Southern New England Chapter

American Fisheries Society

2012 Winter Meeting

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University of Rhode Island, Graduate School of Oceanography
Coastal Institute Building
Narragansett, RI

Program

AGENDA FOR SNEC AFS 2012 WINTER MEETING THURSDAY JANUARY 26, 2012

8:20-8:50 ***Registration and Coffee***

8:50-9:00 **Opening Comments.** Sean Lucey, SNEC AFS President

9:00-9:20 **The effect of elevated CO_2 on the growth and food consumption of juvenile winter flounder *Pseudopleuronectes americanus*.*** Bumpus, Chris[1,2], Janet Nye[2], Jason Grear[2], Doranne Borsay Horowitz[2], and Jesyka Melendez[1,3], *[1]University of Rhode Island, Graduate School of Oceanography, Narragansett, RI 02882; [2]U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI 02882; [3]Universidad de Puerto Rico en Cayey, 205 Avenida Antonio R. Barceló Cayey, PR 00736*

9:20-9:40 **Using spatially-explicit spawning stock distributions and larval connectivity models to downscale stock-recruit relationships.** Shank, Burton V.[1], G. Law[2,3], D.R. Hart[1], K.D. Friedland[4], and J. Quinlan[2,5], *[1]NOAA National Marine Fisheries Service, Woods Hole, MA 02543; [2]Rutgers University, New Brunswick, NJ 08901; [3]Oregon Health & Science University, Portland, OR 97239; [4]NOAA National Marine Fisheries Service, Narragansett, RI 02882; [5]NOAA National Marine Fisheries Service, Miami, FL 33149*

9:40-10:00 **Potential influence of climate change on the response of an endangered spring-run Chinook population to habitat restoration in the Pacific Northwest.** Honea Jon[1,2], Jeff Jorgensen[1], Michelle McClure[1], and Mark Scheuerell[1], *[1]NOAA Fisheries Service, Northwest Fisheries Science Center, Seattle, WA 98112; [2]Emerson College, Boston, MA 02116*

10:00-10:20 ***Rhinichthys atratulus*, the Eastern Blacknose Dace, post-Glacial recolonization of New England.*** Tipton, Michelle L. and Barry Chernoff, *Wesleyan University, Middletown, CT 06459*

10:20-10:40 ***Break***

10:40-11:0 **Modeling interannual variability in larval haddock, *Melanogrammus aeglefinus*, transport patterns on Georges Bank.** Boucher, Jason M., Chen Changsheng, and Tian Rucheng, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, New Bedford, MA 02744*

11:00-11:20 **Evaluating habitat use of bridle shiner while accounting for imperfect detection.*** Jensen, Timothy and Jason C. Vokoun, *University of Connecticut, Department of Natural resources and the Environment, Storrs, CT 06269*

11:20-11:40 **Using molecular techniques to identify Atlantic Cod (*Gadus morhua*) remains in Spiny Dogfish (*Squalus acanthias*) stomach contents.** Pitchford, Steven[1], Brian Smith[2], Sheila Stiles[1], Christopher Brown[1], and Richard McBride[2], [1]*NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Milford, CT 06460;* [2]*NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543*

11:40-12:00 **Exploratory stock identification of winter flounder in the Great South Channel.*** DeCelles, Greg and Steve Cadrin, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA 02719*

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

12:10-1:00 ***Lunch***

1:00-1:50 **Poster session**

1:50-2:10 **Testing thresholds in ecological indicators as tools for ecosystem-based fisheries management using multispecies production models.** Fay, Gavin, Jason S. Link, Robert J. Gamble, and Scott I. Large, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543*

2:10-2:30 **Population genetic analysis of Atlantic horseshoe crabs (*Limulus polyphemus*) in coastal Massachusetts.*** Terkanian, Katherine[1,2], [1]*University of Massachusetts Amherst, Amherst, MA 01003;* [2]*Massachusetts Audubon Society, South Wellfleet, MA 02663*

2:30-2:50 **Angler survey of the Connecticut River: Have angler impacts on Connecticut River fish populations increased over the last decade?** Davis, Justin, Neal Hagstrom, and Bob Jacobs, *Connecticut Department of Energy and Environmental Protection, Inland Fisheries Division, Marlborough, CT 06447*

2:50-3:10 **Changes in larval flatfish distributions on the northeast U.S. continental shelf.** Walsh, Harvey J., David E. Richardson, and Jonathan A. Hare, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI 02882*

3:10-3:30 ***Break***

3:30-3:50 **Use of dual-frequency identification sonar (DIDSON) to monitor adult river herring in a small coastal stream.** Magowan, Kevin[1], Joshua Reitsma[1,2], and Diane Murphy[1,2], [1]*Cape Cod Cooperative Extension, Barnstable, MA 02630;* [2]*Woods Hole Sea Grant, Woods Hole, MA 02543*

3:50-4:10 **Selection of spawning habitats by horseshoe crabs (*Limulus polyphemus*) along the complex Connecticut coast.*** Landi, Alicia[1], Jason Vokoun[1], Peter Auster[2], and Penny Howell[3], [1]*University of Connecticut, Department of Natural Resources and the Environment, Storrs, CT 06269;* [2]*University of Connecticut at Avery Point, Department of Marine Sciences, Groton, CT 06340;* [3]*Connecticut Department of Energy and Environmental Protection, Marine Fisheries Division, Old Lyme, CT 06371*

4:10-4:30 **Modeling Pacific Hake, *Merluccius productus*, distribution using satellite and oceanographic modeling products.** O'Connor, Megan[1] and Melissa Haltuch[2], [1]*NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI 028802;* [2]*NOAA Fisheries Service, Northwest Fisheries Science Center, Seattle, WA 98112*

* Denotes student paper

Poster Session

P1 **The performance of the Northwest Atlantic cooperative Research Set Aside programs.**** Adams, Erin K. and Daniel Georgianna, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, Fairhaven, MA 02719*

P2 **Diadromous fish passage restoration at three mainstem dams on the Pawcatuck River, southwestern Rhode Island.** Ferry, Kristen[1], James Turek[2], Sean Arruda[3], Nils Wiberg[3], Phil Edwards[4], and Chris Fox[5], [1]*NOAA Restoration Center, Gloucester, MA 01930;* [2]*NOAA Restoration Center, Narragansett, RI 02882;* [3]*Fuss & O'Neill, Providence, RI 02908;* [4]*Rhode Island Department of Environmental Management, Division of Fish and Wildlife, West Kingston, RI 02892;* [5]*Wood Pawcatuck Watershed Association, Hope Valley, RI 02832*

P3 **Examining trophodynamic, climate, and exploitation effects with a multispecies production model.** Gamble, Robert, Jason Link, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543*

P4 **Magnitude and analysis of marine ornamental fish and invertebrates entering the United States.**** Holmberg, Robert[1], Laura Stevenson[1], and Andrew L. Rhyne[2,3], [1]*Roger Williams University, Department of Environmental Science, Bristol, RI 02809;* [2]*Roger Williams University, Department of Marine Biology, Bristol, RI 02809;* [3]*New England Aquarium, Boston, MA 02110-3309*

P5 **The significance of the human-marine mammal relationship in the effectiveness of training.**** Hulbert, Kimberly[1,2], [1]*U.S. Coast Guard Academy, New London, CT 06320;* [2]*Mystic Aquarium, Mystic, CT 06355*

P6 **Mercury bioaccumulation in elasmobranchs.**** Kutil, Nicholas and David L. Taylor, *Roger Williams University, Department of Marine Biology, One Old Ferry Rd, Bristol, RI 02809*

