Northeast Fisheries Science Center Reference Document 06-23

Tenth Flatfish Biology Conference, November 29-30, 2006, Water's Edge Resort, Westbrook, Connecticut

by

Conference Steering Committee:
Renee Mercaldo-Allen (Chair),
Anthony Calabrese, Donald J. Danila,
Mark S. Dixon, Ambrose Jearld,
Thomas A. Munroe, Deborah J. Pacileo,
Chris Powell, and Sandra J. Sutherland

October 2006

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06-09 **42nd Northeast Regional Stock Assessment Workshop (42nd SAW) Stock Assessment Report**, by the Northeast Fisheries Science Center. May 2006.

06-10 **Assessment of the Georges Bank Atlantic Cod Stock for 2005**, by L O'Brien, N Shepherd, and L Col. June 2006.

06-11 **Stock Assessment of Georges Bank Haddock, 1931-2004**, by J Brodziak, M Traver, L Col, and S Sutherland. June 2006.

06-12 **Report from the Atlantic Surfclam (*Spisula solidissima*) Aging Workshop Northeast Fisheries Science Center, Woods Hole, MA, 7-9 November 2005**, by L Jacobson, S Sutherland, J Burnett, M Davidson, J Harding, J Normant, A Picariello, and E Powell. July 2006.

06-13 **Estimates of Cetacean and Seal Bycatch in the 2004 Northeast Sink Gillnet and Mid-Atlantic Coastal Gillnet Fisheries**, by DL Belden, CD Orphanides, MC Rossman, and DL Palka. July 2006.

06-14 **43rd SAW Assessment Summary Report**, by the 43rd Northeast Regional Stock Assessment Workshop. July 2006.

06-15 **Documentation for the Energy Modeling and Analysis eXercise (EMAX)**, by JS Link, CA Griswold, ET Methratta, and J Gunnard, Editors. August 2006.

06-16 **Northeast Fisheries Science Center Publications, Reports, and Abstracts for Calendar Year 2005**, by L Garner and J Gunnard. August 2006

06-17 **Stock Assessment of Summer Flounder for 2006**, by M Terceiro. August 2006.

06-18 **Environmental preferences of herring under changing harvest regimes**, by KD Friedland, JE O'Reilly, JA Hare, GB Wood, WJ Overholtz, and MD Cieri. August 2006.

06-19 **Estimated Average Annual Bycatch of Loggerhead Sea Turtles (*Caretta caretta*) in U.S. Mid-Atlantic Bottom Otter Trawl Gear, 1996-2004**, by KT Murray. September 2006.

06-20 **Sea Scallop Stock Assessment Update for 2005**, by DR Hart. September 2006.

06-21 **A Laboratory Guide to the Identification of Marine Fish Eggs Collected on the Northeast Coast of the United States, 1977-1994**, by PL Berrien and JD Sibunka. September 2006.

06-22 **The Analytic Component to the Standardized Bycatch Reporting Methodology Omnibus Amendment: Sampling Design, and Estimation of Precision and Accuracy**, by SE Wigley, PJ Rago, KA Sosebee, and DL Palka. September 2006.

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Conference Steering Committee:
Renee Mercaldo-Allen (chair)[1], Anthony Calabrese (retired)[1], Donald J. Danila[2], Mark S. Dixon[1], Ambrose Jearld[3], Thomas A. Munroe[4], Deborah J. Pacileo[5], Chris Powell[6], and Sandra J. Sutherland[3]

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts

October 2006

Northeast Fisheries Science Center Reference Documents

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Flatfish Biology Conference
2006

November 29th & 30th
Water's Edge Resort, Westbrook, CT

Agenda

Oral Presentations
Salons A/B

Wednesday, November 29th

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

8:45 a.m. Welcome and Introduction

Renee Mercaldo-Allen
National Marine Fisheries Service
Northeast Fisheries Science Center
Milford, CT

Frank Almeida
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, MA

Session I

Don Danila, Chair

Dominion Nuclear Connecticut, Inc.
Millstone Environmental Laboratory, Waterford, CT

