Northeast Fisheries Science Center Reference Document 14-15

14th Flatfish Biology Conference 2014
Program and Abstracts

December 3-4 2014
Water's Edge Resort and Spa, Westbrook, CT

by Conference Steering Committee: Renee Mercaldo-Allen (Chair), Christopher Chambers, Donald Danila, Mark Dixon, Stephen Dwyer, Elizabeth Fairchild, Penelope Howell, Ambrose Jearld, Thomas Munroe, Christopher Powell, and Sandra Sutherland

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Woods Hole, Massachusetts

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14th Flatfish Biology Conference
2014

December 3rd & 4th
Water's Edge Resort and Spa, Westbrook, CT

Oral Presentations
Salons A/B

Wednesday December 3rd

8:00 a.m. **Registration/Coffee/Continental Breakfast**

8:45 a.m. Welcome and Introduction
Renee Mercaldo-Allen, Chair
NOAA Fisheries, Northeast Fisheries Science Center
Milford Laboratory, Milford, CT

Dr. Fred Serchuk, Senior Scientist
NOAA Fisheries, Northeast Fisheries Science Center
Woods Hole Laboratory, Woods Hole, MA

Session I
Donald Danila, Chair
ASA Analysis & Communication, Inc.
East Lyme, CT

9:00 a.m. Fisheries, Fishers, and Flatfish Biodiversity in Tropical Waters:
The Crossroads of Conservation
Thomas A. Munroe
National Systematics Laboratory, NMFS/NEFSC, Smithsonian Institution, Washington, DC

9:20 a.m. Tropical Flatfish Fisheries: Progress towards Sustainability in the Sole Fishery in the Gambia, West Africa
Kathleen Castro[1], Ousman Drammeh[1], Dawda Saine[2] and Ousman Bojang[2]
[1]University of Rhode Island, Fisheries Center, East Farm, Kingston, RI,
[2]National Sole Fishery Co-management Committee, Bakau Community Fisheries Center, Kanifing Municipality, Kanifing Municipal Council, Gambia, West Africa

9:40 a.m. Windowpane and Winter Flounder Responses to Temperature Extremes in New York/New Jersey Harbor, USA

Dara Wilber[1], Jenine Gallo[2], and Catherine Alcoba[2]
[1]Bowhead Science and Technology, Charleston, SC,
[2]US Army Corps of Engineers, New York District, New York, NY

10:00 a.m. Rearrangement of Mitochondrial Genome in Pleuronectiformes

Xiao-Yu Kong, Wei Shi, Li Gong, Dong-He Li, and Ming Yang
Key Laboratory of Tropical Marine Bio-resources and Ecology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China

10:20 a.m. **Break/Coffee/Refreshments**

Session II

Thomas A. Munroe, chair
National Systematics Laboratory, Smithsonian Institution
NOAA Fisheries, Northeast Fisheries Science Center
Washington, DC

10:40 a.m. A Geospatial Analysis of Winter Flounder (*Pseudopleuronectes americanus*) Habitat Use in Long Island Sound

Jose J. Pereira[1], Penelope Howell[2], Eric Schultz[3], and Peter Auster[4]
[1]NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT, [2]Connecticut Department of Energy and Environmental Protection, Marine Fisheries Division, Old Lyme, CT, [3]Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs, CT, [4]Department of Marine Sciences at the University of Connecticut and Sea Research Foundation at Mystic Aquarium, Groton, CT

11:00 a.m. Trends in Winter Flounder Condition Factor and Demographics in Long Island Sound

Penelope Howell[1], Jose Pereira[2], Kurt Gottschall[1], and Deborah Pacileo[1]
[1]Connecticut Department of Energy and Environmental Protection, Marine Fisheries Division, Old Lyme, CT, [2]NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT

11:20 a.m. Effectiveness of Norwalk Harbor as a Nursery Ground for Winter Flounder, *Pseudopleuronectes americanus*

Richard Harris[1], Susan Steadham[2], and Students from Wilton Marine Biology Club[2]
[1]Earthplace, Westport, CT, [2]Wilton High School, Wilton, CT

11:40 a.m. Nocturnal Off-Bottom Movements of Adult Winter Flounder (*Pseudopleuronectes americanus*) in the Southern Gulf of Maine: Evidence of Selective Tidal Transport?

Elizabeth A. Fairchild[1], Laughlin Siceloff[1], Hunt Howell[1], Bill Hoffman[2], and Michael P. Armstrong[2]

[1]University of New Hampshire, Department of Biological Sciences and School of Marine Science and Ocean Engineering, Durham, NH, [2]Recreational and Anadromous Fisheries, Annisquam River Marine Fisheries Station, Massachusetts Division of Marine Fisheries, Gloucester, MA

12:00 p.m. **Hosted Buffet Lunch**

Session III

Christopher Chambers, Chair

NOAA Fisheries, Northeast Fisheries Science Center
James J. Howard Marine Sciences Laboratory, Highlands, NJ

1:20 p.m. Female Summer Flounder Maturity: a 30 Year Time-series and Accuracy of Macroscopic Classifications

W. David McElroy[1] and Mark Terceiro[2]

[1]Integrated Statistics, Falmouth, MA, [2] NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA

1:40 p.m. Empirical Stock Assessment of Flatfishes as a More Robust Approach to Climate Change

Steve Cadrin, Kevin Stokesbury, and Greg DeCelles

University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA

2:00 p.m. Habitat Stability Factors and Winter Flounder (*Pseudopleuronectes americanus*) Population Fluctuations in Southern New England Inshore Waters 1870-1931

Timothy C. Visel

The Sound School Regional Vocational Aquaculture Center, New Haven, CT

2:20 p.m. Food Web Ecology of *Citharichthys arctifrons,* Gulf Stream Flounder, in the Northwest Atlantic

Stacy Rowe and Brian E. Smith

NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA

2:40 p.m. Biotic Interactions between Age-0 Summer Flounder and Winter Flounder in New England Tidal Rivers
David L. Taylor
Roger Williams University, Department of Marine Biology, Bristol, RI

3:00 p.m. **Refreshment Break**

Session IV

Christopher Powell, Chair
Roger Williams University
Bristol, RI

3:20 p.m. Diel-Cycling Hypoxia and pH Impacts on Juvenile Summer Flounder Growth: Nothing Good Happens after Midnight
Max I. Davidson[1], Timothy E. Targett[1], and Paul A. Grecay[2]
[1]University of Delaware, School of Marine Science and Policy, Lewes, DE, [2]Salisbury University, Department of Biological Sciences, Salisbury, MD

3:40 p.m. The Physiological Effects of Catch and Release Angling on *Paralichthys dentatus* in Long Island Sound
Patrick Vogt
University of New Haven, Department of Biology and Environmental Science, West Haven, CT

4:00 p.m. *In situ* Observations from ROVs Provide Rare Insights on Occurrences, Distributions, Habitat and Behavior of Flatfishes (Teleostei: Pleuronectiformes) in and near Submarine Canyons on the Outer Continental Shelf and Upper Continental Slope off the Eastern United States
Thomas A. Munroe[1], Steve W. Ross[2], Michael P. Rhode[2], and Andrea M. Quattrini[3]
[1]National Systematics Laboratory, NMFS/NEFSC, Smithsonian Institution Washington, DC, [2]University of North Carolina at Wilmington, Center for Marine Science, Wilmington, NC, [3]Southeast Ecological Science Center, US Geological Survey, Gainesville, FL

4:20 p.m. **Poster Set-up**

4:40 p.m. **Hosted Mixer and Poster Session**

Thursday December 4th

8:00 a.m. **Registration/Coffee/Continental Breakfast**

Session V
Elizabeth Fairchild, Chair
University of New Hampshire, Department of Biological Sciences
Durham, NH

9:00 a.m. Benthic Habitat Mapping for Winter Flounder in New York/New Jersey Using Underwater Video and Sled
Casey Stokes[1], David S. Davis[1], Sarah Zappala[1], Catherine Alcoba[2], and Jenine Gallo[2]
[1]Henningson, Durham and Richardson Engineering, Inc., Pearl River, NY, [2]US Army Corps of Engineers, New York District, New York, NY

