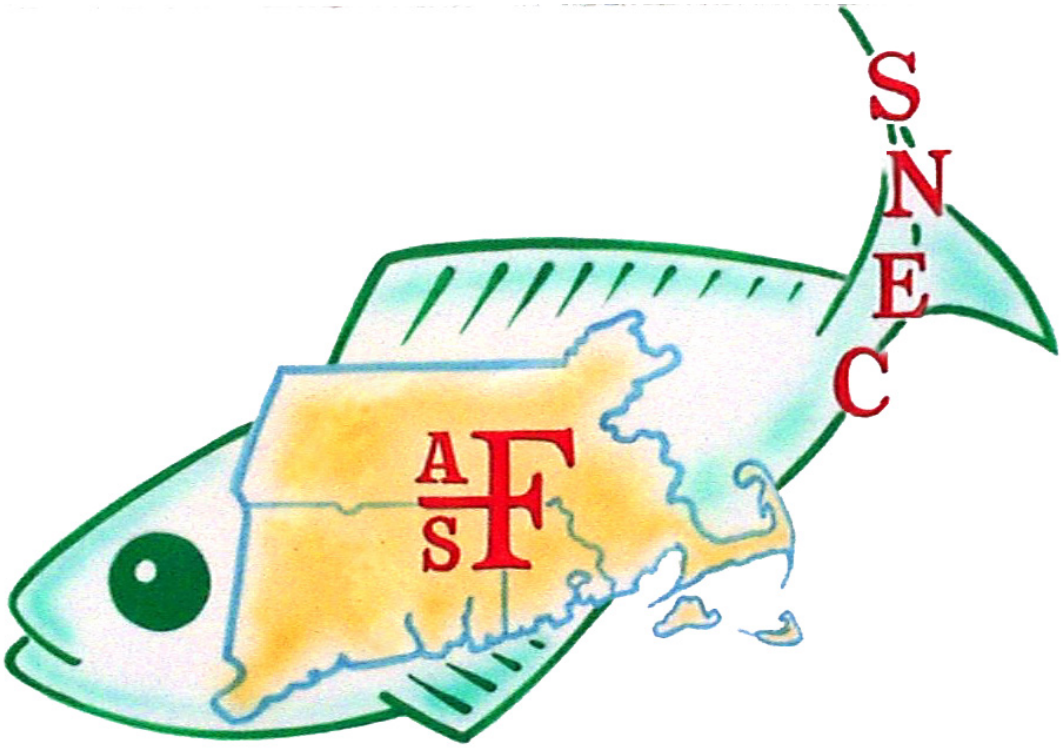
2014 Winter Science Meeting



Southern New England Chapter

American Fisheries Society

January 22, 2014

US Fish and Wildlife Service

Hadley, MA

Program

AGENDA FOR THE SNEC AFS 2014 WINTER SCIENCE MEETING
WEDNESDAY, JANUARY 22, 2014

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

8:45 – 9:00 **Opening Comments** Syma Ebbin, SNEC President
Deb Rocque, USFWS Deputy Director
Sherry White, USFWS Assistant Regional Director for Fisheries

9:00 – 9:20 **Application of corrective measures to improve the accuracy of electronic fish counting systems in estimating run size of large anadromous river herring populations.** Sheppard, John J. and Michael S. Bednarski, *Massachusetts Division of Marine Fisheries, New Bedford, MA 02740*

9:20 – 9:40 **Responses of migratory fishes to passage restoration in the Mill River, Massachusetts.** Bednarski, Michael[1] and Beth Lambert[2], [1]*Massachusetts Division of Marine Fisheries, New Bedford, MA 02740,* [2]*Massachusetts Division of Ecological Restoration, Boston, MA 02114*

9:40 – 10:00 **Juvenile river herring habitat use and migrations from Maine to Florida**.* Turner, Sara M., *SUNY College of Environmental Science and Forestry, Syracuse, NY 13210*

10:00 – 10:20 **This isn't your father's bass: Assessing the role of angling-induced evolution in shaping Connecticut largemouth bass populations**. Davis, Justin[1], Robert Jacobs[1], Eileen O'Donnell[1], Jan-Michael Hessenauer[2] and Jason Vokoun[2], [1]*Connecticut Department of Energy and Environmental Protection, Marlborough, CT 06447,* [2]*University of Connecticut, Storrs, CT 06269*

10:20 – 10:40 ***Break***

10:40 – 11:00 **Looking for patterns of fisheries induced evolution in largemouth bass populations from historically fished and unfished lakes.*** Hessenauer, Jan-Michael[1] , Jason Vokoun[1], Justin Davis[2], Robert Jacobs[2], Eileen O'Donnell[2], and Cory Suski[3], [1]*University of Connecticut, Storrs, CT 06269,* [2]*Connecticut Department of Energy and Environmental Protection, Marlborough, CT 06447,* [3]*University of Illinois at Urbana-Champaign, Urbana, IL 61801*

11:00 – 11:20 **Cluster sampling: A pervasive, yet little recognized survey design in fisheries research.** Nelson, Gary, *Massachusetts Division of Marine Fisheries, Gloucester, MA 01923*

11:20 – 11:40 **Factors of success in fishery funded cooperative fisheries research.*** Adams, Erin K., Kevin D.E. Stokesbury, and Daniel Georgianna, *School for Marine Science and Technology, Fairhaven, MA 02719*

11:40 – 12:00 **Progress on the development and incorporation of decision trees into a smartphone and tablet app for harbor seal rehabilitation.*** Durand, Catherine M., John P. Tabb, Cathleen A. Giguere, John J. Giovanni, Royce James, Karina Mrakovcich, Lucy Vlietstra, *United States Coast Guard Academy, New London, CT 06320*

12:00 – 12:10 ***Awards and Business***

12:10 – 1:00 ***Lunch***

1:00 – 1:40 **Poster Session**

1:40 – 2:00 **A study of benthic populations in the Mid-Atlantic Bight using HabCam.*** Turner, Alyssa J.[1], Sam C. Wainright[1], Deborah R. Hart[2], and Burton Shank[2], [1]*U. S. Coast Guard Academy, New London, CT 06320,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543*

2:00 – 2:20 **DIDSON ARIS high resolution imaging sonar: The newest tool for fisheries research**. Rillahan, Chris and Pingguo He, *School for Marine Science and Technology, Fairhaven, MA 02719*

2:20 – 2:40 ***Ichthyophonus sp.* infection in yellowtail flounder on Georges Bank.** Huntsberger, Carl[1] and Roxanna Smolowitz[2], [1]*Coonamesset Farm Foundation, Falmouth, MA 02536,* [2]*Roger Williams University, Bristol, RI 02809*

2:40 – 3:00 **Fish consumption habits and mercury exposure of RI recreational anglers and their families.*** Williamson, Patrick R. and David L. Taylor, *Roger Williams University, Bristol, RI 02809*

3:00 – 3:20 ***Break***

3:20 – 3:40 **Field and laboratory evidence for the impacts of episodic acidification and aluminum on Atlantic salmon.** Kelly, John T.[1,2,3], Amy M. Regish[1], Michelle Y. Monette[1,2,4], Keith H. Nislow[5], and Stephen D. McCormick[1,2], [1]*USGS, Conte Anadromous Fish Research Center, Turners Falls, MA 01376,* [2]*University of Massachusetts, Amherst, MA 01003,* [3]*University of New Haven, West Haven, CT 06516,* [4]*Western Connecticut State University, Danbury, CT 06810,* [5]*USDA Forest Service, Northern Research Station, Amherst, MA 01003*

3:40 – 4:00 **Monkfish age validation.*** Bank, Crista[1], Kenneth Oliveira[1], Steven X. Cadrin[1], Graham D. Sherwood[2], Jonathan H. Grabowski[4], R. Anne Richards[3], and Larry A. Alade[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*

