Northeast Fisheries Science Center Reference Document 22-18

17th Flatfish Biology Conference 2022
Program and Abstracts

December 2022

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17th Flatfish Biology Conference 2022 Program and Abstracts

November 15-16, 2022
Water's Edge Resort and Spa, Westbrook, CT

by Conference Steering Committee: Renee Mercaldo-Allen[1], Stephen Dwyer[2], Elizabeth Fairchild[3] (co-chairs), Larry Alade[4], R. Christopher Chambers[5], Mary Carla Curran[6], David Davis[7], Thomas Munroe[8], Sandra J Sutherland[4]

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Northeast Fisheries Science Center Reference Documents

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17th Flatfish Biology Conference
2022

November 15th & 16th
Water's Edge Resort and Spa, Westbrook, CT

Oral Presentations
Salons A/B

Tuesday November 15th

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

8:30 a.m. Welcome and Introduction

Renee Mercaldo-Allen, Flatfish Biology Conference co-chair
NOAA Fisheries, Northeast Fisheries Science Center
Milford Laboratory, Milford, CT

Nicole Cabana, Deputy Director
NOAA Fisheries, Northeast Fisheries Science Center
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Stephen Dwyer, Flatfish Biology Conference co-chair
Dominion Energy, Millstone Environmental Laboratory
Waterford, CT

Session I
Christopher Chambers, Session Chair
NOAA Fisheries, Northeast Fisheries Science Center
James J. Howard Marine Sciences Laboratory, Highlands, NJ

9:00 a.m. Keynote: Everything You Wanted to Know About Flatfishes, But Were Afraid to Ask: An Overview of the Current State of Knowledge Regarding Systematic Relationships of Flatfishes (Order Pleuronectiformes?)
Thomas A. Munroe
NOAA Fisheries, OS&T National Systematics Laboratory, Smithsonian Institution, National Museum of Natural History, Washington, DC

9:30 a.m. Flatfish and Gadid Dietary Habits Relative to an Offshore Wind Farm in Southern New England
Dara Wilber[1]*, Lorraine Brown[2], Mathew Griffin[1], Gregory DeCelles[3], and Drew Carey[1]
[1]Inspire Environmental, Newport, RI, [2]Exa Data and Mapping, Poulsbo, WA, [3]Orsted Offshore North America, Providence, RI

9:50 a.m. Movement, Migration, and Seasonal Habitat Residency of Atlantic Halibut (*Hippoglossus hippoglossus*) on the Scotian Shelf
Elizabeth M. T. Bateman[1]*, Danni L. Harper[2], Nell den Heyer[2], Aaron MacNeil[3], and Michael J. W. Stokesbury[1]
[1]Department of Biology, Acadia University, Wolfville, NS, Canada, [2]Population Ecology Division, Fisheries and Oceans Canada, Dartmouth, NS, Canada, [3]Department of Biology, Dalhousie University, Halifax, NS, Canada

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

Session II

Sandra Sutherland, Session Chair
NOAA Fisheries, Northeast Fisheries Science Center
Woods Hole Laboratory, Woods Hole, MA

11:00 a.m. Will a Warming Subarctic Bering Sea Favor Yellowfin Sole Production?
Cynthia Yeung*, Louise Copeman, Beth Matta, and Mei-Sun Yang
NOAA Fisheries, Alaska Fisheries Science Center, Seattle, WA

11:20 a.m. Flatfish Habitat Use of a Small Southeastern US Tidal Creek: Long- and Short-term Occupancy Patterns
Mary Carla Curran[1]*, Jennie J. Wiggins[1], and Dara H. Wilber[2]
[1]Marine Sciences Program, Savannah State University, Savannah, GA, [2]College of Charleston, Charleston, SC

11:40 a.m. Abundance of Juvenile Winter Flounder, (*Pseudopleuronectes americanus*), in Norwalk Harbor, CT
Students from the Wilton High School Marine Biology Club[1]*, Nicole Spiller[2] Suzanne Steadham[1], Kasey Tietz[2], and Mary Donato[2]
[1]Wilton High School, Wilton, CT, [2]Harbor Watch, Earthplace, Westport, CT

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

Session III

Larry Alade, Session Chair

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

1:30 p.m. Variation in Fecundity of Winter Flounder (*Pseudopleuronectes americanus*) and Yellowtail Flounder (*Myzopsetta ferruginea*): Patterns across Stocks over Ten Years
Mark J. Wuenschel[1]*, Emilee Tholke[2], Yvonna Press[2], W. David McElroy[1], and Richard S. McBride[1]
[1]*NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA,* [2]*IBSS Corp, Silver Spring, MD*

1:50 p.m. Reproductive Behavior of Atlantic Halibut (*Hippoglossus hippoglossus*) Interpreted from Electronic Tags
Rachel Marshall*, Jonathan Fisher, Paul Gatti, Dominique Robert, and Arnault Le Bris
University of Rhode Island, Graduate School of Oceanography, Narragansett, RI

2:10 p.m. Using Collaborative Research with the Fishing Industry to Increase Availability of Biological Samples from a Data Limited Flatfish Stock
George Maynard[1,2]*, Richard S. McBride[1], Scott P. Elzey[3], Daniel R. Hennan[1], Emilee K. Tholke[4], Jocelyn Runnebaum[5] and Christopher H. McGuire[5]
[1]*NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA,* [2]*Formerly with the Cape Cod Commercial Fishermen's Alliance, Chatham, MA,* [3]*Massachusetts Division of Marine Fisheries, Gloucester, MA,* [4]*IBSS Corporation, Silver Spring, MD under contract with NOAA Fisheries,* [5]*The Nature Conservancy, Arlington, VA*

2:30 p.m. Extinction Risk Assessments for Members of the Flatfish Suborder Pleuronectoidei (Teleostei: Pleuronectiformes): A Global Perspective on Conservation Evaluations for a Diverse Taxon
Thomas A. Munroe[1]*, Gina M. Ralph[2, 3], and Christi Linardich[2]
[1]*NOAA Fisheries, OS&T National Systematics Laboratory, Smithsonian Institution, National Museum of Natural History, Washington, DC,* [2]*IUCN Marine Biodiversity Unit, Department of Biological Sciences, Old Dominion University, Norfolk, VA,* [3]*Department of Fisheries, Virginia Institute of Marine Science, College of William & Mary, Gloucester Point, VA*

2:50 p.m. **Refreshment Break**

Session IV
Dave Davis, Session Chair
HDR Engineering
Woodcliff Lake, NJ

3:20 p.m. Close Kin Mark Recapture in Atlantic Halibut: Genetic Marker Panel Development for Efficient and Cost-effective Downstream Analysis
Mallory Van Wyngaarden[1]*, Ellen M. Weise[1], Cornelia Den Heyer[2], Tony Kess[2], Anthony Einfeldt[1], and Daniel E. Ruzzante[1]
[1]*Dalhousie University, Department of Biology, Halifax, NS, Canada,* [2]*Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, NS, Canada*