9:00 a.m. Flatfish Biology Conference Twentieth Anniversary 1986-2006: Historical Overview

Don Danila[1] and Chris Powell[2], Steering Committee Members

[1]Dominion Nuclear Connecticut, Inc., Millstone Environmental Laboratory, Waterford CT; [2]Rhode Island Division of Environmental Management, Division of Fish and Wildlife, Marine Fisheries, Jamestown, RI

9:10 a.m. Estuary-Scale Movement of Telemetered Winter Flounder, *Pseudopleuronectes americanus*, in a Fixed Hydrophone Array

Thomas Grothues[1], Beth Phelan[2], and Eleanor Bochenek[3]

[1]Institute of Marine and Coastal Sciences, Rutgers University Marine Field Station, Tuckerton NJ; [2]NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ; [3]Institute of Marine and Coastal Sciences, Rutgers University Haskin Shellfish Laboratory, Port Norris, NJ

9:30 a.m. Possible Impacts of Nutrition on Metamorphosis in Atlantic Halibut (*Hippoglossus hippoglossus* L.)

M. Moren, M.[1], Ø. Sæle, [2], K. Pittman[2], and K. Hamre[1]

[1]NIFES (National Institute of Nutrition and Seafood Research), Nordnes, Bergen, Norway; [2]Department of Biology, University of Bergen, Bergen, Norway

9:50 a.m. Stock and Parental Effects on the Early Life History of Winter Flounder (*Pseudopleuronectes americanus*)

Ian A. E. Butts and Matthew K. Litvak

Department of Biology and Centre for Coastal Studies and Aquaculture, University of New Brunswick, Saint John, New Brunswick, Canada

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

Session II

Sandra Sutherland, Chair
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, MA

10:40 a.m. Visual and Vestibular Control of Swim Posture during Southern Flounder Metamorphosis
Alex M. Schreiber
Carnegie Institution, Department of Embryology, Baltimore, MD

11:00 a.m. Winter Flounder Movements in Southern New Hampshire
Michelle L. Walsh and W. Huntting Howell
University of New Hampshire, Durham, NH

11:20 a.m. Distribution of Winter Flounder Eggs among Shallow Water Habitats in Two Harbors in Long Island Sound
Jose J. Pereira[1,4], Meghan Plourde[2], Peter J. Auster[3] and Eric T. Schultz[4]
[1]NMFS/NEFSC/Milford Laboratory, Milford CT; [2]University of Connecticut, Department of Marine Sciences, Groton CT; [3]University of Connecticut, National Undersea Research Center, Groton CT; [4]University of Connecticut, Department of Ecology and Evolutionary Biology, Storrs CT

11:40 a.m. Habitat-Specific Chemical and Gene Expression Signatures in Winter Flounder
Peter F. Straub[1,2], Ashok D. Deshpande,[1] William C. Phoel,[2] Mary L. Higham[2] and Bruce W. Dockum[1]
[1]NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ; [2]Richard Stockton College, Pomona NJ

12:00 p.m. Where and Why Winter Flounder are Found: Observations from a Summer Field Study in the Hampton-Seabrook Estuary, NH
Elizabeth A. Fairchild[1], James Sulikowski[2], Nathan Rennels[1], W. Huntting Howell[1], and Christopher Gurshin[1]
[1]University of New Hampshire, Department of Zoology, Durham NH; [2]University of New England, Marine Science Center, Biddeford ME

12:20 p.m. **Hosted Buffet Lunch**

Session III

Chris Powell, Chair

Rhode Island Division of Environmental Management
Division of Fish and Wildlife, Marine Fisheries, Jamestown, RI

1:30 p.m. Recent Trends in Weight-at-Age and Growth of New England Flatfishes
Sandra J. Sutherland, Loretta O'Brien, Sarah E. Pregracke, J. Burnett, and Ralph K. Mayo
NMFS/NEFSC/Woods Hole Laboratory, 166 Water Street, Woods Hole MA

1:50 p.m. Design and Function of Flatfish Feeding Mechanisms
Austin W. Francis, Jr.
Villanova University, Department of Biology, Villanova PA