4:00 – 4:20 **Integrating DNA barcoding of fish eggs into ichthyoplankton monitoring programs.** Lewis, Leah A. and David E. Richardson, *National Marine Fisheries Service, Narragansett, RI 02882*

4:20 – 4:40 **Determinate versus indeterminate fecundity in American Shad, an anadromous clupeid.** Hyle, A. Reid[1], Richard S. McBride[2], and John E. Olney[3], [1]*Florida Fish & Wildlife Conservation Commission, Melbourne, FL 32901,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543,* [3]*Virginia Institute of Marine Science, Gloucester Point, VA 23062(Deceased)*

*Denotes student paper

Poster Session

P1 **Restoring a watershed: Improving the Taunton River for both fish and people.** Bozek, Cathy, *The Nature Conservancy, Northampton, MA 01060*

P2 **Multispecies modeling for fisheries management advice: A pilot project for Georges Bank, USA.** Gamble, Robert, Sarah Gaichas, Michael Fogarty, Laurel Smith, Sean Lucey, Tim Miller, Gavin Fay, Gerey DePiper, and Kiersten Curti, *Northeast Fisheries Science Center, Woods Hole, MA 02536*

P3 **Seasonal patterns of oogenesis and spawning of female Yellowtail Flounder (*Limanda ferruginea)* in the Gulf of Maine to define a period to measure potential annual fecundity.** Towle, Emilee K.[1] , W. Dave McElroy[1], and Richard S. McBride[2], [1]*Integrated Statistics, Woods Hole, MA* 02536, [2]*Northeast Fisheries Science Center, Woods Hole, MA 02536*

P4 **Predicting the effects of climate change on *Hemigrapsus sanguineus* populations in intertidal cobble beaches.** Durant, Daisy[1], Kenneth B. Raposa[1], and Ivan Mateo[2], [1]*Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI 02872,* [2]*NOAA Alaska Fisheries Science Center, Juneau, AK 99801*

P5 **Abundance, growth and diet analysis of winter flounder and summer flounder in Rhode Island tidal rivers.**** Mills, Christopher D. and David L. Taylor. *Roger Williams University, Bristol, RI 02809*

P6 **Beyond "Flatland": using gonad histology to classify female Winter Flounder reproductive status.** McBride, Richard S.[1], Mark J. Wuenschel[1], W.David McElroy[2], Yvonna K. Press[2], and Emily K. Towle[2], [1]*National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543,* [2]*Integrated Statistics, Woods Hole, MA 02543*

P7 **Detecting an environmental gradient in maturity of female winter flounder (*Pseudopleuronectes americanus*) stocks: does thermal habitat create spatial heterogeneity of life history parameters within stock boundaries?** Winton, Megan V.[1,3], Mark J. Wuenschel[2], and Richard McBride[2], [1]*Integrated Statistics, Woods Hole, MA 02543,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543,* [3]*Current address: Coonamessett Farm Foundation, East Falmouth, MA 02536*

P8 **Testing of modified groundgear to reduce capture of yellowtail flounder (*Limanda ferruginea*) and sub-legal Atlantic cod (*Gadas morhua*) in the Georges Bank multispecies otter trawl fishery.**** Endres, Corinne[1], Natalie Jones[1], Christopher Rillahan[1], Tor Bendiksen[2], Manuel Magalnaes[3], Sally Roman[4] and Pingguo He[1], [1]*School of Marine Science and Technology, New Bedford, MA 02744,* [2]*Reidar's Manufacturing Inc., Fairhaven MA 02719,* [3]*F/V Hera, New Bedford, 02740,* [4]*Virginia Marine Resources Commission, Newport News, VA 23607*

P9 **Linear programming as a tool for prioritizing removal of fish passage barriers in western Massachusetts.**** Weiter, Rachael and David Ahlfeld, *University of Massachusetts Amherst, Amherst, MA 01003*

P10 **Surfclam survey strategies.**** Kretsch, Alexa, Daniel Georgianna, and Kevin Stokesbury, *School for Marine Science and Technology, Fairhaven, MA 02719*

P11 **Changes in the distribution of four coastal SNE/MAB species: Black sea bass, scup, summer flounder, and winter flounder.** Bell, Richard J.[1,2], David Richardson[2], and Jon Hare[2], [1]*National Research Council Postdoctoral Fellow,* [2]*National Marine Fisheries Service, Narragansett, RI 02882*

P12 **Elucidating post-release mortality and 'best capture and handling' methods in sublegal Atlantic cod discarded in Gulf of Maine recreational hook-and-line fisheries.**** Capizzano, Connor W.[1], John Mandelman[2], James Sulikowski[1], William Hoffman[3], Micah Dean[3], and Douglas Zemeckis[4], [1]*University of New England, Biddeford, ME 04005,* [2]*John H. Prescott Marine Laboratory, New England Aquarium, Boston, MA 02110,* [3]*Massachusetts Division of Marine Fisheries, Gloucester, MA 01930 ,* [4]*School for Marine Sciences and Technology, Fairhaven, MA 02719*

P13 **The survival of rajids discarded in the New England scallop dredge fisheries.**** Knotek, Ryan J.[1], David Rudders[2], John Mandelman[3], James Sulikowski[1], and Hugh Benoit[4], [1]*University of New England, Biddeford, ME 04005,* [2]*Virginia Institute of Marine Science, Gloucester Point, VA 23062,* [3]*John H. Prescott Marine Laboratory, New England Aquarium, Boston MA 02110,* [4]*Fisheries and Oceans Canada, Moncton, NB E1C 9B6, Canada*

P14 **The Northeast Climate Science Center.** Staudinger, Michelle, Mary Ratnaswamy, Richard Palmer, Toni Lyn Morelli, and Addie Rose Holland, *DOI Northeast Climate Science Center, Amherst, MA 01003*

** Denotes student poster

Abstracts:
Platform Presentations

Factors of success in fishery funded cooperative fisheries research. Adams, Erin K., Kevin D.E. Stokesbury, and Daniel Georgianna, *School for Marine Science and Technology, Fairhaven, MA 02719; erin.adams@umassd.edu*

Research funded through the utilization of part of the Total Allowable Catch is a method for supporting cooperative fisheries research. Between 2000-2009, industry funded Research Set Asides (RSA) were implemented in the sea scallop, monkfish, herring, and in nine mid-Atlantic fisheries where a small percentage of the Total Allowable Catch (TAC) was set aside to fund high priority fisheries research in support of fishery management plans. We performed an evaluation of the RSA to determine how the programs performed in their first ten years. We asked if the programs were industry funded cooperative research which we defined as projects where the fishing industry not only funds the research, but also helps develop and execute the research projects. We also looked at the program's success in fulfilling research priorities, scientific contributions through peer reviewed publications and use in fisheries management, and promotion of stewardship in the fishing industry. The evaluation found that all programs fulfilled research priorities, but varied in cooperation and utility of research results in fisheries management and support from the fishing industry. Of all of the programs, the scallop RSA has been utilized most in fisheries management and has the most widespread support from the fishing industry. Factors that may contribute to the scallop RSA success are the initial buy-in and development of the RSA program by the scallop fishing industry, the involvement of RSA scientists in the management process, and the high price of scallops. The factors for success in the scallop RSA can be applied to future industry funded programs.

Monkfish age validation. Bank, Crista[1], Kenneth Oliveira[1], Steven X. Cadrin[1], Graham D. Sherwood[2], Jonathan H. Grabowski[4], R. Anne Richards[3], and Larry A. Alade[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 the commercial fishery in the Northeast United States, but annual catch limits are precautionary, because of uncertainty in the stock assessment, including uncertain age determination. Annual growth rings are

presumed to follow a seasonal pattern and are counted on the vertebrae to determine age. To confirm the timing of annulus formation, we injected a chemical marker, oxytetracycline or fluorexon, into monkfish, kept them alive for a year in the laboratory, and subjected them to a seasonal cycle of temperature and light. Monkfish were also injected and released into the wild as part of a data storage tag study. The injected chemical leaves a visible mark on the growth ring that is being formed at the time of injection. After a year in the laboratory, monkfish were euthanized and digital images of the vertebrae were taken with an ultraviolet light to illuminate the mark, and reflected light, which obscures the mark but shows the growth rings. To validate the ageing method, annuli were counted from the reflected light image. The two images were then merged to reveal the location of the true annuli. Average percent error and coefficient of variation were used to evaluate whether annuli counts on the vertebrae can be used to accurately determine the age of monkfish. Our results validate the timing of annulus formation over the size range we sampled.