3:40 p.m. Genomic Sex Identification and Population Abundance Estimation in Atlantic Halibut
Ellen M. Weise[1]*, Mallory Van Wyngaarden[1], Cornelia Den Heyer[2], Joanna Mills Flemming[3], Jonathan Fisher[4], Reina Ditta[5], Guillaume Pare[5], and Daniel E. Ruzzante[1]
[1]*Department of Biology, Dalhousie University, Halifax, NS,* [2]*Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, NS,* [3]*Department of Statistics, Dalhousie University, Halifax, NS,* [4]*Marine Institute, Memorial University of Newfoundland, St. John's, NL,* [5]*Population Health Research Institute, East Hamilton, ON*

4:00 p.m. Spatio-temporal Dynamics of American Plaice (*Hippoglossoides platessoides*) in US Waters of the Northwest Atlantic
Alexander Hansell[1]*, Larry Alade[1], Andrew Allyn[2], Steve Cadrin[3], and Lisa Kerr[2]
[1]*NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA,* [2]*Gulf of Maine Research Institute, Portland, ME,* [3]*School for Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, MA*

4:20 p.m. Catch Rate Standardization of the American Plaice Trawl Fishery
Keith Hankowsky[1]*, Max Grezlik[1], Lucy McGinnis[1], Gavin Fay[1], Alex Hansell[2], and Steve Cadrin[1]
[1]*School for Marine Science and Technology, University of Massachusetts Dartmouth, New Bedford, Massachusetts,* [2] *NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA*

4:40 p.m. **Poster Set-up**

5:00 p.m. **Hosted Mixer and Poster Session**

Wednesday November 16th

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

Session V
Mary Carla Curran, Session Chair
Savannah State University, Marine Sciences Program
Savannah, GA

8:40 a.m. Growth Trends of American Plaice (*Hippoglossoides platessoides*) in the Georges Bank and Gulf of Maine
Ashley Silver[1] and Larry Alade[2]*
[1]University of Maryland Eastern Shore, Princess Anne, MD, [2]NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA

9:00 a.m. Population Dynamics of an Estuary Spawning Winter Flounder (*Pseudopleuronectes americanus*) Subpopulation during Ecosystem and Fisheries Shifts
Richard G. Balouskus*, John Lake, M. Conor McManus, Katie Rodrigue, and Scott Olszewski
Rhode Island Department of Environmental Management, Division of Marine Fisheries, Jamestown, RI

9:20 a.m. How Might Future Ocean Conditions Affect Pre-Recruit Flatfishes?
R. Christopher Chambers[1]*, Ehren A. Habeck[1] and Delan J. Boyce[2]
[1]NOAA Fisheries, Northeast Fisheries Science Center, Howard Marine Sciences Laboratory, Highlands, NJ, [2]Lynker, NOAA Fisheries, Northeast Fisheries Science Center, Highlands, NJ

9:40 a.m. A Multidimensional Approach to Identifying Spawning Habitat and Migration Corridors for the North Carolina Stock of Southern Flounder (*Paralichthys lethostigma*)
Caitlin McGarigal*, Brian Bartlett, Paul Salib, Rebecca Asch, Joseph Luczkovich, Tyler Peacock, and Eric Diaddorio
East Carolina University, Department of Biology, Greenville, NC

10:00 a.m. Assessing Migration and Spawning Habitats of Southern Flounder (*Paralichthys lethostigma*) in the South Atlantic Using Pop-up Satellite Tags (PSATs)
Shelby B. White[1]*, Michael S. Loeffler[1], Anne L. Markwith[1], Mason G. Collins[2], and Frederick S. Scharf[2]
[1]North Carolina Division of Marine Fisheries, Morehead City, NC, [2]University of North Carolina, Wilmington, NC

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

Session VI
Thomas Munroe, Session Chair
NOAA Fisheries, Office of Science and Technology
National Systematics Laboratory, Smithsonian Institution, Washington, DC

10:50 a.m. Modelling Consequences of Climate-driven Sex Reversal for Southern and Summer Flounder Population Dynamics
Hailey M. Conrad* and Holly K. Kindsvater
Virginia Tech, Department of Fish and Wildlife Conservation, Blacksburg, VA

11:10 a.m. Diversity in Spawning and Migration: Implications for Winter Flounder Stock Structure
Tara Dolan[1]*, Shannon O'Leary[2], Kevin Feldheim[3], Michael Frisk[4], Catherine Ziegler Fede[5], Matthew Siskey[6], and Anne McElroy[4]
[1]Massachusetts Division of Marine Fisheries, Salem, MA, [2]Department of Biology, St. Anselm College, Manchester, NH, [3]Department of Biological Sciences, University of Illinois at Chicago, Chicago, IL, [4]School of Marine and Atmospheric Sciences, Stony Brook University. Stony Brook, NY, [5]New York State Department of Environmental Conservation, East Setauket, NY, [6]School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA

11:30 a.m. Flatfish Distributions across the Northeast US Continental Shelf: Comparing Bottom Trawl and eDNA Metabarcoding Results for Fall, 2019
Richard McBride[1]*, Yuan Liu[2, 3], and Thomas Munroe[4]
[1]NOAA Fisheries, Northeast Fisheries Science Center, Woods Hole Laboratory, Woods Hole, MA, [2]NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT, [3]A.I.S., Inc., 540 Hawthorn Street, North Dartmouth, MA, [4]NOAA Fisheries, OS&T National Systematics Laboratory, Smithsonian Institution, National Museum of Natural History, Washington, DC

11:50 a.m. Determining the Age, Growth, and Maturity of Southern Flounder in the Waters of North Carolina
Justin Mitchell*, Rebecca Asch, Joseph Luczkovich, Roger Rulifson, Patrick Harris, and Derek Aceituno
East Carolina University, Department of Biology, Greenville, NC

12:10 p.m. **Closing Comments**

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

Poster Session
Tuesday November 15th, 5 p.m.

Stephen Dwyer[1], Elizabeth Fairchild[2], Renee Mercaldo-Allen[3], Session Co-Chairs
[1]Dominion Energy, Millstone Environmental Laboratory, Waterford, CT,
[2]University of New Hampshire, Department of Biological Sciences, Durham, NH,
[3]NOAA Fisheries, Northeast Fisheries Science Center, Milford Laboratory, Milford, CT

What's for Lunch? Revealing the Diet Preferences of Winter Flounder Larvae in the Southern Gulf of St. Lawrence
Etienne Germain*, Sarra Nasraoui, Gesche Winkler, and Dominique Robert
Institut des Sciences de la Mer de Rimouski, Canada Research Chair in Fisheries Ecology, Ressources Aquatiques Québec, Rimouski, QC, Canada

Thermal Tolerance Variation in Young-of-the-Year Winter Flounder across the Southern New England Region
Geresa-Leigh Luke*, Anne McElroy, Michael Frisk, and Janet Nye
School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY

Energetic Fitness Considerations to Explain Within and Between Year Habitat Selection by Atlantic Halibut
Lucas Martin[1]*, Hugues Benoit[2], and Dominique Robert[1]
[1]UQAR-ISMER, Rimouski, QC, Canada, [2]Maurice-Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, QC, Canada

Assessing Seasonal Occupancy of Winter Flounder (*Pseudopleuronectes americanus*) in Massachusetts Embayments' Using eDNA
Carly McCall[1]*, Amanda Davis[2], Steve Voss[2], John Logan[2], and Tim O'Donnell[1]
[1]Gloucester Marine Genomics Institute, Gloucester, MA, [2]Massachusetts Division of Marine Fisheries, New Bedford, MA

