# 2015 Summer Science Meeting

# Southern New England Chapter

# American Fisheries Society

June 25, 2015

University of Massachusetts
Dartmouth, MA

# Program

## AGENDA FOR THE SNEC AFS 2015 SUMMER SCIENCE MEETING
## THURSDAY, JUNE 25, 2015

8:20 – 8:45 ***Registration and Coffee***

8:45 – 9:00 **Opening comments** Heidi Fitzpatrick, SNEC President

9:00 – 9:20 *__Developing an optical survey for Georges Bank Yellowtail Flounder.__ Lowery, Travis, Greg DeCelles, and Kevin Stokesbury, *Department of* Fisheries *Oceanography, University of Massachusetts, School for Marine Sciences and Technology, 200 Mill Road, Suite 325, Fairhaven, MA 02719*

9:20 – 9:40 *__Delineation of Brook Trout landscape-level genetic structure among headwater stream networks: isolates or metapopulations?__ Nathan, Lucas R.[1], Jason C. Vokoun[1], and Amy B. Welsh[2]. [1]*Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT 06269.* [2]*Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506*

9:40 – 10:00 *__Age validation of Monkfish (*Lophius americanus*).__ Bank, Crista[1], Kenneth Oliveira[1], Steven X. Cadrin[1], Graham D. Sherwood[2], Jonathan H. Grabowski[4], R. Anne Richards[3], Larry A. Alade[3], and Sandra J. Sutherland[3], [1]*School for Marine Science and Technology, New Bedford, MA 02744,* [2]*Gulf of Maine Research Institute, Portland, ME 04101,* [3]*Northeast Fisheries Science Center, Woods Hole, MA 02543,* *[4]Northeastern University, Marine Science Center, Nahant, MA 01908*

10:00 – 10:20 **Environmental monitors on lobster traps.** Manning, James, *NOAA's Northeast Fisheries Science Center, 166 Water St, Woods Hole, MA 02543*

10:20 – 10:40 ***Break***

10:40 – 11:00 **Trends and potential drivers of distribution overlap among migratory, pelagic marine fishes.** Turner, Sara M.[1], Jonathan A. Hare[1], David E. Richardson[1], and John P. Manderson[2], [1]NOAA NEFSC, Narragansett, RI 02882, [2]NOAA NEFSC, Highlands, NJ 07732

11:00 – 11:20 **Citizen science on the move: detailing the spawning migration patterns of Alewife and Blueback Herring in a coastal Massachusetts watershed.** Jones, Andrew. W.[1], Linda A. Deegan[2, 3], Charles B. Cooper[2], Louis C. Turner[2], Peter J. Hargraves[2], Michael D. Scherer[2], R. Charles Martinsen[4], Derrick J. Alcott[5], and Christopher Neill[3]. *[1]Woods Hole Oceanographic Institution, Woods Hole, MA 02543, [2]Coonamessett River Trust, Falmouth, MA 02540, [3]Marine Biological Laboratory, Woods Hole, MA 02543, [4]Falmouth Department of Natural Resources, Falmouth, MA 02540, [5]Univeristy of Massachusetts, Amherst, MA 01003*

11:20 – 11:40 **Winter Flounder larval timing in Narragansett Bay.** Klein-MacPhee, Grace[1] and Richard J. Bell[2,3], *[1]Graduate School of Oceanography, University of Rhode Island, Rhode Island, Department of Environmental Management, [2]National Research Council Postdoctoral Fellow, [3]Northeast Fisheries Science Center, National Marine Fisheries Service, Narragansett, RI 02882*

11:40 – 12:20 ***Annual business meeting and awards***

12:20 – 1:20 ***Lunch***

1:20 – 2:20 **Keynote – Marine Ecosystem Production: Meeting the Food Security Challenges of the 21st Century**. Fogarty, Michael J., *National Marine Fisheries Service, Woods Hole, MA 02543*

2:20 – 2:40 ***Untangling drivers, mechanisms and scales of environmental effects on squid availability to a seasonal inshore fishery.** Nichols, Owen C.[1], Jeremy R. King[2], Jonathan A. Hare[3], and Steven X. Cadrin[1], *[1]School for Marine Science and Technology, University of Massachusetts – Dartmouth, Fairhaven, MA 02719, [2]Massachusetts Division of Marine Fisheries, New Bedford, MA 02740, [3]Northeast Fisheries Science Center, Narragansett, RI 02882*

