,111	61,476,815
Atlantic Surf Clam	111,529,349	18,013,673
Eastern Oyster	4,341,821	10,841,745
Atlantic Herring	76,896,926	10,987,774
Ocean Quahog	119,443,982	10,231,104
Jonah Crab	10,096,633	9,111,707
Goosefish	9,501,994	8,872,963
Winter Flounder	5,376,430	8,829,960
Atlantic Cod	4,145,541	8,377,339
Pollock	7,940,483	7,697,292
Haddock	3,974,359	5,728,777
Channeled Whelk	2,240,693	5,533,602
White Hake	3,721,232	4,835,723
Soft Clam	3,228,322	4,625,440
Redfish	7,536,520	4,091,999
Silver Hake	6,547,610	3,854,645
American Plaice	2,392,593	3,852,503
Northern Quahog	5,453,215	3,835,280
Striped Bass	1,004,537	3,130,297
Witch Flounder	1,238,212	3,090,419
Yellowtail Flounder	1,876,564	2,646,184
Bluefin Tuna	363,331	2,520,369
Bay Scallop	1,075,121	2,482,432
Summer Flounder	859,384	2,422,023
Atlantic Razor Clam	779,836	2,347,954
Skates	7,037,999	2,335,216
Swordfish	628,111	2,007,241
Atlantic Red Crab	1,806,603	1,806,603
Blue Mussel	6,714,709	1,511,645
Hagfish	1,314,897	1,426,919
Atlantic Mackerel	7,279,352	1,222,957
Longfin Squid	866,896	1,080,258
Black Sea Bass	329,823	1,042,393

Source: ACCSP Data Warehouse, as of May 21, 2014.

Certain fisheries are managed by quota in Massachusetts and were monitored in 2013 using the dealer reported landings in the SAFIS database. Automated scripts ran on a nightly basis and were displayed on the *MarineFisheries* website (Figure 8). On a weekly basis during the open season, staff reviewed compliance, by species, from dealers which had already purchased during the year, or in past years, and accounted for potential landings if the dealer did not yet report. A regression analysis was run at least once per week for each fishery still open, the results of

which were used to estimate a closure date. Any overages were applied to the following year's total harvest.

QUOTA MANAGED SPECIES
2013 Landings and Quota Information
as of Jan 27, 2014 - 02:25 P.M.

Species	2013 MA Landings	2013 Quota	Quota Type	Percent Landed
Black Sea Bass	329,223	282,100	MA	116.7%
Bluefish	591,710	809,606	MA	73.1%
Dogfish	6,044,911	23,688,360	CW	to NMFS
Fluke	859,830	791,236	MA	108.7%
Horseshoe Crab*	112,056	165,000	MA	67.9%
Menhaden	2,290,956	3,126,019	MA	73.3%
Scup *(Winter I)*	269,893	10,613,157	CW	to NMFS
Scup *(Summer)*	1,094,975	1,978,050	MA	55.4%
Scup *(Winter II)*	37,776	3,750,249	CW	to NMFS
Striped Bass	1,002,519	997,869	MA	100.5%
Tautog	69,882	58,063	MA	120.4%

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

Figure 8. Example display of quota monitoring data available on *MarineFisheries*' 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 permit. Those individuals holding a federal permit with reporting requirements to NOAA Fisheries (e.g., Vessel Trip Report, VTR), were exempt from reporting to *MarineFisheries* for those activities occurring on their federally-permitted vessel. All other individuals were required to report to *MarineFisheries*.

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

Fishermen either submitted their trip-level reports in paper form or on-line using the SAFIS eTrips application, a web-based program developed jointly by ACCSP staff and program partners. Project staff used the same application or a bulk upload process called eTrips upload to enter data submitted on paper forms. Thus, the primary repository for all trip-level data, except those reported to NOAA Fisheries, is the SAFIS database.

Grant support has continued to be provided by ACCSP to help fund the cost of data entry services brought on by the trip-level program. The grant stipulates that ACCSP receive all trip-level data submitted to *MarineFisheries*. Making SAFIS the primary repository fulfills this requirement and meets the needs of the Fisheries Statistics Project as data can easily be downloaded from the SAFIS database to be used for compliance and fisheries analysis.

In 2013, *MarineFisheries* issued 7,609 commercial harvester permits, of which 1,161 (15%) were for federal reporting vessels. The remaining 6,448 commercial permits were designated as "state-reporting", and of those, 2,130 (or 28% of total permit holders) chose to report electronically using the SAFIS eTrips application. However, in the end, only about 22% of all permit holders actually reported electronically, leaving about 63% submitting paper reports to *MarineFisheries*. This followed a similar trend in the previous three years, with a slight uptick in electronic reporting participation. Of the 112,318 commercial trips entered into the SAFIS database for 2013, approximately 21% were entered by commercial permit holders using the SAFIS eTrips application, with the remaining trips entered by *MarineFisheries* staff.

Starting in 2013, *MarineFisheries* implemented a new compliance monitoring program to improve harvester adherence to reporting due dates, thus reducing the customary surge in end-of-year reporting. Reporting periods covered activities for an entire month and were due by the 15th day of the following month. If a report was submitted after 30 days from that due date (or 45 days from the end of the month), then it was considered "late." If 25% or more of the reports submitted by a permit holder were late at the end of the year, that permit was considered to have "failed" the reporting requirements for the year, and was put on "probation" for the following year. If the same permit fails the reporting requirements while on probation, the permit may be suspended or revoked. For permit holders that were missing reports, monthly electronic reminders were sent to those with email addresses, and those without email addresses received a quarterly letter. Figure 9 shows the harvester report volume for the last four years with improved compliance during 2013.

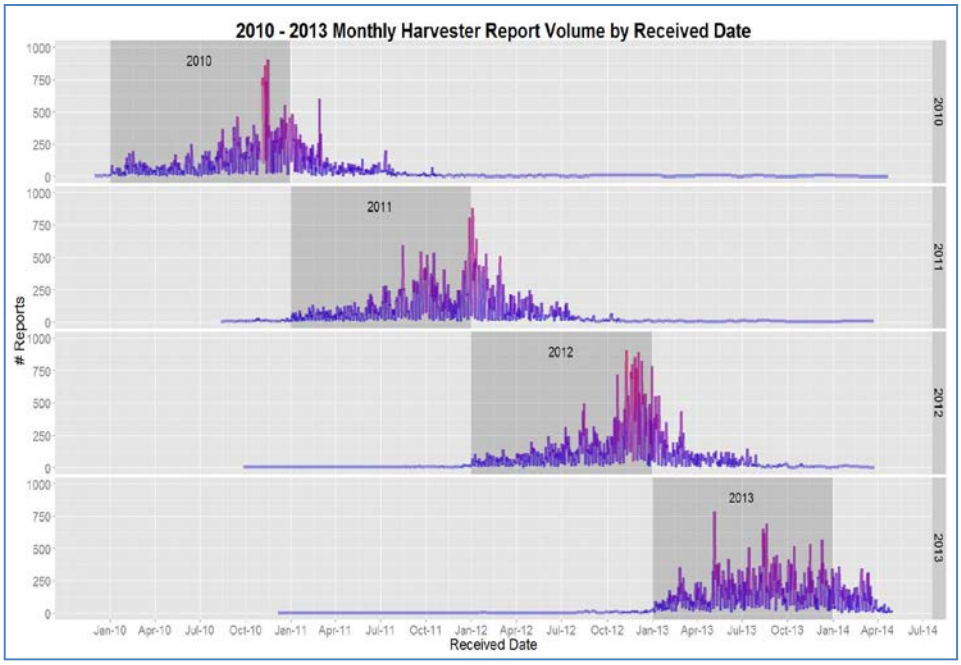

Figure 9. 2010 – 2013 State-Reporting Harvester Report Volume by Received Date

The collection of both harvester- and dealer-reported landings allows for comparison between the two sources. Figures 10 and 11 compare landings for lobster and striped bass, respectively, in 2013. The results are encouraging, as the figures indicate a relatively good match. They also depict the relative contribution between state-reported and federal-reported (VTR) catch from harvesters.

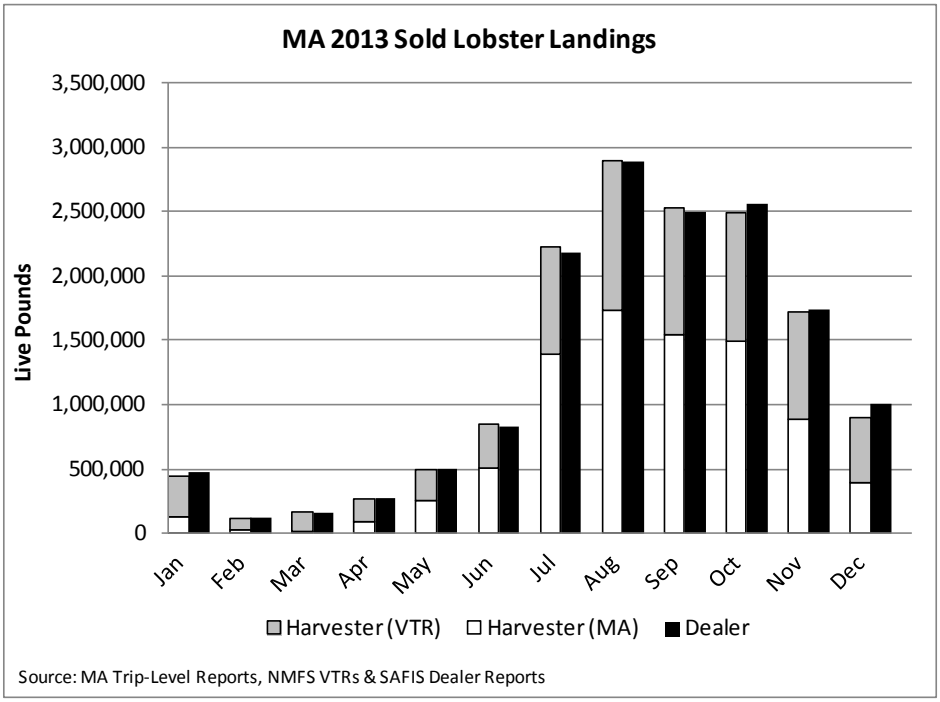

Figure 10. Dealer-Reported and Harvester-Reported Landings of Lobster in 2013.

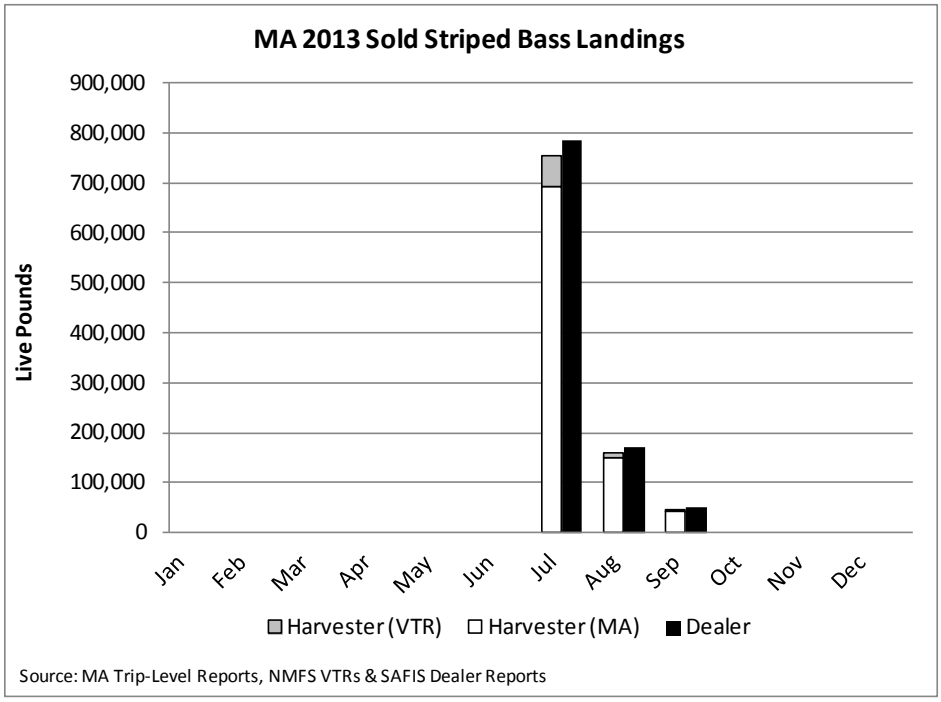

Figure 11. Dealer-Reported and Harvester-Reported Landings of Striped Bass in 2013.

Data Analysis and Dissemination

Project staff provided a wide variety of data and technical support to *MarineFisheries* staff and filled numerous public stakeholder data requests during 2013. Several major projects are described below.

***MarineFisheries* Website Migration:** *MarineFisheries* transitioned to a "portalized" web environment on June 5, 2013, which is now maintained via a Content Management System (CMS) integrated with all other Massachusetts state agency websites. The move modernized the prior website, making it more compliant with web accessibility standards, enhancing cross-browser performance (especially mobile), and standardizing its look and feel so it is consistent with all Mass.gov sites. Transitioning to the CMS environment proved problematic for some content because of the limited capabilities of the CMS to handle dynamic html pages and JavaScript. Specifically, all pages maintained by the Statistics Project to distribute dynamic, time sensitive information about quota managed species, permit holder information, paralytic shellfish poisoning closures, and compliance monitoring needed to be completely reworked and coded. Considerable time was dedicated to updating and testing these pages so they would function properly in the new CMS and be available for *MarineFisheries*' constituents upon launch of the new website.

Resource Assessment Tow Locations: The Resource Assessment Project conducts a biannual trawl survey of Massachusetts state waters every spring and fall. The survey relies on a stratified-random sampling design to designate approximately 100 tow locations each survey cruise. Resource Assessment Project staff randomly generate these locations based on strata weighting and towable bottom parameters. For survey planning and outreach purposes, these tow locations need to be buffered by 0.75 nautical miles to define the potential towable area. This involves buffering each tow location, then clipping the buffered area to the tow location stratum. In the past, this task was done via a manual, labor intensive process in ArcGIS and was not easily recreated by other users. Additionally, the process became more bug prone with each update of ArcGIS software. This process was translated to an R script that can be run by any user without prior knowledge of the geoprocessing steps. R was the optimal choice because it has powerful geoprocessing capabilities, its scripting design makes it easily reproducible, and it is freely available. The final result was tested and validated against results from the old ArcGIS method and ultimately used to generate the buffered tow locations for the 2013 fall survey.

Compliance Monitoring: The new compliance measures implemented in 2013 were directed to both commercial harvesters and dealers. These measures hold each permit holder accountable for the timeliness of their report submission. Fine-tuning the compliance monitoring methods and associated industry outreach needs was a continual process. Changes were made to improve the accuracy of the compliance report card web pages and the underlying SQL scripts that generate those pages. Additionally, comprehensive compliance tracking was incorporated into the quarterly dealer compliance report mailed to all Massachusetts primary buyers. Dealers can now view which weeks they reported late, as well as other statistics about their reporting, including: average days late, total transactions, number of transactions missing critical information, and compliance status. This was part of a larger enhancement to dealer monitoring procedures that now employ local database snapshots of Massachusetts SAFIS dealer data rather than directly querying the data from SAFIS (inefficient).

Massachusetts Ocean Plan: Project staff's contribution to the five-year review of the Massachusetts Ocean Plan (MOP) focused on providing updates of important commercial

fisheries activity areas based on historical *MarineFisheries* catch report data and SAFIS dealer data. The process involved aggregating historical effort and value data onto a single map to show important commercial areas. Generally, the same methodologies employed in the original 2009 MOP were followed; however, slight changes were required in order to accommodate Division trip-level data from 2010-2012. This involved restructuring key analysis steps that estimated average effort and value densities across the entire 1988-2012 time-series. The process culminated in an updated raster image of Massachusetts state waters that differentiates areas of relative high, medium, and low commercial activity. This updated raster image was compared with the previous version generated in 2009 (1988-2007) and residuals were taken from the raster images to highlight areas of relative change (increase or decrease). The analysis methods and preliminary results were presented to the MOP Fisheries Working Group in December 2013. Final methods, results, and analyses were prepared for dissemination to this working group in early 2014.

ASMFC Lobster Stock Assessment: In preparation for the 2014 Lobster Stock Assessment, ASMFC requested *MarineFisheries* state lobster catch and effort data from 2007-2012. Initially, project staff used the proportion of harvester-reported lobster landings by area and quarter of the year to assign annual SAFIS dealer-reported lobster landings to the correct statistical area and quarter. Upon further review of this methodology, several inconsistencies between the data sources became apparent, creating errors in the landings information. Consequently, Division lobster biologists preferred using solely the harvester-reported lobster landings for the assessment, which were submitted to ASMFC. An in-depth audit of *MarineFisheries'* lobster data was then performed to establish a process to fix the inconsistent data across all data sources.

ACCSP Participation and Planning

With the transition to trip-level reporting for all Massachusetts harvesters in 2010, continued procedural development occurred during the year, including the preparation, submittal, and acceptance for future funding support from ACCSP. *MarineFisheries* staff continued to provide feed-back to ACCSP with regard to its web-based reporting applications, a valuable part of the continual improvement of these applications. Fisherman permit and vessel information was routinely uploaded to the SAFIS database. Both the state boat registration database and the coast guard registration database were used to verify registration or documentation numbers for all vessels before adding the vessels to the SAFIS database.

At the end of the calendar year, the Program leader became chair of the ACCSP Operations Committee, which is a two-year term.

Law Enforcement, Permitting, and Industry Interaction

Project staff routinely worked with *MarineFisheries* administrators and law enforcement on enforcement and regulatory issues and provided data, support, and outreach to the industry when needed. For example, continued cooperation with the industry made the quota-monitoring element of the Winter Fluke Fishery Pilot Program a success. Other industry support was provided by phone, individually at Division facilities, and at meetings such as at the Massachusetts Lobstermen's Association annual meeting and the Massachusetts Aquaculture Association annual meeting.

Support was also provided for the issuance of *MarineFisheries* commercial, recreational, and for-hire permits from the Gloucester facility, in addition to working with our contractor, Active Outdoors, to continue to fine-tune the recreational permitting system for both *MarineFisheries* and the Division of Fisheries and Wildlife.

SHELLFISH AND HABITAT SECTION

J. Michael Hickey, Section Leader

Shellfish Sanitation and Management Program

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Richard Hardy, Laborer
Peter Kimball, Laborer
Paul Thistlewood, Laborer

Overview

The Shellfish Sanitation and Management Program (Shellfish Program) focuses on public health protection, as well as the direct and indirect management of the Commonwealth's molluscan shellfish resources. Public health protection is achieved through the sanitary classification and marine biotoxin monitoring of all 1.7 million acres of coastal waters within the state territorial sea and Nantucket Sound.

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

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

Sanitation – Public Health Protection Project

Shellfish Growing Area Classification

Surveys: Public health protection is accomplished through 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 review in order to maintain a classification allowing shellfish harvesting. Minimum requirements are set by the *NSSP Guide for the Control of Molluscan Shellfish*.

The NSSP provides five area classifications:

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., oil spill or red tide).
2. CONDITIONALLY APPROVED: Closed some of the time due to rainfall or seasonally poor water quality or other predictable events. When open, it is treated as an Approved area.
3. RESTRICTED: Contains a limited degree of contamination at all times. When open, shellfish can be relayed to a less contaminated area or harvested for depuration.

4. CONDITIONALLY RESTRICTED: Contains a limited degree of contamination at all times, subject to intermittent pollution events and may be closed some of the time due to rainfall or seasonally poor water quality. In Massachusetts, when open, only softshell clams may be harvested by Master/Subordinate Diggers for depuration at the *MarineFisheries* Shellfish Purification Plant.
5. PROHIBITED: Closed to the harvest of shellfish under all conditions, except the gathering of seed for municipal propagation programs under a *MarineFisheries* permit.

Massachusetts utilizes all five classifications (Figure 13). Overall, Massachusetts saw a small net gain in "open" shellfish areas in 2013, with an increase in Approved and Conditionally Restricted acreage and a decrease in Prohibited and Conditionally Approved acreage (Table 2).

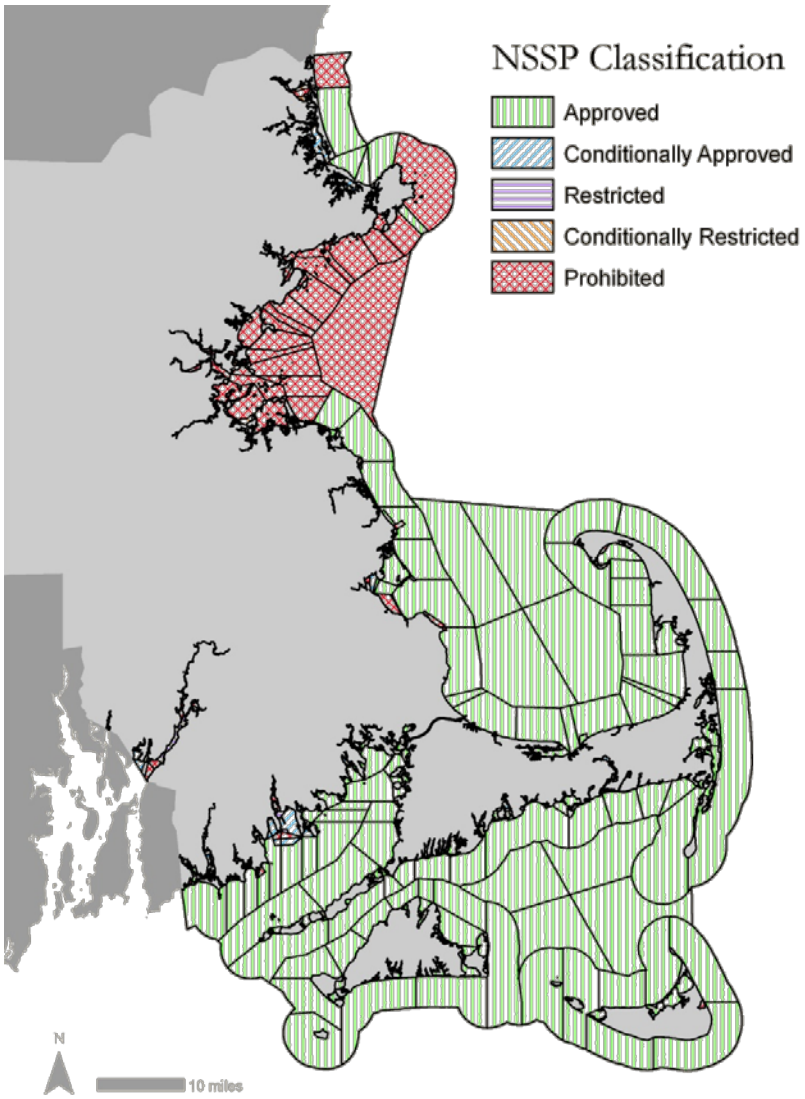

Figure 13. NSSP classification map of Massachusetts' shellfish growing areas as of December 31, 2013.

Table 2. Change in Massachusetts shellfish growing area classification, 2012 to 2013

Area Classification	Acreage		
	2012	2013	*Change*
Approved	144,355	144,829	*474*
Conditionally Approved	25,672	25,286	*-386*
Restricted	2,992	2,992	*0*
Conditionally Restricted	4,783	5,086	*303*
Prohibited	266,997	266,606	*-391*

USFDA evaluates Massachusetts annually for compliance with the NSSP. USFDA reviews *MarineFisheries* shellfish growing area files for compliance with the NSSP standards for minimum sampling frequency, completion of required growing area reports, conditional area management plan updates, and conformity with appropriate classification area water quality criteria requirements. USFDA determined Massachusetts remained in compliance with the NSSP during 2013.

To satisfy NSSP requirements, staff biologists completed 274 annual shellfish area reports, 49 triennial evaluations, and 69 sanitary survey reports, and re-evaluated 29 conditional area/rainfall management plans. A total of 9,957 water samples were collected and analyzed for fecal coliform bacteria from 248 shellfish growing areas in 62 cities and towns of the Commonwealth (Table 3). All samples were tested at either of *MarineFisheries* shellfish laboratories in Gloucester and New Bedford using the mTEC method. Of these, 9,039 samples were taken at classification stations, 343 were pollution source samples, while an additional 75 ad hoc samples were collected.

Table 3. Numbers of Water Quality Samples in 2013

	Gloucester Lab	New Bedford Lab	Total
# of Water Samples	3,013	6,944	9,957
# of Shellfish Growing Areas Sampled	23	225	248
# of Classification Areas Sampled	112	391	503
# of Cities/Towns Sampled	22	40	62
# of Classification Station Samples	2,878	6,161	9,039
# of Pollution Source Samples	110	233	343
# of Ad hoc Samples	25	50	75

Notification: A legal notice is required by *MarineFisheries* for each change in a shellfish growing area's classification or status. These notices reflect the type of opening or closure, dates, reason for the change, and other pertinent descriptive information. Copies are sent to municipal managers, the state Office of Law Enforcement (OLE), Massachusetts Department of Public Health (*Mass*DPH), USFDA, and other interested parties. In 2013, legal notices were generated by Shellfish Program staff and distributed for sanitary reclassification, rainfall closures and re-openings, paralytic shellfish poisoning (PSP) events, and emergency closures (i.e., raw sewage discharge).

Shellfish Classification Improvements: During 2013, the Shellfish Program was involved in a number of initiatives designed to improve shellfish classifications. The result was seven changes in classification, with work ongoing at the end of the year on additional areas.

Effective September 1, several re-classifications affected CCB43, located in the towns of Kingston and Duxbury. After reviewing water quality data from Kingston Bay Center (CCB43.3), it was determined that a portion of this *Conditionally Approved* area met the NSSP criteria for an Approved classification. The newly *Approved* portion is now part of Kingston Bay East (CCB43.1). Also, Gray's Beach (CCB43.5) was absorbed into CCB43.3, as they both had the same classification. A new *Prohibited* area was created as a buffer zone around three pollution sources located at the end of Boundary Lane and is now labeled Boundary Lane CCB43.6. A new Memorandum of Understanding was written and signed off by the Board of Selectmen and shellfish constables from both towns.

On October 1, *MarineFisheries* opened "Seaplane Basin" in the City of Revere to the *Conditionally Restricted* commercial harvest of soft-shell clams. Seaplane Basin was last harvested in August 1989. Designated as shellfish growing area N26.4, it consists of approximately 52.5 intertidal acres, most of which are productive (Figure 14). In the event of rainfall greater than or equal to 0.25 inches, N26.4 will close for seven days. This area is open for harvest October 1 through June 30, Monday through Friday only, with a daily limit of four 50-pound depuration plant racks (or 200 pounds total) per day per digger.

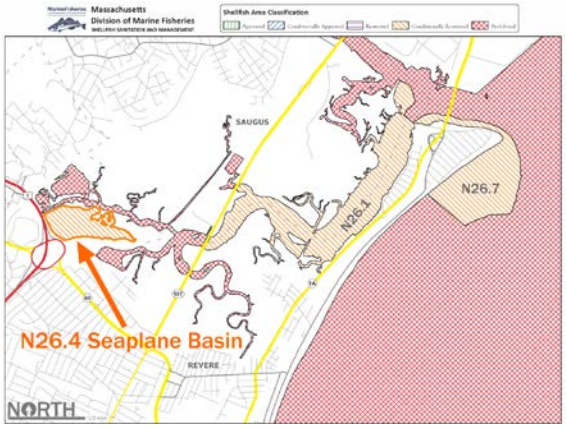

Figure 14. Seaplan Basin area reclassification

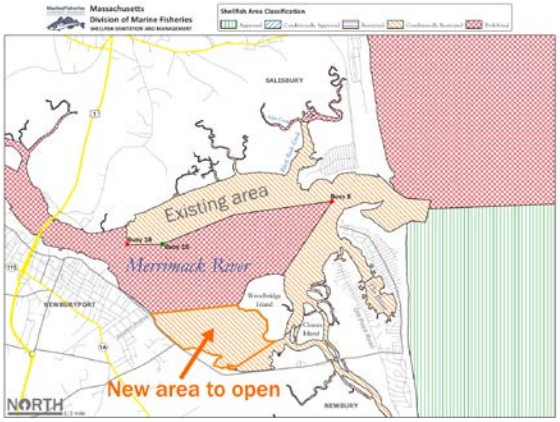

Figure 15. Joppa Flat area reclassification

On October 15, *MarineFisheries* reclassified and reopened 251 acres in the southeast portion of Joppa Flat, in the Merrimack River estuary, to the *Conditionally Restricted* commercial harvest of soft-shell clams for depuration (Figure 15). Once considered among the top clam producing flats in Massachusetts, bacterial contamination shut down the highly productive bed for over 80 years. Concerted clean-up efforts spanned over a 20-year period by local, state, and federal programs, followed by aggressive sampling by *MarineFisheries*, allowed for the upgrade in classification and reopening. In reopening the area, improved water quality was cited. A comprehensive management plan was developed with the city of Newburyport, which combined with restrictive state and local harvesting regulations, ensured harvested clams as safe to eat.

Results of a sanitary survey of the area indicate rainfall triggers intermittent and predictable episodes of bacterial contamination in excess of standards. Accordingly, *MarineFisheries* is required to close the area to shellfishing for five to seven days after rainfalls of greater than or equal to 0.25 inches. Rainfalls exceeding 1.50 inches or greater will prohibit shellfishing for an extended duration, subject to re-sampling.

The North and South River (MB5 and MB6, respectively), located in the towns of Marshfield and Scituate, had their open season for shellfishing extended one month, encompassing November 1 to May 31. The constables had requested an extension of the opening date for these two *Conditionally Approved* areas from the existing December 1 start to September 1. While there was not enough water quality data to support a September 1 opening, there was enough to support a new opening date of November 1. An addendum to the sanitary survey was written and notice sent to the towns for this new opening date.

At the end of the year, program biologists continued to re-evaluate a number of shellfish classification areas in order to upgrade the classification of individual areas and/or extend the shellfishing seasons. Areas under investigation included: Lobster Cove in Gloucester; the coastal waters of Rockport; Nantasket Beach in Hull; Lynn Harbor; the Saugus River in Lynn, Saugus, and Revere; Plymouth Harbor; Kingston Bay; the North and South Rivers in Scituate and Marshfield; the Santuit River in Mashpee; the Wild River and Inner Harbor in Falmouth; the Bass River in Yarmouth and Dennis; Oyster Pond, Edgartown Great Pond, and Tisbury Great Pond on Martha's Vineyard; and Sesachacha Pond on Nantucket Island.

PSP Monitoring

A major aspect of the shellfish program is monitoring for naturally occurring marine biotoxins produced by microscopic algae, in the *Alexandrium* genus, that can cause paralytic shellfish poisoning (PSP) or red tides. Consumption of shellfish containing certain levels of PSP toxin can cause severe illness and even death.

Shellfish Program personnel collect shellfish from 15 primary stations weekly from March through mid-November. Samples are sent to the *MarineFisheries* Gloucester Shellfish Lab where bioassays determine the levels of toxin in the shellfish. If toxin is present, the frequency of sampling and number of sample sites increase. Shellfish areas are closed if toxin levels exceed safe limits. In certain years, 2005 and 2008 particularly, the intensity, duration, and spatial distribution of toxic algal blooms increased. Figure 16 depicts the extent of PSP closures within Massachusetts during 2013. Figure 17 illustrates the timing of continuous toxicity (positive results that span more than one sample) from primary stations.

The 2013 PSP sampling season began on March 11 with three blue mussel samples taken from the primary stations within the Nauset Estuarine System in the towns of Orleans and Eastham. The Roberts Cove OC3 sample site in Orleans tested positive for toxicity (43 µg/100g). The other two samples were below the assay detection limit (~ 40 µg/100g). A second sample at Roberts Cove was collected on March 14 to ensure toxicity in the area was not increasing (43 µg/100g). Subsequent collection runs returned to the regular weekly interval through the end of the sampling season in October.