P7 **Ecological indicator thresholds respond to both fishing pressure and environmental forcing.** Large, Scott I., Gavin Fay, and Jason S. Link, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543*

P8 **Movement patterns of *Limulus polyphemus* between two adjacent embayments with varying harvesting pressures: Implications for management.**** Martinez, Sarah[1,2], K. Terkanian[1,2], A. Danylchuk[2], F. Juanes[2], and Vin Malkoski[3], [1]*Massachusetts Audubon Society, South Wellfleet, MA 02663;* [2]*University of Massachusetts at Amherst, Department of Environmental Conservation, Amherst, MA*

01003; [3]Massachusetts Division of Marine Fisheries, Pocasset, MA 02559

P9 **Intra-fish variability in Atlantic salmon (*Salmo salar*) smolt scales from the Sheepscot River, ME.**** McCarthy, Molly[1], Ruth Haas-Castro[2], and Mark Renkawitz[2], *[1]University of Rhode Island, Department of Fisheries, Animal and Veterinary Sciences, Kingston, RI 02881; [2] NOAA National Marine Fisheries Service, Woods Hole, MA 02543; mmccarthy11@my.uri.edu*

P10 **Modeling gradients of abundance of yellowtail flounder (*Limanda ferruginea*) across the boundary of a temperate marine protected area.**** Miller, Jonas and Chris P. Shivock, *U.S. Coast Guard Academy, New London, CT 06320*

P11 **Study on management of Atlantic bluefin tuna (*Thunnus thynnus*) in the Northeast Region of the United States.**** Morris, Brett and Alex Cropley, *U.S. Coast Guard Academy, New London, CT 06320*

P12 **Historical abundance of early life history summer flounder (*Paralichthys dentatus*) in the Narragansett Bay.**** Palance, Danial G. and David L. Taylor, *Roger Williams University, Department of Marine Biology, One Old Ferry Rd, Bristol, RI 02809*

P13 **Tropical fish spawning in cold climates: Developing a photographic key based on barcodes for species spawning at public aquariums.**** Sme, Noel[1], Andrew L. Rhyne[1,2], Michael Tlusty[2], Dan Laughlin[2], and Brad Bourque[1], *[1]Roger Williams University, Bristol, RI 02809; [2]New England Aquarium, Boston, MA 02110*

P14 **Identifying spawning events of the sea scallop, *Placopecten magellanicus*, on Georges Bank.**** Thompson, Katherine, Susan Inglis, and Kevin D. E. Stokesbury, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, Fairhaven, MA 02719*

P15 **Spermatogenesis, reproductive maturation, and spawning seasonality of male winter flounder, *Pseudopleuronectes americanus*.** Towle, Emilee K., W. David McElroy, Yvonna K. Press, and Richard S. McBride, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543*

P16 **Physiological effects of recreational catch and release angling on summer flounder (*Paralichthys dentatus*) in Long Island Sound.**** Vogt, Patrick R. and John T. Kelly, *University of New Haven, Department of Biology and Environmental Science, Marine Biology Program, West Haven, CT 06405*

** Denotes student poster

ABSTRACTS:
Platform Presentations

Modeling interannual variability in larval haddock, *Melanogrammus aeglefinus*, transport patterns on Georges Bank. Boucher, Jason M., Chen Changsheng, and Tian Rucheng, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, New Bedford, MA 02744; jboucher1@umassd.edu*

Fluctuations in the year-class strength of haddock, *Melanogrammus aeglefinus*, on Georges Bank have been attributed to variability in the spawning stock, environmental conditions, feeding conditions, and/or predation. For successful self-recruitment to occur, individuals must remain in the nursery area and survive through the early life history stages. Numerical modeling experiments coupling an individual-based model to the FVCOM physical model were utilized to estimate variability in transport of haddock eggs and larvae from 1995 through 2009. Passive individuals released on the northeast peak of Georges Bank were tracked for ninety days under stratified, wind-induced mixing, or wind-induced mixing with vertical shear conditions. Physical driving on Georges Bank varies on multiple time scales, directly impacting the dispersal dynamics of passive individuals. Wind forcing and circulation patterns resulted in substantial interannual differences in transport, with highest retention rates in 2000 and lowest in 1996. Above average retention in 2003 indicates that good retention appears to be necessary but not sufficient to explain large recruitment events for haddock on Georges Bank.

The effect of elevated CO_2 on the growth and food consumption of juvenile winter flounder *Pseudopleuronectes americanus*. Bumpus, Chris[1,2], Janet Nye[2], Jason Grear[2], Doranne Borsay Horowitz[2], and Jesyka Melendez[1,3], [1]*University of Rhode Island, Graduate School of Oceanography, Narragansett, RI 02882;* [2]*U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI 02882;* [3]*Universidad de Puerto Rico en Cayey, 205 Avenida Antonio R. Barceló Cayey, PR 00736; bumpus.chris@epa.gov*

Increasing levels of atmospheric carbon dioxide are causing changes in seawater chemistry in the world's oceans. In estuarine waters, atmospheric CO_2 exacerbates already declining pH due to high productivity and respiration caused by cultural eutrophication. These two sources of CO_2 in estuarine waters may even reduce the buffering capacity of seawater to further increasing levels of CO_2. The effects of reduced pH on estuarine-dependent organisms may be as severe or as variable as those seen in marine organisms, but few estuarine species have been studied. Winter flounder is a commercially important fish species whose landings in Southern New England are at their lowest levels in history and declines in recruitment have been observed in estuaries coastwide. Adult winter flounder spawn in bays and estuaries where their offspring may be exposed to low pH waters. In this study, we exposed juvenile winter flounder to levels of CO_2 projected to occur within this century, to determine its effects on growth and food consumption. Over a 14-day experiment, growth and consumption were reduced in the CO_2-treated fish. However, we detected no difference in their ability to capture live prey in simple predator-prey experiments. Slower growth could affect juvenile survival and adult condition through a variety of mechanisms, suggesting that increases in CO_2 could indirectly impact the winter flounder population.

Angler survey of the Connecticut River: Have angler impacts on Connecticut River fish populations increased over the last decade? Davis, Justin, Neal Hagstrom, and Bob Jacobs, *Connecticut Department of Energy and Environmental Protection, Inland Fisheries Division, Marlborough, CT 06447; justin.davis@ct.gov*

The Connecticut River is the largest and most diverse inland fishery resource in the State of Connecticut. Significant improvements in water quality over the past 30 years have led to progressive increases in recreational use, presumably increasing fishing pressure on some species and possibly decreasing overall fishing quality. To address this concern, the Inland Fisheries Division (IFD) of the Connecticut Department of Energy and Environmental Protection (CT DEEP) conducted an angler survey on the entire portion of the Connecticut River within the state during March-October of 2008-09. The survey used a similar design as a smaller-scale survey of the river's fisheries conducted during 1997-98. The objectives of the 2008-09 survey were to assess contemporary angler effort, catch, and harvest, as well as to quantify changes in these quantities since the 1997-98 survey. In addition, the 2008-09 survey assessed angler demographics and attitudes towards harvesting fish. Anglers spent an estimated 263,264 hours annually fishing on the Connecticut River during March-October of 2008-09, catching 35 different fish species. Total angler effort declined by 29-32% between 1997-98 and 2008-09. Declines in effort were largely the result of declines in shore angling effort as well as reduced angling activity during July-August. Total catch of species typically targeted by shore anglers declined by 26-82% between 1997-98 and 2008-09; harvest rates for almost all species either decreased or did not change. Overall, there was no evidence that angler impacts to Connecticut River fish populations have increased over the last decade.

