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MarineFisheries

A Commonwealth of Massachusetts Agency

DMF Staff Image

Barge deploying concrete material at the reef site.

MarineFisheries builds new Artificial Reef in Nantucket Sound

If you build it, the fish will come . . . and reproduce, and survive.

On March 23, 2016, sixteen hundred cubic yards (CY) of concrete rubble was deployed into the waters of Nantucket Sound, and the Harwich artificial reef was born. The nearly ten-acre site is located two miles south of the entrance to Saquatucket Harbor in Harwich at approximately 32 feet of depth. The artificial reef provides structured habitat that will attract and enhance survival of many recreationally important species that spend all or part of their lifecycle in Nantucket Sound, including black sea bass, tautog, and scup. Deployed structures rise three to six feet off the bottom and are dispersed in patches to minimize disturbance to the natural bottom. The reef site is designed to enhance fishing by providing benthic relief and interstitial spaces in an otherwise featureless sandy habitat and is expected to provide additional recreational fishing access opportunities for decades to come.

Creating the Harwich reef was a collaborative effort spanning several years. Work began in 2007 when local fishermen first approached *MarineFisheries* and the Massachusetts Seaport Advisory Council (SAC). The SAC provided funds to the Division for a feasibility study and to identify a potential location for a new reef site. In 2011, *MarineFisheries* presented the results of the feasibility study and site selection work to the Harwich Conservation Commission. The town was very supportive of the project and agreed to a partnership to obtain permits. By the spring of 2014, all local, state, and federal permits had been secured and in November of 2015, the project was presented to the Division's Marine Recreational Fisheries Development Panel as a "shovel ready" project option to be considered for funding through monies collected from the sale of Massachusetts recreational saltwater fishing permits.

Once funding for the project's construction was secured, the process moved quickly. In February, the contract to

deploy materials was awarded to the Robert B. Our Company, through a competitive bid process conducted by the Town of Harwich. In early March, the concrete rubble material was trucked to a staging area in New Bedford and loaded onto a 54-foot by 160-foot barge. One thousand cubic yards of the material came from the demolition of the old Harwich High School. Additional concrete material, such as unused septic tanks and storm drains, was provided by the contractor. This material was stored for several years at the Harwich transfer station and was exclusively for use on this project. Winter weather inhibited the deployment schedule, and for more than a week the barge and tug remained tied to the pier in New Bedford Harbor waiting for the weather to clear. On March 22, the barge made the trip from New Bedford to the reef site. Material deployment began at sunrise on the morning of March 23 and all 1,600 CY of material was off the barge and on the bottom by 10:00 a.m.

Concurrent with the planning and staging for material deployment, *MarineFisheries* worked to establish a regulation prohibiting all commercial fishing activity on the reef site and within a buffer zone extending an additional 328 feet (100 meters) from the site in all directions. The rationale behind the regulation is that the reef was created using revenue from the recreational saltwater fishing permit and that recreational fishing opportunities could be optimized by excluding commercial fishing activity and eliminating potential user group conflicts on the site. This regulation establishes the Harwich artificial reef site as the first and only site in Massachusetts dedicated exclusively to recreational saltwater fishing.

MarineFisheries divers began monitoring the Harwich reef a few weeks after deployment. Site visits for monitoring will occur at least twice annually, with more frequent visits the first year, to document the presence of species over time. As the reef ages, it will undergo various stages of colonization and succession and is expected to resemble natural structured habitat over time. Although colonization is in the very early stages, structure-oriented fish and invertebrate species were observed on the site within the first month, including substantial numbers of cunner, horseshoe crab, and spider crab. There have also been recent reports of black sea bass and tautog catches on the reef. A bottom temperature monitor was deployed to record water temperature every two hours. An acoustic receiver was also deployed on April 6 to document presence of any fish fitted with an acoustic tag, such as striped bass, black sea bass, cod, and white sharks. Through June 15, 2016, the receiver has detected seven striped bass and one Atlantic sturgeon tagged in previous years by the agency. These devices will remain on-site for the foreseeable future.

Planning for future monitoring and study is currently underway. This summer, staff will generate a detailed map of the reef using sidescan sonar acoustics. Also staff will conduct black sea bass tagging to assess differences in size structure, sex ratio, and relative abundance between fish caught on the reef and fish caught nearby at similar depth. Finally, we are considering using the reef site and surrounding buffer zone to assess channeled and knobbed whelk population structure in an un-fished location, comparing whelk across fished and unfished areas to assess size structure differences. In 2017, an acoustic

DMF Staff Image

After one month, the reef was already exhibiting signs of colonization, including these cunner and spider crabs. Later in June, agency divers observed scup, sea bass, tautog, sea robin, and cunner on the reef. We expect to see more fish visiting the reef.

array will be set up surrounding the reef site and black sea bass caught onsite will be fitted with an acoustic transmitter to document their movement, site fidelity, and seasonal duration of stay.

Approximately 20–30% of the total area of the site was covered by this first deployment of material; more deployments are expected in the future, depending on funding sources. More information on this and other artificial reef sites in Massachusetts can be found on *MarineFisheries*' Artificial Reefs webpage: ***http://www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/artificial-reefs.html***.

By Mark Rousseau, Environmental Analyst and Artificial Reef Coordinator

Mystic River Cooperative River Herring Restoration a Success

MarineFisheries teams up with DCR and private groups to restore a historic run

Over the past five years, the Mystic River has seen dramatic improvements in river herring runs due to the restoration of the Upper Mystic Lake Dam in 2012. Most notable of these changes came last year, when the river herring doubled in numbers and fish were making it further upstream than ever before. This collaborative effort to restore the historic run has now made the Mystic River, one of the primary tributaries to Boston Harbor, one of the largest runs in the Commonwealth.

Built in 1864, the Upper Mystic Lakes Dam in Medford became a barrier to fish migration in the Mystic River. River herring persisted in the 85-acre Lower Mystic Lake, but each year thousands of fish were seen at the dam spillway trying to move upstream. From 2005 to 2009, the Medford Boat Club, *MarineFisheries*, and many volunteers formed a "bucket brigade" to manually lift fish over the dam and into the 165-acre Upper Mystic Lake. The interest and publicity generated from the bucket brigade resulted in Department of Conservation and Recreation (DCR) rehabilitating the dam. *MarineFisheries* worked cooperatively with DCR to design and integrate fish passage features for river herring and American eel into the plans. The Department of Conservation and Recreation rebuilt the dam in 2010 and 2011, with sea-run fish reaching the Upper Mystic Lake on their own for the first time in over 150 years in the spring of 2012. Much credit is due to DCR and all project partners for opening fish passage to the Upper Mystic Lakes by constructing the first fish passage facility in a coastal Massachusetts river with integrated fish ladder, eel ramp, and downstream fish passageway features.

Google Map Amended

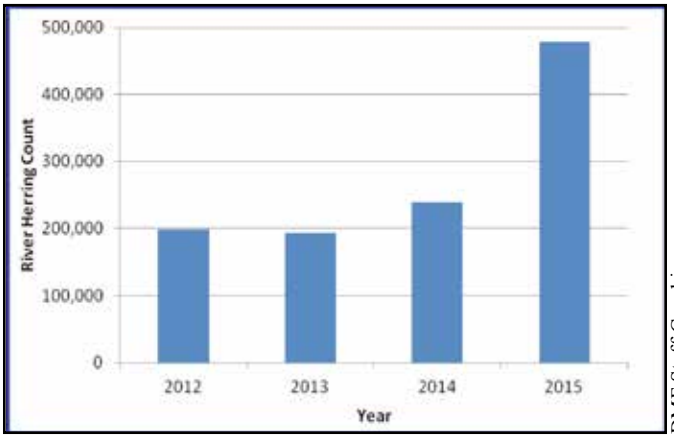
Map of the Mystic River.

The Denil fish ladder and eel ramp have already proven to be highly successful by passing over one million diadromous fish in the first four years of operation. They have also provided a unique opportunity for the local communities to connect with the aquatic resources around them. The Mystic River Watershed Association (MyRWA) has done an excellent job coordinating a volunteer fish count based upon *MarineFisheries* methods, which has yielded a statistically-based estimate of river herring passage each year. *MarineFisheries* and MyRWA also cooperatively count eels at the dam, releasing over 25,000 eels into Upper Mystic Lake since 2012. On any warm day in spring, you can now find birdwatchers, fish lovers, and anglers at the dam, brought there by the thousands of river herring passing daily and the train of life that follows them.

Beyond large numbers of fish passed, the benefits of passage truly emerged in 2015. River herring spawn in freshwater, with the resulting young of the year typically spending a few months in freshwater before emigrating to the ocean. They mature at sea for three to five years before returning, usually to their river of birth, to spawn. Consequently in 2015, we saw the first year class of fish that might have resulted from the increased habitat availability in Upper Mystic Lake and the estimated


DMF Staff Photo

MarineFisheries ***biologist Brad Chase observes river herring entering Horn Pond in Woburn.***



DMF Staff Graphic

Fish passage counts to the Upper Mystic Lake, 2012 – 2015.

count increased from 239,000 to nearly 478,000 river herring.

This abundance of fish coincided with dam work at Central Falls in Winchester, and river herring were also documented by *MarineFisheries* staff entering Horn Pond in Woburn. This marked the first time in over 150 years that alewife and blueback herring have ascended the Mystic and Aberjona Rivers so far inland. In part due to this success, *MarineFisheries* is providing technical advice to the Town of Winchester and *de maximis*, *inc.* to build a new fishway at the Center Falls Dam and modify the overflow spillway into Horn Pond to act as a natural fish passage structure under most flows. These projects will allow river herring to access an additional 102 acres of spawning habitat, further supporting a growing herring run that may soon rank among the largest in the Commonwealth.

MarineFisheries has been committed to improving diadromous fish passage and habitats in the urban watersheds of the Boston Harbor region for decades. The Mystic River, along with the Charles and the Back Rivers, now exceeds one million spawning fish every year, nourishing Boston Harbor and the Gulf of Maine.

By Ben Gahagan, Biologist and Brad Chase, Senior Biologist and Diadromous Fisheries Project Leader

MarineFisheries Kicks Off New Cod Industry–Based Survey

This April, *MarineFisheries* launched the Gulf of Maine (GOM) cod Industry-Based Survey, funded in part by the Groundfish Disaster Economic Assistance Program and Baker-Polito Administration, to address fishermen's concerns that the cod status is better than currently assessed. More than half of the groundfish stocks in the GOM are currently considered overfished or the status is unknown. Some severely depleted stocks, such as Atlantic cod, are currently estimated at less than 10% of their target biomass, despite repeated management interventions to promote stock rebuilding. The low commercial catch quotas for these stocks have severely limited the ability of fishermen to pursue healthier, more abundant stocks in the groundfish complex (haddock, pollock, etc.), given the multispecies nature of this fishery.