9:20 a.m. Factors of Yellowtail Flounder Bycatch in the Georges Bank Sea Scallop Fishery
Brooke L. Wright, Catherine E. O'Keefe, Gregory R. DeCelles, and Steve X. Cadrin
University of Massachusetts Dartmouth, School of Marine Science and Technology, New Bedford, MA

9:40 a.m. Assessing Risks of Exposure of Winter Flounder (*Pseudopleuronectes americanus*) to Suspended Sediment Plumes: Two Dredging Scenarios
Douglas Clarke[1], Paul Schroeder[2], and Catherine Alcoba[3]
[1]*HDR Engineering, Vicksburg, MS, [2]Engineer Research and Development Center, Vicksburg, MS, [3]US Army Corps of Engineers, New York District, New York, NY*

10:00 a.m. An Overview of the Biodiversity and Biogeography of Flatfishes (Pleuronectiformes) in Chinese Waters
Xiao-Yu Kong[1] and Thomas A. Munroe[2]
[1]Key Laboratory of Tropical Marine Bio-resources and Ecology, South China Sea Institute of Oceanology, Chinese Academy of Sciences, Guangzhou, China, [2]National Systematics Laboratory, NMFS/NOAA, Smithsonian Institution, Washington, DC

10:20 a.m. Abundance and Distribution of Yellowtail Flounder on Georges Bank
Greg DeCelles[1], Katherine Thompson[2], Megan Winton[2], and Steve Cadrin[1]
[1]University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA, [2]Coonamessett Farm Foundation, East Falmouth, MA

10:40 a.m. **Break/Coffee/Refreshments**

Session VI
Penny Howell, Chair
Connecticut Department of Energy and Environmental Protection
Marine Fisheries Division, Old Lyme, CT

11:00 a.m. Microchemical Signatures in Juvenile Winter Flounder Otoliths Provide Identification of Natal Nurseries
David S. Bailey[1], Elizabeth A. Fairchild[1], and Linda H. Kalnejais[2]
[1]Department of Biological Sciences and School of Marine Science and Ocean Engineering, University of New Hampshire, Durham, NH, [2]Department of Earth Sciences and Ocean Process Analysis Laboratory, University of New Hampshire, Durham, NH

11:20 a.m. Early Life-history Strategy and Habitat Influence the Susceptibility to Ocean Acidification of Two Species of Flatfish from the Northeast USA
Allison Candelmo, Chris Chambers, Ehren Habeck, Kristin Habeck, Matthew Poach, Daniel Wieczorek, and Beth Phelan
NOAA Fisheries, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ

11:40 a.m. A Comparative Analysis of Flatfish Spawning Stock-Recruit Relationships
R. Christopher Chambers[1] and Olaf P. Jensen[2]
[1]NOAA Fisheries, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ, [2]Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ

12:00 p.m. Are Climate Induced Changes Evident in the Flatfish Assemblage of Lower Chesapeake Bay and Its Major Tributaries? A Multi-decadal Perspective
Thomas A. Munroe[1], Troy D. Tuckey[2] and Mary C. Fabrizio[2]
[1]National Systematics Laboratory, NMFS/NOAA, Smithsonian Institution, Washington, DC, [2] Department of Fisheries Science, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA

12:20 p.m. **Closing Comments**

12:30 p.m. **Hosted Buffet Lunch**
Adjourn Meeting

Poster Session
Salon C
Wednesday December 3rd, 4:40 p.m.

Stephen Dwyer[1] and Sandra Sutherland[2], Co-chairs
[1]*Dominion Nuclear Connecticut, Inc.,*
Millstone Environmental Laboratory
Waterford, CT

[2]*NOAA Fisheries, Northeast Fisheries Science Center*
Woods Hole Laboratory, Woods Hole, MA

Seasonal Flatfish Abundance Patterns in a Shallow Estuarine Creek in Georgia, USA over a 10-year Period
Mary Carla Curran and Katherine R. Doyle
Department of Marine and Environmental Sciences, Savannah State University, Savannah, GA

Stock Structure of Winter Flounder in the Great South Channel and Nantucket Shoals
Greg DeCelles
University of Massachusetts Dartmouth, School for Marine Science and Technology, Fairhaven, MA

Can You Dig It? Impact of Dredging on the Abundance of *Pseudopleuronectes americanus* in Clinton Harbor
Emily C. Hauck[1, 2] and Joseph A. DiRenzo[3]
[1]*Cedar Island Marina Research Laboratory, Clinton, CT,* [2]*Southern Connecticut State University, New Haven, CT,* [3]*North Carolina State University, Raleigh, NC*

Seasonal and Diel Patterns of Abundance and Age of Larval Winter Flounder *Pseudopleuronectes americanus* in Barnegat Bay, NJ
Ursula A. Howson[1], Tara Engelken[2], and James Nickels[3]
[1]*Monmouth University, Department of Biology, West Long Branch, NJ,* [2]*Marine Academy of Science and Technology, Sandy Hook, NJ,* [3]*Urban Coast Institute, Monmouth University, West Long Branch, NJ*

Summer Flounder (*Paralichthys dentatus*) Tag Retention of the Dorsal Loop Tag in the Laboratory
John E. Rosendale[1], Beth Phelan-Hill[1], and Jeff Dement[2]
[1]*NOAA Fisheries, Northeast Fisheries Science Center, James J. Howard Marine Sciences Laboratory, Highlands, NJ,* [2]*American Littoral Society, Highlands, NJ*

Specificity and Sensitivity of a PCR-based Approach for Detecting Winter Flounder in Blue Crab Stomachs
Abigail K. Scro[1], Kelly J. Cribari[1], Kathryn R. Markey[2], and David L. Taylor[1]
[1]*Roger Williams University, Department of Marine Biology, Bristol, RI,* [2]*Aquatic Diagnostic Laboratory, Bristol, RI*

Taxonomic Evaluation of Family Cynoglossidae from Indian Waters
Shravan Kumar Sharma
Central Institute of Fisheries Education, Mumbai

Sources of Variation in Estimates of Summer Flounder, *Paralichthys dentatus,* Batch Fecundity
Emilee K. Towle[1], W. Dave McElroy[1], and Richard S. McBride[2]
[1]*Integrated Statistics, Falmouth, MA,* [2]*NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA*

Winter Flounder Larval Morphometrics: Measurement of Early Life Stage Condition in New York/New Jersey Harbor
Dara H. Wilber[1], Laura McLean[2], Catherine Alcoba[3], and Jenine Gallo[3]
[1]*HX5, Charleston, SC,* [2]*Henningson, Durham and Richardson Engineering, Inc., Pearl River, NY,* [3]*US Army Corps of Engineers, New York District, New York, NY*

Modeling Variation in Fecundity of Winter Flounder, *Pseudopleuronectes americanus,* in US Waters: Does the Autodiametric Method Mask Individual Variation?
Mark J. Wuenschel[1], W. David McElroy[2] Emilee K. Towle[2], and Richard S. McBride[1]
[1]*NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA,*
[2]*Integrated Statistics, Falmouth, MA*

Abstracts

Oral Presentations

Fisheries, Fishers, and Flatfish Biodiversity in Tropical Waters: The Crossroads of Conservation

Thomas A. Munroe

National Systematics Laboratory, NMFS/NEFSC, Smithsonian Institution
PO Box 37012, NHB, WC57, MRC-153, Washington, DC 20013-7012

Email: munroet@si.edu

Tropical seas represent one of the largest marine biomes on earth and these waters hold the most diverse assemblages of marine flatfishes (616+ species). Tropical coastlines support large human populations where approximately 95% of the world's fisher population ploy their trade. Most tropical and subtropical flatfishes are thin-bodied, small-sized species reaching only to ca. 30 cm SL. Relatively few species (84 species) attain sizes ≥40 cm SL. Tropical and subtropical flatfishes, though frequently caught in artisanal and industrial fisheries, seldom exceed 5% of fish biomass of tropical demersal fish communities, and consequently these fishes contribute comparatively minor economic value to fisheries. Only a small proportion of the total diversity of flatfishes captured in tropical fisheries is used directly for human consumption including the commercially important *Psettodes erumei*, and larger species in the families Cynoglossidae, Soleidae, Paralichthyidae and Bothidae. Temporal trends in fishery landings of tropical flatfishes are summarized over the past 25 years and compared among four different tropical regions. The majority of species of flatfishes landed in tropical fisheries is not identified beyond family, thus catch statistics for individual species are not available. Large numbers of flatfishes are killed or damaged in industrial and artisanal trawl fisheries operating within tropical waters. Over-fishing, combined with other anthropogenic factors including pollution and habitat degradation, pose the most significant threats to the great diversity of flatfishes found in tropical waters. Because basic life-history and ecological information is wanting for most tropical flatfishes, only limited approaches are available to protect these species from over-exploitation.

