

Department of Fish and Game

Massachusetts Division of Marine Fisheries

2012 Annual Report

Commonwealth of Massachusetts

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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 laws 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

MassDARMassachusetts Department of Agricultural ResourcesMassDCRMassachusetts Department of Conservation and RecreationMassDEPMassachusetts Department of Environmental Protection

Massachusetts Department of Transportation
Massachusetts Department of Public Health

Massport Massachusetts Port Authority

MassWildlife 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

NMFS National Marine Fisheries Service

NOAA National Oceanic and Atmospheric Administration

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
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Melanie Griffin, Fisheries Management Specialist
Nichola Meserve, Fisheries Policy Analyst
Jared Silva, Program Coordinator

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), a nine-member citizen board 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 2012 unilateral of interstate or federal fisheries management actions.

Marine Fisheries Advisory Commission

The MFAC held seven business meetings during 2012. Additionally, two subcommittees of Commissioners met in February and May to discuss commercial striped bass fishery management options and regulatory compliance and enforcement issues, respectively.

The Commission approved regulatory revisions for: a renewal of the state-waters river herring harvest moratorium (322 CMR 6.17); a prohibition on the use of natural bait with embedded or attached weights not themselves attached to the end of the fishing line (322 CMR 6.42); revisions to the Gulf of Maine haddock recreational size and bag limits to complement federal rules, although these were never finalized because the federal rules were rescinded; amendments to the seasons, bag limits, and minimum sizes for recreational summer flounder (fluke), scup, and black sea bass (322 CMR 6.22 & 6.28); the adoption of a v-notching requirement for Lobster Management Area 2 (322 CMR 6.2(3)); and a rule that trip limits for quota managed species apply to vessels (322 CMR 6.41(2)). A regulatory change to clarify that the taking of lobster by open and collapsible traps is prohibited that was approved by the Commission in 2011 also became effective in 2012 (322 CMR 6.02(1)). The MFAC also approved annual specifications and/or mid-season adjustments for spiny dogfish trip limits, Atlantic herring days out, the Winter II commercial scup fishery trip limit, and northern shrimp landing days.

MarineFisheries and the MFAC conducted a total of three public hearings and four comment periods on the above changes. Additionally, two public scoping meetings were held on whelk management. *MarineFisheries* also hosted five public hearings for the ASMFC on the interstate management of striped bass, American lobster, northern shrimp, winter flounder, and Atlantic menhaden.

In September 2011, the MFAC selected Mr. John T. Hughes to receive the Dr. David L. Belding Award (Figure 1). Mr. Hughes managed the Division's lobster hatchery on Martha's Vineyard for over 30 years, conducting lobster life history studies and rearing research. On March 23, 2012, MarineFisheries hosted the Belding Award Ceremony and the Dedication of the John T. **Hughes Hatchery and** Research Station (formally the state lobster hatchery) in Oak Bluffs.



Figure 1. John Hughes (left) displays the sign for the newly named research facility with members of his family.

Recreational Saltwater Fishing Permit

2012 Massachusetts Saltwater Angler Permit Survey: During 2012, MarineFisheries collaborated with the National Marine Fisheries Service (NMFS) to collect information on the Commonwealth's recreational saltwater fishery to measure its economic value. Surveys were mailed to a random sample of 2012 recreational fishing permit holders. These surveys used various economic evaluation tools to estimate the value each individual placed on access to marine fishing in Massachusetts. In addition to providing important information about the socioeconomic value of saltwater fishing in Massachusetts, the federally-funded study will help to validate the various survey tools used. Analysis of the results was expected to occur in 2013.

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 allocations from the Marine Recreational Fisheries Development Fund should be spent. The panel consists of two members of the MFAC and three members of the public at large, all of whom have specific expertise and background in the Commonwealth's marine recreational fisheries.

During 2012, the Panel met twice to discuss and make recommendations for spending of the expected FY13 fund appropriation. The approved spending plan included, but was not limited to: construction of a sport fishing pier at Oak Bluffs, Martha's Vineyard; expanded and enhanced sampling of the recreational fishery; additional public informational and educational materials and programs; stocking and monitoring of diadromous fish populations; and research into the migration and stock structure of striped bass.

Fluke, Scup, and Black Sea Bass

Summer Scup Commercial Trip Limit: Regulations allow the Director to make in-season adjustments to commercial scup limits via declaration to support attainment of the annual quota. With an 83% increase to Massachusetts' summer scup quota in 2012, the fishery had only landed 17% of its allowed 2.35 million pounds one-month into the season. In response, *MarineFisheries* proposed to increase the summer trip limit for all authorized gear types (except weirs which are exempt from scup trip limits) from 800 lbs to 1,500 lbs. Following a two-week public comment period and approval by the MFAC, the higher limit was implemented July 10, 2012 for the remainder of the summer season (October 31). Nonetheless, 40% of the quota went unharvested, prompting the Division to plan to consider more liberal regulations for 2013.

Commercial Winter Fluke Pilot Program: As done for the 2011 Period I Fluke Fishery, *MarineFisheries* offered letters of authorization (LOAs) to interested fluke permit endorsement holders to land 2,000 lbs of fluke per week rather than 500 lbs per trip during the 2012 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 2012 program also began early, on December 18, 2011, to capitalize on the remaining 2011 fluke quota. To ensure timely monitoring of the quota, participants were required to sell their fluke to designated dealers that report their transactions daily.

MarineFisheries issued 63 LOAs to participate in the 2012 program, up from 54 LOAs in 2011. The program ended on February 19, 2012, when 25% of the annual quota (217,056 lbs) was projected to be caught; the possession limit then dropped to 100 lbs. In total, 36 vessels landed

fluke during the pilot program. Opening the pilot program on December 18 resulted in 73,421 lbs of fluke being landed between December 18 and 31, helping to bring the year's harvest to within 2% of the annual quota. Due to the success of the program, *MarineFisheries* planned to reauthorize the pilot program in 2013.

Moratorium on Issuance of Commercial Black Sea Bass Permits: In response to the seasonal, near-shore abundance of black sea bass, a limited and static commercial fishing quota, and increased commercial fishing effort in recent years, the Director used his authority, with the consent of the MFAC, to cease the issuance of new commercial black seas bass permit endorsements effective May 11, 2012 and until further notice. The moratorium primarily affects hook and line fishermen, as the pot fishery has been closed to new entrants since the 1980s.

Sea Scallops

Response to Increased Inshore Participation: In October 2011, in response to a substantial increase in participation, effort, and landings of scallops in state waters by vessels without a federal permit, the Division held scoping meetings 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 on November 1, 2011, a 200-pound state waters sea scallop (shucked) trip limit (or 2,000 pounds whole), and on January 1, 2012, a 10" twine top minimum mesh size and a 4" minimum dredge ring diameter. Federally permitted scallop vessels can transit state waters and land larger amounts of scallops in state ports provided they comply with the federal plan and their gear is stowed. The two gear restrictions were made effective at the later date in order to allow the fleet sufficient time to make adjustments. In June 2012, the MFC supported the Director's recommendation to take public comment on adopting the permit conditions as rules. Final regulations were expected in 2013.

Striped Bass

Circle Hooks and Yo-Yo Fishing: In November 2011, *MarineFisheries* held public hearings on the use of circle hooks and so-called "yo-yo rigs" in the striped bass fishery. The proposals would require fishermen to use circle hooks when using natural bait and prohibit the use of yo-yo rig gear; i.e., baits weighted and stiffened with artificial materials which are not themselves

attached to the terminal tackle (Figure 2). The proposed regulations aimed to reduce discard mortality. Based on the public comment received and a review of rules in other states, in January 2012 the Director recommended and the MFAC supported making it unlawful in Massachusetts waters for both commercial and recreational fishermen to use a yo-yo rig where the embedded materials are not attached to the terminal tackle. Rather than a circle hook rule, *MarineFisheries* plans to invest in additional angler education promoting responsible angling techniques, including the use of circle hooks. The yo-yo rig rule became effective on July 6, 2012. The regulation applies to all hook and line fisheries.



Figure 2. These materials used to weight and stiffen bait fish were found inside the belly of striped bass likely as a result of their not being attached to the terminal tackle.

Commercial Fishery Management: In December 2011, a commercial striped bass industry group requested the Division to consider management revisions that might improve the profitability of the fishery. In response, a subcommittee of MFAC members met in February 2012 to discuss modifications aimed at extending the season, reducing market gluts, and stabilizing the exvessel value at higher levels. In March, the Director and MFAC decided to postpone further consideration of changes until after the 2012 season to see if the dense aggregation of fish off Chatham that fueled much of the market dynamics the prior two years returned again. Following the shortest season on record, heavy fishing pressure, and escalating congestion on the fishing grounds and boat ramps, the Division analyzed at the request of the MFAC the expected change in season length under various open fishing day and bag limit scenarios. In December, the MFAC supported the Division holding an industry-based focus group meeting to further refine a proposal for public hearing early in 2013.

Horseshoe Crab

Lunar Closure Amendment: In May 2012, *MarineFisheries* received a petition from the Town of Wellfleet to extend the May – June lunar closures into April and to close Wellfleet Harbor to all harvest of horseshoe crabs. In September, the MFAC supported the Division's plan to take the lunar closure proposal to public hearing in recognition of environmental factors influencing the timing of spawning. However, in October, the Director recommended against adopting the closure of Wellfleet Harbor due to inadequate scientific evidence to support the claim that the closure would enhance shellfish production, concerns about displaced effort caused by a closure, and insufficient data to assess horseshoe abundance and a trigger to re-open the area. A public hearing for the lunar closure extension was expected to occur in early 2013.

Whelk

Spawning Stock Protection: In late 2011, *MarineFisheries* brought to the attention of the MFAC developing issues in the state's channeled whelk fishery. With increases in effort (especially in Nantucket Sound) and the price per pound, the value of landings had reached an all-time high. In the meantime, the fishery lacked a standard method or certified gauge for measuring whelk against its minimum size and there were allegations of excessive harvest over the Commonwealth's 5% tolerance for undersized whelk. Staff biologists had expressed concern about sustainability of the current fishery given the declining trend of channeled whelk relative abundance in the Division's trawl survey (Figure 3), as well as anecdotal reports from commercial fishermen that portions of Buzzards Bay and Nantucket Sound had seen substantial declines. However, there was insufficient scientific information for management measures. This prompted *MarineFisheries* to initiate a channeled whelk life history study to generate the necessary basic biological information.

MarineFisheries completed the life history study in 2012, which indicated that female channeled whelk are not sexually mature at the current 2 ¾" minimum shell width, and this could lead to depletion of spawning stock. Consequently, MarineFisheries held two public scoping meetings in March 2012 to review available information about the resource, the fishery, and its management and begin to develop consensus for appropriate management measures. Staff continued to work with industry members throughout the year. Public hearings on the resulting proposed measures were anticipated to occur in early 2013.

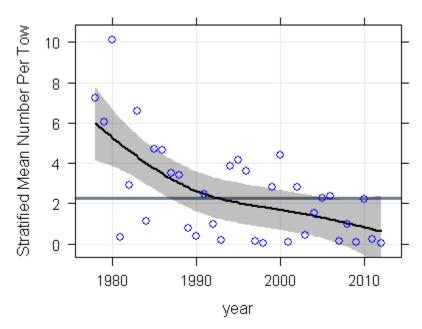


Figure 3. Relative abundance of knobbed whelk in *MarineFisheries* fall trawl survey; the black line shows the overall trend, the grey line shows the timeseries mean.

Interstate and Federal Fisheries Management

Following below are actions taken and issues confronted by *MarineFisheries* in 2012 to address interstate or federal fisheries management actions.

River Herring

Harvest Moratorium: In 2008, the MFAC approved continuing a moratorium on the directed harvest of river herring for another three years (through 2011) with a 5% bycatch tolerance for offshore bait fisheries. This action was necessitated by a lack of recovery of river herring runs in the region. In May 2009, the ASMFC approved Amendment 2 to the Shad and River Herring Fishery Management Plan, requiring states to develop sustainable fishery plans for any recreational and/or commercial river herring fisheries they intended to keep open after January 1, 2012.

Based on continued low levels, *MarineFisheries* did not submit a sustainable fishery plan for any run, but instead proposed, and the MFAC agreed, to take to public hearing a proposal that would strike the January 1, 2012 moratorium expiration. Massachusetts regulations already provided the Director with the authority to open runs when sustainability can be demonstrated. A public hearing was held in January 2012. The limited comment received was in support of the harvest moratorium. The rule change became effective on March 16, 2012.

Winter Flounder

ASMFC Addendum II: With members of our state-waters commercial groundfish fleet asking for more access to resources, *MarineFisheries* realized that there may be opportunity to increase the Gulf of Maine winter flounder trip limit. The existing 250-lb commercial trip limit, as well as a 10% recreational fishery reduction, had been adopted in the interstate plan in response to the

stock being overfished; however, an updated stock assessment indicated that overfishing had ended, leading NMFS to substantially increase the state waters annual catch limit subcomponent. Revising the Commonwealth's trip limit and eliminating its two-month recreational fishery closure would require an addendum to the interstate plan.

MarineFisheries requested and helped draft the addendum to the interstate plan under a "fast-track" process. In October 2012, MarineFisheries hosted an ASMFC hearing on Draft Addendum II, which proposed a doubling of the trip limit and the return of a year-round recreational fishery. The addendum was subsequently approved by the ASMFC. MarineFisheries implemented compatible regulations via emergency action, which became effective November 26, 2012. A public hearing was planned for January 2013 in order to permanently codify the regulations.

Spiny Dogfish

2012/2013 Fishery Specifications: With the resource continuing to be rebuilt and fished at a level well below the target, NMFS and ASMFC raised the commercial quota for the 2012/2013 fishery to 35.6 million pounds, a 78% increase from the 20 million pound quota the previous year. *MarineFisheries* supported this quota increase, as well as the maintenance of the 3,000-lb trip limit to preserve market stability and season length. After a public comment period in Massachusetts on the trip limit, the MFAC voted in April to approve the 3,000-lb trip limit for the fishery starting May 1, 2012 until the Northern Region (ME – CT) quota allocation (58% of the coastwide quota) was taken.

Experimental Short-soak Gillnet Fishery: With roughly 30% of the Northern Region quota remaining at the end of September, and an existing two-month state waters groundfish closure in Upper Cape Cod Bay and Massachusetts Bay about to take effect and exclude gillnetting, *MarineFisheries* authorized an experimental fishery to allow "short-soak" gillnet fishing for spiny dogfish in the closure area in October. An existing exemption already allowed longlining for spiny dogfish during the time/area closure.

Six letters of authorization were issued to participate in the experimental fishery with conditions such as net tending and monitoring requirements. Access to the area was subject to revision if regulatory discards became problematic; at-sea observations found discards to be negligible. The program was extended into November.

Even with additional access to the spiny dogfish resource provided, the 2012/2013 commercial spiny dogfish fishery in Massachusetts remained open at the end of 2012 given the low trip limits and dramatic increase in the quota. The past two years under lower quotas, the fishery was closed in August.

Striped Bass

ASMFC Addendum III: In response to a recent multistate and federal investigation into the commercial striped bass fishery, the ASMFC initiated a draft addendum in 2012 to consider mandatory tagging of commercially harvested striped bass throughout its Atlantic coast range. In June 2012, the Division hosted an ASMFC hearing on the draft addendum, and in August, the ASMFC approved Addendum III to the interstate FMP.

The addendum requires Massachusetts to implement either a point-of-harvest or point-of-sale tagging program for commercially harvested striped bass for 2014. Recognizing that industry input will be vital to developing a program that meets the compliance criteria while minimizing the burden for all involved, the Division planned to convene a panel of industry advisors before taking specific proposals to public hearing in mid-2013 in advance of the 2014 fishing season.

Atlantic Menhaden

ASMFC Amendment 2: In October, *MarineFisheries* hosted an ASMFC public hearing on Draft Amendment 2 to the Interstate Fishery Management Plan for Atlantic menhaden. The ASMFC initiated the amendment in response to stock assessment findings indicating that menhaden is experiencing overfishing and may be overfished. The amendment proposed options to end overfishing, update the biological reference points, implement a commercial quota management program, and require certain fishery-independent and -dependent monitoring.

In December, the ASMFC approved Amendment 2, establishing the first coastwide commercial total allowable catch (TAC) for menhaden. Due to the stock's status, 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 just 0.84% of the TAC (3.16 million pounds for 2013). The vast majority of quota (85.32%) went to Virginia, home of the historical menhaden reduction plants.

MarineFisheries will need to implement regulations to manage the Commonwealth's menhaden quota by July 1, 2013, in order to maintain compliance with the interstate plan.

Fluke, Scup, and Black Sea Bass

Annual Measures: *MarineFisheries* revised the regulations for the 2012 harvest of scup, black sea bass, and summer flounder (fluke) pursuant to adjustments made by ASMFC.

Changes to recreational management measures were implemented by emergency regulation on April 30, 2012 due to late breaking decisions of the ASMFC. Public hearings occurred in June 2012. A near doubling of the scup recreational harvest target from 2011 allowed the states of Massachusetts through New York to significantly liberalize measures in 2012. *MarineFisheries* opened the for-hire season two weeks earlier and the private angler season three weeks earlier,

added more than three months to the end of the season for all modes, lengthened the for-hire bonus season by 10 days, doubled the private angler and for-hire regular season trip limit to 20 fish, and increased the for-hire bonus season trip limit from 40 to 45 fish. With a 41% recreational black sea bass harvest increase allowed for the Northern Region (MA – NJ), *MarineFisheries* was able to increase the

MarineFisheries was able to increase the recreational season by one month, and double the bag limit to 20 fish for four months during the open season (Figure 4). Lastly, for fluke, MarineFisheries was able



Figure 4. An angler displays a black sea bass.

to reduce the size limit by one inch to 16.5 inches.

On the commercial side, the fluke and scup quotas were reduced and the black sea bass quota unchanged. The regulations remained the same as in 2011. As authorized in the regulations, the Director (with the approval of the MFAC) declared an increase in the summer scup fishery's trip limit from 800 lbs to 1,500 lbs effective July 10 to encourage full harvest of the quota. Later in the year, when initiating discussion about 2013 commercial management for these species, the MFAC asked that the Director request the ASMFC to consider whether climate-induced distributional shifts of migratory fish populations – such as scup, black sea bass, and fluke – have occurred and if these distributional shift(s) can be used as a basis for re-evaluation of quota allocation decisions. The ASMFC's Management and Science Committee was later assigned this task.

Fluke Winter Period II Scup Trip Limits: With nearly 7.2 million pounds of unused Winter I quota being rolled into the Winter II fishery in 2012, NMFS increased the Winter II trip limit to 8,000 pounds (the maximum). So as to avoid disparate and more conservative rules in Massachusetts, *MarineFisheries* adopted the higher trip limit, effective November 1, by declaration following public comment and MFAC approval.

Northern Shrimp

ASMFC Addendum I: In October 2012, *MarineFisheries* hosted an ASMFC hearing on Draft Addendum I to Amendment 2 to the Interstate Fishery Management Plan for Northern Shrimp. Approved in November 2012, the addendum established a commercial quota, set annually to be between the fishing mortality target and threshold, and allocates it 87% to the trawl fishery and 13% to the trap fishery. The quota replaces a harvest target, frequently surpassed, which in conjunction with recent poor recruitment has resulting in an overfished and overfishing stock status. The quota is managed through annual specifications, including season start dates, open days, and trip limits.

2012/2013 Fishery Specifications: The poor stock status of northern shrimp led the ASMFC to set the 2012/2013 quota at 625 metric tons (mt), representing a 72% reduction from the prior year. The trawl and trap fisheries were set to close when 85% of their sub-quota is landed. The Northern Shrimp Section selected an opening day of January 22, 2013 with two landings days (Monday and Wednesday) for the trawl fishery, and an opening day of February 5 with six landing days (everyday but Sunday) and an 800 lb trip limit for the trap fishery. The Director established the specifications by declaration, following a public comment period and approval by the MFAC.

Atlantic Herring

Annual Specifications: As a member of the NEFMC, *MarineFisheries* participated in the setting of Atlantic (sea) herring annual catch limits for all management areas in the Gulf of Maine, Georges Bank, and Southern New England/Mid-Atlantic. As required by the interstate management plan and state regulations, *MarineFisheries* set days-out and opened and closed the 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 fall in the inshore portion of the Gulf of Maine. The default spawning closure of September 21 through October 18 was extended several weeks through November 12 due late spawning.

Amendment 5: *MarineFisheries* also had a major role in the development of the NEFMC's Amendment 5 establishing a comprehensive catch monitoring program for the limited access herring fishery, addressing river herring bycatch in the herring fishery, and establishing criteria for mid-water trawl vessel access to groundfish closed areas.

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 stock starting January 1, 2013. The population's decline is a product of poor juvenile lobster survival related to warmer ocean temperature. The addendum represents the first phase of a rebuilding program for the stock. Under the addendum, states must adopt regulatory changes to bring about the required reduction in Lobster Conservation Management Areas 2 through 6 (all areas but the Gulf of Maine and Outer Cape Cod), with action in Massachusetts needed for Area 2 (waters off MA and RI) and Area 3 (offshore federal waters between ME and NC).

MarineFisheries worked with the Lobster Conservation Management Teams and fishery agencies in other states to develop proposals for ASMFC approval. In February 2012, the ASMFC approved the following plans for LMAs 2 and 3:

- LMA 2: mandatory v-notching of all legal-sized egg bearing females beginning by June 1, 2012. Early implementation was required for the reduction in exploitation to begin in 2013; if by 2014 the reduction in exploitation is inadequate, a closed season will be implemented.
- LMA 3: a minimum size of 3 $^{17}/_{32}$ " effective by January 1, 2013.

Given the need for quick action for LMA 2, *MarineFisheries* implemented the v-notching program by emergency regulation effective May 1, 2012, with public hearings following in June 2012. The $^1/_{32}$ " LMA 3 size limit increase was also implemented by emergency action, effective December 31, 2012, with a public hearing expected in February 2013 in order to permanently codify the rule change.

The second phase of the SNE stock rebuilding program, an effort consolidation plan, was approved by the ASMFC in August 2012 (Addendum XVIII). The plan calls for trap allocation cuts over six successive years resulting in an approximately 50% reduction overall. Its implementation by states is contingent upon NMFS' implementation of transferability and trap reduction rules for federal waters, still pending at the end of 2012.

Atlantic Large Whale Take Reduction Plan: In 2012, MarineFisheries continued to urge NMFS to reconsider its proposed management strategy to further reduce the risk of serious injury or mortality to right, humpback, and finback whales resulting from entanglement in vertical lines associated with fixed gear fisheries off the U.S. We contend that 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, will result in far less risk reduction than NMFS suggests while placing small vessel fishermen in jeopardy. MarineFisheries recommended the consideration of alternative strategies, such as a winter/early spring prohibition on all fixed gear in the Cape Cod Bay Critical Habitat.

Shad

Historic low levels of shad (Figure 5) throughout most of their range have prompted the need for greater conservation. In 2010, the ASMFC approved Amendment 3 to the Interstate Fishery

Management Plan for Shad and River Herring, establishing a coastwide moratorium on recreational and commercial shad harvest beginning in 2013. Exempt from this closure are systems for which it can be demonstrated in a Sustainable Fishery Plan that their stock could support a fishery that will not diminish future stock reproduction and recruitment.



Figure 5. An American shad.

MarineFisheries worked to draft its Shad Sustainable Fishery Plan in 2012 with input from biologists at MassWildlife. Only seven rivers in the Commonwealth have recent records of supporting shad spawning runs, and only two of these – the Merrimack and Connecticut Rivers – have long-term fish lift counts that serve as indices of population abundance. Consequently, the Shad Sustainable Fishery Plan pursued preserving a retention fishery on the

Merrimack and Connecticut Rivers only, with the bag limit reduced from six shad per angler per day to three shad per angler per day to improve conservation, and requiring catch-and-release-only fishing at all other locations. This plan was approved by the ASMFC in October. At year's end, *MarineFisheries* was planning public hearings for 2013 to be held jointly with *MassWildlife* that would enable implementation of new rules by May, when shad return to state waters.

Groundfish

Complimentary Measures: During 2012, *MarineFisheries* took action to compliment federal regulations for recreational Gulf of Maine cod. Anglers in the Gulf of Maine Management Area may take nine cod (rather than 10 cod) at a minimum size of 19 inches (rather than 24 inches) during April 16 – October 31 (rather than April 1 – October 31). During November 1 to April 15, anglers aboard for-hire vessels may not retain cod, while private anglers may retain two fish per day not to exceed 75 lbs per vessel, at 19 inches minimum. These regulations were implemented by emergency action on May 1, 2012, with public hearings occurring in June.

Amendment 18: MarineFisheries was instrumental in continued work on the development of the NEFMC's Amendment 18 to the federal Northeast Multispecies Fishery Management Plan with goals to maintain inshore and offshore fleets and a diverse groundfish fishery with a balanced geographic distribution of permits to protect fishing communities and their infrastructure. A key aspect of the Amendment championed by MarineFisheries is to prohibit any person or government entity from acquiring or controlling excessive shares to the groundfish resource.