Responses of migratory fishes to passage restoration in the Mill River, Massachusetts.

Bednarski, Michael[1] and Beth Lambert[2], [1]*Massachusetts Division of Marine Fisheries, New Bedford, MA 02740,* [2]*Massachusetts Division of Ecological Restoration, Boston, MA 02114; mike.bednarski@state.ma.us*

Dam removal is a popular option for restoring migratory fishes. However, studies of the effectiveness of dam removal, particularly for southern New England, are limited. To address this information gap, we designed a study to track the response of migratory fishes to the removal of three dams on the Mill River, Taunton, Massachusetts. Our objectives were to (1) assess which migratory fishes utilize habitats above the former dam sites, (2) describe run characteristics, including timing, peak, and relative abundance of observed migratory species and (3) compare the run characteristics of river herring (*Alosa pseudoharengus* and *A. aestivalis*) in the Mill to the Nemasket River, a nearby reference system. The first dam, Hopewell Mills, was removed in summer 2012. We employed a video monitoring system above the former dam site from April 1 to May 30 2013. We identified at least 13 different fishes including spawning runs of alewife, sea lamprey (*Petromyzon marinus*), yellow perch (*Perca flavescens*), and white sucker (*Catastomus commersonii*). Peak run activity for each species was associated with moon phase. Run duration varied from 16 days (sea lamprey) to 44 days (river herring). Although the Mill River herring run was three orders smaller than our reference site, we noted similarities in hourly timing. Our results demonstrate that the migratory fish community of the Mill River responded positively and rapidly to the removal of the Hopewell Mills Dam. Further work will assess the future response of river herring and sea lamprey to full restoration of the Mill River.

This isn't your father's bass: Assessing the role of angling-induced evolution in shaping Connecticut largemouth bass populations. Davis, Justin[1], Robert Jacobs[1], Eileen O'Donnell[1], Jan-Michael Hessenauer[2] and Jason Vokoun[2], [1]*Connecticut Department of Energy and Environmental Protection, Marlborough, CT 06447,* [2]*University of Connecticut, Storrs, CT 06269; Justin.Davis@ct.gov*

Examples of evolutionary change in exploited fish populations, a phenomenon commonly referred to as "fisheries-induced evolution" (FIE), are now myriad and have led to a growing call for the development of "evolutionarily-enlightened" fisheries management practices. The foundational discoveries elucidating FIE were made in commercially exploited fish stocks, but relatively little effort has been devoted to assessing whether recreational angling might also act as a strong selective agent. Recent research on largemouth bass, a popular and widely distributed freshwater gamefish, has shown that individual largemouth bass vary in their vulnerability to angling, and that physiological and behavioral traits relevant to vulnerability are heritable. In Connecticut, we have a unique opportunity to test the hypothesis that FIE has altered largemouth bass populations because a) we have small bass populations that experience high fishing pressure (i.e. there is potential for strong selection), and b) we have numerous drinking water reservoirs that are closed to fishing and support unexploited bass populations. Previous research by the DEEP Inland Fisheries Division (IFD) demonstrated that largemouth bass in unexploited drinking water reservoirs were much more vulnerable to angling than bass from public lakes, a dynamic that we now believe may be partially attributable to evolutionary selection against high vulnerability in public lakes. IFD, in cooperation with the UConn Department of Natural Resources and the Environment, has embarked on a multi-faceted research project to investigate the potential for angling-induced evolution in Connecticut largemouth bass populations, and to assess the potential for remediation of undesirable evolutionary change via re-introduction of desirable genes from unexploited reservoir bass populations.

Progress on the development and incorporation of decision trees into a smartphone and tablet app for harbor seal rehabilitation. Durand, Catherine M., John P. Tabb, Cathleen A. Giguere, John J. Giovanni, Royce James, Karina Mrakovcich, Lucy Vlietstra, *United States Coast Guard Academy, New London, CT 06320; Catherine.M.Durand@uscga.edu*

Stranding facilities located across the United States and other countries concentrate their resources on rehabilitating *Phoca vitulina*, or harbor seals, and other marine mammals and birds. There are many factors that must be considered by a rehabilitation center when rescuing or rehabilitating an animal. Some of these include safety of employees, status of the animal,

and the animal's probability of successful rehabilitation. In order to mitigate these risks, decision trees for different situations have been developed to provide a systematic approach to decision-making. In 2013, Giguere and Giovanni created three decision trees that applied to the rehabilitation process. These were created using the software program NovaMind 5 after conducting interviews with professionals in the rehabilitation field from multiple facilities. Giguere and Giovanni's "Respond" and "Rescue" trees were modified for this project, and a third tree named "Report" was developed. Report, Respond & Rescue, and Rehabilitation trees for harbor seals are now complete. The "Report" decision tree is designed to guide untrained persons who encounter an animal that is possibly stranded. This tree can be used to determine if the animal is in distress and if it should be reported to a rehabilitation center. The "Respond & Rescue" decision tree is designed for rehabilitation center employees that arrive on sight to assess if the environment is safe enough to continue with the rescue. The "Rehabilitation" decision tree is to determine if an animal that arrives at the center should be rehabilitated or euthanized considering financial, ethical, and logistical factors. These three decision trees are the foundation used in the development of a smartphone and tablet app that will aid the user in making stranding decisions. The three trees have been integrated into one linked PowerPoint that will be the basis of the app created. The next step is for three electrical engineering students will provide assistance in converting the decision trees from PowerPoint format to an app. The aim is to imbed the robustness of decision trees into a convenient and easy to use intelligent matrix. Progress on the smartphone and tablet app development will be reported. This app could help to raise awareness of the presence of rehabilitation centers across the nation, as well as reduce the risks associated with rehabilitation.

Looking for patterns of fisheries induced evolution in largemouth bass populations from historically fished and unfished lakes. Hessenauer, Jan-Michael[1] , Jason Vokoun[1], Justin Davis[2], Robert Jacobs[2], Eileen O'Donnell[2], and Cory Suski[3], [1]*University of Connecticut, Storrs, CT 06269,* [2]*Connecticut Department of Energy and Environmental Protection, Marlborough, CT 06447,* [3]*University of Illinois at Urbana-Champaign, Urbana, IL 61801;* *jan-michael.hessenauer@uconn.edu*

Understanding the possible evolutionary effects of anthropogenic activities on wild populations of fish and wildlife is important for informed management. Increasing evidence links evolutionary changes with exploitation of commercially fished stocks, but less research has investigated the effects of recreational angling. Experiments in selective breeding have determined that some Largemouth Bass (*Micropterus salmoides*) are more vulnerable to recreational angling than others; high vulnerability individuals have been documented to have higher metabolic rates, provide better parental care, and have higher fitness in the absence of

angling, relative to lower vulnerability individuals and that these traits are heritable. At present, corroboration of these results from wild populations has been difficult because few unexploited populations of Largemouth Bass exist for comparison. For the current study, we collected age-0 Largemouth Bass from two unexploited Connecticut drinking water reservoirs, and two heavily fished reservoirs, and stocked them into a common 0.11 acre rearing pond during fall 2012 to quantify the effects of fishing exploitation on metabolic characteristics. Individuals were allowed to acclimate to pond conditions throughout the summer of 2013 to eliminate plastic effects associated with environmental conditions. During fall 2013 we estimated field metabolic rates for one individual from each population per day (~25 total individuals per population) using computerized intermittent-flow respirometry. A mixed-model ANCOVA was used to analyze the data, and revealed that individuals originating from the unexploited drinking water reservoirs had metabolic rates that were higher than individuals from the heavily fished populations ($P>0.05$). These findings are consistent with the expectations of fisheries induced evolution for exploited populations, suggesting that recreational angling may be an evolutionarily relevant force.