Tropical Flatfish Fisheries: Progress towards Sustainability in the Sole Fishery in the Gambia, West Africa

Kathleen Castro[1], Ousman Drammeh[1], Dawda Saine[2] and Ousman Bojang[2]

[1]*University of Rhode Island, Fisheries Center, East Farm, Kingston, RI 02881*

[2]*National Sole Fishery Co-management Committee, Bakau Community Fisheries Center Kanifing Municipality, Kanifing Municipal Council, Gambia, West Africa*

Email: kcastro@mail.uri.edu

In June 2008, a Marine Stewardship Council (MSC) pre-assessment for The Gambian red and black sole was conducted. The sole fishery was assessed against the Principles and Criteria of MSC using the Risk Based Framework (RBF). This assessment found that the fishery scored above 60 for all of the performance indicators and scored above 80 for principles 2 (Ecosystem) and 3 (Management). However, a score below 80 was received for Principle 1 (Target population) and the final score was not passing. To assist the Gambia in improving their score, a follow up visit by MSC resulted in a document laying out 9 critical areas for improvement specifically targeting Principle 1. The action plan was designed to ensure that the Gambia sole fishery will on completion of the indicated activities, meet the requirements for the Marine Stewardship Council certification.

In 2009, a new project was initiated with University of Rhode Island, World Wide Fund for Nature-West Africa Marine Ecoregion (WWF-WAMER), and the Gambian Government funded by USAID. The sole fishery was selected as a first case study with this goal: *Artisanal fisheries ecosystems in the Gambia and selected stocks shared with Senegal are being managed more sustainably, incorporating significant participation of fisheries stakeholders and attaining improved economic benefits for both male and female stakeholders in the market value chain.* Those 9 activities became the principal focus areas for the USAID/BaNafaa Project. A memorandum of understanding, signed in Dec 2010, had specific action items to be accomplished by the Gambian Department of Fisheries, USAID/BaNafaa, the Atlantic Seafood Company and GAMFIDA.

Project results indicate significant improvement in sustainability of the sole fishery demonstrated clearly with the development of “The Fishery Co-Management Plan for The Gambia Sole Complex” which was approved in Jan 2012, bringing 121,245 ha under improved management. Exclusive use rights to the sole fishery in this zone were granted to the National Sole Fishery Co-Management Committee (NASCOM). Management measures approved by NASCOM include a seasonal closure of one nautical mile from the coastline from May 1 to Oct 31 for all fish species and gear types; a minimum fish size; a minimum mesh size which increased in 2013 and a ban on use of drift nets for The Gambia River mouth. The Gambia is preparing for the second pre-assessment of the improved fishery in Jan 2015.

Windowpane and Winter Flounder Responses to Temperature Extremes in New York/New Jersey Harbor, USA

Dara Wilber[1], Jenine Gallo[2], and Catherine Alcoba[2]

[1]*Bowhead Science and Technology*
664 Old Plantation Road, Charleston, SC 29412

[2]*US Army Corps of Engineers, New York District*
26 Federal Plaza, Room 2146, New York, NY 10278

Email: darawilber@gmail.com

Potential dredging impacts from deepening channels in New York/New Jersey Harbor on winter flounder *Pseudopleuronectes americanus* and other demersal fish were a concern for biological resource managers. Therefore, the US Army Corps of Engineers New York District conducted long-term (2002-2010) bottom trawl and epibenthic sled surveys to better understand the spatial and temporal patterns of demersal fish habitat use in the Harbor. In particular, flatfish, such as winter flounder and windowpane *Scophthalmus aquosus*, are susceptible to benthic disturbances, such as dredging. Study results were used to map Harbor habitat use of all flatfish life history stages and determine the seasonal timing of spawning activity. This site specific knowledge can be used to reduce the spatial and temporal overlap between dredging activities and flatfish occurrences in the Harbor, and thus minimize risk to biological resources without incurring unnecessary project delays and costs. In addition, data collected provide valuable insights into flatfish responses to fluctuations in regional environmental conditions. For instance, juvenile and adult size distributions for both species vary annually in association with the severity of winter temperatures. Results suggest extreme cold temperatures cause overwinter mortality in juvenile windowpane and reduced growth in juvenile winter flounder. Thus, it is apparent that regional environmental factors strongly influence year-class strength and flatfish population structure in this estuary.

Rearrangement of Mitochondrial Genome in Pleuronectiformes

Xiao-Yu Kong, Wei Shi, Li Gong, Dong-He Li, and Ming Yang

Key Laboratory of Tropical Marine Bio-resources and Ecology
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Complete mitochondrial genome typically encodes 37 genes, including 13 protein-coding genes, 22 tRNAs and two rRNA in fish species. So far, we have determined about 45 complete mitochondrial DNA sequences including 13 families (except Paralichthodidae) in Pleuronectiformes. Mitogenome rearrangements have been detected in five families (Citharidae, Bothidae, Poecilopsettidae, Samaridae, Cynoglossidae), whereas the gene orders of the rest (Psettodidae, Scophthalmidae, Paralichthyidae, Pleuronectidae, Rhombosoleidae, Achiropsettidae, Achiridae, Soleidae) are intact.

Surprisingly, the gene rearrangements of mitogenomes exhibit different types.

Cynoglossus semilaevis (Cynoglossidae) mitogenome has discovered the translocation of control region and *tRNA-Gln* gene inversion, accompanied by *tRNA-Ile* gene shuffling. Another case is the mitogenome of *Samariscus latus* (Samaridae), which is characterized by two control regions (CRs) with the genes between them divided into two clusters. Intriguingly, in the mitogenome of *Crossorhombus azureus*, *Bothus myriaster*, and *Lophonectes gallus* (Bothidae), although their *ND6* and seven tRNA genes have been translocated to the same position, their two large non-coding regions (NC1, 2) and *tRNA-Asp* genes are different from each other. What's more, the translocation of ND2, *tRNA-Ala* and *tRNA-Trp* gene has been found in *Poecilopsetta natalensis* (Poecilopsettidae) mitogenome. Additionally, two *tRNA-Lys* genes were observed in *Citharoides macrolepis* (Citharidae) mitogenome.

A Geospatial Analysis of Winter Flounder (*Pseudopleuronectes americanus*) Habitat Use in Long Island Sound

Jose J. Pereira[1], Penelope Howell[2], Eric Schultz[3], and Peter Auster[4]

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[2]*Connecticut Department of Energy and Environmental Protection*
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Variability in growth opportunity and predation risk results in seascapes of varying habitat quality. Models of habitat selection when habitat quality varies in space offer divergent predictions regarding changes in distribution accompanying changes in population abundance. We tested 30 years (1984-2013) of winter flounder data from the Long Island Sound Trawl Series (LISTS) against model predictions. Geospatial analysis of catch data revealed that distribution did not change while abundance has declined 10-fold. This result supports the Proportional Density Model (PDM) versus the Constant Density Model (CDM) and the Basin Model (BM), two models that predict retracted ranges during periods of low abundance. Furthermore, spatial variability in body condition indicates that fitness is site related, which is consistent with the PDM and CDM but not the BM.