Frameworks 48 and 50: During 2012, *MarineFisheries* helped develop the NEFMC's Frameworks 48 and 50 to the Northeast Multispecies Fishery Management Plan involving the setting of annual catch limits for 2013-2015 and measures giving the commercial fishing industry more freedom and flexibility to deal with the groundfish fishery failure declared by the Secretary of Commerce for May 1, 2013. *MarineFisheries*, assisting the Patrick Administration, helped provide the justification for the declaration and need for industry financial assistance.

Shellfish

Vibrio Control Plan: To meet federal Food and Drug Administration mandates pertaining to the consumption of raw oysters and *Vibrio parahaemolyticus* ("vibrio") health related risks, *MarineFisheries* issued permit conditions to certain Massachusetts commercial shellfish permit

holders and seafood dealers, which were effective June 22 – September 8, 2012. The permit conditions were designed to better regulate the time-temperature related conditions of the oyster harvest in Eastern Cape Cod Bay. The affected permit holders included those shellfish growers in Eastern Cape Cod Bay (Barnstable to Provincetown), wild shellfish harvesters in the town of Wellfleet, and the seafood dealers that purchase product from these growers and harvesters.

In recent years, there has been an increased attention paid to the human health risk associated with consumption of raw shellfish, particularly oysters, due to the presence of the *vibrio* bacteria. *Vibrio* thrives in warmer temperatures with the bacteria multiplying faster as temperature increases. The more *vibrio* present in shellfish, the greater the risk of infection; the consumption of raw shellfish with high counts of *vibrio* can cause gastrointestinal illness and in severe cases it can be lethal. In 2011, two incidences of *vibrio* infection were traced back to the consumption of raw seafood harvested in Eastern Cape Cod Bay. The tidal movements in the area leave shellfish harvest and growing areas exposed to the air and direct sunlight during low tide, and during the warm summer months this exposure substantially increases the risk of infection. In response, *MarineFisheries* and the Massachusetts Department of Public Health designated a series of time-cooling requirements to minimize the risk of *vibrio* infection. Similar requirements were anticipated for 2013. See the Shellfish Sanitation and Management Program section for more information.

Other Activities

Publications

DMF News: *MarineFisheries'* newsletter was published twice in 2012. Two editions covering the $1^{st} \& 2^{nd}$ Quarter and the $3^{rd} \& 4^{th}$ Quarter were mailed to subscribers and are available through the Division's website.

Annual Report: MarineFisheries 2011 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 Diodati completed the first full year of his ASMFC Chairmanship, and continued to serve as Co-Director of the Massachusetts Marine Fisheries Institute. Dr. David Pierce was Chair of the ASMFC Atlantic Herring Section.

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 made from outside the agency. Project personnel also participate in the planning and development of the Atlantic Coastal Cooperative Statistics Program (ACCSP) and provide support to administrative staff for policy and 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 both harvester and dealer reporting information. Work began at the end of 2012 to migrate the Division's Internet website to the mass.gov portal format.

Oracle Database / Application Development & Maintenance

MarineFisheries continued to use and enhance four production databases during 2012: Commercial Permits and Statistics; Lobster Sampling; Shellfish Sampling & Area Management; and Time Tracking for Federal Grants.

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 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 2012, 1,753 businesses obtained a MA dealer permit. Of those, 482 (27%) were categorized as primary buyers, purchasing marine species directly from fishermen during 2012. These dealers were required to report their primary purchases, including products retailed themselves. Of the 482 dealers, 220 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 262 dealers were categorized as "state-reporting".

Even though many of the primary buyers in 2012 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, 172,838 transactions (not including negative reports) were entered into the SAFIS database, covering over 385,349 individual species landings, or 2.23 species per transaction. Federal-reporting dealers submitted over 70% of these transactions electronically. Of the remaining transactions submitted by state-reporting dealers, one-third was submitted electronically and two-thirds 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 770 million pounds, valued at \$618 million. The top five species in order of value were sea scallop, American lobster, Atlantic cod, Atlantic surf clam and goosefish, totaling \$466 million, or 79 percent of the total. When grouped together, offshore shellfish (sea scallop, surf clam and ocean quahog) make up 63 percent of the total value landed in MA, whereas inshore and intertidal landings of shellfish (such as soft shell clam, northern quahog, blue mussel, and oyster) amounted to just over 5 percent of total value landed. Landings of crustaceans (lobster, crabs, and shrimp) amounted to 25.6 million pounds, valued at \$62.2 million, or 10 percent. All finfish landings, including both pelagic and benthic species, make up 21 percent of the total value, with groundfish species amounting to 14.5 percent of the total value. Landed species with a total gross value over \$1 million are shown in Table 1.

Table 1. 2012 Massachusetts Landed Species with Value Greater than \$1 Million.

		144 1 5 1 2	14 L (A)
Species	Meat Pounds	Whole Pounds ²	Value (\$)
Scallop, Sea	36,741,225	306,052,488	365,034,026
Lobster, American		14,477,653	53,325,120
Cod, Atlantic		8,982,402	18,555,900
Clam, Atlantic Surf	18,239,339	95,581,828	16,065,768
Goosefish		11,569,618	13,579,039
Oyster, Eastern	309,398	4,119,326	12,050,951
Herring, Atlantic		81,781,049	11,696,736
Clam, Ocean Quahog	14,957,800	123,401,850	10,140,896
Flounder, Winter		5,146,796	10,133,111
Pollock		11,144,191	9,429,692
Haddock		4,174,298	7,529,049
Clam, Soft	971,322	4,759,483	6,410,554
Whelp, Channeled	1,146,904	3,601,278	6,155,115
Crab, Jonah		7,540,280	5,573,163
Tuna, Bluefin		623,079	5,523,790
Redfish, Acadian		8,184,129	5,478,744
Flounder, Yellowtail		4,351,690	5,414,124
Hake, White		4,792,116	5,291,802
Plaice, American		3,052,669	4,638,639
Hake, Silver		7,384,501	4,514,169
Quahog, Northern	609,789	4,695,873	3,682,345
Flounder, Witch		1,953,484	3,671,731
Squid, Longfin Inshore		2,944,256	3,583,127
Striped Bass		1,219,664	3,509,243
Dogfish, Spiny		13,133,911	2,893,835
Swordfish		851,283	2,698,921
Crab, Red		2,570,479	2,570,425
Flounder, Summer		891,495	2,341,765
Skates		8,574,315	2,240,926
Scallop, Bay	170,118	965,624	2,113,834
Scup		2,005,267	1,369,448
Conchs	171,786	539,408	1,206,983
Tuna, Bigeye		215,920	1,188,283
Skate, Winter		5,034,134	1,075,900

¹ Source: ACCSP Data Warehouse, as of April 30, 2013.

Certain fisheries are managed by quota in Massachusetts and were monitored in 2012 using the dealer reported landings in the SAFIS database. Automated scripts ran on a nightly basis and were displayed on the *MarineFisheries* website (Figure 6). 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

² All reported units converted to whole pounds.

which were used to project closure dates. Overages are applied to the following year's total harvest, where required.

QUOTA MANAGED SPECIES 2012 Landings and Quota Information as of Jan 01, 2013 - 10:00 P.M.					
Species	2012 MA Landings*	2012 Quota	Quota Type	Percent Landed	
Black Sea Bass	248,463	221,936	MA	112.0%	
Bluefish	686,121	692,986	MA	99.0%	
Dogfish	13,113,610	17,153,856	CW	to NMFS	
<u>Fluke</u>	891,495	868,226	MA	102.7%	
Scup ()	1,416,412	2,346,406	MA	60.4%	
Striped Bass	1,218,426	1,057,783	MA	115.2%	
Tautoq	67,870	61,180	MA	110.9%	

MA = Massachusetts-specific quota
CW = Coast-wide quota shared between MA and other Atlantic states

Figure 6. Example display of quota monitoring data available on MarineFisheries' website.

Fisherman Catch and Effort Data Collection

Starting in 2010, all commercial fishermen began submitting, on a monthly basis, comprehensive, standardized trip-level data for all commercial trips conducted under the authority of a MA commercial permit. Those individuals holding a federal permit with reporting requirements to NMFS (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 to enter data submitted on paper forms, and a newer bulk upload process called eTrips Upload, which made data entry considerably more efficient. 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 new 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 2012, *MarineFisheries* issued 7,767 commercial harvester permits, of which 1,209 (15%) were for federal reporting vessels. The remaining 6,558 commercial permits issued were designated as "state-reporting", and of those, 2,102 (or 27% of total permit holders) chose to report electronically using the SAFIS eTrips application. However, in the end, only about 18% of all permit holders actually reported electronically, leaving about 66% submitting paper reports to *MarineFisheries*. This followed a similar trend in the previous two years.

Of the 122,883 commercial trips entered in the SAFIS database for 2012, approximately 20% were added by commercial permit holders using the SAFIS eTrips application, with the remaining trips added by *MarineFisheries* staff. As in 2011, a large percentage of reports were submitted late, often not until the end of the year when permits were renewed for 2013. Consequently, *MarineFisheries* was inundated with reports at year's end and was still entering 2012 data throughout a good portion of the first quarter of 2013.

The collection of both harvester- and dealer-reported landings allows for comparison between the two sources. Figures 7-9 compare landings for lobster, groundfish and striped bass, respectively, in 2012. 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.

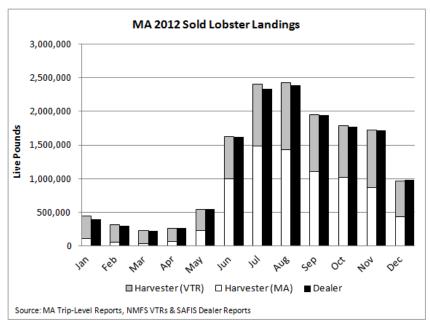


Figure 7. Dealer-Reported and Harvester-Reported Landings of Lobster in 2012.

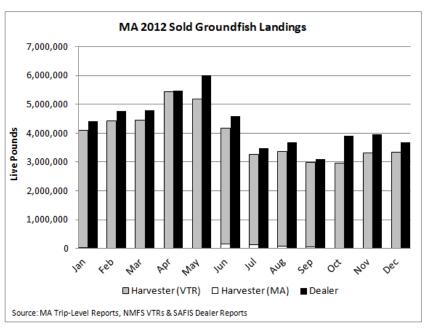


Figure 8. Dealer-Reported and Harvester-Reported Landings of Groundfish in 2012.

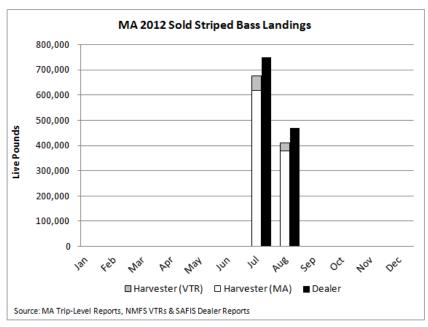


Figure 9. Dealer-Reported and Harvester-Reported Landings of Striped Bass in 2012.

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 in 2012. The core database routines that populate many of the Division's intranet, quota monitoring, and permit information web pages were documented. Larger analysis projects were again focused on the commercial striped bass and groundfish fisheries due to intense public interest. Several major projects are described below.

Analysis of Massachusetts Commercial Striped Bass Fishery: A highly accessible aggregation of striped bass centered off Chatham during the summers of 2010 – 2012 prompted a review of potential regulatory measures to address the issue of premature season closure and market gluts. Projections were made to estimate the effect of adjustments to the bag limit and number of weekly open days on season length. Different regulatory scenarios along with recent landings statistics were prepared for presentation to the Marine Fisheries Advisory Commission.

Management and Analysis of Federal Vessel Monitoring System (VMS) Data: Due to the increased demand for vessel location data required for state commercial fisheries management, *MarineFisheries* entered into a Vessel Monitoring System (VMS) data sharing agreement with NOAA. A routine was automated that parses the VMS data and loads it into the Division's secure Oracle™ database. Several scripts were also developed that interface with the data and cartographically display it in a manner that indicates trip duration, fishing locations, and vessel bearing. The data are available for query and updated quarterly.

Massachusetts Revolving Loan Fund (RLF) Support: MarineFisheries partnered with local lending institutions to aid the transition to sector management for commercial groundfish fishermen by allocating federal grant money via short-term loans to small-scale fishing operations to lease quota. VTR data were analyzed to determine eligibility for the program, and staff continues to support ongoing maintenance of the program.

Clarification of Massachusetts Spiny Dogfish Quota Monitoring Methodology: Project staff documented *MarineFisheries'* methodology for monitoring the Commonwealth's spiny dogfish commercial quota, in response to concerns that late reporting by Massachusetts dealers was partially responsible for overage of the 2011/2012 northern region quota. Staff demonstrated that procedures designed to correct and account for late reporting dealers were generally effective and resulted in significantly less impact on the overall quota monitoring process than thought.

Adding Spatial Analysis Capabilities to Lobster Database: The Division's Coastal Lobster Investigations Project regularly collects fisheries independent and dependent lobster data. Stock assessment scientists use these data, which are periodically uploaded to ACCSP in order to facilitate distribution to other state partners. These assessments require data to be attributed to NMFS statistical areas. Due to an offshore shift in commercial lobster effort, trips now span multiple statistical areas and tend to occur in offshore rather than inshore statistical areas. This spatial shift in effort required attributing a statistical area to each lobster trawl rather than to a single trip (previous method). The existing application could not accommodate this change so a script was developed that translated the latitude and longitude coordinates of each lobster trawl into NMFS statistical areas. This script is then run during data audits and post processing. This was accomplished by building a database table that could be joined to latitude and longitude coordinates in order to retrieve NMFS statistical areas.

ACCSP Participation and Planning

With the transition to trip-level reporting for all Massachusetts harvesters in 2010, continued procedural development occurred during 2012, including the preparation, submittal, and acceptance for future funding support from ACCSP. *MarineFisheries* staff continued to provide feed-back to ACCSP with regard to web-based reporting applications, a valuable part of the continued improvement of these applications. Fisherman permit and vessel information was routinely uploaded to the SAFIS database. Both the state boat registration database and the

United States Coast Guard registration database were used to verify registration or documentation numbers for all vessels before adding the vessels to the SAFIS database.

Law Enforcement, Permitting, and Industry Interaction

Project staff routinely worked with *MarineFisheries* administrators and law enforcement personnel on enforcement and regulatory issues. Project staff continued collaborating with the Office of Environmental Law Enforcement on a lengthy investigation into spiny dogfish overages that began in 2011. Trip-level records were an important piece of this investigation. Additional support was provided to law enforcement for a variety of permitting and reporting issues and inquiries.

Staff provided data, support, and outreach to industry when needed. For example, continued cooperation with the industry made the quota-monitoring piece of the Winter Fluke Fishery Pilot Program a success. Other industry support was provided by phone, individually at DMF facilities, and at meetings such as at the Massachusetts Lobstermen's 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 a contractor, Active Outdoors, to continue to fine-tune the new recreational permitting system for both *MarineFisheries* and the Division of Fisheries and Wildlife. The Gloucester facility began issuing commercial permits in 2008. As more permit holders have become aware of this option, the percent of commercial permits issued in Gloucester has increased from about 1% of the total commercial permits issued to 8.8% in 2012 (885 permits), up from 8.4% in 2011. In addition, Gloucester staff, primarily from the Statistics Project, issued 1,939 recreational permits through the *MassFishHunt* application in 2012. Project staff provided support both for permitting and regulatory questions as well as technical issues.

Conservation Engineering Program

Personnel

Michael Pol, Program Leader David Chosid, Marine Fisheries Biologist Mark Szymanski, Assistant Marine Fisheries Biologist

Overview

Conservation Engineering (CE) collaborates with industry and others to reduce impacts of fishing gear on non-target species. During 2012, staff provided vital leadership to the regional research program GEARNET, including finances, oversight, and direction. Investigations of innovative fishing technology and fish behavior in otter trawls continued. Relationships with individual groundfish sectors were developed and strengthened, enhancing the Program's position as a regional leader in gear research.

Projects

Redeveloping a Sustainable Redfish Trawl Fishery in the Gulf of Maine

This project is a multi-year, NMFS-funded network of gear researchers, net makers, fishermen, NMFS Regional Office and Science Center members, Council staff, fish processors, and others working to re-establish the redfish (*Sebastes fasciatus*) trawl fishery in the Gulf of Maine. CE's role in the network includes coordination, financial administration, contract management, equipment purchase, sharing and maintenance, and logistical support for field work.

In January, staff presented a project update to the New England Fishery Management Council. An exploratory fishing component of the project was completed with two more trips in 2012. Staff contributed significantly to the production of a draft final report on this component. Planning meetings for codend selectivity work were held. New net sensors were purchased and more fieldwork planned for 2013 and 2014.

Conservation Engineering Marine Fisheries Initiative

The intent of this project is to identify vital, immediate gear research that could assist fishermen in their transition to sectors and under new catch limits. The projects provide some personnel support to CE as a means of creating capacity for the anticipated research projects and activities. As a network coordinator, CE arranged meetings, purchased equipment, contracted with vendors, and provided substantial budgetary and administrative leadership and oversight.

In 2011, sixteen proposed projects for gear demonstration or testing were approved. Staff had varying degrees of involvement in each of these projects. Staff handled budgeting, bid solicitation, contracting and financial oversight for seven of the projects. For three projects, staff supplied direct oversight. The Sector 6 proposal to test a Ruhle trawl designed to target haddock while excluding cod was approved and initiated via financial arrangements and gear construction. However, lack of accessible haddock on Georges Bank led the proponents to terminate the project. Sector 10's testing of a larger mesh, knotless codend was approved, and

the codends were built and distributed (Figure 10). Sector members will be interviewed in 2013 regarding their adoption of this gear. Staff also conferred with the Northeast Coastal Communities Sector on a cod potting project.

Proposals for a second round of funding under this project were developed in collaboration with Sectors 5, 6, 10, 13, and the Sustainable Harvest Sector. A cross-sector project to support pinger purchases was developed under staff guidance, targeted at Sectors 3, 11, 12, Common Pool, and Sustainable Harvest. Input on proposals for Sectors 7, 8, and 9 was also provided by staff. Staff also helped organize a flume tank workshop for fishermen in St. John's, Newfoundland in October.

Staff continue to develop Gloucester draggerman Dan Murphy's (F/V Bantry Bay) idea for an inexpensive codend that, when filled with fish, is triggered to break away (and stop fishing) and



Figure 10. Captain Steve Welch, net maker Sarah Fortin (Reidars, Inc.) and Program Leader Mike Pol display a Sector 10 knotless codend.

release an integrated signaling device (built by Superior Trawl, RI). In May, staff and industry participants travelled to St. John's, Newfoundland to test the codend in a flume tank facility. A new release mechanism was developed based on testing. A network meeting to discuss project directions was planned. A presentation on this project was made at the Maine Fishermen's Forum.

Investigation of Haddock and Flounder Behavior Near Standard and Floating Bridles

Funded by NMFS through the MFI, this project examines the effect of floating bridles compared to standard bottom contact bridles in a groundfish trawl net using underwater video and paired testing. Planning for the project, including equipment selection, was conducted in collaboration with Pingguo He of SMAST, and Captain Pedro Cura (F/V Fisherman), our industry partner.

Staff quantitatively analyzed behavior of flatfish and skates through meticulous video analyses, categorizing reaction direction, distance and other metrics. These data were analyzed and used to inform a draft model of fish reaction. It is anticipated that at least one manuscript will be developed based on this project. Future research is under consideration.

Design and Test of a Squid Trawl Intended to Reduce Bycatch

For this NMFS proposal, staff partnered with Pingguo He of SMAST (project lead), net maker Tor Bendiksen (Reidar's Manufacturing, Inc.) and draggerman Mike Walsh (Integrity Fishing Corp.) to reduce bycatch of winter flounder, scup and butterfish in the Nantucket Sound squid fishery using a grid and a raised footrope net design.

Field work was again conducted aboard the F/V Atlantic Prince in May in Nantucket Sound (Figure 11). Video was collected and the catch sampled over 3 field days with DMF assistance. A manuscript was developed by Shannon Bayse of SMAST with staff assistance, editing, and input as coauthors. This manuscript was submitted to the journal Fisheries Research, and accepted in 2013. Further work on this gear modification is under consideration.



Figure 11. Mark Szymanski heads out from the Boston Fish Pier aboard the F/V Atlantic Prince to test and video monitor a modified squid trawl.

Other Activities

Appointments

Michael Pol continued serving as chair of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour, organizing, conducting, and reporting on the 2012 Annual Meeting in Lorient, France. A plan to host the 2014 meeting in New Bedford was developed. Pol helped organize the 2013 meeting in Bangkok, Thailand.

Pol also continued serving on the NEFMC Research Steering Committee, and the ASMFC Fishing Gear Expert Working Group.

Publications

A manuscript was submitted to Fisheries Research titled "Quantitative analysis of the behavior of longfin inshore squid (Doryteuthis pealeii) in reaction to a species separation grid of an otter trawl" with authors Shannon Bayse and Pingguo He (SMAST), Pol and Chosid.

A final report on the Five-Point Haddock Trawl was submitted to the DMF Technical Report Series.

Presentations

In addition to the talks listed under specific projects above, CE staff gave the following presentations:

All staff collaborated with SMAST personnel to present examples of DMF gear research at the Commercial Marine Expo in New Bedford in May. David Chosid coordinated and Mark Szymanski prepared the Division's booth for the 2012 New Bedford Working Waterfront Festival in October (Figure 12).

Pol was invited to present a talk on human networks and collaborative research to the Department of Fisheries and Oceanography at SMAST in February and the Innovations in Fisheries Conference sponsored by GMRI in October in Portland, Maine.



Figure 12. The Division's booth at the New Bedford Working Waterfront Festival; visitors to the booth drew pictures of marine creatures in return for a *MarineFisheries* Saltwater Fish poster.

SHELLFISH AND HABITAT SECTION

J. Michael Hickey, Section Leader

Shellfish Sanitation and Management Program

Personnel

J. Michael Hickey, Program Manager

South Shore

Thomas Shields, Senior Biologist, Section Leader

Jerry Moles, Biologist

Neil Churchill, Biologist

John Mendes, Biologist

Terry O'Neil, Biologist

Gregory Sawyer, Biologist

Jim Rossignol, Lobster Culturist

Mike Syslo, Senior Biologist, Hughes Hatchery & Research Station Manager

Susan Boehler, Laboratory Supervisor

Kelly Kleister, Contract Fisheries Technician

North Shore

Jeff Kennedy, Senior Biologist, Section Leader, Depuration Plant Manager

Dr. Jack Schwartz, Environmental Analyst

Gregory Bettencourt, Biologist

Glenn Casey, Biologist

David A. Roach Jr., Biologist

Paul Somerville, Biologist

Devon Winkler, Biologist

Florence Cenci, Laboratory Supervisor

Ashley Silberzweig, Bacteriologist

Christopher Schillaci, Contract Field Coordinator

Melissa Campbell, Contract Fisheries Technician

Newburyport Shellfish Purification Plant

Diane Regan, Laboratory Supervisor

Natalie Berthiaume, Bacteriologist

Ralph A. Stevens Jr., Plant Foreman

Albert Thistlewood, Assistant Plant Foreman

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 limit, and season 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:

- 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).

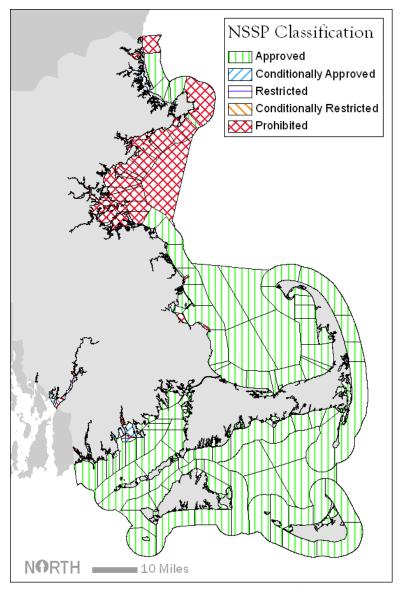


Figure 13. NSSP classification of Massachusetts' shellfish growing areas at the end of 2012.

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 that Massachusetts remained in compliance with the NSSP during 2012.

To satisfy NSSP requirements, staff biologists completed 316 annual shellfish area reports, 63 triennial evaluations, and 22 sanitary survey reports. An additional 18 conditional area rainfall management plans were evaluations.

In 2012, water samples were collected at 1,578 stations in 251 shellfish growing areas in 64 Commonwealth communities. A total of 10,029 water samples were collected from the field and analyzed for fecal coliform bacteria at *MarineFisheries* shellfish laboratories in Gloucester and New Bedford using the m-TEC method. Of these, 9,826 samples were collected at 1,523 classification stations, 171 pollution source samples were taken at 49 stations, while an additional 32 ad-hoc samples were collected at six sites.