Moreover, fishermen in the GOM have questioned the accuracy of such pessimistic stock assessments, particularly in light of their continued catch of these species. Industry disbelief in scientific advice on stock status has focused the discussion in recent public forums (e.g., hearings, workshops, and council meetings) on whether there actually *is* a biomass problem, creating ambiguity as to the way forward: Do we need immediate and austere conservation measures to rebuild stocks? Or, do we need to identify and correct for sources of bias in stock assessments?

Fish stock assessments in the northeastern United States rely heavily on the multiple streams of fishery-dependent and fishery-independent data collected by federal and state agencies. Many of these are of high quality and have been collected in a rigorous and consistent manner for several decades. However, there have been significant changes in the groundfish management regime, vessel and fishermen behavior, environment, and survey methodology over the past decade, making it difficult for existing datasets and models to discern the underlying population dynamics of many groundfish species. These concurrent changes have cast doubt among some stakeholders as to

DMF Photo

Secretary Matthew Beaton, Commissioner George Peterson, and* MarineFisheries *biologist Micah Dean sampling an IBS tow.

Photo Courtesy Kevin Norton

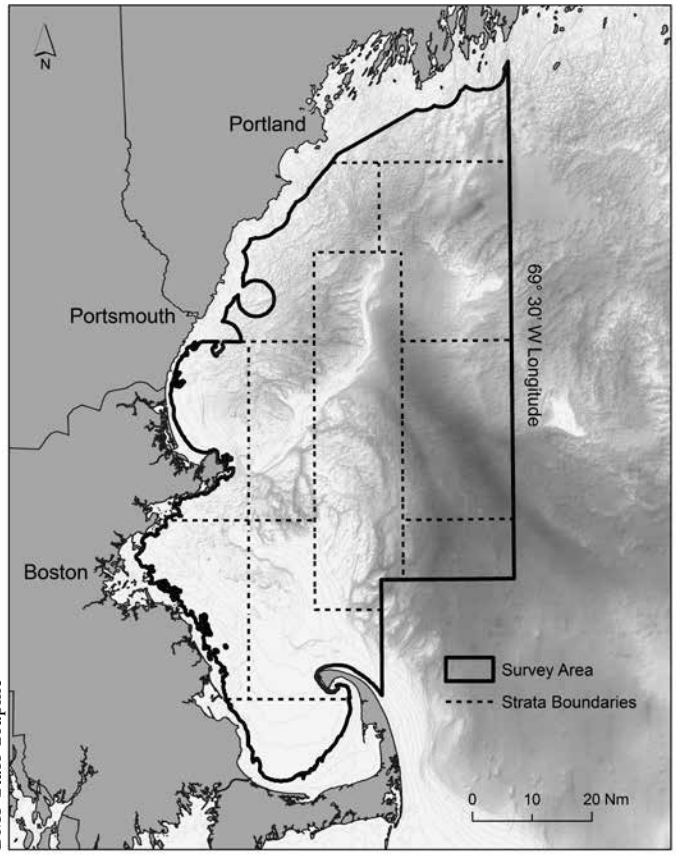
The* F/V Miss Emily *returning from an IBS survey.

whether the recent downward trend in survey indices is tracking the true abundance of fish populations.

This is not the first time *MarineFisheries* has led an industry-based survey for GOM cod. In response to what was then considered a low point in the biomass of the GOM cod stock, we conducted an industry-based trawl survey from 2003 through 2007 (IBS1), specifically aimed at describing the spatial and temporal patterns in stock demographics. While this short time series has seen little use as an index of abundance, it has proven to be an invaluable source of information for spatial management measures (i.e., closed areas) and life history parameters (e.g., growth, maturity).

The IBS1 used contracted commercial fishing vessels to make tows according to a two-stage scientific design that ensured both broad spatial coverage and increased effort in areas important to cod. All US waters from Canada to Chatham were sampled out to a maximum depth of 460 feet, including the offshore ledges of Cashes, Fippennies, and Platts Ledges. The survey net was specifically designed to collect a wide range of cod sizes over a variety of habitats. The tow protocols and net sizes were standardized to ensure that the survey gear was fished the same across all vessels. The primary benefits of this survey concept were the broad seasonal coverage (continuous operation from November through May), high sampling intensity (19x more tows than NOAA's Northeast Fisheries Science Center surveys), and large biological sample sizes (22x more lengths and 8x more sex/maturity observations than the federal surveys for cod).

The new estimated low point in GOM cod biomass has revived the IBS concept, and *MarineFisheries* has initiated a new industry-based trawl survey that began this past April (IBS2). This renewed effort is using identical nets, doors, and tow protocols to IBS1, but learning from the experience of our earlier effort, we have modified the survey design to maximize the utility of the data collected. Specifically, a stratified random design that is aligned to the management system (i.e., month-long cruises stratified by area closures) will maximize the relevance of findings and aid in the estimation of fishery selectivity; the seasonal coverage has been extended to cover the entirety of both winter and spring cod spawning seasons (winter: October–January; spring: April–July); the survey area has been modified to eliminate regions with minor cod biomass (eastern GOM), yet include additional locations that have generated significant commercial cod catch in recent years (deep



DMF Staff Graphic

Map of IBS study area.

water east of Jeffreys Ledge and Stellwagen Bank, including Wildcat Knoll and Wilkinson Basin); and, finally, a single commercial fishing vessel has been contracted to conduct all tows to maximize consistency (IBS1 used four contract vessels).

As with any bottom trawl survey, we are limited by an inability to make tows in areas with concentrated fixed fishing gear (e.g., lobster traps, gillnets, and long lines). We are asking that fishermen move their fixed gear from within a 0.75 nautical mile radius of the survey stations for a brief time period to allow us to complete the survey. Maps of IBS tow locations by month can be found at the *MarineFisheries* website and fishermen can sign up to receive text message alerts notifying them of when the survey vessel will be in their area. The schedule calls for a total of eight monthly survey cruises to be conducted April–July 2016 and October 2016–January 2017.

Despite a focus on GOM cod, this project will allow for credible estimates of biomass for several GOM groundfish species. Cod, yellowtail flounder, and winter flounder all have more than 95% of their biomass inside the IBS2 study area during at least some portion of the year. Providing a robust independent measure of stock size will be extremely valuable for interpreting the existing scientific advice on stock status. Furthermore, the use of consistent gear and protocols will allow for comparison between the two separate IBS time periods, which span the various changes in management, environment, and federal surveys.

A primary goal of the IBS2 effort is to provide information useful to the management and assessment of GOM groundfish that is credible to fishermen, scientists, and mangers. Recent workshops hosted by the Gulf of Maine Research Institute have identified a series of issues that lie at the heart of fishermen's disbelief in existing survey and assessment methodology. Through repeated conversations with fishermen and industry representatives, *MarineFisheries* has arrived on a scientifically

rigorous IBS2 design concept that addresses as many of these issues as possible. By using a survey methodology that is acceptable to a broad array of stakeholders, we are hopeful that the data generated from this effort will help resolve the conflicting views on stock status. An unambiguous answer to the question of whether this is a biomass crisis is necessary for restoring the fishing community's faith in the management process and will clear the way for progress to be made towards managing for stock rebuilding and developing better stock assessment methods.

By Micah Dean, Marine Fisheries Biologist and Bill Hoffman, Senior Marine Fisheries Biologist

Reopening of Newbury Shellfish Area

On April 4, for the first time since January 1986, softshell clams were commercially harvested from the Town of Newbury, specifically the Newbury Shellfish Area N2.1 in the Merrimack and Plum Island Rivers (see map). Once considered among the top clam producing flats in Massachusetts, bacterial contamination had shut down these highly productive beds for the last 30 years. The reopening, largely due to Newbury municipal officials and Shellfish Constable Paul Thistlewood's development of a management plan to keep these areas in compliance, has provided North Shore commercial clammers with an additional 215 acres to dig. All clams harvested must be "cleansed" (depurated) at the Division's Shellfish Purification Plant on Plum Island, Newburyport, before sale. Recreational harvesting and the harvest for direct sale into commerce remain prohibited in this area.

The runoff from rainfall in this area has the ability to produce intermittent, but predictable, events of bacterial contamination in excess of public health standards. The monitoring of rain events and the institution of timely closures when an action level is reached is therefore central to the successful management of this Conditionally Restricted area. Accordingly, *MarineFisheries* shellfish biologists keep tabs on three rain gauges located at the Newburyport Waste Water Treatment Plant in downtown Newburyport, the Newburyport Water Filtration Plant adjacent to Route 95 and the Merrimack River, and the Lawrence Municipal Airport. The gauges are checked daily at 7:00 a.m., seven days a week, 365 days a year. Strategically located, these gauges capture far-field and near-field impacts of rain driven bacterial contaminated runoff.

When rainfall amounts total 0.25 inches or more within a 24 hour period, the area is closed to harvesting for five days. In the event of another action level during a closure, the closure duration is extended for another five days. Similarly, when rainfall amounts equal or exceed 0.83 inches, as recorded at the Lawrence station, the Merrimack is closed for seven days. Lastly, 1.5 inches or more rain as recorded at any rain gauge station closes the Merrimack until subsequent examination demonstrates elevated bacterial contamination is no longer present. These indefinite closures sometimes persist for many weeks in the aftermath of extreme storm events yet are critical to the successful management of the area.

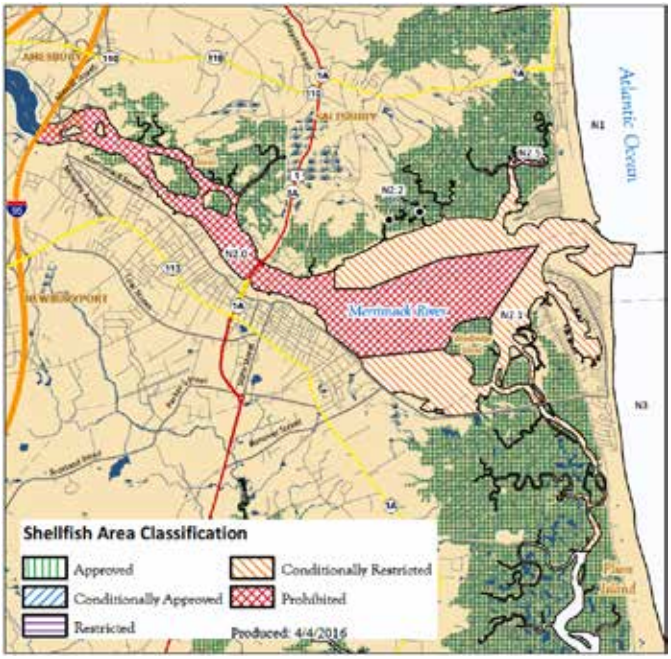
When instituting closures, *MarineFisheries* activates an extensive notification system. This includes updating a telephone message system, alerting state and local officials via email, and publishing legal notices. Concurrently, staff monitor the status of five wastewater treatment plants discharging to the Merrimack River from Newburyport upriver to Lowell for failures or upsets which may also adversely affect closures.