Trends in Winter Flounder Condition Factor and Demographics in Long Island Sound

Penelope Howell[1], Jose Pereira[2], Kurt Gottschall[1], and Deborah Pacileo[1]

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Geospatial analysis of random stratified CT DEEP LIS Trawl Survey winter flounder catches showed no significant change in distribution over the last 30 years (1984-2013) while abundance has declined 10-fold. A constant distribution with falling abundance is consistent with the Proportional Density Model which was developed to explain the relationship between abundance and distribution in marine fishes. This model predicts that a species' distribution will remain constant while local density changes with overall abundance. The relative availability of predator refuges and/or prey availability have been proposed as ecological mechanisms behind such proportional change in local abundance. The Proportional Density Model also predicts measurable differences in fitness in identifiable higher versus lower quality habitats. An index of condition factor (CF) was computed for each individual fish using its deviation from the log-log regression of all fishes' weight (g) by length (mm), performed separately by sex for flounder captured in April and May cruises that had been systematically sub-sampled by length category. Data for fish indentified as mature and resting, or immature were available for 22 years (total N=7,213) and were divided into two time periods: 1992-2002 (stable moderate abundance) and 2003-2013 (declining low abundance). Six habitat designations followed the stratification design of the Survey: mud, sand, and transitional bottom sediment at greater than or less than 18.5 m (60 ft) water depth. Analysis of variance of individual CFs identified four of the six habitats (deep mud plus the three shallow strata) as having fish with statistically higher mean CF for both mature sexes during both time periods. Immature fish showed a similar fitness pattern but habitats were not statistically separable. Comparing the differential in CF between time periods, mature females showed a significant decline from the first to second time period in all habitats, while mature males declined insignificantly between time periods, and immature flounder significantly increased in all habitats. These changes indicate that flounder with the greatest energy demands, (i.e. resting females followed by resting males), are failing to regain body mass following spawning despite declining density. At the same time, immature flounder have been successful in maintaining a higher CF as population abundance declined. In addition to lower densities, demographic changes may also have contributed to the observed increase in condition for immature fish. Delayed maturity and increasing size at Age 2, when fish leave shallow nursery areas, indicate that in recent years fish may be directing somatic growth toward increasing length and weight gain in lieu of sexual maturation. These demographic changes are consistent with increased predation pressure on young small flounder.

Reasons for the observed decline in CF for mature fish, especially larger females, are much more obscure. Calculation of individual CFs for females captured in April versus May show that April CFs declined at a greater rate over the time series than CFs in May. Specifically, female CFs were positive or nearly so from 1998-2002 and then declined significantly in Period 2, especially in 2003 and 2013. The pattern of change in April CF residuals significantly and positively correlates with the pattern in April bottom water temperatures, indicating that mature females were able to gain more weight in warm springs compared to cooler springs. It appears that large females were able to maintain a relatively high CF in high quality habitat during warm years in the late 1990s but not in later years, especially in the few cool years in Period 2. Stress factor(s) present earlier in the winter or prior fall, before or just after the spawn, may be contributing to the low April CFs in recent years. Importantly, the increase in CF from April to May in Period 2 is larger compared to Period 1, especially in high quality habitats, indicating that the habitat available in the Sound in mid-spring is still very capable of supporting mature flounder populations. However, even with a larger April-to-May increase in CF, Period 2 females captured in May only achieved average CFs comparable to females captured in April of Period 1. These analyses support the hypothesis that areas of high quality habitat adjacent to in-shore spawning grounds are a key factor in mature post-spawn winter flounder regaining necessary body weight, a process which may be recently hindered by the increasing presence of predators and/or competitor species.

Effectiveness of Norwalk Harbor as a Nursery Ground for Winter Flounder, *Pseudopleuronectes americanus*

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Since 1996, Harbor Watch has been conducting a survey of juvenile benthic marine fish in Norwalk Harbor to determine the effectiveness of the Harbor as a nursery ground for winter flounder, *Pseudopleuronectes americanus*. Using a 1m beam trawl, individuals are recovered, recorded, and released back into the Harbor. The study observed a resurgence of the winter flounder in 2013, followed by a dramatic decline which extended into the 2014 monitoring season. Multiple factors are being considered for this decline, including but not limited to climate change and predators.

Session II *11:40 a.m.*

Nocturnal Off-Bottom Movements of Adult Winter Flounder (*Pseudopleuronectes americanus*) in the Southern Gulf of Maine: Evidence of Selective Tidal Transport?

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The coastal inshore-offshore migrations of winter flounder (*Pseudopleuronectes americanus*) in the northwest Atlantic Ocean have been well studied by utilizing a variety of conventional and, more recently, acoustic tags. However, these studies have provided only two-dimensional, horizontal movement data. In 2009, depth sensors were utilized with acoustic transmitters on 40 adult fish to not only track movements horizontally, but also vertically (off-bottom) during the spring spawning season. During the two months that fish were monitored, a clear relationship was observed between time of day, horizontal activity, and vertical activity in the water column. Fish displayed vertical ascents at night coupled with horizontal migrations, alternating with sedentary periods during daylight hours. Almost all fish showed a pronounced depth decrease just prior to making nocturnal horizontal movements. In some cases, this depth shift also corresponded to inshore movement up slopes into shallower water, but for others, it was due to significant off-bottom migratory movements. It is possible that these migrations were facilitated by selective tidal transport.

Session III *1:20 p.m.*

Female Summer Flounder Maturity: A 30 Year Time-series and Accuracy of Macroscopic Classifications

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We built upon previous investigations of summer flounder maturity in the northern US stock region to validate the macroscopic maturity criteria and then examined trends in maturity over 30 years. We found at-sea maturity assignments have a high rate of agreement with microscopic classifications (89%) in paired comparisons using a subset of samples taken during recent fisheries resource surveys. The autumn survey monitors summer flounder during peak spawning; and since most of the classification errors were for immature fish identified as resting at sea, removing resting fish from the dataset improved the rate of agreement (95%) between the methods. Macro- and microscopic staging error rates were similar to work in the late 1990’s, indicating the staging methodology was not contributing to observed shifts in maturity schedules over time. There was a declining trend in the proportion mature at age (ages 0-2) of female summer flounder in the most recent ten years, along with an earlier decrease observed in the mid-1990’s. Changes were greatest in the age-1 fish with proportion mature declining from >75% in the late 1980’s to near 30% since 2009. The age at 50% maturity was lowest during the late 1980’s and early 1990’s (~0.5 yr) when stock biomass was at the lowest level of the timeseries, and it is currently near its highest age (~1.25 yr) and biomass. Coincident with the later age at maturity, there has been a recent decrease in the length at age of age-1 and 2 fish. The recent trend of increasing age at maturity was significantly correlated with the estimates of increasing spawning stock biomass and decreasing fishing mortality.

Session III *1:40 p.m.*

Empirical Stock Assessment of Flatfishes as a More Robust Approach to Climate Change

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Many changes have been recently observed in the New England marine environment, including atmospheric patterns, oceanography and ecology. Flatfish populations and their productivity are influenced in complex ways by these environmental changes, and such changes in the marine ecosystem are expected to continue. Current conventions for fishery science are based on population dynamics models that assume a constant environment, but performance of these models is deteriorating as climate change and its effects become more evident. A more robust method for stock assessment and fishery management advice is an empirical approach to estimating stock size and sustainable catch that relies on direct observation and absolute measures of abundance rather than theoretical models that assume stationarity in ecosystem processes. This empirical approach has been successfully applied to Gulf of Maine winter flounder and Georges Bank yellowtail flounder to improve the scientific basis of fishery management. Field experiments to quantify trawl efficiencies would improve the approach. These contributions offer examples of effective collaborative research that have the potential to achieve sustainability in the context of climate change.

Habitat Stability Factors and Winter Flounder (*Pseudopleuronectes americanus*) Population Fluctuations in Southern New England Inshore Waters 1870-1931

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As Connecticut's mini ice age of the 1870s had farmers replacing lost dairy herds from the bitter cold, fishers also noticed changes. Bay scallops were plentiful off Greenwich and Noank became a center for the Southern New England lobster trade. A great cold period had descended upon New England and with strong coastal storms brought tremendous habitat instability to Long Island Sound and the coasts in general. The cold and storm activity moderated and then coastal habitats stabilized in the 1880s.

Estuarine bivalve shell became a dominant habitat type cleaned of organic matter and now host to tremendous sets of the soft shell clam (*Mya arenaria*) (1895 to 1905). Winter flounder (*Pseudopleuronectes americanus*) populations benefited from enhanced habitat quality now recognized as essential habitat characteristics. Habitat stability and habitat type may help guide current understanding of winter flounder recruitment into the public fishery. Habitat quality and long term population changes are viewed against fisher reports, catch statistics and the weather pattern known as the Northeast Atlantic Oscillation (NAO).