Typically, shellfish meats are analyzed for fecal coliform for various area classification purposes including contaminated relays and depuration harvesting. During 2012, a total of 58 shellfish samples (quahog, softshell clam, and oyster) were analyzed for bacterial load.

Notification: A legal notice is required by *MarineFisheries* for each change in a shellfish growing area's classification or status. These notices reflect the type of opening or closure, the dates, the reason, and other pertinent descriptive information. Copies are sent to municipal managers, the state Office of Law Enforcement, Massachusetts Department of Public Health (*Mass*DPH), USFDA and other interested parties. In 2012, 384 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., Hurricane Sandy).

Hurricane Sandy was the deadliest and most destructive tropical cyclone of the 2012 Atlantic hurricane season. The entire Massachusetts coastline was closed to shellfishing when the storm hit the coast on October 29. Most Shellfish Growing Areas were opened to shellfishing on November 1, and the remaining areas were opened to shellfishing by November 14.

Shellfish Classification Improvements: During 2012, the Shellfish Program was involved in a number of initiatives designed to improve shellfish classifications. The result was nine changes in classification, with work ongoing at the end of the year on additional areas.

In January, *MarineFisheries* redefined area N26.1 in Revere and Saugus to include the flat known locally as "Christmas." This added 15 acres in Saugus and resulted in a harvest increase of 44% from N26.1 over 2011. The area is classified as Conditionally Restricted for the harvest of softshell clams for depuration and benefits the Boston diggers. N26.1 will remain seasonally closed from July 16 to September 30 annually. The area is also impacted by rainfall, closing for four days with 24 hour totals ≥0.25", and seven days for ≥0.4".

In February, MarineFisheries redefined, reclassified, and opened the Upper Weir River in Hingham and Hull (GBH1.6). This area is classified as Conditionally Restricted for the harvest of softshell clams for depuration and benefits the South Shore diggers in Hingham, Hull, and Weymouth. GBH1.6 is approximately 50 acres at the head of the Weir River. The area is impacted by rainfall and retains the standard Boston Harbor rainfall policy closing for three days with 24 hour totals \geq 0.50", and five days for \geq 1.00".

In April, *MarineFisheries* redefined, reclassified, and opened the "Point of Pines" clam flat in Revere (N26.7). This is a large area of approximately 150 highly productive acres. The Point of

Pines area is classified as Conditionally Restricted for the harvest of softshell clams for depuration and benefits the Boston diggers. N26.7 will retain the standard annual Pines River seasonal closure from July 16 to September 30. The area is impacted by rainfall, closing for four days with 24 hour totals ≥0.25″, and seven days for ≥0.4″. Also in April, *MarineFisheries* changed the classification of waters within Madaket Harbor on Nantucket Island (NT: 11) from Conditionally Approved to Approved. The classification upgrade, covering 938 acres, was a result of improvements to a number of septic systems along the western shore of the harbor. In addition, 1,692 acres of shellfish growing area in the middle portion of the Taunton River off of Fall River and Somerset (MHB: 2.0) was upgraded from Prohibited to Restricted to accommodate the Contaminated Quahog Relay Program.

In July, a 10-acre portion of the Narrows (SC 21.1) within Cotuit Bay, Barnstable was upgraded from Conditionally Approved to Approved.

In November, a 26-acre portion of the upper reaches of the West Branch of the Westport River (BB: 3.19) was upgraded from Prohibited to Conditionally Approved. Also, a 10-acre portion of Sippican Harbor (BB: 32.1), Marion was upgraded from Prohibited to Conditionally Approved.

In December, *MarineFisheries* reclassified nearly 200 acres of tidal waters within Fairhaven's southern coastal waters (BB:17) from Prohibited to Conditionally Approved. This was due to the general improvement of water quality within the area and the removal of the B1120 oil spill closure of 2003.

At the end of 2012, staff continued to test coastal waters in Rockport, Nantasket Beach in Hull, and various other shellfish growing areas in Cape Cod Bay, Buzzards Bay, Martha's Vineyard, and Nantucket presently classified as Prohibited. The reevaluation of the southeast corner of Joppa Flats in Newburyport continues. Other areas under investigation for possible reclassification include Lobster Cove in Gloucester, a section of Town River Bay in Quincy for depuration, and areas in Lynn and Revere for depuration.

Pollution Discharge: Program biologists also comment and make recommendations regarding United States Environmental Protection Agency (EPA) National Pollution Discharge Elimination System Permits. In 2012, 16 permits required review, including 10 point source discharges from waste water treatment plants, industrial discharges, and marine animal holding facilities. The remaining six permits involved the 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 (MassDEP) 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.

PSP Monitoring

Marine biotoxin monitoring continues to be a major activity of the shellfish program. In Massachusetts, the toxin responsible for paralytic shellfish poison (PSP)—or "red tide"—is produced by the naturally-occurring microscopic algae *Alexandrium fundyense*. Consumption of shellfish containing certain levels of PSP toxin can cause illness and death in severe cases.

Program personnel collect shellfish, primarily blue mussels, *Mytilus edulis*, from 16 primary stations weekly from March to November. Samples are analyzed at the *MarineFisheries*

Gloucester lab where bioassays determine the level of toxin in the shellfish (Table 2). If toxin is found, both the frequency of sampling and the number of sample sites are increased. Shellfish areas are closed if toxin levels exceed safe limits.

Table 2. Number of shellfish samples analyzed for PSP, by species.

Species	Sample Count		
Species	State Waters	Federal Waters	
Blue Mussel	493		
Softshell Clam	9		
Surf Clam	3		
Sea Scallop		1	
Stimpson Surf Clam		6	

Due to the previous mild winter, the 2012 PSP season began on March 4 with three samples taken from primary stations within the Nauset Estuarine System in the towns of Orleans and Eastham. These samples were collected almost a month earlier than historically sampled. On March 5, the toxin level was an elevated 236 μ g/100g at Area OC3, Orleans Roberts Cove. The entire Nauset system (Areas OC2–OC6) was immediately closed to shellfishing, resulting in the earliest closure (March 7) for the Nauset System in the monitoring program's history. Sample frequency and number of sites increased until April 1 when all primary stations were sampled. Toxicity at Roberts Cove continued to increase weekly until April 9 reaching 1,765 μ g/100g. A partial reopening occurred on May 24, with the closures lifted on all species except moon snails in Areas OC2, OC4, and OC5. On May 31, closures on all species except moon snails were lifted for Area OC3. The same species reopenings occurred for Area OC6 on June 7. Except for the early onset, this event represents a typical annual occurrence of PSP toxin within the Nauset system. It is considered separate and unrelated to the annual, larger, Gulf of Maine bloom often affecting areas on the North and South Shores and Cape Cod Bay.

Stations outside of the Nauset system did not develop toxicity above the detection limit (~40 μ g/100g) until May 7, at the three North Shore primary stations (in Areas N4, N7, N9). The first closures outside the Nauset system occurred on May 25, encompassing all species in South Shore Areas MB1 to MB14. This closure was partially lifted on July 18, rescinding the prohibition of harvest on all shellfish species except carnivorous snails and whole sea scallops. Sampling concluded on November 5, after a 20-week period without any detectable toxicity in blue mussels.

Figure 14 illustrates the extent of PSP closures within Massachusetts during 2012. Recent trends in PSP events show an increase in intensity, duration, and geographic extent as well as an earlier onset at some locations. Figure 15 illustrates the timing of continuous toxicity (positive results that span more than one sample) from primary stations.

Overall, toxicity in Massachusetts shellfish was detected in 14 growing areas out of the 23 that were routinely sampled: OC3, OC4, OC5 and OC6 in Nauset; N4, N7, N9, N26 and GBH5 in the North Shore and Boston Harbor; and MB11, MB7, MB5, CCB42 and SC52 in the South Shore, Cape Cod and Islands. Durations of toxicity in shellfish areas ranged from less than one week (in areas CCB42, GBH5 and SC52) to 79 days in area OC6. The range of maximum area toxicity extended from 40 (in areas N4, GBH5 and CCB42) to 1765 μ g/100g (OC3). Seven sampled areas did not experience any detectable toxicity: BB45, CCB4, CCB11, CCB25, CCB45, GBH1, and N2. As

in previous years, there were no reported illnesses due to red tide in Massachusetts or attributed to Massachusetts shellfish in interstate commerce in 2012.

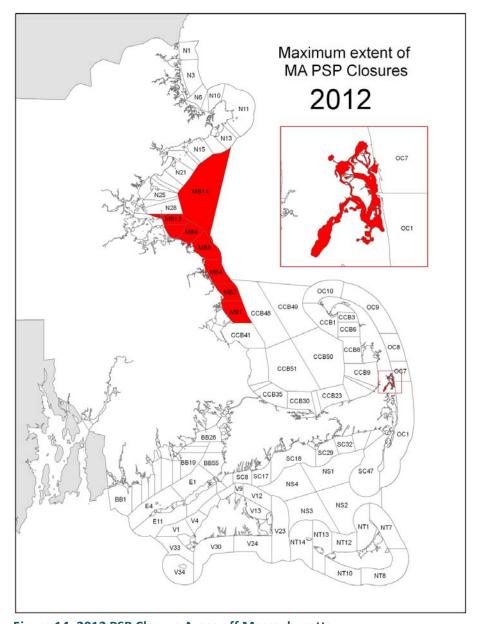


Figure 14. 2012 PSP Closure Areas off Massachusetts.

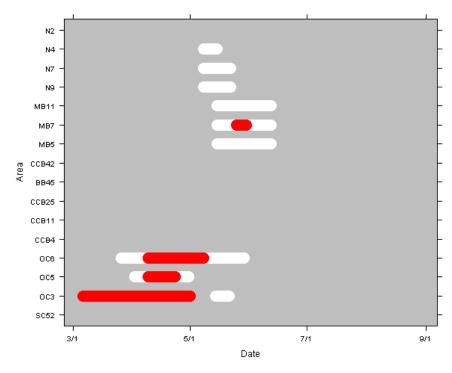


Figure 15. Timing of continuous toxicity (positive results that span more than one sample) from primary stations. White bars denote detectable toxicity levels, while red bars indicate results that trigger area closure ($\geq 80 \,\mu\text{g}/100\text{g}$).

Other Harmful Algal Bloom Monitoring

During 2012, *MarineFisheries* imposed two precautionary closures due to potential risk to public health resulting from harmful algae blooms (HABs).

On February 20, *MarineFisheries* imposed a precautionary closure of a portion of the Wareham River (BB: 36) due to reports of a red or rust coloration of the water. Upon collection and examination of phytoplankton samples, staff detected no presence of *Alexandrium*, the type of dinoflagellate known to cause paralytic shellfish poisoning (PSP). The plankton bloom in the Wareham River was most likely caused by another non-toxic dinoflagellate. The 663-acre area of the Wareham River was re-opened to shellfishing the same day.

On July 10, *MarineFisheries* received notification from the Martha's Vineyard Shellfish Constable in Tisbury of a pink or reddish microalgal film on some of the sand beaches in Lake Tashmoo (V: 8). Samples were collected by the Tisbury Constable and sent to Gary Wikfors, a specialist at the NOAA Aquaculture Center in Milford, Connecticut for identification. He determined that the sample contained *Prorocentrum lima*, a benthic dinoflagellate that contains neurotoxic shellfish poison, okadaic acid, which causes Diuretic Shellfish Poisoning (DSP). As a precautionary measure, *MarineFisheries* closed Lake Tashmoo, a 264-acre salt pond, to the harvesting of shellfish. Reports of minor pinkish to red discoloration of beach sand at locations in Menemsha were reported on July 12. This area was not closed to shellfishing.

Over the course of the next 10 days, sediment, interstitial water, and quahog samples were collected by *MarineFisheries* staff and Tisbury and Chilmark Shellfish Constables on affected beaches in Lake Tashmoo and Menemsha Pond. The samples were delivered to HAB and

neurotoxin specialists at the Woods Hole Institute for analysis. Although very low to moderate numbers of *Prorocentrum lima* were identified within one of the Lake Tashmoo samples, all of the other samples were dominated by *Prorocentrum micans* and other non-toxic dinoflagellate. DSP toxin analyses were run on water samples from two stations in Lake Tashmoo and one station in Menemsha Pond, and on quahogs samples from one station in Menemsha Pond and two stations in Lake Tashmoo. No DSP toxins were detected in any of the samples. Based on these results, *MarineFisheries* re-opened Lake Tashmoo to shellfishing on July 20.

Other Harmful Algal Bloom Monitoring

As part of the 2008 NOAA Red Tide grant, the Shellfish Program has produced outreach materials for distribution in Massachusetts coastal communities. From previous PSP events, *MarineFisheries* determined the need for educational materials developed by biologists to eliminate ambiguous information in the media on PSP and red tides. Outreach materials will be

used during future "red tide" blooms to mitigate adverse economic effects of red tide closures, making certain the public receives clear, accurate, and objective information on the risks of red tide and paralytic shellfish poisoning.

Work was finalized on three educational/outreach products for the general public and commercial and recreational shellfish harvesters. Two posters were produced. One, a legal posting for use during PSP events, is displayed at impacted shellfish growing areas by *MarineFisheries* and local municipalities. The other is an illustrated poster describes common near-shore Massachusetts mollusks, which if consumed during a bloom could expose an individual to paralytic shellfish poisoning. The third product, a Red Tide/PSP FAQ brochure (Figure 16), was produced with quick facts as well as a series of questions and answers covering PSP and red tide.

All three products were provided to members of the Northeast Shellfish Sanitation Association annual meeting in February and at the Massachusetts Shellfish Officers (MSOA) March Annual Meeting in New Bedford. Posters have been provided to numerous marine educational institutions in coastal Massachusetts. In addition, the illustrated poster and brochure are on the *MarineFisheries* website.



Figure 16. Red Tide FAQ brochure cover.

Phytoplankton Monitoring

Phytoplankton monitoring coincides with the start of mussel collection for the PSP season. Monitoring occurs once a week from April through November at the North Shore primary stations in Newburyport, Ipswich, Essex and Gloucester. When biotoxin levels are observed to increase, staff increases the frequency and locations of sampling. During the 2012 season, a total of 208 phytoplankton samples from 11 stations were collected and analyzed.

Until 2012, only qualitative techniques had been used in the phytoplankton monitoring program, observing relative abundance of species at the genus level. This technique gave an estimate of relative abundance of *Alexandrium* as a percentage of all cells, as well as identifying,

in particular, *Dinophysis* (the causative organism of diarrhetic shellfish poisoning) and *Pseudo-nitzschia* (the causative organism of amnesic shellfish poisoning).

While this technique was useful as an early warning system to alert managers to potential threats from phytoplankton cells present in shellfish growing areas, a quantitative evaluation was needed. In July, at the Gloucester office, a new procedure was developed to align with methods used in neighboring states to generate quantitative data in cells/liter. (The relative abundance of other observed phytoplankton species is still recorded.) Due to the late startup and low magnitude of PSP in North Shore areas the technique could not be utilized during the 2012 bloom.

Shellfisheries Management Project

Contaminated Shellfish Resources

MarineFisheries directly manages the 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 (Figure 17), but oysters and soft-shell clams may also be relayed.

Disease monitoring of quahogs in the Taunton River was conducted in late February 2012. Approximately three weeks later, results received from pathologists at Kennebec River Biosciences indicated that the quahogs were free of Dermo, QPX and any abnormalities of the tissues. Three vessels equipped with hydraulic dredge equipment were permitted to harvest quahogs in the Taunton River for relay to various coastal communities beginning in early April. Most of the quahog relays were completed by June 15, while several



Figure 17. Bacteriallycontaminated quahogs under relay to clean waters.

were finished by June 25. Westport carried out a quahog relay in October.

During the 2012 season, three boats harvested a total of 12,099 bushels of quahogs from the Taunton River for relay. Sixteen towns relayed 11,823 bushels of quahogs to 30 separate areas within those towns (Table 4). Westport received 3,148 bushels of quahogs, the most of any town. Barnstable conducted two relays from within town waters; 176 bushels of quahogs were relayed from the Centerville River to North Bay; and 100 bushels of oysters were relayed from North Bay to West Bay.

Table 4. 2012 Contaminated Shellfish Relays.

Town	Harvest Site	Transplant Site	Area	Bushels	Last Day Planted	
Quahog Relays						
Eastham	Taunton River	Salt Pond	OC:6.20	300	20-Apr	
Eastham	Taunton River	Goose Hummuck	OC:4.24	200	18-Apr	
Edgartown	Taunton River	Katama Bay	V:20.20	361	2-May	
Yarmouth	Taunton River	Lewis Pond	SC:31.20	1,200	12-May	
Barnstable	Taunton River	Cotuit Bay (Old Post)	SC: 21.21	544	15-Jun	
Barnstable	Taunton River	Cotuit Bay (Main St.)	SC: 21.22	628	12-May	
Barnstable	Taunton River	Hyannis Harbor	SC:27.22	261	25-May	
Barnstable	Taunton River	West Bay	SC:22.21	693	21-May	
Bourne	Taunton River	Buttermilk Bay	BB:44.20	231	30-May	
Bourne	Taunton River	Red Brook Hbr (Winsor)	BB:49.20	450	9-Jun	
Bourne	Taunton River	Phinney's (N. of Toby's)	BB:46.23	375	4-Jun	
Bourne	Taunton River	Phinney's (Little Bay)	BB:46.21	308	4-Jun	
Oak Bluffs	Taunton River	Lagoon Pond	V:11.21	600	17-May	
Sandwich	Taunton River	Sandwich Harbor	CCB:37.0	325	8-Jun	
Westport	Taunton River	E. Branch (Halfmoon)	BB:4.21	660	6-Jun	
Westport	Taunton River	E. Branch (David Road)	BB:4.22	340	9-Jun	
Fairhaven	Taunton River	West Island North (Round)	BB: 18.20	577.5	3-Jun	
Fairhaven	Taunton River	West Island North (Senior)	BB:18.21	222.5	31-May	
Provincetown	Taunton River	P-Town (Inner Harbor)	CCB:4.20	300	12-Jun	
Truro	Taunton River	Pamet Harbor	CCB: 7.1 & 7.2	150	16-Jun	
Marshfield	Taunton River	North River	MB:5.1	100	13-Jun	
Mattapoisett	Taunton River	Matt. Harbor (Shining Tides)	BB:25.12	170	12-Jun	
Dennis	Taunton River	Bass River Center (Wilbur)	SC:34.7	250	26-Jun	
Scituate	Taunton River	North River	MB:5.1	100	13-Jun	
Swansea	Taunton River	Cole River (Beach)	MHB:4.20	215	22-Jun	
Swansea	Taunton River	Cole River (Back River)	MHB:4.21	214	22-Jun	
Westport	Taunton River	W. Branch (River Road)	BB:3.25	486	8-Oct	
Westport	Taunton River	E. Branch (Let)	BB:4.25	89	24-Sep	
Westport	Taunton River	W. Branch (Grasshopper)	BB:3.26	498	8-Oct	
Barnstable	Centerville R.	North Bay	SC:23.20	176	12-Jun	
Sub-total				12,099		
Oyster Relays						
Barnstable	North Bay	West Bay	SC:22.24	100 (Oys)	23-Aug	

Depuration: The management and oversight of mildly contaminated soft-shell clams, *Mya arenaria*, is a substantial activity for *MarineFisheries*. Clams are harvested from specially designated "Conditionally Restricted" areas in Boston Harbor, Pines River, and the Merrimack River and transported by *MarineFisheries* licensed and bonded Master Diggers under strict enforcement to the Shellfish Purification Plant located on Plum Island in Newburyport. Once at the plant, the clams are treated in a controlled aquatic environment.

The Shellfish Purification Plant is a state of the art facility containing nine depuration tanks. Pure seawater is obtained from two 130-feet deep salt water wells and is continuously disinfected using ultraviolet light. Depuration is a complex biological process requiring constant validation and verification, during and upon completion of the treatment, through analysis of shellfish and tank water. This is accomplished by daily testing in the on-site certified laboratory. The depuration process occurs for a minimum of three days; upon completion, the clams are returned to the harvesters who pay a depuration fee. The purified clams are sold in commerce.

During 2012, the plant received shellfish on 191 days (Figure 18); this is up from 167 days in 2011. However, the total number of lots of shellfish was 480, down from 512 lots the previous calendar year. A total of 9,711 racks (or 485,550 lbs. of softshell clams) were processed generating \$58,266 in fees. In terms of racks, this represents a decline of 19% from 2011. These landings account for 10.2% of all Massachusetts state landings of softshell clams. One new harvest area was opened, N26.7 Point of Pines in Revere. All lots met release criteria in 2012 and once again no lots were recalled. As in prior years, the decrease from 2011 represents a continuing downward trend in landings from Boston Harbor primarily due to neoplasia, a shellfish disease.

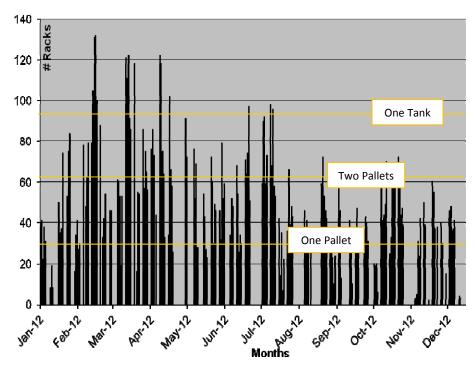


Figure 18. 2012 Conditionally Restricted Depuration Harvest by Day.

As is typical, production came from greater Boston Harbor, the Pines River, and the Merrimack River. Except for the Merrimack River, all harvesting was divided between three digging groups: the Boston diggers (digging in Boston, Revere, Saugus, and Winthrop), the Quincy diggers, and the South Shore diggers (digging in Hingham, Hull, and Weymouth). The Merrimack River is sporadically harvested by "open area" shellfishermen from both the Gloucester and Boston groups.

The Pines River N26.1 showed a 73% increase in landings. Merrimack River landings were down 13.6% primarily due to a decrease in effort, though the daily average harvest per subordinate digger also declined slightly. Shellfish growing area N26.1, Pines River in Revere and Saugus was harvested on 76 days, the most of any area. It also produced more than 44% more racks than the next most productive area, N26.7. Thirty-two conditionally restricted areas were harvested, no overall change from 2011: 29 areas in Boston Harbor, two in Pines River, and one in Merrimack River.

As in 2011, seven Master Diggers delivered clams to the Purification Plant. An average of 23 subordinate diggers harvested each digging tide – no change from 2011. The maximum turnout for one tide by subordinate diggers was 47. In total, 77 Subordinate Digger Permits were issued in 2012, down from 92 previously. Subordinate diggers averaged 2.02 racks per digging tide, down from 2.29.

Commercial Bait Harvest: During each year between 2010 and 2013, there were less than three dredge boats and less than three hand rake 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.

Shellfish Plant

The laboratory tested a total of 1,047 shellfish samples, a slight decrease from 2011. The laboratory also analyzed 969 water samples for fecal coliform, a 19.5% decline from the previous year. Some of the drop in samples analyzed is in response to fewer harvest lots, a reevaluation of sampling frequency, and budget reductions. In an effort to control laboratory costs a detailed analysis of laboratory spending was completed. This resulted in several significant changes; revising supplies and streamlining standard operating procedures. These changes resulted in an overall 37% reduction in the annual laboratory consumable budget.

In March, laboratory supervisor Diane Regan and contractor Christopher 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; results were pending at the end of 2012. Results of the 2011 NELEOM test showed the Shellfish Plant laboratory in compliance.

Plant maintenance continued, including small repairs to roof shingles, several outfall pipe dig outs, and painting. *Mass*DPH inspectors completed routine monthly inspections throughout the year.

The plant hosted several special guests and group tours throughout the year. The tours varied from general to technical depending on the audience, which included public health sanitarians, shellfish managers, seafood dealers, shellfish laboratories, environmental organizations, and school groups. Of note, seven shellfish managers from Canada, the European Union, Mexico,

New Zealand, and the USFDA toured the plant in late September as part of the 2nd International Workshop on Molluscan Shellfish Area Classification and Management, held in Newport, RI. An open house was held on August 4 as part of a larger local event in which over 150 people toured the lab, viewed tanks of clams depurating, read plant posters, investigated clams in a separate touch tank, and received educational pamphlets and activity booklets. The plant also continued to supply seawater to local educators for their saltwater cultures, displays, and aquaria.

Wet Storage Plant

As part of the FY2012 Budget, *MarineFisheries* developed a report outlining opportunities to increase revenue at the Shellfish Purification Plant. In January 2012 the report was finalized for the legislature, wet storage (or de-sanding) was identified as a potential new activity, compatible with depuration. As part of the FY2013 budget *MarineFisheries* was directed to pursue wet storage at the Shellfish Purification Plant to supplement depuration fees. In October, plant staff sent out an email survey questionnaire to current Massachusetts licensed wholesale shellfish dealers to determine industry's need for wet storage services at the plant. Public meetings were held in New Bedford and Gloucester on November 28 and 29, respectively, which were favorably attended. Follow-up meetings with *Mass*DPH were held to evaluate goals and outcomes from wet storage, scope out the regulatory framework, and outline plant operating procedure for a potential startup date in 2013.