These restrictive rainfall closure criteria for the Merrimack River are necessary to ensure success of the controlled depuration process and protect public health under mandates set forth by the National Shellfish Sanitation Program. The quarter inch action level effectively limits open harvest days to 90 or fewer per year. This spring, numerous low level rain events resulted in multiple Merrimack River area closures since reopening in April. Nonetheless, five Master Diggers and their 37 Subordinate Diggers harvested over 43,000 lb. of softshell clams from Newbury over nine days spread between April 4 and May 17, 2016. The wholesale value of the depurated clams harvested totals approximately $87,000. Despite limitations, digging the newly reopened Newbury flats as well as previously reclassified and reopened Merrimack River areas in Newburyport (2006 & 2013) and Salisbury (2006) has proven beneficial to the bottom line of these North Shore shellfishermen.

The reopening of the Newbury flats comes at an opportune time for the North Shore clam fishery. Currently, North Shore clam flats from the Annisquam River in Gloucester to the Plum Island Sound in Newbury are experiencing the largest clam sets seen in decades. Typically, local clam diggers would have no alternative but to continue harvesting legal size clams despite the presence of sublegal size clams, resulting in high mortality of these juvenile clams. The newly opened Newbury flats and the previously reopened flats in Newburyport and Salisbury are providing an important alternative for local clammers

DMF Staff Photo

Subordinate Diggers harvesting Shellfish Growing Area N2.1 Newbury in the Plum Island River within the Parker River National Wildlife Refuge on April 18, 2016.



DMF Staff Graphic

The re-opened area of N2.1 encompasses approximately 215 acres.

beyond their respective communities. In turn, over the next several years, it is expected that softshell clam landings along Massachusetts' North Shore may be the best in a generation or more, thanks in part to the availability of the Merrimack River moderately contaminated flats.

By David Roach, Aquatic Biologist

MarineFisheries Forms Steering Committee for Seafood Marketing Program

The inaugural steering committee meeting for the *MarineFisheries* Seafood Marketing Program took place mid-May at the Massachusetts State House. The steering committee, chaired by Director David Pierce, is a 19-member group comprised of both industry and government representatives. Those legislators and agency heads on the committee include: Senator Bruce Tarr, Senator Anne M. Gobi, Representative Paul A. Schmid, III, Representative Susan Williams Gifford, Department of Fish and Game Commissioner George Peterson, Department of Agricultural Resources Commissioner John Lebeaux, and Director Pierce. Industry committee members in attendance include: Richie Canastra, Lisa Cavanagh**,** Angela Sanfilippo, Frank Mirarchi, Ed Barrett, Tory Bramante, Beth Casoni, and Laura Foley Ramsden. Also in attendance were Representative Jim Cantwell and stakeholders from New Bedford, Gloucester, and ports in between.

This steering committee is tasked with assisting *MarineFisheries* in reaching our goal of increasing consumer awareness and preference for local seafood, in support of the Commonwealth's fishing and seafood industries and communities. This is no small task, as demonstrated in Story Reed's (*MarineFisheries* Permitting and Statistics) presentation to the steering committee, which included the unique challenges that face the Massachusetts commercial fishing industry. Ken Ayars, Chief of the Rhode Island Division of Agriculture, presented as a guest speaker on his state's Seafood Marketing Collaborative, following the main presentation by Wendy Mainardi, the Massachusetts Program Coordinator. All members of the steering committee were optimistic and helpful when asked about the program's budget and priorities. There was an emphasis on informing the public of our environmentally sustainable fishing practices, as well as an urge to build short-term solutions into our plan.

Program Formation: Key Findings

The early development of this program was based on three major resources: past *MarineFisheries* marketing programs, similar programs in other states, and regional organizations with overlapping agendas. The *MarineFisheries'* archive provided printed promotional material from our federally funded program dating back to the 1970s. These photographs, comic books, cook books, posters, and other materials may need some updating, but are inspiring nonetheless.

The national landscape of seafood marketing programs helped inform us of successful implementation and shared challenges. Every state faces traceability and regionality issues, and there is no common metric for these programs. That being said, the practices of Rhode Island, Maryland, New Jersey, Virginia, North Carolina, and Louisiana, among others, were diverse and enlightening. Some states target tourists while some target chefs and restaurants to nudge consumers; some states spend resources monitoring the use of their standards-based brand; some states promote a particular species.

It was important to survey the local and regional programs to ensure that our new program does not compete with successful ones and so that we can identify any areas of opportunity and collaboration. The Massachusetts Department of Agricultural Resources (MDAR) and the Gulf of Maine Research Institute (GMRI) both run branding programs for seafood products based on quality and environmental standards, respectively. In addition, the cities of Gloucester and New Bedford are each in the process of creating their own brand programs which we need to consider when positioning the *MarineFisheries* Seafood Marketing Program in the field.

Consumer Engagement

It was proposed to the steering committee to create an inclusive educational brand that will appeal to people's sense of history and pride of the Massachusetts commercial fishing legacy. This communication tool will be easily identifiable with its consumer-facing logo, an emblem to showcase seafood availability, preparation, health, and sustainability information. Upon completion (the brand identity is in the works), we will be creating print and digital educational material, a marketing

DMF Staff Graphic

The Division's Seafood Marketing Program logo at time of printing. Final logo will be launched this August.

DMF Staff Photo

A vintage photo from the* MarineFisheries *archive. Fried fish is a classic, but today's consumers are more motivated than ever by the health benefits of seafood.

toolkit for consumer-facing businesses, and other merchandise to distribute at existing and new events.

We are planning on launching the revitalized program to the greater public at the 2016 Boston Seafood Festival on August 7, held by the Boston Fisheries Foundation (BFF). In addition to the BFF, we are in the process of developing partnerships with other great organizations such as the Massachusetts Restaurant Association, the Massachusetts Office of Travel and Tourism, and fishermen themselves. The Division is also proud to announce our exciting new participation in the Massachusetts Farm to School program that will feature a "Harvest of the Month" in 139 public schools, two medical centers, and 25 colleges in May of 2017 and 2018. We will be serving over 800,000 locally sourced seafood meals, organizing institutional food service demonstrations, and sponsoring a track at the Farm & Sea to Cafeteria conference to encourage year-round procurement.

More information on the Seafood Marketing Program, including seafood events, educational opportunities, industry resources, and Steering Committee agendas, will be added to the program's webpage at: ***http://www.mass.gov/eea/agencies/dfg/dmf/programs-and-projects/seafood-marketing.html***

By Wendy Mainardi, Seafood Marketing Coordinator

White Shark Research: Expanding the Acoustic Array

With the growing seal population off the coast of Massachusetts, the white shark is becoming more common in our coastal waters during the summer and fall months. Since 2009, *MarineFisheries'* Shark Research Project has been using state-of-the-art tagging technology to study the biology and ecology of this species in our waters and along the east coast of the United States. During this period, we have tagged more than 80 individual white sharks ranging in size from seven to 18 feet, primarily in the nearshore waters east of Cape Cod to the southern tip of Monomoy. These fish were tagged with multiple technologies, including acoustic transmitters, satellite-based tags, and accelerometers. Our findings to date show that white sharks travel extensively when they leave Massachusetts, with most moving to shelf waters off the southeastern US from North Carolina to the Gulf of Mexico, while others move into the open Atlantic and dive to depths as great as 3,000 feet. Regardless of where they go, many of these sharks return to our coastal waters each year.

Over the last two years, we expanded our research from studying where these sharks go to figuring how many visit our waters and how they interact with other species. Although there are indications that this population is rebounding from overexploitation, estimates are lacking for white sharks in the Atlantic. Knowing the number of white sharks that visit our waters each year is not only helpful for conservation and resource management, but it may have implications for public safety. To conduct this research, *MarineFisheries* initiated a traditional mark-recapture study in 2014 with financial and technical assistance from the Atlantic White Shark Conservancy (AWSC). Using aerial and vessel surveys, we identified, videotaped, and sexed 68 individual white sharks in 2014 and 141 white sharks in 2015 off the east coast of Cape Cod from mid-June to the end of October. Of the 141 sharks from 2015, 40 returned to Massachusetts from the previous year.

As part of her PhD research, SMAST (School for Marine Science and Technology, University of Massachusetts Dartmouth) student Megan Winton will use these numbers—and those we collect in the coming years—to estimate total population size based on the assumption that the number of our marked individuals within these samples is proportional to the number of marked individuals in the whole population. However, given that we are studying an open population, we need to take into consideration other factors, like immigration/emigration rates and population demographics. Our tagging efforts will provide us with this kind of information and, as a result, we are expanding our acoustic receiver array throughout Massachusetts waters.

To date, 65 of the 80 tagged white sharks are carrying acoustic transmitters that emit an individually-coded high frequency ping every 60–100 seconds. These pings are detected by an array of acoustic receivers maintained by *MarineFisheries* and the AWSC. When one of these sharks swims within 200 meters (656 feet) of a moored receiver, it is detected and the receiver logs the date, time, and unique tag number of that shark. After we download data from the receivers, we can examine local movements of the sharks as they relate to habitat use, residency, site fidelity, and other factors like temperature, tide, and time of day. In addition to white sharks, *MarineFisheries* has been using this technology for many years to study a number of fish species including cod, striped bass, and sand tiger sharks (see *DMF News* 1st & 2nd Quarters 2015 and 3rd & 4th Quarters 2015).

Since the quantity and quality of information coming from these tags is only as good as the geographic coverage of the

acoustic array, *MarineFisheries* is expanding the receiver network throughout Massachusetts. With funding facilitated by the Department of Fish and Game through the Executive Office of Energy and Environmental Affairs, 70 additional receivers have been purchased and are being deployed in areas not previously covered including the North Shore, Cape Cod Bay, off the islands, and Buzzards Bay. The agency works closely with local towns and harbormasters to choose specific areas including heavily populated beaches, surfing hotspots, and seal haul-outs. Although white sharks are typically associated with the eastern coast of Cape Cod, our expansion of the array to the South Shore and Cape Cod Bay in 2015 indicated that these areas are occasionally visited by our tagged sharks. We are hopeful that the dramatic increase in receivers this year will allow us to evaluate the extent to which white sharks use Massachusetts waters. This information will not only improve our ecological and population research, but also provide local towns with the means by which to evaluate the presence of these sharks. We encourage towns to contact the agency if interested in the placement of an acoustic receiver off their coast.

By Dr. Greg Skomal, Senior Marine Fisheries Biologist

MarineFisheries wraps up distribution of groundfish disaster aid

MarineFisheries has concluded direct aid payments to the Massachusetts groundfish industry stemming from the 2012 fishery disaster declaration. Over the past two years, the Division was awarded $21.7 million in federal grants to distribute funds to not only mitigate for past impacts, but also improve the future for the Massachusetts groundfishery and groundfishing community. The Commonwealth's Groundfish Disaster Economic Assistance Program is part of a greater distribution of $32.8 million in federal disaster aid monies to the Northeast groundfish industry. The state fishery directors from Maine to New York, in partnership with NOAA Fisheries, determined the monies would be apportioned between three themes (roughly $11 million each): one-third to be used for direct assistance, one-third to be split among the states and used at their discretion, and one-third to be used in developing a federally-funded buyout or industry-funded buyback. In May 2015, the funds from the third bin were reprogrammed to a second round of state-by-state allocations (see *DMF News* 1st & 2nd Quarters 2015).