Exploratory stock identification of winter flounder in the Great South Channel.
DeCelles, Greg and Steve Cadrin, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA 02719; gdecelles@umassd.edu*

Winter flounder in U.S. waters are currently managed as three regional stock complexes; Southern New England/Mid-Atlantic, Georges Bank and the Gulf of Maine. The southern New England stock complex is currently overfished, and managed under a ten-year rebuilding plan. In response to slower than anticipated stock rebuilding, the fishery for winter flounder in southern New England has been closed since 2009. Few studies have examined the stock structure of winter flounder in the Great South Channel, which is near the management unit boundary between southern New England and Georges Bank..

Fishermen familiar with the region contend that winter flounder in the Great South Channel are a unique stock, and should be assessed and managed separately. A recently completed industry-based survey found large abundances of winter flounder in the Great South Channel, suggesting that flounder in the Channel are exhibiting a distinctly different trend in productivity than the regional stock complex as a whole. To investigate the stock identity of winter flounder in the Great South Channel, a subsample of fish (n = 237) captured during the survey were retained for meristic analysis. Dorsal and anal fin ray counts, which have previously been used to differentiate between winter flounder stocks, were enumerated for each fish. Fin ray counts of winter flounder from the Great South Channel were significantly different ($P<0.001$) than values previously reported for the southern New England stock complex (Perlmutter, 1947). For anal fin ray counts, no significant difference ($P=0.34$) was found between winter flounder sampled in the Channel and earlier values reported for Georges Bank. However, a significant difference ($P=0.005$) was found for dorsal fin ray counts of flounder taken from the Channel and Georges Bank. The results suggest that winter flounder in the Great South Channel may be part of the Georges Bank stock, but contemporary sampling from each putative stock and further interdisciplinary stock identification research is needed to confirm the results of the meristic analysis.

Testing thresholds in ecological indicators as tools for ecosystem-based fisheries management using multispecies production models. Fay, Gavin, Jason S. Link, Robert J. Gamble, and Scott I. Large, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543; gavin.fay@noaa.gov*

Threshold values in ecological indicators have been suggested as useful tools for implementation of ecosystem-based fisheries management, by defining possible values for reference points associated with change points in marine ecosystems. Successful application of ecological indicators as fisheries management tools requires an understanding of how changes in system drivers (including exploitation) translates to both changes in the values for individual indicators, and in the interactions among indicators. We use a simulation model of the finfish community in the Northeast US Large Marine Ecosystem to evaluate tradeoffs and changes among values for proposed ecological indicators given alternative fishing scenarios. A multispecies biomass production model, which incorporates competition and predation in addition to harvest of target species, is used to generate time series of ecological indicators. We examine how changes in these indicator values are driven by fishing pressures, and explore how these indicators are sensitive to community dynamics. We compare responses in indicators among scenarios that consider caps on system-wide catch levels in addition to single-species exploitation rates. Finally, we discuss how the simulation framework can be extended to employ Management Strategy Evaluation for testing the performance of indicator-based fishery harvest control rules relative to single species approaches to fisheries management.

Potential influence of climate change on the response of an endangered spring-run Chinook population to habitat restoration in the Pacific Northwest. Honea Jon[1,2], Jeff Jorgensen[1], Michelle McClure[1], and Mark Scheuerell[1], [1]*NOAA Fisheries Service, Northwest*

Fisheries Science Center, Seattle, WA 98112; [2]Emerson College, Boston, MA 02116; jon_honea@emerson.edu

Localized changes in water temperature and flow regime as a consequence of predicted changes in global climate have the potential for profound impacts on aquatic organisms, particularly those already at risk due to other stressors. We coupled a system of high resolution Distributed Hydrology Soil and Vegetation Models (DHSVMs) calibrated for the Wenatchee River and its tributaries with a spatially explicit lifecycle population model calibrated for the endangered spring-run Chinook salmon population that lives in the basin. The population model estimated survival at each life stage transition in each subwatershed of the basin based on habitat condition, including water temperature and discharge estimates that were produced by the DHSVMs under scenarios of future change in air temperature and precipitation. The integrated physical and population models indicated that the abundance of this already endangered salmon population may decline further by the end of the century following increased stream water temperatures and decreased discharge. Furthermore, climate change substantially reduced the positive effects of maximum potential habitat restoration. Decline in survival through the spawner stage due to increased water temperature was responsible for most of the change in salmon numbers resulting from climate change. Our study illustrates the value of combining high resolution models of habitat change, such as the DHSVM, with salmon population dynamics models to estimate fish response to climate change, and thereby contribute to salmon recovery efforts and water management decisions.

Evaluating habitat use of bridle shiner while accounting for imperfect detection.

Jensen, Timothy and Jason C. Vokoun, *University of Connecticut, Department of Natural resources and the Environment, Storrs, CT 06269; timothy.jensen@uconn.edu*

Bridle shiner (*Notropis bifrenatus*) have reportedly declined throughout much of their native range in eastern North America, carrying special designations ranging from state-endangered to regionally rare. In the most recent Connecticut state-wide stream survey, bridle shiner were found to occupy only 15% of the sites they once inhabited. In general, the progressive extirpation of this species has been attributed to habitat alteration, although specific requirements have not previously been identified. Evaluating habitat use by rare species is confounded by the fact that the species may not always be detected when present (i.e., imperfect detection). We used patch occupancy modeling to identify factors that comprise bridle shiner habitat while accounting for imperfect detection. Twenty habitat patches spread across 10 km of stream in southeastern Connecticut were repeatedly sampled during three survey periods in spring and summer 2011. Fish were sampled using a fine-mesh seine equipped with a bag. Patch area, nearest-neighbor distance, lotic/lentic ecosystem classification, macrophyte percent cover, mean depth, mean velocity, and mean temperature were determined for each survey period. Detection probability (p) was lowest in late-spring (p=0.52, SE=0.10) and highest in late-summer (p=0.82, SE=0.06). Covariates to occupancy and detection were evaluated using an information-theoretic approach. Velocity was selected as the best covariate to detection probability, with detectability decreasing as velocity increased. Velocity and nearest-neighbor distance were the best

covariates to patch occupancy during mid- and late-summer surveys. Macrophyte percent cover was the best covariate to occupancy during late-spring, which is peak spawning period for the species. These results indicate that bridle shiner select low velocity habitats where late-spring macrophyte cover is high. Bridle shiner monitoring programs should focus efforts on such habitats where the probabilities of occupancy and detection are highest. Furthermore, these habitat characteristics may be used to determine critical bridle shiner habitat for conservation and identify potential translocation sites to re-establish extirpated populations.

Selection of spawning habitats by horseshoe crabs (*Limulus polyphemus*) along the complex Connecticut coast. Landi, Alicia[1], Jason Vokoun[1], Peter Auster[2], and Penny Howell[3], [1]*University of Connecticut, Department of Natural Resources and the Environment, Storrs, CT 06269;* [2]*University of Connecticut at Avery Point, Department of Marine Sciences, Groton, CT 06340;* [3]*Connecticut Department of Energy and Environmental Protection, Marine Fisheries Division, Old Lyme, CT 06371; alicia.landi@uconn.edu*

The Atlantic horseshoe crab (*Limulus polyphemus*) is a multiple-use resource that has recently come under environmental conflict. This research focused on the Long Island Sound population of horseshoe crabs and aimed to characterize the coastal habitats of Connecticut by various traits using remote sensing and geographic information system technologies. Data layers representing the coastal area were created within which slope, wave exposure, substrate type, and distance from offshore aggregations of crabs were summarized for the western, central, and eastern regions of Connecticut. Spawning abundances derived from field surveys of a subsample of sites conducted in May-June of 2009 and 2010 were used with the remotely sensed habitat characteristics to develop a resource selection function from a candidate model set based on polytomous logistic regression. An information-theoretic approach was followed to select a best approximating model for predicting the probability of habitat use by spawning horseshoe crabs. A single best model (Akaike w_i = 0.967) was selected that included slope, wave exposure, and distance. The parameter estimates predicted a higher probability of habitat use with increasing slope, decreasing wave exposure, and decreasing distance from offshore hotspots. This research described the potential spawning habitats of horseshoe crabs at a landscape scale and can be used by habitat managers as a starting point for selection of spawning survey locations.