Boston Harbor Soft-Shell Clam Enhancement

During spring 2012, *MarineFisheries* and its partners committed to a seventh year of enhancement and monitoring of softshell clams (*Mya arenaria*) in Boston Harbor. From June 21 through October 21, an estimated 1.25 million juvenile clams, purchased from the Northeastern Massachusetts Aquaculture Center (NEMAC) hatchery, were planted within 141 plots at six sites in Boston, Hingham, Hull, Quincy and Weymouth (Figure 19).

Enhancement efforts shifted away from Winthrop areas in 2012 because of the change in funding from the original Hubline mitigation monies to Massport mitigation monies. This new finance source explicitly prohibits the creation of wildlife attractant within a 10,000-foot radius surrounding the Logan Airport property. Softshell clam propagation is considered to create a potential food source for various species of waterfowl.

Standardized techniques were used for all procedures. The seed clams averaged about ½ inch in shell length and were planted roughly 30 per square foot. Enhancement plots were covered with nets to protect clams for predators (Figure 20). *MarineFisheries* personnel monitored the enhancement plots regularly throughout the growing season to inspect for net fouling, tears, over-siltation or other impediments to clam growth and survival. Six undergraduate students of Northeastern University assisted in net construction, seed planting, site monitoring, and net removal. Master and Subordinate Diggers in Quincy were compensated for net removal from the enhancement site at Snug Harbor and a part-time shellfish constable for the City of Weymouth was paid for enhancement site enforcement. All nets were extracted from the enhancement site starting in mid-December and continuing into January. Those with minor damage were repaired for reuse the subsequent year.

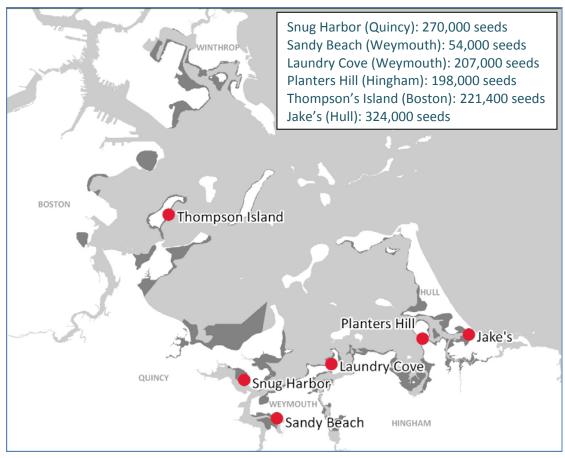


Figure 19. Location and seed quantity for 2012 clam enhancement sites.

Sampling of shell lengths from several enhancement sites was underway at the end of 2012 and will continue in 2013. Measuring the planted clams achieves two goals: it aids in site selection, as sites that promote growth are favorable, and it ensures the clams have attained the minimum

legal size before they are reopened to commercial harvesters. Most seeded clams attain the minimum harvest size of 2 inches after approximately 18 months post- planting.

Since 2006, project outreach has served to develop important relationships with researchers, advocacy groups, municipalities, and commercial fishermen engaged in the Boston Harbor contaminated shellfish harvest. In 2011, this was expanded by leading the development and



Figure 20. Softshell clam enhancement plots covered with predator-exclusion netting (highlighted blue) on the intertidal mudflat of Thompson Island.

implementation of a multi-year educational initiative based at the Thompson Island Outward Bound Education Center in Boston Harbor. This collaborative effort is aimed at protecting the

long-term commercial and biological sustainability of shellfish while educating participants on the role softshell clams play in the ecology and economy of Boston Harbor. Additional partners involved in the project include: the City of Boston, Thompson Island Outward Bound Green Corps, the National Park Service, Save the Harbor/Save the Bay, Salem State University, and UMass Boston's Green Harbor Project.

On July 25, the outreach collaborative organized a soft-shell clam seeding event led by *MarineFisheries*. Over 50 volunteers from local communities assisted the project by planting more than 50,000 clams in the intertidal mudflats of Thompson Island. In addition to the seeding, volunteers assisted the Green Ambassador's Island monitoring program by conducting a fish seine of a salt pond and a biological inventory of the rocky intertidal.

All *MarineFisheries* enhancement plots are closed to harvest for three years after clams are planted. Starting in the 2010 season, yellow buoys were deployed at enhancement sites to delineate them as closed areas, protect the validity of the plots, and aid in enforcement efforts. Buoys were placed and maintained at all 2009, 2010, 2011 and 2012 sites. In the spring, all six of the 2009 sites – Hingham Whites; Hull Jake's; Quincy Hibbard Street; Weymouth Laundry Cove; Winthrop Snake Island, and Winthrop Ballpark – were reopened to commercial harvest.

Technical Assistance Project

In Massachusetts, the cities and towns manage the shellfisheries in all waters within their boundaries that are not closed by *MarineFisheries* for public health reasons, with the exception of commercial harvest of surf clams and ocean quahogs that remain under state control. The Shellfish Program assists municipalities concerning a wide variety of shellfisheries management issues by providing technical and regulatory information as well as recommendations to local shellfish managers. Assistance is furnished regarding shellfish propagation techniques, predator controls, shellfish survey methods, management openings and closures, habitat improvements, shellfish management plans, aquaculture development and regulation, water quality, sanitation and public health, and permitting. Each shellfish biologist and the program supervisors provide technical assistance to municipal managers and boards, state and federal agencies, academia and non-governmental research and management organizations, and individuals. It is estimated that throughout 2012, staff rendered technical assistance on over 4,000 separate occasions to more than 2,000 entities.

Environmental Protection Project

Shellfish Program personnel respond to pollution events in coastal waters in order to assess possible damage to shellfish resources 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 2012 are detailed below.

- 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.
- On October 18, a lightly treated discharge of approximately 100,000 gallons of sewage was released by the Plymouth Waste Water Treatment Plant into Plymouth Harbor. On

October 19, a total of 5,076 acres of nearshore tidal flats and waters within the towns of Plymouth, Kingston, and Duxbury were immediately closed to shellfishing for a period of two weeks. Seven commercial oyster aquaculture operations were impacted by the closure. Following extensive sampling and oceanographic modeling, the closure was lifted on November 2.

- On October 22, MarineFisheries was notified by the City of New Bedford of a discharge of raw sewage into New Bedford Outer Harbor from a Combined Sewer Unit at the Fredrick Street Boat Ramp. It was estimated that as much as 720,000 gallons of untreated sewage may have been discharged into Outer New Bedford Harbor. MarineFisheries immediately closed the impacted areas (3,046 acres) to the harvest of shellfish. No recreational or commercial fishing occurred within New Bedford waters that were affected by the closure. Some commercial fishermen (divers and hydraulic dredge boats) were fishing for quahogs within Fairhaven waters that were affected by the closure. The Fairhaven Shellfish Constable managed to intercept all affected commercial fisherman, except one dredge boat operator who had delivered 15 bushels of quahogs to a seafood dealer in Fall River. MassDPH staff located the 15 bushels of quahogs and oversaw the seafood dealer's voluntary disposal of the product. Following extensive sampling and oceanographic modeling, the closure was lifted on November 15.
- On November 21, Gloucester experienced a sanitary sewer overflow due to a break in private pressure sewer line, discharging overland and through storm drains to the prohibited section of Annisquam River.

Program staff also participated in periodic meetings with the United States Coast Guard (USCG), NOAA, and *Mass*DEP relative to oil and hazardous material spill contingency planning and drills. Churchill served on committees that develop and update Area Contingency Plans and state Geographic Response Plans for oil and hazardous substance discharges in the Coast Guard Sectors for Boston and Southern New England. He was also a member of the Boston Area Maritime Security Committee and the Port of Boston Recovery Committee. Related activities in 2012 included three planning or training meetings in Fall River (June 6, Sept 9 and 27), a one-day table top exercise in Falmouth (Sept 19) and an on-water drill in Sandwich (October 17).

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 discharges into the marine environment. In 2012, staff biologists reviewed 219 project proposals.

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, nonnative species, and other pests or predators that could affect natural populations and damage both aquaculture and wild fisheries.

In 2012, shellfish propagation permits were issued to 311 aquaculture license site holders operating shellfish aquaculture projects in 30 coastal municipalities throughout the Commonwealth. See Table 5 for the number of shellfish propagation permits by town.

Table 5. 2012 Shellfish Propagation Permits by Town.

Town	# permits	Town	# permits	Town	# permits
Aquinnah	1	Edgartown	11	Orleans	15
Barnstable	50	Fairhaven	2	Plymouth	3
Bourne	1	Falmouth	7	Provincetown	6
Brewster	8	Gosnold	1	Rowley	12
Chatham	1	Kingston	3	Truro	2
Chilmark	5	Marion	3	Wareham	5
Dennis	24	Mashpee	3	Wellfleet	85
Duxbury	24	Mattapoisett	2	Westport	3
Eastham	24	Nantucket	6	Yarmouth	4

The most significant aquaculture siting developments during the 2012 calendar year are presented below:

- A total of 15 new proposed private aquaculture licenses were surveyed and approved, comprising a total of 26.6 acres surveyed. Two 25-acre subtidal aquaculture zones in the Towns of Truro and Provincetown, recently permitted by the United States Army Corps of Engineers (Army Corps), were still being finalized subject to potential entanglement risk regarding right whales and turtles.
- The Town of Bourne approved a one-acre license site off Tobey Island in Buzzards Bay.
- The Town of Eastham had a new one-acre site approved in the Aquaculture Zone located off First Encounter Beach. Although surveyed years ago, this section in the aquaculture development area (ADA) had gone unused for more than two years and required a new survey.
- The Town of Chilmark approved two one-acre sites in Menemsha Pond. These sites are located alongside the three existing sites within the pond.
- Nantucket further subdivided Town area located in Head of the Harbor into two four-acre sites for floating aquaculture. Oysters will be grown in floating cages at these sites.
- Mashpee saw a pre-existing two-acre site forfeited by an applicant due to a lawsuit brought by an abutting land owner. MassDEP required the applicant to file an Environmental Notification Form because the site was in a velocity zone. This was a rare and first ever requirement from MassDEP for an aquaculture applicant. The applicant has

re-applied for a new aquaculture site, but faces numerous lawsuits from fellow abutting land owners for use of the new site.

- 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 defined site coordinates.
- The Town of Wellfleet approved a one-acre site in Loagy Bay. The town of Plymouth had three new four-acre applicantions for sites in Plymouth Harbor.
- The Town of Truro received and approved a one-acre site in Cape Cod Bay for an intertidal license.

Other aquaculture-related activities include: assisting growers in the licensing and permitting process, providing information on aquaculture to interested parties, assisting municipalities with site selection prior to formal site survey in order to avoid *MarineFisheries* denial, assisting growers in finding seed sources, and working with hatcheries to become certified to sell seed in Massachusetts. A list of approved shellfish hatcheries is maintained on the *MarineFisheries* website.

Landings

The total value of Massachusetts aquaculturally reared shellfish in 2012, as reported by dealers, was \$9.3 million. The primary species grown was eastern oysters, which accounted for almost 87% of the landed value, at over \$8 million, followed by northern quahog at nearly 9% (\$825,000). Bay scallops (2% of the total value or \$190,000), mussels, and soft shell clams comprised the remainder; because of the limited number of commercial aquaculturists growing mussels and soft shell clams, 2012 landing statistics cannot be reported for these species due to confidentiality restrictions.

Over the last six years, the value of Massachusetts oyster landings has grown an average of 22% per year (Figure 21). Over this same time period, the value of Massachusetts quahog landings has fluctuated between a high of \$2 million in 2008 and a low of \$825,000 in 2012.

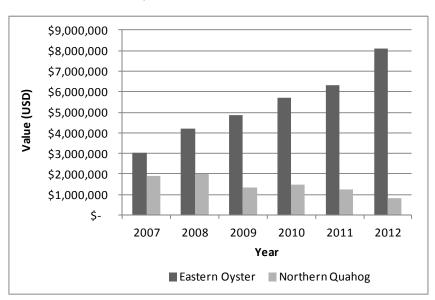


Figure 21. Annual aquaculture value of eastern oysters and northern quahog in Massachusetts, 2007 – 2012.

Shellfish Disease

Incidences of the quahog disease known as QPX continued to occur in individual aquaculture sites in both Wellfleet and Barnstable although the number of reported cases had declined. This may in part be the result of the shift by growers away from quahogs to oysters because oysters yield a higher price for growers and because they reach marketable size quicker than quahogs due to the availability of larger seed in the spring. Additionally, *MarineFisheries* relaxed the 3" size limit on cultured oysters to 2½" longest diameter in 2011. The purpose of the size reduction was to allow growers to market a smaller "petite" oyster before they succumbed to the oyster diseases MSX and DERMO which usually occurs when oysters are between 2½" and 3" in length. At the same time, the quahog size limit was also eased for aquaculture from 1" diameter (hinge width) to $^7/_8$ " diameter as a strategy to minimize losses to QPX. Significant oyster mortalities continued to occur particularly in Buzzards Bay in oysters just under 3". About 100 aquaculture permits were endorsed for either petite oysters and under sized quahogs in 2012.

Vibrio Management

As a result of USFDA and ISSC concerns about the naturally occurring pathogen *Vibrio* parahaemolyticus (Vibrio) associated with consumption of raw or undercooked oysters in the summer months, the water temperature monitoring study using automatic temperature recorders, initiated in 2008, was continued in 2012. Monitors were located at 14 sites (June – September) In addition, *Marine Fisheries* staff deployed four thermometers to monitor air temperature at locations in Marion, Wareham, Eastham and Truro. Temperature data are used to annually assess the risk of Vibrio illness and the need for more stringent requirements, such as time-to-refrigeration, for the harvest of oysters during warm weather as required by the NSSP. To date, average water temperatures have remained below threshold levels that would trigger controls.

However, during the summer of 2011, two epidemiologically confirmed cases of Vibrio associated with the consumption of raw oysters from food establishments on Cape Cod were reported. Two or more cases in one year from the same area automatically require a Vibrio Control Plan. Consequently, in spring 2012, the USFDA directed Massachusetts public health and marine fisheries officials to implement an Enhanced Vibrio Control Management Plan for Eastern Cape Cod Bay. This determination was based on a variety of physical factors in that area, including: a long tidal shelf, more extensive exposed areas at low tide, higher salinity, warmer air and water temperatures, oyster culture and harvest techniques used in the area, as well as reports of human illness associated with oysters specifically from Eastern Cape Cod Bay.

In response to USFDA's mandate to minimize the risk associated with Vibrio related to the consumption of raw oysters, *MarineFisheries* developed a Vibrio Control Plan for 2012 by establishing permit conditions, effective during the period June 17 through September 8, that governs the activities of oyster harvesters in eastern Cape Cod Bay and seafood dealers. Such permit conditions have the force of law pursuant to M.G.L. c. 130 § 80 and 322 CMR § 7.01(7).

The plan and these permit conditions affected harvest of wild oysters from the public fishery by commercial permit holders in the Town of Wellfleet and to those aquaculture operations within Eastern Cape Cod Bay (EECB) in the towns of Barnstable, Yarmouth, Dennis, Brewster, Orleans, Eastham, Wellfleet, Truro and Provincetown (Figure 22). The plan required refrigeration by harvesters within five hours of harvest; and subsequently the receiving dealer must cool the

oysters to 50°F in 10 hours. In combination, all oysters had to be chilled to 50°F in no more than 15 hours after Time of Harvest.

The 2012 Vibrio Control Plan impacted 232 oyster aquaculturists in seven towns from Barnstable to Provincetown, and about 100 wild oyster harvesters in Wellfleet, which is the only Cape Cod Bay municipality that has a wild harvest commercial oyster fishery.

In order to monitor the effectiveness of the 2012 Vibrio Control Plan, it was necessary for the major State and Federal regulatory authorities to monitor compliance by commercial oyster harvesters within the affected regions of Eastern Cape Cod Bay. *MarineFisheries*, acting as the lead Agency, worked with members of the DPH Food Protection Program's Seafood Unit, Office of Law Enforcement, local Town Shellfish Departments and FDA to carry out compliance inspections of

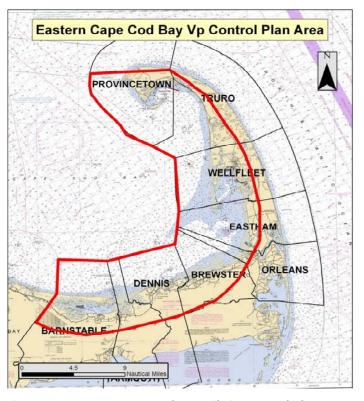


Figure 22. Eastern Cape Cod Bay Vibrio Control Plan Area.

commercial oyster operations. Between June 17 and September 8, 2012, a total of 55 compliance interviews were conducted in Wellfleet (4 trips), Barnstable (2 trips), Dennis (3 trips), Brewster (1 trip) and Eastham (1 trip). During early 2013, the information gathered from these compliance inspections will be used to assess the success of the 2012 Vibrio Control Plan and to help make improvements to the 2013 plan.

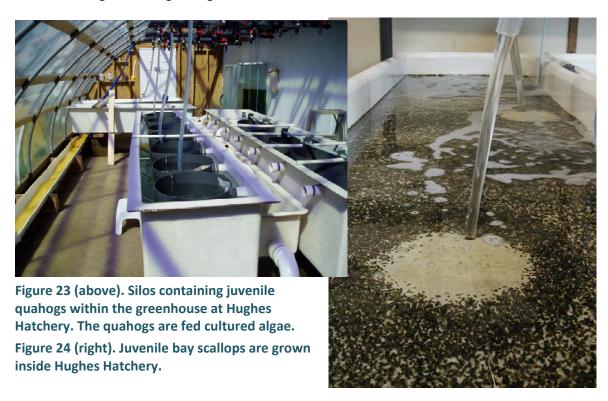
John T. Hughes Hatchery & Research Station

The State Lobster Hatchery in Oak Bluffs on Martha's Vineyard was built in 1949 under supervision of renowned lobster culturist, John Hughes. Lobster aquaculture and research at the Martha's Vineyard Facility ceased in 2002. In a March 2012 ceremony held at the Martha's Vineyard Commission office in Oak Bluffs, *MarineFisheries* Director Paul Diodati announced that the name of the hatchery was being changed to the John T. Hughes Hatchery and Research Station, in honor of Mr. Hughes' distinguished career with *MarineFisheries*.

In July of 2011, Director Diodati announced that *MarineFisheries* was re-tasking the State Lobster Hatchery in Oak Bluffs to support municipal shellfish propagation programs. To achieve this goal, *MarineFisheries* formed a new partnership with the Martha's Vineyard Shellfish Group (MVSG) to grow shellfish at the hatchery. 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. In 2011 and 2012, *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. Additional renovations were planned for 2013.

The MVSG began shellfish culture operations at Hughes Hatchery in May (Figures 23 & 24). Staff spent the 2012 season familiarizing themselves with the new facility and seawater systems, and developing optimal culture strategies for nursery production of bay scallops, quahogs and oysters. MVSG had a good, shake-down, first season. They produced 3-4 million quahog seed and 188,000 seed scallops. They also introduced 2 million eyed larvae into tanks filled with shell bag cultch that successfully resulted in the production of hundreds of thousands of oyster spat that were planted out in Edgartown Great Pond. This production is expected to be more than doubled during the 2013 growing season.



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 2012, Massachusetts hosted NESSA meetings in New Bedford allowing all program staff to attend. Numerous staff gave presentations. Laboratory staff participated in training and workshops of the Northeast Laboratory Evaluation Officers and Managers, funded by USFDA. In May, four Shellfish Program staff participated in a three-day USFDA training course entitled "Sanitary Surveys of Shellfish Growing Areas", held in Austin, Texas.

During February, June and October 2012, 18 soft-shell clam samples were collected from tidal flats in seven coastal towns on the South Coast and Cape Cod for analysis of the presence of Hemic Neoplasia. North Shore samples were also collected for analysis. Since 2011,

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 soft clam disease throughout Massachusetts coastal waters. Neoplasia has been implicated in extensive clam die-offs in Boston Harbor and other regions of the coast.

Shellfish staff also collected mussel samples for the Gulf of Maine Council GulfWatch Mussel Sampling Program and for NOAA's Mussel Watch. Samples were analyzed for metals and PCB contamination. In 2012, NOAA was interested in obtaining blue mussel samples from seven previously sampled stations throughout Buzzards Bay. Two of the locations were sampled in March; prior reconnaissance trips indicated that the other five locations had insufficient mussel populations for sample collection.

In September, MarineFisheries in partnership with New Hampshire Sea Grant, University of New Hampshire, Spinney Creek Shellfish Inc., USFDA, Dauphine Island, AL and Maine Department of Marine Resources, initiated a collaborative study of enteric virus contamination and mitigation strategies, to reduce the extent of permanently closed shellfish growing areas. The study is funded by the NOAA Sea Grant Aquaculture Research Program 2012. In the Northeast, many 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 commercial access, but are also proximal to municipal wastewater treatment plant outfall and combined sewer overflows. The understanding of enteric viruses such as norovirus and hepatitis A virus with respect to molluscan shellfish sanitation has progressed significantly over the past two decades. The rapid development of molecular techniques has led to detection/enumerations methods for these pathogenic enteric viruses that is responsible for the majority of shellfish consumption related viral disease worldwide. Recently, 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 to be considered a replacement for fecal coliform, the mainstay of the NSSP, but rather a specialty indicator that better reflects the persistence of viruses in molluscan shellfish and source identification. A strong association between MSC and norovirus has been demonstrated in three recent studies with soft-shelled clams in Maine and Pacific oysters in England and Ireland.

The primary research objectives are to determine the appropriateness of using MSC as an indicator of enteric viral contamination for American oysters and quahogs and for modeling depuration and relay viral removal kinetics. The specific research objectives are to determine seasonal levels of MSC, fecal coliform, and norovirus in Eastern oysters and hard-shelled clams harvested from the Taunton River and to determine norovirus and MSC elimination kinetics during depuration and relay as they relate to water temperature. Field work was conducted throughout the winter and will continue through 2013.

Habitat Program

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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 2012, Habitat Program staff reviewed 567 projects, representing 117 municipalities. Major project reviews included a variety of energy, dredging, monitoring, and coastal development projects. Important improvements that will enable mapping of the review projects were implemented. The In-lieu Fee (ILF) mitigation program disbursed its first project funding round, awarding \$166,000 to 3 coastal restoration projects. The ILF Program continues to develop into an expanded statewide program. Under the five-year HubLine eelgrass restoration program, an acre of eelgrass was planted. The Habitat Program conducted seafloor video and acoustic mapping on eelgrass beds in Clark's Cove, New Bedford, on 4 artificial reef sites, and on one research cruise aboard the Environmental Protection Agency (EPA) vessel, the OSV Bold. 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 and 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 as 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 2012, 567 specific projects in 117 municipalities were reviewed. Three full-time staff members dedicated up to 75% of their time on technical review. Two contractors, one full-time and one part-time, continued to play a vital role in maintaining records and assisting with the preparation of comment letters.

Major review projects included City of Salem port expansion, Freeman's Pond restoration in Brewster, Massport safety area expansion at Logan Airport, Quincy Town Brook improvement, Barnstable Mill Pond improvement, Winthrop Shores Reservation beach nourishment, Lower Mill Pond Dam Rehabilitation in Brewster, City of Beverly Bass River dredging, intertidal dredging in Marshfield, Wheelabrator fish return pipe in Saugus, Barnstable Inner Harbor dredging, 201 Marginal Street LLC in Chelsea, Buzzards Bay National Estuary Program revision, City of Revere's Oak Island Salt Marsh Restoration, Nonquitt Salt Marsh Restoration in Dartmouth, National Grid Commercial Point Facility in Dorchester, seawall discussions in Marshfield, Footprint Power Company in Salem, Town of Falmouth Comprehensive Wastewater Management Plan, Iron Hill Dam in Weymouth, New Bedford South Terminal, Manchester dredging, shoreline protection in Oak Bluffs, Whittier Bridge, and the ACE General Permit Amendment. They all involved multiple meetings, workgroups, and interagency communications due to the complexities of the proposals. Of note are the increasing conversations about seawalls and beach nourishment, as well as nutrient attenuation on the Cape.

Time of Year Work Windows

The Habitat Program completed its programmatic time of year recommendation for the Barnstable County Dredge in 2011. This project involved creating a habitat map for all Cape Cod embayments, linking dredge locations with resource information. All documents, including maps, were released publicly in 2012. Meetings representing the end of the formal stages of the project were held in 2012, though work on improving the document will continue. Staff planned to examine in 2013 how to build the document's recommendations into dredging permits.