Action level toxicity (111 µg/100g) was first observed from the sample taken on April 21 at OC3, Roberts Cove. All species of shellfish were subsequently closed to harvest on April 24, when

analysis was complete. The closure included all growing areas within the Nauset system (OC2 through OC6) and remained in effect until June 13, when areas OC2 through OC5 were reopened to all species except moon snails (*Polinices duplicates* and *Lunatia heros*). Area OC6, Salt Pond in Eastham, was reopened similarly on June 20.

Sampling in the rest of the Commonwealth's waters began on April 7 and continued at regular weekly intervals until the end of the sampling season in October. Unusually, none of the other primary sampling sites (13 spread throughout the North and South Shores, Cape Cod Bay, and Pleasant Bay in Chatham) displayed toxicity above the detection limit.

A total of 428 state shellfish samples were processed through the Gloucester laboratory for PSP during 2013. The majority was the indicator species, blue mussel (422), but also sampled were: softshell clam (3), northern quahog (2), and eastern oyster (1). As part of the agreement between *Mass*DPH, *MarineFisheries,* and NOAA, the Gloucester Shellfish Lab analyzed 64 samples of shellfish from dredge vessels harvesting in federal waters. These consisted of 33 surf clam and 11 ocean quahog whole animals, and 15 surf clam and five ocean quahog homogenate samples.

During 2013, there were no reported illnesses due to red tide in Massachusetts or attributed to Massachusetts shellfish in interstate commerce.

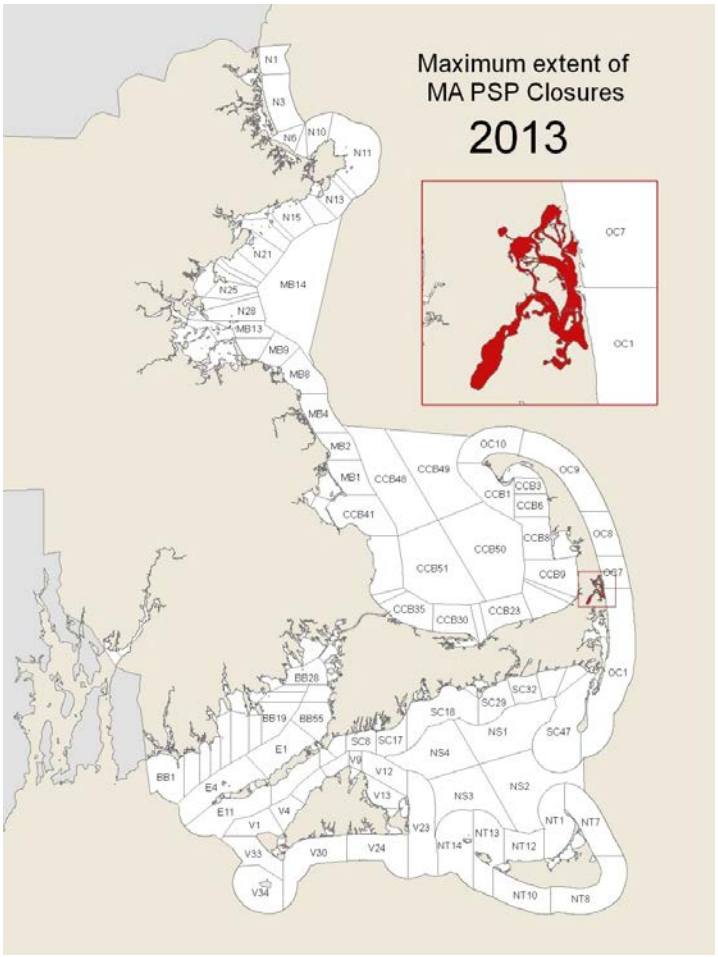

Figure 16. 2013 PSP Closure Areas off Massachusetts

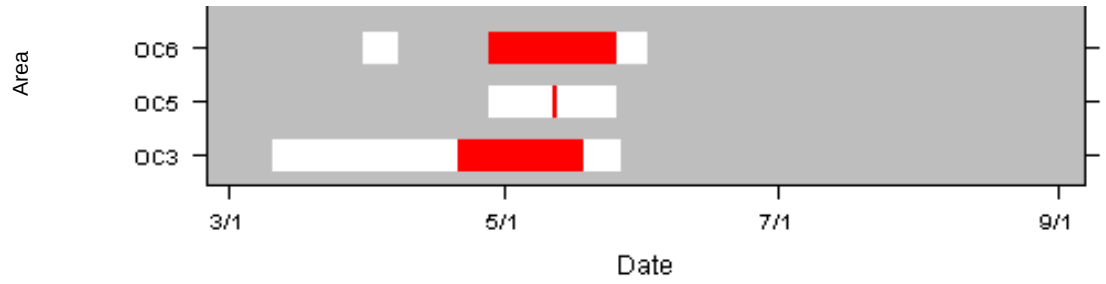

Figure 17. Timing of continuous toxicity (positive results that span more than one sample) from primary stations. White bars denote detectable toxicity levels; red bars indicate results that trigger area closure (≥ 80 µg/100g).

Phytoplankton Monitoring

Phytoplankton monitoring coincides with the start of mussel collection for the PSP season. In total, 259 phytoplankton samples were collected and analyzed from 11 stations over an eight-month period.

On the North Shore, phytoplankton monitoring occurred at least once a week throughout the sampling season at the primary stations in Newburyport, Ipswich, Essex, and Gloucester. Sampling was conducted semi-weekly in N7 Essex Bay and N9 Annisquam River for the first nine weeks, until it was determined no significant bloom would occur. Beginning in 2013, the phytoplankton season was extended later into the calendar year to specifically incorporate monitoring for diatom *Pseudo-nitzschia* spp., the causative organism for amnesic shellfish poisoning (ASP). A total of 129 phytoplankton samples were collected; more than the three previous years combined due to the implementation of quantitative sampling, which eases field collections. *Alexandrium* spp. were indentified on May 21 at both the N7 and N9 stations, but at non-actionable levels. No other samples contained *Alexandrium* the remainder of the season. On November 29, a diatom bloom was observed at N7 Essex Bay. As the organism resembled *Pseudo-nitzschia*, a Jellett rapid test for ASP was performed; the result was negative.

On the South Shore, *MarineFisheries* personnel collected phytoplankton samples weekly, throughout the PSP biotoxin monitoring season, from seven stations spread along the coast in Cohasset, Scituate, Plymouth, Sandwich, Wellfleet, Orleans, and Falmouth. A total of 130 samples were analyzed qualitatively for relative abundance of potentially toxic species. No species of concern was observed in actionable levels with the exception of increasing numbers of *Alexandrium* spp. cells in samples taken from the Orleans station in the Nauset estuary during the normal spring bloom. As noted above, results from meat samples analyzed as part of the Division's biotoxin monitoring program closed the entire Nauset estuary from April 24 through June 20, 2013.

Additional phytoplankton tows were performed in several embayments in Buzzards Bay and along the south shore of Cape Cod in response to reported visible plankton blooms. In each of these cases, *Cochlodinium polykrikoides* was identified as the source of the bloom. Reports of these often dramatic rust colored blooms have become commonplace along the southern Massachusetts coast, from the Rhode Island border northward into Cape Cod Bay, including the islands of Martha's Vineyard and Nantucket, during the warm summer months.

Other Harmful Algal Bloom Monitoring

In mid-July 2013, *MarineFisheries* received notification from USFDA that Area CCB50 had been implicated by USFDA and the State of New Jersey as a possible source of blue mussels involved in a case of Amnesiac Shellfish Poisoning (ASP) of two individuals in New Jersey. ASP is caused by domoic acid, a metabolite which is produced by phytoplankton in the genus P*seudo-nitzschia*. A commercial harvester dredging mussels within CCB50 was one of a number of implicated sources of the contaminated mussels. On July 17, staff biologists collected mussels from the implicated vessel and shipped them to USFDA's Dauphin Island Laboratory in Alabama for analysis. Shortly thereafter, *MarineFisheries* was informed that the mussels collected from CCB50 did not test positive for domoic acid. In was later determined that the contaminated mussels most likely came from Nova Scotia.

Illness Outbreak Review

On June 20, 2013 *MarineFisheries* received notification from *Mass*DPH that multiple reported norovirus illnesses had been traced to oysters harvested from a private aquaculture grant site in Oyster Pond River in the town of Chatham. In response, the Division immediately closed the 171-acre SC49 Oyster Pond River growing area to all shellfishing. Additionally, *MarineFisheries* closed the 318-acre SC50 Oyster Pond growing area due to its contiguity with Oyster Pond River.

Oysters implicated in the outbreak had been harvested on June 11 and 13. A recall was initiated on June 21 for all oysters harvested between June 11 and June 20. Of the estimated 26,240 oysters sold in that timeframe, 14,594 were consumed and 10,546 were returned to the grant and segregated under supervision of the shellfish constable; 1,100 were destroyed.

On June 24, staff biologists collected oyster samples from the grant sites in SC49 and SC50 and shipped them to the USFDA Dauphin Island Laboratory to be tested for the presence of norovirus. In addition, staff conducted a shoreline walk of the SC49 and SC50 growing areas to look for any possible sources of contamination, collected water quality samples at all existing classification stations, and collected additional oyster samples from the two grant sites for fecal coliform analysis. *MarineFisheries* efforts to deduce the likely cause of this norovirus contamination event further included a review of Chatham's live aboard policy for boats in the area, site visits and appraisals of the two marina facilities in Oyster Pond River, sampling and fecal coliform analysis of all nearby potential pollution sources, a review of the town's records relative to the status of adjacent properties' septic systems, and the operation of the municipal sewer collection system and pumping stations.

Both growing areas were reopened to shellfishing on October 11, 2013 after all NSSP requirements were met and testing indicated the areas were safe for harvest. *MarineFisheries* biologists are committed to working closely with the Town of Chatham during 2014 to monitor water quality in both growing areas to ensure harvested shellfish remain safe.

Pollution Discharge and Contaminants

Program biologists comment and make recommendations regarding United States Environmental Protection Agency (EPA) National Pollution Discharge Elimination System Permits. In 2013, 15 permits required review, including 11 point source discharges from waste water treatment plants, industrial discharges, and marine animal holding facilities. The remaining four permits involved the intake and discharge of non-contact cooling water.

Comments on public health consequences and environmental impact on shellfish growing areas were made. Direct consultation with EPA and the Massachusetts Department of Environmental Protection (*Mass*DEP) was provided to resolve issues raised by shellfish staff before issuance of final permits. Recommendations and comments involved end-of-pipe fecal coliform bacteria standards and facility chlorination requirements, along with impacts associated with other industrial discharges.

Staff biologists also conducted assessments of chemical contaminants in fisheries resources. Contaminant information and data were identified, researched and reviewed, and recommendations were provided to *MarineFisheries* senior staff to inform and guide management decisions. This included investigations on PCBs and mercury in quahogs for the contaminated relay program. Information on lead in Arctic quahog was provided to assist the Commonwealth of Virginia shellfish program. Health advisories and data for PCBs in fish and shellfish in the New Bedford Harbor superfund site were evaluated, with follow up consultation with *Mass*DPH, Massachusetts Office of Law Enforcement (OLE), *Mass*DEP, Town of Fairhaven Health Department, and City of New Bedford Mayor's Office and Health Department. PCBs in dogfish were investigated in response to a request from New Bedford seafood processors whose product was embargoed from entry to the European market. An evaluation of available information on radionuclides in fish and shellfish at the Massachusetts Bay disposal site was conducted in response to a request from *Mass*DPH, and the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA).

Shellfisheries Management Project

Contaminated Shellfish Resources

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

Relaying: *MarineFisheries* permits municipalities to relocate (between and within communities) bacterially-contaminated shellfish to clean waters for natural purification and propagation. Relays are conducted under stringent NSSP guidelines and are heavily supervised by state and local enforcement authorities. Contaminated shellfish must remain at the recipient site for a minimum of three months and also for the duration of one spawning season. Shellfish are tested prior to relay and again before harvest for human consumption. Quahogs are most often the species relayed, but oysters and soft-shell clams may also be relayed.

Disease monitoring was conducted in the Taunton River in late February 2013. Approximately three weeks later, results were received from Kennebec River Biosciences (all negative).

Three dredge boats were allowed to start relaying in early April. Most of the relays were completed by June 15, while Westport continued relaying into August. The three boats relayed a total of 15,117 bushels of quahogs during the 2013 season. Barnstable also relayed 219 bushels of quahogs from the Centerville River. Seventeen towns relayed 15,336 bushels of quahogs to 31 separate areas within those towns. Westport received 5,074 while Barnstable received 2,000 bushels of quahogs. See Table 4.

Oysters were relayed from Barnstable, Chatham, and Falmouth. Barnstable's came from North Bay (150 bu.), Chatham's from Stage Harbor due to a norovirus outbreak (1,043 bu.), while Falmouth was completing a phase of a nitrogen study (272 bu.). See Table 5.

Table 4. 2013 Contaminated Quahog Relays

Town	Harvest Site	Transplant Site	Area	Bushels	Last Day Planted
Bourne	Taunton R.	Fisherman's Cove (MMA)	BB43.30	424	4-Jun
Bourne	Taunton R.	Phinney's Harbor (Toby's)	BB46.23	451	10-Jun
Bourne	Taunton R.	Back River (mouth)	BB47.1	325	14-Jun
Yarmouth	Taunton R.	Lewis Bay (Standish Shore)	SC28.7	1,201	2-May
Eastham	Taunton R.	Salt Pond	OC6.21	230	19-Apr
Eastham	Taunton R.	Town Cove (Ellis Road)	OC4.25	270	17-Apr
Edgartown	Taunton R.	Sengekontacket Pond	V16.22	353	22-May
Barnstable	Taunton R.	Cotuit Bay (Bluff Point)	SC21.20	540	7-May
Barnstable	Taunton R.	Cotuit Bay (Main Street)	SC21.22	549	2-May
Barnstable	Taunton R.	Cotuit Bay (Old Post Road)	SC21.21	591	29-May
Barnstable	Taunton R.	North Bay (Sand Point Road)	SC23.22	320	3-Jun
Fairhaven	Taunton R.	North Cove	BB21.20	1,000	22-Jun
Dennis	Taunton R.	Bass River Center	SC34.20	250	6-Jun
Barnstable	Centerville R.	North Bay (Bay Street)	SC23.20	219	15-Jun
Provincetown	Taunton R.	P-town Harbor (Captain Jacks)	CCB4.25	311	6-Jun
Truro	Taunton R.	Pamet Harbor	CCB7.1 & 7.2	202	13-Jun
Oak Bluffs	Taunton R.	Sengekontacket Pond (1,4,&5)	V16.23, .27&.28	500	14-May
Westport	Taunton R.	East Branch (David Road)	BB4.22	500	3-Jul
Westport	Taunton R.	East Branch (#1380 Drift Rd)	BB4.26	254	3-Jul
Westport	Taunton R.	East Branch (1/2 Moon Flat)	BB4.21	1,165	15-May
Westport	Taunton R.	West Branch (Judy Island)	BB3.19	1,332	15-Jun
Westport	Taunton R.	East Branch (Sunk Rock)	BB4.27	600	3-Jul
Westport	Taunton R.	East Branch (Hillcrest Acres)	BB4.26	1,223	3-Aug
Tisbury	Taunton R.	Lake Tashmoo	V8.25	500	22-May
Mattapoisett	Taunton R.	Mattapoisett Harbor	BB25.12	200	11-Jun
Swansea	Taunton R.	Coles River	MHB4.22	424	20-May
Wareham	Taunton R.	Buttermilk Bay (Miller Cove)	BB44.5	250	12-Jun
Wareham	Taunton R.	Broad Cove	BB42.2	650	12-Jun
Scituate	Taunton R.	North River	MB5.20	100	12-Jun
Sandwich	Taunton R.	Sandwich Harbor	CCB37.0	300	30-May

Table 5. 2013 Contaminated Oyster Relays

Town	Harvest Site	Transplant Site	Area	Bushels	Last Day Planted
Barnstable	North Bay	West Bay (Wianno)	SC:22.24	150 *	14-Aug
Wareham	Taunton R.	Sunset Cove (Agawam Beach)	BB:41.2	150	10-Jun
Chatham	Oys.Pond/R.	Stage Harbor	SC:48.1	641*	18-Jul
Chatham	Oys.Pond/R.	Stage Harbor	SC:48.2	402*	24-Sep
Falmouth	Little Pond	Green Pond	SC:12.20	115*	15-Nov
Falmouth	Little Pond	West Falmouth Harbor	BB:54.20	157*	19-Nov

*Relay amount given in number of oysters.

Depuration: Cleaning contaminated shellfish in controlled purification (also called depuration) plants is a process that has been practiced worldwide for over 100 years. *MarineFisheries* 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 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 substantial activity for *MarineFisheries.*

Clams are harvested from *Conditionally Restricted* areas in Boston Harbor, Pines River, and Merrimack River, 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 salt water wells; all process water is continuously disinfected with ultraviolet light. Each tank has the capacity to hold 108 dealer bushels (or racks) of clams. The depuration process occurs for a minimum of 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 in commerce.

During 2013, the plant received shellfish on 153 days, comprising 219 lots. Although depuration landings declined 29% from 2012, plant-processed soft-shell clams still accounted for 6% of all Massachusetts landings of soft-shell clams. During 2013, two new harvest areas were opened to contaminated harvest: N26.4, Seaplane Basin in Revere, and Joppa Flat (part of N2.1) in Newburyport. All lots met release criteria with no lots recalled.

As in prior years, the decrease in softshell clam harvesting represents a continuing downward trend in landings from Boston Harbor primarily due to neoplasia, a shellfish disease. The resulting softshell clam mortality has had a severe impact on the Boston Harbor fishery. Eight Boston Harbor areas were harvested in 2013, down from 29 in 2012, producing only 19% of the yearly shellfish plant production. The average catch from these Boston Harbor areas was 1.1 racks per digger per digging tide. The remaining 81% of annual plant production was received from area N2.1 in Newburyport and Salisbury and N26.1, N26.4, and N26.7 in Revere and Saugus. Subordinate Digger production averaged 2.6 racks per digging tide in Revere/Saugus, while the Newburyport/Salisbury diggers averaged 3.5 racks per tide.

Five Master Diggers delivered clams to the Purification Plant. An average of eight subordinate diggers harvested at each digging. The maximum turnout for one tide by subordinate diggers was 24. In total, 77 Subordinate Digger permits were issued in 2013.

Commercial Bait Harvest: During each year between 2010 and 2013, there were less than three dredge boat permits issued for the contaminated surf clam bait fishery of Nantasket Beach. Due to confidentiality restrictions, landing statistics for this small fishery cannot be reported for this period.

Wet Storage

For 83 years, the Shellfish Purification Plant operated solely as a depuration facility. This changed in 2013, when the plant began a new service to Massachusetts wholesale shellfish dealers: wet storage processing. In wet storage, sterilized seawater is used to flush sand, mud, and grit out of shellfish harvested from NSSP-classified Approved areas. As these shellfish are already at safe bacterial level;, the focus of wet storage is on enhancing them for market and extending the shelf-life. While there is no mandatory process time or microbiological testing like for depurated shellfish, wet stored shellfish are also regulated by the NSSP, overseen by *Mass*DPH and USFDA, and must comply with strict controls and standards, like traceability.

The Shellfish Plant received its first lot of clams for wet storage on March 4, 2013, following public scoping in late 2012 to gauge interest in wet storage processing. Scoping was conducted through a questionnaire mailed to 160 licensed Massachusetts wholesale shellfish dealers, as well as public meetings. While the number of racks processed in 2013 was less than anticipated, this new service was well-received by the dealers using it and was deemed a successful effort for its first year of operation.

Shellfish Purification Plant and Laboratory

The Shellfish Purification Plant's laboratory tested a total of 506 shellfish samples. The laboratory also analyzed 844 water samples for fecal coliform. This was a 35% decline in shellfish and 7% decline in water samples tested from the previous year. Some of the drop in samples analyzed is in response to fewer harvest lots, a re-evaluation of sampling frequency, and budget reductions.

In March, laboratory supervisor, Diane Regan, and biologists, Greg Bettencourt and Chris Schillaci, participated in the annual USFDA shellfish proficiency evaluation, which included shellfish and depuration water sample analysis. The laboratory was found to be compliant. In December, Regan also participated in the Northeast Laboratory Evaluation Officers and Managers (NELEOM) sponsored Laboratory Proficiency test; the laboratory was found to be compliant. In June, Regan travelled to Norfolk, Virginia, at the request of USFDA, to represent NELEOM to the Mid Atlantic Laboratory Group. Additionally, Regan received training in Male-Specific Coliphage virus testing using softshell clams.

Plant maintenance included roof replacement, several outfall pipe dig-outs, and general painting. *Mass*DPH inspectors completed routine monthly inspections throughout the year finding no objectionable conditions. The plant also continued to supply seawater to local educators for their saltwater cultures, displays, and aquaria.

The plant hosted several special guests and group tours throughout the year. The tours varied from general to technical depending on the audience. For the fourth time, the plant hosted an open house on August 3 as part of a larger Newburyport event in which over 100 people toured the facility and lab.

Boston Harbor Soft-shell Clam Enhancement

In 2013, *MarineFisheries* began a new round of shellfish enhancement and mitigation activities in the greater Boston Harbor area. The project broadened its focus from primarily out-planting hatchery reared soft-shell clams to increased applied research and expanded university, non-profit, and industry partnerships all aimed at improving soft-shell clam resources in Boston Harbor. Brood stock enhancement through the out-planting of hatchery reared seed was scaled down to approximately one million juvenile clams, enabling project staff to focus efforts on maintaining and sampling the enhancement plots in tighter intervals, as well as expand enhancement efforts beyond just out-planting. Additionally, out-planting was limited to sites that have demonstrated prior success.

Expanding our collaborative research efforts, the project launched a multi-year research initiative focused on understanding the decline in natural recruitment and landings of softshell clams in greater Boston Harbor. Additional research on the growth and health of out-planted clams was conducted by project biologists and Salem State University undergraduates as part of our continuing relationship with the Northeast Massachusetts Aquaculture Center (NEMAC).

From June 26 through October 11, 2013, approximately one million clams, with an average shell length greater than 10 millimeters, were purchased from NEMAC and stocked within 111 plots at four sites in Boston, Hingham, Quincy, and Revere (Figure 18). Enhancement efforts were concentrated away from Winthrop areas because of restrictions on our most recent mitigation agreement with the Massachusetts Port Authority. This funding agreement explicitly prohibits the creation of wildlife attractants within a 10,000-foot radius surrounding the Logan Airport property. Soft-shell clam propagation is considered to create a potential food source for various species of waterfowl, thus constituting a risk to air traffic.

Standardized techniques were used for all procedures. Approximately 9,000 seed clams were broadcast distributed by hand onto each plot, resulting in an approximate density of 30 clams per square foot. In order to protect the recently seeded clams, soft-shell clam enhancement plots were raked free of surface predators and covered with predator exclusion netting. *MarineFisheries* personnel and undergraduate students from NEMAC monitored the enhancement plots regularly throughout the growing season to inspect for any impediments to clam growth and survival. All predator exclusion netting was removed by hand in November; those with minor damage were repaired and put into storage for reuse the subsequent year. The corners of each plot were marked with stakes and their coordinates recorded for future sampling.

Sampling of shell length and condition from a subset of out-planted clams was completed monthly from June to October 2013 at Orchard Beach (Quincy) and Blue Bar (Revere). Monitoring the planted clams achieves two goals: it aids in site selection and it ensures the clams have attained the minimum legal size before they are reopened to commercial harvest. Most seeded clams attain the minimum harvest size of 2 inches after approximately 18 months post-planting. Data indicated that the clam seeds in Revere grew faster and heavier than those in Quincy.

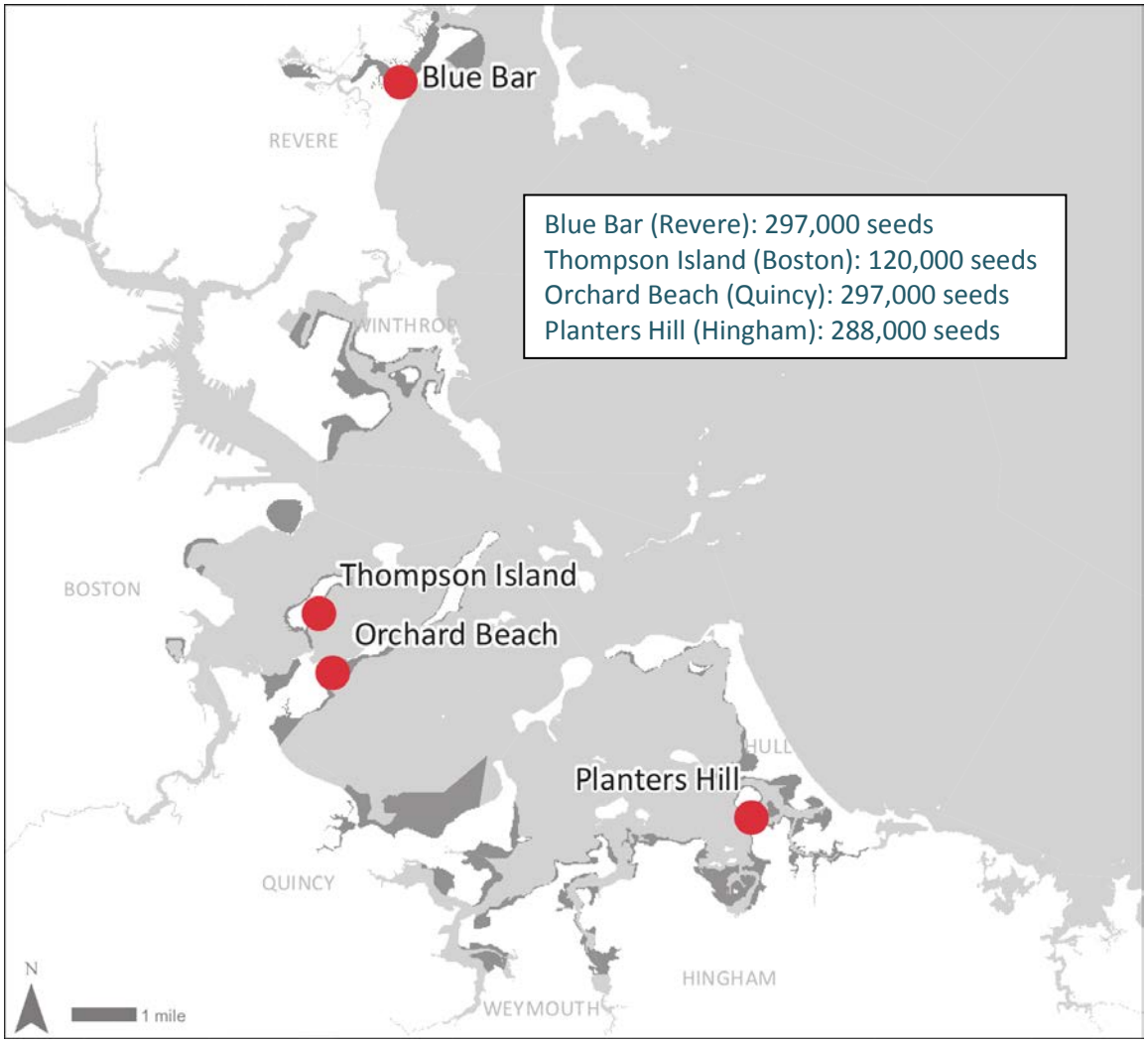

Figure 18. Location and seed quantity for 2013 clam enhancement sites

During April 2013, *MarineFisheries* personnel and volunteer subordinate diggers sampled a subset of enhancement plots from prior planting years to estimate survival. Four enhancement plots in Blue Bar (Revere), planted in 2010, were surveyed, as were two enhancement plots in Laundry Cove (Weymouth), planted in 2012. Survival estimates ranged between 15% and 44% among the sampled plots (Figure 19).

In 2013, *MarineFisheries* personnel entered into a multi-year research initiative focused on understanding the decline in natural recruitment and landings of soft-shell clams in greater Boston Harbor. For the first year, the initiative focused on the impacts of coastal acidification on soft-shell clam recruitment in Boston Harbor; future work will analyze issues associated with brood stock abundance, predation, and disease.

Working with researchers from the University of New Hampshire's Coastal Ocean and Observing Center, *MarineFisheries* personnel began collecting information on larval settlement rates, as well as analyzing the calcium carbonate saturation state of sediment pore water in the project area. The group also looked at the efficacy of calcium carbonate sediment buffers to mitigate the effect of coastal acidification and to increase larval settlement. Initial results from the study

indicate specific buffer materials—and increased concentrations of the buffer materials—have a positive correlation with both the calcium carbonate saturation state of interstitial waters and the recruitment of softshell clams to the study area. This project will be expanded upon in the 2014 season to identify the spatial and temporal patterns of coastal acidification in greater Boston Harbor as well as larger scale buffer work combined with spat collection. There is great potential in the use of buffers as an enhancement technique as spat collection and buffering can be conducted at a considerably lower cost than out-planting hatchery reared clams and yield significantly higher densities.

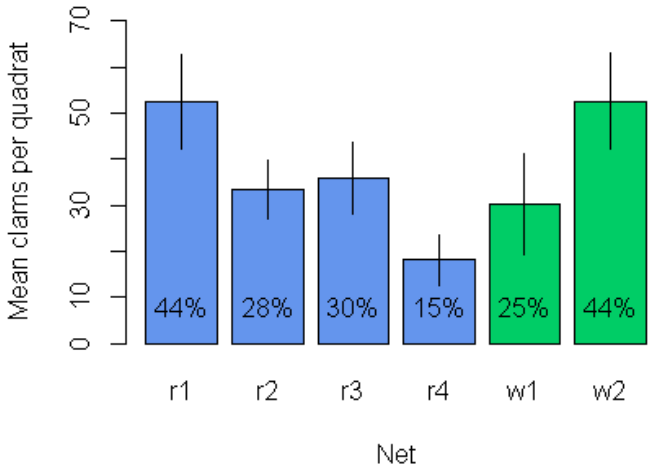

Figure 19. Mean number of clams per sampled plot (y-axis) and estimated percent survival (within the bar) for surveyed enhancement sites in Blue Bar, Revere (r1-r4) and Laundry Cove, Weymouth (w1 and w2).

The project's outreach efforts continued in 2013 with its project partners: Thompson Island Outward Bound Education Center, City of Boston, National Park Service, Save the Harbor/Save the Bay, New England Aquarium, Blue Ambassadors, Massachusetts Bay Keepers, Boston University Community Service Center, and Salem State University. On August 14, the outreach collaborative organized a clam seeding event led by *MarineFisheries*; over 75 volunteers helped plant more than 100,000 clams in the intertidal mudflats of Thompson Island. In addition to the seeding, volunteers assisted the Island Ambassadors' island monitoring program by conducting a fish seine of a salt pond and a biological inventory of the rocky intertidal.

Technical Assistance Project

In Massachusetts, cities and towns manage the shellfisheries in all waters within their boundaries not closed by *MarineFisheries* for public health reasons. This includes all shellfisheries with the exception of commercial harvest of surf clams and ocean quahogs, which remain under state control. The Shellfish Program assists municipalities on a wide variety of shellfisheries management issues providing technical and regulatory information as well as recommendations on numerous subjects to local shellfish managers. Assistance includes: shellfish propagation; predator control; survey methods; management openings and closures; habitat improvement; shellfish management plans; aquaculture development and regulation; water quality; public health and sanitation; and permitting. Program staff provide technical

assistance to municipal managers and boards, state and federal agencies, academia and non-governmental research and management organizations, and individuals.