Use of dual-frequency identification sonar (DIDSON) to monitor adult river herring in a small coastal stream. Magowan, Kevin[1], Joshua Reitsma[1,2], and Diane Murphy[1,2], [1]*Cape Cod Cooperative Extension, Barnstable, MA 02630;* [2]*Woods Hole Sea Grant, Woods Hole, MA 02543; kjmagowan@yahoo.com*

A standard Dual-Frequency Identification Sonar (DIDSON) was deployed in the Herring River, Harwich, Massachusetts for three days in April 2011 to capture video-like images of migrating adult river herring (i.e. alewife *Alosa pseudoharengus*, and blueback herring

Alosa aestivalis). Images recorded 24 hours a day were used to manually count and assign species based on DIDSON images of fish size, shape and behavior. Manual fish counts using DIDSON images estimated the river herring run size to be 1,976 to 2,059 individuals during the study. River herring often temporarily displayed an avoidance behavior towards the DIDSON signal and/or the study site, hesitating to pass the site, however, the herring eventually did pass and often multiple times. This unique avoidance behavior displayed by river herring, complicated counting efforts though was beneficial to discerning species using DIDSON images. With many clear images of river herring collected, DIDSON proved to be an effective type of sonar to monitor and count river herring continuously in a small coastal stream.

Modeling Pacific Hake, *Merluccius productus*, distribution using satellite and oceanographic modeling products. O'Connor, Megan[1] and Melissa Haltuch[2], *[1]NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI 028802; [2]NOAA Fisheries Service, Northwest Fisheries Science Center, Seattle, WA 98112; megan.oconnor@noaa.gov*

Pacific hake are generally distributed along the Pacific west coast of North America from southern California to southeast Alaska and comprise the largest fishery by volume off the west coast of the United States and Canada. Adult hake undergo extensive summer migrations between their winter spawning grounds off of southern California and their northern summer feeding grounds off the west coast of Vancouver Island. The distribution of hake backscatter collected by the joint Canadian Department of Fisheries and Oceans and National Marine Fishery Services acoustic survey along the west coast of North America was modeled in descriptive and forecasting frameworks using biological and physical covariates. The physical covariates were obtained from, observations, satellite products and oceanographic modeling outputs. Satellite products included sea surface temperature (SST) and surface wind velocity. Oceanographic modeling outputs included temperature and velocity at depth (100-300 m). Hake age composition and Bakun's cumulative upwelling index (CUI) were two additional covariates used in the analysis. Age composition was found to be the most important determinant of the north-south distribution of hake.

Using molecular techniques to identify Atlantic Cod (*Gadus morhua*) remains in Spiny Dogfish (*Squalus acanthias*) stomach contents. Pitchford, Steven[1], Brian Smith[2], Sheila Stiles[1], Christopher Brown[1], and Richard McBride[2], *[1]NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Milford, CT 06460; [2]NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543; Steven.Pitchford@noaa.gov*

Fish stomach contents of the northeast U.S. continental shelf have been examined macroscopically by the Northeast Fisheries Science Center for over 30 years. In the case of some piscivores, however, up to 30% of the stomach contents by mass are unrecognizable bony fish remains and are therefore labeled as Osteichthyes. In addition, large fractions of the remaining gut contents are identified only to the Family or Genus level. To increase the resolution of prey and better quantify specific trophic relationships, the use of molecular-based identification techniques is rapidly expanding. The goal of this pilot study was to determine if Atlantic Cod remains could be detected in the stomach contents of spiny dogfish. DNA was extracted from unidentified fish remains recovered from 7 dogfish stomachs. As an initial screen for possible cod remains, a pair of gadid-specific Polymerase Chain Reaction (PCR) primers was used to amplify a 132 base-pair region of the mitochondrial 16s rRNA gene. The results from gel electrophoresis indicated that one of the seven dogfish stomach samples (X36) contained a member of the Gadidae family. To identify X36, PCR was repeated with specific fish primers for the mitochondrial cytochrome C COI gene, or "barcoding" gene, and sequenced. The sequence was then compared to those held in both Genbank and to the BOLD (Barcode of Life Database) and was identified as Atlantic Cod (>99% similarity). Prescreening at the Genus or Family level, prior to sequencing can save considerable time and expense, especially if a large number of unknown stomach samples need to be analyzed for the presence of just one or two specific prey.

Using spatially-explicit spawning stock distributions and larval connectivity models to downscale stock-recruit relationships. Shank, Burton V.[1], G. Law[2,3], D.R. Hart[1], K.D. Friedland[4], and J. Quinlan[2,5], *[1]NOAA National Marine Fisheries Service, Woods Hole, MA 02543; [2]Rutgers University, New Brunswick, NJ 08901; [3]Oregon Health & Science University, Portland, OR 97239; [4]NOAA National Marine Fisheries Service, Narragansett, RI 02882; [5]NOAA National Marine Fisheries Service, Miami, FL 33149; burton.shank@noaa.gov*

Understanding the processes causing interannual variability in recruitment is a central research priority in fisheries research. However, processes that affect recruitment may occur at finer scales than the spatial extent of the stock. Averaging over the too large of a spatial scale can mask the underlying recruitment dynamics that are generated by finer-scale processes, possibly contributing to the poor fit common in many stock-recruit relationships. Using 24 years of survey data for sea scallops (*Placopecten magellanicus*), we reconstruct the spatiotemporal dynamics of recruitment in the Mid-Atlantic Bight (MAB) and spawning stock biomass in the MAB and Georges Bank (GB). Sea scallop recruitment is spatially structured at scales smaller than the stock domain and recruitment time series for subregions within the MAB are poorly correlated when separated by >100km. We estimated spatially-explicit larval supply to subregions in the MAB by linking the spatial distribution of spawning stocks to an environmentally-forced, individual-based model of larval transport. Both shifting spatial distributions of adult spawning stock and variability in larval transport contribute to spatiotemporal heterogeneity in larval supply. For much of the MAB, larval supply from GB is estimated to be greater than the supply from within the MAB. However, larval supplies from the GB stock are more sensitive to variability in coastal circulation than the MAB stock. Modeled realized connectivity produces spatial structures at similar scales to observed recruitment. However, estimated realized connectivity is a poor predictor for observed recruitment. We conclude that larval transport models have potential to address spatiotemporal variability in recruitment processes. However, other processes that occur prior to spawning, during the larval period, and after settlement are necessary for elucidating the importance of larval connectivity in determining recruitment patterns.

Population genetic analysis of Atlantic horseshoe crabs (*Limulus polyphemus*) in coastal Massachusetts. Terkanian, Katherine[1,2], [1]*University of Massachusetts Amherst, Amherst, MA 01003;* [2]*Massachusetts Audubon Society, South Wellfleet, MA 02663; kterkani@eco.umass.edu; horseshoecrab@massaudubon.org*

The Atlantic horseshoe crab is an ecologically and economically important animal that is often overlooked. They are integral to modern medicine and a keystone species in the Atlantic ecosystem. Their role as food source for endangered shorebirds, bait for the eel and conch fisheries, and their biomedical and scientific uses make them an invaluable resource that must be preserved. Management practices currently consider the entire stock of Massachusetts horseshoe crabs as one unit. Harvesters are permitted to take 400 crabs per day, which potentially could remove an entire beach's population from the system. I am currently looking to determine if there are genetically distinct subgroups by examining twelve microsatellite loci in crabs from ten different geographic locations across Massachusetts. If there are genetic differences that correspond to geographic separation, then local populations could be more susceptible to local depletion and should be considered different units with separate management requirements.