Bin 1, 2, & 3 Direct Aid

Efforts to allocate disaster aid funds began in August 2014, when *MarineFisheries* distributed Bin 1 funds, totaling $6.3 million, to eligible federal limited access multispecies permit holders pre-qualified by NOAA Fisheries. Beginning February 2015, *MarineFisheries* distributed Bin 2's $8.1 million in direct aid payments to additional federal and state groundfish permit holders in the commercial and for-hire fisheries, active crew on associated commercial and for-hire vessels, impacted shoreside businesses, and groundfish sectors. By the end of 2015, *MarineFisheries* had also implemented the third and final bin of funds, directing $6 million to federal limited access multispecies permit holders (See *DMF News* 3rd & 4th Quarters 2015). Unlike Bin 1 where eligible permit holders were pre-qualified by NOAA Fisheries, qualifying criteria for the second and third bins were developed through a public process and with input of an Industry Working Group (see *DMF News* 3rd & 4th Quarters 2014, 1st & 2nd Quarters 2015 and 3rd & 4th Quarters 2015).

Throughout the three bins of the program, *MarineFisheries* distributed $20.4 million in direct aid payments to various components of the groundfish industry. The remaining Bin 3 funds have been directed towards an Industry-Based Survey (see page 4 for more details on the cod IBS), expanding opportunities for small mesh fishing, and administrative support for developing an industry-funded buyback program.

Increased Fishing Opportunities

As part of the greater Bin 3 program, $50,000 in disaster aid funds was set aside to assist groundfishermen in their efforts to conduct experimental fishing to amend federal regulations to expand the small-mesh whiting fishery. Funds will be used to pay for at-sea observer coverage and education/training on proper utilization of the raised footrope trawl.

Current industry observations and observer data during the Small Mesh Area 1 (SMA 1) open season off Cape Ann indicate target stocks may have shifted earlier in the season. Similarly, an earlier fishery may exist for the western Raised Footrope Exemption Area (western RFE) off Provincetown. Therefore, *MarineFisheries* will be contracting fishermen impacted by the recent groundfish disaster to conduct small-mesh experimental fisheries for whiting within the SMA 1 during July 1–14 (currently open July 15–November 15) and the western RFE during August 18–31 (currently open September 1–November 20).

This study, which began in July 2016, will gather necessary information to inform potential modifications to the whiting exempted fisheries. An analysis of the catch information will be submitted to NOAA Fisheries for evaluation which may lead to an earlier opening of the relevant areas per the Regional Administrator's authority to modify existing areas.

Disaster Aid Program	Number of Eligible Individuals	Flat Rate Payment Range	Total Amount Paid	Program Completion Date
Bin 1				
Permit Holders	201	$18,642–$32,500	$6,269,198	9/18/2015
Bin 2				
Permit Holders	142	$9,750–$32,500	$3,919,500	4/1/2016
Crew Members	525	$1,209–$10,080	$3,173,562	6/30/2016
Shoreside Businesses	30	$16,071–$26,786	$750,005	10/15/2015
Sectors (fishermen collectives)	10	$18,300–$31,300	$300,000	2/19/2016
Bin 3				
Permit Holders	171	$35,520	$6,027,750	3/11/2016

Industry-Funded Buyback Administration

NOAA Fisheries has allocated an additional non-discretionary $200,000 to support the continued development of an industry-funded buyback program. They selected Massachusetts to administer funds, given its history coordinating a similar program in 2006. *MarineFisheries* has reached out to industry and other state directors to develop a list of individuals interested in participating on the Steering Committee for developing a buyback program. Cate O'Keefe, Fisheries Management Specialist, will be assisting with the coordination of this program.

With direct aid payments wrapped up and remaining programs underway, *MarineFisheries* expresses our thanks to the industry members who participated in the development of this program and provided invaluable insight to the needs of the industry, as well as the Massachusetts Fishermen's Partnership and Cape Cod Commercial Fishermen's Alliance that assisted captains and crew throughout the application processes. It is our sincere hope that these funds, although not enough to make financially whole those who have endured through this difficult period, have provided the Massachusetts groundfishing industry and community with the support needed to shape a more sustainable and resilient future.

Further information and updates on the Groundfish Disaster Economic Assistance Program can be found on the *MarineFisheries* spotlight page ***http://www.mass.gov/dmf/groundfishassistance.***

By Samantha Andrews, Program Coordinator

A Look Inside *MarineFisheries'* Research Vessel Fleet

Charged with the management of fisheries in Massachusetts' coastal waters and beyond, *MarineFisheries* depends heavily on a fleet of boats to conduct scientific research. Over the years, the agency has grown, been given new responsibilities, and developed new capabilities; the fleet has evolved simultaneously to keep up with these changes, growing larger and more diversified.

When I began working for the Division in 1981, the agency fleet consisted of a few small aluminum boats, three 1964 Boston Whalers, a 23-foot Sea OX, and the R/V *Wilbur*. The Division was about half the size it is now and structured differently. The boats were assigned to specific projects for their use and in some cases, purchased by the project using outside funding sources. Likewise, unless the project in question had an independent source of funding, keeping these vessels equipped and operational was a challenge.

The largest of the fleet, the R/V *Wilbur,* was a 50-foot wooden charter boat converted for use by *MarineFisheries*. At the time, it was our only vessel with a fixed radio and electronics for navigation. The *Wilbur* was frequently used to support power plant impact studies around the Cape Cod Canal and Pilgrim Station power plants. The boat was also used to support diver operations for ghost gear work and placement of the Division's first recording bottom water temperature monitors in the 1980s. However, the three Boston Whalers were the workhorses of the Division's fleet. Despite their small size, these boats were used year-round along the entire coast to support a variety of sampling efforts, including diving, otter trawling, potting, and tagging. Most of these boats were trailered, and it was common to launch directly off the beach or from unimproved ramps.

Throughout the 1980s and 1990s, *MarineFisheries* went through a handful of smaller vessels that were integral in collecting invertebrate and finfish samples for PCB analysis, implementing a coast-wide suction sampling program for early benthic phase lobsters, and supporting the Division's Sport Fish Program. Most of these vessels were obtained through other state and federal agencies and required extensive maintenance to become functional again.

By 2004, many of the boats had been worked hard and pushed past their useful life expectancy. Vessels used year-round in the marine environment require constant maintenance, and funding for the ageing fleet was insufficient and difficult to come by. Fortunately, an unexpected ally came along in the form of a great white shark that became trapped in a salt pond off the coast of Falmouth. As *MarineFisheries* staff mobilized to deal with the shark, it became obvious that the small boat fleet was in serious need of an upgrade. In the years that followed, funds were made available to update electronics and safety equipment, and replace much of the outdated fleet with new vessels. Most notably, in 2006, the 28-foot R/V *Alosa* and 31-foot R/V *Mya* were added, marking a major turning point in the Division's fleet and capabilities. As the fleet began to expand, so did *MarineFisheries'* ability to participate in cooperative research and monitoring projects with other state and federal agencies, including the Massachusetts Office of Coastal Zone Management, Department of Environmental Protection, Division of Fisheries and Wildlife, NOAA Fisheries, the US Army Corps of Engineers, Environmental Protection Agency, and Food and Drug Administration.

The latest addition to the fleet came in 2015, when *MarineFisheries* received the *Michael Craven* from the Massachusetts Environmental Police. As the Environmental Police have been transitioning to the use of more Safe Boats, this 38-foot lobster boat was on the water less often. After transfer to *MarineFisheries*, the vessel received an extensive refit. It is used along the coast and offshore to support acoustic tracking, finfish sample collection, and to assist enforcement efforts.

Today, *MarineFisheries'* state of the art fleet ranges in size and capabilities (see below) allowing Division staff to execute groundbreaking research that aids in the management of the Commonwealth's commercial and recreational fisheries. The Division has risen to national prominence as a state-fisheries agency due in part to our ability to support the research and dive teams, both on and under the water.

Fleet Categories

Small Aluminum Boats

These outboard-powered boats range from 14 to 17 feet long and are used near-shore, in coastal ponds and embayments along the entire Massachusetts coastline. Division staff utilize these vessels for a variety of field work projects ranging from beach seine surveys to water sampling for the shellfish program. Also in this class of vessel, although slightly larger, is a 20-foot flat-bottomed dredge boat used by the Shellfish project to conduct shellfish resource surveys within coastal embayments. This boat is equipped with a hydraulic pump, davit, and a culling board. All of these boats are trailered for quick deployment anywhere along the coast.

Medium–Sized Fiberglass Boats

Ranging in size from 17 to 23 feet long, our medium-sized fiberglass vessels support a range of projects up to 10 miles offshore. Projects include eelgrass studies, acoustic tagging, and resource assessment. *MarineFisheries* also utilizes vessels in this category to assist the Center for Coastal Studies with turtle disentanglement. All of these vessels are equipped with GPS plotters, sounders, and VHF radios. Two of the Privateers are also equipped with radar. As with the smaller boats, Division staff trailer these vessels to ramps closest to the work site.

***Clockwise from upper left: 28-foot R/V* Alosa*, the 21-foot Privateer, the 31-foot R/V* Mya*, and the 38-foot* Michael Craven.**

Larger Vessels

The three largest vessels in our fleet are lobster-style boats ranging in size from 28 to 38 feet long. All are equipped with a mast and boom for lifting, a full suite of electronics, a hydraulic pot hauler, and enclosed cabin. These vessels are used coast-wide, often 10 to 20 miles from shore, and are docked in the ports of Gloucester and New Bedford. These larger vessels are used year-round to support large projects and those requiring maximum protection from the elements.

By Vin Malkoski, Senior Marine Fisheries Biologist & Dive Safety Officer

Spiny Dogfish Trip Limit May Increase

The 2016 commercial spiny dogfish fishery kicked off on May 1, 2016 with a 5,000-pound trip limit, the same as the 2015 season (spiny dogfish has a May 1–April 30 fishing year, or FY). However, that may change shortly to a 6,000-pound trip limit, pending a final rule by NOAA Fisheries.

This potential action originated as a request of the interstate management board of the Atlantic States Marine Fisheries Commission (ASMFC). While the New England and Mid-Atlantic Fishery Management Councils (NEFMC and MAFMC, respectively) had recommended NOAA Fisheries retain the status quo trip limit in federal waters for FY2016 back in December 2015, the ASMFC asked NOAA Fisheries in February to consider a 6,000-pound limit for federal waters, which it would match in state waters (Maine–Connecticut). In the interim, the state waters trip limit remains at 5,000 pounds.