Environmental Protection Project

Shellfish Program personnel respond to pollution events in coastal waters in order to assess damage to shellfish populations and to determine the need for public health closures. These events include sewage discharges, boat sinkings, petrochemical spills, and other discharges of hazardous chemicals. Several pollution-related events in 2013 are detailed below.

- In February, heavy rains resulted in failures at some Boston Harbor wastewater treatment facilities/collection systems which triggered a closure of the entire harbor. Notably the Hull Waste Water Treatment Plant suffered a complete failure as a result of flooding from water breaching the nearby seawall. Flats were closed preemptively on February 7. A public safety advisory was issued on February 12 after receiving reports of the public collecting shellfish which had been washed ashore. In total, over 3,300 acres were closed. Some areas remained closed for over a month due to ongoing discharges or operating complications.
- Tropical Storm Andrea caused the Braintree collection system to bypass a total of nearly 2,000,000 gallons of raw sewage on June 7. Another storm on June 14 added to the total of 6,000,000 gallons of raw sewage. Over 360 acres in Quincy and Weymouth, within the Weymouth Fore River, were closed from June 9 to July 1. A major sewer bypass occurred from a sewer pump failure at Wharf Street in Weymouth discharging to the Weymouth Back River, which resulted in the closure of over 1,051 acres of shellfish areas in Quincy, Weymouth, and Hingham. These areas were closed between April 18 and May 2.
- In September, staff investigated the Weymouth Fore River for a report of a spill of beef tallow coating acres of intertidal habitat with the animal fat.

In addition, the Shellfish Program co-reviews, with other *MarineFisheries* staff, various proposed coastal alteration projects with regard to impacts on water quality and shellfish resources and habitat. Recommendations are made through *MarineFisheries'* environmental review process to the permitting agencies concerning the effects of proposed structures, filling, and discharge into the marine environment. In 2013, staff biologists reviewed over 250 project proposals.

Shellfish Disease

Incidence of hemic neoplasia in soft-shell clams throughout the Commonwealth remains high. *MarineFisheries*, in cooperation with West Chester University in Pennsylvania, has been conducting a long term sampling program in an effort to track the prevalence and extent of the clam disease throughout Massachusetts coastal waters. Neoplasia has been implicated in extensive clam die-offs in Boston Harbor and other regions of the coast. The causative agent has yet to be identified.

Aquaculture Permitting and Technical Assistance Project

Permitting

The regulation of shellfish aquaculture is a major management and technical assistance endeavor of the Shellfish Program. This activity involves two areas of concern: licensing of sites by municipalities, and the permitting of aquaculturists to obtain and possess sub-legal shellfish (seed) for transplant and grow-out to legal size. *MarineFisheries* assists the industry and municipalities by certifying (after inspection of the project site as required by Massachusetts General Law, Ch.130, Sec. 57) that license and operation will cause no adverse effect on shellfish or other natural resources of the city or town. The required *MarineFisheries* permit is designed to allow possession of seed and to prevent the introduction of shellfish diseases, non-native species, and other pests or predators that could decimate natural populations and ruin both aquaculture and wild commercial fisheries.

In 2013, shellfish propagation permits were issued to 367 aquaculture license site holders and municipalities (for public propagation activities) operating shellfish aquaculture projects in 28 coastal municipalities throughout the Commonwealth. There were a total of 341 permits issued to strictly private/commercial shellfish aquaculturists. See Table 6 for the number of shellfish propagation permits and acreage under cultivation by town.

All agency aquaculture activities will be comprehensively recorded in the 2013 Aquaculture Report (in progress). Twenty-nine coastal towns contributed data to the report. The most significant aquaculture citing developments during the 2013 calendar year are presented below:

- A total of 17 new proposed private aquaculture license sites were surveyed and approved, comprising a total of 60 acres surveyed. A 30-acre subtidal aquaculture area in the town of Nantucket was part of the 60-acre total.
- Bourne approved a two-acre license extension off Tobey Island in Buzzards Bay. The town of Eastham had a new half-acre site approved in the Aquaculture Development Area (ADA) located off First Encounter Beach. Although surveyed years ago, this section in the ADA had gone unused for more than two years and required a new survey.
- The town of Chilmark approved two licenses, each less than 0.25 acres, for upwellers in a Conditionally Approved area in Menemsha Pond and an Approved area in Nashaquitsa Pond.
- Nantucket further subdivided the town area located in Head of the Harbor into two four-acre sites for floating aquaculture (oysters), along with a 30-acre extension to the exiting 30-acre area. Another 10-acre site in the Head of the Harbor west of the proposed 30-acres site and another 5-acre site inside Polpis were surveyed by *MarineFisheries*. All sites were surveyed by Division divers.
- Roughly two acres were surveyed for the town of Dennis to allow private growers to over-winter oysters in Sesuit Harbor. Under a quarter acre was surveyed for the town of Eastham for a private upweller in Rock Harbor.
- Almost four acres were surveyed outside Cotuit Harbor in the town of Barnstable located in Vineyard Sound by Division divers. This site had been approved by the Town two years prior, but the information was never presented to *MarineFisheries*.

- Two half acre sites were surveyed in Cape Cod Bay outside Rock Harbor for private aquaculture and a less than quarter acre site was surveyed inside Fiddlers Cove, Falmouth for two floating upwellers.
- The town of Mattapoisett had an existing applicant reconfigure and renew an existing Brant Island Cove license site in order to apply for an Army Corps permit and to be in compliance with town coordinates.

Table 6. 2013 Shellfish Propagation Permits and Acreage Under Cultivation, by Town

Town	# Growers	Total Acres	Species Grown
Aquinnah	2	2.6	Quahog
Barnstable	50	131.9	Oyster, Quahog, Soft-Shell Clam
Bourne	1	3.0	Oyster
Brewster	8	7.5	Oyster, Quahog
Chatham	2	7.1	Oyster, Quahog, Soft-Shell Clam Clam, Razor Clam
Chilmark	7	12.8	Oyster, Blue Mussel
Dennis	26	29.0	Oyster, Quahog, Soft-Shell Clam Clam
Duxbury	25	67.4	Oyster, Quahog
Eastham	20	17.7	Oyster, Quahog, Soft-Shell Clam, Mussel
Edgartown	11	11.0	Oyster
Fairhaven	2	1.0	Oyster, Quahog, Bay Scallop
Falmouth	6	30.4	Oyster, Mussel
Gosnold	1	32.0	Oyster
Ipswich	4	2.5	Soft-Shell Clam
Kingston	3	8.5	Oyster
Marion	3	2.0	Oyster
Mashpee	4	13.9	Oyster, Quahog, Soft-Shell Clam
Mattapoisett	2	139.9	Oyster, Bay Scallop
Nantucket	8	41.0	Oyster, Quahog, Soft-Shell Clam
Orleans	18	20.8	Oyster, Quahog, Soft-Shell Clam, Mussel
Plymouth	6	23.1	Oyster, Quahog, Soft-Shell Clam
Provincetown	7	7.0	Oyster, Quahog, Mussel, Surf Clam
Rowley	14	18.5	Oyster, Soft-Shell Clam, Razor Clam
Truro	2	7.0	Oyster
Wareham	7	68.9	Oyster, Quahog
Wellfleet	96	278.3	Oyster, Quahog, Soft-Shell Clam, Mussel, Razor Clam
Westport	3	2.7	Oyster, Quahog
Yarmouth	3	24.0	Oyster, Quahog, Bay Scallop
Totals	**341**	**1,011**	

Vibrio Management

In spring 2012, the USFDA directed *Mass*DPH and *MarineFisheries* to implement an Enhanced Vibrio Control Management Plan for Eastern Cape Cod Bay (ECCB). In response and to minimize the risk associated with *Vibrio parahaemolyticus* (*Vp*) related to the consumption of raw oysters, *MarineFisheries* developed the first *Vp* Control Plan for Massachusetts.

The 2012 plan and permit conditions affected commercial harvesters of wild oyster in the town of Wellfleet (the only area open to wild harvest in the state; about 100 individuals) and to those oyster aquaculture operations within ECCB in the towns of Barnstable, Yarmouth, Dennis, Brewster, Orleans, Eastham, Wellfleet, Truro, and Provincetown (232 aquaculturists). The plan required refrigeration by harvesters within five hours of harvest and subsequent cooling to 50°F in 10 hours by receiving dealer. Compliance inspections of commercial oyster operations were carried out by *MarineFisheries*, acting as the lead agency, with members of the *Mass*DPH Food Protection Program's Seafood Unit, Office of Law Enforcement, local Town Shellfish Departments, and USFDA.

Despite these enhanced controls on oyster harvesting during the 2012 Vibrio season, *Mass*DPH documented 27 confirmed cases of *Vp* illness that were traced back to Massachusetts-only Shellfish Growing Areas. In response, USFDA mandated that a *Vp* Control Plan be developed and implemented for the entire Massachusetts coastline in 2013. Accordingly, *MarineFisheries* and *Mass*DPH re-established and extended the *Vp* Control Plan and are implementing permit conditions for 2013.

The 2013 *Vp* Control Plan was designed to better regulate the time-to-temperature related conditions of oyster harvest, sale, and distribution. Harvesters were required to tag all bags or containers of oysters with the time of harvest; maintain a harvest logbook; adequately shade their oysters during harvest and transportation; and adequately ice their oyster harvest upon landing. Additionally, certain harvester activities related to the culturing and culling of oysters were subject to *Vp* related restrictions. Primary buyers were required to implement a Hazard Analysis and Critical Control Points plan that identifies *Vp* as a significant hazard; ensure that oysters are chilled to an internal temperature of ≤ 50°F within 10 hours of time of harvest; maintain an ambient air temperature of 45°F; and keep receiving records of pertinent harvester information. All oysters that did not conform to these time and temperature restrictions could not be sold into the raw shellfish market. Additionally, primary buyers were subject to all relevant public health regulations at 105 CMR 533.0007. These permit conditions were sent to all Massachusetts aquaculture propagation permit holders, commercial shellfish permit holders in the town of Wellfleet, and all primary buyers of raw oysters. They were effective during the period of May 24 through October 20. The 2013 Vibrio Control Plan impacted 352 oyster aquaculturists in 29 municipalities throughout the Commonwealth, and about 100 wild oyster harvesters in Wellfleet.

MarineFisheries staff focused compliance monitoring efforts on commercial aquaculture activities in areas where the oyster aquaculture industry is prevalent. Shellfish Program staff conducted the majority of compliance inspections during the 2013 *Vp* season. Individuals from Town Shellfish Departments, *Mass*DPH, and USFDA accompanied *MarineFisheries* on some inspections, and in some cases Town Shellfish Constables carried out the inspections independently. *MarineFisheries* and its partners carried out a total of 115 monitoring events. An attempt was made to dedicate monitoring effort proportionally, based on the number of oyster growers in each town. Program biologists interviewed commercial oyster growers at various

points of landing, whether or not they were landing product destined for market, and recorded interview information on a standard form.

Of the 115 monitoring events, 52 involved oyster landings. Eighteen of these landings (34.6%) were 100% compliant with the 2013 *Vp* Control Plan. At 77% of the observed landings, oyster growers complied with the most critical components of the *Vp* Control Plan; containers were properly marked with time of harvest and the landed oysters were adequately iced and shaded. Most observed non-compliant landings involved minor infractions.

John T. Hughes Hatchery & Research Station

In 2012, *MarineFisheries* re-named its Oak Bluffs facility as the "John T. Hughes Hatchery and Research Station" in recognition of its longtime supervisor and renowned lobster culturist. The facility has been re-purposed to support municipal shellfish propagation programs. To achieve this goal, *MarineFisheries* formed a partnership with the Martha's Vineyard Shellfish Group (MVSG) to grow shellfish at the facility. A two-year agreement was forged allowing MVSG to use portions of the hatchery to culture bay scallops and quahogs. Access to the facility greatly expanded the MVSG's capacity to enhance the public shellfish stocks in the six towns on Martha's Vineyard. *MarineFisheries* expended $247,000 to renovate the existing green house, upgrade the seawater and aeration systems, install a new state of the art greenhouse for algal culture, and accomplish general building improvements.

In 2013, *MarineFisheries* continued renovations at Hughes Hatchery to expand shellfish culture activities and improve general operation of the facility. Major improvements included: installation of new seawater, fresh water, and electrical systems in the green house to expand culture capacity (Figure 20); design and placement of additional tanks and tables in the greenhouse, expanding remote set oyster and scallop nursery culture; extensive repair and renovation of quahog nursery silos; reconstruction of tank supports to bear more weight, improving safety and enabling a substantial increase in quahog seed nursery production; installation of a new lightning protection system in the main building and pump house; and installation of a new security alarm system to notify key personnel in the event of a seawater pump failure.

Figure 20. Culture capacity was expanded in the Hughes Hatchery green house in 2013.

Figure 21. Scallop seed cultured in the Hughes Hatchery greenhouse.

With these improvements to the facility, the MVSG met their 2013 objectives to fine tune operations and increase production. During the year, roughly 5.7 million quahog seeds were successfully cultured in the hatchery for distribution to the town shellfish constables for further grow out in field nursery systems before being planted in public beds for harvest. Nearly 20,000 single oysters were nursery cultured in the hatchery prior to being moved to field nurseries in Edgartown Great Pond. About 139,000 seed scallops were cultured in the new greenhouse (Figure 21). Additionally, in a cooperative project with The Nature Conservancy, MVSG remote set 2 million eyed oyster larvae on shellbags in two tanks in the new greenhouse resulting in about 146,000 spat on shell that were planted in Tisbury Great Pond in an effort to improve water quality and increase marine habitat for biodiversity.

MarineFisheries also supported a University of New Hampshire graduate student (Shelley Edmundson) in her PhD research project on whelk management. This was accomplished by providing her with tanks of flowing, aerated seawater that served as a holding facility for the whelks she was tagging. Edmundson tagged about 4,000 whelks at the hatchery. Her whelk research could provide useful data for the management of the island's most valuable offshore fishery.

In December 2013, *MarineFisheries* renewed its License Agreement with MVSG for an additional three years, through December 2016. This partnership assists *MarineFisheries* in meeting our goal to preserve and enhance the local recreational and commercial shellfisheries. The reopening of Hughes Hatchery and more seed shellfish production provides additional educational and economic opportunities for the residents and visitors of Martha's Vineyard. There is an increased understanding of the role that shellfish play in maintaining or improving water quality and marine habitats. Shellfish production will likely have increasing application in bioremediation projects to restore and protect the water quality and marine ecology of the island's water bodies. During the 2014 season, MVSG will continue to expand production of juvenile quahogs, oysters, and bay scallops at Hughes Hatchery.

Other Activities

Program staff participate in many professional organizations such as the Northeast Shellfish Sanitation Association, the Massachusetts Shellfish Officers Association, and the New England Estuarine Research Society. In 2013, Program staff participated in the Northeast Shellfish Sanitation Association annual meeting in Providence, Rhode Island.

Shellfish staff also collected mussel samples for the Gulf of Maine Council Gulf Watch Mussel Sampling Program at three sites. Samples were analyzed for metals and PCB contamination.

MarineFisheries continued partnership with New Hampshire Sea Grant/University of New Hampshire, Spinney Creek Shellfish Inc. (Eliot, Maine), USFDA in Dauphine Island, Alabama, and the Maine Department of Marine Resources, in a collaborative study of enteric virus contamination and mitigation strategies, to reduce the extent of permanently closed shellfish growing areas. In the Northeast, acres of productive shellfish growing waters are permanently closed to aquaculture and harvesting activities due to concerns associated with human fecal pollution. Often, these potential aquaculture sites are sheltered, near shore locations with good access, but proximal to municipal wastewater treatment plant outfall and combined sewer overflows. The understanding of enteric viruses, such as norovirus and hepatitis A virus, in molluscan shellfish sanitation continues to improve with the rapid development of molecular

techniques leading to the detection and enumeration for pathogenic enteric viruses responsible for the majority of shellfish consumption related viral diseases worldwide. Male-specific coliphage (MSC), a bacteriophage of *E. coli* bacteria, has been validated for use as a viral indicator of enteric viral contamination within the NSSP. MSC is not a replacement for fecal coliform within the NSSP, but rather a specialty indicator reflecting the persistence of viruses in molluscan shellfish. The association between MSC and norovirus has been documented in recent studies.

The primary research objectives are to determine the appropriateness of MSC as an indicator of enteric viral contamination for American oysters and quahogs as well as modeling shellfish depuration and relay viral removal kinetics. Specific research objectives are to determine seasonal levels of MSC, fecal coliform, and norovirus in Eastern oysters and hard shell clams harvested from Northeast Regional estuaries to determine elimination kinetics in relation to water temperature. Field work began in Taunton River and Mount Hope Bay, then moved to Salem Sound in late summer. After initial field assessment, three sites were chosen: Riverhead, Marblehead Harbor; Forest River Park, Salem Harbor; and Collins Cove, Danvers River. In total, 14 soft-shell clam samples were collected and analyzed; five European oyster samples; three quahog samples; one American oyster sample; and 11 water samples. The study will continue throughout the summer of 2014.

Drifter studies were completed in the Weymouth Fore River and Lynn Harbor with a total of four deployments, two at each location. Information collected will be used for estimating time of travel from various sewer bypass locations within Fore River and estimating effluent time of travel for Lynn Wastewater Treatment facility outfall within Lynn Harbor and Broad Sound.

Habitat Program

Personnel

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Wesley Dukes, Marine Fisheries Biologist
Eileen Feeney, Program Coordinator
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Bailey Stauffer, intern

Overview

The goal of the Habitat Program is to protect and enhance marine fisheries resources by reviewing coastal alteration projects, writing best management policies, and conducting fisheries habitat research and restoration. The objectives of the program are to provide science-based guidance and policies that address potential impacts of coastal alteration activities to fisheries resources and habitats of the Commonwealth, to initiate and perform fisheries habitat research and applied studies, to develop and oversee *MarineFisheries'* climate change program, and to coordinate technical responses to emerging issues. The Habitat Program provides input to the Massachusetts environmental permitting process through review and comment to permitting agencies on a project's potential impact to marine fisheries resources and habitats.

In 2013, the Habitat Program staff reviewed 549 projects, representing 91 municipalities. Reviews included beach nourishment projects, repair of failing sewer pipes, tide gate designs, waterfront developments, and significant dredging projects in Boston and New Bedford. A new Microsoft Access database was developed to improve data management and mapping of review projects. One full-time review position was backfilled. The In-Lieu Fee (ILF) mitigation program oversaw three restoration projects and awarded funds to a fourth project. The ILF Program continued to develop into a Department-led statewide program. Monitoring of the state's four artificial reefs was conducted and the impact of dock shading on salt marsh health was assessed. One acre of eelgrass was planted in Boston Harbor. The Habitat Program further developed acoustic methods to map eelgrass beds, supported a deep-sea coral mapping project at the Massachusetts Institute of Technology, and mapped Boston Harbor marine habitats using a new national classification system. Program staff also represented *MarineFisheries* on a variety of committees and supported other Division programs.

Technical Review Project

The goal of the Technical Review Project is to protect and enhance marine fisheries resources by providing information regarding those resources to regulatory agencies during coastal alteration permit review. This project is also responsible for recommending mitigation and tracking mitigation projects. To meet these goals, the Technical Review team tracks coastal and marine construction projects, solicits specific resource information from *MarineFisheries* biologists, conducts literature reviews, attends site visits, writes project comment letters, reviews options for compensatory mitigation, and participates in interagency meetings. The Technical Review team also creates programmatic approaches to resource recommendations, improves access to coastal resource information, and supports research specific to review needs. The major tasks and projects are presented below.

Technical Review

The Project continued to respond to a high volume of requests for technical review for specific construction permits as well as for reviewing state and federal policy documents. In 2013, 549 specific projects in 91 municipalities were reviewed. To meet this demand, a full-time staff position was backfilled in Gloucester, bringing staff resources to four full-time members, two in New Bedford and two in Gloucester, who dedicate up to 75% of their time to technical review. One part-time contractor continued to play a vital role in maintaining records and assisting with the preparation of our comment letters in New Bedford.

Major review projects included City of Salem port expansion, *Mass*DOT's South Coast Rail Project, Salem's South Essex Sewerage District, Friends of Ellisville Marsh permit extension, Logan Runway Mitigation, New Bedford's South Terminal, Suffolk Downs Racecourse, ComCast/NSTAR fiber optic cable, Mohegan Sun Casino in Revere, Town of Marshfield's dredging North Pier in Green Harbor, Wynn MA, LCC Casino in Everett , Town of Truro's Aquaculture Development Area, Boston Boat Works, Town of Falmouth's Comprehensive Wastewater Management Planning Project, Salem Port Expansion, South Shore YMCA – Mill Pond Dam Removal and Stream Restoration, Commercial Point Facility in Dorchester, Schifter/Wasque Partners bank stabilization in Edgartown, White Island Pond phosphorus treatment in Plymouth, Boston Harbor Deep Draft Navigation Improvements, Army Corps/Town of Barnstable Vegetation Management Plan, Blacks Creek Tidegate, and Army Corps/Town of Bourne maintenance dredging of Buttermilk Bay. They all involved multiple meetings, workgroups, and interagency communications due to the complexities of the proposals. Of note is increasing attention and discussion of seawalls, beach nourishment, and nutrient attenuation on Cape Cod. The Habitat Program also contributed to an EOEEA nutrient removal guidance document by characterizing the effectiveness of using shellfish and algae for nutrient remediation.

Data Management

The Habitat Program has recorded all documentation associated with the review process via Microsoft Excel for the past decade. The limitations of that program for managing the records grew over time and project staff migrated to Microsoft Access. The project was conceived, designed, and developed, including the training of staff, in a two-month period. The new format is more efficient for entering and searching records and allows a direct link to mapping in

ArcGIS. In the development of the new database, efforts were made to standardize how impact is assessed and quantified.

In addition to improving the database, the Habitat Program focused on improving access and use of geographic data by holding two GIS training days for staff. The group is also exploring tools including Google Earth and ArcGIS Online to provide platforms for the reviewers to have quick and easy access to information.

We continued to implement our archiving standard, developed in 2012. These advancements have greatly improved our efficiency and we will now be more prepared to migrate to the Environmental Information and Public Access System that EOEEA is developing.

Anadromous Mapping

The Habitat Program is facilitating a project between *MarineFisheries* and *Mass*DOT to develop a statewide map of spawning runs with site specific time of year restriction windows. A draft map of the entire coastal zone was completed in 2013; review and testing was underway at the end of the year in order to finalize the map. In 2013, the review team began using the draft GIS data as part of project review screening (Figure 22). The *Mass*DOT-funded project is utilizing the data and expertise of several *MarineFisheries* biologists, and both *Mass*DOT and *MarineFisheries* will benefit from the spatial database of fish runs. It is of interest to the programs involved to expand the work and create linkages between the rivers and streams of the state and the marine habitats.

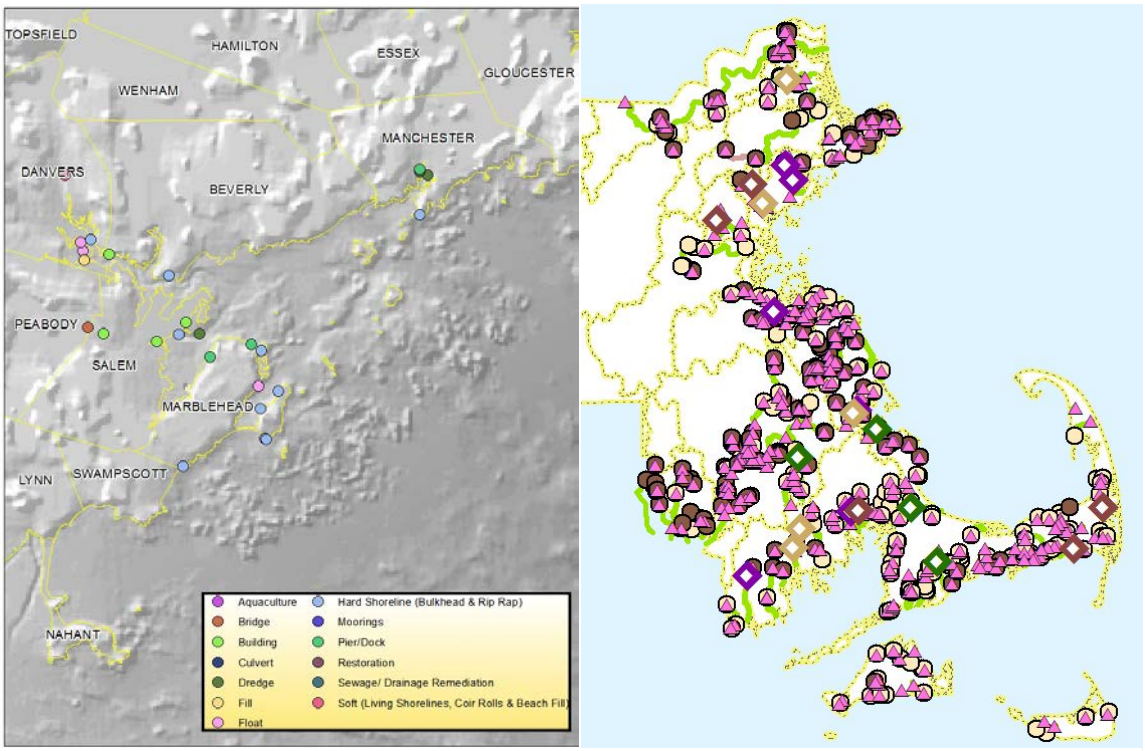

Figure 22. Advancements in our use of database and GIS software have enabled us to map environmental review projects (left) and diadromous fish runs (right).

In-Lieu Fee Program

This was the fifth year of the *MarineFisheries* and Army Corps of Engineers (Army Corps) In-Lieu Fee (ILF) program. This program addresses authorized impacts of less than one acre in extent to coastal aquatic resources, particularly Essential Fish Habitat (EFH) and aquatic habitats of managed diadromous fish and marine finfish and shellfish species in Massachusetts' waters, resulting from projects permitted under the Massachusetts General Permit (GP). Twenty-seven projects impacting 18,980 square feet of aquatic habitats have contributed nearly $230,000 to the program between 2009 and 2013. All obligations under the program, including project tracking, fund disbursement, and annual reporting, were accomplished.

In 2013, ILF funds were expended on projects selected through a Request for Proposals (RFP) process initiated in September of 2012. The RFP received seven proposals that were reviewed and ranked by a panel comprised of restoration professionals. The project ranking followed criteria developed by *MarineFisheries* through a 2012 grant from the Massachusetts Bays Program (Mass Bays). The project selection committee selected the top three ranked projects for full funding. A fourth eligible project was selected for partial funding.

Effective June 9, 2013, the MOU between the Army Corps and *MarineFisheries* establishing the Massachusetts ILF program in 2008 expired. Throughout 2013, program staff continued to work with the Commissioner of Department of Fish and Game (DFG), DFG staff, and the Army Corps in developing a statewide ILF Program that will address unavoidable impacts under the GP, as well as unavoidable impacts associated with Individual Permit projects. An ILF Program Instrument was submitted to the Army Corps for formal review in September 2013. The Army Corps determined that the Draft ILF Program Instrument was complete and that it addresses the required elements as described in the Mitigation Rule (33 CFR 332). The ILF Draft Instrument was undergoing a final review at year's end.

Fisheries Habitat Research Project

The goal of the Fisheries Habitat Research Project is to conduct research, monitoring, and restoration relevant to the mapping, identification, and quality of marine fisheries habitats. This project also aids in the creation of new data products now viewed as critical in the fisheries management community (e.g., seafloor maps). Research that the Project is currently working on includes: eelgrass monitoring, restoration, and conservation; artificial reef siting, construction, and monitoring; dock impacts on salt marsh; bottom temperature continuous monitoring; and seafloor mapping. Project staff serve on a variety of habitat-related committees, including the ASMFC's Habitat and Reef Committees, the Atlantic Coastal Fish Habitat Partnership, the NEFMC's Habitat Plan Development Team, the Northeast Regional Ocean Council's Habitat Classification Working Group, and the Mass Bays Management Committee. We also participate in working groups for the Boston Harbor Habitat Atlas. Some of the highlights from committee work include contributing to the development of the habitat section of the lobster fishery management plan for ASMFC and conducting analysis of closed areas for the Omnibus Habitat Amendment for NEFMC.

Habitat Characterization

The Habitat Research team conducts research focused on seafloor mapping. Using a single-beam sonar, a sidescan sonar, and video equipment, the team maps eelgrass beds and shallow coastal areas not covered by other seafloor mapping studies each year. In 2013, work was performed to quantify the single-beam sonar results with eelgrass diver data and test a new single-beam sonar instrument. An intern joined our team in 2013 to explore the use of remote controlled platforms for mapping eelgrass. This is a very promising technology used in many parts of the world for natural resource characterization.

For the past several years, efforts to quantify and characterize marine habitats have been explored on many levels, culminating with the publication of the Coastal and Marine Ecological Classification System (CMECS), a national standard for the classification of marine habitats. It is a corollary to the National Vegetation Classification System. The Habitat Research team contributed to the development of CMECS over the past several years. In 2013, under a grant from the Land Conservation Corps, the Habitat Research team worked in collaboration with the Nature Conservancy and the University of Rhode Island to apply the classification at multiple scales along the eastern seaboard (Figure 23). This work was finalized at the end of 2013 and was expected to be available publicly in early 2014.

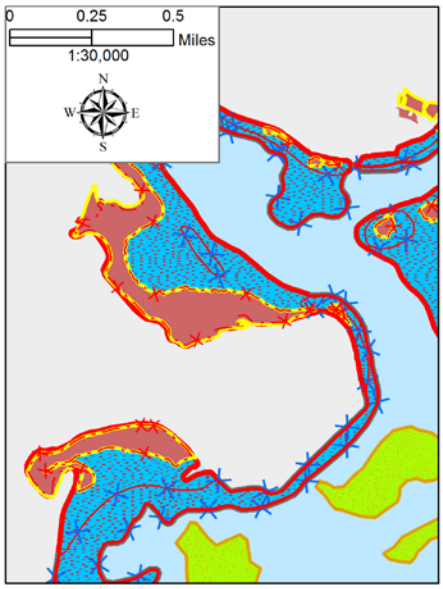

Figure 23. CMECS mapping of biotic habitats in Boston Harbor.

The Habitat Research team has also been using *MarineFisheries*' resource survey and sediment data to identify important habitat types for commercially and recreationally important species. We are coming closer to a robust habitat framework for important fish species in Massachusetts.

The Project also maintains a blog to promote discussion of seafloor mapping tools and issues (seafloormapping.blogspot.com).

Eelgrass

Due to its value in supporting commercial and recreational fisheries and its vulnerability to impact, eelgrass has been a habitat of primary importance to the Division for over a decade. The eelgrass team focuses on research, monitoring, and restoration of eelgrass in Massachusetts. In 2013, six sites were test planted and one acre was planted at three sites around the outer islands in Boston Harbor. The team reached the goal of two acres planted in Salem Sound and Boston Harbor by the end of 2013, partially fulfilling the commitment under the HUB3 (HubLine Eelgrass Restoration Project) mitigation agreement. A mid-project report was finalized and sent to *Mass*DEP, Spectra/Algonquin, and other interested federal, state, and local agencies by the fall of 2013.

We continued our partnership with the University of New Hampshire (UNH) and Mass Bays to transplant eelgrass to Plum Island Sound, measuring transplant success of a variety of populations planted in a common garden experiment.