Recruitment Patterns of the Bay Whiff (*Citharichthys spilopterus)* in Wylly Creek
Eric M. Parks* and Mary Carla Curran
Marine Sciences Program, Savannah State University, Savannah, GA

Size and Abundance of Fringed Flounder (*Etropus crossotus*) in Wylly Creek across 18 Years
Emely D. Perez*, Mary Carla Curran, and Amanda M. Kaltenberg
Marine Sciences Program, Savannah State University, Savannah, GA

Characterizing Winter Flounder Populations in Massachusetts Waters

Katrina A. Zarrella-Smith[1]*, William S. Hoffman[2], Bradley P. Schondelmeier[2], Micah J. Dean[2], Adrian Jordaan[1], and Michael P. Armstrong[2]
[1]*Graduate Program in Organismic and Evolutionary Biology, Department of Environmental Conservation, University of Massachusetts Amherst, Amherst, MA,*
[2]*Massachusetts Division of Marine Fisheries, Gloucester, MA*

Abstracts

Oral Presentations

Session I

Everything You Wanted to Know About Flatfishes, But Were Afraid to Ask: An Overview of the Current State of Knowledge Regarding Systematic Relationships of Flatfishes (Order Pleuronectiformes?)

Thomas A. Munroe

NOAA Fisheries, OS&T National Systematics Laboratory, PO 37012
Smithsonian Institution, National Museum of Natural History, MRC-153
Washington, DC 20013-7012

Email: munroet@si.edu

Flatfishes are a diverse group of teleost fishes with 800+ valid species distributed among 16 families. Historically, fishes possessing ocular and bilateral asymmetry were classified in the Order Pleuronectiformes, although some earlier authors proposed that ocular asymmetry arose independently in several different groups. The phylogeny and systematic relationships of flatfishes has become an area of active research especially over the past two decades as more advanced molecular analyses have been developed and new interpretations of fossils have been published. Both morphological (including fossils) and molecular approaches have recently proposed several novel hypotheses regarding hypothesized sister group relationships of the flatfishes, have questioned the monophyly of the flatfishes, have debated the systematic placement of flatfishes among teleost fishes, and several of these studies have also shed new light on the intrarelationships of taxa within the suborder Pleuronectoidei that change our views of flatfish intrarelationships. This presentation will discuss some of these recent findings and will highlight areas where controversy exists among competing hypotheses.

Session I

Flatfish and Gadid Dietary Habits Relative to an Offshore Wind Farm in Southern New England

Dara Wilber[1]*, Lorraine Brown[2], Mathew Griffin[1], Gregory DeCelles[3], and Drew Carey[1]

[1]*Inspire Environmental, 513 Broadway, Newport, RI 02840*

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[3]*Orsted Offshore North America, 56 Exchange Terrace, Providence, RI 02903*

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The expanding offshore wind industry on the northeastern US coast originated with Block Island Wind Farm (BIWF), which was built on a pilot scale of five, 6-MW wind turbine generators that became operational in 2016. Local commercial and recreational fishing interests and the scientific community collaborated to design a demersal trawl survey in the wind farm area and in two reference areas to assess potential wind farm effects. The survey occurred over seven years that spanned baseline, construction, and operation time periods. Stomach content analysis was conducted on 3,457 flounder, gadids, and black sea bass, along with an examination of fish condition and stomach fullness. Temporal variation in trophic metrics was more common than spatial differences, with no consistent indication of an effect of wind farm operation across metrics or species. Prey accumulation curves indicated that diets were adequately characterized with sample sizes of approximately 40 stomachs for most time period by area combinations. Inclusion of mussels and mysids in fish diets following turbine installation indicate fish forage on the colonized turbines. Although substantial changes to fish diets were not evident at BIWF, potential trophic effects of larger wind farms should be examined as the US offshore wind industry expands. Results from BIWF monitoring provide valuable information for future offshore wind development monitoring efforts.

Session I

Movement, Migration, and Seasonal Habitat Residency of Atlantic Halibut (*Hippoglossus hippoglossus*) on the Scotian Shelf

Elizabeth M. T. Bateman[1]*, Danni L. Harper[2], Nell den Heyer[2], Aaron MacNeil[3], and Michael J. W. Stokesbury[1]

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33 Westwood Avenue, Wolfville, NS, B4P 2R6, Canada

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[3]*Department of Biology, Dalhousie University*
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Atlantic Halibut (*Hippoglossus hippoglossus*) is Atlantic Canada's most valuable groundfish, yet the movements and migrations of this deep-water species on the Scotian Shelf are not well resolved. In collaboration with Fisheries and Oceans Canada, the Atlantic Halibut Council, and the Ocean Tracking Network, 144 km^2 of a known juvenile halibut "hotspot" on the northern tip of the Gully (a large submarine canyon near Sable Island) are now being monitored by an acoustic array. This is the first acoustic telemetry project for Atlantic Halibut on the Scotian Shelf, enabling the determination of seasonal habitat residency and movements for both adult and juvenile fish within the area through three detection methods: fixed receivers (downloaded annually), active glider tracking, and opportunistic detections on other receiver networks maintained by OTN. Since 2020, we have acoustically tagged 245 halibut ranging from 50-141 cm fork length. Detection data will be obtained by gliders by late October 2022, but preliminary data from August 2021 suggest frequent localized movements within the array and greater residency at stations deeper than 140 m. So far, two halibut have been detected on other receiver lines making larger-scale dispersive movements of up to 300 km away. These preliminary results indicate that acoustic telemetry is an effective method of observing both broadscale migrations and fine scale movements for Atlantic Halibut on the Scotian Shelf.

Session II

Will a Warming Subarctic Bering Sea Favor Yellowfin Sole Production?

Cynthia Yeung*, Louise Copeman, Beth Matta, and Mei-Sun Yang

NOAA Fisheries, Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle, WA 98115

Email: cynthia.yeung@noaa.gov

The southern Bering Sea (SBS) sustains the valuable yellowfin sole (*Limanda aspera*; YFS) fishery. Following recent record-high water temperatures, the biomass of YFS has increased in the subarctic northern Bering Sea (NBS). Summer bottom temperatures were anomalously warm from 2016 to 2019, except for 2017 when temperatures returned to near the 2010-2019 average. The abundance of juvenile YFS (age-5 and younger) has increased steadily in the NBS since 2017. Juvenile YFS inhabit depths of less than 50 m (inner shelf) and historically were concentrated in the SBS. We divided the inner shelf latitudinally into three areas – north, central, and south – to assess the implications of a northward habitat shift on juvenile growth potential. Faster growth and larger length-at-age were associated with warmer temperatures. As the Bering Sea warms, the summer bottom temperatures in the north are becoming increasingly warmer than those in the south. In 2019, the highest concentration of juveniles was in the north. They were also younger in the north (age-1 and age-2) than in the south (age-3). The estimated growth rate (2018-2019) based on otolith increment width was higher in the north. Growth was lowest in the central area, which typically had the lowest summer bottom temperatures among the three areas. It appears that conditions in the NBS in the summer are favorable to juvenile growth, and a northward shift in habitat may increase productivity of the stock. However, negative effects on the growth and condition of this cold-adapted species may occur if warming continues.