***Ichthyophonus* sp. infection in yellowtail flounder on Georges Bank.** Huntsberger, Carl[1] and Roxanna Smolowitz[2], [1]*Coonamesset Farm Foundation, Falmouth, MA 02536,* [2]*Roger Williams University, Bristol, RI 02809; chuntsberger@cfarm.org*

The parasitic protozoan, *Ichthyophonus sp.,* has been recently discovered in yellowtail flounder (*Limanda ferruginea*) on Georges Bank. This raises concern since *Ichthyophonus* spp. has been identified as the causative agent in mass mortality events for several fish species in the northwest Atlantic, which could have a significant impact on the overfished yellowtail stock on Georges Bank. In recent years yellowtail bycatch quota in the sea scallop fishery has become an important management issue. Recent stock assessments estimate high levels of natural mortality with no clear explanation for the cause. This project focuses on the effect of *Ichthyophonus* sp. on individual fish and the prevalence of infection on Georges Bank. Yellowtail flounder were randomly selected during a seasonal bycatch survey aboard commercial scallop vessels on Georges Bank every six weeks from June 2012 through December 2013 for at-sea examination. The pericardial cavity of each fish was macroscopically examined for abnormalities. Each abnormality was noted, imaged and fixed in 10% neutral buffered formalin for histological evaluation. During this study 70.7% of flounder sampled hosted a variety of parasites including *Ichthyophonus* sp. as well as nematodes and cestodes. Clinical signs of *Ichthyophonus* spp. in severely infected animals (2.7% of the fish sampled) included systematic granulomatous inflammation causing significant tissue necrosis. Histological results suggest that *Ichthyophonus* spp. may spread quickly through tissues causing significant damage

and resulting in direct fish mortality or indirect mortality due to dehabilitation. Further research is needed to determine the effect of this parasite on Georges Bank yellowtail flounder.

Determinate versus indeterminate fecundity in American Shad, an anadromous clupeid. Hyle, A. Reid[1], Richard S. McBride[2], and John E. Olney[3], [1]*Florida Fish & Wildlife Conservation Commission, Melbourne, FL 32901,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543,* [3]*Virginia Institute of Marine Science, Gloucester Point, VA 23062(Deceased); Richard.McBride@noaa.gov*

Historical estimates of American Shad *Alosa sapidissima* fecundity used a determinate method, estimating annual fecundity as the standing stock of oocytes at a single point of time prior to spawning. Such fecundity estimates have been reported for populations from the Canadian Maritimes to Florida, USA; applied to hypothesis tests of life history evolution; and used in demographic models to advise management policy. However, American Shad have asynchronous development of yolked oocyte clutches, which suggests that new oocytes could arise after spawning commences, biasing a determinate fecundity method as too low. If so, annual fecundity should be a product of batch size and number of batches – an indeterminate fecundity method. We investigated oocyte recruitment, atresia, and spawning intervals using gonad histology of females from the Mattaponi River, Virginia. Batch size, the number of hydrated oocytes prior to a spawning event, was estimated using a gravimetric method. Spawning duration was obtained from an independent acoustic tagging study. A size hiatus between primary and secondary oocytes was only evident in some individuals during spawning, so we conclude that an indeterminate fecundity method is necessary for this population of American Shad. Atresia was evident during spawning but was low at the end of the 2002 spawning season. Females spawned every 2.2 – 2.9 days, releasing 11-17 batches per season. Batch fecundity (range: 12,700 – 81,400) was 23% higher for repeat versus virgin spawners. A bootstrapped estimate of potential annual fecundity for a virgin female – as calculated with an indeterminate fecundity method – was 478,000 – 544,000 eggs (95% confidence interval), about double the previous (determinate) estimates from this river system (260,000 and 288,000). Until more comparisons are done with other populations, we urge caution in using the many published 'determinate' fecundity estimates of American Shad and other *Alosa* species.

Field and laboratory evidence for the impacts of episodic acidification and aluminum on Atlantic salmon. Kelly, John T.[1,2,3], Amy M. Regish[1], Michelle Y. Monette[1,2,4], Keith H. Nislow[5], and Stephen D. McCormick[1,2], [1]*USGS, Conte Anadromous Fish Research Center, Turners Falls, MA 01376,* [2]*University of Massachusetts, Amherst, MA 01003,* [3]*University of New Haven, West Haven, CT 06516,* [4]*Western Connecticut State University, Danbury, CT 06810,* [5]*USDA Forest Service, Northern Research Station, Amherst, MA 01003; jkelly@newhaven.edu*

Extirpations from chronic acidification have been well documented for Atlantic salmon (*Salmo salar*) in Norway, but the impacts of episodic acidification that occurs in eastern North America are less certain. In lab studies, smolts were exposed to low pH and inorganic aluminum (acid/Al) to determine the thresholds for short-term physiological impacts. Acid/Al impairs salinity tolerance at moderate levels and is lethal under more severe conditions. Smolts exposed to moderate acid/Al for 5 days took 4-7 days for salinity tolerance to recover. Further, we found a differential sensitivity to acid/Al in the freshwater and seawater isoforms of the alpha subunit of Na^+,K^+-ATPase, which corresponds to their relative impacts on freshwater and seawater osmoregulation. Seasonal water chemistry profiles from 29 sampling sites in Vermont and New Hampshire (2007-2009) found many locations where acid/Al levels exceeded physiological thresholds, especially in the Merrimack River system. Smolts emigrating from the upper Merrimack watershed had elevated gill aluminum and decreased gill Na^+,K^+-ATPase activity compared to smolts in the more buffered Connecticut River system. These observations indicate that episodic acidification is impacting Atlantic salmon in North America in regions where underlying buffering capacity is low.

Integrating DNA barcoding of fish eggs into ichthyoplankton monitoring programs. Lewis, Leah A. and David E. Richardson, *National Marine Fisheries Service, Narragansett, RI 02882*; *leah.lewis@noaa.gov*

The identification of fish eggs and larvae (collectively referred to as ichthyoplankton) is critical to our understanding of fish population ecology. Historically, the ability to identify fish eggs has relied upon minute morphological characteristics, making it difficult to identify fish eggs in ichthyoplankton monitoring programs. Over the past years, the use of molecular identification techniques has increased in response to the limitations associated with morphological identifications. However, many of these methodologies have primarily focused on discriminating among a limited number of species, and have therefore rarely proven versatile enough for use in fisheries monitoring programs or large-scale egg surveys where the identification of a wide diversity of species is necessary. Recent efforts have shown that nearly all species of fish may be identified by mitochondrial DNA sequences, a concept termed DNA

barcoding. We selected fish eggs for DNA barcoding from a ten-year, multi-seasonal archive of samples collected by the Northeast Fisheries Science Center (NEFSC, NMFS/NOAA). In total, 1607 unidentified fish eggs were sequenced from 250 ethanol-preserved ichthyoplankton samples. The sequence-based identifications of these eggs had a success rate of 91%, representing a total diversity of 50 fish species. The eggs of 25 of these species have never before been identified to the species-level by the NEFSC; therefore, this approach drastically improves the identification of fish eggs in large-scale regional ichthyoplankton surveys. Furthermore, our results prove that DNA barcoding is sufficiently advanced for use in programs that monitor the distribution and abundance of spawning fish populations in support of single-species and ecosystem-based management.