2:10 p.m. Predator-Prey Interactions between Summer Flounder (*Paralichthys dentatus*) and Longfin Squid (*Loligo pealeii*) in the Northwest Atlantic Ecosystem
Michelle D. Staudinger[1], Francis Juanes[1], and Jason Link[2]
[1]University of Massachusetts, Department of Natural Resources Conservation, Amherst MA; [2]NMFS/NEFSC/Woods Hole Laboratory, Woods Hole MA

2:30 p.m. Effect of Deoxycorticosterone on Renal Inorganic Sulfate Secretion by Winter Flounder, *Pseudopleuronectes americanus*
J. Larry Renfro and Sonda L. Parker
University of Connecticut, Department of Physiology and Neurobiology, Storrs CT

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

Session IV

Mark Dixon, Chair
National Marine Fisheries Service
Northeast Fisheries Science Center
Milford, CT

3:20 p.m. Trends in Distribution and Abundance of Age – 0 Winter Flounder, *Pseudopleuronectes americanus*: 31 Years of Seine-Survey Observations on the Estuaries of Nantucket Sound
Vincent M. Manfredi
Massachusetts Division of Marine Fisheries, Resource Assessment Project, Pocasset MA

3:40 p.m. Sediments from Jamaica Bay New York Cause Endocrine Disruption in Young-of-the-Year Winter Flounder – Nonylphenol Implicated as Causative Agent
Anne McElroy[1], Lourdes Mena[1], Victoria Taibe, [2,3] and Christopher Chambers[2]
[1]Marine Sciences Research Center, Stony Brook University, Stony Brook NY; [2]NMFS/NEFSC/James J. Howard Laboratory, Highland NJ; [3]Living Marine Resources Cooperative Science Center, University of Maryland at Eastern Shore, Princess Anne MD

4:00 p.m. Parental and Environmental Influences on Variation in Winter Flounder Early Life-Stages
R. Christopher Chambers, Bridget S. Green, and Dawn D. Davis
NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ

5:00 p.m. **Poster Set-up**

5:30 p.m. **Hosted Mixer and Poster Session**

Thursday November 30th

8:15 a.m. **Registration/Coffee/Continental Breakfast**

Session V

Ambrose Jearld, Chair
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, MA

9:00 a.m. Occurrence and Distribution of Two Diminutive Flatfishes, *Citharichthys gymnorhinus* and *C. cornutus* (Paralichthyidae), on the Continental Shelf of the Eastern United States
Thomas A. Munroe[1] and Steve W. Ross[2]
[1]National Systematics Laboratory/NMFS/NEFSC, Smithsonian Institution, Washington DC; [2]University of North Carolina at Wilmington, Center for Marine Science, Wilmington NC

9:20 a.m. Assessing Habitat Suitability of Mount Hope Bay and Narragansett Bay using Growth, RNA:DNA, and Feeding of Caged Juvenile Winter Flounder
Lesa Meng[1], David L. Taylor[2], Jonathan Serbst[1], and J. Christopher Powell[3]
[1]U. S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Laboratory, Atlantic Ecology Division, Narragansett RI; [2]Roger Williams University, Department of Marine Biology, Bristol RI; [3]Division of Fish and Wildlife-Marine Fisheries, Fort Weatherill Marine Laboratory, Jamestown RI

9:40 a.m. Geographic Variability in Habitat Use by Paralichthyid Flounders in Florida
Theodore S. Switzer and Sean F. Keenan
Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg FL

10:00 a.m. Experimental Assessment of the Effects of Contaminated Sediments from Raritan Bay, New Jersey, on Young Winter Flounder
Victoria G. Taibe[1,2], R. Christopher Chambers[1], Eric B. May[2], and Y. Waguespack[2]
[1]NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ; [2]University of Maryland Eastern Shore, Princess Anne MD

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

Session VI

Thomas A. Munroe, Chair

NMFS/National Systematics Laboratory, Smithsonian Institute, Washington, DC

10:50 a.m. Ecological Factors Influencing Abundance and Distribution of *Etropus microstomus* in Lower Chesapeake Bay and Tributaries