Session II

Flatfish Habitat Use of a Small Southeastern US Tidal Creek: Long- and Short-term Occupancy Patterns

Mary Carla Curran[1]*, Jennie J. Wiggins[1], and Dara H. Wilber[2]

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[2]*College of Charleston, Charleston, SC 29412*

Email: curranc@savannahstate.edu

Many flatfish species utilize coastal areas during at least one of their life-history stages. Estuaries on the eastern US Atlantic coast provide important settlement and nursery habitat for flatfishes. Small tidal creeks serve as transition zones between upland and estuarine environments and are a consistent settlement and nursery habitat for flatfish. Flatfish habitat use in Wylly Creek, a southeastern US tidal creek, was examined to determine whether assemblage composition has changed over a decadal time period (2004-2007 vs. 2016-2019). In addition, the potential effect of cold winters on juvenile flatfish recruitment and subsequent spring flatfish assemblage composition were examined. Flatfish assemblages have undergone subtle shifts in composition between initial and recent time periods, with decreases (5-16 fold) in abundance occurring for ocellated flounder *Ancylopsetta quadrocellata*, summer flounder *Paralichthys dentatus*, and southern flounder *Paralichthys lethostigma*, while abundances of more common species, bay whiff *Citharichthys spilopterus* and blackcheek tonguefish *Symphurus plagiusa*, remained relatively consistent. Bay whiff recruitment into the creek occurred in early spring, but was delayed in most years with colder winters. Minimum residency for bay whiff within an approximately 350 m stretch of creek was estimated to be approximately 5-10 days. Flatfish habitat use in this small tidal creek adjacent to a relatively undeveloped coastal area may reflect a shifting baseline against which potential assemblage shifts in developed areas can be assessed.

Session II

Abundance of Juvenile Winter Flounder, (*Pseudopleuronectes americanus*), in Norwalk Harbor, CT

Students from the Wilton High School Marine Biology Club[1]*, Nicole Spiller[2] Suzanne Steadham[1], Kasey Tietz[2], and Mary Donato[2]

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Email: n.spiller@earthplace.org

Abundance of juvenile winter flounder, *Pseudopleuronectes americanus*, were studied in Norwalk Harbor, CT during the summer of 2022. The data collected were a continuation of a 32-year demersal fish study organized by Harbor Watch, who worked in collaboration with students from the Wilton High School Marine Biology Club to conduct weekly trawls from May through October. Winter flounder abundance (catch per trawl) and length (to the nearest millimeter) were recorded as well as species composition and abundance of all other finfish and invertebrates caught. These data were analyzed and compared against data from previous years. Dissolved oxygen and temperature data were also studied in the harbor over the same time period and were considered as potential drivers of trends in winter flounder abundance. An overall decline in juvenile winter flounder abundance has been observed over the last three decades, while dissolved oxygen has decreased and water temperature has increased over the course of the study. This long-term study can assist in understanding changes in Norwalk Harbor and other Long Island Sound embayment's.

Session III

Variation in Fecundity of Winter Flounder (*Pseudopleuronectes americanus*) and Yellowtail Flounder (*Myzopsetta ferruginea*): Patterns across Stocks Over Ten Years

Mark J. Wuenschel[1]*, Emilee Tholke[2], Yvonna Press[2], W. David McElroy[1], and Richard S. McBride[1]

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Annual fecundity estimates in marine fishes have been limited for most species due in part to the challenges of traditional methods, however recent advances in image analysis have facilitated fecundity estimation. Ongoing monitoring of potential annual fecundity (PAF) in winter and yellowtail flounder across multiple stocks (Gulf of Maine, Georges Bank, and Southern New England/Mid-Atlantic) provides a rich dataset to explore spatial and temporal variation in annual fecundity. We modeled annual fecundity as a function of fish size, liver size, relative condition (Kn), and the mean oocyte diameter for these two species with different reproductive strategies (total vs. batch spawning) using generalized additive models (GAMs). Spatial and temporal effects were assessed as factors- across three stock areas over a ten-year period (2010-2019). As expected, fish size, condition metrics (Kn and liver size) and mean oocyte diameter (which served as a proxy for time before spawning) explained significant portions of variation in potential annual fecundity. For both species, GAMs also indicated significant spatial and temporal effects, as well as the interactions between them suggesting regional level forcing that has varied through time. Observed variation in reproductive output across stocks, species, and years provides empirical data to propose and test hypotheses related to 'upstream' regulation of fecundity (via environmental drivers and productivity) and 'downstream' effects on population replenishment and recruitment.

Session III

Reproductive Behavior of Atlantic Halibut (*Hippoglossus hippoglossus*) Interpreted from Electronic Tags

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Reproductive timing, location, and behavior are important characteristics that determine marine population dynamics, structure, and persistence to threats such as harvesting and climate change. It is challenging to evaluate factors driving variability in these reproductive traits in wild flatfish because of the difficulties observing individuals in their natural environments. In this study, high resolution depth, temperature, and acceleration time series recorded by pop-up satellite archival tags are used to (1) identify and characterize patterns in depth use and acceleration that may be indicative of spawning events in large Atlantic halibut (*Hippoglossus hippoglossus*), and (2) estimate the influence of individual traits (body size and sex) and environmental factors (location and temperature) on spawning time and frequency. We demonstrate that unique rapid rises observed in the winter corresponds to spawning events. The number of rises of batch spawning females was not related to female size, which is contrary to our first hypothesis. In accordance with our second hypothesis, the timing of the first spawning rises was negatively correlated to growing degree day experienced during the pre-spawning season, suggesting that climate change may induce phenological change in halibut spawning time. This study demonstrates that electronic tagging technologies can be used for in-depth characterization of timing, location, and behaviors associated with spawning in large flatfish species. Electronic tag studies can furthermore inform spatiotemporal management and conservation measures aiming to protect critical spawning events from directed fishing and bycatch.

Session III

Using Collaborative Research with the Fishing Industry to Increase Availability of Biological Samples from a Data Limited Flatfish Stock

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Atlantic halibut are a data poor stock in US waters. The stock's biomass is characterized as "significantly below target levels," and little is known about their geographic stock structure and life history. The rejection of the 2015 stock assessment drew attention to the paucity of information for managing this stock. A 2016 Saltonstall-Kennedy award to The Nature Conservancy paired state, federal and academic researchers, and the Cape Cod Commercial Fishermen's Alliance on a collaborative research project. Commercial fishermen collected samples for age, DNA, and maturity analysis from Atlantic halibut during their normal fishing activities. Additionally, some fishermen were trained to deploy pop up satellite transmitters on halibut. Over the course of the project, 253 Atlantic halibut were sampled on 122 trips. Commercial fishermen collected samples across all seasons rather than the spring and fall seasons sampled by the NEFSC bottom trawl and bottom longline surveys. Six chartered trips with scientists on board allowed for tagging six fish, with ten additional tags deployed by commercial fishermen on two (non-chartered) trips. Importantly, in addition to the field portion of this research, commercial fishermen were also involved in the planning of sample collection efforts. Early and repeated engagement with industry partners throughout the project resulted in a sustained, high-quality sampling effort. Ultimately, the data collected led to multiple posters and presentations at scientific conferences, as well as three peer-reviewed publications, and for stock assessment, an index that tracks the proportion of mature adults in the catch.