2:40 – 3:00 **Changing trophic structure and energy dynamics in the Northwest Atlantic influences Atlantic Salmon abundance.** Renkawitz, Mark D.[1], Sheehan, Timothy F.[1], Dixon, Heather J.[2], and Nygaard, Rasmus[3], *[1]Northeast Fisheries Science Center, Woods Hole, Massachusetts 02543 USA, [2]University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada, [3]Greenland Institute of Natural Resources, Nuuk, Greenland*

3:00 – 3:20 ***Break***

3:20 – 3:40 ***Modeling Yellowtail Flounder** b**ycatch in the Georges Bank** s**ea scallop fishery.** Wright, Brooke L., Catherine E. O'Keefe, Gregory R. DeCelles, and Steve X. Cadrin, *School for Marine Science and Technology, University of Massachusetts - Dartmouth, Fairhaven, MA 02719*

3:40 – 4:00 ***Effects of zebra mussel (*Dreissena polymorpha*) on the feeding ecology of early-stage Striped Bass (*Morone saxatilis*)**

**in the Hudson River Estuary.** Smircich, Michael G. and Eric T. Schultz, *Department of Ecology & Evolutionary Biology, University of Connecticut, 75 North Eagleville Road, U-3043, Storrs, CT 06269*

4:00 – 4:20 ***Mapping the distribution of Atlantic Cod spawning during the winter in Massachusetts Bay using multiple acoustic technologies**. Zemeckis, Douglas R.[1], Micah J. Dean[2], William S. Hoffman[2], Sofie Van Parijs[3], Leila Hatch[4], Christopher H. McGuire[5], and Steven X. Cadrin[1]. [1]*School for Marine Science and Technology, University of Massachusetts - Dartmouth, Fairhaven, MA 02719,* [2]*Massachusetts Division of Marine Fisheries, Annisquam River Marine Fisheries Field Station, Gloucester, MA 01930,* [3]*NOAA Northeast Fisheries Science Center, Passive Acoustics Group, Woods Hole, MA 02543,* [4]*NOAA National Ocean Service, Stellwagen Bank National Marine Sanctuary, Scituate, MA 02066,* [5]*The Nature Conservancy, Boston, MA 02111*

*Denotes student paper

# Abstracts:

**Age validation of Monkfish (*Lophius americanus*).** Bank, Crista[1], Kenneth Oliveira[1], Steven X. Cadrin[1], Graham D. Sherwood[2], Jonathan H. Grabowski[4], R. Anne Richards[3], Larry A. Alade[3], and Sandra J. Sutherland[3], [1]*School for Marine Science and Technology, New Bedford, MA 02744,* [2]*Gulf of Maine Research Institute, Portland, ME 04101,* [3]*Northeast Fisheries Science Center, Woods Hole, MA 02543,* [4]*Northeastern University, Marine Science Center, Nahant, MA 01908; cbank@umassd.edu*

Monkfish, *Lophius americanus,* are an important component of commercial fisheries in the Northeastern United States, but assessment of this species is less reliable due to uncertainties with age determination. Vertebral growth rings are presumed to follow an annual pattern and are counted to estimate age. However different calcified structures, illicia and otoliths, have been used to age other *Lophius* species. To validate the vertebral ageing method, monkfish were injected with a chemical marker, oxytetracycline or fluorexon, and reared for a year in the laboratory while being subject to seasonal cycles of temperature and light. Wild-caught monkfish were also injected and released as part of a data-storage tagging study. The injected chemical marks the growth ring that is forming at the time of injection and is visible under ultraviolet light. Vertebrae, illicia, and otoliths were sampled from fish that lived six months or more after injection, (both laboratory and field), and digital images of these structures were captured under ultraviolet light. Annuli were counted in reflected light and compared with the marked image. Results did not validate the vertebral ageing method, nor were annual rings consistently identifiable on otoliths. Therefore, the illicia ageing method should be explored further for this species.