Anadromous Mapping

The Habitat Program is facilitating a project with *MarineFisheries* and the *Mass*DOT Accelerated Bridge Program to develop a programmatic approach to time of year work windows for bridge projects in rivers with anadromous fish runs. The goal of this project is a statewide map of spawning runs with site specific time of year restriction windows. A draft map for the south shore was completed in 2012. 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.

Standard Protocols

The Habitat Program initiated changes to enable better mapping of the projects it reviews and more efficient record-keeping and archiving. We developed archiving standards consistent with the state archiving regulations established by the Records Conservation Board, we modified our standard review log to capture information we are interested in tracking to establish performance measures, and we contributed to the development of the Executive Office of Energy and Environmental Affairs' Environmental Information and Public Access System (EIPAS).

In-lieu Fee Program

This was the fourth year of the *MarineFisheries* and Army Corps ILF program. This program addresses authorized impacts of <1 acre in extent to aquatic resources, in particular Essential Fish Habitat 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). Seventeen projects have contributed nearly \$195,000 to the program between 2009 and 2012. All obligations under the program, including project tracking, fund disbursement, and annual reporting, were accomplished.

Two important programmatic developments occurred during 2012: 1) a 12% rate assessed on all in-lieu fees collected by the program was approved by an Interagency Review Team (IRT) for use by the Division to cover the program's administrative expenses; 2) restoration project proposals were solicited and funds were disbursed to three eligible projects. The program developed a comprehensive project ranking methodology through a 2012 grant funded by the Mass Bays Program (MBP) to assess proposals and select eligible projects. The MBP project examined impact and restoration trends in Massachusetts and developed a restoration project ranking tool. We found the majority of identified impacts were to intertidal, stream and open water habitats, with a spatial concentration in the metro-Boston region. The majority of identified potential restoration projects were for stream and salt marsh habitats, with spatial concentrations in the Upper North Shore and Cape Cod regions. This information will help to funnel future restoration efforts funded through the ILF program toward areas and habitat types that have been identified as priority restoration needs. The ranking tool was utilized by a multiagency proposal review committee in the selection of coastal restoration projects for funding in 2012, awarding \$166,000 to three coastal restoration projects.

Throughout 2012, program staff continued to work with the Commissioner, DFG staff, and the Army Corps in developing an expanded ILF Program that will address unavoidable impacts under the GP as well as unavoidable impacts associated with Individual Permit projects. The Prospectus for the new program was submitted to the Army Corps and approved in November 2012; the Comprehensive Planning Framework was being drafted for submittal to the Army Corps in 2013.

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 (Figure 25). 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; and seafloor mapping. Project staff serve on a variety of habitat-related committees, including the ASMFC Habitat and Reef Committees, the Atlantic Coastal Fish Habitat Partnership, the NEFMC Habitat Plan Development Team, the NROC Habitat Classification Working Group, and the MassBays Management Committee. We also participate in working groups for the Boston Harbor Habitat Atlas.



Figure 25. Clockwise from upper left: Tay Evans showing volunteers how to weave eelgrass into hemp for eventual transplanting; preparing photo equipment for deployment; eelgrass monitoring quadrat, Manchester; squid mop on Sculpin Ledge, Boston Harbor.

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 in each year. In 2012 work was performed on the artificial reef in Buzzards Bay and in Clark's Cove, New Bedford. In August, Project staff supported efforts to map Massachusetts Bay on the EPA's research vessel, *Bold*.

One challenge to assessing and managing marine fisheries habitats has been a lack of a comprehensive description of which habitats are critical. In 2012, the Habitat team drafted "The Critical Marine Fisheries Habitats of Massachusetts." This document is intended to provide a roadmap for a phased approach to mapping those habitats.

The Project also maintains a blog to promote discussion of seafloor mapping tools and issues. It is online at: 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 at least a decade. The eelgrass team focuses on research, monitoring and restoration of eelgrass in Massachusetts. A large restoration project funded as mitigation for damage caused by the construction of the HubLine pipeline reached its halfway mark in 2012. The goal of the project is to restore and monitor two acres of eelgrass. Half an acre of eelgrass was planted and ten sites were test-planted in 2011; one acre of eelgrass was planted and two sites were test-planted in 2012. Planting is being conducted in Beverly, Salem, and Boston.

We are in our second year of study with the University of New Hampshire eelgrass genetics study. The 2012 genetic work determined the genetic diversity of eelgrass populations throughout Southern New England and identified populations with greater resilience to stressors and high potential for restoration success, as well as others that are less tolerant to stressors. The 2013 follow up study will measure transplant success of a variety of populations all planted in a common garden experiment in Plum Island Sound.

Ongoing monitoring of mooring scars in Manchester has shown some regrowth of eelgrass into the scars since moorings were changed to conservation type mooring systems but sites with mooring blocks continue to scour even after the chain has been removed. We expect full eelgrass recovery will take several years.

In addition to research and restoration, the eelgrass team is in its sixth year of monitoring a long term transect in an eelgrass bed in Salem Sound, as part of the international SeagrassNet monitoring 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. We post regularly on our seagrass blog (seagrasssoundings.blogspot.com) and have increased the blog authors to include representatives from other organizations conducting eelgrass work.

Artificial Reefs



Figure 26. Anemones colonizing natural bottom near the Dartmouth artificial reef site.

The Fisheries Habitat team continues to collaborate with the towns of Harwich and Yarmouth 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. Using site selection data collected in 2009 and 2010 we identified a 10 acre site approximately 2 miles off the coast of Harwich capable of accepting up to 280,000 ft³ of reef materials. In addition, we determined the previously permitted 128 acre Yarmouth artificial reef site (a.k.a. the tire reef) is capable of accepting up to an additional 2.5 million ft³ of additional approved materials. 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 off the bottom to maximize fish habitat potential and edge area while minimizing the amount of habitat disturbance at each location. These new reef sites will provide hard bottom structured habitat for marine fish and invertebrate species and additional near-shore fishing opportunities for anglers. Permits received in 2012 for both sites include Notice of Intent (NOI) filed with the local Conservation Commissions, MEPA Secretaries Certificates, and DEP 401 Water Quality certifications. *MarineFisheries* hired an engineering firm to complete required engineering plans for the DEP Ch. 91 license and Army Corps Individual Permit (IP) applications and will coordinate with the towns to file the remaining permit applications once the plans are completed in early 2013. Program staff also established permanent monitoring stations at all four state permitted artificial reef locations this year (Figure 26). Monitoring sites will be visited annually to document the presence of finfish and invertebrates, including invasive species.

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 2012, the Project created actions for 2013 consistent with the strategies and priorities. They are: 1) meet with program leaders to assemble climate-related data; 2) examine how to identify optimal locations for a carbon dioxide sensor network; and 3) in response to coastal erosion caused by climate change, draft a policy document regarding the impacts of beach fill activities on marine fisheries resources.

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 the Executive Office of Energy and Environmental Affairs as well as to the Bureau of Offshore Energy Management by participating in the Massachusetts Renewable Energy Task Force and the Joint RI-MA Renewable Energy Task Force. The Habitat Program was involved in creating monitoring and mitigation methodologies for the development of South Terminal, the first dedicated wind support facility in the northeast. The Program also supported agency participation at the Northeast Regional Planning Body inaugural meeting, and all Massachusetts Ocean Plan meetings.

Outreach & Peer Review

Habitat Program staff provided scientific peer review for grants and manuscripts submitted to Bulletin of Marine Science, Deep Sea Research II, Environmental Biology of Fishes, Hydrobiologia, Journal of Fish Biology, Journal of Northwest Atlantic Fishery Science, Journal of Ocean University of China, Journal of Sea Research, Life and Environment, Limnology and Oceanography: Methods, Marine Ecology Progress Series, Marine Mammal Science, MIT SeaGrant, ACFHP, Estuaries and Coasts, Northeastern Naturalist, and NOAA Habitat Conservation Division.

Habitat Program staff continued its tradition of participating in a variety of outreach events. Efforts included manning booths 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, including leading a field trip to Gloucester to demonstrate smelt spawning to high school students. Volunteers from Salem Sound Coastwatch and the New England Aquarium participated in two eelgrass restoration days in Salem Sound. Habitat Program staff is also serving on one graduate student thesis committee at Northeastern University and gave lectures in university courses and seminar series, including Salem Sound Coastwatch's "Underwater in Salem Sound" community lecture series.

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 2012, staff cleaned, processed, and aged hard-part structures from recreational and commercial samples of bluefish, Atlantic cod river herring (alewife and blueback herring), black sea bass, American shad, smelt, striped bass, tautog, and winter flounder. Structures collected from a study of wolffish were also processed and aged. Table 6 shows the number of structures processed and aged.

Much of 2012 was spent processing and ageing hard part structures of ASMFC-managed species. In addition, black sea bass and winter flounder from the *MarineFisheries* trawl survey, previously aged by the NMFS ageing lab, were added to the list of species that will be permanently aged by the Age and Growth Project. Project staff met with NMFS staff to standardize techniques for ageing between labs. NMFS agreed to section all winter flounder otoliths aged five or higher. It is important to section the otoliths of older fish because the annuli become difficult to distinguish on whole otoliths (Figure 27). The lab will continue to improve ageing and quality control methods in 2013.

Table 6. Samples processed for age in 2012; all samples were collected in 2012.

Species	Structure	Process	Quantity (Fish)
Bluefish	Otoliths	Baked, Sectioned, Aged	113
Black Sea Bass	Scales	Cleaned, Mounted, Aged	1,383
River Herring	Otoliths and Scales	Cleaned, Mounted, Aged	2,027
Shad	Otoliths and Scales	Otoliths aged, scales checked for repeat spawning	243
Smelt	Scales	Cleaned, Mounted, Aged	1,636
Striped Bass	Otoliths	Extracted, Sectioned, Aged	200
Striped Bass	Scales	Cleaned, Pressed	2,167
Tautog	Otoliths and Opercula	Cleaned, Sectioned, Aged	256
Winter Flounder	Otolith	Sectioned and Aged	1,081
Wolffish	Otoliths	Extracted, Sectioned, Aged	300

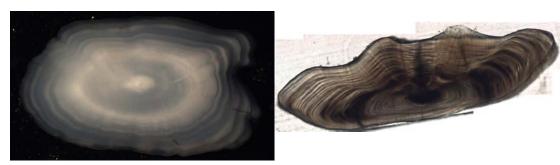


Figure 27. Images of a winter flounder whole otolith (left) and its cross section (right). This fish was aged as a six year old using the whole otolith, and as a ten year old using the section. This illustrates the need to section otoliths of older winter flounder to get more accurate age readings.

Fisheries Dependent Sampling Project

The Fisheries Dependent Sampling Project is responsible for the oversight and sampling of commercial fisheries, implementation of fish biology studies, and support to other projects and senior staff.

Commercial Fisheries Sampling

MarineFisheries conducts at-sea and shore-side (port) sampling of commercial fisheries to document fishery performance and collect biological samples for stock assessment research. Data collected strengthen MarineFisheries' participation on – and contributions to – the fishery management councils and ASMFC. Sampling efforts in which project staff participated during 2012 are shown in Table 7. Units for at-sea sampling are shown as number of sea days and port sampling are shown as number of sampling events, or trips, made to intercept vessels or dealers where information was successfully collected.

Table 7. Participation by Fisheries Dependent Sampling Project staff in commercial sampling and other sampling projects during 2012.

At-Sea Sampling (Sea Days)	North Shore	South Shore
Coastal Lobster (commercial)	79	74
Marine Recreational Information Program (recreational)	10	
Resource Assessment (fishery-independent)	20	11
Acoustic Tagging (fishery-independent)	98	
Atlantic Cod (commercial)	7	
Squid (commercial)		10
Striped Bass Tagging (fishery-independent)	2	
Summer Flounder (commercial)		6
Horseshoe Crab (commercial)		2
Smelt Fyke Net (fishery-independent)		5
Winter Flounder Young-of-Year (fishery-independent)		5
Total	215	113
Port Sampling (Intercepts)	North Shore	South Shore
Striped Bass Market Sample (commercial)	6	7
Atlantic Sea Herring Bycatch Study (commercial)	220	14
Atlantic Sea Herring Mid-water Trawl (commercial)	5	
Atlantic Herring GSI (commercial)	6	
Northern Shrimp (commercial)	17	
Menhaden (commercial)	2	
Spiny Dogfish (commercial)	17	30
Total	268	51

Small Pelagic Fishery Dockside Monitoring and Avoidance System

MarineFisheries has conducted portside sampling of the herring and mackerel fisheries since 2008 with the goal of quantifying catch composition and verifying landings to assist stock assessment and management. The River Herring Bycatch Avoidance Study was conducted for the third year, supported by a grant from the National Fish and Wildlife Federation and collaboration with SMAST and the commercial fishing organization, Sustainable Fisheries Coalition. The goal of the study is to develop a bycatch avoidance incentive system to minimize the bycatch of river herring in the mid-water trawl fishery. Through this grant, and with the assistance from a contracted sea sampling program, we sampled 220 trips (dockside) in 2012 which increased port sampling levels to cover 52% of the trips landed in Massachusetts.

The Fisheries Dependent Sampling team was responsible for the following activities performed in 2012: coordination of port sampling staff; participation and support of *MarineFisheries* staff at NEFMC and Herring Plan Development Team meetings; conduct and oversight of port sampling; contracting of port sampling staff and management of this staff; outreach and enlistment of fishery stakeholders for the participation in the bycatch avoidance study; presentation of the bycatch avoidance study at the Sustainable Fisheries Coalition captains' meeting; training of sampling staff; and data maintenance and entry into a relational database.

Cod Conservation Zone (CCZ) Investigations

Working in collaboration with SMAST, Program staff continued studies using acoustic telemetry, data storage tags, traditional t-bar anchor tags, and underwater video to help understand the fine-scale population structure of inshore Atlantic cod, as well as their behavior and movement patterns. In 2012, 65 Atlantic cod were tagged with data storage tags, 14 were tagged with Vemco transmitters (Figure 28), and 671 cod with traditional t-bar tags. An acoustic array of 25 Vemco receivers was deployed in the Spring CCZ to detect cod spawning aggregations and their movements in non-real time. Data collection was also conducted in the Winter CCZ to document cod spatiotemporal distribution and stock demographics.



Figure 28. On the left, an Atlantic cod photographed after an acoustic transmitter tag (right) was surgically implanted.

Through collaboration with the Stellwagen Bank National Marine Sanctuary (Sanctuary) and the Northeast Fisheries Science Center), *MarineFisheries* undertook a project to use Passive Acoustic Monitoring to identify and describe undocumented cod spawning aggregations that exist in the GOM in 2012. Male Atlantic cod are known to produce a low-frequency vocalization, known as a "grunt," during courtship and spawning. A series of Marine Autonomous Recording Units (MARUs) were deployed in the Spring CCZ to record the temporal and spatial pattern of these grunts on the spawning ground. Once the acoustic source level and vocal behavior of spawning cod was sufficiently described in the Spring CCZ, recordings from MARUs deployed throughout the GOM (supporting other research initiatives) were mined for evidence of undocumented spawning aggregations. Micah Dean and William Hoffman co-authored a manuscript on the findings that has been accepted for publication in the ICES Journal of Marine Science (*Hernandez, K.M., D. Risch, D.M. Cholewiak, M.J. Dean, L.T. Hatch, W.S. Hoffman, A.N. Rice, D.R. Zemeckis, S.M. Van Parijs. (In Press). Developing passive acoustic monitoring for Atlantic cod (Gadus morhua) management and conservation. ICES Journal of Marine Science).*

Duties preformed by Program staff included coordination and implementation of all tagging efforts and field related activities; collaboration with SMAST and Sanctuary partners; data management and analysis; and presentation of findings to *MarineFisheries* senior staff, the Stellwagen Bank Sanctuary Advisory Committee, and NOAA Fisheries Northeast Regional Office. A manuscript by Michael P. Armstrong, Micah J. Dean, William S. Hoffman, Douglas R. Zemeckis, Thomas A. Nies, David E. Pierce, Paul J. Diodati, Daniel J. McKiernan entitled *The application of small scale fishery closures to protect Atlantic cod aggregations in the inshore Gulf of Maine* was accepted for publication in *Fishery Research*.

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 stripers are major factors contributing to the success of this fishery. Without a doubt, striped bass are the backbone of our recreational industry and provide enjoyment to hundreds of thousands of recreational anglers each year. Accordingly, we give this important resource 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 2012, Striped Bass Research Project staff conducted 15 trips aboard contracted vessels, tagging a total of 643 striped bass. Staff, volunteer anglers, and vessel captains were coordinated via daily phone calls and e-mails for all trips. Trip data were entered into appropriate databases.

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 2012, Striped Bass Research Project staff conducted 13 market sampling trips, collecting length, weight, and age structures (scales) from 760 commercially-caught fish.

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 the Federal 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.

During 2012, staff deployed three acoustic receiver arrays which included a total of 22 receivers. These three arrays were located: 1) off the tip of Cape Ann and running in an east-west direction extending 9 miles; 2) off the town of Truro, on the ocean side extending from the beach out to the Massachusetts state territorial line; and 3) in the eastern and western entrances of the Cape Cod Canal. This was the final year of data collection for the project. The transmitters used have a battery life of approximately two and a half years; tagging was last conducted in 2010 meaning all transmitters have turned off and fish returning to the array will no longer be detectable in 2013. Analysis of data began in 2012 and will continue in 2013.

Volunteer Recreational Angler Data Collection Program

The objective of the Volunteer Recreational Angler Data Collection Program is to generate a time series database of biological characteristics of Massachusetts's striped bass recreational harvest and discards. During 2012, participating anglers collected over 1,743 paired length/age samples. Twenty-one anglers also registered to use the web-based *eLogbook* to submit trip information; they entered 837 length records on 13 species of marine fish including striped bass. Program staff prepared an in-house report on the *eLogbook*. The Division continued its carcass collection program, utilizing several freezers placed at sites along the coast, to obtain otolith samples from recreationally caught striped bass. Volunteer anglers donated 200 striped bass carcasses in 2012.

Investigation of Dermal Lesions in Striped Bass

In mid-June of 2012, reports and photographs of striped bass with dermal lesions were received by *MarineFisheries* from anglers fishing south of Cape Cod (Figure 29). The lesions were described commonly as being small in diameter, red, and distributed from the underside of the fish through

the lateral line region of the body, although some fish had redness below many scales. MarineFisheries staff investigated the incidence of lesions by surveying charter boat captains who target striped bass and examining striped bass sold in local fish houses. The incidence was generally low (<5%). Five striped bass with lesions were sent to the University of Connecticut's Department of Pathobiology and Veterinary Science Veterinary Medical Diagnostic Laboratory for histopathology and microbial testing in an attempt to identify potential pathogens such as Mycobacterium schottsi, a bacterium known to cause lesions in resident striped bass of Chesapeake Bay. The results of the laboratory test indicated that Mycobacterium was not present in any fish. Although the causative agents of the dermal lesions were not identified, the pathologists commented that external parasites not present on the carcasses could be a causative agent. Coincidentally, MarineFisheries staff noted the incidence of parasitic copepods



Figure 29. An example of the lesions observed on striped bass during the summer of 2012; testing proved they were not symptomatic of mycobacteriosis.

was high on striped bass and other fish species during spring and summer of 2012, so it is possible that an external parasite may have caused the dermal lesions.

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 2012, Dr.

Gary Nelson served as the Massachusetts representative to the ASMFC's striped bass tagging, technical, and stock assessment sub-committees, and the river herring stock assessment sub-committee; Micah Dean served on the ASMFC menhaden technical committee and multispecies committee; and William Hoffman served on the ACCSP bycatch and biological sampling priorities committees. In addition, Dr. Nelson developed Visual Basic/AD Model Builder assessment models for striped bass, and a data entry and analysis program for Massachusetts watershed groups interested in estimating river herring run size by using visual counts.

Publications

In addition to the publications previously mentioned, Dr. Gary Nelson contributed a monitoring report of Massachusetts' 2011 striped bass fishery to the Division's Technical Report Series (#53). Dr. Michael Armstrong, Micah Dean and William Hoffman published a peer-reviewed paper related to the cod conservation zone study: *Dean, M. J., W. S. Hoffman, and M. P. Armstrong. 2012. Disruption of an Atlantic cod spawning aggregation resulting from the opening of a directed gill-net fishery. North American Journal of Fisheries Management 32: 124-134.*

Assessment and Survey Program

Personnel

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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
Jillian Carr, Seasonal Fisheries Technician

Protected Species Project

Erin Burke, Protected Species Specialist

Scientific Diving Project

Holly Martel Bourbon, Diving Safety Officer (through June 2012) Vin Malkoski, Diving Safety Officer (beginning July 2012)

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. The year 2012 marked the completion of the 35th consecutive annual spring and fall statewide trawl surveys and the 37th consecutive annual seine survey conducted in Cape Cod estuaries. Data provided by the surveys are used in assessments of numerous regional fish stocks. In addition, the surveys 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, and northern shrimp. Fishery-dependent and -independent surveys as well as applied research projects are conducted to characterize the populations of, and the fisheries for, these valuable species and to inform their management. Additional tasks include research grant writing and administration, and participation in ASMFC technical meetings 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 2012, 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 2012, these activities covered a range of issues such as the sea turtle disentanglement network, ghost gear removal, acoustic validation of right whale calls, the Massachusetts Lobster labeling and promotion campaign, participation in federal Take Reduction Teams, general grant management, and providing protected species guidance to *MarineFisheries* staff.

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

2012 Trawl Survey

The 35th spring and fall surveys were accomplished aboard the R/V Gloria Michelle. During the spring survey, 100 stations were completed in 16 consecutive days from May 7-22. During the fall survey, 97 stations were sampled successfully from September 4-24 (Figure 30).

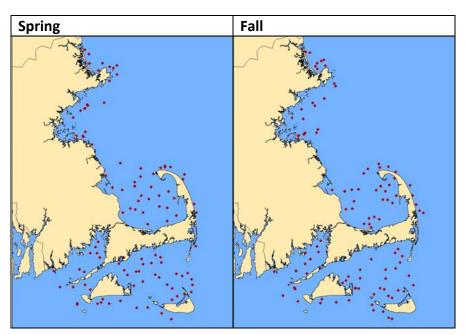


Figure 30. 2012 spring and fall trawl survey station locations.

A combined total of 95 different species of fish and invertebrates were weighed, counted, and measured during the 2012 trawl surveys (including the first clearnose skates, *Raja eglanteria*, recorded in the spring series and the first mahogany snapper, *Lutjanus mahogoni*. To aid

cooperative fisheries assessments, over 3,000 scale/otolith samples, and sex and maturity observations were taken from Atlantic cod, haddock, summer flounder, yellowtail flounder, winter flounder, windowpane flounder, black sea bass, and scup.

Project personnel contributed to work of the ASMFC's Northeast Area Monitoring and Assessment Program (NEAMAP) Committee. NEAMAP has a goal of improving the collection and dissemination of fishery-independent data. In addition, the project leader presented an overview of the Division's trawl survey as a panel member at the Northeast Fishermen's Groundfish Science Forum

2012 Seine Survey

The 37th Nantucket Sound Estuarine Winter Flounder Young-of-Year (YOY) Seine Survey was completed from June 11 – July 2, 2012 (Figure 31). The primary objective of this survey is to provide a winter flounder YOY abundance index 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.



Figure 31. Project staff conducting a tow for the 2012 Seine Survey.

The 2012 pooled (all strata combined) winter flounder YOY index falls in the lowest quartile of the time series, as have seven of the past 11 annual indices (Figure 32). The 2012 YOY fluke index is the third highest in the time series. A total of 39 species were encountered in seine hauls, including the pinfish, *Lagodon rhomboides*, a southern fish not encountered in previous surveys.

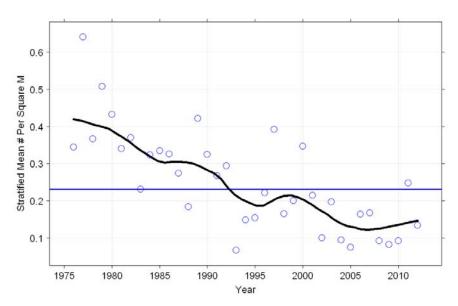


Figure 32. Abundance index for YOY winter flounder, *Pseudopleuronectes americanus*, in Southern New England from the seine survey, 1976-2012 (black line = Loess smoothed index; blue line = time series median value).

Assessment and Fisheries Management Support

Project personnel provided survey data and summary graphics for inclusion in compliance reports for ASMFC-managed species. Survey data supported 2012 stock assessments for numerous species including scup, summer flounder, Cape Cod/Gulf of Maine yellowtail flounder, Gulf of Maine/Georges Bank American plaice, witch flounder, ocean pout, Atlantic wolffish, and Gulf of Maine cod.

Survey data provided senior managers with evidence to inform management of whelk, horseshoe crabs, cod, and winter flounder resources in Massachusetts state waters.