Session III

Extinction Risk Assessments for Members of the Flatfish Suborder Pleuronectoidei (Teleostei: Pleuronectiformes): A Global Perspective on Conservation Evaluations for a Diverse Taxon

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Flatfishes constitute a diverse group of interesting fishes characterized by bilateral asymmetry. They occur in shallow to moderately deep (ca. 2000 m) demersal habitats worldwide. Most species inhabit marine waters, several reside within estuaries, and a limited number occur strictly in freshwater. Flatfishes range from 2.5 to 365.0 cm. Larger species support major commercial and recreational fisheries, while smaller, primarily tropical, species are important components of non-selective trawl fisheries. In collaboration with 20+ international experts, we applied IUCN Red List methodology to assess conservation status of 811 flatfish species. Nearly 4% of species for which data are available are considered threatened (range 2-43%). Most threatened species are large, heavily exploited members of the Pleuronectidae, many of which are also impacted by warming waters associated with climate change. However, this family also includes key examples of species with well-managed fisheries, particularly those occurring in the northeast Pacific Ocean. In contrast, speciose families, Soleidae, Bothidae, and Cynoglossidae, record high numbers of Data Deficient species. Many of these experience high levels of anthropogenic threats, though population-level changes could not be quantified because of limited data. Taxonomic issues can impede accurate application of IUCN Red List criteria, while assessments themselves highlight data gaps and can inspire new avenues for research. For example, inconsistencies in taxonomy applied to several populations, once considered subspecies of *Platichthys flesus*, have implications when assessing conservation status of these taxa. This first comprehensive extinction risk assessment of flatfishes forms the baseline for evaluating future changes in biodiversity of these fishes.

Session IV

Close Kin Mark Recapture in Atlantic Halibut: Genetic Marker Panel Development for Efficient and Cost-effective Downstream Analysis

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Current fisheries science relies increasingly on genetic and genomic data for management and conservation. One example is the use of genomic data to estimate population abundance using the Close Kin Mark Recapture (CKMR) approach. Based on the principle that an individual's genotype can be considered a "recapture" of the genotypes of its parents, this approach analyses the number and pattern of parent-offspring pairs in a mark-recapture framework and uses the results to estimate population size. CKMR requires the precise genotyping of thousands of individuals at many molecular markers, so for a study of this kind to remain efficient and cost effective, front-loading the careful planning of genomic approach, marker selection, sample collection and organization, and wet-lab work is required. We used CKMR to estimate population size in Atlantic halibut (*Hippoglossus hippoglossus*) on the Scotian Shelf. Using existing published genomic data, we developed a panel of 4000 genetic markers spread across the entire genome, focusing on a sex-determining region and a previously identified chromosomal inversion. Samples were stored in 95% ethanol with no other treatment required, processing involved simple DNA extractions, and sequencing was completed at a collaborating facility using the custom panel produced by Illumina. This method enabled us to collect 5000+ samples and sequence 3500+ fish within the first two years of the project. In addition to the population size estimates, the expanding dataset is also being used for the development of a genetic aging clock and genetic sex determination, both currently costly, labour-intensive, and inefficient processes.

Session IV

Genomic Sex Identification and Population Abundance Estimation in Atlantic Halibut

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Atlantic Halibut are the target of an important fishery in the Northwest Atlantic and knowledge of their abundance is crucial for proper management and conservation. However, estimating the population size of a widely distributed and abundant marine fish is notoriously difficult. We plan to estimate the population abundance of Atlantic Halibut on the Scotian Shelf using the Close Kin Mark Recapture (CKMR) approach. The method is based on the genotypic identification of kin (parent-offspring pairs, half-sib pairs, etc.) which are used as a substitute for physical recaptures in a traditional mark-recapture framework. Our goal is to genotype 12,000 halibut at 4000 single nucleotide polymorphic (SNP) markers over a period of four years. Within those 4,000 SNPs are approximately 200 SNPs that were previously shown to distinguish genetic males and females. These SNPs were used to differentiate phenotypically identified males and females using a DAPC approach. This framework was then used to identify unknown individuals and misidentified phenotypic males and females. The ultimate goal of the project is to provide the modeling framework for the estimation of population abundance, survivorship rates and connectivity for Atlantic Halibut that can be used to assess the state of the population on the Scotian Shelf and adjacent areas.

Session IV

Spatio-temporal Dynamics of American Plaice (*Hippoglossoides platessoides*) in US Waters of the Northwest Atlantic

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This work supports the 2022 American plaice (*Hippoglossoides platessoides*) research track stock assessment. Data was compiled from four bi-annual trawl surveys: The Northeast Fisheries Science center (NEFSC) Albatross (1963 – 2008); NEFSC Bigelow (2009– 2019) Maine New Hampshire (MENH; 2005 – 2019); and Massachusetts Division of Marine Fisheries (MADMF; 1981 – 2019). A vector auto-regressive spatio-temporal model (VAST) was applied to the different trawl surveys to estimate changes in spatial distribution and create standardized indices of abundance. Results suggest that the effective area of American plaice has decreased and the center of gravity has been variable. Model selection indicated that bottom temperature and depth were both important modulates of density. Spatio-temporal indices are similar to designed based estimates for the NEFSC and MADMF surveys; however, they are different for the MENH survey. The combined index that incorporates all data is most similar to the NEFSC survey. The results presented here document spatial-temporal changes of American plaice and provide indices that account for these changes, which can be explored within the stock assessment.

Session IV

Catch Rate Standardization of the American Plaice Trawl Fishery

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A standardized landing per unit effort (LPUE) series from fishery dependent data was developed for consideration as an index of abundance for the 2022 American plaice stock assessment. Stock assessment models often assume that abundance indices are proportional to stock size and catchability is constant over time. However, the behavior of commercial fishing fleets responds to market conditions and fishery regulations. Thus, fishery catch rate indices need to be standardized to account for factors that influence catch rates. American plaice catch rates were developed from merged logbook-dealer data, and a series of linear models were fit with calendar year, statistical area, quarter of the year, vessel tonnage class, mesh size, depth, and price as main effects. The model with year, statistical area, quarter, vessel tonnage class, depth, and price was selected as the optimal model based on model validation, Akaike's Information Criterion, and deviance explained. The standardized index from the optimal model explained 24% of the deviance and showed catch rates for plaice have increased since the early 2000s, but the increase was not as substantial as the unstandardized (nominal) LPUE. The standardized index was correlated with Northeast Fisheries Science Center bottom trawl survey series (spring: r = 0.58 and fall: r = 0.73), supporting the exploration of the LPUE series as an index of stock size within the American plaice stock assessment. The LPUE index provides an avenue for fishermen's data to be incorporated into the American plaice stock assessment, creating a more complete estimate of relative abundance.