**Winter Flounder larval timing in Narragansett Bay.** Klein-MacPhee, Grace[1] and Richard J. Bell[2,3], [1]*Graduate School of Oceanography, University of Rhode Island, Rhode Island, Department of Environmental Management,* [2]*National Research Council Postdoctoral Fellow,* [3]*Northeast Fisheries Science Center, National Marine Fisheries Service, Narragansett, RI 02882*; *Rich.Bell@NOAA.gov*

Grace Klein-MacPhee devoted much of her life to the study of winter flounder. From 2001 to 2008, working with the Rhode Island Department of Environmental Management, she conducted a fish larvae sampling program throughout Narragansett Bay, RI. Winter flounder were one of the dominant fish in Narragansett Bay, but have declined over the last thirty years.

While the initial decline is largely attributed to fishing pressure, the lack of recovery has been linked with increasing water temperatures during the period when eggs and larvae are developing.   We examined the abundance, timing and duration of winter flounder larvae in Narragansett Bay in relation to winter temperature and adult biomass with Generalized Additive Models.  Over the eight years of data, larvae were present in a single peak in abundance which typically varied from late March to late April.  The high concentrations of larvae were present within a limited temperature range (3 – 11 °C), but within that range, there was not a significant relationship with total annual larval numbers or length of time in the water column.  Despite links with environmental factors in broad scale studies, over the range of data observed during the eight years of sampling, temperature did not appear to be driving changes in abundance or larval duration of Narragansett Bay winter flounder.

**Marine Ecosystem Production: Meeting the Food Security Challenges of the 21st Century**.

Fogarty, M.J. *Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, MA 02543; Michael.Fogarty@NOAA.gov*

The need to increase global food supplies in the face of a burgeoning human population in increasingly evident. Recent projections suggest that population levels will reach 9 billion by 2050.  Currently, three billion people obtain nearly 20 percent of their dietary animal protein needs from aquatic sources and 4.3 billion obtain approximately 15 percent of these requirements from fishery and aquaculture products..  Global per capita consumption of aquatic food products has increased steadily in recent years, and sharp regional differences between availability and utilization and between developed and developing countries make this an important issue in global food security. Recent evaluations have focused on terrestrial food sources to meet future human dietary requirements.  There is, however, a long history of attempts to estimate the production potential of marine systems in relation to global food supplies.  Here,   production potential from marine sources using simple food web models are used to trace pathways for utilization through wild capture fisheries and mariculture. Satellite imagery has revolutionized our ability to obtain synoptic coverage of marine ecosystems and to estimate production at the base of marine food webs.  Satellite derived estimates of microplankton and pico-nanoplankton primary production coupled with information on ecological transfer efficiencies derived from meta-analyses of food web models are combined to estimate ecological production potential in large marine ecosystems throughout the world ocean.

**Citizen science on the move: detailing the spawning migration patterns of alewife and blueback herring in a coastal Massachusetts watershed.** 
Jones, Andrew W.[1], Linda A. Deegan[2,3], Charles B. Cooper[2], Louis C. Turner[2], Peter J. Hargraves[2], Michael D. Scherer[2], R. Charles Martinsen[4], Derrick J. Alcott[5], and Christopher Neill[3]. [1]*Woods Hole Oceanographic Institution, Woods Hole, MA 02543,* [2]*Coonamessett River Trust, Falmouth, MA 02540,* [3]*Marine Biological Laboratory, Woods Hole, MA 02543,* [4]*Falmouth Department of Natural Resources, Falmouth, MA 02540,* [5]*University of Massachusetts, Amherst, MA 01003; ajones@whoi.edu*

Every spring anadromous river herring return to Southern New England's coastal streams and lakes to spawn. This phenomenon occurs over a period of weeks, and is both culturally and ecologically important. All across coastal Massachusetts volunteers use visual counts to enumerate fish on their way to spawn, but are typically unable to gather information on the fine-scale details of these migrations. As a result the nuanced movement patterns of these species, which are vital to count estimates and our understanding of their basic biology, have yet to be explored in a variety of watersheds. Herein we detail a recent volunteer-based PIT tagging effort to describe the patterns of migration exhibited by river herring in the Coonamessett River, a small coastal river in southeastern Massachusetts. Key findings from this project include: 1) movement primarily occurred under the cover of darkness, with peak periods of movement occurring immediately following sunset and just prior to sunrise. 2) Movement through the river was typically rapid, with many fish covering the 5.5 km stream length in a single night. 3) Individuals from each species navigated to both of watershed's lake, suggesting that spawning of the two species may overlap. 4) Even small surmountable barriers in the watershed slowed migration, and likely increased mortality from predation. The implications of this work for visual count-based estimates of herring returns in the Coonamessett River will be discussed, as well as how the application of these methods could enhance counting methods more broadly.