Food Web Ecology of *Citharichthys arctifrons*, Gulf Stream Flounder, in the Northwest Atlantic

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Gulf Stream flounder, *Citharichthys arctifrons*, are regularly observed in fish diets on the northeast US continental shelf, yet lack commercial value and are often ignored. Similarly, Gulf Stream flounder diets on the shelf have remained largely unexamined, except for a period in the 1970's. During 2005-2010, sampling resumed and the majority of stomachs were examined at sea macroscopically, with large proportions of unidentifiable prey. This effort was expanded in 2011-2012 by processing all stomachs in the laboratory microscopically. We document 15 fishes that consumed Gulf Stream flounder, and what Gulf Stream flounder eat (percent mass and percent frequency of occurrence) by season, region, and year. Gammarids and polychaetes dominated the diet in all years, seasons, and regions, but brittle stars were also prominent in the fall and in Southern New England. Macroscopic prey identification for Gulf Stream flounder is difficult due to their small size and benthivorous diet. Therefore, to determine if at-sea sampling is satisfactory, we compared diets derived macroscopically to those in the laboratory (2005-2010). We assessed identification accuracy, taxonomic resolution, volume estimates, and frequency of empty stomachs for the two methods. At sea and in the laboratory, Gulf Stream flounder diets were consistent across regions and time, with minor differences between seasons and one region; thus, aside from greater prey resolution in the laboratory, diets were similar. Besides their role as notable flatfish prey, Gulf Stream flounder are specialized benthic feeders, and laboratory processing of their stomachs may offer novel methods for sampling small benthic macrofauna.

Biotic Interactions between Age-0 Summer Flounder and Winter Flounder in New England Tidal Rivers

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Summer flounder (SF), *Paralichthys dentatus*, and winter flounder (WF), *Pseudopleuronectes americanus,* utilize southern New England tidal rivers as nursery habitat during the juvenile, post-settlement stage. The biotic interactions between these species, however, have not been examined in this geographic area or habitat-type. In this study, the putative competitive and predator-prey interactions between age-0 SF and WF were elucidated using conventional stomach content analysis. Flounder were collected from the Seekonk and Taunton Rivers (RI/MA) from May to September 2009-2014 and subsequently preserved in 70% ethanol. In the laboratory, individual flounder were measured for total length (TL), and prey contents were extracted from stomachs and identified to the lowest practical taxon (SF: *n* = 675, size = 24-172 mm TL; WF: *n* = 894, size = 20-90 mm TL). Direct visual analysis of stomach contents affirmed that SF and WF undergo ontogenetic dietary shifts. The principal prey of SF measuring less than 50 mm TL were mysids and copepods, whereas sand shrimp, amphipods, and fish were the dominant prey of larger conspecifics. Similarly, WF initially fed on copepods, transitioning to amphipods and bivalves (e.g., siphon cropping) with increasing body size. Nematodes and polychaetes were also frequently consumed by WF, irrespective of their body size. Biologically significant competitive interactions, as determined by the Schoener's Index, were observed between small SF and WF (< 50 mm TL). Disparity in species-specific growth rates during the summer season, however, equated to SF preying on smaller WF, albeit to a limited extent. Length estimates of WF extracted from SF stomachs indicated that predation was highly size-dependent and partially constrained by predator-to-prey size ratios.

Diel-Cycling Hypoxia and pH Impacts on Juvenile Summer Flounder Growth: Nothing Good Happens After Midnight

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A series of laboratory experiments were conducted to determine the impact of diel-cycling dissolved oxygen (DO) and pH on young-of-the-year summer flounder (*Paralichthys dentatus*). Flounder were exposed to two cycling DO levels (extreme = 1-11 mg O_2 l^{-1}; moderate = 3-9 mg O_2 l^{-1}), two cycling pH levels (extreme = 6.8-8.1; moderate = 7.2-7.8), and a constant normoxia (7.5 mg O_2 l^{-1}) & pH (7.5) control treatment in a fully crossed 3X3 experimental design at 25°C. DO and pH levels were chosen to reflect summertime conditions in shallow estuarine nursery areas. Growth Curve Analysis and Dunnett's tests were used to analyze all data. Growth rate (change in mass) was significantly reduced in fish exposed to the most extreme diel-cycling DO across all pH treatments over the course of 20 d experiments. No consistent growth detriment was observed in the other treatments, indicating a) that a moderate DO cycle has little or no impact on growth and b) that pH has neither an independent nor interactive effect with DO on growth rate. In a series of experiments to examine growth rate recovery and acclimation, flounder experienced an initial growth rate detriment when subjected to extreme diel-cycling DO and pH for 10 days, but then exhibited growth rate recovery (growth returned to control levels) when exposed to static normoxia and normal pH conditions the following 20 days. Flounder did not exhibit growth rate acclimation when subjected to extreme diel-cycling DO and pH for an extended period, as growth rate detriment persisted after 20 d of exposure. In fact, flounder exhibited mortality after two to three weeks of exposure to extreme diel-cycling DO and pH. These results demonstrate that young summer flounder exhibit growth rate detriment, and ultimately mortality under the diel-cycling DO and pH conditions present in shallow, highly eutrophied, nursery habitat.

Session IV *3:40 p.m.*

The Physiological Effects of Catch and Release Angling on *Paralichthys dentatus* in Long Island Sound

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Summer flounder *Paralichthys dentatus* is a species of both recreational and commercial importance in Long Island Sound. Due to minimum legal size restrictions, summer flounder are subjected to catch and release angling within the recreational rod and reel fishery, as many fish caught do not meet the minimum size requirements. Previous studies have investigated angling mortality in summer flounder caught in the field; however, no quantifications of the physiological effects of catch and release angling have been made for this species. Sixty summer flounder were held in captivity in flow-through tanks supplied by water from Long Island Sound. The fish were exposed to one of three experimental treatments, control, 30-second air exposure, or a simulated catch and release event, and then held for 30 days in order to quantify both the lethal and sub-lethal physiological effects of catch and release angling on the species. Flounder exposed to catch and release angling or air exposure exhibited significantly elevated levels of plasma cortisol 30-minutes post-treatment. Plasma glucose and lactate were also elevated in these groups; however, the highest levels of these metrics were noted in the air exposure treatment. Significant post-treatment mortality and dermal parasitic infestation were observed only in fish that were subjected to catch and release angling. It is apparent that summer flounder do experience measurable sub-lethal and lethal effects of stress from the process of catch and release angling, but also endure significant long-term impacts, such as increased susceptibility to parasites.

In situ Observations from ROVs Provide Rare Insights on Occurrences, Distributions, Habitat and Behavior of Flatfishes (Teleostei: Pleuronectiformes) in and near Submarine Canyons on the Outer Continental Shelf and Upper Continental Slope off the Eastern United States

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Flatfishes (Pleuronectiformes) are generally not common or abundant components of deepwater fish assemblages. Relatively few species occur deeper than 1,000 m, and only two species have occasionally been reported as deep as 2,000 m. Most flatfish species (601/819 = 73.4%) occur in estuaries and coastal seas to the middle continental shelf. About 218 species (26.6% of total) live on the outer shelf and upper continental slope, with only 29 (3.5% of all flatfishes) considered permanent residents on the upper slope. During ROV operations conducted in and near submarine canyons along the outer continental shelf and upper continental slope off the eastern United States, 10 species of flatfishes, representing five families and eight genera, were observed and/or collected. Three species of Pleuronectidae, Atlantic halibut (*Hippoglossus hippoglossus*), Greenland halibut (*Reinhardtius hippoglossoides*) and witch flounder (*Glyptocephalus cynoglossus*), were videotaped, with witch flounder being the most commonly observed flatfish. Three deepwater tonguefishes (Cynoglossidae), *Symphurus billykrietei*, *S. nebulosus* and *S. stigmosus*, were also seen or collected at these sites, as was *Poecilopsetta beanii* (Poecilopsettidae). Observations of *S. nebulosus* and *P. beanii* are the first to document these species in their natural habitats. Other flatfishes videotaped included *Citharichthys arctifrons* and *Hippoglossina oblonga* (Family Paralichthyidae). *Monolene sessilicauda* (Family Bothidae), a poorly-known deepwater species, was trawled from soft-sediments adjacent to Baltimore and Norfolk canyons. Only *Glyptocephalus cynoglossus* was observed (to 1476 m) or collected deeper than 600 m. ROVs provide unique opportunities to collect invaluable information and insights into micro-habitats and behavior of deepwater species.