Hank Brooks[1], Thomas A. Munroe[2], and Wendy A. Lowery[1]

[1]Department of Fisheries Science, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point VA; [2]NMFS/NEFSC/National Systematics Laboratory, Smithsonian Institution, Washington DC

11:10 a.m. Recent Recruitment of Yellowtail Flounder in Southern New England

Steve Cadrin[1] and Russell Brown[2]

[1]NOAA/University of Massachusetts, Cooperative Marine Education and Research Program, New Bedford MA; [2]NMFS/NEFSC/Woods Hole Laboratory, Woods Hole MA

11:30 a.m. Sub-Legal Summer Flounder Exhibiting Apparent Site Fidelity at Structure Sites for Significant Warm-Season Periods in Virginia's Chesapeake Bay

Jon A. Lucy[1] and Claude M. Bain, III[2]

[1]Virginia Institute of Marine Science, College of William and Mary, Gloucester Pt. VA; [2]Virginia Saltwater Fishing Tournament, Virginia Marine Resources Commission, Virginia Beach VA

11:50 a.m. Habitat Selection by Flatfishes in the Northern Gulf of Mexico: Implications for Susceptibility to Hypoxia

Theodore S. Switzer [1], Edward J. Chesney[1,*], and Donald M. Baltz[2]

[1]Louisiana Universities Marine Consortium, Chauvin LA; [2]Coastal Fisheries Institute and the Department of Oceanography and Coastal Sciences, Louisiana State University, Baton Rouge LA ([*]Present address: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg FL)

12:10 p.m. Using Bycatch Reduction Panels to Conserve Fishes and Increase CPUE in Weirs

Chris Hager

Virginia Sea Grant, Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA

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

Adjourn Meeting

Poster Session
Salon C
Wednesday, November 29, 5:30 p.m.

Trends in Abundance, Biomass, and Distribution of Windowpane, *Scopthalmus aquosus,* in Nearshore Massachusetts Waters
Matthew Camisa and Steven Correia
Massachusetts Division of Marine Fisheries, New Bedford, MA

Contaminant Analysis of Juvenile *Pseudopleuronectes americanus*: Separating Tissue Levels from Gut Content Load
Thomas Cleary[1], A. F. J. Draxler[1], D. Wieczorek[1], and B. Balogun[2]
[1]NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ; [2]University of Maryland Eastern Shore, Princess Anne MD

Seasonal Use of a Small Tidal Creek by Flatfishes in Georgia
Guy' D. DuBeck[1], Elizabeth King Rhodes[2], and Mary Carla Curran[1]
[1]*Marine Science Program, Savannah State University, Savannah GA;* [2]*Department of Geology and Environmental Geosciences, College of Charleston, Charleston SC*

Influence of the Tidal Cycle on the Abundance of Flatfishes in Wylly Creek, Georgia
April M. Pressler and Mary Carla Curran
Marine Science Program, Savannah State University, Savannah GA

Using Stable Isotopes of Carbon ($\delta^{13}C$) and Oxygen ($\delta^{18}O$) to Differentiate Winter Flounder Nursery Areas: Methodology and Application
B. K. Taplin[1], R. J. Pruell[1], H. Burnell[1], and J. Karr[2]
[1]US EPA/ORD/NHEERL, Atlantic Ecology Division, Narragansett RI; [2]Duke University, Department of Biology, Durham, NC

A Dramatic Influence of Thyroid Hormone on Larval Southern Flounder Otolith Development
X. Wang, Y. Tan, and A.M. Schreiber
Johns Hopkins University and Carnegie Institution, Department of Embryology, Baltimore MD

Alteration in Behavioral Responses of Juvenile Winter Flounder Exposed to
Sediments from Newark Bay
Daniel Wieczorek and A. F. J. Draxler
NMFS/NEFSC/James J. Howard Laboratory, Highlands NJ