**Developing an optical survey for Georges Bank Yellowtail Flounder.** 
Lowery, Travis, Greg DeCelles, and Kevin Stokesbury, *Department of* Fisheries *Oceanography, University of Massachusetts, School for Marine Sciences and Technology, 200 Mill Road, Suite 325, Fairhaven, MA 02719*; *tlowery@umassd.edu*

Yellowtail flounder (*Limanda ferruginea*) is an important target and bycatch species on Georges Bank. In response to uncertainty in recent yellowtail biomass estimates we developed a new optical survey technique. A live feed video camera is placed in an open trawl net, which was developed with fishermen, to record fish species passing through along with periodically closed tows to collect biological data. Our objective is to investigate the abundance, spatial

distribution, and biological characteristics of yellowtail flounder and other groundfish species. There has been five survey trips along the southern portion of Closed Area II on Georges Bank thus far: spring and fall of 2013 and 2014 and spring 2015. Yellowtail flounder were the most prevalent flatfish in the closed tow counts in the fall of 2013 and 2014 surveys and second most prevalent flatfish in the spring of 2014 and 2015 surveys with total fish counts of 1993, 3315, 1370 and 1195 respectively. Over one hundred hours of video footage were obtained from these past surveys. While the video is informative, the vast amount of footage collected presents analytical challenges. Independent observers watched video from each sampling tow in one-minute intervals viewed at half speed. Counts of flatfish observed in the video were compared to catches in the net. The accuracy regarding tows categorized as having low, medium, and high visibility were 51%, 84%, and 92% respectively. A number of sampling techniques have been investigated to determine the most accurate and precise method to analyze the videos.

**Environmental monitors on lobster traps.** Manning, James, *NOAA's Northeast Fisheries Science Center, 166 Water St, Woods Hole, MA 02543; James.Manning@NOAA.gov*

Approximately 70 New England lobstermen have been installing temperature sensors on their traps for several years. Some now have hourly time series for well over a decade. Some have also experimented with salinity monitors, cameras, tide gages, acoustic listening devices, and current meters. The data is served on-line and is being used to evaluate numerical ocean models. Bottom temperatures have been assimilated into hindcast simulations to help improve their performance. A variety of processes are affecting the bottom temperatures at different time scales. The dominant processes at a particular site differ depending on water depth and proximity to geographic features. In some areas, the wind, for example, drives the largest variation while areas near the shelfedge are affected by intrusions of the deep ocean. In general, however, the eMOLT time series document the upward trend in water temperatures throughout the region with 2002, 2006, and 2012 being relatively warm. Some discussion on the future of eMOLT will also be presented including a move towards more real-time data collection.

**Delineation of Brook Trout landscape-level genetic structure among headwater stream networks: isolates or metapopulations?** Nathan, Lucas R.[1], Jason C. Vokoun[1], and Amy B. Welsh[2]. [1]*Department of Natural Resources and the Environment, University of Connecticut, Storrs, CT 06269.* [2]*Division of Forestry and Natural Resources, West Virginia University, Morgantown, WV 26506*; *lucas.nathan@uconn.edu*

Defining the appropriate scale and extent at which to designate management of biological populations is an important component of prioritizing and implementing conservation actions. Brook Trout in Southern New England streams are known to have fine-scale genetic structuring, and are mostly sedentary with rather restricted upstream spawning migrations within headwater stream networks. These findings indicate that brook trout management should be focused at the local (i.e. stream) level, with a focus on protecting remaining isolated populations due to low rates of dispersal. As few as one migrant per generation between populations, however, may be enough to support increased genetic diversity and promote long term population viability, indicating that management units may need to be focused at broader spatial scales in an effort to protect important, rare dispersal events. We conducted genetic analyses of 15 brook trout populations across the Willimantic River and Hop River watersheds, in northeastern Connecticut. Results indicated that putative genetic boundaries expanded beyond single headwater stream networks and included reaches separated by up to 10 river km. Average pairwise Fst values between neighboring populations (≈5 km apart) was 0.068, suggesting at least moderate levels of gene flow have occurred during recent generations which may be indicative of extant metapopulations. Bayesian methods were used to estimate dispersal rates between genetic populations and will be used in future analyses to identify potential landscape features that limit brook trout movement in an effort to better inform management and conservation practices.