Session V

Growth Trends of American Plaice (*Hippoglossoides platessoides*) in the Georges Bank and Gulf of Maine

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American plaice is a pleuronectid that inhabits relatively deep waters from southern Labrador on the eastern coast of Canada to Rhode Island. This species of flatfish is of interest for the investigation of new growth parameters because it underwent a research track assessment in 2022. Growth analyses to examine length-at-age and length-weight relationships of American plaice on data collected during the Spring and Autumn Bottom trawl surveys conducted by the Northeast Fisheries Science Center from 1980-2021 were used to derive new growth parameters. The main objective of the study was to explore spatial and temporal differences in growth for American plaice. Data were stratified into regions, gender, season, and various time block to explore spatial, seasonal, temporal, and gender differences. Our analyses show that American plaice growth is sexually dimorphic and a comparison of regional growth between Georges Bank and the Gulf of Maine indicate that size at age and weight at length were similar between regions. There was a temporal trend in size at age with higher maximum size achieved in the early 1980' followed by a decline through the late 1990's and 2000's and increase in maximum size at age in the 2010's. The result of this study will be explored in a state-space stock assessment model to examine the impact of the new growth parameters on population estimates. This study provides the most accurate and up to date growth information that played a role in providing reliable scientific advice for management of American plaice.

Session V

Population Dynamics of an Estuary Spawning Winter Flounder (*Pseudopleuronectes americanus*) Subpopulation During Ecosystem and Fisheries Shifts

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The SNE/MA winter flounder spawning niche was well suited to historic local conditions by reducing predation during spawning and early life history stages. However, the environmental niche occupied by spawning SNE/MA winter flounder is shrinking in space and time. This research examines young-of-year and spawning stock biomass surveys within a single coastal lagoon, Point Judith Pond in Rhode Island across two decades (1999-2020). Winter flounder in Point Judith Pond have experienced wide fluctuations in both fishing effort and the prevalence of young-of-year and adult winter flounder predators during the time period explored. Despite decreases in fishing mortality both within the pond as well as in offshore habitats, there has been no discernible recovery within the Point Judith Pond subpopulation. It is possible that an increase in predators of the young-of-the-year and spawning adults may be hindering the recovery of this subpopulation. Local abundance of predators including piscivorous birds, fish, and mammals have increased, in some cases starkly, prior to and during the study period. With environmental drivers creating stressors on winter flounder through biotic (predation) and abiotic (water temperature, habitat loss) means, it is critical for managers to provide mechanisms for the stock's survival. By the time a fishing moratorium was implemented in PJP, abundance was already well below time series historic minimums. With fishing pressure no longer dictating population status, other management ideas will need to be developed to address natural mortality (predation) and habitat loss. It is becoming apparent that once a local winter flounder population is depleted it will not return to that area under current environmental conditions. With this in mind, maintenance of spatial complexity may be critical to the long-term persistence and fishery sustainability of marine fish.

Session V

How Might Future Ocean Conditions Affect Pre-Recruit Flatfishes?

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The scope of biological response of an organism to changes in climate and other environmental factors varies and is a species characteristic. Some taxa show greater levels of plasticity, have greater resiliency to environmental change, and/or display higher adaptive potential (i.e., greater heritable variation). Others are more conservative on all of these fronts. These patterns are of value in understanding both the dynamics of wild populations and the production potential of captive (aquacultural) ones. In order to achieve a more predictive understanding of how environmental change might affect marine life and fishes in particular, science must progress from 1st-order, descriptive, and qualitative assessments of effects to more quantitative depictions of relationships between environmental drivers and biotic responses. Here we review the underlying principles of phenotypic variation then summarize our studies and experimental methods developed to reveal the scope of responses to environment drivers. Using examples from experiments on flatfish taxa, we describe patterns of responses that would be unanticipated based on experimental designs with a small number of treatment levels. The approaches described have applicability to a broad range of studies including those on climate change, ocean acidification, hypoxia, and other environmental factors as well as on aquaculture.

Session V

A Multidimensional Approach to Identifying Spawning Habitat and Migration Corridors for the North Carolina Stock of Southern Flounder (*Paralichthys lethostigma*)

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Southern flounder (*Paralichthys lethostigma*) is an economically valuable fishery in North Carolina, but uncertainty surrounding the life history of adult fish in ocean environments, such as spawning location and degree of interstate stock connectivity, are creating current management challenges. 210 adult flounder were collected by commercial pound net in the Albemarle, Pamlico, and Core Sounds in the Fall of 2020 and 2021. Fish were acoustically tagged and monitored using a network of acoustic receivers and an SV2 Wave Glider outfitted with a VR2C receiver. Movement from 85 tagged individuals detected to date indicate emigration corridors are spatially variable but primarily occurs in November-December. Likewise, between January and March some individuals move offshore to the shelf break while others migrated south within the nearshore waters between Cape Lookout and Cape Fear. Additionally, seven fish exhibited potential skip-spawning behavior, eight individuals made return migrations to North Carolina sounds, and one flounder was detected making consecutive, multiyear offshore migrations. Ongoing investigation into potential spawning locations is being pursued using particle tracking model (CMS) to predict larval origin and DNA barcoding analysis of fish eggs collected during February and March at sites spanning the continental shelf. Adult movement data, and preliminary larval dispersal results, suggest that southern flounder are distributed across inner, mid, and outer shelf habitats and mixing with southern stocks may be less extensive than previously thought.

Session V

Assessing Migration and Spawning Habitats of Southern Flounder (*Paralichthys lethostigma*) in the South Atlantic Using Pop-up Satellite Tags (PSATs).

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The coastwide stock assessment for southern flounder (*Paralichthys lethostigma*) indicates a need to better understand offshore migration and movement patterns of the species. Collaborative research between the North Carolina Division of Marine Fisheries and the University of North Carolina Wilmington uses two Pop-Up Satellite Archival Tag (PSAT) models to identify offshore spawning locations and timing of spawning movements for southern flounder. Tagging efforts occurred in Fall 2020-2022 with tags released primarily throughout North Carolina, although a subset of tags were released in South Carolina. Female southern flounder were captured using commercial pound nets, hook-and-line, gill net, and dependent sampling gears. Models suggests that the area the fish was tagged in, as well as timing of satellite tag release are indicators of movement to inner and outer shelf habitats, although the area where the fished tagged was only significant in one year. Results of PSAT releases indicate that while some fish migrate out of the estuaries to inner and outer shelf habitats, others remain inshore. The PSAT model collecting temperature and depth suggests that fish migrating to outer shelf habitats fluctuate between depths across short periods, which may be indicative of spawning behavior (e.g., spawning rises) similar to other flatfish species. An understanding of southern flounder migration patterns and offshore spawning habitats and behaviors will provide valuable information on the spatial scale for management of the South Atlantic population and offer avenues for future research on histology and reproduction of southern flounder.

Session VI

Modelling Consequences of Climate-driven Sex Reversal for Southern and Summer Flounder Population Dynamics

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Climate change is predicted to threaten vertebrate species for which sex determination is influenced by temperature by skewing population sex ratios. Southern and summer flounder are economically and culturally valuable fish species that are capable of temperature-induced sex reversal. Recent evidence suggests that the sex ratios of southern flounder populations have been masculinizing over time. It is crucial to understand how temperature-induced sex reversal may contribute to the risk of overfishing and potentially impact recovery from fishing pressure in these closely related species. We developed a size-, age-, and sex- structured population dynamics model for both species to understand how temperature-induced sex reversal will interact with harvesting to impact population productivity. Our model predicted that as the proportion of females decreased, so did the overall population size. We also show that the traditional biological reference point used in fishery stock assessments to determine the reproductive potential of a stock, the spawning potential ratio (SPR), is not sensitive to the sex ratio at differentiation, so changes in stock productivity can go undetected. Accounting for changes in stock productivity due to climate-induced shifts in sex ratios could explain recent declines in recruitment and biomass of both southern and summer flounder.