The Prevalence of Axial Skeletal Deformities in American Plaice Collected Near the Massachusetts Bay Sewage Outfall
John Ziskowski[1] and the NEFSC Ecosystems Surveys Branch[2]
[1]*NMFS/NEFSC/Milford Laboratory, Milford CT;* [2]*NMFS/NEFSC/Woods Hole Laboratory, Woods Hole MA*

Abstracts
Oral Presentations

Estuary-Scale Movement of Telemetered Winter Flounder, *Pseudopleuronectes americanus*, in a Fixed Hydrophone Array

Thomas Grothues[1], Beth Phelan[2], and Eleanor Bochenek[3]

[1]*Institute of Marine and Coastal Sciences, Rutgers University Marine Field Station, 800, c/o 132 Great Bay Blvd., Tuckerton NJ 08087*

[2]*NMFS/NEFSC/James J. Howard Laboratory, 74 Magruder Road, Highlands NJ 07732*

[3]*Institute of Marine and Coastal Sciences, Rutgers University Haskin Shellfish Laboratory, 6959 Miller Avenue, Port Norris NJ 08349*

Winter flounder (*Pseudopleuronectes americanus)* spawn demersal adhesive eggs in estuaries, leaving them susceptible to disturbance from dredging. Broadly-defined "spawning habitat" is protected as essential fish habitat (EFH), resulting in denial of many winter-spring dredging permits in estuaries of New England and the Mid- Atlantic states. As part of an effort to more precisely identify estuarine spawning sites and timing for winter flounder, we telemetered twelve ripe adult winter flounder through a fixed hydrophone array in the Navesink River estuary (New Jersey) to identify areas of high habitat residence time and visitation. Transmitters with temperature and pressure sensors on five of these fish provided additional information on habitat use. Tagged winter flounder did not use the entire estuarine gradient, and the number of fish detected by hydrophones decreased with distance up-estuary. Up-estuary movements occurred early and late in winter within a narrow range (7-12 ^{o}C) of the total temperature range (0-20 ^{o}C); although not all tagged fish participated in either migration. Occupied depth ranged from 0 to 7.3 m; maximum occupied depth by hydrophone was a function of surrounding water depth. However, fish used shallow water even in deeper regions, especially at night. This recent work will optimize the placement of a high density array of hydrophones capable of examining fine scale habitat use in following years and could help reveal possible management strategies to resolve resource use conflicts.

Possible Impacts of Nutrition on Metamorphosis in Atlantic Halibut (*Hippoglossus hippoglossus* L.)

M. Moren[1], Ø. Sæle[2], K. Pittman[2], and K. Hamre[1]

[1]*NIFES (National Institute of Nutrition and Seafood Research), PO Box 2029 Nordnes, N-5006 Bergen, Norway*

[2]*University of Bergen, Department of Biology, PO Box 7800, N-5020 Bergen, Norway*

Fatty acids, vitamin A and thyroid hormone have all been shown to affect development of flatfish larvae and they are ligands to nuclear receptors that participate in the control of development. Our hypothesis was that one of these factors or an interaction between them may be the cause of abnormal development of Atlantic halibut larvae.

Atlantic halibut larvae were fed either DHA-selco enriched *Artemia* or copepods from first-feeding. In fish that had been fed *Artemia*, only 7 % had normal pigmentation and 10% normal eye migration. The numbers for fish fed copepods were 68 and 88 %, respectively. The differences in development were probably nutrient dependent, since all other conditions were similar for the two groups. Larvae fed copepods had dramatically higher body levels of DHA and EPA and lower levels of arachidonic acid (ARA) than larvae fed *Artemia*. The DHA/EPA ratio was similar in the two groups, but the EPA/ARA ratio was more than 4 times higher in larvae fed copepods than in larvae fed *Artemia*. Larvae fed copepods had higher body levels of total retinol than larvae fed *Artemia*, but the difference was due to higher levels of the storage forms, retinyl esters, whereas the levels of free retinol and retinal were similar in the two groups. The level of iodine was 700 times higher in copepods than in *Artemia* and 3-4 times higher in larvae fed copepods than in larvae fed *Artemia*. There was a significantly higher level of T_4 in larvae fed copepods during the "window of opportunity", 15-30 days after first-feeding.