**Untangling drivers, mechanisms and scales of environmental effects on squid availability to a seasonal inshore fishery.** Nichols, Owen C.[1], Jeremy R. King[2], Jonathan A. Hare[3], and Steven X. Cadrin[1], *[1]School for Marine Science and Technology, University of Massachusetts – Dartmouth, Fairhaven, MA 02719, [2]Massachusetts Division of Marine Fisheries, New Bedford, MA 02740, [3]Northeast Fisheries Science Center, Narragansett, RI 02882; onichols@umassd.edu*

A seasonal fishery for longfin inshore squid (*Doryteuthis pealeii*) occurs in the shallow waters of Nantucket and Vineyard Sounds (northeast USA). Inter-annual variability in landings presents challenges for fishers and managers due to the 'boom-or-bust' nature of the fishery. Data from an inshore spring trawl survey (1978-2012) were analyzed to test the relative influence of environmental variables on variability of biomass indices at multiple scales. To assess linkages between stock-wide distributional shifts and inshore abundance, the annual mean along- and cross-shelf location of the *D. pealeii* population was estimated from offshore spring trawl surveys conducted on the continental shelf. Annual inshore biomass indices and mean locations on the continental shelf were tested for temporal patterns and relationships with indices related to ocean temperatures and circulation patterns, including the North Atlantic Oscillation (NAO), Atlantic Multidecadal Oscillation (AMO), and the Gulf Stream North Wall Index (GSNWI).

At a fine scale, seawater temperature was most correlated with squid catch at each station relative to date or year, while survey date and year were most correlated with annual mean biomass indices. At a larger spatial scale, NAO, GSNWI and cross-shelf center of population abundance were most correlated with inshore biomass indices. Along-shelf distribution was strongly correlated with GSNWI. A multi-scale approach is required to model the relative effects of local environmental variables and ocean basin-scale processes on measures of squid abundance, distribution, and availability to surveys and fisheries.

**Changing trophic structure and energy dynamics in the Northwest Atlantic influences Atlantic Salmon abundance.** Renkawitz, Mark D.[1], Sheehan, Timothy F.[1], Dixon, Heather J.[2], Nygaard, Rasmus[3], [1]*Northeast Fisheries Science Center, Woods Hole, Massachusetts 02543 USA,* [2]*University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada,* [3]*Greenland Institute of Natural Resources, Nuuk, Greenland; Mark.Renkawitz@noaa.gov*

In the Northwest Atlantic, changes in large-scale climate conditions resulted in a phase shift in productivity, thereby altering trophic pathways that influence the growth, survival, and abundance of many species. Coherent abundance declines of disparate North America and European Atlantic Salmon populations during this time, despite diverse population structures and management regimes, suggests that conditions experienced at common marine areas are causative. To understand the trophic mechanisms behind these declines, 1451 stomachs were examined from Atlantic Salmon caught at the West Greenland feeding grounds between 2006 and 2011 and compared to stomach data from 1965-1970. Standardized stomach content weights and stomach composition varied among years but not between stock complexes. Atlantic Salmon consumed a variety of prey taxa (primarily capelin and *Themisto sp.*) over a broad size spectrum. Standardized stomach content weight and proportions of taxa consumed were similar between historic and contemporary samples, although lower-quality boreoatlantic armhook squid, nearly absent from historic data, was of moderate importance in contemporary samples while higher-quality capelin decreased in importance. Congruent with the regional phase shift in productivity, mean energy density estimates of the keystone forage species, capelin, decreased by approximately 33.7%, resulting in lower estimates of total energy consumption by Atlantic Salmon over time. These results indicate altered trophic dynamics caused by 40 years of changing ocean conditions negatively influenced Atlantic Salmon, and likely many other commercially, culturally, and ecologically important species in the Northwest Atlantic. Determining causal mechanisms that influence marine food webs is necessary to fully understand and evaluate survival and productivity trends, and establish realistic management targets for commercial, recreational, and protected species.