Benthic Habitat Mapping for Winter Flounder in New York/New Jersey Using Underwater Video and Sled

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The US Army Corps of Engineers – New York District in conjunction with the project co-sponsor (Port Authority of New York/New Jersey) has developed an extensive Aquatic Biological Sampling (ABS) program to inform dredging management practices and promote the protection of early life history stages of winter flounder, *Pseudopleuronectes americanus*, during harbor deepening work in New York and New Jersey Harbor. To supplement and expand the understanding of this data, underwater video transects were recorded at 11 channel and non-channel locations across Upper and Lower bay to characterize physical and biological features of the benthic habitat. A bottom contacting, towed sled was used to record approximately 30 minutes of footage at each location. The sled was equipped with a GoPro camera and underwater lights, and designed to be field configured to adapt to a wide range of conditions and recording needs. In order to map observations, GPS positions were recorded and synced to the video. The sediment features and organisms observed were typical of the NY/NJ Harbor, with some locations exhibiting broad expanses of habitat homogeneity, and others showing a shifting mosaic of differing shell hash abundances and mussel beds. The video transect data provides additional insights into the habitats of the NY/NJ Harbor complex that can be used in tandem with other sources of data to better inform future dredging project management decisions.

Factors of Yellowtail Flounder Bycatch in the Georges Bank Sea Scallop Fishery

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

Assessing Risks of Exposure of Winter Flounder (*Pseudopleuronectes americanus*) to Suspended Sediment Plumes: Two Dredging Scenarios

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Where navigation dredging occurs in proximity to winter flounder (*Pseudopleuronectes americanus*) habitat, characterizations of exposures to dredging-induced perturbations and responses of affected flounder life stages can be used to assess the risk of detrimental effects. Decisions regarding adequate protection measures and selection of effective dredging project management practices are best informed by knowledge of both exposure and response. Exposure to elevated suspended sediment concentrations in dredge plumes is a persistent concern cited by regulatory agencies. New predictive tools have been developed to accurately characterize dredge plume dynamics in terms of spatial and temporal scales and suspended sediment concentration gradients. The approach integrates knowledge of project site-specific conditions (e.g., bathymetry, hydrodynamics, *in situ* sediment properties) and factors that determine sediment release rates (e.g., selected dredging equipment and production rates). To illustrate the approach, two divergent dredging scenarios are examined: hydraulic pipeline cutterhead dredging in a shallow-draft coastal inlet entrance channel and mechanical bucket dredging in a deep-draft inner harbor navigation channel. The approach is designed to be used in tandem with best available knowledge of tolerance thresholds of flounder and other fishery resources. The two case studies compare predicted plume dimensions and structure with empirical data collected at both sites. One advantage of the approach is that representative plume predictions can be derived to support decisions during individual project planning stages for locations where plume monitoring data may not be available.

An Overview of the Biodiversity and Biogeography of Flatfishes (Pleuronectiformes) in Chinese Waters

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The marine waters of China are extensive and encompass a diversity of biogeographic provinces including cold temperate areas (Bohai and Yellow seas), warm temperate waters (East China Sea), and tropical regions (along southern coast from Taiwan Straits westward to Guangxi Province and including the continental islands of Taiwan, Hong Kong, Hainan, and extending southward to the Paracel and Nansha (Spratly) islands in the South China Sea). The flatfish fauna inhabiting Chinese waters is among the most diverse in the world and comprises nine families, approximately 50 genera and 134 species. The most diverse families are the Bothidae (15 genera, 36 species), Cynoglossidae (3 genera, 19 species), Soleidae (9 genera, 18 species), Paralichthyidae (4 genera, 16 species), and the Pleuronectidae (12 genera, 14 species). Approximately 10 species (mostly Pleuronectidae) occur in cold-temperate waters, 15 species inhabit warm-temperate areas, about 39 are subtropical species, and approximately 70 species are known from tropical waters. Of the 134 species, at least 30 are commercially important, including the paralichthyid, *Paralichthys olivaceus*, several pleuronectids (*Cleisthenes herzensteini*, *Pseudopleuronectes yokohamae* and *Pleuronichthys cornutus*) and the cynoglossids *Cynoglossus semilaevis* and *C. joyneri*. In northern regions, populations of the species are larger and many of these species are targeted by commercial fisheries. In subtropical and tropical regions, although flatfish species diversity is greater, the population sizes and the average adult sizes of most of these species are much smaller and these species do not constitute major fishery species. This study discusses the diversity and biogeography of flatfishes inhabiting Chinese waters.

Abundance and Distribution of Yellowtail Flounder on Georges Bank

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Scientists at the Coonamessett Farm Foundation, the School for Marine Science and Technology (SMAST), and the Virginia Institute of Marine Science (VIMS) partnered with members of the scallop fleet to complete an industry-based survey on Georges Bank. An objective of the survey was to investigate seasonal patterns in the distribution and abundance of groundfish species, such as yellowtail and winter flounder, on scallop fishing grounds. Eight survey trips were completed in 2013, and 696 survey dredge tows were completed over the course of the year. Yellowtail flounder catch rates were generally greatest in Closed Area 2, intermediate on the southwest part of Georges Bank, and lowest in Closed Area 1. In Closed Area 2 and on the southwest part of Georges Bank there was a strong seasonal pattern to yellowtail flounder catch rates, peaking in late summer, suggesting that yellowtail flounder migrate to and from these areas during the course of the year. Area-swept estimates of yellowtail flounder density and biomass were calculated for each trip, and considered during the most recent stock assessment for the Georges Bank yellowtail flounder stock. Each of the eight survey trips produced an area swept biomass estimate of adult-sized yellowtail flounder (range = 872 to 3462mt) that was greater than the estimate of adult biomass (826mt) derived from the 2013 stock assessment, suggesting that the Virtual Population Analysis model was underestimating the biomass of the resource. This example demonstrates how the high resolution, fishery-independent information from industry-based surveys can be considered formally in the stock assessment process for groundfish species.

Microchemical Signatures in Juvenile Winter Flounder Otoliths Provide Identification of Natal Nurseries

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Variation in otolith microchemical signatures of young-of-the-year (YOY) winter flounder, *Pseudopleuronectes americanus,* between natal nursery areas was evaluated. Fish were collected from 12 nursery areas from New Jersey to New Hampshire, US, over an expanse >500 km in summer 2012. Nursery specific microchemical signatures were developed using element:Ca ratios, which were determined with solution-based inductively coupled plasma-mass spectrometry (SB-ICP-MS) on the whole otolith. YOY flounder microchemical signatures showed significant nursery-specific differences and varied on a small spatial scale (~12 km) based on elemental (Li, Na, Mg, Mn, Sr, Cd, and Ba) ratios. Fish were classified back to natal nursery areas with 73% average cross-validation classification accuracies using a quadratic discriminant function analysis. Based on this preliminary study, otolith microchemistry has the potential to be an effective tool to assess the connectivity between the inshore nursery areas and the offshore adult populations of winter flounder, however, further baseline studies are needed. In particular, the degree of temporal variation between and within years in the otolith elemental concentrations must be quantified. These elemental analyses need to be linked to specific management needs in order to be useful to fisheries managers; for winter flounder, the ability to rank estuaries by the yield of recruits may help with solving estuary-specific anthropogenic challenges.

Early Life-history Strategy and Habitat Influence the Susceptibility to Ocean Acidification of Two Species of Flatfish From the Northeast USA

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Recent studies reveal that species and life-stages of finfish vary in their responses to ocean acidification. Tolerances to elevated levels of pCO_2 and temperature may be associated with early life-history strategies, habitat use, and parental exposure. In five experiments over two years we exposed winter flounder, *Pseudopleuronectes americanus*, and summer flounder, *Paralichthys dentatus*, to multiple, constant pCO_2 and temperature levels at various life-stages (gametes, embryos, and larvae). Winter flounder spawn in estuaries, their eggs adhere to the substrates, and their early life-stages are exposed to variable water chemistry. We predicted that winter flounder would be more tolerant of water acidity variations than summer flounder; the latter spawn buoyant eggs in the more stable waters of the Northeast shelf. Our results for winter flounder show increased fertilization success and embryonic survival with elevated pCO_2. Summer flounder exhibited reduced fertilization and lower embryonic survival with elevated pCO_2. Regarding temperature interactions, summer flounder displayed increased fertilization rates at warmer temperatures, while winter flounder exhibited decreased fertilization and survival at warmer temperatures. Our results also showed that the location of the winter flounder adults - southern Gulf of Maine (GOM) versus Mid-Atlantic Bight (MAB) - influences the response of their early life-stages to increased acidity levels, e.g., young winter flounder from GOM origin were more tolerant than those from the MAB. Differences in response to variations in ocean chemistry at these earliest life-stages may influence each species' and, in some cases, population's ability to adapt and persist with predicted levels of near-future climate change.