Session VI

Diversity in Spawning and Migration: Implications for Winter Flounder Stock Structure

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The expression of alternative life-history strategies within and among populations can be critical for persistence of species that experience fluctuating environmental conditions. Intra-species differences in migration propensity and the timing of spawning create diverse population components which can respond differentially to environmental variability, promoting long-term stability within the population (portfolio effect). However, such intra-specific diversity can also lead to challenges for the assessment and management of harvested species because we can no longer assume that stocks with such diverse subcomponents have homogeneous population dynamics. Winter flounder (*Pseudopleuronectes americanus*) are a coastal flatfish that have declined to less than 11% of their historic abundance in the Southern New England/Mid-Atlantic region of the United States. A concern for the assessment and management of winter flounder is whether diversity in migration propensity and the timing and location of spawning results in isolation of population components, giving rise to persistent stock structure. We characterized intra-specific behavioral diversity in migration propensity for winter flounder across multiple spatial scales. The migration propensity and natal origin for individual flounder were cross-referenced with their genotype, allowing us to compare genetic signatures of population structure with migration and spawning behavior. Including the role of behavior in mediating population connectivity should lead to more accurate interpretation of the causes and consequences of changes in fisheries productivity, and thus help us design more accurate assessment and effective management strategies.

Flatfish Distributions across the Northeast U.S. Continental Shelf: Comparing Bottom Trawl and eDNA Metabarcoding Results for Fall, 2019

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Environmental DNA holds promise for monitoring biodiversity in dynamic ecosystems and may have broad applications for resource assessments. Here, we evaluate the sufficiency of a common eDNA mitochondrial marker (i.e., the Riaz 12S primers) to match all 47 pleuronectiform species (8 families) documented from North Carolina to the Gulf of Maine. For this marker, 51% of the 47 species lack reference sequences; only 21 full and 2 partial sequences were available in GenBank (https://www.ncbi.nlm.nih.gov) as of September, 2022. We also compared flatfish taxa observed by a fishery-independent bottom trawl survey to flatfishes observed using the Riaz 12S primers across the same sampling range (35.4 – 43.0ºN) of the US east coast during Fall, 2019. The bottom trawl survey identified 12 flatfish taxa (3 identified as sp.) using morphological traits. The eDNA metabarcoding survey using filtered water samples identified 11 taxa (2 identified to family). Five common species were identified in both surveys. Much less water was strained by the eDNA method to reveal the same biodiversity: 301 20-minute trawl tows vs. a total of 346 liters of filtered seawater for eDNA metabarcoding. Additional reference sequences in GenBank are needed to improve estimates of flatfish diversity. Regarding fishery applications, 5 flatfishes with formal stock assessments are represented by sequences in GenBank, as well as an additional 2 sequences that can only be identified to family (Pleuronectidae). An initiative by NOAA Fisheries' National Systematics Laboratory, Smithsonian, will add reference sequences from vouchered specimens to GenBank. Use of multiple markers will also improve taxonomic identifications.

Session VI

Determining the Age, Growth, and Maturity of Southern Flounder in the Waters of North Carolina

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Understanding a fish's movements and reproductive behavior allows a more accurate stock definition to be created that reflects dynamics of the wild population and can be used to guide fisheries management plans to better protect said species. Southern Flounder (*Paralichthys lethostigma*) is a historically valuable commercial finfish species in North Carolina and has become overfished and experiencing overfishing. With improved knowledge about the life history through research on their growth and reproduction, management plans may be created to help recover the species Southern Flounder were collected from Albemarle, Pamlico, and Core Sounds, and Cape Fear from fall 2020 to fall 2021. In total 432 Southern flounder were collected, with length data indicating sexual dimorphism. Males averaged 325.1 mm TL (SD 15.9 mm) and females were 395.2 mm TL (SD 38.8 mm). Flounder sampled were aged ranging from 0-4 years, with most fish aged to be one (265 individuals) and two (121 individuals) years old. GSI (gonadosomatic index) showed a significant increase during the mid-to-late fall in preparation for winter spawning. A subsample of 200 individuals had their gonadal tissue analyzed to determine their phase of maturity. Initial results from histology indicate asynchronous oocyte development is common among Southern Flounder with a majority of the fish analyzed being in the development phase. The data collected will provide information on Southern Flounder maturity and that can be used to help protect the species by better identifying spawning age individuals and potentially protecting their spawning migration and period.

Abstracts

Poster Presentations

What's for Lunch? Revealing the Diet Preferences of Winter Flounder Larvae in the Southern Gulf of St. Lawrence

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When newly hatched fish larvae run out of vitelline resources, they must quickly turn to live prey to survive. The switch between endogenous and exogenous diets constitutes a critical period for fish larvae, considering their limited swimming and hunting capacities. During this transition, many factors like prey availability, temperature and hydrographic features can influence the feeding success of larvae, leading to high and variable mortality rates, which translate into enormous variability in recruitment. This project focuses on Winter Flounder (*Pseudopleuronectes americanus*) larvae, a commercially important Atlantic coastal flatfish. Recent stock assessments revealed that in the southern Gulf of St. Lawrence, the stock is facing very high levels of mortality and low recruitment. Very little is known about larval dynamics in the southern Gulf of St. Lawrence, and in particular, larval feeding requirements of the Winter Flounder remain unknown. Hence, understanding the diet of early-life stages can contribute to a better understanding of potential recruitment drivers in this declining stock. In this study, we use historical samples from the Magdalen Shallows collected in 1998. Zooplankton assemblage was taxonomically resolved, and every prey consumed by larvae was identified to the lowest taxonomic level possible, including developmental stage. Relying on these high-resolution data, prey selectivity of Winter Flounder larvae is quantified using Chesson's α-selectivity index.

Thermal Tolerance Variation in Young-of-the-Year Winter Flounder across the Southern New England Region

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Warming estuaries driven by climate change pose a risk for early life stages of fish. Warming estuaries can induce thermal stress in juveniles symptomatic of growth inhibition, increased respiration, and mortality thus reducing recruitment into the stock. This research aims to identify thermal tolerance variation along a latitudinal gradient among juvenile Winter Flounder subpopulations within the Southern New England region, in support of planed modeling efforts on this species. We conducted a common garden laboratory experiment using Young-of-the-Year Winter Flounder from Boston Harbor, MA, Narragansett Bay, RI, Shinnecock Bay, NY and Sandy Hook Bay, NJ. The test subjects from each population were placed in individual bowls in 3 recirculating seawater systems and acclimated to 14, 20 and 24°C. Over the course of 5 weeks, length and weight were measured to determine temperature's effect on growth rates. Additionally, opercular flaps were recorded on video and used as a proxy for ventilation and respiration rates. Growth was strongly influenced by temperature and fish population. Fish from Shinnecock Bay and Narragansett Bay, grew at the highest rate, with positive growth observed for all populations at temperatures of 14°C and 20°C, with most populations experiencing negative growth rates at the warmest temperature (24°C). As expected ventilation tended to increase as a function of temperature, but the response varied among the populations tested. Further statistical analysis of the preliminary data is still ongoing. The preliminary results suggest that growth and ventilation vary across populations of winter flounder and response to warming conditions may vary by location.