The eelgrass team began studying the potential benefits of replacing traditional chain moorings with flexible rubber rode moorings, known as "conservation moorings." Traditional chain moorings can destroy eelgrass beds as the chain sweeps the seafloor in circular patterns due to tidal and wind-driven currents. Ongoing monitoring of mooring scars in Manchester has shown gradual re-growth of eelgrass into the scars since moorings were changed to conservation moorings. In West Falmouth, seven moorings were changed to conservation moorings under a grant from the Atlantic Coastal Fish Habitat Program in 2013. We conducted initial monitoring and aerial photography of the site and plan to return for follow up monitoring and plantings in 2014. As with our site in Manchester, we expect full eelgrass recovery to take several years. We presented our initial findings at community events in West Falmouth and Salem hosted by the National Estuaries Program.

MarineFisheries continues to coordinate the Massachusetts Interagency Seagrass Group, an informal network designed to maintain and improve communications across researchers and managers involved with seagrass. The group regularly posts on Seagrass Soundings, the groups blog (seagrasssoundings.blogspot.com), and has increased authorship to include representatives from other organizations conducting eelgrass work.

Artificial Reefs

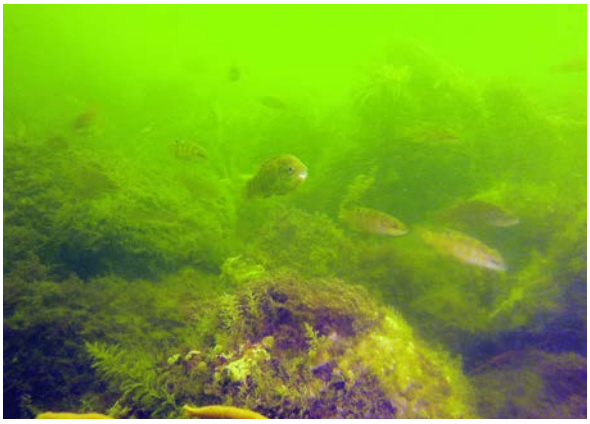

Figure 24. An artificial reef monitoring site.

Properly sited and constructed artificial reefs serve as hard bottom structured habitat for marine fish and invertebrate species and provide near-shore fishing opportunities for anglers. The Fisheries Habitat team has been collaborating with the towns of Harwich and Yarmouth since 2009 to acquire permits for creating a new artificial reef off the coast of Harwich and to reopen a previously permitted reef site off the coast of Yarmouth. Careful site selection work, engineering plans, and routine monitoring activities have been conducted at the 10-acre site approximately two miles off the coast of Harwich and the previously permitted 128-acre Yarmouth artificial reef site.

Consistent with the *MarineFisheries* Artificial Reef Plan, both sites will maintain a 2:1 ratio of structural footprint to undisturbed bottom and have a vertical profile of 3 – 6 ft to maximize fish habitat potential and edge area while minimizing the amount of habitat disturbance. Permits received in 2013 for both sites include Notices of Intent (NOI) filed with the local Conservation Commissions, Massachusetts Environmental Policy Act Secretaries Certificates, *Mass*DEP 401 Water Quality certifications, and *Mass*DEP Chapter 91 Waterways license. An Army Corps Individual Permit (IP) was filed in 2013 and was pending at year's end. Program staff also revisited permanent monitoring stations at all four state permitted artificial reef locations this year and installed bottom temperature monitoring stations at the sites. Monitoring sites are visited annually to document the presence of finfish, invertebrates, and invasive species (Figure 24).

Salt Marsh

Salt marsh vegetation is an important foraging and nursery habitat for many fish species. Docks are commonly built across marshes to protect the marsh while allowing access to a nearby waterbody. Current permit conditions require a specific height-to-width ratio under the assumption that it will protect the marsh from shading. In order to test this assumption, the habitat team constructed and installed a matrix of 24 docks set at different heights on a parcel of salt marsh in Marshfield wildlife management area to look specifically at the relationship between height and marsh health (Figure 25). Shading effects were quantified by monthly visual surveys and an end of season plot survey. After the first field season, salt marsh under docks that did not meet current height guidelines (2 ft docks) had already significantly declined. The dock study will be continued in 2014 to better assess longer term impacts. This project is funded by the Mass Bays Program.

Figure 25. Dock shading study site in Marshfield (left) and the footprint of a 2 ft dock after end-of-season removal showing loss of vegetation due to dock shading (right).

Climate Change Project

The Climate Change Project was created in 2010 with the goal of providing data and analysis regarding the effect climate change is having on fisheries and marine habitats in Massachusetts. In 2013, the Project convened a meeting of *MarineFisheries* Project Leaders to create an action plan to address the strategies and priorities previously identified for the project. The meeting identified three priority action items to address: 1) create an inventory of existing *MarineFisheries* data sets relevant to climate change research; 2) identify, develop, and publish data collection and storage standards for *MarineFisheries* climate data and; 3) begin to examine how to forecast fisheries shifts resulting from climate change. Project staff also joined several climate change-related committees in 2013, including the Gulf of Maine Climate Network's Sentinel Monitoring Project to provide input outlining *MarineFisheries* data collection efforts in the region, and the EOEEA's Climate Change Adaptation subcommittee to highlight the need to recognize and protect important recreational and commercial fisheries habitats and stocks while adapting to climate threats. Many other Division staff are involved with climate change related

activities as well, primarily focusing on changes associated with sea level rise and ocean acidification.

Other Activities

Offshore Wind Energy & Ocean Planning

There has been considerable focus on the development of offshore wind energy in recent years in Massachusetts. The Habitat Program has provided support and information to EOEEA as well as to the Bureau of Offshore Energy Management by participating in the Massachusetts Renewable Energy Task Force and the Joint Rhode Island-Massachusetts Renewable Energy Task Force. In preparation for the Massachusetts Ocean Plan update in 2014, the Program chaired the Fisheries Workgroup and participated in the Science Advisory Council and the Ocean Advisory Commission. New surveys and map products were developed to aid in Ocean Planning discussions. The Program also supported Division participation at the Northeast Regional Planning Body and the Northeast Regional Ocean Council Habitat Classification Working Group.

Outreach & Peer Review

Habitat Program staff provided scientific peer review for grants and manuscripts submitted to *Canadian Journal of Fisheries and Aquatic Sciences, Deep Sea Research II, Estuaries and Coasts, Marine Ecology Progress Series, Marine Environmental Research*, MIT SeaGrant, Atlantic Coastal Fish Habitat Partnership, and NOAA Habitat Conservation Division.

Publications were submitted to the *Journal of Fish Biology*, *Deep Sea Research II*, ASMFC's habitat hotline, the Massachusetts Association of Wetland Scientists, and *MarineFisheries* newsletter.

Habitat Program staff continued its tradition of participating in a variety of outreach events. Efforts included a panel discussion at the Massachusetts Association of Conservation Commissions, the Boston Boat Show, the Topsfield Fair, and Salem Sound Coastwatch events. We also organized presentations at Salem State University's Women in Science and Engineering Conference and gave presentations at local schools and colleges. Volunteers from Salem Sound Coastwatch and the New England Aquarium participated in two eelgrass restoration days in Salem Sound. Habitat Program staff also served on one graduate student thesis committee at the University of New Hampshire, supervised an undergraduate internship and thesis project at Endicott College, and gave lectures in university courses and seminar series, including Salem Sound Coastwatch's "Underwater in Salem Sound" community lecture series, Endicott College's Environmental Science course, and SMAST's geological oceanography course.

FISHERIES BIOLOGY SECTION

Dr. Michael Armstrong, Section Leader

Fish Biology Program

Personnel

Dr. Gary Nelson, Program Manager
Micah Dean, Senior Biologist
William Hoffman, Senior Biologist
Scott Elzey, Biologist
Brian Kelly, Biologist
Nicholas Buchan, Assistant Biologist
Brad Schondelmeier, Assistant Biologist
Jennifer Stritzel-Thomson, Assistant Biologist
Kate Rogers, Ageing Technician
Kimberly Trull, Ageing Technician

Overview

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

Age and Growth Project

In 2013, staff aged hard-part structures from recreational and commercial samples of American shad, bluefish (*Pomatomus saltatrix*), black sea bass, rainbow smelt (*Osmerus mordax*), river herring (alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*), striped bass, tautog, and winter flounder. Table 7 shows the number of samples processed.

Table 7. Samples processed for age in 2013; all samples were collected in 2013.

Species	Structure	Process	Quantity (Fish)
American Shad	Otoliths and Scales	Otoliths aged, scales checked for repeat spawning	268
Bluefish	Otoliths	Baked, Sectioned, Aged	133
Black Sea Bass	Otoliths and Scales	Cleaned, Mounted, Aged	511
Rainbow Smelt	Scales	Cleaned, Mounted, Aged	669
River Herring	Otoliths and Scales	Cleaned, Mounted, Aged	4,704
Striped Bass	Otoliths	Extracted, Sectioned, Aged	209
Striped Bass	Scales	Cleaned, Pressed	1,793
Tautog	Otoliths and Opercula	Cleaned, Sectioned, Aged	268
Winter Flounder	Otolith	Sectioned and Aged	1,105

Several species projects in which the Age and Growth Project was involved in 2013 are highlighted below.

Atlantic Cod: In conjunction with biologist Micah Dean, lab staff conducted a study to attempt to discriminate between winter and spring spawned Atlantic cod. It was determined that most cod can be separated into the two spawning populations by the diameter of the first annulus (Figure 26). The first annulus is larger on winter spawned cod because these fish have a whole year of growth before laying down this first ring, while fish spawned in spring have about six months of growth before the first annulus is laid down.

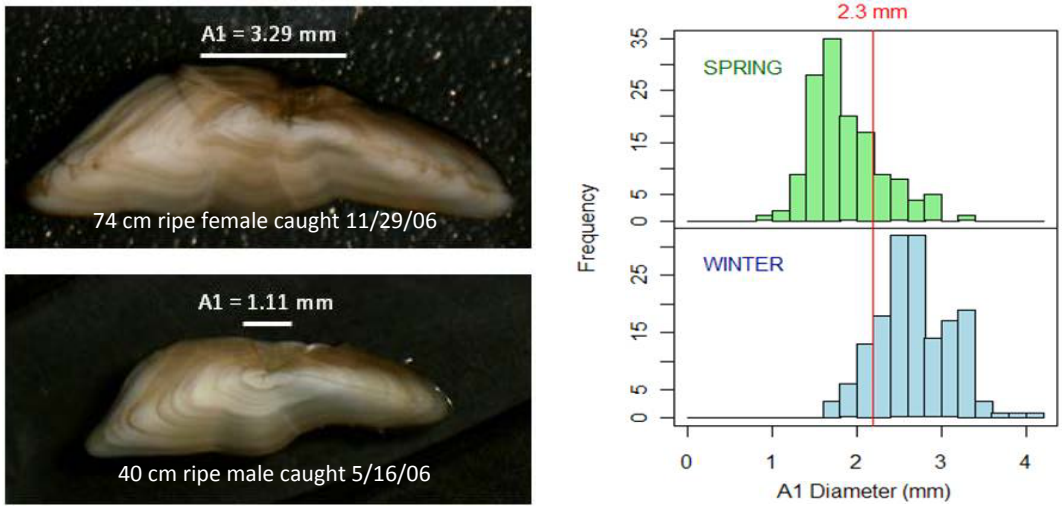

Figure 26. (Left) Otolith cross sections from two cod; the top image is from a winter spawned fish and the bottom image is from a spring spawned fish; note the difference in the size of the first annulus (A1). (Right) Most winter and spring spawned fish can be separated using a first annulus diameter measurement of 2.3 mm.

Striped bass: Otoliths and scales from striped bass were aged to track bias between the ageing methods. As fish grow older, growth increments on scales become compacted, making identification of annuli difficult. However, collecting scales from fish is non-lethal so it is

preferred in some situations. Lab staff aged 143 striped bass by both methods. Agreement between scales and otoliths was high until after age twelve (Figure 27).

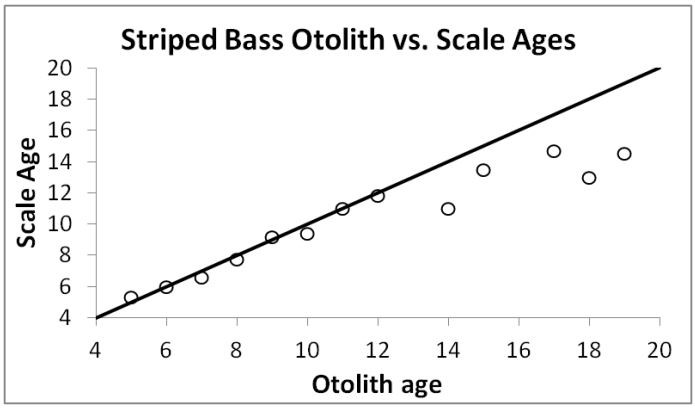

Figure 27. Comparison of average scale age versus otolith age. Bold line is the 1:1 line.

River herring: Aging of river herring increased substantially in 2013 due, in part, to extensive sampling of the Atlantic herring fishery's bycatch of these species. Lab staff processed these fish (n = 1300) by taking length, sex, genetic samples and otoliths, and aging a sub-sample. Alewife caught as bycatch ranged in age from 1 to 5 years, while blueback herring ranged in age from 1 to 6 years.

Tautog: The tautog age-validation study continued in 2013. Twenty-nine fish were held in captivity and were injected with oxytetracycline (OTC) in different body locations to determine the best injection site for obtaining clear OTC marks in the bony structures of tautog (Figure 28). The fish were held for six months before they were sacrificed and hard-part structures were examined.

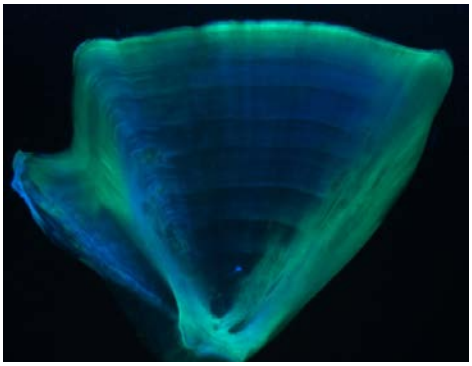

Figure 28. The green coloration in this tautog operculum is the mark left by the oxytetracycline.

Other activities: During the year, the age and growth laboratory staff trained ageing technicians from several state and federal laboratories, including USFWS and the Smithsonian Environmental Research Center, as well as a graduate student from the University of New Hampshire.

Laboratory staff also participated in two ASMFC-sponsored ageing workshops. In July, the staff hosted the black sea bass ageing workshop. In December, staff traveled to the Connecticut Department of Energy and Environmental Protection to participate in the river herring ageing workshop.

Fisheries Dependent Sampling Project

The Fisheries Dependent Sampling Project is responsible for the at-sea and shore-side sampling of catch and assessment of fishery performance from the commercial fisheries that occur in and

adjacent to Massachusetts territorial waters. The Project also executes other fish biology research studies and provides support to other projects and senior staff.

Commercial Fisheries Sampling

Project staff collects data and biological samples from commercial fisheries to document fishery performance, characterize the fishery for stock assessment research, and answer specific management questions. Data collected strengthens *MarineFisheries*' participation on – and contributions to – the fishery management councils and ASMFC.

In 2013, an in-house evaluation of the Project's port sampling component was conducted. Federal and state stock assessment biologists and participants of fishery plan development teams were contacted, and data needs were identified for all targeted and non-targeted species commercially caught by the Massachusetts commercial fishing fleet. Using this information, a sampling matrix was created and sampling priorities were identified. Five species that were not sampled in previous years were added to the priority list. These included: black sea bass, scup, tautog, bluefish, and longfin squid (*Loligo pealeii*). Port sampling of spiny dogfish, horseshoe crabs, whelks, Atlantic herring, and striped bass continued (Table 8).

Spiny dogfish landings were unusually erratic and low in 2013, due to collapse of the European dogfish market, providing limited opportunities to obtain samples. Chatham was the primary port of landings (over 60% of the total catch). The longfin squid fishery was also unusually slow with commercial landings reduced by 70% from 2012.

Table 8. Number of port sampling events, or trips, made to intercept vessels or dealers where information was successfully collected.

Species	Intercepts	Number individuals	Number age samples
Black sea bass	17	562	325
Bluefish	1	54	0
Horseshoe crab	2	113	0
Longfin squid	2	54	0
Northern shrimp	8	*	0
Scup	5	236	129
Spiny dogfish	17	821	0
Striped Bass	17	476	476
Tautog	5	220	0
Whelk	1	63	0

* Sampled in 2 kilogram batches

Regarding at-sea sampling, the Project's largest undertaking in 2013 was sampling the commercial lobster fishery (Table 9). Sea sampling on state lobster boats between May and November and was conducted out of seven ports: Rockport, Lanesville, Beverly, Boston, Provincetown, Orleans, and Chatham.

Project staff also provided sea sampling support to a collaborative study between The Nature Conservancy, the New England groundfish management Sector 10, and *MarineFisheries*. The study's goal was to characterize an Atlantic cod spawning aggregation that historically occurred

off of Scituate, with the intent to protect it from future disruption by the directed fishery. State samplers, as well as contracted personnel, conducted 13 trips on state and federal otter trawl and gillnet vessels, and collected biological information that will be used to identify the spatiotemporal distribution of spawning cod within the region.

Table 9. Summary of at-sea sampling efforts by Project staff in 2013.

Sea Days	Project
65	Lobster fishery (trap)
13	State waters groundfish (gillnet)
4	Summer flounder (trawl)
5	Longfin squid (trawl)
3	Conservation engineering
17	Acoustic telemetry studies
13	Resource assessment

Small Pelagic Fishery Dockside Monitoring and Avoidance System

MarineFisheries has conducted portside sampling of the Atlantic herring and mackerel (*Scomber scombrus*) fisheries since 2008 with the goal of quantifying catch composition and collecting biological information on landings to assist stock assessment and management. Beginning in 2010, data were further utilized to develop and implement a River Herring Bycatch Avoidance Program. Initially funded through the National Fish and Wildlife Foundation, this collaboration between the mid-water trawl Atlantic herring and mackerel fishermen, SMAST, and *MarineFisheries* was slated to end in 2013, but the award of the Atlantic herring Research Set-Aside by the NEFMC created funding for the next two years. In addition, The Nature Conservancy, who has funded a second River Herring Bycatch Avoidance Program with a group of Rhode Island-based bottom trawl herring fishermen since 2011, volunteered to fund both bycatch avoidance programs for 2014.

The goal of the program is to reduce the incidental catch of river herring (alewife and blueback herring) and American shad in the pelagic mid-water trawl (MWT) fishery and Rhode Island based small-mesh bottom trawl (RI SMBT) fisheries. Under the bycatch avoidance system, the fisheries' catch is sampled and bycatch rates by area are reported back to the industry, allowing vessels to make more informed decisions about where to fish in order to reduce river herring and shad bycatch.

In 2013, with the aid of a contracted observer, *MarineFisheries* sampled 176 trips (dockside): 62 MWT and 114 RI SMBT. Sampled landings totaled 13,541 metric tons from MWT vessels landing in Massachusetts ports and 2,212 metric tons from RI SMBT vessels. This represented roughly 26% of the entire fishery's landings from areas where river herring and shad bycatch is a concern (southern New England, Cape Cod, and Gulf of Maine). Length measurements were collected from 18,296 Atlantic herring, 6,244 alewife, 1,290 blueback herring, and 87 American shad. A sub-sample of river herring was provided to the Age and Growth Project for determining age-composition.

Bycatch rates were aggregated nightly and reported back to the fishermen using a grid system for each fishery (Figure 29). Twenty-seven instantaneous bycatch advisories and 19 weekly

sampling summaries were broadcast during the winter fishery, which ended in early April. Overall, river herring bycatch was higher (about 300 mt) in 2013 than in previous years, but was lower than the maximum observed (765 mt) in 2007. More vessels were integrated into the program in 2013, and by the end of the year, all active MWT vessels were openly communicating with the River Herring Bycatch Avoidance Program.

A peer-reviewed paper resulting from this collaborative work was accepted for publication in North American Journal of Fisheries Management and will be published in 2014:

Bethoney, N.B., Schondelmeier, B.P., Hoffman, W.S., Armstrong, M.P., Stokesbury, K.D.E. 2014 (in press). Characterization of river herring bycatch in the northwest Atlantic mid-water trawl fisheries. North American Journal of Fisheries Management.

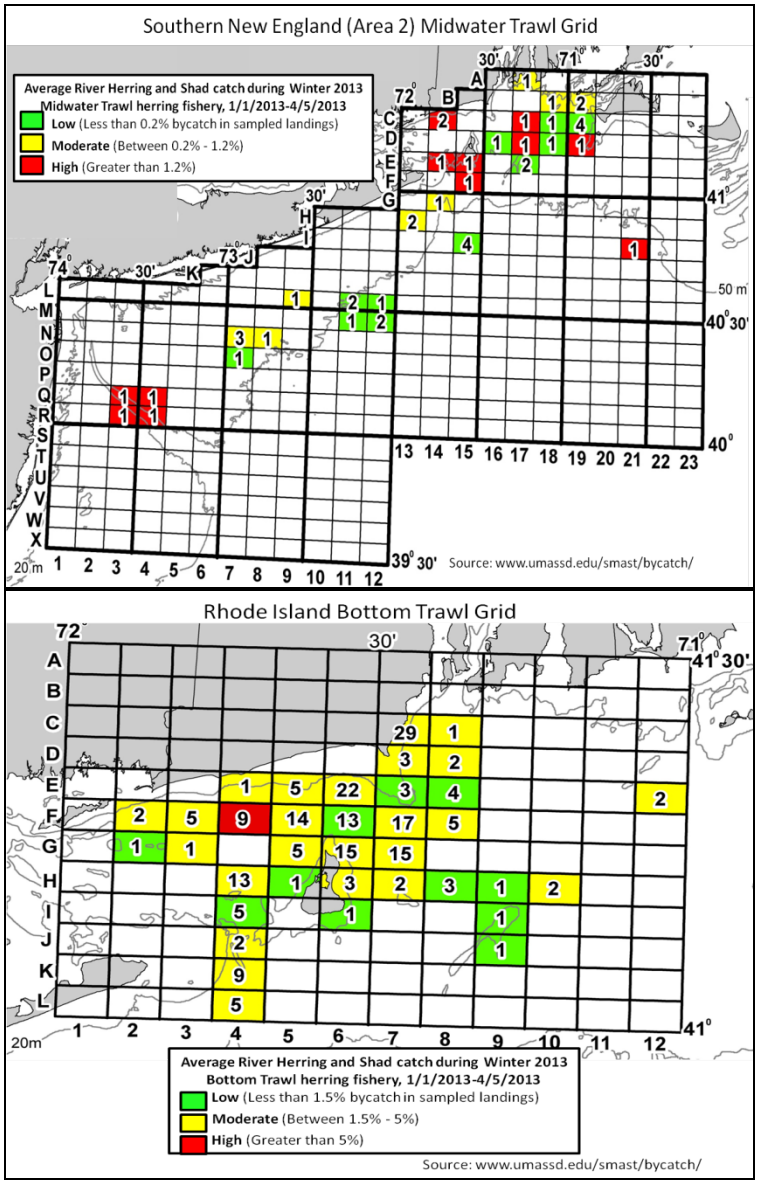

Figure 29. Plots of the bycatch levels and color coding system used to report information to the MWT fleet (upper) and RI SMBT fishery (lower).

Special Fisheries Research Projects

Atlantic Cod Spawning Activity

Project biologists continued their investigations into the spawning activity of Gulf of Maine cod in 2013. During the spring spawning season, a total of 36 cod were tagged with acoustic transmitters and released in the Spring Cod Conservation Zone (SCCZ). Their movements were tracked in non-real-time using three separate arrays of acoustic receivers: SCCZ (6 receivers), Whaleback (13 receivers), and Eagle Ridge (six receivers). The goal of this project is to describe the connectivity between spawning grounds within the genetically related spring spawning sub-population. Furthermore, given the strong spawning site fidelity of cod and the extended battery life of transmitters (up to six years), detections of tagged fish that return in subsequent seasons will be used to describe the inter-annual variability in spawning behavior. The information provided by this research informs the design of effective conservation measures by determining the appropriate size and duration of seasonal fishery closures. Results from this research initiative were presented at two scientific conferences in 2013: a meeting of the American Institute of Fisheries Research Biologists in August, and the ICES Gadoid Symposium in New Brunswick in October.

Two peer-reviewed papers resulting from this work were published:

Armstrong, M.P., M.J. Dean, W.S. Hoffman, D.R. Zemeckis, T.A. Nies, D.E. Pierce, P.J. Diodati, and D.J. McKiernan. 2013. The application of small scale fishery closures to protect Atlantic cod spawning aggregations in the inshore Gulf of Maine. Fisheries Research *141:62-69*

*Hernandez, K.M., D. Risch, D.M. Cholewiak, M.J. Dean, L.T. Hatch, W.S. Hoffman, A.N. Rice, D. Zemeckis, and S.M. Van Parijs. 2013. Acoustic monitoring of Atlantic cod (*Gadus morhua*) in Massachusetts Bay: implications for management and conservation.* ICES Journal of Marine Science *70:628-635*

In addition, three manuscripts were reviewed and accepted at high-profile scientific journals:

*Dean, M.J., W.S. Hoffman, D.R. Zemeckis, and M.P. Armstrong. 2014. Fine-scale diel and gender-based patterns in behaviour of Atlantic cod (*Gadus morhua*) on a spawning ground in the Western Gulf of Maine.* ICES Journal of Marine Science*.*

*Zemeckis, D., M. Dean, and S. Cadrin. 2014 (in press). Spawning dynamics and associated management implications for Atlantic cod (*Gadus morhua*).* North American Journal of Fisheries Management.

*Zemeckis, D., W. Hoffman, M. Dean, and M. Armstrong. 2014 (in press). Spawning site fidelity by Atlantic cod (*Gadus morhua*) in the Gulf of Maine: implications for population structure and rebuilding.* ICES Journal of Marine Science*.*

Building on the successes of our work with spring spawning cod, an additional research project was initiated to investigate the spawning activity of winter spawning cod. This initiative is a collaborative effort between *MarineFisheries,* the Nature Conservancy, SMAST, Stellwagen Bank National Marine Sanctuary, and NOAA. While less is known about the behavior of winter spawning GOM cod, there is substantial evidence of spawning events that occur in Massachusetts Bay between Boston and Plymouth. Currently, only the state waters portion of this area (WCCZ) offers protection to spawning cod from harvest and fishery-induced disruption. In recent years, an intense fishery has developed in adjacent federal waters to capitalize on

these aggregations of spawning fish. Fishermen from the port of Scituate approached us early in the year, requesting assistance in collecting objective information to serve as the basis for a seasonal protection measure to prevent the extirpation of this unique spawning group. To achieve a broad view of the spawning activity in this area, a large number of acoustic transmitters were released (n=150), along with a widely spaced array of 32 receivers. In addition, five passive acoustic monitoring devices were deployed to record the vocalizations produced by male cod during spawning. This technique has been used previously to provide a measure of the seasonal and diel intensity of a spawning aggregation (Hernandez et al., 2013). Lastly, *MarineFisheries* biologists were able to make at-sea observations of over 1,200 cod from 11 commercial fishing trips during the winter spawning season, providing critical information about the maturity and sex ratio of cod captured by the commercial groundfishing fleet.

Atlantic Cod Post-Release Mortality

To fill critical void of information, *MarineFisheries* biologists, in partnership with the New England Aquarium, SMAST, and the University of New England, embarked on a research project to provide a more accurate estimate of the post-release mortality of recreationally caught cod. Past assessments assumed 100% post-release mortality of recreationally caught sub-legal fish even though many biologists believed it is much lower.

During the summer season, when recreational post-release mortality is expected to be highest, a total of 150 cod from below and just above the minimum size limit were caught and affixed with acoustic transmitters. Two gear configurations were evaluated: jigs and baited hooks, in addition to a suite of potential mortality predictors (e.g., depth, water temperature, handling time). A dense array of 31 acoustic receivers was maintained for over three months, allowing us to monitor their post-release activity. Movement between receivers, as well as depth sensor information from each tag, allowed for the determination of post-release mortality under natural conditions and over an extended period of time. Additionally, over 400 recreational fishermen were interviewed to determine the composition of gear types used by the recreational cod fishing fleet. The methods used to estimate post-release mortality under this project represent a vast improvement over previous attempts and the resulting information will be incorporated directly into future stock assessments.

Striped Bass Research Project

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

Survival Tagging Study

MarineFisheries joined the Striped Bass Cooperative State-Federal Coast-wide Tagging Study in 1991. The study's primary objective has been to develop an integrated database of tag releases

and recoveries that will provide current information related to striped bass mortality and migration rates. During 2013, Striped Bass Research Project staff conducted 15 trips aboard contracted vessels, tagging a total of 488 striped bass. Trip data were entered into appropriate databases. Annual post-release survival of striped bass (28 inches and greater) tagged in Massachusetts waters has been relatively stable over the last decade, averaging 74%.

Market Sampling

Continued and improved monitoring of the age, size, and sex composition of the commercial harvest of striped bass is indispensable for identifying effective management and for substantiating estimates of mortality derived from fishery-independent sources. The objective of this project is to generate a time series database of biological characteristics of Massachusetts's commercial striped bass landings. During 2013, Striped Bass Research Project staff conducted 15 market sampling trips, collecting length, weight, and age structures (scales) from 427 commercially-caught fish. The size distribution of striped bass measured at wholesale dealers is shown in Figure 30.

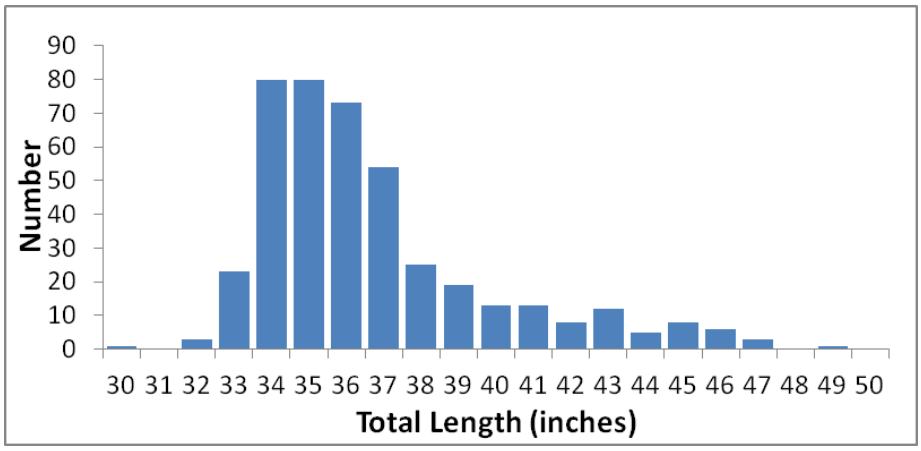

Figure 30. Size distribution of striped bass measured in fish houses during market sampling in 2013.

Acoustic Tagging Study

The Acoustic Tagging Study is a two-phase, multi-year effort to provide fisheries managers with information that can be used to enhance evaluations of striped bass fishing mortality and the impact of the prohibition on recreational striped bass fishing in federal waters (Exclusive Economic Zone – EEZ). The primary objective of the study is to determine if striped bass located in the EEZ, adjacent to Massachusetts, enter Massachusetts territorial waters. The secondary objectives are to identify the spatiotemporal patterns of local striped bass movements, confirm if the Cape Cod Canal is an important passageway for striped bass migration, and further investigate the temperature and depth preferences of migrating striped bass. The study ended in 2013 because all transmitters have turned off and fish returning are no longer detectable.

Two manuscripts based on the results of this study were submitted in 2013; both will be published in 2014.