It is concluded that *Artemia* probably offers a sufficient access to vitamin A precursors to cover the larval requirement. In an experiment where Atlantic halibut larvae were fed *Artemia* enriched in iodine up to the levels found in copepods, there was a significant effect on the body level of iodine. Further, a slight increase in growth (measured as standard length) was found on day 45 post first feeding (post metamorphosis), but we did not find any improvement in eye migration nor pigmentation. Fatty acid composition is still the most likely candidate for causing abnormal development in Atlantic halibut larvae. Selected results from these experiments will be presented and discussed.

Stock and Parental Effects on the Early Life History of Winter Flounder (*Pseudopleuronectes americanus*)

Ian A. E. Butts and Matthew K. Litvak

*Department of Biology and Centre for Coastal Studies and Aquaculture,
University of New Brunswick, Ganong Hall, P.O. Box 5050,
Saint John, New Brunswick E2L 4L5, Canada*

Geographically separated winter flounder (*Pseudopleuronectes americanus*) populations in the northwest Atlantic Ocean are both phenotypically and genetically distinct. A hierarchical breeding design using eggs from Passamaquoddy Bay females was used to 1) determine if fish sired by Georges Bank males grew faster than fish sired by Passamaquoddy Bay males and 2) to examine parental contributions to variations in growth and performance during early life history stages. Mixed-model nested ANOVAs revealed that larvae sired by Georges Bank males grew faster than those sired by Passamaquoddy Bay males and that maternal, paternal, and parental interactions all contributed to growth and survival during early life history. Results will be discussed with reference to winter flounder genetic variation in the wild and development of this species for aquaculture.

Visual and Vestibular Control of Swim Posture during Southern Flounder Metamorphosis

Alex M. Schreiber

Carnegie Institution, Department of Embryology,
3520 San Martin Drive, Baltimore MD 21218

Flatfish transform from symmetric, upright-swimming larvae into asymmetric juveniles that swim on one side. Lateralized posture develops independent of eye position during metamorphosis, suggesting a strong vestibular, as opposed to visual, involvement. This study used infrared videography to address visual and vestibular roles in larval swimming by measuring posture in light versus dark. Pre-metamorphic larvae (5-15 dph) in the dark swam to the surface and descended passively, head first with the body perpendicular to the bottom. Laterality was first observed during passive descent at 20 dph by an inclination of the left side upwards. Left side bias continued with development, and by late pre-metamorphosis (23 dph) larvae were parallel to the ground during passive descent, like juveniles. By contrast, in the light pre-metamorphic through early-climax larvae switched from the passive descent posture to upright when feeding or actively swimming. After severing either left or right optic nerves larvae starting eye migration still swam upright in the light, indicating each eye is capable of controlling posture. Furthermore, during eye migration both eyes respond equally well to optokinetic stimuli, demonstrating the migrating eye is visually functional. After early-climax, fish swam only on one side in both light and dark. These findings suggest alteration in larval swim posture is a continuous integration of visual and vestibular signaling, ultimately ending with vestibular control in juveniles.

Winter Flounder Movements in Southern New Hampshire

Michelle L. Walsh and W. Huntting Howell

University of New Hampshire, 46 College Road, Durham NH 03801

It is widely accepted that three distinct populations of winter flounder exist: Mid-Atlantic Bight, Georges Bank, and the Gulf of Maine. Movements of both the Mid-Atlantic and Georges Bank populations have been studied extensively; however, there is little information on the movements of fish that inhabit the Gulf of Maine north of Cape Cod. We conducted a preliminary study of winter flounder movements off the New Hampshire coast using biotelemetry techniques. Ten adult flounder (5 females: 5 males) were captured by otter trawl in May 2006, externally tagged with Vemco V-13 ultrasonic transmitters, and released at the point of capture, one mile outside the Hampton-Seabrook Estuary. Flounder were tracked using stationary (Vemco VR-2) and hand-held hydrophones (Vemco VR-100) over the following months. Preliminary results suggest that flounder movements during the spring and summer months were minimal, with most fish remaining in shallow waters (≤12 meters) within 2.5 km of the release site.