Cluster sampling: A pervasive, yet little recognized survey design in fisheries research. Nelson, Gary, *Massachusetts Division of Marine Fisheries, Gloucester, MA 01923; gary.nelson@state.ma.us*

The estimation of biological parameters of fish populations such as average size, maturity-at-age, etc. is a major task of many state, federal and academic fisheries researchers. Such information is often used in the stock assessment process where model estimates of management values (e.g., fishing mortality) are used by regulatory boards to control the harvesting of fish population or in ecological studies devised to test some statistical hypothesis about populations (e.g., growth differences). If population attributes are estimated incorrectly, the results, and conclusions on which they are based, will be misleading and may impact unnecessarily the livelihoods of fishers if used in management. Cluster sampling is a common survey design used pervasively in fisheries research to sample fish populations, but it is not widely recognized by researchers. Cluster sampling occurs because types of gear used to collect fish (e.g. seines, trawls, long-lines, etc.) capture them in groups or clusters. Because fish collected via cluster sampling are not independent of each other, random cluster sampling estimators must be used to estimate population attributes and statistical tests must be adjusted to account for clustering to obtain unbiased results. This presentation will review the nature of clustered data in fisheries research, identify the random cluster sampling estimators of population attributes, explore the implications of ignoring clustering in fisheries data, and review current statistical approaches that can be used to analyze appropriately clustered data.

DIDSON ARIS high resolution imaging sonar: The newest tool for fisheries research. Rillahan, Chris and Pingguo He, *School for Marine Science and Technology, Fairhaven, MA 02719; crillahan@umassd.edu*

High resolution imaging sonar systems operate by emitting acoustic pulses and convert the returning echoes into digital images. This allows users the ability to "see" in zero visibility environments. These "acoustic cameras" have been used to study fish behavior, migration and population assessments. The morphology and behavior of steelhead trout were studied using the latest high resolution Sound Metric ARIS imaging system in an aquaculture pen at the Coastal Marine Laboratory of the University of New Hampshire. This data will be used in this presentation to serve as a case study to highlight the advantages and disadvantages of these systems as well as their potential for studying fish behavior and other aspects of fisheries research.

Application of corrective measures to improve the accuracy of electronic fish counting systems in estimating run size of large anadromous river herring populations. Sheppard, John J. and Michael S. Bednarski, *Massachusetts Division of Marine Fisheries, New Bedford, MA 02740; john.sheppard@state.ma.us*

Automated electronic counting systems are used by resource agencies to estimate river herring (alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*) passage throughout New England. Measuring the accuracy of these counting systems is essential to understanding the limitations of counter derived population estimates, which comprise a vital component of river herring stock assessments. Anecdotal information suggests that electronic counting systems underestimate river herring runs, especially at the high rates of passage that occur during peak migration periods. The purpose of our study was to conduct a direct visual-electronic comparison of passage to derive a better understanding of the accuracy of estimates determined from a single channel electronic counting system. From 1999-2011, we conducted over 300 direct comparisons. We explored various modeling techniques, including regression and re-sampling, to correct for any identified biases in data collected during our sampling period. Our results confirmed that our counting system consistently underestimated passage, particularly at higher passage rates. Although our results demonstrate an important limitation, they provide evidence that single channel counters provide the resolution needed to allow managers to infer population trends. Future monitoring efforts should correct any biases in single channel counters, and when possible, explore alternative technologies that provide greater accuracy.

A study of benthic populations in the Mid-Atlantic Bight using HabCam. Turner, Alyssa J.[1], Sam C. Wainright[1], Deborah R. Hart[2], and Burton Shank[2], [1]*U. S. Coast Guard Academy, New London, CT 06320,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543; Alyssa.J.Turner@uscga.edu*

The Northeast Fisheries Science Center (NEFSC), National Marine Fisheries Service (NMFS) conducts annual sea scallop surveys off of New England and in the Mid-Atlantic. Recently, they have added an entirely new perspective on sea scallop distributions with HabCam, a Habitat Characterization Camera System developed by Woods Hole Oceanographic Institution. The camera system is towed behind a ship traveling 5 to 7 kts, and takes 3-6 stereo image pairs per second of the sea floor as well as collecting oceanographic and side scan sonar data. By collecting millions of images and associated in-situ data on the benthic environment, HabCam can not only help improve estimates of scallop biomass, but also can be used to better understand benthic environments and aid the development of ecosystem-based fishery science and management. Data generated from images taken on the 2013 sea scallop survey were used to estimate the abundances and distributions of prominent benthic species over the Mid-Atlantic Bight. Species of interest included the sea scallop *Placopecten magellanicus,* sand dollars (*Echinarachnius parma*), *Cancer* spp. crabs, an unusual unidentified "convict worm" tubeworm species, and finfish. Based on examination of thousands of images, sand dollars are abundant in the shallower depths of the continental shelf, while in greater depths *Astropecten americanus* are more abundant. The unidentified tubeworms tended to appear in greater depths. Sea scallops appear to be concentrated between 30 and 80 meters. The goal for the future is to work towards examining the community structures in addition to the patterns of individual species.

Juvenile river herring habitat use and migrations from Maine to Florida. Turner, Sara M., *SUNY College of Environmental Science and Forestry, Syracuse, NY 13210; smturner@syr.edu*

River herring (alewife, *Alosa pseudoharengus*, and blueback herring, *A. aestivalis*) populations have declined to a fraction of historic levels throughout their ranges, and most management efforts to protect and restore populations have experienced limited (if any) success. Many studies have focused on freshwater habitat use and emigration patterns of juvenile river herring but these generally focus on single watersheds. Using otolith chemistry, we can generally infer movements among fresh waters, estuaries, and the ocean, and also estimate size at emigration. Using this information, I was able to compare behaviors within each species throughout its range and investigate how general watershed characteristics such as length of river accessible to fish, watershed area, and urbanization might affect population traits,

specifically size at emigration or time spent in a given habitat (freshwater or estuarine). I also compare how behaviors differ in rivers that both species inhabit versus those that only one of the species utilizes. Understanding broadly how these species behave in different watershed types can have important implications for management and habitat restoration projects.

Fish consumption habits and mercury exposure of RI recreational anglers and their families.

Williamson, Patrick R. and David L. Taylor, *Roger Williams University, Bristol, RI 02809; pwilliamson607@g.rwu.edu*

In this study an exposure assessment model was used to estimate mercury (Hg) intake by RI anglers and their families owing to local fish consumption. The study sought to: (1) measure muscle Hg concentrations in a variety of recreationally-targeted fishes using atomic absorption spectrometry; (2) disseminate food frequency questionnaires (FFQ) to RI anglers and their families to ascertain each person's fish eating habits, and; (3) model Hg exposure rates in this sensitive subpopulation by coupling their dietary habits with fish Hg data. Muscle Hg content was positively related to fish length across all species, indicating Hg bioaccumulation. Moreover, for striped bass, bluefish, and tautog, Hg concentrations were near the US EPA action level (0.3 ppm) at their legal catch size, while remaining fishes had contaminant levels mostly below this threshold. The FFQ was completed by 284 individuals, of which 78.2% were male and the mean age was 52.4 (range = 15-81). Respondents' mean fish consumption rate was 7.8 meals per 30 days (range = 0-30), which is significantly higher than estimates for national and coastal populations, and equivalent to the high-end fish eating habits of NY/NJ harbor anglers. The mean estimated Hg exposure rate for RI anglers and their families was significantly higher than rates reported for other US coastal regions. Moreover, 38% of the respondents were estimated to have Hg exposure rates above the US EPA reference dose through their fish consumption. These results reveal that many RI anglers and families are highly exposed to Hg due to elevated rates of fish consumption. Hence, continuing research on fish consumption rates and Hg exposure in this sensitive subpopulation will support public health risk assessments and risk management decisions related to the issuance of fish consumption advisories.