The ASMFC based its request on a number of factors, including: stock biomass being at 106% of its target; recent and projected underutilization of the fishery's quota by a substantial amount; an expected reduction in regulatory discards; desire to promote economies of scale in the fishery; a means to encourage more participation in the fishery with low risk of an early quota closure (despite a 20% reduction); and industry requests to slowly and methodically phase in any regulatory changes in order to promote full market potential and avoid market disruptions. The NEFMC and MAFMC supported this rationale and in April both revised their recommendations to NOAA Fisheries for a 6,000-pound trip limit in federal waters.

The 6,000-pound trip limit continues a gradual increase that has been allowed through the resource's rebuilding period (2000–2007) and thereafter (2008–present). Spiny dogfish were declared over-exploited in 1998, leading to federal and interstate fishery management plans being implemented in 2000 and 2003, respectively. The stock decline resulted from a surge in large scale, directed fishing effort in federal waters beginning in the late 1980s, in part at the encouragement of federal fishery managers amidst reductions in more traditional groundfish resources but without any regulations, along with the development of export markets. These markets preferred larger fish, resulting in reproductive females comprising most of the harvest.

During the fishery's growth years, Massachusetts had become a major player; between 1988 and 1997, an average of 55% of the annual coastwide commercial harvest was landed here, primarily in the ports of Chatham, Plymouth, and Gloucester. This meant our state arguably had the most to lose under the federal rebuilding plan, which called for the closure of the directed fishery in federal waters, with just a small bycatch limit (300 and 600 pounds depending on the time of year), and the complementary interstate plan that followed.

The Division fought hard to maintain a small-scale directed fishery (e.g., 2,000-pound trip limit) in state waters, and nearly succeeded after completing a catch monitoring study that demonstrated discards of dogfish in the state waters directed fishery were much lower (as a percentage of the catch) than previously thought. However, it would not be until late 2006, after the completion of a stock assessment update showing the resource was no longer overfished and a modest quota increase would not cause overfishing, that Massachusetts was able to have a state waters trip limit of 2,000 pounds for at least part of the year.

After another stock assessment update in 2008, NOAA Fisheries declared the resource rebuilt. This was much sooner than the 15- to 20-year rebuilding period that some had projected—based on the slow growth and reproductive capabilities of spiny dogfish (e.g., females take at least eight years to reach sexual maturity and have a two-year gestation period for an average litter of six pups). The quotas would continue to increase incrementally through FY2015 (to 50 million pounds, up from 6 million pounds in FY2008), with the trip limits slowly following: 3,000 pounds for FY2008–2012; 4,000 pounds for FY2013–2014; and 5,000 pounds for FY2015. (Note that these trip limits have not applied to North Carolina since FY2008 and Connecticut–Virginia since FY2011, when these states were granted state-specific allocations of the coastwide quota, allowing them to specify any trip limit for their state waters. The Northern Region of Maine–Connecticut shares 58% of the coastwide quota, and is bound by the ASMFC-set trip limit for state waters.)

The ASMFC and Council's gradual approach to increasing the trip limit is largely reflective of industry input on the matter; specifically, the Massachusetts industry due to its dominance in the landings. The day-boat longline and gillnet fishermen responsible for the vast majority of dogfish landed here have advocated against large increases in the trip limit for fear of driving down the price paid per pound without a concurrent increase in market demand. Processors on Cape Cod have instituted no-buy days in some recent years to ward off market gluts and low pricing. Another industry concern was that large trips may result in a degradation of product quality, seen as critical for maintaining price and the existing market. However, other industry participants have argued that higher landings are needed to foster new markets and improve their bottom line.

What harvesters and dealers coastwide do agree on is a need to increase market demand for spiny dogfish. Underutilization of the spiny dogfish quota amidst another decline of more traditional fisheries (e.g., cod and certain flounders) has reinvigorated efforts among industry, managers, environmental groups, and other partners to grow the domestic market and broaden the export market beyond the typical European buyers. With the creation of the Massachusetts Seafood Marketing Program (see page 7 for related article), the Division will likely be more involved in bringing spiny dogfish to a plate near you soon.

By Nichola Meserve, Fishery Policy Analyst

Conservation Engineering Highlights

MarineFisheries' Conservation Engineering (CE) Project works alongside members of the commercial fishing industry and others to understand and improve the design and performance of fishing gear and fishing practices, and to reduce impacts of fishing gear on non-target species. Read below about a new study launched this year to quantify "ghost gear," and catch-up on other new research projects by the Conservation Engineering team.

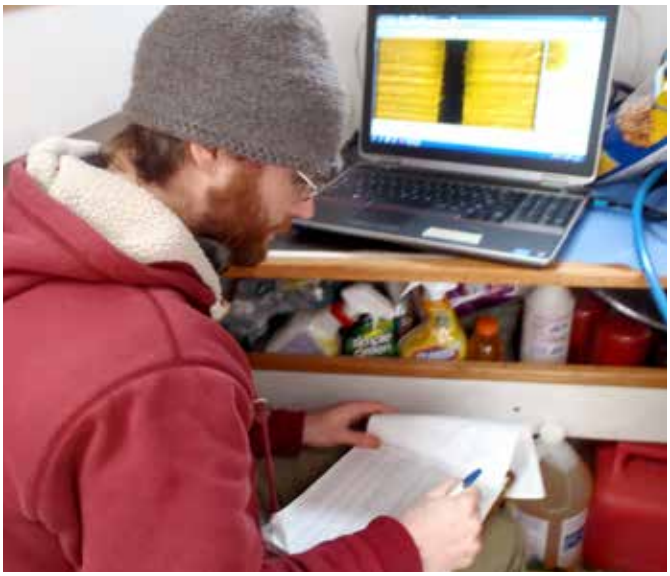
Using Side-Scan Sonar to Find Lobster Pots

Lost or abandoned fishing gear endures and accumulates. Whether from abandonment, deliberate discarding, loss from storms, or other reasons, derelict gear often continues to catch and kill fish, crabs and lobsters. This active derelict fishing gear is known as "ghost gear."

Lobster pots, a gear type often becoming derelict, are required to have a section that degrades over time, allowing species to escape so that the pot does not continue to "ghost fish." However, the life of the degradable section is often far longer than expected, due to encrusting organic growth on the degradable components, lack of air exposure to rust the components away, user interference, or illegal modifications.

Not only do lobstermen experience economic loss due to replacement costs of derelict gear itself, but also from the lobsters that ghost pots kill on the seafloor and which therefore cannot be landed. Surveys conducted from a recent project led by *MarineFisheries* estimated the replacement value for pots lost within Massachusetts waters to be between $676,000 and $1,587,000 annually. On top of that, we estimate that each derelict pot (that might continue to fish) kills 4.8 lobsters per year in Cape Cod Bay and 3.6 lobsters per year in Buzzards Bay, on average. Unfortunately, we do not know the number of derelict pots in the water and thus cannot estimate the total number of lobsters killed and the total value lost.

Attempts to determine the number of derelict pots using techniques such as SCUBA dive surveys or grappling off of vessels in areas notorious for lost gear have met with mixed results due to the time commitments, costs, and questionable effectiveness. Side-scan sonar, another technique, images the seafloor by echoing sound off objects (and the seafloor itself)



DMF Staff Photo

MarineFisheries ***biologist and sonar operator, Steve Voss, searching for lobster pots on board the F/V*** **Andrea C.**

DMF Staff Photo

The project team for the ultra-low-opening groundfish trawl at the flume tank in Newfoundland. From left: Mike Pol (*MarineFisheries*), Pingguo He (SMAST), Jon Knight (Superior Trawl), Captain Tom Testaverde, Steve Eayrs (GMRI), Chris Glass (UNH), Captain Jim Ford, and Captain Dan Murphy.

and has been used previously to identify derelict pots with some success over flat, featureless bottom—where a pot might stand out well. In structurally complex habitats, such as rocky areas, pot detection is more difficult, because pots and rocks might appear similar in the sonar imagery, and acoustic shadows from rocks, where sound can't reach, can hide pots. Although a clear need exists, no research to-date has provided a reliable way to quantify the accuracy of pot detection in sonar surveys over various bottom habitats, especially complex habitats. Once we know how accurate sonar is detecting pots, we can then determine the number of lost pots in an area and improve our estimates of the quantity of lobsters lost to ghost fishing.

In a coordinated effort, *MarineFisheries'* Fisheries Habitat, Invertebrate Fisheries, and Conservation Engineering staff began work on a project, which aims to determine the detection rate (accuracy) for side-scan sonar pot identification on featureless simple bottom and structurally complex bottom. We plan to apply this detection rate to a pilot survey in an area of Cape Cod Bay to estimate the amount of derelict pots within simple and complex bottoms. This research is funded through the National Fish and Wildlife Foundation – Fishing for Energy 2015 grant.

Field work began in March 2016 from the chartered lobster fishing vessel *Andrea C.* out of Fairhaven, owned and operated by Captain Aaron Cebula. *MarineFisheries* consulted with Captain Cebula and initially chose an area for a baseline survey in Buzzards Bay that provided a good mix of simple and complex bottom habitats. We deployed a Klein 3000, high-resolution, side-scan sonar unit (owned by MIT) off the stern of the lobster vessel. Captain Cebula steered over track lines so that the sonar signal would cover a broad swath and provide a complete seafloor image of the area. Our sonar operator would try to identify existing abandoned traps, both during vessel operations and post-process.

After the baseline day, six more days within the same area were dedicated towards pot detection rate trials. Each day (trial), we would set new lobster pots in planned simple and complex habitat locations (using a randomizing technique). Again, we deployed the side-scan sonar and conducted swaths of the area while the sonar operator would try to identify our placed lobster pots on each trial, as well as the existing baseline pots identified earlier. The six trials will allow us to determine our sonar operator's detection rate and error over each bottom type. This fieldwork has been completed and we are currently analyzing the data.

The pilot survey was completed in April 2016 in Cape Cod Bay using *MarineFisheries* research vessel, *Mya*. Much like in the Buzzards Bay baseline work, we selected an area with both simple and complex habitats and imaged the area fully. The sonar operator will again attempt to identify lobster pots on the bottom. We plan to use the pot detection rate, calculated from the prior trials, and apply it as a correction to the number of pots detected. Results are expected to be reported by September 2016. Information regarding the total impact of derelict gear and ghost fishing (and financial loss) might encourage fishermen to try to prevent or recover pot losses. An effective sonar method would also map lost gear and set the stage for removal efforts.

In Brief: Revision of Whiting Special Access Areas

Whiting (or silver hake) is typically targeted by Massachusetts trawl fishermen using 2.5 or 3.0-inch mesh codends, in limited areas and for limited times. As part of the third phase of groundfish disaster aid (see page 9), Conservation Engineering conducted a cooperative research to support an earlier opening of whiting small mesh areas in Ipswich Bay and west of Provincetown in Cape Cod Bay. Fish distributions are changing in response to warming seawater temperatures and other factors related to climate change. The main concern in an earlier opening of these areas is bycatch of cod and other groundfish with limited quotas. The EFP will allow a pool of fishermen to conduct test fishing in the areas with *MarineFisheries* biologists or contracted observers onboard. *MarineFisheries* will analyze and submit the results to NOAA Fisheries and the New England Fishery Management Council for consideration in adjusting the timing of the openings.