**Effects of zebra mussel (*Dreissena polymorpha*) on the feeding ecology of early-stage Striped Bass (*Morone Saxatilis*) in the Hudson River Estuary.** Smircich, Michael G. and Eric T. Schultz, *Department of Ecology & Evolutionary Biology, University of Connecticut, 75 North Eagleville Road, U-3043, Storrs, CT 06269; michael.smircich@uconn.edu*

Invasion of zebra mussel (*Dreissena polymorpha*) in the Hudson River in the early 1990s sharply reduced phytoplankton biomass and markedly altered estuarine energy flow. Previous studies suggest that early-stage fishes of several species were negatively impacted by the invasion; one such species was the Striped Bass (*Morone saxatilis*). While abundance, growth, and distribution of Striped Bass are well documented throughout the zebra mussel invasion, diet and feeding success has been unanalyzed. The objective of the present study is to assess feeding success indicated by condition index as well as diet composition of Striped Bass over multiple years, including pre-invasion and post mussel invasion years. We hypothesized reduced feeding success and thus lower bodily condition in zebra mussel impacted years. We also hypothesized dietary shifts towards a more littoral based diet rather than pelagic. Analysis to test this hypothesis is possible thanks to 21 years of early-stage fish samples collected as part of the Hudson River Utilities' long-term monitoring program. We found that condition of bass varied among years, such that condition was relatively high in some pre-invasion years and relatively low in some post-invasion years. Diet composition did not differ between years nor were there clear shifts in littoral or pelagic prevalence. We are currently conducting multivariate analyses of gut fullness and diet composition.

**Trends and potential drivers of distribution overlap among migratory, pelagic marine fishes.**
Turner, Sara M.[1], Jonathan A. Hare[1], David E. Richardson[1], and John P. Manderson[2], [1]NOAA NEFSC, Narragansett, RI 02882, [2]NOAA NEFSC, Highlands, NJ 07732; sara.turner@noaa.gov

Recent increases in efforts to protect and restore river herring (Alewife, *Alosa pseudoharengus*, and Blueback Herring, *A. aestivalis*) have resulted in increased concern over their incidental catch in the commercial Atlantic Herring (*Clupea harengus*) and Atlantic Mackerel (*Scomber scombrus*) fisheries. Efforts have mainly focused on reducing river herring incidental catches, with little attention on the ecological drivers. As long-term commercial data on mixed catches are lacking, we used fishery-independent data from the NOAA Northeast Fisheries Science Center to examine temporal trends in species' overlap and potential ecological drivers of these trends. The proportions of Alewife caught with Atlantic Herring, Blueback Herring caught with Atlantic Herring, Alewife caught with Atlantic Mackerel, and Blueback Herring caught with Atlantic Mackerel have changed substantially over the time series, with changes varying by

season and region of the northeast U.S. continental shelf. We found that strata-weighted abundances for individual species and bottom temperature were correlated with proportional changes, but the effects varied between seasons and among regions. These findings suggest that management of these fisheries should take an adaptive approach, specifically focusing on the potential effects of species abundances and climate change.

**Modeling Yellowtail Flounder bycatch in the Georges Bank sea scallop fishery.** Wright, Brooke L., Catherine E. O'Keefe, Gregory R. DeCelles, and Steve X. Cadrin, *School for Marine Science and Technology, University of Massachusetts - Dartmouth, Fairhaven, MA 02719; brooke.wright@umassd.edu*

Reduced catch limits of Georges Bank Yellowtail Flounder (*Limanda ferruginea*) in recent years have become a constraint to New England fisheries, including the Atlantic sea scallop (*Placopecten magellanicus*) fishery, in which Yellowtail Flounder are caught as bycatch. As a complement to an existing bycatch avoidance program, we are examining the use of environmental variables as predictive factors for bycatch occurrence through exploratory statistical analysis and generalized model building. Despite an existing body of literature on factors that determine Yellowtail Flounder abundance, there is limited information available on the relationships between bycatch of Yellowtail Flounder in the scallop fishery and environmental factors. We analyze catch data from a bycatch survey to develop models of Yellowtail Flounder bycatch in the scallop fishery in response to depth, temperature, substrate, zenith angle, month, time of day, and location. Models are cross-validated using fisheries observer data and data from the bycatch avoidance program. Results will be useful for predicting the magnitude and location of bycatch prior to fishery openings and in areas of non-reporting and may aid in enhancing the bycatch avoidance efforts of the scallop fleet. Fishery management can be improved by using such information to refine spatial and seasonal regulations for more effective avoidance of Yellowtail Flounder, resulting in low-cost proactive bycatch mitigation measures.