Abstracts:
Poster Presentations

Changes in the distribution of four coastal SNE/MAB species: Black sea bass, scup, summer flounder, and winter flounder. Bell, Richard J.[1,2], David Richardson[2], and Jon Hare[2], [1]*National Research Council Postdoctoral Fellow,* [2]*National Marine Fisheries Service, Narragansett, RI 02882; Rich.Bell@NOAA.gov*

Effective management of natural marine resources requires an understanding of the factors that regulate their abundance and distribution. Fishing pressure and climate variability are important drivers which influence the quantity and location of those resources. Along the east coast of the United States there have been major changes in fish populations due to the impacts of fishing and subsequent regulations as well as changes in the climate. Black sea bass, scup, summer flounder and winter flounder are important commercial and recreational species which utilize inshore and offshore waters on the north east shelf. We examined the distribution of the four species with the NEFSC trawl surveys to determine if the along shelf center of biomass had changed over time and if the change was attributed to changes in temperature or fishing pressure through changes in abundance and length structure. Black sea bass, scup and summer flounder exhibited a significant poleward shift in distribution in at least one season while the SNE/MAB stock of winter flounder did not shift. Generalized additive modeling indicated that the northerly shift for black sea bass and scup in the spring was related to climate, while the change in distribution of summer flounder was largely attributed to a decrease in fishing pressure and an expansion of the length/age structure. While the increase in ocean temperatures will have major impacts on marine taxa, the exact nature of those impacts will vary among species and combine with other drivers. It is important for management to take all factors into consideration when developing regulations for natural marine resources.

Restoring a watershed: Improving the Taunton River for both fish and people. Bozek, Cathy, *The Nature Conservancy, Northampton, MA 01060; cbozek@tnc.org*

The Taunton River, a ~500 sq mi watershed in Southeastern Massachusetts, hosts one of the largest river herring runs in New England and was designated Wild and Scenic in 2009. However, the watershed has a long history of impacts from industry and agriculture, and is located in one of the fastest developing regions of Massachusetts. Many of the Taunton's

tributaries are blocked by obsolete and deteriorating dams which obstruct fish passage and pose safety hazards for the surrounding communities. Land development and water use practices have led to water quality issues and water budget deficits which impact fish habitat as well as drinking water supplies. Protecting the Taunton for future generations demands a comprehensive approach to watershed protection, as well as coordination between freshwater, estuarine, and marine conservation strategies. With public and private partners, The Nature Conservancy is advancing innovative water management projects, removing dams, improving road crossings and stormwater management, restoring estuarine habitat, and protecting key lands. These site based strategies are linked with statewide policy efforts such as establishing streamflow standards, and regional scale research and fisheries management. Through a comprehensive, coordinated approach, the Taunton River watershed is being improved and protected for the benefit of fish populations and the surrounding human communities.

Elucidating post-release mortality and 'best capture and handling' methods in sublegal Atlantic cod discarded in Gulf of Maine recreational hook-and-line fisheries. Capizzano, Connor W.[1], John Mandelman[2], James Sulikowski[1], William Hoffman[3], Micah Dean[3], and Douglas Zemeckis[4], [1]*University of New England, Biddeford, ME 04005,* [2]*John H. Prescott Marine Laboratory, New England Aquarium, Boston, MA 02110,* [3]*Massachusetts Division of Marine Fisheries, Gloucester, MA 01930 ,* [4]*School for Marine Sciences and Technology, Fairhaven, MA 02719; ccapizzano@une.edu*

The Atlantic cod, *Gadus morhua*, is and has been one of the most important commercial and recreational fish species in the western north Atlantic. However, the Gulf of Maine stock has been overexploited over the past century due to commercial industry pressures and, until recently, an increase in the recreational hook-and-line fishery. Since a majority of recreational discards are undersized individuals, management recently reduced the minimum retention size of GOM cod from 24” to 19”to reduce discards due to the 100% mortality upon release assumption used in current stock assessments. The current project aims to discern physical, biological, and other factors most detrimental to post-release survival by evaluating representative hook-and-line capture and handling methods. Both undersized and just legal cod (13 – 27 in.) were angled and visually inspected (N = 608) on southern Jeffreys Ledge from July to August 2013. Angled cod were caught by either stainless steel jigs (47%) or baited J-hooks (53%) at depths ranging from 146 to 272 ft. Small ultrasonic transmitters equipped with depth sensors (n = 136) were affixed to a select subsample before being released into an acoustic array that would monitor mortality over a 30-day conservative period. A mixed-effects logistic regression model will be applied to the data to determine the effectiveness of the variables as predictors of post-release mortality. Results will be disseminated to management sources and

the recreational angling community by various pathways to enhance survival through “best practice guides”.

Predicting the effects of climate change on *Hemigrapsus sanguineus* populations in intertidal cobble beaches. Durant, Daisy[1], Kenneth B. Raposa[1], and Ivan Mateo[2], [1]*Narragansett Bay National Estuarine Research Reserve, Prudence Island, RI 02872,* [2]*NOAA Alaska Fisheries Science Center, Juneau, AK 99801; daisy@nbnerr.org*

In only 25 years, the Asian shore crab, *Hemigrapsus sanguineus*, has invaded and become established along the eastern US coast. Unfortunately, environmental factors that affect the distribution and density of this invasive species are not fully understood. In this study we identify environmental and substrate factors that affect *H. sanguineus* density and use the results to infer the potential response of this species to future changes in climate. A generalized additive model (GAM) with Gaussian distribution errors was used to explore nonlinear relationships between *H. sanguineus* density and water quality, weather, and substrate data collected around Prudence Island, RI. Percent deviance explained, as well as variables’ relative influence (percentage of the contribution to the deviance reduction) were calculated. One-Way ANOVA was used to determine significant differences in density, abiotic and substrate characteristics among sites. The GAM fits explained 76% of the deviance in the model. The three variables that contributed the most to the percentage explanation of the deviance were year (43%), site (15%) and cobble (13%); the least influential (<1%) were gravel, shell, and PAR. Our results showed that habitats with significantly higher percent cobble and significantly lower salinity had significantly higher crab densities (ANOVA, $P<0.001$). The long-term data sets analyzed provided valuable insights into the ecology of *H. sanguineus*. According to predicted climate change scenarios of higher temperatures and more precipitation (hence lower salinities) in RI, we might expect that invasive species like *H. sanguineus* will be more prevalent as the climate changes, as long as the proper habitat is available.

Testing of modified groundgear to reduce capture of yellowtail flounder (*Limanda ferruginea*) and sub-legal Atlantic cod (*Gadas morhua*) in the Georges Bank multispecies otter trawl fishery. Endres, Corinne[1], Natalie Jones[1], Christopher Rillahan[1], Tor Bendiksen[2], Manuel Magalnaes[3], Sally Roman[4] and Pingguo He[1], [1]*School of Marine Science and Technology, New Bedford, MA 02744,* [2]*Reidar's Manufacturing Inc., Fairhaven MA 02719,* [3]*F/V Hera, New Bedford, 02740,* [4]*Virginia Marine Resources Commission, Newport News, VA 23607; cendres@umassd.edu*

The fishing on Georges Bank (GB) faces great challenges due to lower stock abundances for many species and yet relatively healthy status for others. Fish often mix with each other on the grounds and occupy the same niches. For example, Atlantic cod (*Gadas morhua*) and yellowtail flounder (*Limanda ferruginea*) often live in the same area of the sea floor. The GB yellowtail stock quota for FY 2013 has been reduced compared to the previous fishing year, as has the GB cod stock quota, which was drastically cut. By-catch of these species while fishing for other fish goes toward a vessel's overall allocated quota for the by-catch species. Since yellowtail flounder are essential in two major fisheries in New England, the by-catch is of great concern. The decrease in juvenile or sub-legal cod as by-catch is also a goal of the groundfish fishery. The modified groundgear that we tested has 8" x 8" 'escape windows' in the center and 8” x 6” ‘windows’ at the wings. The ‘windows’ are located between the fishing line and the groundgear. These windows take advantage of the escape behavior of sub-legal cod and flatfish. They are designed to allow these fish a chance to escape prior to capture. Generally, a fish’s survival is greater the sooner it escapes the net. This paper will report methods and results of sea trials that were conducted on Georges Bank in June 2013. It was found that the modified net showed about a 67% reduction in yellowtail flounder catch and about a 37% reduction in sub-legal cod catch. The catch of legal cod was found to be less in the modified net when compared to the control, about a 39% reduction. In addition, the two nets showed identical length distributions in Atlantic cod meaning the two nets caught proportionally the same sized fish. The reduction in the capture of sub-legal cod and yellowtail flounder will benefit the fishing industry by ameliorating the reduction of fish stocks. However, the reduction in legal-cod is too significant to be commercially viable. Further modification may be needed to fine tune the size of the windows. With the ever-changing fishing regulations, having a variety of groundgears’ that are designed for specific species will become increasingly valuable.