In Brief: Developing an Ultra-low-opening Groundfish Trawl to Avoid Cod

Conservation Engineering is part of an expert team compiled to develop and test a trawl with a very low headline height, with the idea of fishing under cod for flatfish. The team of researchers, commercial harvesters, and a gear maker reviewed current knowledge about cod and flatfish behavior in front of various types of trawl nets, including video clips previously collected by CE, to select candidate models for testing. Multiple possible designs were developed, considered, and then modeled by

computer and physically at Memorial University's flume tank in Newfoundland in February 2016. A design with a modeled opening of 2.5 ft., with a slight cutback in the headrope, was chosen by the team for 14 days of filming and comparative tows on a commercial vessel.

In Brief: Reducing Juvenile Haddock and Cod Catch in the Georges Bank Haddock Fishery

Juvenile haddock and cod filtered out of the codends of trawl nets may still be injured or killed, by squeezing through the 6 or 6.5-inch meshes, or because they don't escape the codend until the net begins being hauled to the surface, exposing the fish to more sources of harm including predation by midwater predators or birds at the surface. CE has partnered on a project to improve the survival of these small haddock and cod with a gear modification designed to encourage their escape while at the bottom. The "dual-grid system" consists of three hinged panels installed in front of the codend. The forward two panels are grids, one tilted forward and the second one flat, while the third panel adds stability but is covered to prevent fish swimming

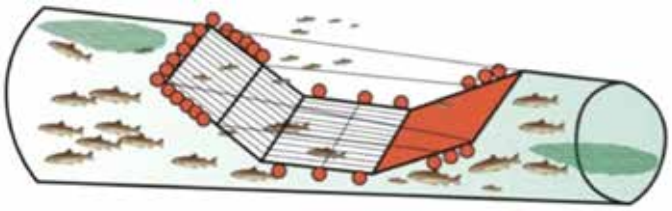


Image Courtesy Pingguo He, SMAST

A schematic of the dual grid system.

back in. A small fish should meet the first grid, swim through it and escape, while larger fish should pass under the dual grid system to the codend. A similar project using a dual grid system to release small redfish showed some success. Field testing may begin in the summer of 2016.

In Brief: Reducing Flatfish Bycatch in the Sea Scallop Fishery

Conservation Engineering is taking part in plans to test a simple modification to the New Bedford-style scallop dredge to reduce flatfish bycatch. By suspending drop chains from the bail, or leading part of the dredge, we hope to disturb flatfish that are on the bottom, causing them to swim up and away from the approaching cutting bar and avoiding capture in the dredge. We will be using an updated camera system and comparison tows to see if it works, beginning in July 2016.

By David Chosid, Conservation Engineering Biologist and Mike Pol, Conservation Engineering Project Leader

Photo Courtesy Center for Coastal Studies NOA Permit # 14603-1

Right whale mother-calf pair in Cape Cod Bay April 2016.

Highs and Lows for the 2016 Right Whale Season

Another right whale season has come to a close in Massachusetts. *MarineFisheries* collaborates with the Provincetown-based Center for Coastal Studies (CCS) and NOAA Fisheries to collect information on the demographics, distribution, and abundance of the right whales that visit our waters. The 2016 season saw exceptional numbers of right whales return to Cape Cod Bay with a peak in sightings earlier than usual. A single-day season-high of 85 individuals was documented by aerial survey at the end of March, approximately one month earlier than the typical peak in sightings. Right whales again utilized the waters of western Cape Cod Bay, similar to 2013 and 2015—a recent pattern shift which contrasts with the distribution observed during most of the 18 year study. Overall, approximately 30% of the known right whale population, currently estimated at 500 individuals, was observed in Cape Cod Bay and adjacent waters in 2016, though that number may rise as photo analysis of the season continues.

Among the right whale visitors to Cape Cod Bay this season were six mother-calf pairs. This important segment of the population stayed later than the rest of the right whales this season, feeding near the Plymouth shoreline through late April. *MarineFisheries* and CCS were closely monitoring these mother-calf pairs as the May 1 opening of the fixed gear closure approached. However, it appeared the nursing mothers soon depleted the zooplankton food supply in the Bay and moved on to other habitats outside Massachusetts. Unfortunately one of the calves was found dead east of Cape Cod only six days later. Large propeller wounds on the animal suggest it died from vessel collision, which is supported by the preliminary necropsy results that also found evidence of blunt force trauma. These injuries all occurred pre-mortem.

The continued high abundance of right whales in Cape Cod Bay and the tragic loss of the calf illustrate how important this habitat is to the species and how crucial it is to remain vigilant in safe-guarding them from harmful impacts such as vessel collision and entanglement.

Our sincere appreciation goes out to the staff of the Center for Coastal Studies who completed their 20th consecutive year of right whale surveys for the Commonwealth.

By Erin Burke, Protected Species Specialist

Funding Provided for Research on Modified Ropes to Reduce Whale Entanglement

On June 16, 2016, EEA Secretary Matthew Beaton announced two initiatives to fund research to reduce whale entanglement. The first will provide the New England Aquarium's Anderson Cabot Center for Ocean Life with $180,000 to develop modified fishing rope to reduce the entanglement of endangered whales and other marine species. The second will provide a $19,000-grant from the Massachusetts Environmental Trust (MET) for the South Shore Lobster Fishermen's Association to assist the Aquarium with field testing of the developed rope prototypes. Stay tuned for updates on these initiatives in future issues of *DMF News*.

Humpbacks Whales May Soon Be Removed from the Endangered Species List

In April 2015, NOAA Fisheries announced a proposed rule to revise the listing status of the humpback whale by dividing the globally-listed species into 14 distinct population segments (DPS). Of those 14 population segments, 10 would subsequently *not* be awarded listing under the Endangered Species Act, including humpback whales in northeast US waters, which are part of the West Indies DPS. Under this proposal, humpback whales that are seasonal residents off the coast of Massachusetts would no longer be listed as an endangered species, though they would still be protected under the Marine Mammal Protection Act.

The outcome of this proposed change would be subtle because it will affect the Potential Biological Removal (PBR) level for humpbacks. Under the Marine Mammal Protection Act, NOAA Fisheries is required to calculate PBR for each species, which represents the amount of human-induced mortality (i.e., takes*) the species can sustain without causing a decline. The annual number of human-induced serious injuries or mortalities for humpback whales has been above PBR for a number of years.

A change in listing status for humpback whales will affect the current relationship between takes and PBR by altering the "recovery factor" component of the PBR equation. This value, between 0.1 and 1.0, represents the level of risk posed to the species' survival. For example, an endangered species with low population levels like the North Atlantic right whale is given a recovery factor of 0.1. If the proposed listing change for humpback whales is approved, their recovery factor would increase, likely to 1.0, which would greatly increase PBR for the species and put takes within acceptable levels. However, even with a change in listing status, the humpback whale would not be removed from the whale species covered by the Atlantic Large Whale Take Reduction Plan. The protections from entanglement that are provided by the plan would still apply.

NOAA Fisheries anticipates the announcement of a decision on the proposed rule this summer.

By Erin Burke, Protected Species Specialist

*Take, as defined under the Marine Mammal Protection Act (MMPA), is "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1362).

What is a Distinct Population Segment?

Humpback whales are well-known seasonal visitors to Massachusetts. Our cold, productive waters are one of the top whale-watching spots in the world, mainly due to the gregarious humpback whale who feed on small schooling fish in the Gulf of Maine from spring through fall. However, humpback whales that frequent Stellwagen Bank are a small portion of the larger population called the West Indies Distinct Population Segment (DPS). Animals in a DPS are separated from the rest of the species by interbreeding. So while humpbacks in the West Indies DPS feed across different habitats including the Gulf of Maine, eastern Canada, and Greenland, they intermingle each winter in the Caribbean to breed and give birth. The primary breeding and calving area is on Silver Bank, off the coast of the Dominican Republic. Humpback whales that feed in the Gulf of Maine are part of this melting pot.

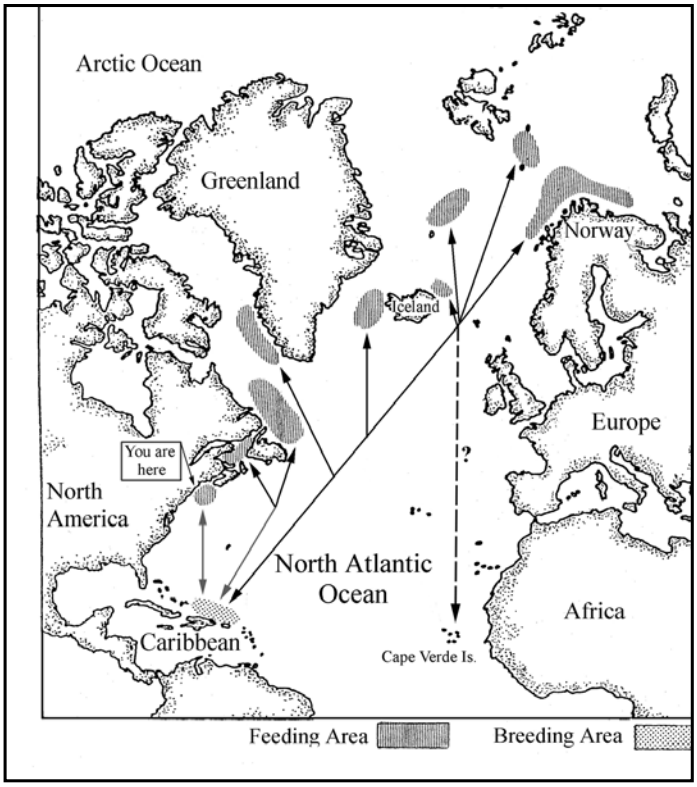


Image Courtesy Center for Coastal Studies

Approximate locations of breeding and feeding areas for the humpback whale West Indies DPS.

Creature Feature: Sand Tiger Shark

It has small eyes and a gaping mouth full of sharp, pointy teeth. The back rises up, making it look even more intimidating, as if the 10-foot length wasn't impressive enough. Despite its appearance, the sand tiger shark (*Carcharias taurus*) is a docile animal. This steady swimmer usually cruises slowly and isn't known to be as curious as its more active cousin, the white shark.

Sand tiger sharks—also sometimes known as grey nurse sharks—live in subtropical and temperate waters. These sharks like to stay near the coast, never leaving the continental shelf. Worldwide, they live off the coasts of North and South America, Japan, Australia, South Africa, and in the Mediterranean Sea. Off the east coast of the United States, young sand tiger sharks tend to live in warmer waters from North Carolina to Florida during the cold winter months. In the spring, they migrate northward to spend the warmer months in waters off New England and Long Island. In recent years, summer nursery grounds for these young sharks have been found in the Gulf of Maine, specifically off Plymouth, Kingston, and in Duxbury Bay. Each time these young animals migrate, they travel over 1,500 miles!