***Rhinichthys atratulus*, the Eastern Blacknose Dace, post-Glacial recolonization of New England.** Tipton, Michelle L. and Barry Chernoff, *Wesleyan University, Middletown, CT 06459; mtipton@wesleyan.edu*

Post-glacial colonization is well researched in the field of phylogeography. However, a large gap exists for the study of post-glacial colonization of flora and fauna in the Northeast region of the United States and adjacent Canada. Of specific interest to us are the fishes. We have begun conducting the only phylogenetic study of any New England fishes published to date for the freshwater fish species *Rhinichthys atratulus,* the Eastern Blacknose Dace (Tipton et al. 2011). At the end of the last glacial maximum, deglaciation in this region began only ~20,000 years ago (Hewitt 2000), representing a very recent (geologically and evolutionarily speaking) starting point for the progression to the flora and fauna communities that we consider native today. But where did they come from? This study will determine the glacial refugia or refugium responsible for harboring the populations that recolonized the northern part of their current day distribution. Two mitochondrial genes and nine microsatellites have been sequenced revealing multiple refugia contributed to the recolonization of *R. atratulus's* northern extent. These genetically distinct populations rarely mix, illustrating an east-west divide. The data indicate glacial refugia locations were likely in Pennsylvania and New Jersey, supporting the Pleistocene refugia theory of these southeast locales harboring the populations during the last ice age (Schmidt 1986; Whitworth 1996). We also conclude that the rivers in the state of Connecticut served as a gateway to the eastern post glacial recolonization. We theorize that they specifically dispersed through the temporary glacial river in Long Island Sound before it was inundated by seawater (Stone et al. 2005; Tipton et al. 2011). This study begins to reveal the complex and recent history of the phylogeography of fishes in this region with the elucidation of their origins and recolonization routes which may be applicable to many other freshwater fishes in the region.

Changes in larval flatfish distributions on the northeast U.S. continental shelf. Walsh, Harvey J., David E. Richardson, and Jonathan A. Hare, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Narragansett, RI 02882; Harvey.Walsh@noaa.gov*

Changes in climate and fishing affect juvenile and adult fish distributions on the northeast U.S. continental shelf. Many species have experienced shifts northward and into deeper waters (Lucey and Nye 2010, Nye et al. 2009). Shifts in distribution of adults may cause shifts in spawning distribution potentially affecting larval dispersal, settlement patterns, and ultimately recruitment. The Northeast Fisheries Science Center (NOAA / NMFS) has conducted ichthyoplankton sampling along the northeast U.S. continental shelf since the early 1960's. The Marine Resources Monitoring, Assessment and Prediction (MARMAP; 1977 - 1987) and Ecosystem Monitoring (ECOMON; 1999 - present) programs conducted shelf-wide surveys from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia. We examined the larval distributions of seven flatfish species between the two programs to determine if distributions had changed over the four decades. The seven species were Gulf Stream flounder, fourspot flounder, summer flounder, windowpane, winter flounder, witch flounder, and yellowtail flounder. The relative larval proportion (percent of annual sum) of estimated absolute number of larvae within each of 47 strata by year and bimonthly season was calculated. Significant differences of stratum larval proportion between MARMAP and EcoMon for each bimonthly season were tested using a Kruskal-Wallis H test. All seven species showed changes in larval distribution. Gulf Stream flounder, witch flounder, and yellowtail flounder all exhibited northward shifts in larval distribution. Fourspot flounder, summer flounder, windowpane, and winter flounder changed distribution among strata, but with no obvious pattern. In conclusion, the distribution of larvae has changed over four decades and in three of the seven species examined, there was clear evidence of a poleward shift. The consequences of these changes in larval distribution for the population dynamics of the species need to be evaluated, but this study provides further evidence that conditions in the northeast U.S. shelf ecosystem have changed over the past 40 years.

ABSTRACTS:
Poster Presentations

The performance of the Northwest Atlantic cooperative Research Set Aside programs.
Adams, Erin K. and Daniel Georgianna, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, Fairhaven, MA 02719; erin.adams@umassd.edu*

Research Set-Asides (RSA), where a portion of the Total Allowable Catch (TAC) is set-aside to fund high priority research not covered by U.S. state or federal funding in the support of fishery management plans, have been implemented in the sea scallop, monkfish, herring, and mid-Atlantic fisheries in the Northwest Atlantic. First initiated in the Atlantic sea scallop fishing industry in 2000, the set-asides research priorities are allocated through the New England and Mid-Atlantic Fishery Management Councils. The RSA is a unique program where fishermen fund and actively co-work with scientists to produce information for use in fisheries management. While there are many encouraging aspects of the RSA program such as a fostering of cooperative fisheries research between the fishing industry and scientists, and the opportunity to collect valuable fisheries data, little evaluation of the program's performance has occurred. The objective of our research is to develop performance measures of the four different Research Set-Aside programs during the fishing years 2000 through 2009 and create a performance baseline to aid in the development of the overall RSA program. Performance measures include success in fulfilling stated priorities of the RSA program, scientific contributions, and promotion of stewardship and governance in the fishing industry. Indicators for these performance measures have been developed and will be applied to individual RSA projects, individual RSA programs, and the overall RSA program. Through the creation of a baseline for RSA program, the continued development of the RSA, and consequently cooperative fisheries research, will result.

Diadromous fish passage restoration at three mainstem dams on the Pawcatuck River, southwestern Rhode Island. Ferry, Kristen[1], James Turek[2], Sean Arruda[3], Nils Wiberg[3], Phil Edwards[4], and Chris Fox[5], [1]*NOAA Restoration Center, Gloucester, MA 01930;* [2]*NOAA Restoration Center, Narragansett, RI 02882;* [3]*Fuss & O'Neill, Providence, RI 02908;* [4]*Rhode Island Department of Environmental Management, Division of Fish and Wildlife, West Kingston, RI 02892;* [5]*Wood Pawcatuck Watershed Association, Hope Valley, RI 02832; Kristen.Ferry@noaa.gov*

The Pawcatuck River is a 300-mi^2 Southern New England watershed, which historically provided significant spawning and rearing habitat for diadromous fishes. The presence of 8 mainstem dams and 20 structures on its tributaries has contributed to the decline of American shad (*Alosa sapidissima*), river herring (*Alosa pseudoharengus, Alosa aestivalis*), and American eel (*Anguilla rostrata*) in the Pawcatuck. With a 2009 American Recovery and Reinvestment Act funding award through NOAA, Pawcatuck restoration partners focused on creating passage at the three remaining significant mainstem barriers. Restoration methods included dam removal and installation of nature-like weirs, construction of a Denil fishway and eel pass, and construction of a rock ramp. The removal of the Lower Shannock Falls Dam was supplemented by bedrock removal and backwatering weir installation to improve fish passage efficiency at the site. Installation of a Denil fishway at the Horseshoe Falls Dam along with a gravity fed eelway and an outmigration passage is expected to provide effective passage at this historic structure. At the uppermost Kenyon Mill Dam, a river-wide rock ramp will be installed to provide fish passage, while maintaining an emergency fire water supply source to the nearby mill and local village. Design and construction challenges associated with each of these projects will be presented. The innovative design measures applied in these projects are expected to serve as examples for future fish passage projects in the region. When complete in 2012, these three projects will provide access to an 87-mi^2 portion of the watershed for diadromous fishes.