Multispecies modeling for fisheries management advice: A pilot project for Georges Bank, USA. Gamble, Robert, Sarah Gaichas, Michael Fogarty, Laurel Smith, Sean Lucey, Tim Miller, Gavin Fay, Gerey DePiper, and Kiersten Curti, *Northeast Fisheries Science Center, Woods Hole, MA 02536; Robert.Gamble@NOAA.gov*

Most scientific advice for fisheries management is based on results from single species population dynamics models. If fisheries management is to become ecosystem-based, models that consider multispecies and environmental interactions are required, as are effective ecological indicators and reference points. In the Northeast U.S., fisheries managers have recently committed explored plans to either develop place-based Fishery Ecosystem Plans or incorporatespecies interactions into existing management plans as part of a broader move towards ecosystem based fisheries management. Ultimately, multi-model inference and the comparative approach can be especially effective for addressing the challenges of ecosystem modeling for management advice. A suite of multispecies and ecosystem models for the Northeast US shelf already exist, including Atlantis (a spatially explicit bio-geochemical end-to-end ecosystem model), Kraken (a multispecies production model framework), several static mass-balance food web models, empirical nonlinear time series models, and several single species population dynamics models extended to include predators. Currently in development are a multispecies size structured assessment model (Hydra) and a set of spatially linked Ecopath with Ecosim models. While many of these models have an established role in providing strategic advice, the next step is to provide tactical management advice for fisheries in a multispecies context that can be readily used within the existing management framework. For tactical management, multispecies models must credibly estimate the status of up to 39 important fish and invertebrate stocks in the Northeast U.S. marine community relative to appropriate reference points. We first focused on estimating status relative to biomass at multispecies maximum sustainable yield (B_{MMSY}) for 10 species on Georges Bank, one of three Northeast U.S. shelf ecological production units. To establish model credibility over a range of plausible system states, Hydra was used as an operating model to generate input "data" with known properties for input into Kraken and nonlinear time series analyses. Comparisons between nonlinear time series and Kraken estimates and the known quantities from Hydra helped improve parameter estimation methods. These results were then used to refine the structure of Kraken and the process is being repeated. This ongoing work will eventually include comparisons between outputs of Kraken, Hydra as an estimation model, and non-linear time series models for the region to allow for multimodel inference in evaluating management options. We ultimately envision a functional ensemble of models incorporating the rich Northeast U.S. data resources to support sustainable fishery management decision making.

The survival of rajids discarded in the New England scallop dredge fisheries. Knotek, Ryan J.[1], David Rudders[2], John Mandelman[3], James Sulikowski[1], and Hugh Benoit[4], [1]*University of New England, Biddeford, ME 04005,* [2]*Virginia Institute of Marine Science, Gloucester Point, VA 23062,* [3]*John H. Prescott Marine Laboratory, New England Aquarium, Boston MA 02110,* [4]*Fisheries and Oceans Canada, Moncton, NB E1C 9B6, Canada; rknotek@une.edu*

Due primarily to regulatory factors, skates from the family Rajidae account for nearly half the total bycatch discarded during commercial fishing operations in the U.S. portion of the Northwest Atlantic Ocean. Although the New England scallop dredge fishery has the second highest skate discard rate, no information regarding the resiliency of skates to interaction with this gear type exists. In order to gain insight into species-specific mortality rates in this fishery, 295 tows were conducted across six, seven-day research trips during the 2012-2013 scallop fishing season. A total of 4020 skates spread across three species (little, *Leucoraja erinacea*, winter, *Leucoraja ocellata*, and barndoor, *Dipturus laevis*), were evaluated and scored based on a vitality (i.e. reflex impairment) and condition (i.e. overt physical trauma) index. In order to quantify mortality rates associated with these indexes, a subset of 290 skates were maintained in a novel on-deck refrigerated flow-through seawater system for 72-hours. In addition to these predictive mortality indexes, this study also assessed the effect of factors such as fishing conditions (e.g. season and depth) and practices (e.g. tow times, volume of catch, deck duration) on post-release mortality. Preliminary data based on condition and vitality indexes, suggests that species-specific difference in post-release mortality exist. For example, highest mortality rates (up to 100%) were observed in barndoor skates while winter skates were found to be most resilient (up to 23.5%) to impacts of capture by scallop dredge. In addition, these data also suggest that other factors, such as tow duration, can exacerbate mortality rates for skate species assessed thus far in the study.

Surfclam survey strategies. Kretsch, Alexa, Daniel Georgianna, and Kevin Stokesbury, *School for Marine Science and Technology, Fairhaven, MA 02719; akretsch@umassd.edu*

Surveys of fishery resources come in many varieties and each collects different kinds of data which can be used in different ways. Integrating two or more surveys can diversify and amplify the data available to stock assessment scientists and managers. The Atlantic Surfclam (*Spisula solidissima*) has been surveyed by dredge by the Northeast Fisheries Science Center from 1965 through today but, many areas remain unexplored due to gear limitation. The NEFSC dredge survey conducts tows, 485 in 2011, from Cape Hatteras to the Gulf of Maine and Georges Bank and collects data on number of clams per tow on a 1.5nm transect. The SMAST video survey, collects video images of the seafloor, four quadrats per station on a 1.5-3nm grid. These images

cannot identify clams by sight, as they can with scallops, but record the holes of burrowing species, such as the surfclam and the ocean quahog (*Arctica islandica*). Surfclams and ocean quahog are separated by a depth contour varying with region and temperature. By identifying and counting holes in the video survey along and on either side of this contour, this study seeks to establish this contour from visual data and to combine point estimates of density from holes with the dredge survey's number per transect. The goal of this study is to combine two different survey strategies into a new, fine scale dataset able to describe surfclam presence and density throughout its range.

Beyond "Flatland": using gonad histology to classify female Winter Flounder reproductive status. McBride, Richard S.[1], Mark J. Wuenschel[1], W.David McElroy[2], Yvonna K. Press[2], and Emily K. Towle[2], [1]*National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543,* [2]*Integrated Statistics, Woods Hole, MA 02543; Richard.McBride@noaa.gov*

Spawning stock biomass is based on separating immature and mature components of a fishery stock. Maturity is typically identified by characters observable at sea, such as gonad size, shape, or color. How do we know these macroscopic characteristics are valid? At the NEFSC, we used gonad histology to validate these visual characters used at sea. Here, we depict a flatfish example and liken this to E. A. Abbott's book, "Flatland," where A. Square's 2-dimensional world is changed when he receives a visit from Sphere, an inhabitant of a 3-dimensional world called Spaceland. As in the book, we find that gonad histology reveals dimensions of flatfish reproduction that are unknowable from macroscopic characters. In this poster, we illustrate the dynamics of key diagnostic characters relative to each maturity class: fish size, gonad size, and gonad wall thickness and gonad color and transitions of the germ cell itself, the oocyte.