Groups—or shivers—of sand tiger sharks have been seen hunting schools of bony fish like menhaden, herring, and bluefish. They also eat other small bony fish, squid, crabs, skates, and even smaller sharks. While these sharks tend to spend most of their time on the sea floor (no deeper than roughly 630 feet), they sometimes can be seen hovering in the water column, something most sharks can't do since they do not have an air bladder like bony fish. To hover, these sharks swim up to the surface, take a gulp of air, and hold it in their stomach to stay neutrally buoyant in the water column.

While sand tiger sharks are floating in the water column, they change their breathing technique. Most sharks are ram ventilators—they have to keep moving to push water over their gills for breathing—others can stay still on the ocean floor and

DMF Staff Photo

The Division's John Chisolm displaying the shark's teeth. Although intimidating, the sand tiger shark is more docile than some of its relatives.

pump water over their gills with something called a buccal pump. Sand tiger sharks can do both! Sand tiger sharks can ram ventilate then switch to buccal pumping.

Sand tiger sharks are popular to see in zoos and aquariums because of their aggressive appearance and the fact that they are easier to take care of than most other sharks. It is only in these kinds of facilities that most people will see sand tiger sharks. The species saw a huge decline (80–90%) in the 1970s and currently remains listed as Vulnerable (IUCN). Because of this listing and current state and federal regulations, if an angler catches a sand tiger shark, it must be released back into the water immediately.

By Elaine Brewer, Information and Education Coordinator

Recent Publications

Fish don't often stay in one place, and for that matter, neither do fishermen. Many fish species undergo seasonal migrations between breeding grounds and feeding areas (e.g., striped bass, bluefin tuna, and Atlantic menhaden). Often, not all members of the population participate in these migratory loops: juveniles may occupy "nursery" habitat prior to joining the adult migrations; younger adults may not migrate as far or at the same time as older adults. When fishing occurs more intensively over a portion of this migratory range, the size selectivity of the fishery can differ dramatically from what is typically associated with the fishing gear. The Division's **Micah Dean**, on a team with researchers from Beta Scientific Consulting Inc. and NOAA Fisheries, created a simulation model to explore how the shape of the selectivity curve can be influenced by a suite of fishery (gear, season, area) and biological (age, season, area of migration) processes. Using Atlantic menhaden as a case study, they demonstrate that despite a "flat-topped" selectivity curve associated with purse seine fishing gear, the selectivity of the fishery is actually "dome-shaped" due to the spatial and seasonal patterns of the population and the fishery. Building simulations that reflect the life history of a population can help guide assessment efforts and produce reasonable management advice. To read this paper in its entirety, find it on our Publications webpage as Contribution 62. The citation is: O'Boyle, M. Dean, and C. M. Legault. 2016. **The influence of seasonal migration on fishery selectivity**. *ICES Journal of Marine Science* DOI: 10.1093/icesjms/fsw048.

Building on an earlier paper, **Mike Pol**, with colleagues from the Institute of Marine Research (Norway), the Irish Institute for Marine Research, University of Dartmouth (SMAST), and the UN Food and Agricultural Organization (Rome) published a paper on how our understanding of fishing gear selectivity impacts the potential implementation of a balanced harvest approach. "Balanced harvest" aims to apply a moderate level of fishing mortality across the widest possible range of species, stocks, and sizes in an ecosystem. Under current management, usually the largest, most valuable fish are targeted and caught, and this selection causes changes within an ecosystem. In theory, balanced harvest helps maintain ecosystem health through maintenance of biodiversity and potentially improves yield. Supporters argue that size and species selective fishing, which has been the norm for decades, should be reconsidered. In their paper, Pol and his co-authors introduce the unrecognized complexity of multiple levels of selectivity (individual fish, individual nets, fishermen and vessels, and fleets) and examine the feasibility of actually implementing balanced harvest. They concluded that, surprisingly, balancing the harvest would require more detailed monitoring of ecosystems and of fishing, and would likely also require development and use of even more selective fishing gears and practices. The citation for this paper is: Breen, M., Graham, N., Pol, M. V., He, P., Reid, D., Suuronen, P., 2016. **Selective fishing and balanced harvesting.** *Fisheries Research* DOI:10.1016/j.fishres.2016.03.014.

Mike Pol was on a team, led by Shannon Bayse of the School for Marine Science and Technology at UMass-Dartmouth (SMAST), testing a squid trawl configured with drop-chain ground gear to reduce bycatch of finfish in the Nantucket Sound squid fishery using underwater video recordings. Video cameras were placed on the net with the lens pointing towards the mouth of the trawl. Afterwards, video was analyzed to count how many squid, summer flounder, and skate entered the trawl mouth or escaped underneath the fishing line. Results from the video analysis showed that the drop-chain trawl configuration retains all squid while allowing skates to escape. However, it is ineffective at avoiding the bycatch of summer flounder. The entire study can be found on our Publications webpage as Contribution 61. The citation is: Bayse, S. M., M. V. Pol, and P. He. 2016. **Fish and squid behavior at the mouth of a drop-chain trawl: factors contributing to capture or escape.** *ICES Journal of Marine Science* DOI: 10.1093/icesjms/fsw007.

Dr. Greg Skomal, with researchers from Pelagios Kakunjá (Mexico) and the Oceanographic Systems Laboratory of Woods Hole Oceanographic Institution, published a study in the *Journal of Fish Biology* on the use of an autonomous underwater vehicle (AUV) to directly observe the behavior of marine animals. More specifically, this study looked at the behavior, habitat use and feeding ecology of white sharks *Carcharodon carcharias* near Guadalupe Island, Mexico. The AUV was deployed on six missions, tracking four tagged white sharks through broad depths and temperature ranges. Results of this study not only demonstrated that an AUV is a viable tool for tracking and videotaping the fine-scale behavior of a large pelagic animal, they also documented the first observations of subsurface predatory behavior for *C. carcharias*. To read this paper in its entirety, find it on our Publications webpage as Contribution 60. The citation is: Skomal, G. B., E. M. Hoyos-Padilla, A. Kukulya, and R. Stockey. 2015. **Subsurface observations of white shark *Carcharodon carcharias* predatory behavior**

using an autonomous underwater vehicle. *Journal of Fish Biology* 87, 1293-1312. DOI: 10.1111/jfb.12828.

Mike Pol, with researchers from SMAST, SINTEF Fisheries and Aquaculture (Norway), and the University of Tromsø (Norway), determined the selectivity and retention of pollock in a Gulf of Maine trawl fishery. Size selectivity is controlled by the mesh size of the codend, the part of the trawl where fish are retained. Three sizes of diamond-shaped mesh opening (4.5, 5.5, and 6.5) were tested using a commercial fishing vessel conducting tows off Provincetown, Massachusetts. Using data from the tows, models for the mean selection length and selection ranges were developed for all three tested mesh sizes. Results from this study can be used to guide fishery managers, stock assessment scientists, and fishermen on size-dependent retention of pollock by codend mesh size. The entire study can be found on our Publications webpage as Contribution 58. The citation for this paper is: Pol, M. V., B. Herrmann, C. Rillahan, and P. He. 2015. **Selectivity and retention of pollock Pollachius virens in a Gulf of Maine trawl Fishery**. *Fisheries Research* DOI: 10.1016/j.fishres.2015.07.029.

John Sheppard and **Dr. Mike Bednarski** published research on the accuracy of electronic counting systems in estimating river herring populations in the *North American Journal of Fisheries Management*. This study compared direct visual and electronic passage data collected over a 13-year period to evaluate the accuracy and biases of single-channel electronic counters. Results showed a consistent underestimation of passage via single-channel electronic resistivity counting systems as compared to direct visual observations, primarily due to multiple fish passing through the counter at the same time. Sheppard and Bednarski explored two techniques to account for the observed bias in the estimates of run size that can be used to infer population trends. Future research should explore alternative technology that provides greater accuracy. The full paper can be found on our Publications webpage as Contribution 57. The citation is: Sheppard, J. J. and M. S. Bednarski. 2015. **Utility of single-channel electronic resistivity counters for monitoring river herring populations**. *North American Journal of Fisheries Management* 35 (6), 1144-1151. DOI: 10.1080/02755947.2015.1084407.

Accolades

Former *MarineFisheries* Senior Biologist and Assessment and Survey Program Manager, **Steve Correia**, received the New England Fishery Management Council's (NEFMC) *Janice Plante Award of Excellence* for 2016. This award was established in 2015 to pay special tribute to those who have displayed outstanding commitment and contributions of time and energy in service to the Council fishery management system. For the past 26 years, Steve participated on numerous technical and management committees including the NEFMC Groundfish, Monkfish, and Atlantic Herring Plan Development Teams, and the NEFMC Scientific and Statistical Committee. Throughout his many years of service, Steve was an invaluable asset to both the Division and the Council. He retired in 2015. Congratulations to Steve for being presented this prestigious award!

This past May, the Atlantic States Marine Fisheries Commission presented its Annual Awards of Excellence for outstanding contributions to fisheries management, science, and law enforcement along the Atlantic coast. Among the recipients were members of the Division's Permitting staff, **Story Reed** and **Kerry Allard** and former *MarineFisheries* MIS & Fisheries Statistics Program Manager **Tom Hoopes**, whose award was in the category of management and policy contributions. Reed, Allard, and Hoopes participated on the American Lobster Trap Tag Team, which is a group of 19 state and federal fishery and data managers and ACCSP staff responsible for the creation of the first of its kind cooperative permitting and trap allocation tracking database for American lobster. This database, which became fully operational in late 2015, provides the Commission, Atlantic Coastal Cooperative Statistics Program, and associated partners a central database to manage and track trap tag transfers and allocations between commercial lobstermen across jurisdictions, while improving effort data essential for making informed management decisions.

Comings and Goings

Paul Thistlewood resigned in February to become the full-time Newbury Shellfish Constable after sixteen years at the Shellfish Purification Plant. As a life-long clammer, former Essex Shellfish Constable, and recent Newbury Shellfish Commissioner, Paul brought a unique skill set to the job. For the Town of Newbury, he will now oversee the contaminated softshell clam fishery in the Merrimack River, as well as the approved fishery in Plum Island Sound. We look forward to continuing a close working relationship and wish him success in his new job.

Ralph Stevens Jr. retired in July after 35 years at the Division's Shellfish Purification Plant in Newburyport. Following four years in the Coast Guard, Ralph joined the Division in 1981. Over the years he held several positions working his way up from Conservation Helper, to Skilled Laborer, quickly rising to Plant Maintenance Working Foreman, and finally Depuration Program Coordinator in 2008. His hard work and dedication helped him lead the Shellfish Plant labor workforce for over 25 years, maintaining compliance with all state and federal regulations. In those positions he interacted daily with shellfish fishermen, wholesale dealers, and the visiting public, becoming the face of the Shellfish Purification Plant. We wish him all the best in retirement!