Examining trophodynamic, climate, and exploitation effects with a multispecies production model. Gamble, Robert, Jason Link, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543; robert.gamble@noaa.gov*

A triad of drivers (trophodynamic, climate, and exploitation) that affect marine ecosystems is a valuable concept in the developing field of using models for Ecosystem Based Fishery Management. A relatively simple, multispecies production model (MS-PROD) was parameterized based on the Northeast Continental Shelf Large Marine Ecosystem (NES LME) in order to explore the relative effects of the drivers on the simulated fish community. MS-PROD explicitly models trophodynamic interactions (competition and predation) and exploitation. Adjustments to the growth rates of selected species were done to simulate the effects of increasing temperature in the NEUS LME. The results indicate that simple multispecies production models can be valuable tools in exploring the effects of the triad of drivers, as the simple change to growth rates which simulates climate effects, does not always lead to intuitive and expected responses among the species modeled. In a community with strong interactions between species, at an aggregate level, functional groups that were affected by a 10% decrease in intrinsic rate of growth tended to decrease, while the other functional groups which competed with them, or were prey, tended to increase. However, our results show that even if all members of a functional group (e.g. groundfish) have a 10% decrease in their intrinsic rate of growth, some members of that group exhibited an increase in biomass compared to the simulations where climate effects were not included, because of the trophodynamic interactions between species. Additionally, increasing levels of exploitation appeared to intensify the effects of climate more than when climate was considered alone. The value of such simulations is that it allows fishery managers to explore potential harvest levels under different climate scenarios, and illuminates possible risks to both targeted and non-targeted species in an ecosystem before those harvest levels are applied to the actual ecosystem.

Magnitude and analysis of marine ornamental fish and invertebrates entering the United States. Holmberg, Robert[1], Laura Stevenson[1], and Andrew L. Rhyne[2,3], [1]*Roger Williams*

University, Department of Environmental Science, Bristol, RI 02809; [2]Roger Williams University, Department of Marine Biology, Bristol, RI 02809; [3]New England Aquarium, Boston, MA 02110-3309; rholmberg278@g.rwu.edu

The international trade of live marine animals is a multi-billion dollar industry fueled in part by the aquarium trade; approximately 95% of these organisms are captured from the wild. A loss in biodiversity, overfishing, the threat of introductions of nonindigenous species and/or their diseases, and the use of environmentally destructive fishing practices have led to a concern about the sustainability of the trade. This is especially true for coral reefs that are already under intense stress from global climate change, overexploitation, habitat destruction, and poor watershed management. The aquarium trade has seen a shift in consumer preference since 1990 from fish-only aquariums to miniature reef ecosystems. Collectors now extract the full suite of coral reef biodiversity for both life support and aesthetic roles in home aquariums, and the total number of animals collected has increased. By quantifying and identifying the marine ornamental species imported into the U.S., starting with the 2004-2005 year, we have provided a foundation to infer effects on biodiversity and the ecosystem as well as monitor the importation of marine ornamentals. Data was collected from invoices provided by the U.S. Fish and Wildlife Service, entered into our database both manually and with text recognition software. Analysis revealed that previous estimates of biodiversity consumption by the trade are greatly underestimated.

The significance of the human-marine mammal relationship in the effectiveness of training. Hulbert, Kimberly[1,2], [1]*U.S. Coast Guard Academy, New London, CT 06320;* [2]*Mystic Aquarium, Mystic, CT 06355; Kimberly.M.Hulbert@uscga.edu*

Since the early 1900s, marine mammal research has been essential in understanding how to best train captive marine mammal species. These captive marine mammals rely on humans for socialization, food, and shelter. The specific relationship that exists between trainers and captive marine mammals helps create a training environment that results in more effective response and overall training of the marine mammal. The purpose of my study is to evaluate the effect of the relationship between trainers and captive marine mammals on their training. My study is being conducted at the Mystic Aquarium, looking at the relationship of multiple trainers with one beluga whale, Naluark, a 30-year old male on breeding loan from Shedd Aquarium. Observations recorded include enrichment tools used, types of behavior displayed, length of session, and a behavior score based on specific criteria. Observations are on-going with a total of 60 training sessions expected over a period of 20 weeks. Preliminary results from observations have shown that enrichment tools used consisted mainly of basketballs, Frisbees, musical instruments, and buoys. Naluark rarely deviated from the expected behavior and sessions were very successful. The behavior of Naluark will be compared overtime to evaluate improvements, and compared to each trainer and their time of experience. This research should help understand factors that result in improved quality of life for captive marine mammals, by enriching their training experience, reducing stress during medical sampling, and increased understanding of marine mammal behavior.

Mercury bioaccumulation in elasmobranchs. Kutil, Nicholas and David L. Taylor, *Roger Williams University, Department of Marine Biology, One Old Ferry Rd, Bristol, RI 02809; nkutil553@g.rwu.edu*

Mercury (Hg) is a toxic environmental contaminant that bioaccumulates in fish tissues, including numerous marine species. Cartilaginous fish of the subclass Elasmobranchii are important ecological constituents of marine ecosystems, yet the fate of Hg contaminants in their body tissues is largely unknown. In this study, four species of elasmobranchs: little skate (*Raja erinacea*), winter skate (*R. ocellata*), smooth dogfish (*Mustelus canis*), and spiny dogfish (*Squalus acanthias*), were collected from the Rhode Island/Block Island Sound, and the Hg content (ppm wet wt) of white muscle tissue was analyzed using automated combustion atomic absorption spectrometry. Diet and feeding habits for each species were also assessed by stomach content and stable nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotope analyses. Mean Hg concentrations differed significantly among species, with highest levels measured in smooth dogfish (mean Hg = 0.680 ± 0.107 ppm, n = 15), followed by spiny dogfish (mean Hg = 0.312 ± 0.034 ppm, n = 44) and skates (mean Hg = 0.110 ± 0.008 ppm, n = 78 and 0.069 ± 0.005 ppm, n = 56 for little and winter skate, respectively). The Hg concentration of skate muscle tissue did not vary by body weight, suggesting that Hg does not bioaccumulate in these species. Conversely, smooth and spiny dogfish both bioaccumulate Hg with respect to body size, although smooth dogfish have a higher Hg content relative to spiny dogfish. The elevated Hg concentration of smooth dogfish may be explained by their higher trophic level status, as determined from $\delta^{15}N$ signatures (mean $\delta^{15}N$ = 13.29 ± 0.88, 11.82 ± 0.60, 12.33 ± 0.65, and 12.12 ± 1.06 for smooth dogfish, spiny dogfish, little skate, and winter skate, respectively). The enriched $\delta^{13}C$ values of skates and smooth dogfish indicated benthic foraging (range of mean $\delta^{13}C$ = -16.39 ± 0.32 to -17.42 ± 0.46), which was further confirmed by the dominance of decapods and crustaceans in the stomach contents. Conversely, squid and butterfish were the principal prey of spiny dogfish, and the contribution of these pelagic prey was reflected in the depleted $\delta^{13}C$ signature (mean $\delta^{13}C$ = -21.97 ± 0.83). Future work includes researching the effect habitat use and prey Hg to better understand bioaccumulation patterns in these species.