Project personnel fulfilled survey data requests to support research and answer management questions at other government and academic institutions across New England including studies related to: power plant impacts, shallow water habitat usage of Atlantic cod in the GOM, management and assessment of squid/butterfish resources, distribution of groundfish species, research on ecological valuation indices, surf zone fish communities, and juvenile winter flounder distributions.

Invertebrate Fisheries Project

Commercial Lobster Trap Sampling

The 32nd year of Commercial Lobster Trap Sampling was completed. This is an ongoing cooperative effort conducted with Massachusetts commercial lobstermen dating back to 1981. A total of 85 trips were conducted in 2012, during which 45,703 lobsters were sampled from 16,460 trap hauls. Data from the sampling program contributed to *MarineFisheries'* bi-annual lobster status of the stock report, and were provided to the ASMFC and ACCSP.

Ventless Lobster Trap Survey

The 7th year of the Coastwide Ventless Trap Survey was completed. The survey is a multi-state cooperative effort between state fisheries agencies and commercial lobstermen to evaluate American lobster in coastal waters from Maine to New York. This survey design allows biologists to develop more precise estimates of lobster relative abundance and to adequately characterize the size distribution of lobsters in coastal waters.

In 2011 and 2012, with additional funding from the Commercial Fisheries Research Foundation, the survey was expanded in Southern New England waters to include a portion of federal waters. Each year, stations are randomly selected and are then sampled twice monthly from June through September. Through 64 sampling trips, *MarineFisheries* staff sampled 60 stations north of Cape Cod and 42 stations south of Cape Cod. Nearly 30,000 lobsters were sampled from 4,816 trap hauls. Results were made available to the ASMFC Lobster Technical Committee for incorporation into the 2014 Lobster Stock Assessment.

Annual Early-Benthic-Phase Lobster Suction Sampling

The 18th year of *MarineFisheries'* Annual Early-Benthic-Phase Lobster Suction Sampling Program was completed. In addition to 19 of the coastal sites surveyed in 2011 spanning Buzzards Bay, Cape Cod Bay, and Massachusetts Bay, two new stations were added along the South Shore near Scituate. These stations were added to close spatial gaps in our survey and better monitor recruitment signals in Massachusetts waters.

Project staff using SCUBA conducted this year's survey over 12 field days from mid-August to mid-October. Mean densities of young-of-the-year (YOY) lobsters (Figure 33) in all survey regions were below time series means with the exception of Cape Ann (Table 8). The increase in the number of lobsters just over traditional YOY size bins (5-12 mm north of Cape Cod, 5-13 mm south of Cape Cod) has led to new discussions about expanding the size definition of YOY lobsters. There is evidence that

Figure 33. Newly settled YOY lobster

increases in water temperature have led to changes in hatch timing. Earlier egg hatch would provide YOY lobsters additional time to molt/grow before being collected in our survey. A change in the YOY definition by a couple of millimeters could increase our measure of YOY density in some regions.

Table 8. Comparison of YOY lobster densities in 2012 and the time series mean, by area.

Area	2012 Mean (0 -16mm YOY)	Time Series Mean (0-16mm YOY)	# Years
Cape Ann	1.92	1.03	3
Salem Sound	0.39	0.80	17
Boston	0.06	0.31	16
South Shore	0.67	0.67	1
Cape Cod Bay	0.17	0.33	18
Buzzards Bay	0.00	0.09	18
Vineyard Sound	0.00	0.03	3

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 is conducting field and laboratory work that examines how male lobsters may be limited in their ability to supply sperm to females, with the end goal being to account for male contributions to reproductive success in the stock assessment process. A manuscript documenting the results of the field work and one describing the at-sea sampling methodology were submitted for publication.

Early in 2012, *MarineFisheries* staff re-located several large lobster tanks from the John T. Hughes Hatchery and Research Station on Martha's Vineyard to the Hodgkin's Cove UMass Amherst Marine Station in Gloucester, and constructed a seasonal outdoor wetlab (Figure 34), where Pugh conducted experiments over the summer and fall months. These experiments included an examination of the quality of spermatophores produced by males, mating experiments to establish the number and sizes of females with which an individual male might successfully mate, and a mating experiment to determine if males can successfully mate with hard-shelled females (potentially an alternative mating strategy for American lobster).



Figure 34. Lobster research tanks at the UMass Amherst Marine Station at Hodgkin's Cove.

Ghost Gear Study

Despite the large scale and high value of the American lobster fishery, little information exists on the number of lobster pots lost annually or how long these "ghost pots" continue to fish. To address these concerns, *MarineFisheries* initiated a study in 2010, made possible with a research grant from the National Fish and Wildlife Foundation and NOAA Marine Debris Program.

In May of 2010, project staff set and "abandoned" two 6-pot trawls in both Cape Cod Bay and Buzzards Bay. Another trawl was added to each location in November of 2010, and an additional trawl was set in both locations in late spring of 2011. All lobster traps had two degradable ghost panels which are designed to release lobsters and bycatch within one year if a trap is lost. However, our research has shown that if ghost pots continue to fish for even a short-term, there may be a substantial loss of yield and revenue to the industry. Catch lost to ghost fishing could jeopardize long term conservation goals and undermine our ability to fully model lobster population dynamics.

The Cape Cod Bay portion of the study concluded in November of 2011. At the time of trap removal, all survey traps that had been set in 2010 had become disabled. The mean number of days the gear was last seen fishing was 264 (±58) days. While the gear did disable within one

year meeting current regulation standards, the mechanism that disabled the trap was often storm damage to the trap (snapped bungees, etc.), not the disablement of the ghost panels. The gear set in Buzzards Bay was subjected to very little storm activity due to the enclosed nature of the Bay. Every trap set in 2010 lasted longer than one year, and two of those 18 traps had not disabled when the gear was retrieved in December of 2012, 929 days after the gear was set.

Degradable uncoated ferrous metal hog rings are the most commonly used material for attaching ghost panels in the lobster industry. This study has shown that this method is ineffective. Hog rings may rust out within one year's time when hauled regularly and exposed



Figure 35. Escape vent/ghost panel of simulated ghost pot covered with tunicates and other organisms after nearly three years in the water.

to air, but when traps are lost or abandoned and not subjected to air exposure, they do not have a chance to oxidize and break down. Encrusting tunicates and other organisms (Figure 35) can further delay the release of the ghost panels.

Results from this study suggest that lobster mortality rates from ghost fishing are generally low. However, when the scale of the commercial fishery and persistence of traps are considered, it is likely that ghost fishing represents a substantial source of unaccounted mortality for lobster, Jonah crab, and tautog. This is especially true if losses from other trap fisheries that use these ineffective ghost panels, including the recreational lobster and fish pot fisheries, are similar.

Northern Shrimp Survey and Assessment

Northern Shrimp Assessment Survey: In July and August, staff participated on several one-week legs of the annual northern shrimp assessment survey conducted throughout the Gulf of Maine aboard the R/V Gloria Michelle. The 2012 survey indicated lower than average abundance of all stages of shrimp, with time-series lows in new recruits and shrimp which will be fully-recruited to the fishery in the upcoming fishing season. The ASMFC Technical Committee recommended a 2012/2013 harvest moratorium based on survey and assessment model results, and noted that recently-observed unfavorable water temperatures may contribute further to poor recruitment.

Commercial Fishery Sampling: During the 2012/2013 northern shrimp fishing season, Project staff conducted biweekly port sampling from vessels landing shrimp in Gloucester and Newburyport. Samplers interviewed fishermen and dealers for tow time, areas fished, catch, and number of boats fishing. They also collected and analyzed 2 kg biological samples from catches. The port samples provided information on size and stage distribution, egg hatch, and disease prevalence. Findings were reported weekly to the ASMFC Technical Committee to assist real-time monitoring of the biological condition of the catch.

Assessment and Management Support: Invertebrate Fisheries Project staff contributed to the preparation of the 2012 ASMFC Northern Shrimp Stock Assessment as member of the ASMFC Northern Shrimp Technical Committee. During the fishing season, Project staff weekly assessed progress toward the total allowable catch and the biological status of shrimp catches. Project staff also participated on the ASMFC Northern Shrimp Plan Development Team in the preparation of Addendum I to Amendment 2 to the interstate FMP.

Horseshoe Crab Monitoring

Commercial Fishery Sampling: Monitoring of the commercial bait and biomedical harvests continued in accordance with the ASMFC Horseshoe Crab FMP. Prosomal width measurements were obtained from 1,174 crabs during dealer and biomedical facility sampling. In addition, prosomal width measurements were obtained from 93 crabs during sea sampling trips aboard a dragger in Nantucket Sound. A short-term marking technique and holding study continued at the NMFS Woods Hole Aquarium to evaluate the effectiveness of marks employed by the biomedical facility to identify bled crabs and ensure long-lasting marks.

Spawning Surveys: Nearly 100 volunteers participated in the annual survey of horseshoe crab spawning beaches (Figure 36). Relative abundance of spawning crabs on the beaches remains low, although the 2012 estimates may have been skewed by warmer water temperatures resulting from the mild winter. Active spawning was observed in April in several areas along the South Coast and Cape Cod prior to the start of the survey.



Figure 36. Horseshoe crab spawning activity

Acoustic Telemetry: Having completed the field portion of this effort in 2011, project staff worked with UMass graduate student Sarah Martinez to analyze the data. As part of this effort, Martinez completed and successfully defended her thesis and earned her Master's degree. Data from the telemetry study provided strong evidence that horseshoe crabs were exhibiting spawning site fidelity to a general area within and between years, but were not necessarily exhibiting spawning beach fidelity as many horseshoe crabs were detected during one or both spawning seasons in an area ~ 2.0 km from where they were initially tagged. Additionally, horseshoe crabs dispersed between the two areas but they were not necessarily at these spawning locales at the same time and there was little evidence suggesting that horseshoe crabs from the two groups were spawning during the same time. Continued research is recommended

to assess spawning site fidelity to and movement within and between other embayments on Cape Cod.

Bottom Temperature Monitoring

The Invertebrate Fisheries Program maintains nine permanent temperature monitoring stations in water between 5 and 30 meters deep from Boston Harbor to Southern Buzzards Bay (Figure 37). Data from these monitors are valuable in detecting environmental change in Massachusetts' waters. Many of the stations have collected bi-hourly temperature readings for over 20 years. Temperature data from southern New England has shown a warming trend and has helped explain changes in population dynamics of some cold-water species, including American lobster.

In 2012, *Marine Fisheries* SCUBA divers performed eight dives to locate and replace temperature monitors. Monitors are retrieved annually, but the Martins Ledge and Rocky Point sites were not hauled due to logistical constraints and will be hauled in the spring of 2013. Warming temperatures in the time series reached unprecedented levels in 2012. Most temperature monitors were retrieved in August, and despite having incomplete data for 2012, numerous temperature records were broken. Among the records broken for highest recorded daily temperature were the Buzzards Bay Barge (20.6 °C), Cleveland Ledge (25.5 °C), and Cuttyhunk (22.4 °C). The Barge and Cleveland Ledge sites had more daily mean temperatures above 20 and 25 °C, respectively, than the rest of their respective time series combined. More temperature records are likely to be broken when the remaining 2012 data are collected in 2013.

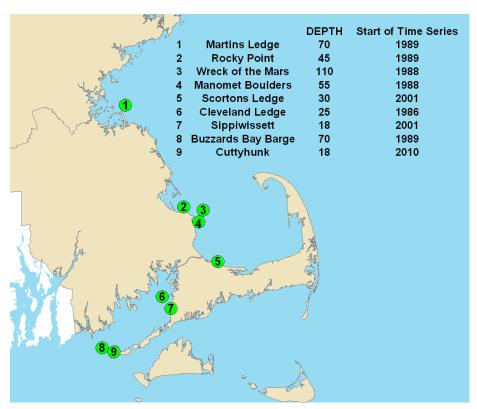


Figure 37. Map of temperature monitoring stations (depth given in feet).

Whelk Studies

Maturity Study: UMass-Dartmouth, in collaboration with *MarineFisheries*, was awarded a grant through the Commercial Fisheries Research Foundation investigating the biology of the

channeled whelk, *Busycotypus canaliculatus*. Staff member Steve Wilcox concluded his Master's degree work with Dr. Kenneth Oliveira at UMass-Dartmouth to determine the size and age of maturation and seasonal reproductive timing for the channeled whelk in Buzzards Bay, Vineyard Sound, and Nantucket Sound.

The two year grant included the collection and processing of 1,349 channeled whelk between the fall of 2010 and the fall of 2011 (Figure 38). Processing included taking external measurements and weights, removal of the shell, dissection of reproductive structures, and aging by way of the operculum. Results indicated that no female channeled whelk are mature at the minimum legal size of 2 ¾". Recommendations were made to fisheries managers to increase the minimum



Figure 38. Collecting channeled whelk for sampling.

legal size at least ¾" in shell width to protect some spawning stock. In 2013, staff will continue to work with industry members to better characterize the channeled whelk fishery as well as begin to investigate the life history of the knobbed whelk, *Busycon Carica*.

Protected Species Project

Cape Cod Bay Right Whale Surveillance Program

In 2012, the Division of Marine Fisheries partnered with the Provincetown Center for Coastal Studies (PCCS) and NOAA Fisheries to carry out the 14th 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 continued in 2012. We documented 214 individual right whales in CCB and adjacent waters (Figure 39) – approximately 44% of the known population (509 whales). Interestingly, the high abundance of whales appeared a month or more earlier than the average over the last 15 year, with February abundance more typical of that seen in March. The whales also departed Cape Cod Bay earlier than usual. The unusually warm conditions in 2012 likely impacted the zooplankton resource and the subsequent habitat-use patterns of right whales; habitat monitoring found that zooplankton did not follow previously documented patterns of enrichment, with densities the lowest seen in the past five years. The Division issued a public advisory in March – the earliest ever – about right whale aggregations and the potential for vessel collisions through email lists and standard media outlets.

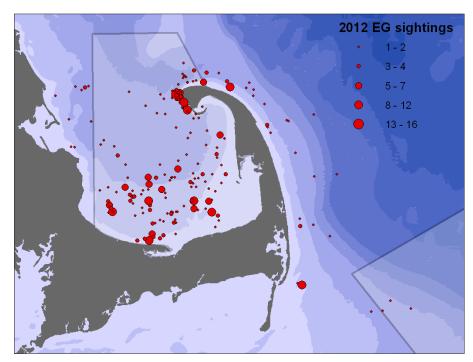


Figure 39. Map of 2012 right whale sightings (PCCS aerial data)

Large Whale Disentanglement Network

MarineFisheries and the PCCS cooperatively administer large whale disentanglement efforts around Massachusetts through a grant from NMFS. During 2012, the Massachusetts entanglement hotline received over 200 reports concerning marine animals, including entanglements, strandings, out of habitat animals, and carcasses. Staff confirmed that 93 were entanglement-related sightings, involving 69 individuals – four right whales, 22 humpback whales, one fin whale, five minke whales, 34 leatherback sea turtles, two loggerhead sea turtles, and one Kemp's Ridley sea turtle. PCCS and their partners performed more than 45 on-water responses, wholly or partially resolving the entanglement of one right whale, 10 humpbacks, and 19 leatherbacks. Project staff from MarineFisheries performed grant management and assisted in investigating gear retrieved from entangled animals.

Leatherback Sea Turtle Research and Disentanglement

Seasonal visitors to Massachusetts waters, leatherback sea turtles are known to become entangled in vertical lines associated with fixed fishing gear. *MarineFisheries* has operated the Massachusetts Sea Turtle Disentanglement Program with the PCCS since 2005. In 2010, *MarineFisheries* was awarded a three-year grant to partner with the UMass and PCCS on leatherback tagging, disentanglement, gear analysis, and outreach.

During the 2012 field season, seven GPS-linked satellite tags and three daily diary tags were deployed on leatherback turtles off Cape Cod and the Islands (Figure 40). In addition, a record number of confirmed entanglement cases were documented (n=37), of which 19 live entanglement cases were resolved by network responders. Project Staff assisted in disentanglement efforts, tagging efforts, gear analysis, and performed all grant management activities.



Figure 40. Leatherback turtle with suction-cup mounted daily diary, acoustic, and VHF tags, Nantucket Sound (photo courtesy of Connie Merigo, NEAq)

NMFS Vertical Line Reduction Plan

Through the Atlantic Large Whale Take Reduction Team, NMFS is pursuing a vertical line reduction solution for fixed gear to reduce the risk of entanglement for large whales. *MarineFisheries* staff assisted NMFS and their contractor, Industrial Economics, in the development and evaluation of this plan. This involved fixed gear data analysis for Massachusetts, writing comments and strategies, conducting outreach to the fishing industry on the reduction plan, and attending numerous meeting regarding this matter.

Environmental Review of Massachusetts Wind Energy Area

State and federal governments are assessing the area south of Martha's Vineyard and Nantucket for future offshore wind energy development. Project staff serve 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. Project staff participated in several meetings of the Habitat Working Group and helped *MarineFisheries* develop comments on leasing activities and documents.

Harbor Porpoise Bycatch Reduction and Management

In 2010, an updated Harbor Porpoise Take Reduction Plan was issued to reduce bycatch in gillnets to levels below the Potential Biological Removal (PBR) rate. Takes have risen above PBR since the early to mid 2000s and the updated plan was designed to bring takes below PBR. However, numerous problems with the 2010 Plan have become apparent, including fishing effort changes attributable to groundfish sector management, data gaps, and faulty bycatch thresholds. Project staff are member to the Harbor Porpoise Take Reduction Team and participated in numerous meetings and deliberations related to the problems with the 2010 Plan and ways to correct it.

Scientific Diving Project

In 2012, *MarineFisheries'* scientific divers conducted approximately 750 research dives to support on-going research and monitoring programs, including coast-wide benthic temperature monitoring; eelgrass monitoring and restoration; lobster ghost gear and early-benthic-phase suction surveys; shellfish abundance and habitat surveys; acoustic telemetry receivers for numerous finfish species; PCB monitoring sample collection; and dive program training.

In addition to routine management duties, project staff provided diver rescue training and skill review safety, first responder, and dive training for *MarineFisheries'* scientific divers. The updated Dive Policy was brought on-line and the divers implemented some small procedural changes. Leadership of the Scientific Diving Project transitioned in mid-2012. Educational and outreach efforts to dive clubs, schools, and local dive shows continued.

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. In that role, he generated analyses to support development of Frameworks 48, 49 and 50 for the Groundfish FMP, Amendment 5 to the Atlantic Herring FMP, and Amendment 6 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 2012, the Program Manager served as chair of ASMFC Winter Flounder Technical Committee and continued as a member of the ASMFC Herring Technical Committee and Assessment Science Committee. The Program Manager finalized the ASMFC winter flounder ageing manual. He continued to provide technical assistance on sampling designs and statistical analyses on an as-needed basis to other *MarineFisheries* projects and graduate students of SMAST and the University of Rhode Island.

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 Maria Piraino, Seasonal Fisheries Technician Ray Jarvis, Seasonal Fisheries Technician Bryan Legare, Seasonal Fisheries Technician

Large Pelagics Research Project

Dr. Gregory Skomal, Senior Marine Fisheries Biologist, Project Coordinator John Chisholm, Marine Fisheries Biologist

Diadromous Fisheries Project

Brad Chase, Senior Marine Fisheries Biologist, Project Coordinator John J. Sheppard, Marine Fisheries Biologist Mike Bednarski, Marine Fisheries Biologist 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 to support local sustainable fisheries; 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 For-Hire Sampling Project

Since 1983, recreational fisheries catch and harvest data have been collected along the Atlantic Coast through NMFS' Marine Recreational Information Program (MRIP). In 2012, *MarineFisheries* continued to manage the "party 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 NMFS, Research Triangle Institute (RTI), regarding survey performance and head boat sampling. During 2012, 67 sea sampling trips were completed for a total of 131 sampler days and 1,224 angler intercepts (Figure 41).

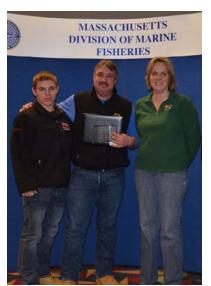
MarineFisheries expected to assume the shore-side sampling of all fishing modes (charter vessels, shore anglers, and private vessel anglers) from RTI in 2013. Accordingly, much of staff's time in 2012 was spent updating the NMFS registry of approximately 600 fishing access sites with site location data, site attributes, and estimated fishing pressures by mode. Starting



Figure 41. Anglers aboard a for-hire vessel are interviewed for recreational catch data.

in 2013, these data will be used to select locations and timing of sampling assignments. In addition, arrangements were made with a regional personnel provider (AIS Observers) to hire additional seasonal staff for our expansion of the sampling program.

Recreational 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 42). 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.

Figure 42. 2012 Recreational Fishing Derby winners receive an award from DFG Commissioner Mary Griffin

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 2012, 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 2012, 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 compliance reports were submitted for each species.

Striped Bass Sampling: Staff contributed to tagging efforts, collection of otoliths, and market sampling for striped bass (see Striped Bass Research Project section).

Tautog Age and Growth: *MarineFisheries* started voluntary age and growth sampling of tautog in 1995, followed by mandatory sampling under a 2002 interstate management plan revision. The resulting age/length data from Massachusetts is used in coast-wide stock assessments and local assessments for Massachusetts and Rhode Island which allows these two states to manage tautog unilaterally, in addition to continuing to contribute to the overall ASMFC assessment and management process.

In 2012, *MarineFisheries* obtained a total of 256 tautog through directed sea sampling and purchase from commercial fishermen. Opercula were obtained from all samples, cleaned and read. Age data were entered into the database and a 2012 age-length key created.

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 2012, staff conducted 10 summer flounder sampling trips on *MarineFisheries* research vessels, tagging 213 fish, for a total

of 1,200 summer flounder tagged over four years. Since the study began, 60 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.

Bluefish Age and Growth: Sampling of bluefish otoliths was expanded in 2012; 113 samples were obtained in compliance with a recently enacted ASMFC coast-wide age sampling program. Data were entered and samples forwarded to *MarineFisheries'* Gloucester field station for reading.

Public Access

The Division added a new position for a Public Access Coordinator with funds from the Marine Recreational Fisheries Development Fund in 2012. 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 2012, requests for information regarding public access were related to Boston Logan Airport, MacMillan Pier in Provincetown, the Orleans/Chatham area launch ramps, and future public access projects. Multiple meetings were attended with fishing groups and other state and federal agencies related to public access.

At the Craven's Landing access site 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 installation of a vehicle control gate, fence repair, general cleanup, and replacing information signs. As in 2011, a partial closure of Craven's Landing was necessary due to the presence of federally protected piping plovers. The site was also closed for the period directly before, during, and after Hurricane Sandy for safety reasons.

MarineFisheries, in collaboration with the Office of Fishing and Boating Access, funded the construction of a new fishing pier on Bass River in Yarmouth which was completed summer 2012 (Figure 43). Over 40 days were spent during 2012 visiting locations where public access is available to the fishing public for analysis of potential site improvements. Proposals were developed for several sites of interest for possible 2013 and 2014 expenditures from the Marine Recreational Fisheries Development Fund. Signs providing information on the requirement to have a recreational saltwater fishing permit were posted at all marine Office of Fishing and Boating Access sites and some municipal sites throughout the state.



Figure 43. The new fishing pier at the Bass River in Yarmouth.

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.

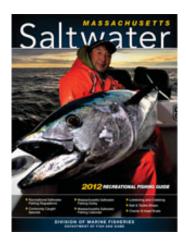


Figure 44. The cover of the 2012 fishing guide.

Informational materials were distributed at the Standish Sportsman's Club, Worcester Sportsman's Show, Rhode Island Sportfishing Association Expo, Massachusetts Striped Bass Association Fishing Expo, New England Boat Show, and Topsfield Fair. 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 44) 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 (three releases in 2012) 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.

Massachusetts Sportfishing 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 2012, Project staff obtained data from two tournaments (Table 9). The tournament database was updated, and data summaries were distributed to tournament organizers and participants, and NMFS (for inclusion in the federal tournament monitoring program). Massachusetts big game tournament fishermen spent a minimum of 1,810 boat hours. Program personnel tallied 1,148 fish comprising 11 species. The proportion of fish released ranged from 0 to 100% by species; overall, 92.7% of the tournament catch was released and the balance was boated; 0.2% was tagged when released. Size data were collected from 39 fish boated during the 2012 events.

Table 9. 2012 Massachusetts offshore fishing tournaments.

Tournament	Species	Dates	# Boats	Boat Hrs.
Oak Bluffs Monster Shark, 26 th Annual	Shark	7/20-21	104	1,691
Falmouth Grand Prix, 23 rd Annual	Billfish/tuna/shark	7/28-29	7	119
Total			111	1,810

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 13.7 million pounds of sharks landed in 2012, the vast majority were spiny dogfish (13.6 million pounds) with a commercial value of \$2.89 million (Table 10). The balance consisted of shortfin mako (*Isurus oxyrinchus*) and porbeagle (*Lamna nasus*) taken incidentally.

Table 10. Estimates of 2012 commercial shark landings in Massachusetts.