Kneebone, J., W.S. Hoffman, M.J. Dean, and A.P. Armstrong. 2014 (in press). Movements of Striped Bass between the Exclusive Economic Zone and Massachusetts State Waters. North American Journal of Fisheries Management.

Kneebone, J., W.S. Hoffman, M.J. Dean, D.A. Fox, and A.P. Armstrong. 2014 (in press). Movement Patterns and Stock Composition of Adult Striped Bass Tagged in Massachusetts Coastal Waters. Transactions of the American Fisheries Society.

Volunteer Recreational Angler Data Collection Program

Implemented in 2002, the objective of the Sportfish Angler Data Collection Team (SADCT) program is to generate a time series database of biological characteristics of Massachusetts' striped bass recreational catch. During 2013, 27 participating anglers collected over 1,200 paired length/age samples from striped bass. The size composition of striped bass reported by participating anglers and fishing mode (shore versus boat fishing) is shown in Figure 31.

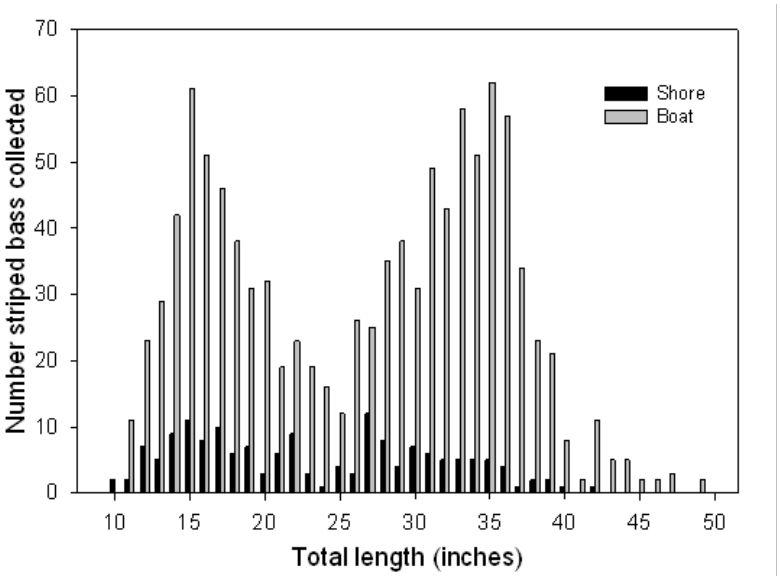

Figure 31. Size composition of striped bass collected by anglers participating in the SADCT program in 2013.

In 2013, the SADCT program was expanded to include black sea bass, scup, and fluke. In this first year, 75 samples from black sea bass, 10 samples from fluke, and 53 samples from scup were collected.

Eighteen anglers also registered to use the web-based *eLogbook* to submit trip information; they entered 364 length records on 14 species of marine fish including striped bass. Program staff prepared an annual report on the SADCT program for the contributing SADCT anglers and a ten-year retrospective analysis of the SADCT program that will be turned into a technical report. The striped bass carcass collection program continued in 2013 and obtained 156 otolith samples from volunteer anglers.

Chatham Area Aggregations of Striped Bass

Since 2011, dense aggregations of large striped bass have been forming east of Chatham during July and August. These schools occur in a small area close to shore and this proximity has caused commercial fishing effort to increase greatly in the area. *MarineFisheries* staff examined the stomach contents of 53 large striped bass from a local commercial fish house and found that sand lance (*Ammodytes* spp.) comprised about 73% of the diet by weight (Figure 32). Therefore, it is likely that striped bass are attracted to this area because of the high abundance of this prey.

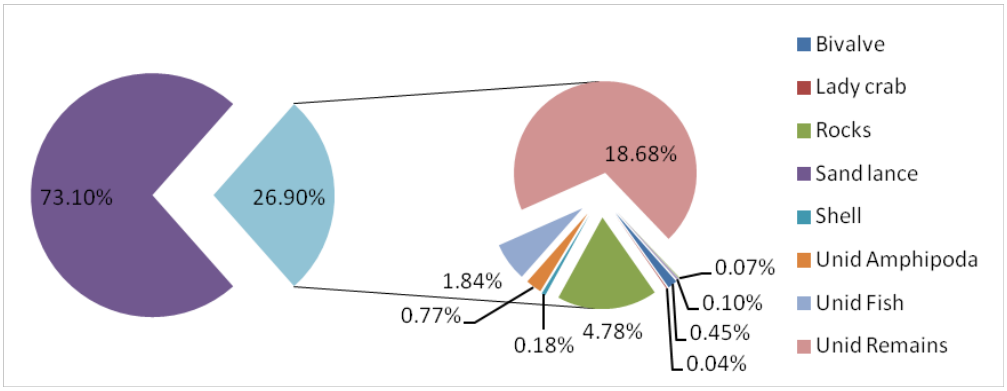

Figure 32. Diet composition of 53 striped bass captured off Chatham in 2013 by the commercial fishery.

Other Activities

Sportfisheries Technical Assistance

Fish Biology Program staff provide technical expertise to other governmental organizations, private groups, and individuals with concerns about marine fisheries and serve on technical and advisory committees to support management efforts of important marine species. In 2013, Dr. Gary Nelson served as the Massachusetts representative to the ASMFC's striped bass tagging, technical, and stock assessment sub-committees, and developed Visual Basic/AD Model Builder assessment models for striped bass. He conducted the entire benchmark stock assessment for the ASMFC and defended the assessment during the peer-review process at NOAA Fisheries' Northeast Fisheries Science Center. In addition, he developed several new analytical functions related to cluster sampling in fisheries research for his R statistical package, *fishmethods*. Micah Dean served on the ASMFC menhaden technical committee and multispecies committee. William Hoffman served on the ACCSP bycatch and biological sampling priorities committees.

Publications

In addition to the publications previously mentioned, Dr. Gary Nelson contributed a monitoring report of Massachusetts' 2012 striped bass fishery to the Division's Technical Report Series (#55).

Assessment and Survey Program

Personnel

Steven J. Correia, Program Manager

Resource Assessment Project
Jeremy King, Senior Biologist
Matthew Camisa, Biologist
Vincent Manfredi, Biologist

Invertebrate Fisheries Project
Robert Glenn, Project Leader
Vin Malkoski, Senior Biologist
Derek Perry, Biologist
Tracy Pugh, Biologist
Kelly Whitmore, Biologist
Steve Wilcox, Assistant Biologist
Mike Trainor, Seasonal Fisheries Technician

Protected Species Project
Erin Burke, Protected Species Specialist

Scientific Diving Project
Vin Malkoski, Diving Safety Officer

Overview

The Assessment and Survey Program includes the Resource Assessment Project, Invertebrate Fisheries Project, Protected Species Project, and Scientific Diving Project.

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

The **Invertebrate Fisheries Project** focuses on research and monitoring of commercially important marine invertebrates including American lobster, horseshoe crab, whelk, Jonah crab (*Cancer borealis*), and northern shrimp (*Pandalus borealis*). 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 for key invertebrate species.

The **Protected Species Project** is involved in a variety of activities related to the conservation and management of protected species in Massachusetts waters. In 2013, this covered 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. In addition,

project staff oversees and participates in work on other protected species, such as harbor porpoise and sea turtles. In 2013, these activities covered a range of issues such as the sea turtle disentanglement network, ghost gear removal, subtidal aquaculture, participation in federal Take Reduction Teams, and general grant management.

The **Scientific Diving Project** is responsible for the safe management of the scientific diving activities conducted by *MarineFisheries*. Operated in accordance with the Occupational Safety and Health Administration's scientific diving exemption, formal standards for training and dive operations afford *MarineFisheries*' divers better protection from accidental injury and/or illness. Since the Dive Project's inception, diving within *MarineFisheries* has markedly increased and contemporary diving and risk management procedures are warranted.

Resource Assessment Project

2013 Trawl Survey

The 36th spring and fall surveys were accomplished aboard the R/V *Gloria Michelle*. During the spring survey, 100 stations were completed in 17 consecutive days from May 6-22. During the fall survey, 98 stations were sampled successfully from September 3-20 (Figure 33).

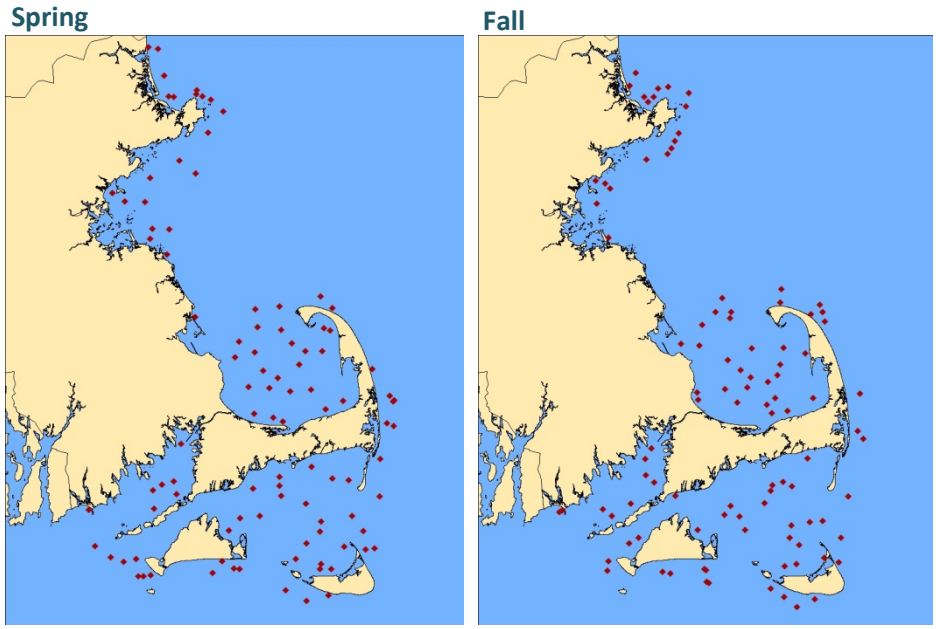

Figure 33. 2013 spring and fall trawl survey station locations.

A total of 99 different species of fish and invertebrates were weighed, counted, and measured during the 2013 trawl surveys (including the first catch of cownose ray, *Rhinoptera bonasus*, and sharksucker, *Echeneis naucrates)*. To aid cooperative fisheries assessments, over 2,600 scale/otolith samples and sex and maturity observations were taken from Atlantic cod, haddock, summer flounder, yellowtail flounder, winter flounder, windowpane flounder (*Scopthalmus aquosus*), black sea bass, and scup.

Project personnel contributed to committee work of the ASMFC's Northeast Area Monitoring and Assessment Program (NEAMAP), including presenting at and participating in the NEAMAP

Data Management Committee's –Onboard Data Practices Workshop in Woods Hole, Massachusetts. *Marine Fisheries* staff also presented an annual update of trawl survey practices and results to the NEAMAP Board at the annual meeting of the ASMFC. Project members serve on the following committees of NEAMAP: Operations, Data Management, and Trawl Technical.

2013 Seine Survey

The 38th Nantucket Sound Estuarine Winter Flounder Young-of-Year (YOY) Seine Survey was completed from June 17 – July 5, 2013. The primary objective of this survey is to index winter flounder YOY abundance for the Southern New England stock; however, all commercially and recreationally-important finfish and invertebrates are counted. All species not counted are noted for presence.

The 2013 stratified mean (all estuaries combined) winter flounder YOY index was the highest observed since 2000 and is above the time series median (Figure 34). A total of 43 species was encountered in seine hauls, including the pinfish, *Lagodon rhomboides*, a southern fish encountered for the first time in 2012. One new species was captured this survey, the barrelfish, *Hyperoglyphe perciformis.*

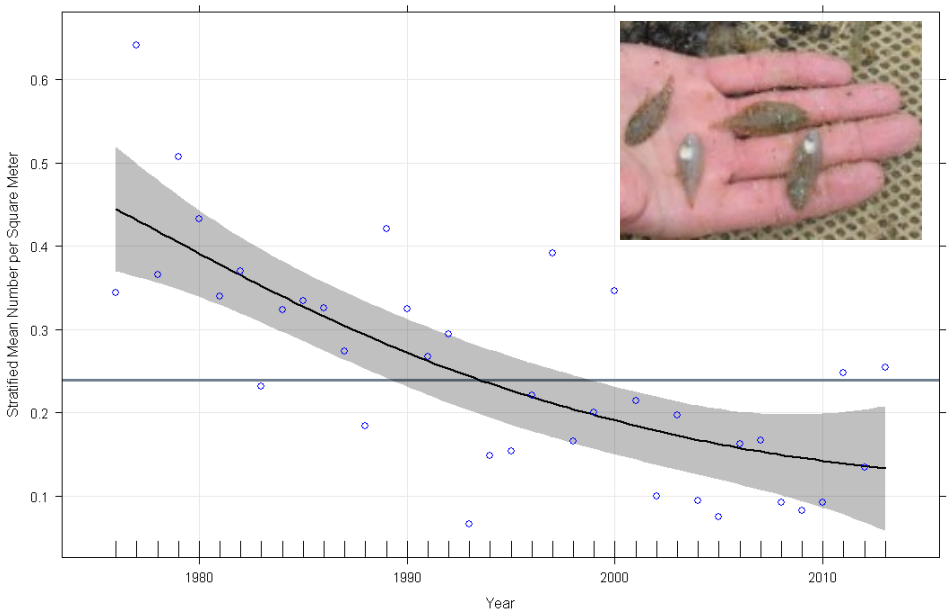

Figure 34. Abundance index for YOY winter flounder, *Pseudopleuronectes americanus,* in Southern New England from the seine survey, 1976-2013 (black line = GAM fit; grey line = time series median). Inset: YOY winter flounder captured in the seine survey.

Assessment and Fisheries Management Support

Project personnel fulfill requests for survey data to support various fisheries research, monitoring, and management initiatives both within the Division and at other government, consulting, and academic institutions. In 2013, survey data provided to *MarineFisheries* senior managers helped inform state-waters management considerations for whelk, black sea bass, groundfish, and the small-mesh trawl fishery. As in years past, survey data were provided to staff for inclusion in annual compliance reports for ASMFC-managed species. Survey data

supported regional assessment or review processes of lobster, horseshoe crab, summer flounder, scup, butterfish (*Peprilus triacanthus*), and black sea bass in 2013.

Project staff contributed to the five-year review and update of the Massachusetts Ocean Management Plan, initiated in 2013. Staff represented *MarineFisheries* on the Fisheries Workgroup, and generated 46 trawl survey indices to update the "important fish resource area maps", a primary product of the workgroup's report. In addition, catch data for every available cruise, station, and species were compiled for the development of species and season specific stratum assessment maps as an added ocean planning tool.

Additional survey data requests from outside institutions fulfilled in 2013 supported studies related to: salt marsh decline, cod distribution, cod and dogfish predator/prey interactions, squid abundance, and power plant impacts.

Invertebrate Fisheries Project

Commercial Lobster Trap Sampling

The 33rd year of Commercial Lobster Trap Sampling was completed. This is an ongoing cooperative effort conducted with Massachusetts commercial lobster fishermen dating back to 1981. A total of 92 trips were conducted in 2013, during which 51,824 lobsters were sampled from 17,705 trap hauls. This effort also includes shell disease monitoring, which tracks the incidence of shell disease symptoms on lobsters in Massachusetts coastal waters. In 2013, a total of 8,421 lobsters were sampled for incidence of shell disease. Sampling data contributed to *MarineFisheries*' bi-annual lobster status of the stock report, and were provided to the ASMFC and ACCSP.

Ventless Lobster Trap Survey

For the first time in eight years, the Ventless Trap Survey did not take place due to lack of funding. Staff focused on data management and analysis, and manuscript development, in 2013. Data from the original survey years (2004 – 2006 Mass Bay survey, and 2005 – 2006 Buzzards Bay survey) were thoroughly reviewed for quality control and compiled into a master database with the more current 2006 – 2012 Coastwide Ventless Trap Survey dataset. Manuscripts under development primarily focused on lobster demographics.

A technical report was drafted covering the Coastwide Ventless Trap Survey relative abundance time series and detailed catch characteristics from the 2006 – 2012 survey periods; it will be submitted to the *MarineFisheries* Technical Report Series.

Staff also prepared a final report for the Commercial Fisheries Research Foundation (CFRF), the funding source for part of the 2011-2012 ventless survey. Analysis of data from an expanded Southern New England survey area led to a recommendation to continue the ventless trap survey at the expanded spatial extent in the future. These and other findings were presented at the CFRF's Research Session on lobster, scallop, and whelk in Kingston, Rhode Island in November, and in a poster at the International Collaborative Research Summit hosted by CFRF in Narragansett Beach, Rhode Island in October.

For the first time, data from the Ventless Trap Survey are being used in a separate index of relative abundance in the ASMFC Lobster Stock Assessment. Staff assisted ASMFC with the development of a master database to house survey data from multiple participating states.

Annual Early-Benthic-Phase Lobster Suction Sampling

The 19th year of *MarineFisheries'* Annual Early-Benthic-Phase Lobster Suction Sampling Program was completed. A total of 23 coastal sites were surveyed in 2013 spanning Buzzards Bay, Cape Cod Bay, Massachusetts Bay, and the South Shore near Scituate. This included two new stations along the South Shore to close spatial gaps in the survey and better monitor recruitment signals in Massachusetts waters.

Project staff conducted the SCUBA-based survey over 13 field days from mid-August to late-September (Figure 35). Mean densities of YOY lobsters in all survey regions were below time series means with the exception of Buzzards Bay (Table 10). The increase in the number of lobsters just over traditional YOY size bins (3-12 mm north of Cape Cod, 3-13 mm south of Cape Cod) has led to new discussions about expanding the size definition of YOY lobsters. New information suggests that hatch timing has changed in response to recent increases in water temperature. Earlier egg hatch would provide YOY lobsters more time to molt/grow before being collected in the survey.

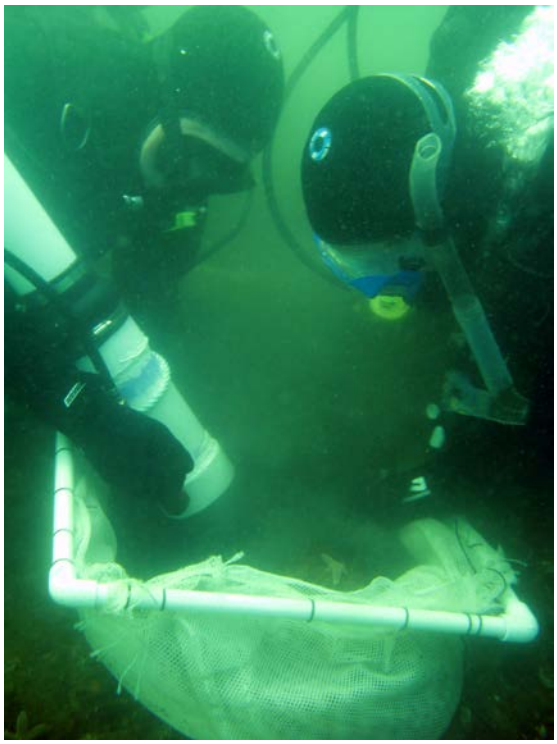

Figure 35. Division divers conducting suction sampling for early benthic phase lobster.

Table 10. Comparison of YOY lobster densities in 2013 and time series means by region.

Area	2013 Mean (3 -16mm YOY)	Time Series Mean (3-16mm YOY)	# Years
Cape Ann	0.50	0.90	4
Salem Sound	0.11	0.77	18
Boston	0.00	0.17	17
South Shore	0.12	0.40	2
Cape Cod Bay	0.17	0.33	19
Buzzards Bay	0.17	0.09	19
Vineyard Sound	0.00	0.03	4

Lobster Reproduction Studies

Tracy Pugh continued collaborative work with the University of New Hampshire (UNH) to conduct research on lobster reproduction as part of her PhD dissertation. Working with UNH professor Dr. Win Watson, Pugh has conducted field and laboratory work that examines how

male lobsters may be limited in their ability to supply sperm to females, with the end goal of characterizing male contributions to reproductive success and effects on stock dynamics. Two manuscripts on the field components of this work have been submitted and published (a third is in preparation):

*Pugh, T.L., J.S. Goldstein, K.L. Lavalli, M. Clancy, and W.H. Watson III. 2013. At-sea determination of mating activity in female American lobsters (*Homarus americanus*): Patterns vs. expectations.* Fisheries Research*, 147: 327 - 337.*

Goldstein, J.S., T.L. Pugh, E.A. Dubofsky, K.L. Lavalli, M. Clancy, and W.H. Watson III. 2014. A non-invasive method for in-situ determination of mating success in female American lobster. Journal of Visualized Experiments*, 84.*

Work in 2013 focused on data analysis. Pugh worked in collaboration with scientists M. Comeau and K. Benhalima from the Canada Department of Fisheries and Oceans (DFO) on histological processing of male spermatophores that represent the results from three separate laboratory experiments. Digital images of histological section slides are being analyzed to describe the size and contents of the spermatophore (Figure 36).

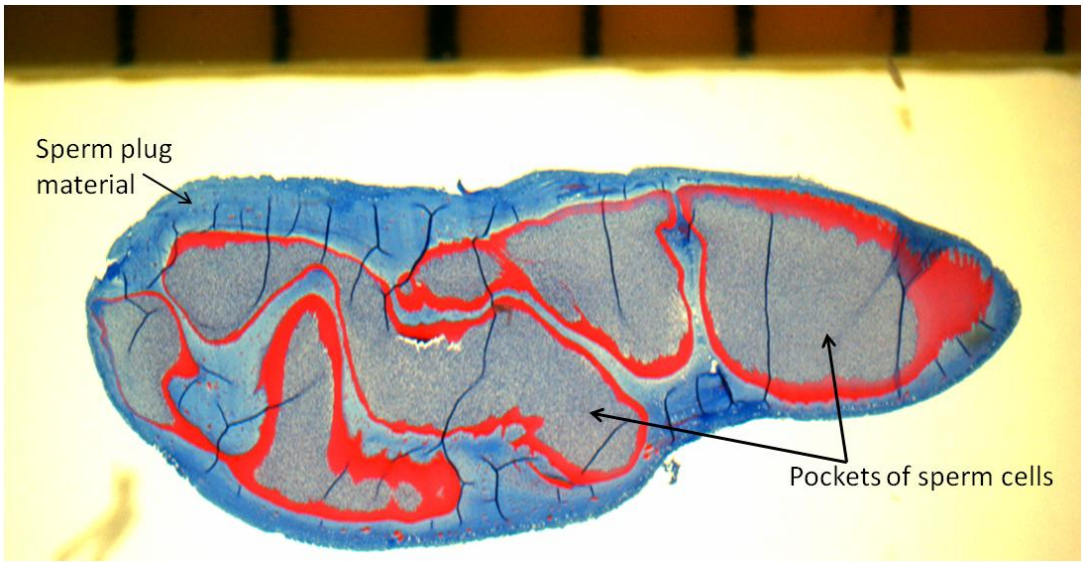

Figure 36. Histological section of a male lobster's spermatophore, showing multiple pockets of sperm cells contained within material that hardens into a sperm plug.

Northern Shrimp Survey and Assessment

Northern Shrimp Assessment Survey: In July and August, *MarineFisheries* staff participated on several one-week legs of the annual northern shrimp assessment survey conducted throughout the Gulf of Maine aboard the NOAA Ship R/V *Gloria Michelle*. The 2013 survey indicated record low abundance of all stages of shrimp, including new recruits and shrimp which will be fully-recruited to the fishery in the upcoming fishing season (Figure 37). The ASMFC Technical Committee recommended a 2013/2014 harvest moratorium based on survey and assessment model results, and noted that recently-observed unfavorable water temperatures may contribute further to poor recruitment.

Figure 37. Male and female stages of northern shrimp sampled in the annual Northern Shrimp Assessment Survey.

Commercial Fishery Sampling: An interstate harvest moratorium was erected for the 2013/2014 northern shrimp fishing season; consequently, no sampling of commercial catch was conducted by *MarineFisheries* staff.

Assessment and Management Support: Project staff helped prepare the 2013 ASMFC Northern Shrimp Stock Assessment and, as Chair of the ASMFC Northern Shrimp Technical Committee, presented the assessment to the ASMFC Northern Shrimp Section. Project staff also participated on the ASMFC Northern Shrimp Plan Development Team, analyzing commercial catch and effort data in exploration of developing a possible limited access system for the fishery.

Whelk Studies

Figure 38. Channeled whelk, *Busycotypus canaliculatus.*

MarineFisheries continued investigating the commonwealth's whelk fisheries (Figure 38). In collaboration with the University of Massachusetts Dartmouth, Project staff concluded a two-year maturity study of channeled whelk. Staff prepared and submitted the final report to the study's funding source, Commercial Fisheries Research Foundation. Staff also conducted a maturity study on knobbed whelk. Results indicate no female knobbed whelk are mature at the minimum legal size of 2 ¾ inch width, similar to findings for the channeled whelk. The combined findings from these maturity studies led to two ⅛ inch gauge increases for 2014 and 2015 to protect more spawning stock. Staff also conducted at sea sampling aboard commercial vessels as well as market sampling with fisheries dealers. Since fishermen and dealers report only in poundage, sampling provides essential information about the size distribution of the catch.

Horseshoe Crab Monitoring

Commercial Fishery Sampling: Monitoring of the commercial bait and biomedical harvests continued in accordance with the ASMFC Horseshoe Crab FMP. Lunar-based harvest closures (five days around new and full moon periods) in May and June were supplemented in 2013 by the addition of closures during the second lunar period in April. Prosomal width measurements were obtained from 1,040 crabs during sampling at local dealer and biomedical facilities. In addition, prosomal width measurements were obtained from 114 crabs during sea sampling trips of weirs and a trawl vessel in Nantucket Sound (Figure 39). The median prosomal width for male crabs was consistent, with the 13-year median value of 20 cm for males. The median width for females was similar to that observed in 2011 and 2012 (24 cm), which is 2 cm smaller than the 13-year median value for females.

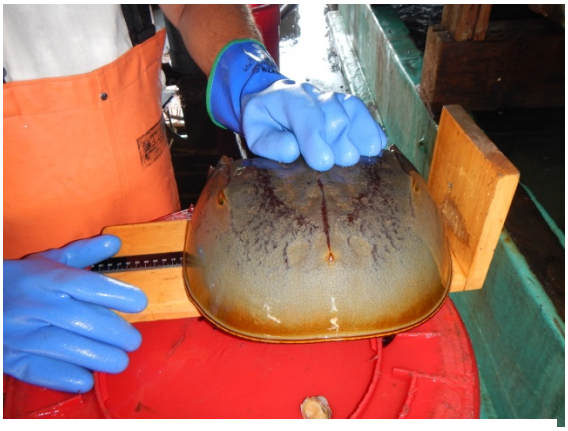

Figure 39. Measuring a horseshoe crab during sea-sampling

Spawning Surveys: Annual volunteer-based spawning surveys continued at multiple beaches along the South Coast, Cape Cod, and the islands. Relative abundance of spawning crabs remained low on the beaches and remains a concern. Possible explanations include changes in horseshoe crab spawning activity (e.g., an increase in sub-tidal spawning due to harvest pressure or other human activities, such as coastal development). In addition, review of the landings data suggests that harvesters have adapted to the closure periods by shifting their effort to the open days within these months. Lunar closures will continue during the 2014 spawning season and *MarineFisheries* will investigate different survey techniques and additional management actions.

Jonah Crab

While half of the Jonah crab catch in the U.S. is landed in Massachusetts, the species has traditionally been considered a bycatch from the American lobster fishery (Figure 40). However in 2013, the value of this fishery substantially increased and it was the seventh most important fishery in Massachusetts: over 10 million pounds worth roughly $9.1 million. An increase in price has led to a steady increase in landings (Table 11). The growth of this fishery has drawn the attention of industry stakeholders with whom *MarineFisheries* has teamed with to develop a Fisheries Improvement Plan (FIP) to promote the sustainable harvest of Jonah crab. The FIP working group, consisting of fishermen, processors, seafood dealers, retailers, non-governmental organizations, academia, and government agencies, met in the New Bedford *MarineFisheries* office twice in November to discuss industry

Figure 40. A tote of Jonah crabs

concerns, research needs, and the future of the fishery. *MarineFisheries* plans to initiate a port sampling program in 2014 to collect biological data from the commercial fishery.

Table 11. Landings and value of Jonah crabs landed in Massachusetts (from dealer reports).

Year	Live Pounds	Est. Value	Price/lb.
2005	3,663,582	$2,017,215	$.055
2006	3,614,261	$1,792,316	$0.50
2007	4,118,477	$2,393,498	$0.58
2008	4,478,505	$2,652,304	$0.59
2009	4,869,605	$2,769,169	$0.57
2010	5,689,431	$3,211,302	$0.56
2011	5,379,792	$3,648,497	$0.68
2012	7,540,392	$5,573,252	$0.74
2013	10,096,633	$9,111,707	$0.90

Bottom Temperature Monitoring

The Invertebrate Fisheries Project maintains nine permanent temperature monitoring stations in water between 5 and 30 meters deep from Boston Harbor to Southern Buzzards Bay (Figure 41). Monitors are usually deployed in the summer and record data every 30 minutes until they are retrieved the following summer. Many of the stations have been collecting temperature data for over 25 years, making these data sets among the longest running bottom temperature time series in the northeast. Data from these monitors are valuable in detecting environmental change in Massachusetts waters. Bottom temperatures from Southern New England have shown a warming trend and are correlated with changes in population dynamics of some cold-water species, including American lobster.

MarineFisheries SCUBA divers retrieved and replaced data loggers at all nine stations during the summer of 2013. The monitors contained data from the fall of 2012 through the summer of 2013. South of Cape Cod, many record high temperatures were broken in 2012, including the highest daily mean temperature at Sippiwissett (26.2°C breaking the 2002 high of 25.7°C), Buzzards Bay Barge (21.2°C breaking the 2010 high of 20.3°C), and Cuttyhunk (22.4°C breaking the 2010 high of 21.3°C). In addition, the Buzzards Bay Barge station had 28 days with a daily mean above 20°C in 2012, compared to a combined total of 10 days from 1989-2011. Prior to 2012, there were only two years where daily means were above 25°C at Cleveland Ledge, 1988 (10 days) and 1994 (6 days); there were 13 days above 25°C at Cleveland in 2012. Water temperatures north of Cape Cod also showed a warming trend, though 2012 was not as anomalously warm as south of Cape Cod. Coast-wide data through the summer of 2013 shows temperatures to be generally above average, though not as warm as 2012. However, the Sippiwissett daily mean temperature was broken again in 2013 (26.6°C).

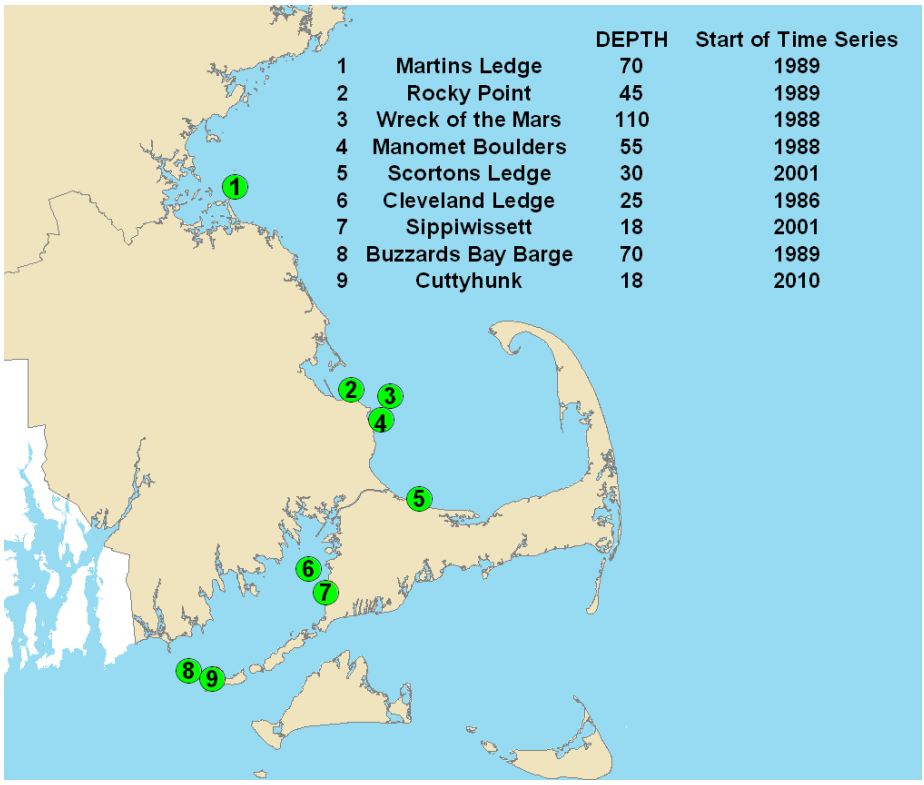

Figure 41. Map of temperature monitoring stations (depth given in feet).