Ecological indicator thresholds respond to both fishing pressure and environmental forcing. Large, Scott I., Gavin Fay, and Jason S. Link, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543; scott.large@noaa.gov*

In addition to fishing, environmental forces ranging from local to global scales may influence the structure of marine ecosystems. To understand these systems and progress towards implementing an ecosystem approach to managing fisheries, ecological indicators of cumulative change should convey the status of fished ecosystems. To use ecological indicators in this context, it is important to understand the relative contributions of fishing pressure and the environment upon the response indicators, and further, to identify inflection points where these drivers significantly influence ecological indicators.
Here, we assessed how ecological indicators change over time, and empirically determined thresholds where environmental forces (i.e., AMO and SST) and fishing pressure significantly influence the response of the ecological indicators. These indicators were

derived from NMFS survey data, and fishing pressure was measured as total landings in the Northeastern United States Large Marine Ecosystem. To calculate thresholds, we used three approaches: dynamic factor analysis, breakpoint analysis, and second derivative estimation. These complementary approaches allowed us to delineate the level at which drivers were significantly influencing the rate and direction of ecosystem indicators. Identifying inflection points and thresholds on more aggregate ecosystem properties is important in establishing the foundation for managing fisheries from a more systemic basis.

Movement patterns of *Limulus polyphemus* between two adjacent embayments with varying harvesting pressures: Implications for management. Martinez, Sarah[1,2], K. Terkanian[1,2], A. Danylchuk[2], F. Juanes[2], and Vin Malkoski[3], *[1]Massachusetts Audubon Society, South Wellfleet, MA 02663; [2]University of Massachusetts at Amherst, Department of Environmental Conservation, Amherst, MA 01003; [3]Massachusetts Division of Marine Fisheries, Pocasset, MA 02559; SMartinez@eco.umass.edu*

Horseshoe crabs (*Limulus polyphemus*) are a valuable and highly contested resource in Massachusetts. They are much admired by the public, conservation groups and the pharmaceutical and fishing industries for the spectacle of their beach spawning behavior, their ecosystem roles as food for migrating shorebirds and the bio-turbation of estuarine habitats, the use of their blood for LAL production, and as bait for the conch and eel fisheries. For these reasons, the sustainability of horseshoe crab populations is of utmost importance to both humans and the ecosystem. We use acoustic telemetry to determine whether areas closed to harvest are acting as source populations for other unprotected areas, or whether they are self-contained spawning sanctuaries where we can expect protected populations to grow, but which will not benefit populations in adjacent embayments. Our approach involves quantifying movement patterns of mature horseshoe crabs. We have acoustically tagged 75 horseshoe crabs (66 females and 9 males) in three locations off the coast of Chatham, MA. Also, 22 fixed listening receivers have been deployed. Movement between the two zones will be quantified and compared via cluster analysis and a multi-response permutation procedure; however, preliminary results show that 28% of crabs tagged in the harvestable zone were detected in the no-harvest zone, while 72% of crabs tagged in the no-harvest zone were detected in the unprotected zone. Of the 65 recaptured crabs, 35% returned for a second spawning season in the next year; only approximately half of these crabs were loyal to their spawning site from the previous year. Our results will help determine if management strategies are effective at maintaining a sustainable population and fishery for both the bait and biomedical industries.

Intra-fish variability in Atlantic salmon (*Salmo salar*) smolt scales from the Sheepscot River, ME. McCarthy, Molly[1], Ruth Haas-Castro[2], and Mark Renkawitz[2], *[1]University of Rhode Island, Department of Fisheries, Animal and Veterinary Sciences, Kingston, RI 02881; [2] NOAA National Marine Fisheries Service, Woods Hole, MA 02543; mmccarthy11@my.uri.edu*

Scale measurements are routinely used for fish growth rate and length-at-age back-

calculations. Variability in features among scales from the same fish may be sufficient to influence scale measurements and subsequently the results of such investigations. We measured 5 scales from 10 Atlantic salmon smolts sampled from the Sheepscot River, Maine, to examine scale variability within each fish. Distances to scale features along a line transect from the scale focus to the scale edge were measured using a computer image analysis system. Distances from the scale focus to the scale edge and to the first freshwater annulus, mean spacing between the first 10 circuli and the total number of circuli per scale did not vary significantly among scales from the same fish. Our study indicates that smolt scales collected from the same region of the fish exhibit little variation in scale morphology. Within-fish variability for scales from adult salmon should be analyzed before assuming that scale variability will not influence growth or other analyses.

Modeling gradients of abundance of yellowtail flounder (*Limanda ferruginea*) across the boundary of a temperate marine protected area. Miller, Jonas and Chris P. Shivock, *U.S. Coast Guard Academy, New London, CT 06320; jonas.p.miller@uscga.edu*

The concept of spillover from marine protected areas is studied broadly in the tropics and coral reef habitats, however much less is known about spillover from marine protected areas into adjacent fisheries in the North Atlantic. This study explores the existence of a population abundance gradient of Yellowtail Flounder (*Limanda ferruginea*) across the Georges Bank Closed Area II Boundary. Georges Bank Closed Area II (CAII) is one of three large-scale no-take marine reserves in the Northwestern Atlantic Ocean. Since 1994, the implementation of CAII has helped facilitates the recovery of overfished groundfish stocks most notably sea scallops (*Placopecten magellanicus*), but also in finfish species such as Yellowtail Flounder. It was hypothesized in this study that a population density gradient exists across the boundary of CAII. A general additive model (GAM) and a geographic information system (GIS) spatial analysis applied to 30 years of dredge data from the NOAA's National Marine Fisheries Service Sea Scallop Survey. The results of both the GIS spatial analysis and the GAM provided evidence (r^2=0.523) of a gradient based on distance, depth, habitat, and spatial variation. These results are similar to studies conducted outside CAII based on industry catch/effort data. The presence of a population gradient across the boundary justifies the industry practice of fishing the line along the boundary of these Closed Areas. A population gradient also provides strong evidence of spillover from CAII within 20 km of the boundary.

Study on management of Atlantic bluefin tuna (*Thunnus thynnus*) in the Northeast Region of the United States. Morris, Brett and Alex Cropley, *U.S. Coast Guard Academy, New London, CT 06320; brett.a.morris@uscga.edu*

The purpose of this study is to further understand the various aspects of fisheries management of Atlantic bluefin tuna (*Thunnus thynnus*) within the waters of the eastern seaboard of the United States. Atlantic bluefin tuna is one of the most popular fish for the Japanese sushi trade, much of which has led to the steep decline in its population size. Atlantic bluefin tuna are known to spawn in the Gulf of Mexico and the Mediterranean Sea.

They are heavily fished along the eastern seaboard of the United States, where they feed on the abundance of smaller bait fish that are present. Many different gear types are used to harvest these fish, and the regulations that fishermen follow depend on these gear types. Over the course of this study, interviews and research in scientific journals was conducted to determine if there was a difference in views among the various individuals in the Atlantic bluefin tuna industry. Preliminary results have shown that the current method of stock assessment does not yield an accurate population size which makes setting effective quota allocations for fishermen difficult. Plans for future research include interviewing agents from the National Marine Fisheries Service (NMFS), other different gear type fishermen, academic researchers, and Coast Guard officers involved with fisheries management. At the conclusion of this study possible solutions for a more accurate stock assessment will be discussed.