**Mapping the distribution of Atlantic Cod spawning during the winter in Massachusetts Bay using multiple acoustic technologies**. Zemeckis, Douglas R.[1], Micah J. Dean[2], William S. Hoffman[2], Sofie Van Parijs[3], Leila Hatch[4], Christopher H. McGuire[5], and Steven X. Cadrin[1]. *[1]School for Marine Science and Technology, University of Massachusetts - Dartmouth, Fairhaven, MA 02719, [2]Massachusetts Division of Marine Fisheries, Annisquam River Marine Fisheries Field Station, Gloucester, MA 01930, [3]NOAA Northeast Fisheries Science Center, Passive Acoustics Group, Woods Hole, MA 02543, [4]NOAA National Ocean Service, Stellwagen*

*Bank National Marine Sanctuary, Scituate, MA 02066, [5]The Nature Conservancy, Boston, MA 02111; dzemeckis@umassd.edu*

Rebuilding of Atlantic Cod (*Gadus morhua*) in the Gulf of Maine has been much slower than expected. Decreases in the stock have been associated with the depletion of many historical spawning components. These declines in biodiversity have compromised stock productivity and stability, and little evidence exists for recolonization of abandoned spawning sites. In response, fishery managers have implemented a variety of spawning protection measures to promote reproductive success and prevent the extirpation of remnant spawning components. However, an improved understanding of cod spawning dynamics is required to inform future fishery management plans. We used acoustic telemetry and passive acoustic monitoring to map the spatial and temporal distribution of cod spawning during the winter in Massachusetts Bay. Spawning cod captured by commercial fishing vessels during the last two winters were tagged with acoustic transmitters (n=317). Tagged cod were tracked using acoustic receivers, deployed either as part of a stationary receiver array or mounted on a pair of underwater gliders, which traversed the spawning ground in December 2014. Marine autonomous recording units were also deployed throughout the spawning ground to identify locations and periods of spawning by recording grunts produced by male cod as part of their courtship rituals. Preliminary results suggest that peak spawning occurred from November through January. Spawning site fidelity was documented, and multiple 'hotspots' were identified as areas where tagged cod were aggregating and where cod grunts were recorded, including inter-annual variability among the first two project years. Continued fieldwork will provide further insights into cod spawning dynamics in the Gulf of Maine. Results will be useful for consideration in the development of future fishery management measures to protect cod spawning aggregations, including potential modifications to existing measures.

# Summer Meeting Evaluation

Your Comments can help improve future meetings. Please fill out this form and return it to the registration desk at the conclusion of the meeting.

| MEETING CONTENT | NOT APPLICABLE | INADEQUATE | SATISFACTORY | GOOD | ABOVE AVERAGE | EXCELLENT |
|---|---|---|---|---|---|---|
| Suitable meeting location and venue? | | | | | | |
| Organization of meeting | | | | | | |
| Learned useful information? | | | | | | |
| Good variety of speakers/topics? | | | | | | |
| Discussion Q & A time sufficient? | | | | | | |
| How was the keynote speaker? | | | | | | |
| Were your goals for attending met? | | | | | | |
| Overall rating of meeting | | | | | | |

A. We hope this meeting has provided you with: 1) information you can use professionally, 2) the opportunity to interact with other professionals in your field and, 3) exposure to a broad array of topical issues in the fisheries field. Do you feel these goals were met?

B. How did you hear about this meeting?

C. What is your primary reason for attending? Were your expectations met?

E. Are there any special themes or workshops you would like to see at future meetings?

F. If this is your first time at a SNEC meeting, will you consider attending future meetings?

***Please write any additional comments on the back of this sheet***
***Thank you so much for attending and for helping SNEC to provide better meetings***