A Comparative Analysis of Flatfish Spawning Stock-Recruit Relationships

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The relationships between various measures of the level of reproductive output and the level of successful recruits have long been of interest to biologists and resource managers. These relationships have special utility in economically important taxa such as flatfish. As with most marine finfish, the relationship between spawning stock size and the magnitude of recruitment is notoriously noisy due in part to the broad, often multi-year temporal gap between the two events, the intrinsic variability of nature, and the inherent difficulty in obtaining accurate estimates of such large marine populations. We take advantage of the substantial foundation of population-level estimates of worldwide stock size and recruitment found in the RAM Legacy Stock Assessment Database, and the comparably broad coverage of estimates of life history, location, and habitat features found in FishBase (augmented with data on early life-stages from the primary literature) in order to evaluate a series of stock-recruitment hypotheses with respect to flatfishes. We use meta-analytical methods in order to test a series of comparative (i.e., across group) hypotheses of general interest to the community of biologists who study flatfish, finfish, and life history theory. We report on hypotheses pertaining to the explanatory value of 1) taxonomy (hierarchical analysis from family to stock); 2) geography (latitude); 3) habitat (inshore/estuarine, coastal, shelf, and pelagic); and life history (life period durations; maturation size and age; maximum size; lifespan). Limitations of these analyses and suggestions for further research are identified.

Are Climate Induced Changes Evident in the Flatfish Assemblage of Lower Chesapeake Bay and Its Major Tributaries? A Multi-decadal Perspective

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Chesapeake Bay lies at the southern end of a cold-temperate province and is positioned just a short, oceanic distance north of a major biogeographical boundary separating it from a warm-temperate province to the south. The flatfish assemblage inhabiting the Bay has mixed biogeographical affinities: some are cold-temperate species at or close to their southern limits of distribution; some are at mid-points of their ranges; while others are at northern limits of their distributions. Its pivotal location, together with its unique assemblage of flatfishes, renders Chesapeake Bay an interesting platform to examine climate-induced effects over time for flatfishes occurring within the Bay. Long-term surveys (since 1955) conducted in lower Chesapeake Bay and its major tributaries, together with information from other studies, provide information to characterize and detect changes in the flatfish assemblage occurring within this estuary over the past century. No common and abundant species have been lost over time, but some minor shifts in species composition of the assemblage inhabiting the Bay have occurred. Prior to 1980, 11 species were recorded from Chesapeake Bay and its tributaries. Since 1980, 10 species have been reported, but only eight were recorded previously from the Bay. Most recently, several warm-temperate species have been captured, or have been captured with greater frequency, than previously noted. None of these warm-temperate species, however, are common or abundant elements of the assemblage. Long-term records also do not indicate major shifts in relative abundances for common flatfish species, with exception of winter flounder, a cold-temperate species, which has declined in abundance in recent years.

Abstracts

Poster Presentations

Seasonal Flatfish Abundance Patterns in a Shallow Estuarine Creek in Georgia, USA over a 10-year Period

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Temperature and seasonal changes may play crucial roles in the selection of nursery habitats by flatfishes. The purpose of the present study was to investigate the patterns in use of a shallow estuarine creek by flatfishes to determine the effect of season on species composition and abundance over multiple years. Monthly samples were collected during ebb tide in Wylly Creek (31°59’52”N, 81°03’18”W) in Savannah, Georgia beginning in January 2004. Three replicate tows were conducted for 2 minutes each using a 1 m-wide beam trawl with a 3 mm mesh net. Means were calculated as the number of individuals per sample date by season. Six species were collected throughout the study: the blackcheek tonguefish *Symphurus plagiusa*, the bay whiff *Citharichthys spilopterus*, the fringed flounder *Etropus crossotus*, the summer flounder *Paralichthys dentatus*, the southern flounder *Paralichthys lethostigma*, and the ocellated flounder *Ancylopsetta quadrocellata*. The flatfish species used the creek at different times of the year. The most abundant species was *Symphurus plagiusa* (6.60 ± 0.77 individuals d^{-1}), with peak abundance during summer (11.96 ± 2.14 individuals d^{-1}). *Citharichthys spilopterus* was most abundant during winter (12.28 ± 4.54 individuals d^{-1}) when mean size was shortest (18.1 ± 0.4 mm) and least abundant during fall (1.10 ± 0.51 individuals d^{-1}) when mean size was longest (81.9 ± 5.3 mm). The major finding of this study was that recently settled *Citharichthys spilopterus* used Wylly Creek as a nursery in early winter while the other species utilized this creek in later juvenile stages.

Stock Structure of Winter Flounder in the Great South Channel and Nantucket Shoals

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Although winter flounder (*Pseudopleuronectes americanus*) has been the subject of extensive stock identification research, the stock structure of winter flounder in the Great South Channel is poorly understood. Fin ray counts, which have been used to differentiate between winter flounder stocks, were compared between fish collected in the Great South Channel, Georges Bank and southern New England. Winter flounder from Georges Bank had the highest fin ray counts, fin ray counts were intermediate in flounder taken from the Great South Channel, and lowest from flounder sampled in southern New England. The differences in fin ray counts between the three areas were significant, suggesting that winter flounder from the Great South Channel may comprise a unique group that is discrete from other stocks. The findings could have important implications for the management and assessment of the winter flounder resource, and the stock structure of winter flounder in the Great South Channel merits further investigation.

Can You Dig It? Impact of Dredging on the Abundance of *Pseudopleuronectes americanus* in Clinton Harbor

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Clinton Harbor, located on coastal Connecticut within Long Island Sound, is a nursery habitat for juvenile *Pseudopleuronectes americanus* (winter flounder). The harbor is also home to several marinas, which lends it to the detriments of regular marina activities, including dredging. Dredging is an excavation activity that removes bottom sediments in boating channels. It is usually performed on a two to three year cycle. With a historically steady decline in *P. americanus*, the question remains whether dredging activities affect the winter flounder population. Cedar Island Marina, within Clinton Harbor, was chosen as the study site, where intermittent sampling for *P. americanus* occurred between 1990 and 2013 at nine different sites in and around the marina. Data were analyzed using a generalized linear model in R; preliminary results suggest a significant relationship between *P. americanus* abundance and dredging activity.

Seasonal and Diel Patterns of Abundance and Age of Larval Winter Flounder *Pseudopleuronectes americanus* in Barnegat Bay, NJ

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Larval winter flounder *Pseudopleuronectes americanus* were collected as part of a larger, three year ongoing study examining the zooplankton community in Barnegat Bay, NJ. Zooplankton samples were collected with 500 µ and 200 µ bongo nets at each of five locations along a latitudinal transect in the bay. Sampling was conducted twice per month from March to October, and once per month from November to February, from May 2012 to the present. Additionally, in April 2014 samples were collected every four hours over a 24 hr period to examine diel patterns in abundance at one location.

Ichthyoplankton were removed from all fresh zooplankton samples and stored in 95% ETOH. There were no significant differences in abundance or size of larvae collected in each of the two mesh sizes. Winter flounder larvae were only collected in April of both years. There were significantly more larvae collected in the northern part of the bay, which is characterized by lower salinity. Significantly fewer larvae were collected in early morning and mid-day samples than in late afternoon and evening samples.

Age analysis of the collected larvae is currently being conducted. Otoliths were removed from larval winter flounder (TL = 5 – 10 mm) and mounted on microscope slides with Crystal Bond. Otoliths will be examined on a Zeiss image analysis system with polarized light to determine age structure of the population.

Summer Flounder (*Paralichthys dentatus*) Tag Retention of the Dorsal Loop Tag in the Laboratory

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The American Littoral Society (ALS) has conducted a citizen funded fish tagging program for nearly 40 years. Summer flounder are its second highest tagged species, yet the tag retention rate of the dorsal loop tag has never been tested for the summer flounder. NOAA Fisheries utilizes the dorsal loop fish tagging data from other species with known tag retention rates.