Protected Species Project

Cape Cod Bay Right Whale Surveillance Program

In 2013, *MarineFisheries* partnered with the Provincetown Center for Coastal Studies (PCCS) and NOAA Fisheries to carry out the 15th year of the Cape Cod Bay Right Whale Surveillance Program. The program conducts aerial surveillance and habitat monitoring of right whales in Cape Cod Bay Critical Habitat. Project staff managed the grant associated with this work.

The trend of increased abundance of right whales in Cape Cod Bay (CCB) seen since 2007 continued in 2013. We documented 241 individual right whales in CCB and adjacent waters (Figure 42) – approximately 47% of the known population (510 whales). Of the 20 calves born in 2013, 10 of them were documented with their mothers in CCB. The number of whales observed in 2013 was consistent with the pattern of high abundance seen since 2007. The length of the season when right whales were present was also consistent with previous years; however, there were some unusual features of the 2013 season.

Firstly, a right whale mother/calf pair was spotted in shallow water off Plymouth in mid-January, the earliest such sighting in Cape Cod Bay; the previous earliest sighting was March 26, 2001. The physical characteristics of the calf indicated it was only a week or two old, meaning it was likely born in the Northeast and possibly in Cape Cod Bay itself. Secondly, right whales were also unusually abundant in the western portion of the bay, even aggregating outside the boundary of the Critical Habitat. Project staff issued two public advisories to mariners about right whale aggregations in Western Cape Cod Bay and the potential for vessel collisions. Habitat monitoring

in 2013 revealed dense zooplankton in the western part of the bay which was responsible for the shift in distribution.

Figure 42. Map of 2013 right whale sightings (PCCS aerial data)

Large Whale Disentanglement Network

MarineFisheries and the PCCS cooperatively administer the large whale disentanglement efforts around Massachusetts through a grant from NOAA Fisheries. During 2013, an unusually low number of whale entanglements occurred, likely due to the redistribution of whales, in particular humpback whales which spent the season further offshore and away from observers. Also unusual was the documentation of two right whale entanglements in the Mid-Atlantic in the summer, when the majority of the population is in Atlantic Canada. PCCS staff documented nine new entanglement cases off the coast of Massachusetts – two right whales, five humpback whales, and two minke whales. Only one of these cases was able to be fully resolved, a humpback that was disentangled. The origin of those entanglements is unknown. Project staff from *MarineFisheries* performed grant management and assisted in investigating gear retrieved from entangled animals.

Leatherback Sea Turtle Disentanglement and Research

Seasonal visitors to Massachusetts waters, leatherback sea turtles (*Dermochelys coriacea*) are known to become entangled in vertical lines associated with fixed fishing gear (Figure 43). In response, *MarineFisheries* oversees and participates in sea turtle disentanglement with the PCCS since 2005. Project Staff assisted in disentanglement efforts, gear analysis, and performed all grant management activities.

In 2013, the number of turtle entanglement reports reached a record high with 52 confirmed cases, surpassing the prior record of 37 reports in 2012. These record high numbers are in

contrast to all previous years where an average of 15 entanglement events was documented each year.

Photo credit: PCCS

Figure 43. Leatherback sea turtle entangled in buoyline in Nantucket Sound.

NOAA Fisheries Vertical Line Reduction Plan

Through the Atlantic Large Whale Take Reduction Plan, NOAA Fisheries is pursuing a vertical line reduction strategy for fixed gear to reduce the risk of entanglement of large whales. Program staff assisted NOAA Fisheries and their contractor, Industrial Economics, in developing and evaluating the vertical line reduction plan. NOAA Fisheries released the Draft Rule in 2013 and accepted public comment on it. During this time, Project staff helped write comments for *MarineFisheries*, conducted outreach to the fishing industry on the reduction plan, and attended public hearings about the proposed rule.

Environmental Review of Massachusetts Wind Energy Area

State and federal agencies are assessing the area south of Martha's Vineyard and Nantucket for future offshore wind energy development. Project staff serves on the Massachusetts Habitat Working Group, which assists EEOEA, the 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. In 2013, this included participation at several meetings of the Habitat Working Group related to the results of the first year of monitoring for whales, turtles, and other marine life in the area.

Subtidal Aquaculture Projects

The potential for open water aquaculture grants to increase entanglement risk for whales and turtles warrants careful consideration when developing and licensing these projects, especially when they fall within the boundaries of Right Whale Critical Habitat. In 2013, Project staff provided guidance to *MarineFisheries* shellfish personnel and municipal shellfish authorities on the potential impacts of subtidal aquaculture projects for protected species, and participated in several meetings with the towns of Provincetown and Truro, PCCS staff, and growers to discuss ways to mitigate entanglement risk of subtidal aquaculture gear.

Harbor Porpoise Bycatch Reduction and Management

Project staff is a member of NOAA Fisheries' Harbor Porpoise Take Reduction Team. In 2013, activities included initiating and hosting two meetings of the Team to discuss options for a new strategy to estimate and reduce harbor porpoise bycatch. NOAA Fisheries assigned this task to the Team after discovery of numerous problems with the 2010 update of the Harbor Porpoise Take Reduction Plan related to assessing and managing potential biological removal, including changes in the fisheries, the switch to sector management, data gaps, and faulty bycatch thresholds. Additional Team meetings were also attended.

Outreach

Project staff conducts various outreach and education efforts on behalf of *MarineFisheries* on protected species issues in the Commonwealth. In 2013, many of these efforts focused on disentanglement and included a radio interview, two disentanglement training workshops with Cape Cod fishermen, and two presentations at Massachusetts Shellfish Officers Association trainings.

Scientific Diving Project

MarineFisheries' scientific divers conducted over 700 research dives to support on-going agency-wide 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; PCB monitoring sample collection; and dive program training. Routine program management duties include diver training, equipment maintenance and repair, and maintenance of the air system.

The Dive Project achieved a long-term goal in March, with the development of a reciprocity agreement between *MarineFisheries* and the EPA. This agreement allows divers from both agencies to participate in joint projects and research. Educational and outreach efforts to dive clubs, schools, and local dive shows continued throughout 2013.

Other Activities

The Assessment and Survey Program Manager served as a member of the NEFMC Groundfish, Monkfish, and Atlantic Herring Plan Development Teams and the Scientific and Statistical

Committee. As plan development member, he generated analyses to support development of Frameworks 49, 50, and 51 to the Groundfish FMP, Amendment 5 to the Atlantic Herring FMP, and Amendment 6 and Framework 8 to the Monkfish FMP. As member of the Science and Statistical Committee, he helped develop annual catch limit advice for groundfish stocks and sea scallops.

During 2013, the Program Manager continued to serve as chair of ASMFC Winter Flounder Technical Committee, and continued as a member of the ASMFC Herring Technical Committee, and Assessment Science Committee, and NEAMAP Analytical committee. He continued to provide technical assistance on sampling designs and statistical analyses on an as-needed basis to other *MarineFisheries* projects and graduate students. The program manager participated in the Boston Chapter of the American Statistical Association's Career in Statistic Day program. He also reviewed a manuscript for the Canadian Journal of Fisheries and Aquatic Sciences.

Robert Glenn served as chairperson for the ASMFC American Lobster Stock Assessment (due in 2014), and Tracy Pugh served on the committee as well. Specific work for the assessment entailed preparing all Massachusetts data inputs to the assessment and participating in multiple committee meetings to review lobster life history, data, and model inputs.

Glenn served on a steering committee for the Commercial Fisheries Research Foundation (CFRF) Lobster Research Fleet Pilot Project. This project is designed to explore and test new technologies that will enable lobstermen fishing in Lobster Management Areas 2 and 3 to collect and relay much-needed biological data to managers and scientists monitoring the lobster stock in these areas. He provided advice on survey design and sampling protocols to the program. Glenn and Pugh, along with Derek Perry, Kelly Whitmore, and Steve Wilcox, also participated in the International Collaborative Research Summit hosted by CFRF, where Glenn was invited to speak on data needs in American lobster stock assessment.

Invertebrate Fisheries Project staff members contributed manuscript reviews to the following journals: *Canadian Journal of Fisheries and Aquatic Sciences* and *Journal of Cytology and Histology*.

Wilcox successfully defended his master's thesis, "Size and Age at Maturation of the Channeled Whelk (*Busycotypus canaliculatus*) in Southern Massachusetts." He was awarded a Masters of Marine Biology from the University of Massachusetts Dartmouth on May 11, 2013. Perry successfully defended his master's thesis, "Feeding Ecology of the Smooth Dogfish *Mustelus canis* in Buzzards Bay, Massachusetts." He anticipates being awarded a Masters in Fisheries Oceanography from the University of Massachusetts Dartmouth in the spring of 2014.

Program staff participated in various outreach events, including the Massachusetts Lobstermen's Association Annual Weekend and the Topsfield Fair.

Recreational and Diadromous Fisheries Program

Personnel

Dr. Gregory B. Skomal, Program Manager

Recreational Fisheries Project
Paul Caruso, Senior Marine Fisheries Biologist, Project Coordinator
John Boardman, Marine Fisheries Biologist
Matt Ayer, Marine Fisheries Biologist
Ross Kessler, Public Access Coordinator
David Martins, MRIP Coordinator
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Large Pelagics Research Project
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Ben Gahagan, Marine Fisheries Biologist
Edward Clark, Carpenter
Luis Carmo, Laborer

Overview

The Recreational and Diadromous Fisheries Program includes the Recreational Fisheries Project, the Large Pelagics Research Project, and the Diadromous Fisheries Project.

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

Since 1987, the **Large Pelagics Research Project** has been conducting 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 goals of the Large Pelagics Research Program are to foster cooperative research; to participate in the state, regional, and federal management process;

and to provide public education and technical information on the biology, management, and utilization of highly migratory species.

The **Diadromous Fisheries Project** is comprised of two major initiatives: fish passage and restoration, and fish biology and management. The former is coordinated among *MarineFisheries* staff, state and federal agencies, municipalities, and private groups to facilitate, design, and execute restoration projects with the goal of enhancing diadromous fish populations and habitats. In addition, technical assistance and monitoring are provided as needed for individual restoration projects and coastal watersheds. The latter is responsible for the management, investigations, and assessment of over 10 species of diadromous fish stocks in Massachusetts. Species such as river herring (alewife and blueback herring), rainbow smelt, white perch, tomcod, American eel, and American shad are evaluated for run counts, indices of population abundance, size and age composition, local harvests, and restoration potential. Information generated by this project is necessary for the sustainable management of diadromous fish populations as required by state and federal law.

Recreational Fisheries Project

MRIP Sampling Project

Since 1983, recreational fisheries catch and harvest data have been collected along the Atlantic Coast through NOAA Fisheries' Marine Recreational Information Program (MRIP). In 2013, *MarineFisheries* continued to manage the head boat survey segment of MRIP for Massachusetts waters – training personnel, scheduling trips, logging data, and maintaining equipment. Project staff also attend data review meetings and maintain regular communication with the contractor to NOAA Fisheries, Research Triangle Institute (RTI), regarding survey performance and head boat sampling. During 2013, 88 sea sampling trips were completed for a total of 156 sampler days and 1,489 angler intercepts (Figure 44).

MarineFisheries assumed the shore-side sampling of all fishing modes (charter vessels, shore anglers, and private vessel anglers) from RTI in 2013. In 2013, MRIP field interviewers completed 1,322 assignments (337 shore, 693 private/rental, and 136 charter boat) with 4,977 angler intercepts. To improve awareness about the project, staff presented the new survey methodology to numerous fishing clubs and similar organizations early in the year.

Figure 44. Technicians aboard a for-hire vessel interview anglers and measure catch for future stock assessments.

Recreational Fishing Derby

Figure 45. Dr. Michael Armstrong thanks anglers for their participation in the Saltwater Fishing Derby.

Project staff administered *MarineFisheries'* Saltwater Fishing Derby. This included regular communications to weigh stations, preparing press releases for derby promotion and announcement of winners, logging certified weigh-in shops, and tracking derby standings in a database. Winners were recognized with awards at the annual Worcester Sportsmen's Show (Figure 45). The catch and release derby component was promoted with outreach materials and press releases. Project personnel created, printed, and distributed rule pamphlets and minimum size rulers.

Recreational Species Research, Assessment, and Management

Policy, Technical Committee, and Stock Assessment Support: Participation on various technical committees of the ASMFC and MAFMC continued. In 2013, through these committees, staff undertook stock assessments and presented results to peer reviewers and managers for key recreational species including summer flounder, tautog, scup, bluefish, and black sea bass.

In 2013, project personnel reviewed local and regional fishery performance and assessed potential bag, size, and season restrictions for scup, summer flounder, and black sea bass. Databases of fishery-dependent and –independent abundance indices for tautog, bluefish, black sea bass, summer flounder, and scup were updated, trend analysis performed, and predictive relationships examined. Annual ASMFC compliance reports were submitted for each species.

Summer Flounder Tagging: *MarineFisheries* initiated a tagging study for summer flounder in 2009. The primary purpose of the study is to examine migratory timing and pathways and determine if summer flounder exhibit inter-annual homing. During 2013, staff conducted four summer flounder sampling trips on *MarineFisheries* research vessels, tagging 78 fish, for a total

of 1,278 summer flounder tagged over five years. Since the study began, 71 tags have been returned from recreational and commercial fishermen along the east coast.

Multi-year tag returns indicated that inter-annual site fidelity in Massachusetts is a rare occurrence. Whether this is due to the intensity of the winter fishery cropping off potential returning fish or a change in the migratory patterns of older and larger fish is not clear at this time. There is, however, some anecdotal evidence of the latter, as larger fish, which have become increasingly rare in the local inshore recreational fishery catch, have been noted in catches of anglers further to the north and east in colder water.

The length frequency data collected during the study are also used to project recreational harvest under different minimum size limits. Little other data for this type of analysis are available.

Public Access

The *MarineFisheries'* Public Access Coordinator is funded from the Marine Recreational Fisheries Development Fund. The Coordinator manages all *MarineFisheries* saltwater fishing access projects, working closely with the Office of Fishing and Boating Access to identify, plan, and implement construction/renovation/improvement of new fishing piers and other structures for fishing access, and serves as a liaison to the fishing public for all matters of saltwater fishing access including advocating for beach and shore access.

In 2013, the Coordinator responded to numerous inquiries regarding shore-side fishing access sites, public access rights, and future public access projects. Multiple meetings were attended with fishing groups, and other state and federal agencies relating to public access.

At the Craven's Landing access site on Scorton Creek in Sandwich, periodic site monitoring and maintenance were required. A seasonal contractor was hired for site patrol and coordinated for weekly summer assignments. Upgrades to the site's infrastructure included fence repair, general cleanup, and the replacement of information signs. For the third consecutive year, a brief closure of Craven's Landing was necessary due to the presence of federally protected piping plovers. During the time when piping plover chicks are present, *MarineFisheries* works closely with Mass Audubon to comply with USFWS regulations; access is limited when the chicks are born and re-opened in a timely manner once they have fledged. The site was also closed during a spring storm for safety reasons, because the parking area can be submerged.

To provide site improvements to the Dogfish Bar Fishing Access Site in Aquinnah, an engineering firm was hired for design, permitting, and construction for completion in 2014.

MarineFisheries, in collaboration with the Office of Fishing and Boating Access, funded the construction of a new fishing pier in Oak Bluffs, which was scheduled to be completed in summer 2014 (Figure 46). Over 20 days were spent during 2013 visiting locations where public access is available to the fishing public for analysis of potential site improvements. Many of these visits were made with staff from the Office of Fishing and Boating Access (FBA), US Fish and Wildlife, officials from various municipalities, and local citizens. The focus of these site visits was to assess the benefits of those sites to the Massachusetts fishing and boating community. Proposals were developed for several sites of interest for possible 2014 and 2015 expenditures from the Marine Recreational Fisheries Development Fund.

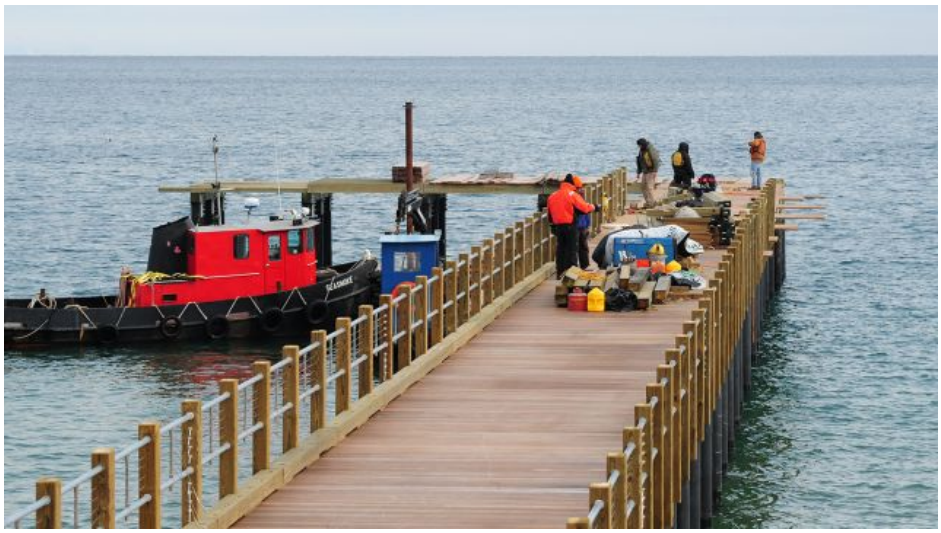

Figure 46. The new fishing pier in Oak Bluffs nears completion.

Outreach

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

Figure 47. The cover of the 2013 fishing guide.

In 2013, informational materials were distributed at the Standish Sportsman's Show, Worcester Sportsman's Show, Springfield Sportsman's Show, Rhode Island Saltwater Anglers Association Fishing Expo, Massachusetts Striped Bass Association Fishing Expo, New England Boat Show, Topsfield Fair, and the On the Water Striperfest. The following fishing club general membership meetings were regularly attended to present information regarding Project jobs and/or public hearing proposals: Cape Cod Salties Sportfishing Club, Barnstable County League of Sportsmen, Plymouth County League of Sportsmen, Bristol County League of Sportsmen, Stellwagen Bank Charter Boat Association, League of Essex County Sportsmen, and Osterville Anglers Club.

The Massachusetts Saltwater Recreational Fishing Guide (Figure 47) was prepared and distributed at the above listed shows, over 140 bait and tackle shops, similar locations along the coast, and to requesting anglers by mail and web site downloads. In addition, an e-mail based newsletter – *The Broadcast* – was developed with the guide's publisher and distributed (two releases in 2013) to permit holders submitting e-mail addresses.

Habitat

Routine communication regarding local fisheries resources and fisheries activity was maintained with Environmental Review Program staff. This included technical assistance to permit review staff on projects related to diadromous and recreational fish resources, including artificial reef site evaluations.

Large Pelagics Research Project

Massachusetts Sport Fishing Tournament Monitoring Program

To better characterize the relative abundance of sharks, tunas, and marlins off the coast of Massachusetts, *MarineFisheries* has been collecting catch and effort data at fishing tournaments since 1987. The program strives to rectify biases in the calculation of catch-per-unit effort indices from tournament data by surveying tournament participants and working with organizers to collect complete catch information (all fish landed, tagged, released, and lost).

In 2013, Project staff obtained data from a single tournament (Table 12). The tournament database was updated, and data summaries were distributed to tournament organizers and participants, and NOAA Fisheries (for inclusion in the federal tournament monitoring program). Massachusetts big game tournament fishermen spent a minimum of 1,139 boat hours fishing for sharks. Program personnel tallied 666 fish comprising 6 species. The proportion of fish released ranged from 44 to 100% by species; overall, 96.7% of the tournament catch was released and the balance was boated; 1.8% was tagged when released. Size data were collected from 13 fish boated during the 2013 event.

Table 12. 2013 Massachusetts offshore fishing tournaments.

Tournament	Species	Dates	# Boats	Boat Hrs.
Oak Bluffs Monster Shark, 27th Annual	Shark	7/19-20	85	1,139
Total			85	1,139

Massachusetts Shark Research Program

MarineFisheries established the Massachusetts Shark Research Program in 1989 to more fully elucidate the ecology, distribution, and relative abundance of sharks subjected to fisheries off the coast of Massachusetts. The program conducts field research and opportunistically collects information and samples from recreational and commercial fishermen. Biological parameters including age, feeding ecology, movements, and reproductive status are examined through dissection and tagging of sharks. The program's goals are to foster cooperative shark research; participate in the state, regional, and federal management process; and provide public education and technical information on the biology, management, and utilization of sharks.

With the exception of trawl, longline, and gillnet fisheries that target spiny dogfish (*Squalus acanthias*), there are no directed commercial fisheries for sharks in Massachusetts. Of the 6.25 million pounds of sharks landed in 2013, the vast majority were spiny dogfish (6.22 million pounds) with a commercial value of $944,192. The balance consisted of shortfin mako (*Isurus oxyrinchus*) and porbeagle (*Lamna nasus*) taken incidentally.

A substantial recreational fishery for sharks occurs in Massachusetts from June through October each year. Harvest estimates from NOAA Fisheries' MRIP indicate that Massachusetts' recreational fishermen caught about 293,000 sharks in 2013, with spiny and smooth dogfish comprising 91% of the catch (Table 13). However, while MRIP data reflect those species commonly taken by shore-based and coastal fishermen, they do not adequately represent the species composition, relative abundance, and temporal and spatial distribution of sharks targeted by fishermen in offshore waters. The NOAA Fisheries Large Pelagic Survey, which is

more reflective of offshore fisheries, reported 11,336 sharks taken by Massachusetts recreational fishermen in 2013 comprising blue (*Prionace glauca*, 11,088), shortfin mako (257), common thresher (*Alopias vulpinus*, 7), and porbeagle (157) sharks; overall, 98% were released (Table 13).

Data from the Massachusetts Sport Fishing Tournament Monitoring Program indicate that of the 666 sharks caught during a single Massachusetts big game fishing tournament in 2013, 578 were blue sharks, 73 were shortfin makos, nine were porbeagles, and four were common threshers; the balance included one dusky (*Carcharhinus obscurus*) and one white (*Carcharodon carcharias*) sharks (Table 13). During these events, 96% of the sharks were released. Although these data represent only tournament-caught sharks taken in offshore waters (>3 miles), they provide an indication of species composition, landings, and catch rates for important recreational shark species off Massachusetts.

Taken together, these data sources indicate that recreational fishermen captured 10 different species of sharks in the coastal and offshore water of Massachusetts. The species composition reported by each data source largely reflects the extent to which each survey sampled coastal/shore-side or offshore fishermen. For example, offshore anglers (LPS and MSTMP data) rarely encounter sand tigers (*Carcharias taurus*). However, regardless of the data source, Massachusetts recreational fishermen consistently exhibit high catch and release rates when they opportunistically encounter and/or target sharks.

Table 13. Estimates of 2013 recreational shark landings (numbers) in Massachusetts.

Source	Species	Boated	Released	Tagged	Total	Percent Released
MSTMP	Blue	2	566	10	578	99.7
	Shortfin Mako	15	57	1	73	79.5
	Common Thresher		3	1	4	100.0
	Dusky		1		1	100.0
	Porbeagle	5	4		9	44.4
	White		1		1	100.0
	Total	**22**	**632**	**12**	**666**	**96.7**
LPS	Blue	21	11,067		11,088	99.8
	Shortfin Mako	79	178		257	69.3
	Common Thresher	7			7	0.0
	Porbeagle	66	91		157	58.0
	Total	**173**	**11,336**		**11,509**	**98.5**
MRIP	Spiny Dogfish	172	229,668		229,840	99.9
	Smooth Dogfish	580	35,169		35,749	98.4
	Dogfish (unspec)		7,193		7,193	100.0
	Blue		4,881		4,881	100.0
	Sand Tiger		340		340	100.0
	Sandbar		418		418	100.0
	Unidentified		14,830		14,830	100.0
	Total	**752**	**292,499**		**293,251**	**99.7**

MSTMP = Massachusetts Sport Fishing Tournament Monitoring Program
LPS = NOAA Fisheries Large Pelagics Survey (Source: NOAA Fisheries, Fisheries Statistics Division)
MRIP = NOAA Fisheries' Marine Recreational Information Program (Source: NOAA Fisheries, Fisheries Statistics Division)

Movement and Habitat Studies: With external funding from private and federal grants, Shark Research Program personnel continued in 2013 to collaborate with federal and academic researchers on the study of broad and fine-scale movements of numerous shark species using pop-up satellite tags, acoustic transmitters, and conventional tags. These species include white, basking, blue, shorfin mako, and sand tiger sharks.

Basking Shark: With funding from the National Science Foundation, Project personnel continued to examine basking shark (*Cetorhinus maximus*) movements as they relate to oceanographic features. Since 2004, 57 basking sharks have been tagged with PSAT tags and 10 with SPOT tags. The broad- and fine-scale horizontal and vertical movements of this species are being examined by Tobey Curtis as part of his PhD project at SMAST. In 2013, Tobey conducted a quantitative analysis of the fine-scale movements of SPOT-tagged basking sharks as they relate to oceanographic features derived from satellites.

White Shark: While known to be relatively rare in the Atlantic, the number of seasonal (summer, early fall) white shark sightings off the coast of Massachusetts has been rising in recent years. There has also been an increase in the reports and evidence of white shark attacks on seals, largely adjacent to Monomoy Island off the coast of Cape Cod, which hosts a sizeable and growing population of gray seals. White sharks, which were thought to generally feed offshore in the Atlantic, are exhibiting a dietary shift in response to changes in seal abundance. For the first time, we now have predictable access to white sharks in the North Atlantic.

From 2009 through 2013, a total of 39 individual white sharks were tagged off the eastern coast of Cape Cod, primarily in nearshore shallow waters from Orleans to the southern tip of Monomoy. Five of these sharks were tagged in partnership with the non-profit organization, OCEARCH, in 2012 and 2013. These five sharks – the first to be tagged with real time satellite transmitters in the Atlantic Ocean – can be followed live through OCEARCH's interactive tracking website (Figure 48). The remaining sharks were tagged with one or more of the following tags: pop-up satellite archival transmitters, passive acoustic coded transmitters, autonomous underwater vehicle transponders, active acoustic transmitters, and NOAA Fisheries conventional tags. The 39 tagged sharks ranged from roughly 7.5 to 18.5 feet in total length. Of the 13 that could be sexed, 12 (92%) were females.

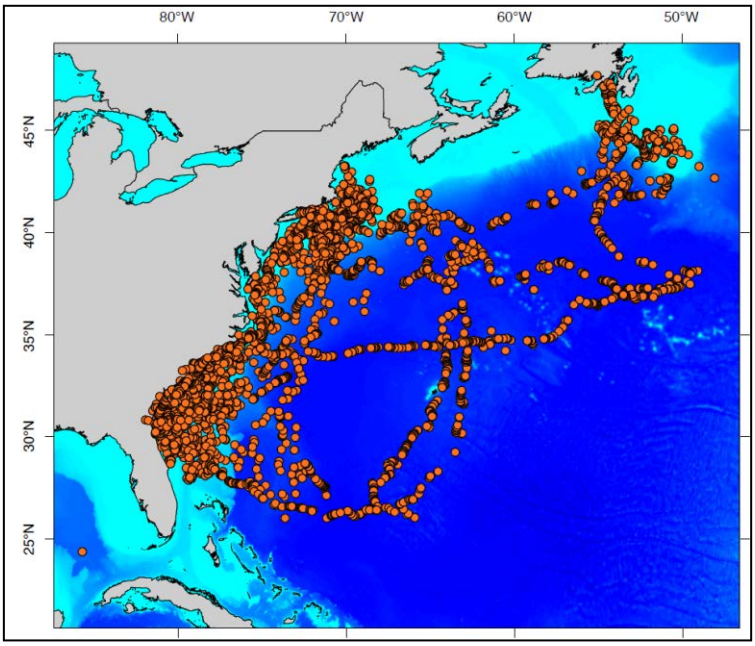

Figure 48. Movements of five white sharks tagged with real-time satellite tags on board the M/V Ocearch.

Sand Tiger Shark: With funding from the NOAA Fisheries Proactive Species Conservation Grant Program, the Massachusetts Environmental Trust, and the Marine Fisheries Institute, our

research continued to examine habitat use, local movements, and broad scale migration of the sand tiger in the Plymouth-Kingston-Duxbury Bay complex, the largest nursery for this species north of Delaware Bay. Using passive acoustic telemetry, the study is being conducted by SMAST graduate student Jeff Kneebone working with Project personnel. During 2009-2012, more than 60 sand tigers were tagged in this embayment and tracked as far south as Florida. In late 2012, Jeff successfully defended his PhD dissertation; two manuscripts were published in 2013.

Blue and Shortfin Mako Sharks: In cooperation with OCEARCH and the Montauk Marine Basin, one blue and three shortfin mako sharks were tagged with real-time SPOT tags during the first annual Shark's Eye All-release Shark Tournament held July 27-28, 2013 in Montauk, New York. The movements of these sharks can be followed on the OCEARCH interactive tracking website.

Post-release Survivorship Studies: In 2013, work continued with University of Massachusetts researcher Diego Bernal and PhD student Heather Marshall to study the physiological effects of longline capture in sandbar and dusky sharks. Funding for the study was obtained from the Saltonstall-Kennedy Program. Field work continued at the shore lab of the Virginia Institute of Marine Science. In 2012, blood was sampled from 50 dusky and 199 sandbar sharks to examine biochemical changes associated with demersal longline capture. Post-release behavior and survivorship were assessed using PSAT tags. *MarineFisheries* personnel assisted Heather with data analysis, interpretation, and report writing in 2013.

In conjunction with the study on sand tiger movements (see above), the physiological effects of capture stress were investigated in this species as part of the graduate research of SMAST student Jeff Kneebone. From 2009-2011, sand tigers were held captive to quantify the physiological effects of the capture stress and recovery. Post-release survival of sand tigers was monitored with passive acoustic telemetry and linked to blood chemistry data collected during the tagging process. In 2013, a manuscript was published in Fisheries Research.

Life History: Project personnel continued to support *MarineFisheries* staff biologist, and SMAST graduate student, Derek Perry on his graduate research into the feeding ecology of smooth dogfish. Over the four years of the study, 370 dogfish have been collected for stomach contents analysis; major prey items included lobster, American rock crab, spider crab, and mantis shrimp. In 2013, Derek defended his thesis and is in the final stages of completion.

Working with NOAA Fisheries and WHOI researchers, Project personnel generated age and growth estimates for the white shark in the western North Atlantic. Using bomb-produced radiocarbon, which acts as a kind of bone marker, vertebral growth bands were counted and validated as annual. In 2013, two manuscripts were prepared for publication.