Species	Landings (lbs)	% of Catch	Value	Price/lb.
Spiny Dogfish	13,618,020	99.43	\$2,891,729	\$0.21
Shortfin Mako	74,481	0.54	\$127,776	\$1.72
Porbeagle	3,304	0.02	\$2,442	\$0.74
Total	13,695,805		\$3,021, 947	

Source: NMFS, Fisheries Statistics Division

A substantial recreational fishery for sharks occurs in Massachusetts from June through October each year. Harvest estimates from NMFS' MRIP indicate that Massachusetts' recreational fishermen caught about 266,000 sharks in 2012, with spiny and smooth dogfish comprising 98% of the catch (Table 11). However, while MRIP data reflect those species commonly taken by land-based and nearshore 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 NMFS Large Pelagic Survey, which is more reflective of offshore fisheries, reported 4,532 sharks taken by Massachusetts recreational fishermen in 2012 comprising blue (*Prionace glauca*, 4,155), shortfin mako (591), common thresher (*Alopias vulpinus*, 180), and porbeagle (48) sharks; overall, 91% were released (Table 11).

Data from the Massachusetts Sportfishing Tournament Monitoring Program indicate that of the 1,089 sharks caught during two Massachusetts big game fishing tournaments in 2012, 863 were blue sharks, 194 were shortfin makos, and 21 were common threshers; the balance included 1 dusky (*Carcharhinus obscurus*), 4 porbeagle, and 6 sandbar (*Carcharhinus plumbeus*) sharks (Table 11). 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.

Table 11. Estimates of 2012 recreational shark landings (numbers) in Massachusetts.

Source	Species	Boated	Released	Tagged	Total	Percent Released
	Blue		863		863	100.0%
	Shortfin Mako	33	159	2	194	83.0%
₫	Common Thresher	10	11		21	52.4%
MSTMP	Dusky		1		1	100.0%
MS	Porbeagle	3	1		4	25.0%
	Sandbar		6		6	100.0%
Total		46	1,041	2	1,089	95.8%
	Blue	10	4,145		4,155	99.8%
	Shortfin Mako	285	306		591	51.8%
LPS	Common Thresher	138	42		180	23.3%
	Porbeagle	9	39		48	81.3%
	Total	442	4,532		4,974	91.1%
	Spiny Dogfish	2,766	244,479		247,245	98.9%
	Smooth Dogfish		12,989		12,991	100.0%
MRIP	Blue		1,038		1,038	100.0%
Σ	Sand Tiger		4,436	_	4,436	100.0%
	Total	2,768	262,942		265,710	99.0%

 ${\sf MSTMP} = {\sf Massachusetts} \ {\sf Sportfishing} \ {\sf Tournament} \ {\sf Monitoring} \ {\sf Program}$

LPS = NMFS Large Pelagics Survey (Source: NMFS, Fisheries Statistics Division)

MRIP = NMFS' Marine Recreational Information Program (Source: NMFS, Fisheries Statistics Division)

Movement and Habitat Studies: With external funding from private and federal grants, Shark Research Program personnel continued in 2012 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, and sand tiger sharks.

Basking Shark: With funding from the National Science Foundation, Project personnel continued to examine basking shark 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 2012, Tobey processed data from the 20 basking sharks tagged with PSAT tags in 2011 and initiated a quantitative analysis comparing the fine-scale movements of SPOT-tagged basking sharks 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 number 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, appear to be 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 2012, we tagged a total of 34 individual white sharks off the eastern coast of Cape Cod, primarily in nearshore shallow waters from Orleans to the southern tip of Monomoy (Figure 45). Two of these sharks, known as Mary Lee and Genie, were tagged in partnership with the non-profit organization, OCEARCH, in 2012. These two 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. The remaining sharks were tagged with one or more of the following tags: pop-up satellite archival transmitters, passive



Figure 45. Tagging locations of 34 white sharks off the coast of Cape Cod, 2009-2012.

acoustic coded transmitters, autonomous underwater vehicle transponders, active acoustic transmitters, and NMFS conventional tags. The 34 tagged sharks ranged from roughly 7.5 to 17 feet in total length. Of the 13 that could be sexed, 12 (92%) were females.

Sand Tiger Shark: With additional funding from the NMFS 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 2012, data analysis was completed and a manuscript was prepared for peer-review publication.

Post-release Survivorship Studies: In 2012, 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 with data analysis and interpretation.

In conjunction with the study on sand tiger movements (see above), the physiological effects of capture stress are being 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 2012, data analyses were completed and a manuscript was prepared for peer-review publication.

Life History: Project personnel continued to support SMAST 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. Work in 2012 focused on thesis preparation.

Working with NMFS 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. Efforts in 2012 included additional annulus interpretation, data analysis, and the preparation of two manuscripts.

Shark Management: Program personnel participated in the development and/or amendment of state (*MarineFisheries*), interstate (ASFMC), federal (NMFS), and international (ICCAT) shark management plans. During 2012, Greg Skomal chaired the ASMFC Coastal Sharks Technical Committee, and was member to the ASMFC Coastal Sharks Plan Development Team, ASMFC Spiny Dogfish Technical Committee, ICCAT Advisory Committee Shark Working Group, and NMFS Highly Migratory Species Advisory Panel.

Outreach and Media: To meet the public's demand for information on sharks, especially white sharks, over 20 presentations pertaining to sharks were delivered by Program personnel in 2012 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 Institute, and the King Abdullah University for Science and Technology, Greg Skomal served on the committees of 13 graduate students; 11 of these students are investigating the relative

abundance, life history, movements, and/or physiology of elasmobranch fishes. He was the primary graduate advisor for three of these students.

Publications

The following peer-reviewed publications were issued in 2012:

Brooks, E.J., J.W. Mandelman, K.A. Sloman, S.L., A. J. Danylchuk, S.J. Cooke, G.B. Skomal, D. P. Philipp, D. W. Sims, and C.D. Suski. 2012. The physiological response of the Caribbean reef shark (*Carcharhinus perezi*) to longline capture. Comparative Biochemistry and Physiology, Part A, 162 (2): 94-100.

Curtis, T., B. Bruce, G. Cliff, S. Dudley, P. Klimley, A. Kock, R. Lea, C. Lowe, J. McCosker, G. Skomal, J. Werry, and J. West (2012). Responding to the risk of white shark attack: updated statistics, prevention, control methods, and recommendations. In: *Global Perspectives on the Biology and Life History of the Great White Shark*, M.L. Domeier (ed), CRC Press, Boca Raton, FL.

MacNeil, M.A., B.C. McMeans, N. Hussey, P. Vecsei, J. Svavarsson, K. Kovacs, C. Lydersen, M. Treble, G.B. Skomal, M. Ramsey, and A.T. Fisk. 2012. Biology of the Greenland shark *Somniosus microcephalus* Bloch & Schneider 1801. J. Fish Biol. 80 (5): 991–1018.

Mandelman, J.W. and G.B. Skomal. 2012. The physiological stress response in elasmobranch fishes: selected papers from a symposium at the 26th annual meeting of the American Elasmobranch Society. Comparative Biochemistry and Physiology, Part A,162 (2): 71–72.

Marshall, H, L. Field, A. Afiadata, C. Sepulveda, G. Skomal, D. Bernal. 2012. Hematological indicators of stress in longline-captured sharks. Comparative Biochemistry and Physiology, Part A, 162 (2): 121-129.

Skomal, G.B. and J.W. Mandelman. 2012. The physiological response to anthropogenic stressors in marine elasmobranch fishes: A review with a focus on the secondary response. Comparative Biochemistry and Physiology, Part A, 162 (2): 146-155. *DMF Contribution No. 38.*

Skomal, G.B., J. Chisholm, and S.J. Correia. 2012. Implications of increasing pinniped populations on the diet and abundance of white sharks off the coast of Massachuestts. In: *Global Perspectives on the Biology and Life History of the Great White Shark*, M.L. Domeier (ed), CRC Press, Boca Raton, FL. *DMF Contribution No. 36*.

Taylor, J.K., J.W. Mandelman, W.A. McLellan, M.J. Moore, G.B. Skomal, and S.D. Kraus. 2012. Shark predation on North Atlantic Right Whales (*Eubalaena glacialis*) in the Southeastern United States calving ground. Mar. Mam. Sci. 29(1): 204–212.

Diadromous Fisheries Project

HubLine Restoration

Anadromous fish restoration is a component of HubLine mitigation and resource restoration efforts dating back to 2003. In 2007 and 2008, scopes of work were drafted for five HubLine restoration projects. The Bound Brook (Scituate) project was not approved for advancement. The Back River (Weymouth) project was completed in 2010. The remaining three projects (described below) were active in 2012.

Fish Ladder Replacement at Herring Brook (Pembroke): Initiated in 2009, this project resulted in a new dam, spillway, fish ladder, and entrance channel completed in 2011. The new Alaskan steeppass fish ladder replaced a wood Denil fish ladder that washed out in 2008, preventing all fish passage. Tasks completed in 2012 include area landscaping and finishing the plunge pool board and spillway substrate. An as-built survey was planned for preparation in 2013.

Smelt Habitat Restoration at Weir River (Hingham): Following receipt of all project permits in June 2012, Project staff oversaw a competitive bidding process in July, selection of a construction firm (SumCo) in August, initiation of construction in September, conclusion of construction in October, and drafting of a memorandum of understanding between the Town of Hingham and *MarineFisheries* for operating the Forge Pond Dam to facilitate fish passage and spawning habitat use. This activity concludes the project with the exception of monitoring and preparation of an as-built survey in 2013.

Restoration of River Herring to Fore River (Braintree): This project focuses on three locations where passage improvements are needed. During 2012, funding proposals to USFWS and the Army Corps were resubmitted, and fish ladder designs for the Hollingsworth Dam and Great Pond Reservoir were completed by the contractor (Dick Quinn). Following meetings with the town and Hollingsworth Dam owners, the project was planned to continue in 2013 with a focus on dam removal at the Hollingsworth Dam.

Cape Cod Water Resources Restoration Project

The National Resource and Conservation Service (NRCS) received federal funding in 2010 for the Cape Cod Water Resources Restoration Project, with one component targeting five to seven anadromous fish passage projects on Cape Cod. The following projects were selected for completion: fishway construction at Carter Beal Park, Monument River, Bourne; fishway reconstruction at Cedar Lake, Falmouth; fishway reconstruction at Red Brook, Bourne; fishway and dam reconstruction at Santuit Pond, Mashpee; and fishway reconstruction at Marston Mills River, Barnstable. Fishway design for a sixth project at Pilgrim Lake, Orleans, began in 2012, but construction will not be funded under this project. Final engineering plans for the Cedar Lake, Red Brook, and Santuit Pond dam projects were reviewed and approved in 2012. The Marston Mills project was reviewed at 85% design stage and the Carter Beal project was delayed by information produced during preliminary design stages. Permitting and contract bidding and selection were completed for Cedar Lake and Santuit Pond Dam late in 2012 with the selected contractors starting site preparation in December. *MarineFisheries* coordination for these five, simultaneous projects is extensive.

Diadromous Fish Restoration Priority List

After several years of compilation and refinement, a diadromous fish restoration priority list was completed in 2011. The list 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. Sites were ranked by restoration potential within each region. The restoration list focuses on river herring, but considers others species of diadromous fish and watershed connectivity.

Efforts on this project in 2012 were directed to converting the priority list from an Excel datafile into a GIS datalayer, and integrating *Mass*DOT transportation infrastructure, diadromous fish

habitat, and *MarineFisheries* species time of year data. *Mass*DOT funded this portion of the project, contracting AECOM, who accomplished merging and ground-truthing datalayers for the Cape Cod region in 2012; work will continue on the remaining three regions in 2013. A poster of the project was prepared and presented at the June Fish Passage Conference in Amherst, MA.

Fishway Operations and Maintenance Plans

A new effort was launched in 2011 to develop standardized fishway operation and maintenance (O&M) 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 needed for present operations and to guide future state and local staff. Nine O&M plans were drafted in 2011 and circulated for local review and Departmental legal review.

Efforts in 2012 were ongoing, but reduced from 2011. Four of the nine draft O&M plans were finalized in 2012 and two new plans were drafted. Some resistance was encountered from property owners over the draft plans. A meeting was held with *MarineFisheries* management staff and Department legal staff to discuss the application of O&Ms. An agreement was reached to have two approaches to secure this needed management of fishways: an O&M plan that serves as recommendations to property owners from *MarineFisheries* and more formal O&M plan that follows Section 19 language as a written order of the Director of *MarineFisheries*.

2012 Completed Fish Passage and Restoration Projects

Morey's Bridge Dam Replacement, Taunton:

MassDOT and MassDCR led a large construction project to replace both the Morey's Street Bridge and the Morey's Bridge Dam in Taunton in 2012. This \$4.5 million project included an eel ramp and steeppass fishway. MarineFisheries was involved in extensive technical assistance and planning and funded the USFWS design of the fish ladder. The bridge and denil fishway were completed in 2012. MarineFisheries staff maintained weekly site visits during construction. Our Fishway Crew planned to construct and install the eel ramp in 2013. A cooperative O&M plan for the dam and fishways was drafted in 2012 between MarineFisheries and MassDCR. This project will provide access where none previously existed to the 266-acre Lake Sabbatia and is part of a large, cooperative restoration effort in the Mill River to remove three downstream dams. With the construction of the fishway and the removal of the first dam, the Hopewell Mills Dam (Figure 46), two of four impediments were remediated in 2012.



Figure 46. Biologist Mike Bednarski displays an alewife captured in the Mill River, Taunton. This fish was one of the first migrants to head upstream of the former Hopewell Mills Dam, built in 1818 and dismantled in 2012.

Pilgrim Lake Eel Pass, Orleans: The *MarineFisheries* Fishway Crew designed and installed an innovative, gravity-fed eel pass at the outlet to Pilgrim Lake, in Orleans in 2010. This technology is unique for a non-siphon, gravity fed eel pass and has promise to assist eel passage in the future. The eel pass collected more than 40,000 eels in 2011, the most recorded for any eel pass in Massachusetts since the first coastal river eel pass was installed in 2007. During 2012, the Fishway Crew installed a custom aluminum tank, designed and constructed the prior year. The new system collected over 42,000 glass eels in 2012; again, the most seen to date among our efforts with eel passage.

Stony Brook Weir Reconstruction, Brewster: MarineFisheries was asked to assist the Town of Brewster in the reconstruction of the stone weirs below the Lower Mill Pond Dam in 2012. This site has one of the more scenic and most visited herring runs in Massachusetts. The Town had received funding from NOAA Restoration Center to reconstruct the dam and sought our advice on improving the fishway weirs below the dam. Time and funding limitations prevented the Town from contracting the project in 2012. MarineFisheries agreed to review a design by NOAA to rebuild fishway weirs and to construct nine new weirs. A contractor (Dick Quinn) was hired to review the NOAA design; he produced an alternative scope with fewer new weirs and adjustments to existing weirs. Reconstruction of the weirs dominated our Fishway Crew's schedule during the month of October as extensive, unanticipated stone and mortar repairs to the channel wall were required.

Parker River Fishway Restoration, Newbury:

MarineFisheries renewed efforts with fish run maintenance and restoration on the Parker River in 2012. Following site visits to all fishways on river's watershed in April, a Request for Determination of Applicability was filed with the Newbury Conservation Commission in May to conduct restoration work. A contractor was selected through a competitive bid to reconstruct the weir at Central Street; however, the firm was not able to clear its fall work schedule to complete the job before winter, and the work was planned for summer 2013. Additionally, our Fishway Crew completed needed repairs at Snuff Mill Dam in 2012 (Figure 47).

Leonard's Pond Fish Ladder, Rochester: An Alaskan Steeppass fish ladder was installed at the Leonard's Pond Dam during December 2010 and January 2011. *MarineFisheries* paid for the scoping design from USFWS and two ladder sections. The Coalition for Buzzards Bay



Figure 47. The weir at Snuff Mill Dam, Parker River, post-repairs.

funded the final design, engineering and construction of the ladder. During 2012, following several site visits, adjustment was made to the ladder's upstream elevation through a cooperative effort of *MarineFisheries* and the dam owner.

New/Ongoing Fish Passage and Restoration Projects

Tihonet Fish Ladder, Wareham: Following a site visit with *MarineFisheries*, contractor Dick Quinn completed the design for a replacement of the Tihonet fish ladder in the Wankinco River watershed, Wareham. The design was subsequently submitted to the property owner, A.D. Makepeace.

Hathaway Pond Dam Removal, Rochester: After actively seeking to remove Hathaway Pond Dam during 2007-2010, site ownership transferred from the Buzzards Bay Coalition to cranberry bog farmer, Beaton Corp. and the project shifted to fish ladder replacement. *MarineFisheries* and Beaton Corp. reached an agreement whereby 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. At the end of 2012, draft engineering plans were submitted for review to *MarineFisheries* and the Rochester Conservation Commission.

Agawam River Dam Reconstruction, Wareham: The Agawam River dam and Rt. 28 bridge are slated to be reconstructed by *Mass*DOT. The project design began in 2011 and reached the 25% design stage in 2012. *MarineFisheries* funded Dick Quinn to design the replacement fish ladder for this site. This design was completed in 2012 and submitted to *Mass*DOT. An effort was also made in 2012 to facilitate property issues between *Mass*DOT and the Elks Club that owns property adjacent to the fishway.

Town Brook Smelt Habitat Enhancement, Quincy: During 2012, *MarineFisheries* continued to provide technical assistance on the permitting and design for this project, led by the City of Quincy and private developers to redevelop a large area in downtown Quincy. To meet this goal, the project sought permitting to move 1,700 feet of Town Brook from its present channelized, mainly underground path. 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 *Mass*DCR to conduct a flow restoration project. Secondly, permission to move Town Brook came with a requirement to daylight nearly 200 feet of brook and construct over 300 feet of spawning substrate based on design specifications provided by *MarineFisheries*. Construction of the new brook channel was underway late in 2012 with plans for completion by the spring smelt run.

Draka Dam Fish Ladder, Dighton/Taunton: Project lead, Save the Bay, awarded an engineering and permitting contract to Tibbetts Engineering to install an Alaskan steeppass ladder at the Three Mile River's Draka Dam in the summer of 2011. During 2012, efforts focused on communications and meetings with the dam owners over their review of the engineering plans (completed in 2011) and acceptance of a Memorandum of Agreement over the fishway construction.

Forge Pond Dam Fish Passage Improvement, Kingston: Following proposal submission in 2011, the Gulf of Maine Council awarded a grant to fund a feasibility study for providing fish passage to Silver Lake in 2012 with *MarineFisheries* as the lead. Gomez and Sullivan was selected for the contract following a competitive bid process. Project partners (NOAA, DER, JRWA, City of Brockton) met in February followed by a project kick-off meeting with Gomez and Sullivan in June. By November, a draft report on the Existing Condition section was available for partner review and one of two public meetings was held in Kingston to present the project to the public.

As project lead, the coordination of project partners and the consultant's contract resulted in a large effort for this project in 2012.

Martha's Vineyard Restoration Projects: A third visit to Martha's Vineyard to continue efforts to become familiar with potential restoration projects on the island resulted in *MarineFisheries'* submitting recommendations on the Mill Brook Watershed to the town and local watershed groups. In addition, staff provided written recommendations on diadromous fish habitat restoration for specific locations to two local property owners.

Wing Pond Herring Escapement, Falmouth: Staff investigated a river herring fish kill in October at the cranberry bog next to Wing Pond in Falmouth. Followed an additional site visit with local and state environmental police, a second meeting was held with the bog owner in December to discuss remedial solutions to the confinement of juveniles in his bog. A plan was made to design screening to exclude juveniles from the pumping system.

Technical Assistance

Staff reviews potential restoration projects upon request from local, state, and federal agencies and interests. The assistance ranges from brief technical advice to joining long-term projects as an active partner. In addition, routine assistance is provided upon request to potential projects in the form of site visits, proposal reviews, support letters, and information on existing resources. Effort spent on such technical assistance can amount to relatively few hours for individual projects; however, on an annual basis the communications and meetings add up to a large expenditure of time to provide this form of constituent service.

River Herring Habitat Assessment: River herring habitat assessments were performed under standard operating procedures provided in *MarineFisheries'* "Quality Assurance Program Plan (QAPP) for Water Quality Measurements Conducted for Diadromous Fish Habitat Monitoring." River herring habitat assessments were carried out monthly from May through September at Whitman's Pond in Weymouth, Pentucket Pond in Georgetown, Lake Sabbatia in Taunton, Mill Pond in Barnstable, Tom Matthews Pond in Yarmouth, and Cedar Lake in Falmouth.

After the field season, effort focused on data processing and assessment writing. The field data for two seasons of sampling in Whitman's Pond were transcribed and sent to project partner, the Town of Weymouth Conservation Commission. Data tables were prepared and audited for the Great Pond Reservoir assessment in the Fore River watershed. The assessment report for the Silver Lake assessment of 2008-2009 began in 2012 with a major effort late in the year to finish a draft for review by all project partners.

River Herring Warden Network: Staff provided assistance to a coalition led by the Cape Cod Commercial Fishermen's Alliance who received a grant to develop a river herring warden network. Project proposals and website design were reviewed. Three presentations on diadromous fish biology and management were given at related workshops and meetings in 2012.

MarineFisheries Stocking Protocols: *MarineFisheries* routinely receives, reviews, and responds to stocking request letters. Four such letters were processed in 2012. It was determined that standardized stock protocols would be beneficial. By the end of the year, a third draft of a guidance document was under review.

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 diadromous fish management issues. Routine monitoring trips were not recorded in the datafile. The interest is to produce a 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, with a summary by major coastal drainage area below. A large majority was directly related to fishway construction, fishway maintenance, and site visits of 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: North Shore -12; Boston Harbor -14; South Shore -42; Cape Cod -42; Buzzards Bay -76.

Biological Assessments for River Herring

The alewife (*Alosa pseudoharengus*) is the most abundant anadromous fish in Massachusetts. A close "cousin" is the blueback herring (*Alosa aestivalis*) which, although a separate species, is often confused with the alewife. The species are commonly lumped together under the heading of river herring.

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; Merrimack River, Lawrence; Parker River, Newbury; Acushnet River, Acushnet; and Charles River, Boston. A total of 1,802 alewives and 1,214 blueback herring (plus 243 American shad) were sampled from nine of these coastal systems in 2012.

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. Counts varied from approximately 3,220 fish in the Acushnet River to 567,952 in the Nemasket River. Electronic monitoring in 2012 indicated that in most coastal systems there were substantial increases in the number of fish returning to their natal spawning grounds. Adult returns increased sharply in the Monument River in 2012 (180,082 fish) compared to 2011 (68,639 fish). Counts increased from 2011 to 2012 in the Mattapoisett River (from 12,857 fish to 28,447 fish), the Agawam River (from 19,064 fish to 73,186 fish), and the Wankinco River (from 10,442 fish to 24,764 fish). However, counts in the Acushnet River in 2012 decreased compared to 2011 (3,679 fish).

MarineFisheries also provides technical assistance to local groups conducting volunteer, visual counts of herring runs. In 2012, a total of 33 rivers were monitored in Massachusetts. Monitoring occurred in 29 towns representing eight major drainage areas.

Passage of diadromous species is monitored during the spring/summer each year at the first obstruction on the Merrimack River (Essex Dam in Lawrence). Passage of American shad on the Merrimack River for 2012 (21,396 fish) increased compared to 2011 (13,835 fish) and 2010 (10,442 fish). In addition, 139 striped bass, 2,067 sea lamprey, and 8,992 river herring (a substantial increase from 740 river herring in 2011) were also lifted above the dam in 2012.

Propagation

Efforts to re-establish, augment, and enhance natal anadromous runs in conjunction with ongoing fishway improvement projects resulted in a total of 7,500 pre-spawning adult river herring trapped and transported via stocking truck or lifted above a barrier into three coastal systems throughout the Commonwealth (Table 12). The three systems that received gravid fish in 2012 were: Town Brook, Plymouth; Monument River, Bourne/Plymouth; and Three Mile River, Dighton. An additional 3,000 alewives were trapped from a Massachusetts donor system and released into three Rhode Island coastal systems (Ten Mile River, Turner Reservoir, East Providence; Kickemuit Reservoir, Warren; and Blackstone River, Pawtucket) in a cooperative effort to sustain their small populations.

Table 12. Number of pre-spawning adult river herring trapped and transported via stocking truck or lifted above a barrier in 2012.