During the 2011-2012, we conducted a tag retention study lasting 368 days at the Howard Marine Sciences Laboratory. Adult summer flounder ((N=78; 340 to 490 mm TL) were collected and maintained in continuous flow circular tanks supplied with ambient water from Sandy Hook Bay During the study period, tag loss was 16.67%. Mortality of tagged fish was 8.3% and of control fish was 0.

Specificity and Sensitivity of a PCR-based Approach for Detecting Winter Flounder in Blue Crab Stomachs

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Increasing water temperatures in the Northwest Atlantic have resulted in blue crabs (*Callinectes sapidus*) extending their geographic range northward to Southern New England coastal habitats, including the Narragansett Bay Estuary (RI, USA). The increased abundance of blue crabs in this area may have important consequences to resident biota. For example, blue crabs may adversely affect juvenile winter flounder (*Pseudopleuronectes americanus*) populations via trophic interactions. In this study, Polymerase Chain Reaction (PCR)-based methods were used to detect blue crab predation on juvenile winter flounder. To evaluate the sensitivity and specificity of the approach, a winter flounder-specific (WF208) primer set was tested against winter flounder, blue crab, and alternative prey items. The effect of digestion time on detecting flounder DNA in crab stomachs was also determined in laboratory feeding experiments (0-10 hr post-feeding). DNA extractions of tissue and gut contents were carried out using a Qiagen DNeasy Blood and Tissue Kit and the 208 base-pair primer set. WF208 primers successfully and exclusively amplified winter flounder tissue (high sensitivity and specificity). The DNA concentration and quality of digested flounder tissue consistently declined as digestion time increased. PCR results were more variable, however, with flounder DNA being positively detected in 0-38% of crab stomachs examined between 0 and 8 hr post-feeding. In the future, additional feeding and spiking experiments will be conducted by manipulating the modes of sacrifice, crab preservation techniques, and DNA extraction protocols in order to optimize the PCR results.

Taxonomic Evaluation of Family Cynoglossidae from Indian Waters

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Morphological (morphometric and meristic) and Osteological studies including scale, otoliths and radiographs of family Cynoglossidae are represented here. A total of 372 specimens of 14 different species under this family were collected from the Indian coast (Mumbai, Ratnagiri, Goa, Mandapam, Digha, Kolkata and Veraval) from August 2013 to May 2014. Two species of the genus *Paraplagusia* and 12 species of the genus *Cynoglossus* were recorded during the course of study. The shape, structure of otoliths; vertebrae number species through radiographs; type, shape and ctenii structure and number were the major tools for taxonomy and were used for species discrimination. Two species *Cynoglossus arel* and *Cynoglossus macrolepidotus* were discriminated based on their morphological and osteological characters. This study demonstrates that *Cynoglossus macrolepidotus* is a valid species and is also found in west coast of India along with *Cynoglossus arel*. The species *Cynoglossus lachneri* is also reported from India (Mumbai coast) based on morphological and comparison from the ZSI Museum type specimens. *Cynoglossus quinquilineatus* and *Paraplagusia bilineata* are also valid species and found in India. A data set of 21 characters (3 morphometric, 9 meristic characters, and 9 qualitative characters) was constructed based on shared characteristics. A distance matrix was created using Euclidian method. Hierarchical cluster analysis (Ward's Minimum- Variance Method) based on theses characters was used to establish relationships among genera and species of the family Cynoglossidae. A new phylogenetic hypothesis for these 14 species of fish belonging to the family Cynoglossidae has been proposed. A field level identification of species of Family Cynoglossidae in Indian waters was also proposed.

Sources of Variation in Estimates of Summer Flounder, *Paralichthys dentatus*, Batch Fecundity

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As the northern stock of summer flounder, managed from Cape Hatteras to Cape Cod, rebuilds, there are more and larger females in the population. How do these changes in abundance and size distribution affect stock reproductive potential? Summer flounder have asynchronous oocyte development and are batch spawners; therefore, an indeterminate fecundity method based on batch fecundity and spawning frequency is appropriate to estimate annual fecundity. Fish were obtained during 2010 - 2012 from commercial fishing vessels participating in cooperative research programs. Females with the most advanced oocyte stage of late nucleus breakdown or hydrated were used and the numbers of these oocyte stages per gram was determined. Batch fecundity was estimated by expanding gravimetric subsamples up to the whole ovary level, after adjusting for the tunica mass (ovarian wall). Homogeneity of mature oocytes within the ovaries was tested by sampling the anterior, middle, and posterior sections of each lobe 3 times. A mixed model was used to account for variation among individuals; no significant effect was shown among the ovary locations or lobes. Two replicate samples were compared for each fish; if the number per gram differed by >10%, a third subsample was completed. Batch fecundity increased with female length. Preliminary results showed both a seasonal and an inter-annual difference in fecundity at length. Batch fecundity was highest in September when spawning began, and was higher in October 2011 compared to October 2010. These patterns suggest the dynamics of fish size, season, and year on batch fecundity may have complex effects on how reproductive potential changes as the summer flounder stock rebuilds.

Winter Flounder Larval Morphometrics: Measurement of Early Life Stage Condition in New York/New Jersey Harbor

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Winter flounder egg and larval conditions were assessed spatially and temporally throughout a spawning season in a highly developed estuary (New York / New Jersey Harbor). All viable eggs were photographed at 90x magnification and assigned a developmental egg stage (ESn) corresponding to cleavage - ES1, blastula - ES2, gastrula - ES3, early embryo - ES4, and late embryo - ES5. Larvae were classified into four developmental stages. Two egg (egg diameter and yolk diameter) and seven larval (total length, head depth, myotome height, body area, notochord length, eye diameter, and yolk sac area for Stage 1 larvae) traits were measured to the nearest 0.01 mm. Egg and yolk diameters were each measured with two line segments that bisected the center of the trait at right angles. The average of the two measurements was used in statistical analyses. A quality assurance / quality control protocol was used to ensure the reliability and reproducibility of measurement methods. Results indicated that egg size varied temporally, reaching a peak in late March and decreasing in April as water temperatures increased. There was no evidence of poor egg condition in the more urbanized harbor areas or in navigation channels. Yolk-sac larval total length was smaller in Lower Bay than other harbor areas. In addition, small yolk-sac larvae with small yolk-sac areas were collected exclusively in Lower Bay. However, as larvae developed into feeding stages, Lower Bay larvae had larger proportional myotome height, head depth and body area than Stage 3 larvae from other harbor areas. Temporal factors, which may reflect prey availability, more strongly influenced larval condition than spatial factors, such as proximity to industrial impacts. Morphometric results complemented distribution and abundance data in demonstrating the importance of Lower Bay habitat to winter flounder early life history stages in the Harbor.

Modeling Variation in Fecundity of Winter Flounder, *Pseudopleuronectes americanus*, in US Waters: Does the Autodiametric Method Mask Individual Variation?

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The recent development of the autodiametric (AD) method has streamlined the acquisition of fecundity data for many fishes. This method automates the measurement of oocyte density (numbers/ g ovary) using mean oocyte diameter for a subsample and a calibration curve based on oocyte packing density. Such calibration curves typically fit the data very well and application of the AD method generally ignores deviations from the predicted curve, thereby assuming all individuals with the same mean oocyte diameter have the same number of oocytes per gram. However, ignoring the deviations from the calibration curve may be ignoring important sources of variation in predicting the realized fecundity of individuals. We explore this possibility by evaluating two different analytical approaches to incorporate measures of fish condition in models of fecundity for winter flounder over four spawning seasons (2010-2013), and three stocks (Gulf of Maine, Georges Bank, and Southern New England), representing a range in fecundity and fish condition. We compared simple models that predicted fecundity via the AD curve to similar models that included fish size and physiological measures of condition. In addition we developed models that predicted relative fecundity without the AD curve. Results indicated that individual-level condition measures when combined with gonad weight and mean oocyte diameter as a proxy for time to spawning explained variation in relative fecundity not fully captured via AD curve derived estimates. Winter flounder are total ovulators with limited down-regulation and deplete stored energy during final egg development; characteristics that support this condition driven modeling approach.

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