Samantha Andrews has worked for the Division as a contract employee administering the Groundfish Disaster Economic Assistance Program since 2014. Recently, Sam was hired as a Program Coordinator in the Boston office. In addition to her duties as an administrator of the Groundfish Disaster Aid grant, she now also provides assistance administering the Commercial Fisheries Revolving Loan Fund; maintaining records on federal programs including grants, contracts, and federal assistance programs; and is co-editor of the *DMF News*. Samantha received her undergraduate degree in Marine Science from Boston University in 2013. In her free time, Sam can be found training for the Falmouth Road Race and cheering on the New England Patriots.

Cate O'Keefe joined *MarineFisheries* in the spring as a Marine Science and Policy Analyst. She works with the team of policy analysts from the Boston office on federal fisheries management, focusing on sea scallops and sea herring. Cate comes to the agency from the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), where she spent 10 years working collaboratively with members of the fishing industry to address issues of bycatch, resource assessment, and application of fishery-dependent data. She received her undergraduate degree from Hampshire College, Master's degree from Boston University, and completed her PhD at UMass Dartmouth focusing on bycatch in the sea scallop fishery. Cate lives on the south coast and enjoys gardening and cooking.

Greg DeCelles was recently hired as a Stock Assessment Specialist based in the New Bedford office. Greg is responsible for serving on the New England Fishery Management Council's Groundfish and Monkfish Plan Development Teams and will also work as an assistant chief scientist on the Division's trawl survey. He received a Bachelor's degree in Marine and Freshwater Biology from the University of New Hampshire in 2004, and then worked for a year as a fisheries observer throughout New England. He left observing for graduate school at the University of Massachusetts Dartmouth School for Marine Science and Technology (SMAST), where he earned a PhD in Marine Resource Science and Management. While at SMAST, Greg also worked for over five years as a Research Technician and Post-Doctoral Research Associate with a focus on cooperative research with the fishing industry. Greg enjoys hiking throughout the south coast with his two dogs and playing golf.

Kristina Dubuque joined *MarineFisheries* this Spring, as the new administrative assistant to Director David Pierce. Kristina previously worked as an administrative assistant at the Suffolk County Sherriff's Department, assisting the public with the civil service process. A native of Somerville, Kristina recently became a certified paralegal through studies at Boston University and will be attending Miami Dade College in the Fall. We wish her all the best in Miami!

Calling All Anglers!

Opportunity to Help Improve Stock Assessment Quality

As part of the Atlantic coastwide effort to manage striped bass, *MarineFisheries* has provided the Atlantic States Marine Fisheries Commission (ASMFC) with annual size, age, and catch data for decades. In 2002, to increase the information provided to ASMFC, *MarineFisheries* initiated the Sportfish Angler Data Collection Team (SADCT) program, in which anglers collect biological samples from striped bass. Due to the program's success, the program was expanded in 2013 to include black sea bass, summer flounder (fluke), and scup.

Anglers who join SADCT are asked to follow simple sampling protocols to collect biological data. Participants record length measurements, date of catch, and general location of catch, and collect scale samples. *MarineFisheries* requests that participants obtain random samples from the targeted species on both kept and released fish of all sizes throughout the sampling season (May–October).

Scale collection is very important, because much like trees, scales lay down rings (annuli) that can be used in age determination. Age determination along with length data collected by SADCT anglers is used in stock assessment models. Information from these models can help determine which age classes are experiencing the highest fishing mortality, track growth of the overall stock, and facilitate proper management of that species in the state of Massachusetts. To date, over 25,000 samples have been collected thanks to the efforts of the dedicated SADCT volunteers.

The Sportfish Angler Data Collection Team provides a means for interested and dedicated anglers to help study the resource they enjoy. All participating anglers receive a hat after their first year of sampling along with an individual report summarizing what they caught, and a chance to win a raffle among all participants.

Anglers who are interested in the preservation and management of recreationally important finfish species can join SADCT by contacting *MarineFisheries* biologist Kimberly Trull at (978) 282-0308 x130 or *kimberly.trull@state.ma.us*.

By Kimberly Trull, SADCT Coordinator

DMF Staff Photo

Scale samples being taken from a striped bass.

DMF *Rules UPDATE*

Public Hearings • Regulations • Legislation

During the period of January 1, 2016 through June 30, 2016, the following regulatory changes were enacted by MarineFisheries after public hearings and Marine Fishery Advisory Commission approval.

Harwich Recreational Fishing Reef Restrictions

During the winter of 2016, *MarineFisheries* built a recreational fishing reef in Nantucket Sound off Harwich, Massachusetts. To maximize the benefits provided by this reef to recreational fishermen and to minimize gear and user group conflicts, the Division established certain restrictions within a 40-acre site surrounding the reef. These restrictions include prohibiting commercial fishing and the setting of fixed gear and/or vertical lines by all fishermen, including recreational fishermen.

Recreational Black Sea Bass Limits

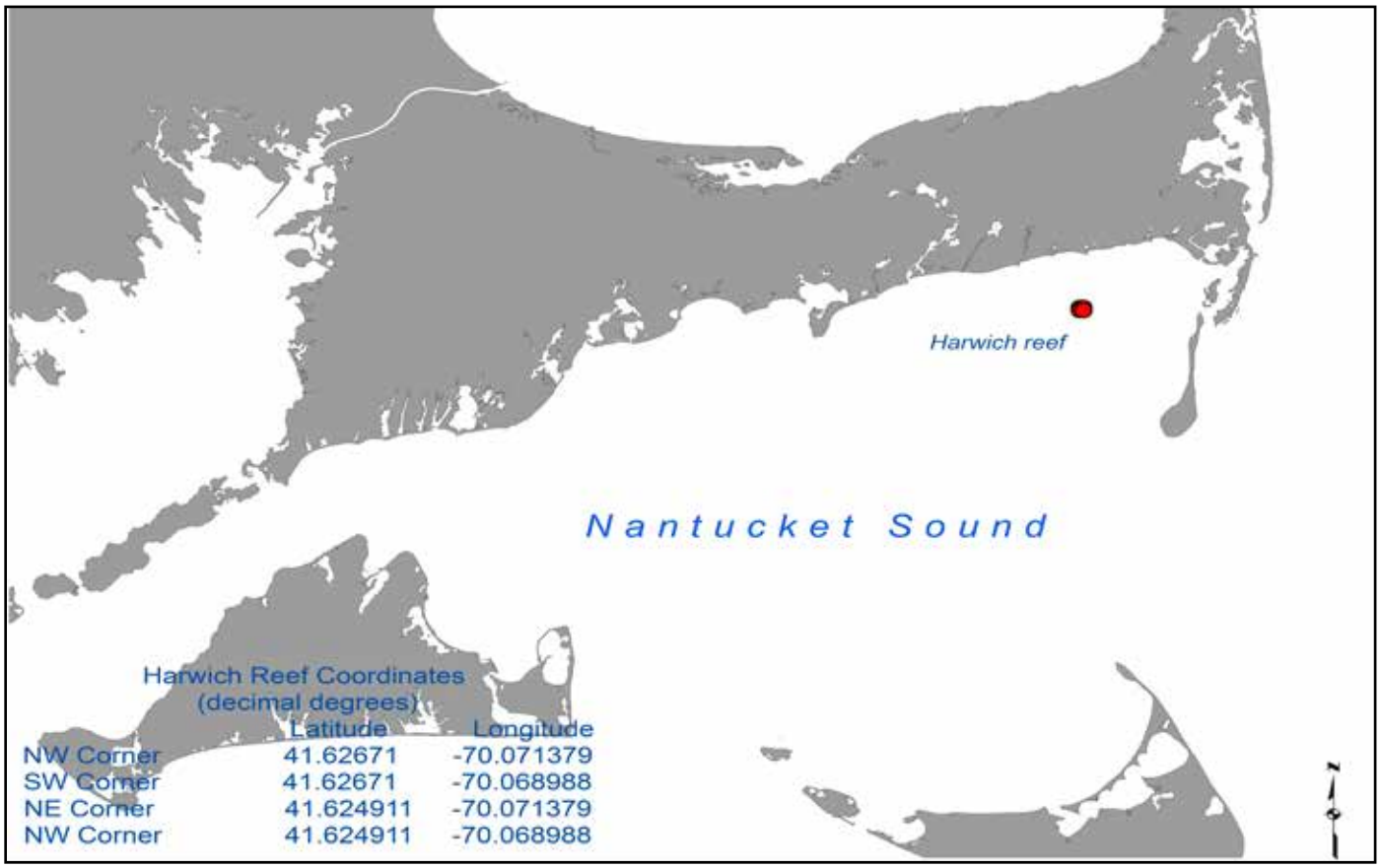
For 2016, *MarineFisheries* adopted an open season of May 21–August 31 with a 5-fish bag limit and 15-inch minimum size for black sea bass. All states in the Northern Region of Massachusetts through New Jersey were required to adopt recreational fishing limits for 2016 that would achieve a 23% reduction in harvest compared to 2015. In Massachusetts, this was accomplished by increasing the minimum size by one inch and decreasing the bag limit by three fish, while also lengthening the open season by six days (two additional days in May and four additional days in August).

Recreational Gulf of Maine Cod

MarineFisheries maintained its existing Gulf of Maine cod limits for private anglers fishing exclusively in state waters: one fish per angler per day at a 19-inch minimum size, year round. These limits differ from the state-waters for-hire limits and the federal limits (for both private and for-hire fishermen). For the for-hire fleet, *MarineFisheries* amended its limits to match federal rules; anglers aboard for-hire vessels may now retain one cod per angler per day that measures at least 24 inches during the open period of August 1–September 1.

Recreational Gulf of Maine Haddock

MarineFisheries liberalized its recreational Gulf of Maine haddock limits for the period of May 1, 2016–April 30, 2017, in response to increased recreational limits in federal waters. Private anglers are now allowed to retain 15 haddock per day, year round, at a minimum size of 17 inches. For-hire limits match the federal limits, and anglers on these vessels are allowed to retain 15 haddock per day. The haddock fishery is closed March 1–April 14, 2017.



DMF Staff Image

Location of the Harwich artificial reef site.

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INSIDE...

This Newsletter & Other Information is available on our Web Site!
http://www.mass.gov/marinefisheries

DMF NEWS

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MarineFisheries receives state and federal funds to conduct research, management and development of the Commonwealth's marine fishery resources. Information in this publication is available in alternative formats.

Charles D. Baker, Governor
Matthew A. Beaton, Secretary, EEA
George N. Peterson, Jr., Commissioner, DFG
David E. Pierce, **Ph.D.**, Director, *Marine-Fisheries*

Comments and suggestions for the newsletter are welcome. Please contact the Editors at (617) 626-1520, or write to:
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