Historical abundance of early life history summer flounder (*Paralichthys dentatus*) in the Narragansett Bay. Palance, Danial G. and David L. Taylor, *Roger Williams University, Department of Marine Biology, One Old Ferry Rd, Bristol, RI 02809; dpalance774@g.rwu.edu*

The summer flounder, *Paralichthys dentatus*, is a temperate flatfish that utilizes Mid-Atlantic estuaries during the juvenile, post-settlement stage. Recent anecdotal observations, however, have noted a northward shift in the distribution of these juveniles that now encompasses southern New England estuaries, e.g., the Narragansett Bay (RI/MA, USA). Moreover, the apparent geographic range expansion of juvenile flounder may be mediated by climate change. To this end, the objectives of this study were twofold: (1) determine if there has been a significant increase in the annual abundance of larval and juvenile summer flounder in the Narragansett Bay, and (2) identify if warmer winter water temperatures have contributed to such an increase. Temporal changes in flounder abundance in the Bay and surrounding coastal ponds was synthesized from current and historical data provided by the RI Department of Environmental Management and Roger Williams University field surveys. Moreover, information on long-term changes in winter water temperature in the Bay (January to March) was provided by the URI/Graduate School of Oceanography. The abundance of summer flounder larvae peaked during October and November, whereas juveniles (age-0 and age-1) were most abundant during the late spring and early summer. Historical information further revealed that there has been no change in the annual abundance of flounder larvae. Conversely, the annual abundance of the age-0 and age-1 juveniles has increased significantly in the Bay and surrounding coastal ponds since 1988 and 1993, respectively. Juvenile flounder abundance was also positively correlated with winter water temperature, as hypothesized, although this relationship was not significant at the $p < 0.0\ 5$ level. Accordingly, warm winter temperatures appear to reduce the overwintering mortality of flounder during the transition from plankton to post-settlement juveniles, yet a multitude of environmental factors likely contribute to the observed annual increases in abundance.

Tropical fish spawning in cold climates: Developing a photographic key based on barcodes for species spawning at public aquariums. Sme, Noel[1], Andrew L. Rhyne[1,2], Michael Tlusty[2], Dan Laughlin[2], and Brad Bourque[1], [1]*Roger Williams University, Bristol, RI 02809;* [2]*New England Aquarium, Boston, MA 02110; nsme374@g.rwu.edu*

Public aquaria serve as a foundation for research, education and conservation, through exhibits displaying tropical marine ornamental species. The majority of these organisms are harvested from coral reef habitats, which suffer a loss of biodiversity and reef ecosystem health. The lack of harvesting management often leads to unregulated collection practices, resulting in high mortality and over-harvesting of industry-targeted species. Public aquaria are developing sustainable sources for the acquisition of display specimens. Large marine tanks such as the Giant Ocean Tank at the New England Aquarium in Boston, MA, contain a multitude of species that are spawning naturally. If the identities of the eggs spawned are known, new technologies for sustainably rearing ornamental specimens can be developed, thus reducing the number of organisms collected from reef ecosystems. Species identification through DNA barcoding process examines species richness within a specific gene region and can be used to amass sequence reference libraries. The 16S ribosomal RNA gene has been used in species identification along with the observance of species-specific morphological characteristics, such as egg shape, diameter, oil drop size and color, as well as yolk sac volume. In this study we used the barcoding 16S and COI genes to identify species in the egg and larval life history forms and constructed an effective protocol that can be applied to on-site identifications in public aquaria. Efficient, reliable species identification is an important step in developing a year-round source of tropical fish eggs and larvae for researchers in cold places.

Identifying spawning events of the sea scallop, *Placopecten magellanicus*, on Georges Bank. Thompson, Katherine, Susan Inglis, and Kevin D. E. Stokesbury, *University of Massachusetts Dartmouth, School for Marine Science and Technology, Department of Fisheries Oceanography, Fairhaven, MA 02719; kthompson1@umassd.edu*

The regional spawning patterns of the sea scallop, *Placopecten magellanicus*, on Georges Bank are unknown despite this aggregation being the largest wild scallop resource in the world. Current scallop management employs a rotational system, which depends on recruitment and growth rates and assumes annual autumn spawning. However, semiannual spawning may have important implications for growth rate. This project will identify spawning events in scallop management areas Closed Area I (CAI) and Closed Area II (CAII) on Georges Bank. We hypothesize that spring spawning occurs in addition to autumn spawning. Scallops are collected during a monthly dredge survey in CAI and CAII, which began in March 2011 and will continue through March 2012. Gonads from frozen samples will be freeze-dried and dry gonad weight will be analyzed to identify significant differences between months. Preserved gonads will be examined using histological techniques to verify reproductive stage. Spawning events will be determined by a significant decrease in gonad weight between months and confirmed by histological examination. Bottom temperature will also be measured and analyzed to determine differences between the two areas. This study will contribute to an understanding of spawning events on a

regional scale, which is important to effectively implement rotational management.

Spermatogenesis, reproductive maturation, and spawning seasonality of male winter flounder, *Pseudopleuronectes americanus*. Towle, Emilee K., W. David McElroy, Yvonna K. Press, and Richard S. McBride, *NOAA National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA 02543; Emilee.Towle@noaa.gov*

Spermatogenesis, reproductive maturation, and spawning seasonality of male winter flounder, *Pseudopleuronectes americanus*, were compared among portions of three U.S. stock areas: Gulf of Maine (GOM), Georges Bank (GB), and Southern New England (SNE). Fish were obtained on a monthly basis (Dec 2009–Dec 2010) from commercial fishing vessels participating in cooperative research programs; and supplemental samples were acquired from fisheries-independent research surveys. Using histology, six stages of spermatogenesis were observed, namely, in order of development: primary and secondary spermatogonia, primary and secondary spermatocytes, spermatids, and spermatoza. The seminiferous development was highly homogeneous within the testes of all individuals. The gonadostomatic index (GSI) began increasing in October; by early winter mature males contained spermatozoa and GSI reached its peak values. However, spawning activity peaked at different months for each stock: SNE peaked the earliest, in March; followed by GB, in April; and finally GOM, in April and May. Overall, GOM displayed a lower peak GSI compared to GB and SNE. Histological criteria were applied to define one immature (I) class and five mature classes: developing (D), ripe (R), ripe and running (U), spent (S), and resting (T).Using this I-D-R-U-S-T scheme, maturity ogives were similar among the two inshore stocks (GOM and SNE) but, maturity occurred at a larger size in the offshore stock (GB).

Physiological effects of recreational catch and release angling on summer flounder (*Paralichthys dentatus*) in Long Island Sound. Vogt, Patrick R. and John T. Kelly, *University of New Haven, Department of Biology and Environmental Science, Marine Biology Program, West Haven, CT 06405; jkelly@newhaven.edu*

Summer flounder are a species of commercial and recreational importance in New England, including the coast of Long Island Sound in Connecticut. Many fish that are captured recreationally are released because they do not meet minimum size limits or the angler practices no-take sport fishing (“catch and release”). Hooking and handling exposes fish to injury and stress which may impact survival or success in the wild. To examine the physiological effects of this practice, 48 fish were captured by otter trawl from New Haven Harbor and allowed to acclimate to captivity. Fish were lightly anesthetized, measured (TL, weight), internally PIT tagged, and allowed to recuperate for 14 days before exposure to one of three treatments: 1) control (no treatment), 2) angling (capture by baited hook, 30 sec on hook, transfer to “boat” deck, handling and hook removal), 3) air exposure (30 sec suspended in net). All fish were anesthetized and measured, and blood was collected by caudal puncture from half of each group. Control fish were bled <5 minutes after first contact before the onset of stress from handling, whereas fish in groups 2 and 3 were bled

15 minutes after treatment to allow the treatment-related stress response to develop. After treatment, fish were held in communal tanks, fed a natural diet ad lib, and observed for 16 days before a final measurement. Growth rate was calculated, and blood samples were analyzed for hematocrit, plasma chloride, plasma glucose, plasma lactate, and cortisol. No mortalities were observed following experimental treatment, but physiological indicators of stress were observed in both hooked and air exposed groups.