Shark Management: Program personnel participated in the development and/or amendment of state (*MarineFisheries*), interstate (ASFMC), federal (NOAA Fisheries), and international (ICCAT) shark management plans. During 2013, Greg Skomal served on the following committees: ASMFC Coastal Sharks Technical Committee, ASMFC Coastal Sharks Plan Development Team, ASMFC Spiny Dogfish Technical Committee, ICCAT Advisory Committee Shark Working Group, and NOAA Fisheries Highly Migratory Species Advisory Panel.

Outreach and Media: To meet the public's demand for information on sharks, especially white sharks, over 25 presentations pertaining to sharks were delivered to the public. Technical information on sharks was also provided to several media outlets. In several cases, bite marks on the carcasses of gray seals, harbor seals, and right whales were analyzed for evidence of shark predation.

As adjunct faculty to SMAST, the UMass Biology Department, Woods Hole Oceanographic Institution, and the King Abdullah University for Science and Technology, Greg Skomal co-advised and/or served on the committees of 12 graduate students; 7 of these students are investigating the relative abundance, life history, movements, and/or physiology of elasmobranch fishes. Four students successfully defended and earned their degrees in 2013.

Publications

The following peer-reviewed publications were issued in 2013:

*Kneebone, J., J. Chisholm, and G.B. Skomal. 2012. Seasonal residency, habitat use, and site fidelity of juvenile sand tiger sharks (*Carcharias taurus*) in a Massachusetts estuary. Marine Ecology Progress Series 471:165-181.* DMF Contribution No. 40.

*Kneebone, J., J. Chisholm, D. Bernal, and G.B. Skomal. 2013. The physiological effects of capture stress, recovery, and the post-release survivorship of juvenile sand tiger sharks (*Carcharias taurus*) caught on rod and reel. Fisheries Research 147:103-114.* DMF Contribution No. 42.

Diadromous Fisheries Project

Major Restoration Projects 2013

Cape Cod Water Resources Restoration Project. The NRCS Cape Cod Water Resources Restoration Project began in 2010 with one component targeting the reconstruction of anadromous fishways on Cape Cod. Project selection, development, design, and permitting were conducted in 2010-2012. Designs were developed for the following five sites: Cedar Lake fishway reconstruction, Falmouth; Santuit Pond, fishway and dam reconstruction, Mashpee; Marston Mills River fishway reconstruction, Barnstable; Red Brook fishway reconstruction, Bourne; Carter Beal fishway construction, Bourne. A sixth project, fishway design at Pilgrim Lake in Orleans, began in 2011, slated only for design and not to be constructed under this funding. For the third straight year, the NRCS Cape Cod restoration project required over 100 hours of effort, ranking 2nd amongst all restoration projects in 2013.

The Cedar Lake and Santuit Pond fishways were constructed in the summer of 2013. Considerable time was spent participating in final design and permit authorizations. The following projects were not constructed due funding dynamics and their status was left at design stage as the NRCS Cape Cod Restoration Plan concluded in 2013: Marston Mills River fishway, Barnstable; Red Brook fishway, Bourne; and Carter Beal fishway, Bourne. Numerous meetings and site visits were made for the two construction projects in support of these essential, long-term fish passage improvement projects. A well-attended celebration for the Santuit Pond Dam fishway occurred in October, 2013.

Forge Pond Dam Fish Passage Improvements, Brockton. A grant was received from the Gulf of Maine Council to fund a feasibility study for providing fish passage at Forge Pond Dam to Silver Lake in 2012 with *MarineFisheries* as the lead, Gomez and Sullivan as project consultant, and NOAA, DER, JRWA, and the City of Brockton as project partners. The feasibility study was completed in 2013 (Figure 49) with all required GOMC progress and final reports submitted by the end of the year. The study demonstrated varying degrees of feasibility for fish ladder,

natural bypass, and dam removal options that would all require flow management to maintain fish passage during migratory seasons. The project was presented at a public meeting in Kingston on April 3rd, and to the Brockton Water Commission on Nov. 25th. Draft and Final project reports by Gomez and Sullivan were reviewed. The project outlook at the year's end was to prepare scoping designs for fish passage at Forge Pond Dam and to bring these before the Brockton Water Commission for discussion in 2014. This project logged the most hours among all diadromous fish restoration tasks in 2013.

Figure 49. A *MarineFisheries* biologist assessed the feasibility for fish passage improvements at Forge Pond Dam.

Fore River Watershed Restoration Project. Work continued on the project to restore diadromous fish to the Fore River Watershed in the Boston Harbor region. This project ranks high among potential diadromous fish restoration projects in the region given the opportunity to create a large river herring run and strong local support. Effort in 2013 was focused on grant applications and planning with project partners. A majority of time was spent preparing an application for a large solicitation from NOAA Restoration Center that sought nearly one million dollars to complete all project restoration components. This application was submitted but not accepted for funding. Meetings were held with Messina Enterprises, the owners of Armstrong Dam, and the Town of Braintree to plan for restoration funding. The owners reiterated their interest in removal of the Armstrong Dam. An earlier proposal to the USFWS FONS network was updated in 2013. In December, efforts began to prepare applications for the NFWF Hurricane Sandy grant solicitation and the MA Division of Ecological Restoration's annual RFR for priority projects.

Draka Dam Fishway, Three Mile River, Taunton. Considerable progress was made in 2013 on the long-standing effort to install a fishway at the presently impassable Draka Dam on the Three Mile River. The project originated in 1999 and was met with several obstacles over ownership support and property disputes. Resolutions to property and ownership challenges were achieved in 2011-2012, and final engineering plans were accepted in 2012. A large effort was made in 2013 working with project partner, Save the Bay, to prepare and provide technical assistance for environmental permit applications and seek construction funding. Meetings were held with Save the Bay in Providence to coordinate permit applications, and with the dam owner, and two adjacent property owners to gain permissions for construction staging. By December all permit applications (DEP WQC, US Army Corps, NOI, Natural Heritage, MHC, and DCR Office of Dam Safety) had been submitted. Save the Bay led a proposal to the Massachusetts Environmental Trust to fund half the construction funds, and *MarineFisheries* led a proposal to fund the other half to the In-Lieu-of-Fee Program in 2013. The project was awarded 39K from ILF Program for the fishway construction, with the MET grant announcement pending in 2014.

Fishway Permitting and Operation and Maintenance Plans

A new effort was launched in 2011 to develop standardized fishway operation and maintenance manuals for all new and recently constructed fishways. The general laws of Massachusetts (Chapter 130, Section 19) prescribe the authority of the Division's Director to prepare and require fishway O&M plans. The documentation of management practices for fishways is clearly needed for present operations and to guide future state and local staff. Six new O&M plans were drafted in 2013, with two plans finalized for Herring Brook outlet dam in Eastham and the Ipswich Mills Dam, Ipswich. *MarineFisheries* issues DMF Fishway Construction Permits following the review of final fishway plans and coordination with Town Conservation Commissions and the U.S. Army Corps of Engineers. Five *MarineFisheries* Fishway Construction Permits were drafted and finalized in 2013.

2013 Completed Fish Passage and Restoration Projects

Hubline Restoration. Anadromous fish restoration was a component of Hubline mitigation and resource restoration efforts that was funded from 2007-2012. The anadromous fish restoration efforts under the Hubline project concluded in 2013 with the post-construction monitoring and preparation of as-built surveys for two Hubline projects completed in 2012: a fish ladder at Third Mill Pond on the Herring River (Pembroke), and smelt spawning habitat improvements at Foundry Pond Dam on the Weir River (Hingham). An RFR was prepared and administered with JC Engineering to conduct both as-built surveys. Weekly monitoring visits were made to the Weir River restoration site in 2013 to measure water depth and velocity, and to record smelt egg deposition to confirm that the constructed spawning channel dimensions met the conditions targeted by the projects hydraulic and hydrologic design model.

Parker River, Newbury. A renewed focus on the Parker River began in 2012 with the hiring of Ben Gahagan as a diadromous fish biologist at our Gloucester laboratory. Improvements were made to concrete weirs at the Snuff Mill Dam by Ben and Ed Clark in 2012. The reconstruction of fishway weirs at the Central Street culvert was completed in 2013 under a contract with McDonald Masonry. This project was funded by the USFWS and had been delayed for two years with contracting and high flow challenges. Ben and Ed also made adjustments to the lower weirs in the fishway at Central Street, adjustments to the Blacksmith Shop Dam Alaskan steeppass ladder, and repaired the walls and some weirs at the River Street Dam fish ladder during the summer of 2013. The fishway repair work of 2012/2013 represents an impressive response to a backlog of needed fishway maintenance. The Larkin Mill Dam is the primary remaining site on the Parker River that needs improvements. This is a targeted dam removal candidate that is supported by *MarineFisheries*. Several site visits were made to Larkin Mill Dam in 2013 and a letter was issued to the Town of Newbury in December requesting action on the needed fish passage improvements at Larkin Mill Dam.

Mattapoisett River Channel Improvements, Rochester. A large tree on the bank of the Mattapoisett River near Snipatuit Pond was toppled during a storm in the late spring of 2013, causing water flow to divert around the root ball, thus leaving the main stem channel and flow into adjacent wetlands. A call came in reporting a fish kill of several hundred emigrating adult alewife in June that were stranded after the flow diversion. A site visit was made and plans initiated to repair the channel bank. Later that summer, a report was received of juvenile

herring dying in the wetland after being diverted at the root ball. The channel was repaired by the *MarineFisheries* Fishway Crew in September by removing the tree trunk and root ball and reconstructing the diverted channel with sand bags and repositioned river cobble.

Savory Bog, Santuit River, Barnstable. The *MarineFisheries* Fishway Crew replaced the fishway at Savory Bog on the Santuit River in 2012 under a cooperative project with NRCS and the bog owner. The flume became unstable after two cycles of flooding the bog and releasing the backed-up water. The Fishway Crew returned to the site in 2013 to remove the fishway flume with the project's mini-excavator, repack the banks with sand, stone and clay, and reset the flume.

Wareham Street Fishway, Nemasket River, Middleborough. The *MarineFisheries* Fishway Crew replaced the concrete fishway entrance at the Wareham Street fishway at the Nemasket River. This is a critical site for one of the State's largest herring runs and was done cooperatively with the Middleborough-Lakeville Herring Commission.

River Herring Run Channel Clearing. Three requests were fielded in 2013 to clear vegetation and debris from river herring runs. A large effort was made at Furnace Brook to connect the main stem Taunton River to Lake Rico in Taunton. The Taunton Conservation Commission held a Request for Determination hearing to conduct this clearing. Site visits were made with DCR (Lake Rico Dam owner) and the Taunton Conservation Commission. Five full field days with crews of 2-3 project staff were spent clearing Furnace Brook, which was highly congested with plant growth and wood debris. Single days were spent at Herring Brook in Pembroke during December to remove wood debris dams downstream of Third Mill Pond with the local herring wardens, and at the Santuit River in Mashpee during November with the Barnstable Conservation Agent.

Town Brook, Quincy. The Town Brook Enhancement and Town Brook Flow Restoration Projects were both completed in 2013. These projects were led by the City of Quincy and private developers as part of an effort to redevelop a large area in downtown Quincy. The redevelopment project included moving 1,700 feet of Town Brook from its present channelized, mainly underground, path to a newly constructed channel. The *Mass*DEP permitting process resulted in two specific efforts to improve smelt spawning habitat in Town Brook. First, a flow restoration plan was developed as a requirement of the Water Quality Certificate and the Order of Conditions. This plan concluded in a Memorandum of Agreement between *MarineFisheries*, Quincy (and project agents), and DCR to conduct a flow restoration project. Secondly, the permissions to move Town Brook came with a requirement to daylight nearly 200 ft. of brook and construct over 300 ft. of spawning substrate based on design specifications provided by *MarineFisheries*. Both projects were successfully constructed in 2013, marking a milestone in a 15-year process to correct damage caused by flood control measures to Town Brook in the mid-1990s. The permitting process now requires three years of monitoring to document the changes and improvements to smelt spawning habitat.

Mystic Lakes Dam, Medford. Efforts continued to work with DCR to improve river herring downstream migration at the Mystic Lakes Dam in Medford. This dam was reconstructed in 2010/2011 with a new Denil fish ladder. River herring mortality, both juveniles and adults, has been observed at the spillway during downstream movements. Efforts have focused on the O&M plan and the function of the spillway bays and low flow channel. In 2013, *MarineFisheries*

staff assisted with the deployment and later removal of over 150 sandbags on the crest of the spillway bays and along the low flow channel to contain flows and emigrating river herring. This short-term fix was successful in avoiding river herring mortality and led to continued discussions on long-term structural fixes and O&M plan improvements.

Hathaway Pond, Rochester. After actively seeking to improve fish passage by removing Hathaway Pond Dam during 2007-2010, the site ownership transferred from the Buzzards Bay Coalition to cranberry bog farmer Beaton Corp. and the project shifted to a fish ladder replacement. *MarineFisheries* and Beaton Corp. reached an agreement where we would donate the needed Alaskan steeppass sections and technical assistance for design and permitting and the owner would fund the engineering plans and constructions costs. Final engineering plans and permitting were completed and the fishway installation occurred during the fall of 2013.

Wing Pond, Falmouth. A river herring fish kill investigation at the cranberry bog next to Wing Pond in Falmouth in 2012 led to consultations with DEP, the Cranberry Growers Association, and the bog owner about options to screen the intake to prevent future mortality. Two meetings were attended on-site and a screen design was prepared and recommended to the owner by Brad Chase and Ed Clark of *MarineFisheries*. The bog owner purchased a new seine net customized for this site and installed the net prior to pumping for the fall cranberry harvest. No observations were made of river herring mortality in 2013.

A letter was drafted earlier in the year summarizing *MarineFisheries*' position on this location and situation. An ongoing court trial is still pending for the 2012 fish kill.

New/Ongoing Fish Passage and Restoration Projects

Cotton Gin Mill Dam, East Bridgewater. After consultation with local and agency partners seeking to improve fish passage in the Satucket River by removing the Cotton Gin Mill Dam, an on-site meeting was held with the dam owner. A follow-up letter was drafted asking for a letter approving the initiation of a study on the feasibility and design of the removal of Cotton Gin Mill Dam. A letter was received from the owner in 2013, which allowed the formal start-up of the restoration project. Four site visits were made to the dam to meet with the owner and project partners. At the end of 2013, the project advanced to fundraising for the initial studies.

Morey's Street Bridge Dam, Taunton. *Mass*DOT and DCR led a large construction project to replace both the Morey's Street Bridge and the Morey's Bridge Dam in 2012, which included a fishway and eel ramp. The bridge, dam, and Denil fishway were completed in 2012. Coordination with *Mass*DOT and DCR continued at a high level in 2013 as problems developed with the function of the low flow channel for downstream fish passage and delays occurred with the procurement of materials for *MarineFisheries* to construct the eel ramp. The low flow channel was reconstructed in 2013 and materials for the eel ramp were received late in the year to allow fabrication and installation for the spring eel run in 2014. This effort is part of the overall Mill River restoration project that made good progress in 2013 with the removal of the Whittenden Dam, the 2nd of three needed dam removals for migratory fish to reach Morey's Street Bridge.

Back River Fishway Barrier Wall, Weymouth. *MarineFisheries* received an earmark of $50K to replace or redesign the flood control tunnel gate at the Back River Jackson Square fishway that has caused several large fish kills in recent years. A contract was prepared to send the funds to the Town of Weymouth. Technical assistance was provided to prepare a project scope and bid documents. A meeting was attended for the Conservation Commission to describe the project. At the end of 2013, the Town initiated the bidding process for design and permitting.

Fishway Scoping Designs. A contract was renewed with the USFWS to provide *MarineFisheries* with fish passage technical assistance and scoping designs for fish ladders. Several site visits were made with Brian Waz of USFWS to investigate potential projects. Agreements were made to proceed with scoping designs at: Bourne Pond, Falmouth; Forge Pond Dam, Westport; Central Falls Dam, Winchester; and Willowdale Dam, Ipswich. In addition, a contract was maintained with Dick Quinn, former USFWS hydraulic engineer, to continue with ongoing designs in the Fore River Watershed, Agawam River, Wareham, and several reviews of recent construction projects.

Talbot Mills Feasibility Study. A feasibility study on improving fish passage at the Talbot Mills Dam on the Concord River was initiated in 2013, led by Ben Gahagan. The dam is presently not passable for diadromous fish. The initiation of the study required *MarineFisheries* contact and correspondence with the dam owner in 2013. A study scope was prepared and the RFR was posted for bid later in the year.

Martha's Vineyard Restoration Projects. A trip was made to Martha's Vineyard in May to continue efforts to advance potential restoration projects on the island. An agreement was made with the Town of West Tisbury to replace the existing fish ladder at Mill Pond within the Tisbury Great Pond watershed in 2014. Ed Clark designed this fishway replacement and assistance was provided to the Town for the Conservation Commission permit application. In relation, a letter was drafted for the Town and homeowner's association on operation practices related to allowing sea-run herring to enter Tisbury Great Pond during traditional beach breaching.

Town River, West and East Bridgewater. An effort was initiated to work with the Towns of East and West Bridgewater to prepare O&M plans for the Town River fish ladders at War Memorial Park and the High Street Dam. Both sites need fishway improvements; however, basic guidelines for fishway operations and flow targets are lacking. A meeting of the herring commission for Town River was attended and plans were made to install flow gauges and work with the owner of the High Street Dam to replace a fish barrier at the fish ladder entrance. A draft O&M plan for the War Memorial Park fish ladder was prepared and circulated for review in 2013.

Technical Assistance

Routine technical assistance is provided to local authorities, private organizations, and other agencies on topics related to diadromous fish resources. Effort spent on such technical assistance can amount to relatively few hours for individual inquiries or requests, or dedicated efforts related to specific tasks such as river herring habitat assessments.

River Herring Habitat Assessment. River herring habitat assessments are conducted to assess the suitability of habitats for restoration potential and to contribute to habitat and water quality

remediation efforts. In 2013, assessments were conducted during May-September at: Snipatuit Pond and Tinkhams Pond in the Mattapoisett River watershed, Rochester; Pentucket Pond, Georgetown; Chebacco Lake, Essex; Lake Sabbatia, Taunton; and four ponds on Cape Cod (Tom Matthews Pond, Yarmouth; and Mill Pond, Red Lily Pond, and Lake Elizabeth, Barnstable). The assessments at Pentucket Pond, Mill Pond, and Tom Matthews Pond were completed in 2013.

After the field season, effort focused on data processing and assessment writing. A draft assessment report for the Silver Lake assessment of 2008-2009 was circulated for review in early 2013. The final report was issued as Technical Report No. 54 in August. The data file and report data tables for the Great Pond Reservoir and Sunset Lake assessments in the Fore River watershed were completed and progress was made drafting the report in 2013. A presentation on the river herring habitat assessment effort was given at the Cape Cod Water Resources Conference in Hyannis on June 13th.

Diadromous Fish Restoration Priority List/*Mass*DOT Diadromous Fish GIS Datalayer. A diadromous fish restoration priority list is maintained by this project to document the status of diadromous fish passageways and to prioritize projects for the agency and outside funders. The list (Excel spreadsheet) was last updated in 2011 and contains about 450 fishways, impediments, and potential restoration sites in the four major coastal regions of Massachusetts: Buzzards Bay, Cape Cod, South Shore, and North Shore/Boston Harbor. The restoration sites were ranked by restoration potential within each region. The restoration list focuses on passageways for river herring but considers others species of diadromous fish and watershed connectivity.

Efforts in 2013 focused on bringing to conclusion a project to link DMF's fish passage survey and priority list to a GIS datalayer that supports *Mass*DOT transportation infrastructure planning. *Mass*DOT funded a cooperative project to create the diadromous fish GIS datalayer and hired AECOM to work with *MarineFisheries* to merge datalayers on transportation infrastructure, diadromous fish habitat, and *MarineFisheries* species Time-of-Year (TOY) data.

River Herring Network. Assistance was provided to a coalition led by the Cape Cod Hook Fishermen's Association who received a grant to develop a river herring warden network. John Sheppard served on their steering committee. Brad Chase reviewed their website design and gave a presentation on diadromous fish biology and management at their annual meeting in October.

Restoration Site Visit Database. An Access database was designed in 2012 to record all site visits made by project staff related to restoration efforts, fishway work, and other site visits related to diadromous fish management. Routine monitoring trips were not recorded in the datafile. The interest is to produce lasting documentation of our field observations at diadromous fish runs in Massachusetts. A total of 186 site visits were recorded by project staff in 2012, followed by 156 in 2013 with a summary by major coastal drainage area below. A large majority were directly related to fishway construction, fishway maintenance, and site visits for potential restoration projects. The process of repeatedly visiting diadromous fish runs builds professional experience and knowledge that is valuable for this project. The maintenance of this new database should contribute to the Division's institutional knowledge of diadromous fish runs over time. Site Visits by Region are: North Shore – 21; Boston Harbor – 16; South Shore – 15; Cape Cod – 39; Buzzards Bay – 65.

Biological Assessments for River Herring

Dedicated monitoring is annually conducted for river herring, which include the closely related alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), and are historically the most abundant and valuable among the diadromous fish species. Monitoring continued with adult river herring counts and biological sample collections from: Monument River, Bournedale; Town Brook, Plymouth; Mystic River, Medford; Agawam River, Wareham; Wankinco River, Wareham; Mattapoisett River, Mattapoisett; Nemasket River, Middleboro; Herring River, Harwich; Merrimack River, Lawrence; Parker River, Newbury; Acushnet River, Acushnet; and Charles River, Boston. A total of 2,093 alewives, 925 blueback herring, and 157 American shad were sampled from these rivers in 2013. *MarineFisheries* made a substantial investment in time and funds to improving automated counting stations in 2013 with new video counting stations deployed at the Charles River, Nemasket River, and Mill River in Taunton (Figure 50). A new electronic counting station was also deployed in the Parker River. Efforts continued throughout the year to develop these monitoring tools. Counts were completed for the Charles River for the first time with totals of 353,174 river herring and 44 American shad observed passing through the Watertown Dam fishway.

Figure 50. Biologists install a video counting system in the Mill River, Taunton.

MarineFisheries data collections indicate that river herring populations are experiencing a truncation in age structure, with fewer older fish being collected and fish apparently smaller at age than in past years. In particular, the age structure of alewives appears to have shifted to younger (modal age-3) fish in the Nemasket, Monument, and Mystic rivers. Counts varied from 6,033 fish in the Acushnet River to 840,033 in the Nemasket River. Electronic counts in 2013 indicated that substantial increases in returning adult herring occurred in some coastal systems. Adult returns increased in the Monument River in 2013 (252,871 fish) compared to 2012 (180,082 fish). Counts increased in the Acushnet River from 3,220 fish in 2012 to 6,033 fish in 2013. Counts increased in the Nemasket river from 567,952 fish (2012) to 840,033 fish (2013). Counts decreased from 2012 to 2013 in the Mattapoisett River (28,447 fish to 21,613 fish), the Agawam River (from 73,186 fish to 33,637 fish), and the Wankinco River (24,764 fish to 8,734 fish). *MarineFisheries* also provided technical assistance to local groups conducting volunteer, visual counts of herring runs. In 2013, a total of 32 coastal rivers in 29 towns representing each of the eight major drainage areas were monitored.

Propagation

Efforts to re-establish, augment, and enhance natal anadromous runs in conjunction with ongoing fishway improvement projects resulted in a total of 1,423 pre-spawning adult river herring trapped and transported via stocking truck or lifted above a barrier into two coastal systems throughout the Commonwealth (Table 14). The two systems that received gravid fish in

2013 were Three Mile River, Dighton and Pentucket Pond, Georgetown. An additional 2,000 alewives were trapped from a Massachusetts donor system (Nemasket River, Middleborough) and released into two Rhode Island coastal systems (Ten Mile River, Turner Reservoir, East Providence and Kickemuit Reservoir, Warren) in a cooperative effort to sustain their small populations.

Table 14. Number of pre-spawning adult river herring trapped and transported via stocking truck or lifted above a barrier in 2013.

Donor System	Recipient System	Number of Adults
Nemasket River	Three Mile River*	1,000
Nemasket River	Ten Mile River**	1,000
Nemasket River	Kickemuit Reservoir**	1,000
Parker River	Pentucket Pond	423

* Denotes out-of-basin transfer (between river systems)
** Denotes out-of-basin transfer (between states)

Restoration efforts of American shad to the Charles River also continued in 2013 with the introduction of over 3 million shad fry into the waters around the Woerd Avenue Boat Launch in Waltham. Monitoring trips were conducted in order to identify the presence of hatchery adult returns. Sampling was conducted via several boat electrofishing trips below the Watertown Dam, yielding a total of 22 adult shad. These fish were ages 4-9, meaning they were from the 2004-2009 year-classes. Of the 22 fish collected, three were from year-classes prior to 2006. These adults were likely part of a remnant run of shad in the river but may have strayed from other rivers. Otolith analysis determined that 14 of the 19 fish that could have potentially been products of restoration efforts (2006-2009 year-classes) were marked with an oxytetracycline (OTC) ring at the core of the structure. The 5 unmarked fish could have been strays, naturally produced Charles River fish, or fish that did not incorporate an OTC mark. Additionally, in 2013 *MarineFisheries* and USFWS cooperated to begin an age validation study for Charles River shad, and all larvae were marked with a second OTC ring 3 days after the first marking. Assessment of the OTC stocking and age validation study will continue as well as part of the project goal of an annual release of 3 million young-of-the-year (YOY) shad juveniles.

Rainbow Smelt Population and Habitat Monitoring

Rainbow smelt are a popular sport fish in Massachusetts and important forage for many species of fish and wildlife. Smelt population declines since the 1980s prompted *MarineFisheries* to initiate spawning run monitoring using in-stream fyke nets in 2004. The fyke net catches of smelt provide a relative index of population abundance and age-structure data. A five-year grant from the NOAA Office of Protected Species (Species of Concern Project) supported the fyke net project for 2008-2012, including a full-time Fisheries Supervisor position. Following the conclusion of the grant in 2012, field monitoring in 2013 was reduced given the staff reduction. The nine fyke net stations monitored during 2008-2012 were reduced to six stations. Smelt were caught at each station in 2013. To date, over 35 species of fish have been caught in the fyke nets, including 10 diadromous species.

Following the spring field season, efforts shifted to data processing and reporting for manuscripts related to the NOAA Species of Concern project on smelt population demographics and smelt spawning habitat characteristics. Time was spent in 2013 to conduct data analyses, literature reviews, and begin manuscript preparations on smelt spawning habitat characterization for monitored smelt spawning habitat in the study area of Maine, New Hampshire, and Massachusetts. At the end of 2013, draft sections were circulated among project partners for review.

American Eel Young-of-the-Year Monitoring

All East Coast states conduct standardized monitoring of YOY American eels under mandatory ASMFC protocols. *MarineFisheries* has monitored the spring migration of YOY eels in the Jones River since 2001 to contribute to a coastwide index of eel population relative abundance, and continued to do so in 2013. YOY monitoring stations were also maintained in the Acushnet and Parker Rivers in 2013. Work continued to organize and improve the trap data files for inclusion in the next coastwide eel stock assessment.

Photo Credit: Eric Hutchins

Figure 51. Eel ramps in coastal rivers provide eel passage over barriers.

In addition to the ASMFC-required YOY traps monitoring, this project is also monitoring eel ramps installed in coastal rivers to provide eel passage over barriers (Figure 51). *MarineFisheries* first installed an eel ramp in the Saugus River in 2007 and has cooperatively installed one ramp annually in most years since. Most ramps are 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 age-1+ eels. The following locations have eel ramps with cooperative monitoring efforts ongoing: Saugus River, Saugus (2007); Cold Brook, Harwich (2008); Wankinco River, Wareham (2008); Pilgrim Lake, Orleans (2009); and Mystic Lakes Dam, Medford (2010). Letters of authorization were drafted for each site to allow local groups to collect and transport juvenile eels upstream. The Mill River, Taunton and Mill Creek, Rockport have had eel ramp projects underway since 2011, with the Rockport ramp installed in 2012 (without collection tank) and project planning occurred in 2013 for the Taunton installation and monitoring at the Rockport ramp.

Other Activities

ASMFC Participation: Staff actively participate in ASMFC Technical Committees and with diadromous fish stock assessments. Compliance reports were drafted in 2013 for sturgeon (Mike

Bednarski), American eel (Brad Chase), and river herring/American shad (Brad Chase and John Sheppard). Brad Chase served on the river herring/American shad, American eel, and Fish Passage Technical Committees and served as chair of the American Eel Technical Committee as well as on the stock assessment subcommittee and eel plan development team.

Publications, Reports, and Presentations:

Chase, B.C., A. Mansfield, and P. DuBois. 2013. River herring spawning and nursery habitat assessment – Silver Lake, 2008-2009. Massachusetts Division of Marine Fisheries, TR-54

Sheppard, J. and B.C. Chase. 2013. Massachusetts River Herring and Shad Compliance Report: 2013, to the Atlantic States Marine Fisheries Commission. Massachusetts Division of Marine Fisheries.

Sheppard, J., and S. Block. 2013. Monitoring Response of Diadromous Populations to Fish Passage Improvements on a Massachusetts Coastal Stream. Journal of Environmental Science and Engineering A. 2 (2) 71-79.

ADMINISTRATION

Personnel

Kevin Creighton, Chief Fiscal Officer

Finance
Darlene Pari, Accounts Payable Coordinator
Eva Morales, Accountant III
Jeanne Hayes, Accounts Receivable Coordinator
Shannon Davis, Program Coordinator - Revenue

Boston Permit Office
Story Reed, Administrator of Permitting
Kerry Allard, Permitting Program Coordinator
Kerry Faugno, Permitting Receiving Teller
Sandra Downing, Permitting Receiving Teller

New Bedford Permit Office
Marie Callahan, Permitting Office Manager
Kim Trotto, Permitting and Administrative Support
Lynne Besse, Permitting and Administrative Support

Gloucester Permit Office
Rosemary Mitchell, Permitting and Administrative Support
Whitney Sargent, Permitting and Administrative Support

Grants Program
Stephanie Cunningham, Federal Aid and Grants Coordinator
Cecil French, Project Leader Clean Vessel Act and Boating Infrastructure Grant
Tom Beaulieu, Contract Personnel, Clean Vessel Act
Melanie Griffin, Project Leader, Revolving Loan Fund

Outreach
Elaine Brewer, Information and Education Coordinator

Capital Assets and Facilities Management
Brian Castonguay, Gloucester Office, Head of Facilities and Capital Assets
Ralph Stevens, Shellfish Purification Plant, Facilities

Overview

MarineFisheries Administrative Program is responsible for the Division's fiscal functions, permitting, grants management, capital assets, and most recently, outreach efforts. The Program develops, analyzes, and manages the Division's financial planning and resource allocation activities including budget submissions to the Legislature. Analysts provide financial and performance analysis of Division programs, operations, and policies. Analysts are responsible for the following: monitoring and forecasting revenue and expenditures; preparing the Division's annual budget recommendation and spending plans; working with Department, Legislative, and Executive Branch budget staff; identifying and monitoring key budget and policy

issues; and, analyzing and proposing policy and savings initiatives. The Program is responsible for permit issuance, collecting fees, and reconciling revenue. The Program also provides all fiscal oversight and reporting on grants, contracts and mitigation projects. In addition, all capital assets are procured, inventoried, managed, and maintained through the Program. Outreach is conducted through the creation of media to be distributed to the general public through face-to-face interactions, direct mail, and by online platforms. Facilities Management is conducted to provide a healthy and productive working environment. This is accomplished by supplying staff agency-wide with the tools needed to meet their project's goals and objectives. This includes a safe working environment and equipment, vehicles, and vessels maintained and repaired on a timely basis.