Donor System	r System Recipient System	
Nemasket River	Three Mile River*	1,000
Nemasket River	Ten Mile River**	1,000
Nemasket River	Kickemuit Reservoir**	1,000
Nemasket River	Blackstone River	1,000
Town Brook	Billington Sea	3,500
Monument River	Great Herring Pond	3,000

^{*} Denotes out-of-basin transfer (between river systems)

Restoration efforts of American shad to the Charles River also continued with the introduction of over 3.3 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 conducted at the fishway as well as several electrofishing trips were made with the USFWS below the Watertown Dam. These trips yielded a total of 30 adult shad (one trap, 29 electrofishing). These fish were ages 3-8, meaning they were from the 2004-2009 year-classes. Of the 30 fish collected, five 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 15 of the 25 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 10 unmarked fish could have been strays, naturally produced Charles River fish, or fish that did not incorporate an OTC mark. Assessment of the OTC stocking will continue and efforts will continue to reach 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 sportfish 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. Smelt were caught at eight of nine fyke net stations in 2012. To date, over 35 species of fish have been caught in the fyke nets, including 10 diadromous species.

^{**} Denotes out-of-basin transfer (between states)

The primary focus for this project in 2012 was preparing products for the NOAA Species of Concern Grant funding the project: a New England Rainbow Smelt Conservation Plan and a Final Grant Report. Data entry, auditing, and analysis were completed on an accelerated schedule. The project partners divided tasks for preparing the two final documents, with *MarineFisheries* staff completing the analysis of water quality and smelt fyke net data and drafting Conservation Plan sections on Smelt Fisheries, Threats to Smelt Habitat, and Smelt Population Dynamics. Multiple rounds of editing followed. In addition, the grant funded preparation of a technical report on the proceedings of the Fourth North American Workshop on Rainbow Smelt held in Portland, Maine, in January 2011. This effort involved project personnel drafting extended abstracts for presentation and posters and formal peer review of assigned abstracts. The workshop proceedings, Smelt Conservation Plan, and Final Grant Report were all completed and printed by December 2012, concluding all required tasks from the six year grant.

American Eel Young-of-the-Year Monitoring

All East Coast states conduct standardized monitoring of YOY American eel 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 2012 (Figure 48). YOY monitoring stations were also maintained in the Acushnet and Parker Rivers in 2012; a station at the Saugus River was terminated in 2011 due to difficulty with the location and data quality. Work continued to organize and improve the trap data files for inclusion in the next coastwide eel stock assessment.



Figure 48. A biologist in training helps *MarineFisheries* monitor the spring migration of YOY eels in the Jones River.

Additional monitoring occurred at eel ramps installed in coastal rivers in Massachusetts that provide eel passage over barriers. MarineFisheries first installed an eel ramp in the Saugus River in 2007 and has since cooperatively installed one ramp annually in most years. Most ramps are outfitted with a collection tank in order 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), Mystic Lakes Dam, Medford (2010), Mill River, Taunton (2012 post-season).

Other Activities

ASMFC Participation: *MarineFisheries* staff participates in ASMFC Technical Committees and with diadromous fish stock assessments. Compliance reports were drafted in 2012 for sturgeon (M. Bednarski), American eel (B. Chase), and river herring/American shad (B. Chase and J. Sheppard). Brad Chase served on the river herring/American shad, eel, and fish passage technical committees and served as chair of the American Eel Technical Committee as well as on the stock assessment subcommittee. He also participated on a steering committee for an ASMFC-sponsored workshop on eel passage.

Publications, Reports, and Presentations: Staff developed the following reports and presentations.

Enterline, C.L., B.C. Chase, J.M. Carloni, and K.E. Mills. 2012. A Regional Conservation Plan for Anadromous Rainbow Smelt in the U.S. Gulf of Maine. *Submitted for* NOAA Species of Concern Grant Program Award #NA06NMF4720249A.

Enterline, C.L, G. Wipplehauser, J.M. Carloni, B.C. Chase. 2012 A Multi-State Collaborative to Develop & Implement a Conservation Program for Three Anadromous Finfish Species of Concern in the Gulf of Maine. Final Report *submitted for* NOAA Species of Concern Grant Program Award #NAO6NMF4720249A.

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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

Kerry Allard, Permitting Leader Cecil French, Permitting Supervisor 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

Grant Programs

Stephanie Cunningham, Federal Aid and Grants Coordinator Tom Beaulieu, Project Leader, Clean Vessel Act Eileen Feeney, Program Coordinator, Clean Vessel Act Melanie Griffin, Project Leader, Revolving Loan Fund

Outreach Program

Elaine Brewer, Information & 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 Bureau. Outreach is conducted through the creation of media to be distributed to the general public through face-to-face interactions and the *MarineFisheries* website. Facilities Management is conducted with the intent 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 as necessary.

Budget

State-Appropriated Funds

The *MarineFisheries* operating budget has been trending down over the past six fiscal years (FY); the FY2012 budget was approximately 15% lower than that of FY2007. Although overall revenues for the Commonwealth have been up in each of the past three years, the *MarineFisheries* operating budget reflected a modest reduction of 0.8% in FY2012. The fiscal year 2011 and 2012 state appropriations are shown in Table 13.

Table 13. Fiscal Year 2011 and Initial 2012 Appropriate to the second se	opriations.
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Title	Acct. Number	FY2011	FY2012	Change
General Operating	2330-0100	\$4,426,578	\$4,355,647	-1.60%
Sportfish Program	2330-0120	\$545,143	\$515,754	-5.39%
Sportfish Retained Revenue	2330-0121	\$217,989	\$204,989	-5.96%
Depuration Retained Revenue ¹	2330-0150	n/a	\$72,000	New FY12
Total		\$5,189,710	\$5,148,390	-0.80%
Saltwater Sportfish Licensing ²	2330-0300	\$101,500	\$491,761	New FY11

¹In 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 13 because expenditures in this appropriation can be used to offset budget reductions in the general operating account.

Although appropriated funds for the overall operating budget were down by less than 1%, annualized costs for payroll alone were up by more than 4%. In order to meet the requirements of the approximate 3% operating budget reduction, *MarineFisheries* continued to utilize "soft money" through grant opportunities and shifted costs where appropriate. In addition, all statefunded travel was suspended, spending in the lower subsidiaries was drastically reduced, three

²In 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 13 so that an accurate comparison between fiscal years on operating costs can be made.

full-time employee positions were eliminated, and 1 full-time employee was shifted to an alternate account.

The breakdown of overall costs by primary spending category for the *MarineFisheries* operating accounts can be seen in Table 14 and Figure 49.

Table 14. Fiscal Year 2012 Costs, State Appropriations (rounded to whole dollars).

Account Number	2330-0100	2330-0120	2330-0121	2330-0150	Line Total
Salaries	\$3,713,750	\$505,944	\$49,717	\$68,227	\$4,337,638
Employee Expenses	\$6,586		\$5,329		\$11,916
Contracts	\$4,500		\$40,003		\$44,503
Facility Maintenance	\$31,180		\$17,996		\$49,176
Field & Lab Supplies	\$43,913		\$8,096		\$52,010
Fringe Costs	\$72,387	\$9,810	\$965	\$1,324	\$84,485
Fuel	\$59,138		\$20,740		\$79,878
Utilities	\$115,239				\$115,239
Lease/Rent	\$67,468				\$67,468
Maintenance/Repair	\$41,630		\$4,977		\$46,607
Office & Administrative	\$83,082		\$41,768		\$124,850
Services/ Equipment Lease	\$10,185		\$13,900		\$24,085
Outside Agencies	\$100,287		\$1,264		\$101,551

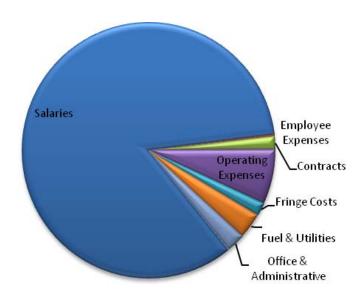


Figure 49. FY2012 Spending Category Summary.

Authorized personnel levels for calendar year 2012 are shown in Table 15.

Table 15. Fiscal Year 2011 and 2012 Authorized Personnel Levels.

Title	Acct. Number	FY2011	FY2012
MarineFisheries General Operating	2330-0100	68	64
Sportfish Program	2330-0120	10	10
Saltwater Sportfish Licensing	2330-0300	n/a	6
Federal Grants and Trust Account	2330-xxxx*	22	21
Total Employees in All Appropriations	100	101	

^{*}Multiple account numbers

A total of five full-time positions were eliminated over the course of fiscal year 2012 when compared to fiscal year 2011. One position eliminated was the result of a retirement; a senior biologist from the south coast facility that served as the facility chief for that office. Three of the positions eliminated were the result of employees seeking alternate job opportunities elsewhere: a systems analyst from the south coast field station, a biologist working on an eel grass project, and the Division's dive safety officer. The final position eliminated from the operating budget was a shellfish biologist from the south coast facility that was hired as the public access coordinator, funded under the new saltwater sportfish license account. Reductions to the overall operating budget did not allow for any of these positions to be backfilled. A total of seven new full-time positions were approved for hire in the new saltwater sportfish licensing account, and six of those positions had been filled by the end of fiscal year 2012.

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 31,692 permits and regulated fishery endorsements were issued by the Licensing Program for the categories of commercial fishing, seafood dealers, and special permit types, producing General Fund revenue of \$2,072,220 in 2012. This represents a slight increase in revenue (~1%) from permit issuance in 2011. The Shellfish Purification Plant processed 9,852 racks of soft-shelled clams in 2012. This resulted in General Fund revenues of \$59,110, which is a dramatic 24.6% decrease over the 2011 value of \$73,668. In addition to General Fund revenue, MarineFisheries issued 155,038 recreational salt water fishing permits in 2012 and generated \$1,251,691 in revenue for the Marine Recreational Fisheries Development Fund. This completed the 3rd year of the recreational fishing permit program since its inception, and the total number of permits issued is still trending upwards, with a 22.4% increase in permits issued in 2012 over 2011.

Commercial Fisherman Permits

Anyone who lands and sells finfish, shellfish, lobsters, edible crabs, or other living marine resources in Massachusetts must have a *MarineFisheries* commercial fishing permit and must sell only to licensed Massachusetts dealers. All commercial permits, except Rod & Reel and Seasonal Lobster, may be endorsed for shellfish at no additional cost. See Table 16 for the number of commercial fisherman permits issued, by type, in 2012 and resulting revenue.

Table 16. 2012 Commercial Licensing and Revenue Statistics.

Permit Type	Permi	Revenue	
(and resident/non-resident fee)	Resident	Non-Resident	Kevenue
Coastal Lobster (\$260/\$520)	1,208	4	\$316,160
Offshore Lobster (\$260/\$520)	334	90	\$133,640
Seasonal Lobster (\$65/\$130)	77	1	\$5,135
Boat 99'+ (\$260/\$520)	12	18	\$12,480
Boat 60-99' (\$195/\$390)	88	145	\$73,710
Boat 0-59' (\$130/\$260)	2,863	292	\$448,110
Individual (\$65/\$130)	336	25	\$25,090
Shellfish (\$40/\$80)	912	17	\$37,840
Shellfish & Rod & Reel (\$55/\$130)	497	1	\$27,465
Rod & Reel (\$35/\$100)	758	88	\$35,330

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 permit are also required.

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

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. 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 17 for the number of dealer permits issued, by type, in 2012 and resulting revenue.

Table 17. 2012 Dealer Licensing and Revenue Statistics.

Permit Type	Permit	Revenue	
(and resident/non-resident fee)	Resident	Non-Resident	Revenue
Wholesale Dealer (\$130/\$260)	424	9	\$57,460
Wholesale Truck (\$130/\$260)	93	139	\$48,230
Wholesale Broker (\$130/\$260)	18	5	\$3,640
Retail Dealer (\$65/\$130)	746	24	\$51,610
Retail Truck(\$65/\$130)	50	4	\$3,770
Retail Boat (\$65/\$130)	95		\$6,175
Bait Dealer (\$65/\$130)	137	8	\$9,945

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 fisheries are issued as endorsements on commercial permits. See Table 18 for the number of special permits issued, by type, in 2012 and resulting revenue.

Permit Type	Perr	Revenue	
(and resident/non-resident fee)	Resident Non-Resident		
Non-Commercial Lobster (\$40/\$60)	8,636	171	\$355,700
Regulated Fishery Endorsements (\$30/\$60)	12,118	718	\$406,620
Master Digger (\$250/\$500)	7		\$1,750
Subordinate Digger (\$100/\$200)	77		\$7,700
Scientific Collection (\$10/\$20)	82	18	\$1,180
"Other" Special Permits (\$10/\$20)	346	1	\$3,480

Table 18. 2012 Special Licensing and Revenue Statistics.

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

Regulated Fishery Endorsement is required for commercial fishing in certain areas under certain conditions. Regulated fishery endorsement are required for dragging, gillnetting, and netting in inshore net areas, operating a shellfish dredge, 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, 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. Limited Entry Permits, include, but are not limited to, Coastal Lobster Permit, fish-pot (scup, conch and sea bass) gillnetting, surf clam, ocean quahog, coastal access permit (CAP), fluke, horseshoe crab, groundfish, and sea bass endorsements. See Table 19 for numbers of limited entry permit transfers in 2012.

Table	19.	2012	Transfer	Statistics.

Dormit Type	Permits Tr	s Transferred (#)	
Permit Type	Resident	Non-Resident	
Coastal Lobster	31	0	
Coastal Access Permit	7	0	
Fish-Pot	3	0	
Fluke	10	1	
Sea Bass	3	0	
Groundfish	4	0	
Surf Clam	1	0	
Ocean Quahog	0	0	
Gillnet	0	0	
Horseshoe Crab	5	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 lbs of lobster or landing and selling lobster on at least 20 occasions, in a single year. 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 Sea bass, Ocean Quahog, Coastal Access Permit (CAP), Fluke, Horseshoe Crab, Groundfish and Sea Bass) may be transferred by the holder provided it has been actively fished 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 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 for the 2011 calendar year. The program was created as a "user-pays, user-benefits" program, ensuring 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. The number of permitted fishermen has significantly grown in each of the first three years of the program, and positive growth is expected over the next two to three years as more fishermen become aware of the permitting requirement. In addition to recreational saltwater permits and for-hire permits, many individuals contributed donations for recreational fishing improvements. See Table 20 for the number of permits issued, by type, in 2012 and resulting revenue.

Table 20. 2012 Recreational Saltwater Permitting and Revenue Statistics.

Permit Type	Permits Issued (#)		Dovernue	
(and resident/non-resident fee)	Resident	Non-Resident	Revenue	
Recreational Saltwater (\$10/\$10)	100,337	14,094	\$1,144,310	
Recreational Saltwater Age 60+ (\$0)	34,863	4,837	No Fee	
Charter Boat (\$65/\$130)	803	43	\$57,785	
Head Boat (\$130/\$260)	57	4	\$8,450	
Donations			\$41,146	
Marine Recreational Development Fund, Total Revenue Collected:			\$1,251,691	

Recreational Saltwater Fishing Permit is required of all fishermen age 16 and over. Exceptions have been made for anglers fishing aboard permitted for-hire vessels, individuals that are disabled, and for those fishermen with a valid recreational saltwater fishing permit from another coastal state that has entered into a reciprocity agreement with Massachusetts. The fee for the permit has been set at \$10 for fishermen between the ages of 16 and 59, inclusive. The permit is free for fishermen aged 60 and over.

Charter Boat Permit is required for a vessel that can carry up to 6 persons fishing as passengers from the for-hire vessel.

Head Boat Permit is required for a vessel that can carry 7 or more persons fishing as passengers from the for-hire vessel.

Grants

In FY2011, *MarineFisheries* had spent approximately \$5.2 million in federal grant monies and mitigation project monies operating out of the Marine Fisheries Research Trust. In FY2012, total spending increased by about \$800,000. Table 21 provides expenditures by account.

Table 21. Fiscal Year 2011 and 2012 Expenditures.

Title of Federal Grant or Trust	Account Number	FY2011	FY2012
Clean Vessel Act	2330-9222	\$800,000	\$925,000
Fisheries Statistics	2330-9712	\$103,000	\$107,000
Boating Infrastructure	2330-9725	\$100,000	\$100,000
Interstate Fisheries	2330-9730	\$230,000	\$230,000
ACCSP	2330-9732	\$71,000	\$76,000
Economic Relief	2330-9738	\$275,000	\$335,000
Turtle Disentanglement/Protected Species	2330-9739	\$770,000	\$660,000
Revolving Loan Fund	2330-9741		new
Fish Age & Growth	2330-9742	\$200,000	\$200,000
Marine Fisheries Research Trust	2330-0101	\$2,650,000	\$3,490,000

The Revolving Loan Fund

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 catchshare programs in New England, while minimizing any potential adverse socio-economic impacts to fishing communities and small-scale fishing businesses that are sometimes attributed to catch-share programs. Operating under a Memorandum of Agreement between the National Marine Fisheries Service 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. The lack of applicants as of CY2012-end likely reflects the dire circumstances the multispecies resource is in, as well as lease market dynamics. Fishermen were struggling to locate sufficient resources to fill their Fishing Year 2012 (May 1, 2012 – April 30, 2013) quotas while they awaited a then unclear future of substantial catch reductions for Fishing Year 2013. Expenditures on this grant will likely begin in the next year of this program.

The Clean Vessel Act Program

MarineFisheries administers the Clean Vessel Act (CVA) Program 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 MassCVA Program, and agency coordination with public and private parties.

In 2012, the 18th year of our participation, we enhanced our program with the addition of five new sub-grantees. 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. Our sub-grantees in 2012 included 49 private marinas, three non-profit organizations, and 52 cities and towns.

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 combination of pumpout vessels and shore-side pumpouts (Figure 50), 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 No Discharge Area (NDA).



Figure 50. A combination of pumpout boats (left) and fixed location pumpout stations (right) help meet the needs of the Commonwealth's recreational boaters.

In 2012, we completed our sixth consecutive year of exhibiting, in partnership with our state boating law enforcement agency, at the New England Boat Show. We were 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 2012 again exceeded expectations; Table 22 summarizes new infrastructure for 2012. We are quickly approaching the removal of 6 million gallons of effluent from state coastal waters. In addition, NDA designations have been approved in all but a few embayments along the Massachusetts coastline.

Table 22. New Infrastructure for 2012.

Location	Infrastructure Type
Harbor Mooring Service	Replacement of engine on pumpout boat
Town of Hingham	New fixed location pumpout station
Town of Kingston	Replacement of pumpout boat
City of Lynn	Replacement of pumpout station

The total project costs for the above new equipment was \$141,000. In addition, \$762,500 was distributed to 85 sub-grantees to cover the operation and maintenance expenses of 66 pumpout boats and 56 fully functional fixed-location pumpout stations.

Boating Infrastructure Grant Program

The Massachusetts Boating Infrastructure Grant (BIG) Program, begun in 2001, is a two-tiered federal grant program, directed through the USFWS and administered by *MarineFisheries*. The BIG Program is paid for by money from the Sport Fish Restoration Fund which in turn is funded by 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. See Table 23 for a summary of projects completed and in progress in Massachusetts.

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. Massachusetts has not yet had a successful Tier II project; however, this year's Tier II applicant, the City of Lynn's Seaport Marina, has put together a very competitive proposal. New awards will be announced in the spring of 2013.

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.

Table 23. Massachusetts BIG Project Summary.

Year	Project	Award	% Complete
	Nantucket Town Pier Transient Boater Restrooms	\$90,413	Complete 100%
2001	Lake Tashmoo, Tisbury, Transient Dockage & Dinghy Dock	\$52,000	100%
	Wellfleet Town Pier Transient Dockage	\$62,625	100%
2002	2002 Stage Habor, Chatham, Transient Moorings & Nav. Aids		100%
	State Harbor, Chatham, Transient Boater Restrooms	\$15,000 \$69,000	100%
2003	Great Misery Island, Beverly, Transient Moorings	\$17,394	100%
	Long Island, Boston Harbor, Transient Moorings		100%
2004	Peddocks Island, Boston Harbor, Transient Moorings	\$25,000	
	Owen Park, Vineyard Harbor, Transient Dockage	\$53,752	100%
	MacMillan Pier, Provincetown, Transient Courtesy Float	\$60,000	100%
2005	Nantucket Harbor Transient Boater Navigational Aids	¢10.202	100%
	Madaket Harbor, Nantucket, Transient Boater Nav. Aids	\$19,382	
2007	New Bedford Harbor Transient Navigational Aids & Moorings	\$95,000	100%
	New Bedford Harbor Transient Dinghy Dock	393,000	
2009	Scituate Harbor Marine Center Transient Access	\$90,000	100%
2011	Wessagusset Yacht Club, Weymouth, Transient Dockage	\$92,250	100%
2012	Nantucket Harbor Pier Transient Dockage	\$89,011	0%

Two grants were open in 2012, and are described in more detail.

Wessagusset Yacht Club Transient Boater Dockage: The objective of the Wessagusset Yacht Club Public Transient Boater Access project is to increase transient boater berthing (Figure 51) and access to Boston Harbor's natural, historic and scenic attractions by providing dockage for 8

transient boats > 26' through the purchase, construction and installation of two heavy-duty 50' x 14' dock units.

The eight additional transient berths at a 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 units will be placed at the terminus of reconfigured YC floats for easy, deep water access in and out of the facility for transients. The units were chosen specifically for their ability to provide stable dockage in a potentially high energy environment and will assure safe dockage under all weather conditions for transient vessels > 26' in length. The project will provide boaters greater access to the natural, cultural,



Figure 51. Wessagusset Yacht Club Transient Boater Dockage.

and historic attractions of the greater Boston Harbor area. And, the project will help the community by supporting new revenue generating businesses in the waterfront area.

Nantucket Town Pier Transient Dockage Improvements: The objective of this project is to



Figure 52. Nantucket Town Pier.

provide safe, convenient dockage for 33 transient boaters with vessels > 26' in length by renovating the Nantucket Town Pier (Figure 52) through the replacement of 300 cross beams, 15 service ladders, 14 pilings, and several hundred feet of decking and hardware.

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 and in the end the economy.

Other Activities: The Boating Infrastructure Grant Coordinator represented the agency on the Massachusetts Legislative Boating Caucus. The Coordinator also maintained agency membership with the States Organization for Boating Access.

The majority of the Coordinator's time was spent preparing annual financial and progress reports, preparing annual grant submissions, and working with potential applicants. In 2012, a considerable amount of technical assistance continued to be provided to this year's Tier II applicant, the Seaport Marina in the City of Lynn. The Coordinator and the agency's Information and Education Coordinator conducted an on-site visit to Nantucket to discuss potential project changes and to inspect existing equipment and infrastructure from both the CVA and BIG Programs. Thomas Beaulieu, CVA Program, and Eileen Feeney, Habitat Program, also contributed significantly in 2012, particularly with subgrantee contracts and payments.

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 FY2012, *MarineFisheries* spent almost \$500,000 in facility planning, infrastructure maintenance, and emergency repairs. Tape backup servers were replaced in both the Gloucester and New Bedford Field Stations. Repairs at the Gloucester Office included a complete renovation of the bacteriological laboratory, and the tear down and removal of a hazardous materials building. Repairs at the Hughes Hatchery and Research Station included the tear down and replacement of an old shed, and the construction of a new greenhouse for shellfish culture and grow-out.

Vehicles and Boats

MarineFisheries maintains a fleet of 40 vehicles and 16 boats. In 2012, just over \$70,000 was paid to the Office of Vehicle Management for lease vehicles, and an additional \$33,000 was spent on maintenance and repair for all stock. In addition, 3 vehicles, 1 construction tractor, and 1 outboard motor were purchased outright in FY2012 for a total cost of \$151,000. No vessels were replaced in FY1012.

Outreach Program

The *MarineFisheries* Outreach Program was created in CY2012 in efforts to establish a more consistent connection with the Massachusetts saltwater fishing community and general public. Funds for the Outreach Program, including the hiring of an information and education coordinator, are from the Marine Recreational Fisheries Development Fund.

In CY2012, the inaugural year of this program, many projects were initiated and completed. Reminder signs for anglers to purchase Massachusetts saltwater recreational fishing permits were designed, printed, and posted at public access sites along the Massachusetts coastline. As part of an initiative to engage Massachusetts youth in marine science, two informational coloring books – on sharks and recreational angling species – were designed, printed, and distributed at trade shows. An e-mail based news update, called the *BroadCast*, was initiated and sent to all Massachusetts recreational permit holders who supplied an e-mail address when purchasing or renewing their license in CY2012 (Figure 53).

The Outreach Program was present at various trade shows throughout CY2012. Informational brochures on research and policy were distributed at the Working Waterfront Festival in New

Bedford, New England Boat Show in Boston, and the Fishing and Outdoor Expo in Worcester, among others.

In synergy with the Department of Fish and Game, *MarineFisheries* commenced a social media initiative to increase connectivity with Massachusetts residents through Twitter (handle @MassDFG). Plans are to make *MarineFisheries* more social media friendly in upcoming years. As part of this plan, the information and education coordinator is the *MarineFisheries* representative to the Atlantic States Marine Fisheries Commission social media steering committee.

The information and education coordinator took over as technical editor for the *MarineFisheries* Technical Report series, publishing six reports in CY2012. The information and education coordinator also became an editor for *MarineFisheries* newsletter, assisting in the publication of two issues in CY2012.



Figure 53. Anglers receive fishing news via e-mail in the *BroadCast*.