Energetic Fitness Considerations to Explain Within and Between Year Habitat Selection by Atlantic Halibut

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Habitat selection by individuals defines distribution at the population scale. Under the Ideal Free Distribution (IFD), individuals distribute themselves to achieve the same fitness. This may result in differences in seasonal distribution and therefore migration. The aim of this study is to evaluate how life strategies, considered from a bioenergetic perspective, influence fish habitat selection within and between years using biotelemetry data for Atlantic halibut (*Hippoglossus hippoglossus*) in the Gulf of Saint-Lawrence (GSL). High frequency observations of acceleration, water temperature and depth over approximately one year were obtained for 45 individuals. Previous analyses of these data produced estimates of daily location, revealing a range of seasonal migratory strategies, involving displacements ranging from several kilometers to hundreds of kilometers. We will evaluate individual variability in bioenergetic costs associated with seasonal migrations, and within season movements, using Dynamic Body Acceleration. Given that energy is a fundamental component of fitness, we expect that individual strategies involving greater energetic costs should be associated with greater gains under the IFD. We will evaluate this using habitat specific observations of individual condition, feeding success using stomach contents and growth rate from large scale surveys. By combining those results with survey information on the relative abundance and distribution of prey, we will attempt to explain interannual changes in Atlantic halibut distribution in the GSL observed while it recovered from a highly depleted state. Our findings should provide a better mechanistic understanding of the density dependent and independent factors affecting the spatial distribution of fish populations.

Assessing Seasonal Occupancy of Winter Flounder (*Pseudopleuronectes americanus*) in Massachusetts Embayment's Using eDNA

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Dredging projects are necessary to maintain and improve the navigational waterways that support the economic growth and sustainability of coastal communities. However, dredging can disturb wildlife habitats and result in detrimental consequences for economically important fish species like winter flounder (*Pseudopleuronectes americanus*) that use coastal embayments as spawning habitat. Turbidity and burial caused by dredging can lead to mortality of demersal eggs, which has prompted conservative dredging restrictions to protect winter flounder spawning success for up to six months of the year due to a lack of detailed information regarding the timing and location of winter flounder spawning within embayments. We have initiated an eDNA study by collecting and filtering (0.2µm pore size) 10-13 1L bottom water samples across six embayments monthly for a year, extracting DNA with the Qiagen DNeasy PowerSoil Pro kit, and applying a species-specific qPCR assay to detect winter flounder and better understand occupancy patterns in coastal Massachusetts. Preliminary results indicate seasonal and embayment-specific trends in winter flounder occupancy likely driven by benthic habitat and differences in behaviors among adult and young-of-year life stages. Completed data will be used to build a spatiotemporal occupancy model to inform dredging regulations that protect the winter flounder fishery while potentially identifying times and/or regions where restrictions can be relaxed.

Recruitment Patterns of the Bay Whiff (*Citharichthys spilopterus*) in Wylly Creek

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Environmental factors can affect fish recruitment into nursery habitats and the time of arrival. The purpose of this study was to determine if larval Bay Whiff *Citharichthys spilopterus* could be collected, and if so, elucidate the recruitment and abundance of individuals in the water column compared to the abundance on the benthos in Wylly Creek near Savannah, GA. Monthly surveys were conducted from November 2020 to March 2021 during flood and ebb currents with a plankton net and beam trawl. The abundance and size of fish obtained on different dates and tidal stages were compared. Only juveniles (n = 30) were collected. Some were obtained in the plankton net (n = 10), but the majority were on the benthos (n = 20). Smaller fish were collected in the water column at flood current (13.5 ± 1.53 mm TL) compared to those on the benthos (16.0 ± 5.24 mm TL) at ebb current. This size difference was expected and is indicative of fish entering Wylly Creek, which is both a settlement and nursery site. The peak occurrence in the plankton net (n = 5) occurred 15 days before the peak occurrence of fish in the beam trawl (n = 10). This study demonstrates that despite the small number of individuals collected, we were able to establish the approximate timing of recruitment, although fish had already metamorphosed into juveniles. Future studies could include extending the survey range closer to the mouth of the estuary to increase the likelihood of collecting larval fish.

Size and Abundance of Fringed Flounder (*Etropus crossotus*) in Wylly Creek across 18 Years

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The Fringed Flounder *Etropus crossotus* ranges from Chesapeake Bay to the Gulf of Mexico and coast of Brazil and can be found in estuaries year-round. Its distribution can be affected by habitat quality and temperature changes. Therefore, long-term monitoring of estuaries is critical for observing the effect of temperature fluctuations on this species. The purpose of the present study was to compare the abundance and size of *E. crossotus* seasonally across 18 years. Samples were acquired monthly from Jan 2004 to Sept 2022. The mean temperature in addition to mean size and abundance of Fringed Flounder were compared over the 4 seasons and across years. Mean abundance was highest in summer at 2.9 ± 3.3 (n=121) when temperature was highest (28.7°C ± 2.0). The mean size was smallest in winter at 40.2 ± 19.1 mm TL (n=9) and largest in fall at 55.6 ± 21.5 mm TL (n= 42) with mean temperatures of 13.6°C± 2.5 and 19.4°C ± 3.1, respectively. However, very few individuals were obtained in winter, and in most years (12), none was collected. The major finding of this study was that although this species can be found year-round in southeastern estuaries, there were only 2 years (2012 and 2016) in which this occurred in Wylly Creek. In fact, Fringed Flounder was usually only found two seasons per year. Long-term monitoring provided a more complete picture for this species in terms of the variable nature of its occurrence.

Characterizing Winter Flounder Populations in Massachusetts Waters

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Diminished winter flounder (*Pseudopleuronectes americanus*) populations within the Gulf of Maine are expected to inhabit Massachusetts Bay (USA) in their highest abundance, but overall population status and current behavior remains poorly understood. Management decisions are consequently impacted, especially in urban estuaries where multiple ecosystem service needs require consideration. We therefore are using a multi-pronged approach to characterize winter flounder populations, particularly in Boston Harbor, with implications for the Gulf of Maine stock. We tagged 150 adults in Boston Harbor to acoustically track movements over three years. In combination with sampling reproductive status of catch at ports, we will determine where tagged fish are located along the coast during spawning season. We are also assessing young-of-the-year (YOY) populations using a weekly beam trawl survey (in Boston Harbor, July–October 2021–2022) to back-track YOY ages to spawning windows and determine what habitat promotes survival. Preliminary analyses suggest that adults do return to Boston Harbor year over year, but spawning behavior remains elusive. We hypothesize that YOY are advected into the estuary in a single recruitment window and undertake fine-scale movements between habitats in this system as they grow. We will also be conducting genetic kinship analyses to assess relatedness in sampled populations, potentially linking spawning adults with YOY. With data from multiple approaches, we anticipate characterizing recruitment processes, including YOY mortality rates, in an estuary deemed critical to winter flounder survival.

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