Abundance, growth and diet analysis of winter flounder and summer flounder in Rhode Island tidal rivers. Mills, Christopher D. and David L. Taylor. *Roger Williams University, Bristol, RI 02809; cmills200@g.rwu.edu*

Summer flounder, *Paralichthys dentatus*, and winter flounder, *Pseudopleuronectes americanus*, utilize estuaries as a nursery habitat during early life history stages. In 2012 and 2013, we sought to identify the spatio-temporal overlap and potential biotic interactions between flounder species in two Rhode Island tidal rivers (Seekonk River, RI; Taunton River, MA). This study specifically focused on the abundance, growth, and dietary habits of the juvenile flounder life stage. From May to late July, sampling occurred fortnightly in tidal rivers, and collected flounder were enumerated, measured for total length (mm), and a sub-sample was preserved

for stomach content analysis. Irrespective of location and year, winter flounder were more abundant than summer flounder. Further, the cumulative abundance of flatfish was higher in the Seekonk River (1.8 fish/m^2) than the Taunton River (0.13 fish/m^2) across all years. The growth rate of summer flounder (0.92-1.87 mm/d) was also significantly faster than winter flounder (0.37-0.44 mm/d), which may be explained by dietary differences across species. Specifically, amphipods and crangonid shrimp were the principle prey of summer flounder, while amphipods, polychaetes, and copepods comprised the most abundant food item in winter flounder stomachs. Fish remains, including winter flounder, were observed in summer flounder stomachs, albeit to a limited extent. The results indicate considerable spatiotemporal overlap between summer and winter flounder, but predator-prey and competitive interactions are minimal.

The Northeast Climate Science Center. Staudinger, Michelle, Mary Ratnaswamy, Richard Palmer, Toni Lyn Morelli, and Addie Rose Holland, *DOI Northeast Climate Science Center, Amherst, MA 01003*; *mstaudinger@usgs.gov*

The Department of Interior Northeast Climate Science Center (NE CSC) is part of a federal network of eight Climate Science Centers (CSCs) created to provide scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change. Recognizing the critical threats, unique climate challenges, and expansive and diverse nature of the northeast region, the University of Massachusetts Amherst, College of Menominee Nation, Columbia University, Marine Biological Laboratory, University of Minnesota, University of Missouri Columbia, and University of Wisconsin-Madison have formed a consortium to host the NE CSC. This partnership with the USGS CSC network provides wide-reaching expertise, resources, and established professional collaborations in both climate science and natural and cultural resources management. This interdisciplinary approach is needed for successfully meeting the regional needs for climate impact assessment, adaptive management, education, and stakeholder outreach throughout the northeast region. Thus, the NE CSC conducts research, both through its general funds and its annual competitive award process, that responds to the needs of natural resource management partners that exist within the NE CSC bounds. This domain includes the North Atlantic, Upper Midwest and Great Lakes, Eastern Tallgrass and Big Rivers, and Appalachian Landscape Conservation Cooperatives (LCCs), among other management stakeholders. For example, researchers are conducting a Designing Sustainable Landscapes project to assess the capability of current and potential future landscapes in the Northeast to provide integral ecosystems and suitable habitat for a suite of representative species and provide guidance for strategic habitat conservation; studying the effects of changes

in the frequency and magnitude of drought and stream temperature on brook trout habitats, spatial distribution and population persistence; and conducting assessments of northeastern regional climate projections and high-resolution downscaling.

Seasonal patterns of oogenesis and spawning of female Yellowtail Flounder (*Limanda ferruginea)* in the Gulf of Maine to define a period to measure potential annual fecundity.

Towle, Emilee K.[1] , W. Dave McElroy[1], and Richard S. McBride[2], [1]*Integrated Statistics, Woods Hole, MA* 02536, [2]*Northeast Fisheries Science Center, Woods Hole, MA 02536; Emilee.Towle@noaa.gov*

In support of Yellowtail Flounder, *Limanda ferruginea*, assessment and management, a histological atlas displaying oogenesis and associated metrics of oocyte development and spawning seasonality were examined. Yellowtail Flounder range from Newfoundland to Chesapeake Bay, with three stocks managed in the United States. This project focused on the Cape Cod/Gulf of Maine stock, where we had the most complete data set. A total of 731 fish were caught over a 4-year period (December 2009 – May 2012). Fish were collected primarily from commercial fishing vessels participating in cooperative research programs; additional samples were acquired from fisheries-independent research surveys. Histology was used to outline oogenesis from oogonial proliferation to ovulation. As expected, oocyte development is group synchronous. Oocytes developed yolk granules in August, in the year preceding spawning, and grew in size steadily, so by January a distinct hiatus for that year's clutch was visible. The gonadosomatic index (GSI) and the percent frequency of the most advanced oocyte stage (MAOS) followed similar trends of seasonal development and spawning. GSI increased steadily from October to May, when the MAOS of most females were late vitellogenic. GSI dropped in June, when some females began spawning. GSI was lowest from July to October, when the ovary was regenerating. Low levels of alpha and beta atresia of secondary growth cells were observed during vitellogenesis and the post-spawn recovery period. No evidence of mass atresia of an entire batch was seen. These results describing the formation and ovulation of a clutch of secondary yolked oocytes indicated, it is best to estimate annual fecundity from fish sampled in late winter and early spring.

Linear programming as a tool for prioritizing removal of fish passage barriers in western Massachusetts. Weiter, Rachael and David Ahlfeld, *University of Massachusetts Amherst, Amherst, MA 01003; rweiter@ecs.umass.edu*

In the United Sates alone, there exist an estimated 2.5 million barriers to fish migration. A single stream network may contain hundreds of these barriers, which pose a serious threat to the health of riverine and diadromous fish populations. Though many barriers may potentially be repaired or removed to improve fish passage, selecting barriers for removal from many candidates is a challenging task often dictated by factors beyond fish habitat needs and completed inefficiently. The ability to prioritize barrier removal based on a complex set of clearly stated criteria such as conservation goals, funding availability, and competing concerns may lead to more effective restoration projects and thus a greater return on funds invested in conservation. To this end, a linear programming model will be used to prioritize barrier removal in the Westfield River watershed in western Massachusetts. Linear programming, a mathematical method for determining an optimal solution to a problem constrained by a set of requirements, will allow a swift but thorough comparison of all possible barrier removal combinations and provide holistic problem solutions. A sensitivity analysis will be conducted with regards to target species considered and estimates of barrier passability, which may vary with time and hydraulic conditions, in order to determine the robustness of the model. Project results are intended to facilitate the decision-making process associated with barrier removal.

Detecting an environmental gradient in maturity of female winter flounder (*Pseudopleuronectes americanus*) stocks: does thermal habitat create spatial heterogeneity of life history parameters within stock boundaries? Winton, Megan V.[1,3], Mark J. Wuenschel[2], and Richard McBride[2], [1]*Integrated Statistics, Woods Hole, MA 02543,* [2]*National Marine Fisheries Service, Woods Hole, MA 02543,* [3]*Current address: Coonamessett Farm Foundation, East Falmouth, MA 02536; megan.winton@gmail.com*

Generalized additive models were used to investigate fine-scale variation in female maturity across the three United States' winter flounder (*Pseudopleuronectes americanus*) stocks. The effect of temperature on maturity was also investigated. Maturity models explicitly incorporating spatial structure performed better than "traditional" methods involving the aggregation of data according to predefined stock boundaries. Models including temperature also explained more of the variability in maturity than those based only on fish size or age but did not improve fit over models incorporating spatial structure. The results suggest that females attain maturity at the largest sizes at average annual temperatures of approximately 9.5^{o}C and that age-at-maturity decreases linearly with temperature. Based on the size- and age-at-

maturity estimates from the spatially explicit models, distinct subareas were objectively identified using a spatially constrained clustering algorithm. The results suggested greater variation within than between existing stock areas. Given the importance of life history information to stock delineation and assessment, the approach outlined here provides a method for identifying areas with different vital rates without the need to presume subjective boundaries.

Winter Meeting Evaluation

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MEETING CONTENT	NOT APPLICABLE	INADEQUATE	SATISFACTORY	GOOD	ABOVE AVERAGE	EXCELLENT
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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?						
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