Budget

State-Appropriated Funds

The *MarineFisheries* operating budget saw a slight increase for the first time since fiscal year (FY) 2007. This increase is reflective of the overall budget of the Commonwealth, which has seen revenue growth in each of the past four fiscal years. The FY2012 and FY2013 state appropriations are shown in Table 15.

Table 15. Fiscal Year 2012 and Initial 2013 Appropriations

Title	Acct. Number	FY2012	FY2013	Change
General Operating	2330-0100	$4,355,647	$4,682,837	+5.22%[1]
Sport Fish Program	2330-0120	$515,754	$591,800	+14.74%
Sport Fish Retained Revenue	2330-0121	$204,989	$217,989	+6.34%
Depuration Retained Revenue[2]	2330-0150	$72,000	$47,578	New FY12
Total		$5,189,710	$5,540,113	+5.67%
Saltwater Sport Fish Licensing[3]	2330-0300	$494,761	$767,191	+55.06%

[1] The final budget for Fiscal Year 2013, Chapter 139 of the Acts of 2012, included an earmark in the amount of $200,000 to the School of Marine Science and Technology. The final budget was reduced mid-way through the fiscal year by Governor Deval Patrick through the 9c budget reduction process, and the earmark was lowered to $100,000. Because this funding is not available for *MarineFisheries* operations, it is not reflected in Table 16 as part of the percent change in general operating appropriation between FY2012 and FY2013, nor the total percent change.

[2] In the Fiscal Year 2012 budget, the Legislature created a new retained revenue appropriation. The account was established so that fees collected from the depuration of shellfish could be used for the operation and maintenance of the Newburyport shellfish purification plant. Although this was a new appropriation in FY2012, the total amount collected has been included in the "Total" amount listed in Table 16 because expenditures in this appropriation can be used to offset budget reductions in the general operating account.

[3] In 2011, *MarineFisheries* instituted a new program to issue recreational saltwater fishing permits as required by the "Saltwater Act" of 2009. The law mandates that all revenue collected under this program be directed to the Marine Recreational Fisheries Development Fund. Available funds may then be appropriated as part of the normal budget process for authorized expenses in the following fiscal year. FY2011 was the first year of this program, and it is expected that the program will continue to grow over the first five years as fishermen become aware of the permit requirement. Because funds from this appropriation cannot be used to offset costs in other appropriations, the appropriated amount is not included in the "Total" amount listed in Table 16 so that an accurate comparison between fiscal years on operating costs can be made.

Although *MarineFisheries* realized an overall increase of approximately 5.6% in appropriated funds for the operating budget, the total appropriation is insufficient when considering the increase to annualized costs for payroll and utilities over the past two fiscal years. As such,

MarineFisheries continued to use "soft money" through grant opportunities and shifted costs where appropriate in order to address the approximate 5% operating budget shortfall. In addition, all state-funded travel remained suspended, spending in the lower subsidiaries was flat, and two full-time employee positions in the shellfish program were not backfilled.

The breakdown of overall costs by primary spending category for the *MarineFisheries* operating accounts can be seen in Table 16 and Figure 52.

Table 16. Fiscal Year 2013 Costs, State Appropriations (rounded to whole dollars)

	General Operating	Sport Fish Program	Sport Fish Retained Revenue	Depuration Retained Revenue	
Account Number	**2330-0100**	**2330-0120**	**2330-0121**	**2330-0150**	**Line Total**
Salaries	$3,968,784	$584,263	$37,808	$46,906	$4,637,761
Employee Expenses	$6,639		$12,671		$19,310
Contracts	$4,297		$46,467		$50,764
Facility Maintenance	$28,141		$15,831		$43,972
Field & Lab Supplies	$43,699		$10,694		$54,393
Fringe Costs	$51,197	$7,537	$488	$605	$59,827
Fuel	$67,964		$5,623		$73,587
Utilities	$105,422		$1,848		$107,270
Lease/Rent	$51,343				$51,343
Maintenance/Repair	$39,993		$6,419		$46,412
Office & Administrative	$86,980		$38,224		$125,203
Services/ Equipment Lease	$12,368		$13,500		$25,868
Outside Agencies	$83,088		$9,611		$92,699
Government Contracts	$20,000				
Grants	$99,954				
IT			$3,573		

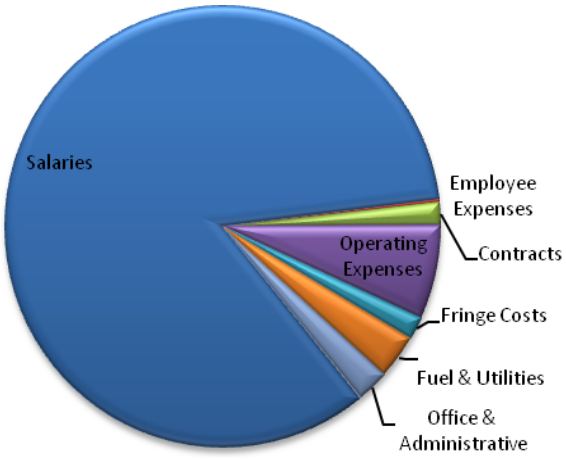

Figure 52. FY2013 Spending Category Summary

Staffing

Authorized personnel levels for calendar year 2013 are shown in Table 17.

Table 17. Fiscal Year 2012 and 2013 Authorized Personnel Levels

Title	Acct. Number	FY2012	FY2013
MarineFisheries General Operating	2330-0100	64	65
Sport Fish Program	2330-0120	10	10
Saltwater Sport Fish Licensing	2330-0300	6	7
Federal Grants and Trust Account	2330-xxxx*	21	22
Total Employees in All Appropriations		**101**	**104**

*Multiple account numbers

Staffing levels remained relatively unchanged over the course of FY2013 when compared to FY2012. A total of four new positions were added, and one position was eliminated. The four new positions include a policy analyst position that was added to the management team in the Boston office, a program coordinator to lead the Marine Recreational Information Program, and two field biologists to work on mitigation projects for shellfish and eel grass. The shellfish program was reduced by one full-time employee with the passing of a shellfish biologist, Michael Syslo, from Martha's Vineyard.

Revenue

MarineFisheries collects fees primarily from permit issuance and from processing racks of soft-shelled clams at the Shellfish Purification Plant in Newburyport. A total of 30,230 permits and endorsements were issued by the Licensing Program for the categories of commercial fishing, seafood dealers, and special permit types, producing General Fund revenue of $2,010,320 in 2013. This represents a slight decrease in revenue (~3%) from permit issuance in 2012.

Revenue from the depuration of soft-shelled clams at the Shellfish Purification Plant in Newburyport has shown a steady decline over the past decade. To increase the plant productivity, the Massachusetts legislature approved an expansion of services in the 2012 budget to include de-sanding of shellfish (see page 46). De-sanding operations began in March of 2013, and the plant processed 9,989 racks of soft-shelled clams during the year (depuration and de-sanding combined), with de-sanding accounting for more than 60% of the plant production. This resulted in General Fund revenues of $59,934, which is a slight increase over the 2012 value of $59,110.

In addition to General Fund revenue, *MarineFisheries* issued 158,886 recreational salt water fishing permits in 2013 and generated $1,250,679 in revenue for the Marine Recreational Fisheries Development Fund. This completed the 4th year of the recreational fishing permit program. Since its inception, the total number of permits issued has increased each year, but permit numbers appear to be leveling off as 2013 saw only a modest increase of 2.5% over 2012 (markedly lower than the 25% increase between 2011 and 2012).

Commercial Fisherman Permits

Anyone who lands and sells finfish, shellfish, lobsters, edible crabs, or other living marine resources in Massachusetts must have a *MarineFisheries* commercial fisherman permit and must sell only to licensed Massachusetts dealers. All commercial permits, except Rod & Reel and Seasonal Lobster, may be endorsed for shellfish at no additional cost. See Table 18 for the number of commercial fisherman permits issued, by type, in 2013 and resulting revenue.

Table 18. 2013 Commercial Licensing and Revenue Statistics

Permit Type (and resident/non-resident fee)	Permits Issued (#)		Revenue
	Resident	Non-Resident	
Coastal Lobster ($260/$520)	1,184	3	$309,400
Offshore Lobster ($260/$520)	315	85	$126,100
Seasonal Lobster ($65/$130)	78	1	$5,200
Boat 99'+ ($260/$520)	12	18	$12,480
Boat 60-99' ($195/$390)	82	157	$77,220
Boat 0-59' ($130/$260)	2,838	303	$447,720
Individual ($65/$130)	296	19	$21,710
Shellfish ($40/$80)	906	19	$37,760
Shellfish & Rod & Reel ($55/$130)	516	2	$28,640
Rod & Reel ($35/$100)	692	80	$32,220

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

Offshore Lobster Permit allows the landing and sale of lobsters and edible crabs (to a licensed dealer) taken outside of the coastal waters of the Commonwealth only; pursuant to appropriate federal permit(s). If the permit is endorsed for the use of pots to harvest lobster, there is a maximum pot limit per vessel that is based on Lobster Management Areas and individual

allocations. The permit may be endorsed to take and sell shellfish and finfish at no additional cost.

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

Boat Permit allows the taking, landing, and sale of fish (to a licensed dealer) and may be endorsed for shellfish. The permit covers everyone aboard the vessel. Price varies with vessel size. No lobsters or edible crabs may be taken.

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

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

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

Dealer Permits

Anyone engaged in the wholesale or retail trade of raw fish, shellfish, lobsters, or bait, whether frozen or unfrozen, must have a *MarineFisheries* Dealer Permit and may be subject to inspection from the Massachusetts Department of Public Health (*Mass*DPH). Shellfish dealers must check Food and Drug regulations for tagging and record keeping requirements. 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. See Table 19 for the number of dealer permits issued, by type, in 2013 and resulting revenue.

Table 19. 2013 Dealer Licensing and Revenue Statistics

Permit Type (and resident/non-resident fee)	**Permits Issued (#)**		**Revenue**
	Resident	**Non-Resident**	
Wholesale Dealer ($130/$260)	412	8	$55,640
Wholesale Truck ($130/$260)	94	145	$49,920
Wholesale Broker ($130/$260)	20	7	$4,420
Retail Dealer ($65/$130)	740	47	$54,210
Retail Truck($65/$130)	40	4	$3,120
Retail Boat ($65/$130)	97	1	$6,435
Bait Dealer ($65/$130)	131	9	$9,685

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

with an inspection specifically stating, “Approved for retail and bait license.” A Hazard Analysis and Critical Control Points (HACCP) plan is required.

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

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

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

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

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

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

Special Permits

Special permits are required for scientific collection, shellfish aquaculture, shellfish propagation, contaminated shellfish harvest, and for the non-commercial harvest of lobster. Regulated fishery endorsements are also issued on commercial permits. See Table 20 for the number of special permits issued, by type, in 2013 and resulting revenue.

Non-Commercial Lobster Permit is required to fish for or take lobsters and edible crabs for personal use. This authorizes the holder and members of the holders' immediate family, residing in the same residence, to fish for and take lobsters using 10 pots only. The immediate family is defined as the spouse, parents, children, grandparents, brothers, and sisters of the holder. This permit may be endorsed for diving by the permit holder only. Other family members may purchase additional permits for diving only.

Table 20. 2013 Special Licensing and Revenue Statistics

Permit Type (and resident/non-resident fee)	Permits Issued (#)		Revenue
	Resident	Non-Resident	
Non-Commercial Lobster ($40/$60)	7,958	148	$327,200
Regulated Fishery Endorsements ($30/$60)	11,498	739	$389,280
Master Digger ($250/$500)	7		$1,750
Subordinate Digger ($100/$200)	54		$5,400
Scientific Collection ($10/$20)	72	15	$1,020
"Other" Special Permits ($10/$20)	377	1	$3,790

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

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

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

Other Special Permits are required for specific activities in the marine environment, including; aquaculture, scientific collection, shellfish propagation, and shellfish relay.

Limited Entry Permit Transfer Program

Limited Entry Permits are those permits that are limited in distribution to renewals only and may be transferable in accordance with established regulations and/or policies. Limited Entry Permits include, but are not limited to: Coastal Lobster Permit, fish pot (scup, conch, and black sea bass), gillnetting, mobile gear fishing (dragging), surf clam dredging, ocean quahog dredging, fluke, horseshoe crab, groundfish, and black sea bass endorsements. See Table 21 for transfer activity in 2013.

Table 21. 2013 Transfer Statistics

Permit Type	Permits Transferred (#)	
	Resident	Non-Resident
Coastal Lobster	22	0
Mobile Gear	8	0
Fish-Pot	8	0
Fluke	9	1
Sea Bass	12	0
Groundfish	4	0
Surf Clam Dredge	5	0
Ocean Quahog Dredge	3	0
Quahog-Dredge	2	0
Gillnet	0	0
Horseshoe Crab	0	0

Coastal Lobster Permit may be transferred by the holder along with lobster related business assets under the historical transfer criteria developed for the coastal lobster fishery. Transfer criteria include two key components: activity and experience. A permit must be actively fished prior to the transfer request; "actively fished" for lobster means landing and selling at least 1,000 pounds of lobster or landing and selling lobster on at least 20 occasions, each year for four of the past five years. The transferee must document that he/she has at least one year of full-time or equivalent part-time experience in the commercial lobster trap fishery or two years of full-time or equivalent part-time experience in other commercial fisheries.

Limited Entry Endorsements (Fish Pot-Scup, Fish Pot-Conch, Fish Pot-Black Sea Bass, Ocean Quahog, Coastal Access Permit, Fluke, Horseshoe Crab, Groundfish, Quahog-Dredge, and Black Sea Bass) can be transferred by the holder provided it has been actively fished for four of the past five years. The definition of "actively fished" differs by endorsement type. Similar to the transfer criteria for the lobster permit, the transferee must document that he/she has at least one year of full-time or equivalent part-time experience in the commercial trap fishery or two years of full-time or equivalent part-time experience in other commercial fisheries

Recreational Fishing Permit

MarineFisheries began issuing recreational saltwater fishing permits in December 2010. All fees collected from the sale of recreational saltwater fishing permits, including permits issued to the for-hire fleet, are deposited into the Marine Recreational Fisheries Development Fund. In addition to permit issuance, many individuals contributed to the program through direct donations for recreational fishing improvements. The number of permitted fishermen showed significant growth in each of the first three years of the program, but growth and revenue may have leveled off in Year 4. Even though permit issuance was up slightly (~2.5%) in 2013 over 2012, revenue declined slightly as a result of fewer for-hire permits and lower donations. See Table 22 for the number of permits issued, by type, in 2013 and resulting revenue.

Table 22. 2013 Recreational Saltwater Permitting and Revenue Statistics

Permit Type (and resident/non-resident fee)	Permits Issued (#)		Revenue
	Resident	Non-Resident	
Recreational Saltwater ($10/$10)	100,534	14,548	$1,150,820
Recreational Saltwater Age 60+ ($0)	37,599	5,332	No Fee
Charter Boat ($65/$130)	773	44	$55,965
Head Boat ($130/$260)	52	4	$7,800
Donations			$36,094
Marine Recreational Fisheries Development Fund, Total Revenue:			**$1,250,679**

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.

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

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

Grants Program

In FY2012, *MarineFisheries* had spent approximately $6.1 million on federal grants and mitigation projects operating out of the *MarineFisheries* Trust account. In FY2013, total spending decreased by about $580,000. Most of the decrease can be attributed to decreased personnel costs and fewer capital improvements to facilities/replacement of equipment. In FY2013, *MarineFisheries* spent approximately $5.5 million on grants and mitigation projects. Table 23 provides expenditures by account.

Table 23. Fiscal Year 2012 and 2013 Appropriations

Title of Federal Grant or Trust	Account Number	FY2012	FY2013
Clean Vessel Act	2330-9222	$925,000	$1,020,000
Fisheries Statistics	2330-9712	$107,000	$30,000
Boating Infrastructure	2330-9725	$100,000	$70,000
Interstate Fisheries	2330-9730	$230,000	$241,000
ACCSP	2330-9732	$76,000	$87,000
Economic Relief	2330-9738	$335,000	$77,000
Turtle Disentanglement/Protected Species	2330-9739	$660,000	$843,000
Revolving Loan Fund	2330-9741	new	$260,000
Fish Age & Growth	2330-9742	$200,000	$202,000
Marine Fisheries Research Trust	2330-0101	$3,490,000	$2,715,000

The Revolving Loan Fund (Groundfish)

MarineFisheries was awarded a $1,000,000-grant to develop and implement a Revolving Loan Fund (RLF) for commercial groundfish fishermen. The Commonwealth of Massachusetts Commercial Fisheries RLF Program seeks to promote the effective implementation of federal catch-share programs, while minimizing any potential adverse socio-economic impacts to fishing communities and small-scale fishing businesses that are sometimes attributed to catch-share programs. Operating under a Memorandum of Agreement (MOA) between NOAA Fisheries and *MarineFisheries*, loan services became available for select fishermen on Cape Cod and the Islands when a contract was entered into with the Community Development Partnership on July 30, 2012. Following dire resource conditions in the CY2012 multispecies groundfish fishery that prevented commercial groundfish fishermen from utilizing the Revolving Loan Fund (RLF) for the intended pilot purposes of leasing quota, *MarineFisheries* expanded the pilot program to include loans for vessel repairs, gear purchases, and refinancing of existing fisheries debt. An amended MOA with NOAA Fisheries was entered into in November of 2013 to allow for expanded uses of loan funds. At CY2013 end, *MarineFisheries* was amending the contract with the Cape and Islands RLF program operator consistent with the revised MOA and several fishermen had expressed interest in submitting loan applications.

Clean Vessel Act Project

MarineFisheries administers the federally supported Clean Vessel Act (CVA) Project to ensure that adequate, convenient pumpout facilities are provided to meet the needs of recreational boaters using Massachusetts coastal waters. This is achieved with the addition of new

infrastructure and funding sub-grantees for operation and maintenance costs. Responsibilities include the identification of appropriate sites for additional pumpout equipment, making technical assistance and information readily available to boaters and others in need of information regarding the *Mass*CVA Project, and agency coordination with public and private parties. In 2013, the 19th year of our participation, *Mass*CVA is proud to have helped Massachusetts achieve status as a No Discharge Area (NDA).

The geography of the Massachusetts coastline, with its hundreds of bays, coves, and inlets, and our short, intense New England boating season, make it fiscally impossible to site enough fixed shore-side facilities to adequately service the total boating population in the coastal zone. Consequently, we have been a leader in the implementation of pumpout vessel use. Our matrix of pumpout vessels and shore-side pumpouts (Figure 53), 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 NDA.

Our capital reinvestment program has enabled *Mass*CVA to expand with minimal costs to new sub-grantees that lack the capital for a full investment in new infrastructure. Through this program, when a sub-grantee replaces an existing *Mass*CVA pumpout boat or fixed-location station, the replaced equipment is provided to a new applicant who will pay to have it refurbished at a fraction of the cost of new equipment. Sub-grantees in 2013 included 45 private marinas, three non-profit organizations, and 49 cities and towns.

Figure 53. A combination of pumpout boats (left) and fixed location pumpout stations (right) help meet the needs of the Commonwealth's recreational boaters.

In 2013, we completed our seventh consecutive year of exhibiting with our public and private partners at the New England Boat Show. Additionally, we partnered with two federal agencies, three state agencies, and more than a half dozen non-profit organizations as part of our information and education efforts.

As a direct result of our outreach and needs assessment efforts to sub-grantees and the general public, program shortfalls are being more effectively identified and addressed. This year's requests for new infrastructure in 2013 again exceeded expectations; Table 24 summarizes new infrastructure for 2013. We are quickly approaching the removal of 6 million gallons of effluent from state coastal waters. The total project costs for the above new equipment was $289,500.

In addition, $723,000 was distributed to 83 sub-grantees to cover the operation and maintenance expenses of 66 pumpout boats and 56 fully functional fixed-location pumpout stations.

Table 24. New Infrastructure for 2013

Recipient - Location	Infrastructure Type
Town of Swansea, Taunton River/Mount Hope Bay	New Pumpout Boat
Town of Tisbury, Vineyard Sound, Martha's Vineyard	2 New Pumpout Stations
Brewers Plymouth Marine, Plymouth/Duxbury Harbor	New Pumpout Station
Brewers Hawthorne Marine, Salem Sound, Salem	New Pumpout Station
Marina Bay, Boston Harbor, Quincy	New Pumpout Station
Dock Side Marina, Lewis Bay, Hyannis south side	New Pumpout Station
Provincetown, Cape Cod Bay	Replacement Pumpout Boat
City of Newburyport, Merrimack River	Replacement Pumpout Boat

During 2013, coordination of *Mass*CVA was merged with that for the Boating Infrastructure Grant Project. Cecil French began overseeing and running both grant programs in September. Tom Beaulieu retired after 19 years supervising and running *Mass*CVA with commendable skill and vision.

Boating Infrastructure Grant Project

The Massachusetts Boating Infrastructure Grant (*Mass*BIG) Project, begun in 2001, is a two-tiered federal grant program, directed through the USFWS and administered by *MarineFisheries*. The Project is funded by Sport Fish Restoration Fund which receives a small percentage of the Federal Gasoline Tax – an amount which represents fuel purchased by boaters across the nation. 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.

Proposed projects filed under Tier II can be much larger in scope than those in Tier I. Unlike Tier I, Tier II proposals are judged in a nationally competitive process based on a strict point system. Both grant tiers are reimbursement grants, meaning that payments are made upon the submission of invoices for work accomplished. Selected applicants provide at least a 25% match for Federal funds received. All payments are based on 75% reimbursement of invoices from work completed.

2013 was an exciting year for *Mass*BIG. This year, the Project was proud to announce the state's first successful Tier II project – the City of Lynn's Seaport Landing Marina Transient Dockage Project. The grant for this project and two Tier I projects were open in 2013, and are described in more detail. See Table 25 for a summary of all projects completed and in progress in Massachusetts.

Figure 54. Wessagusset Yacht Club Transient Boater Dockage - Phase II.

Wessagusset Yacht Club Transient Boater Dockage – Phase II: The objective of this project

is to increase transient boater berthing and access to Boston Harbor's natural, historic, and scenic attractions by providing dockage for four transient boats 26 feet or more in length through the purchase, construction, and installation of one heavy-duty 50 ft x 14 ft dock unit (Figure 54).

These four additional transient berths, at the renovated, full service yacht club, will provide a greater number of transient boaters the much needed opportunity to tie up in a safe berthing in a high demand region. The unit will be placed at the terminus of reconfigured yacht club floats for easy, deep water access in and out of the facility for transients. The unit was chosen specifically for the ability to provide stable dockage in a potentially high energy environment and will assure safe dockage under all weather conditions for transient vessels over 26 feet in length. The project will provide boaters greater access to the greater Boston Harbor area and help the community by supporting new revenue generating businesses in the waterfront area.

Figure 55. Nantucket Town Pier.

Nantucket Town Pier Transient Dockage Improvements: The objective of this project is to provide safe, convenient dockage for 33 transient boaters with vessels 26 feet and greater in length by renovating the Nantucket Town Pier through the replacement of 300 cross beams, 15 service ladders, 14 pilings, and several hundred feet of decking and hardware (Figure 55).

Located in close proximity to downtown, this improvement project will guarantee continued, safe access for the thousands of transient boaters who use the town facility to access the town of Nantucket from the harbor, enhancing tourism.

City of Lynn, Seaport Landing Marina BIG Tier II Transient Dockage: The first state Tier II project, the objective of the project is to provide 12 ADA accessible transient berths for transient boats greater than 26 feet in length and provide a deep-water safe harbor with convenient access to amenities and local attractions for transient boaters travelling along the eastern seaboard (Figure 56). Benefits to recreational boaters include availability to the city owned water front facility with pumpouts, restrooms, and showers and

Figure 56. Seaport Landing Marina, Lynn – site of the first state BIG Tier II transient dockage project

immediate access to the adjacent city of Lynn. Lynn Harbor is centrally located in Massachusetts Bay and is an ideal waypoint for boaters travelling the Atlantic coast between Cape Cod and Portland, Maine.

Table 25. Massachusetts BIG Project Summary

Year	Project	Award	% Complete
2001	Nantucket Transient Boater Restrooms (Town Pier)	$90,413	100%
	Tisbury Transient Dockage & Dinghy Dock (Lake Tashmoo)	$52,000	100%
2002	Wellfleet Transient Dockage (Town Pier)	$62,625	100%
	Chatham Transient Moorings & Navigational Aids (Stage Harbor)	$15,000	100%
2003	Chatham Transient Boater Restrooms (Stage Harbor)	$69,000	100%
	Beverly Transient Moorings (Great Misery Island)	$17,394	100%
2004	Boston Harbor Islands Transient Moorings (Long Island)	$25,000	100%
	Boston Harbor Islands Transient Moorings (Peddocks Island)		
	Owen Park Transient Dockage (Vineyard Harbor)	$53,752	100%
2005	Provincetown Transient Courtesy Float (MacMillan Pier)	$60,000	100%
	Nantucket Transient Boater Navigational Aids (Nantucket Harbor)	$19,382	100%
	Nantucket Transient Boater Navigational Aids (Madaket Harbor)		
2007	New Bedford Transient Navigational Aids & Moorings (New Bedford Harbor)	$95,000	100%
	New Bedford Transient Dinghy Dock (New Bedford Harbor)		
2009	Scituate Marine Center Transient Access (Scituate Harbor)	$90,000	100%
2011	Wessagusset Yacht Club Transient Dockage (Fore River, Weymouth)	$92,250	100%
2012	Nantucket Pier Transient Dockage (Nantucket Harbor)	$89,011	0%
2013	Wessagusset Yacht Club Transient Dockage – Phase II (Fore River, Weymouth)	$92,250	50%
	City of Lynn Seaport Landing Marina Transient Dockage (Lynn Harbor)	$267,700	10%

Other Activities: The former BIG Coordinator represented the agency on the Massachusetts Legislative Boating Caucus. The Project also maintained agency membership with the States Organization for Boating Access (SOBA). Project staff began assisting SOBA and the Vermont Boating Access Program with the 2015 National Boating Access Conference to be held on Lake Champlain in Vermont. The 2015 Conference will highlight boating access in the New England Region. Both the Project Leader and the Federal Grants Coordinator completed USFWS TRACS training in October. The TRACS system is a new grant tracking and reporting system the USFWS has developed for use with all Wildlife and Sport Fish Restoration grant programs, including BIG and CVA.

The majority of the administration of this project entailed preparing annual financial and progress reports, preparing annual grant submissions, and working with potential applicants. In 2013, a considerable amount of technical assistance continued to be provided to prospective Tier II applicants - the Gloucester Waterways Board and the City of Newburyport. A presentation was given to the Gloucester Waterways Board and City Officials in June. Site visits were conducted to assess and assist both Gloucester and Newburyport.

Capital Assets

Facilities

MarineFisheries maintains facilities at several coastal locations throughout the state. Headquarters are located in Boston, and the two primary field stations are located in Gloucester and New Bedford. Other facilities include the Shellfish Purification Plant in Newburyport, the John T. Hughes Hatchery and Research Station on Martha's Vineyard, and a subsidiary field office and storage facility in Sandwich.

In FY2013, *MarineFisheries* spent approximately $350,000 in facility planning, infrastructure maintenance, emergency repairs, and equipment. A new card writer was purchased with swipe technology for a pilot program to develop a newer system allowing commercial fishing sale transactions could be logged electronically at point of sale, and a new phone system was installed in the Gloucester facility. Repairs at the Gloucester Office included an upgrade to the processing area, a new walkway, and minor maintenance. Repairs at the Martha's Vineyard field station included a new seawater aeration system and electrical upgrades. In Newburyport, permitting and design was completed for a replacement to the existing drainage outfall pipe.

Vehicles and Boats

MarineFisheries maintains a fleet of 40 vehicles and 16 boats. In 2013, just over $61,500 was paid to the Office of Vehicle Management for lease vehicles, and an additional $28,000 was spent on maintenance and repair for all stock. In addition, four boat trailers and one outboard motor were purchased outright in FY2013 for a total cost of $35,000. No vehicles were replaced in FY1013.

Outreach

MarineFisheries Outreach was created in CY2012 to establish a more consistent connection with the Massachusetts saltwater fishing community and general public. Outreach funds, including

the hiring of an information and education coordinator, are from the Marine Recreational Fisheries Development Fund.

In CY2013, a number of informational materials were produced (Figure 57). Postcards describing and encouraging the use of circle hooks were designed and printed for distribution through *MarineFisheries* MRIP Project in an effort to re-establish the "responsible angler" initiative. Packages of circle hooks, which were distributed with these postcards, were donated by EagleClaw and MustadUSA. Brochures and pamphlets were designed and printed for various projects within *MarineFisheries*, including one for the Sportfish Angler Data Collection Team. The information and education coordinator also published two reports in the Technical Report series in CY2013, and served as an editor to two issues of DMF News, *MarineFisheries'* newsletter, published during the year.

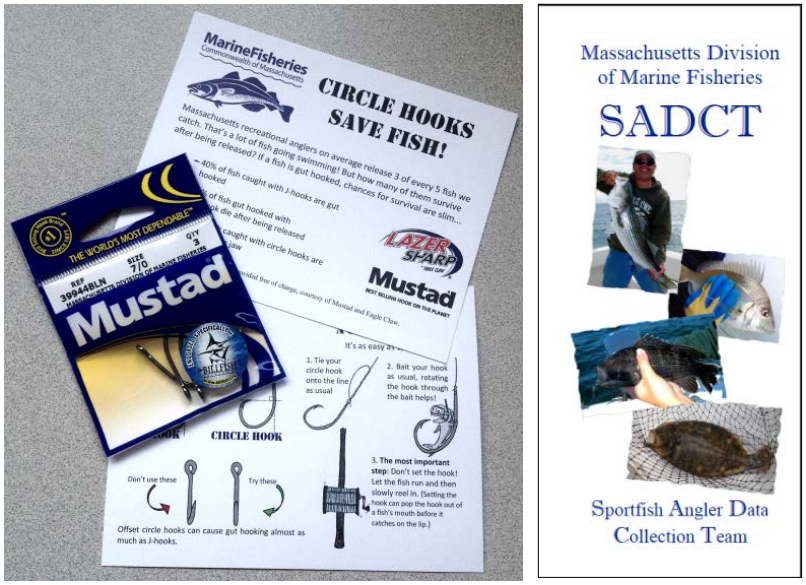

Figure 57. An example of informational Outreach materials developed in 2013.

The Information and Education Coordinator was present at various trade shows throughout CY2013. Informational brochures on *MarineFisheries'* research and policy work were distributed at the Working Waterfront Festival in New Bedford, Topsfield Fair in Topsfield, New England Boat Show in Boston, and Fishing and Outdoor Expo in Worcester, among others.

MarineFisheries' virtual communication with Massachusetts residents was expanded by creation of a social media identity through three platforms: Twitter (handle: @MassDMF), YouTube (channel: MA MarineFisheries), and Flickr (user: MA MarineFisheries). *MarineFisheries* uses these platforms to share information regarding management and research as well as to cross-promote with sister agencies within the Commonwealth. The information and education coordinator is also co-webmaster for the Division's website, which was migrated to a new platform in CY2013. Page content was, and will continue to be, updated in response to current research and information.

As part of Outreach, the Information and Education Coordinator is *MarineFisheries'* representative to local and national educational groups including Massachusetts Marine

Educators (MME), National Marine Educators Association (NMEA), and National Science Teacher Association. The coordinator serves on the Marketing and Communication and the North Shore High School Marine Science Symposium committees for MME, and is the vice-chair for the Communications Committee for NMEA.