Distribution of Winter Flounder Eggs among Shallow Water Habitats in Two Harbors in Long Island Sound

Jose J. Pereira[1,4], Meghan Plourde[2], Peter J. Auster[3], and Eric T. Schultz[4]

[1]*NMFS/NEFSC/Milford Laboratory, 212 Rogers Avenue, Milford CT 06460*

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Winter flounder (*Pseudopleuronectes americanus*) is an important commercial and recreational species providing both a valuable catch for commercial fisherman and an incentive for recreational fisherman to spend money in their pursuit. Winter flounder eggs are at risk of burial during maintenance dredging efforts in harbors. This impact can be minimized if the time and location of egg deposition can be pinpointed. Here we report results of fine-scale sampling for eggs and concurrent substrate characterization using an acoustic system. Benthic sled samples (N = 185), stratified by depth and location, were taken in Milford and New Haven Harbor in February, March and April 2004. The benthic sled samples yielded a total of 164 winter flounder eggs and 122 winter flounder larvae. These occurred in both inner and outer harbor regions. Multivariate analysis on acoustic data was conducted to identify bottom types that were sampled. This analysis identified an unexpected use of fine mud habitats by spawning flounder.

Habitat-Specific Chemical and Gene Expression Signatures in Winter Flounder

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Winter flounder (*Pseudopleuronectes americanus*) were collected by trawl from Newark Bay in the Hudson-Raritan estuary and also from the southern New Jersey coast (control). Fifteen individuals from each group were freeze dried and prepared for organic analysis by Soxhlet extraction. The mean fresh weight plus standard deviation for the fish was 52.9 g +/- 32.5 and the average length plus standard deviation was 153.9 mm +/- 34.2. After extraction, size-exclusion HPLC cleanup, and concentration, PCB's and pesticides were separated and quantified by gas chromatography (GC-ECD). BZ 153 was the major PCB congener found, while p,p'-DDE was the major pesticide. Total PCBs (estimated as Aroclors) were 334.4 ng/g for the Newark Bay fish and 48.8 ng/g for the control fish. Total DDTs were 75.6 ng/g for Newark Bay and 8.7 ng/g for the control sites.

Previous liver gene expression studies by quantitative polymerase chain reaction and microarray have shown differential levels of gene expression for a number of biomarkers related to liver damage and stress in the Hudson-Raritan caught fish versus fish caught in southern New Jersey. These include, among many others: cytochrome P4501A (Cyp1A), cytochrome P45-3A (Cyp3A), complement component C-3, glutathione-s-transferase, tumor suppressor p33ING1, Bal-643-liver regeneration protein, hepatocyte growth factor-1, defender against cell death-1 (DAD-1) and Retinoid-X-receptor (RXR). Quantification of the major organic marker chemicals present in these fish will allow the partitioning of specific chemical compounds with specific gene expression signatures that may be diagnostic of the degree of habitat disturbance caused by sublethal chemical exposure.

Where and Why Winter Flounder are Found: Observations from a Summer Field Study in the Hampton-Seabrook Estuary, NH

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The Hampton/Seabrook Estuary, located in the southeastern corner of New Hampshire, is a small, tidally dominated, shallow estuary. Though there are only two estuaries in NH, relatively little is known about the biological importance of the Hampton-Seabrook Estuary. From July to October 2004, a sampling program was conducted at five sites in the estuary to characterize the winter flounder population. The goals were to determine 1) the abundance of winter flounder in the estuary, 2) the size class distribution of winter flounder, 3) the spatial use of the estuary by different size classes of flounder, and 4) if any factors could explain winter flounder distribution patterns.

Of the 19 species caught in the estuary, winter flounder was the most abundant. Predominantly YOY winter flounder, with low amounts of older fish, were caught. Though spatially separate, the five sites were fairly homogenous in structure (depth, bottom type, benthic community, salinity, temperature). However, YOY abundance ranged from 2.1 to 32.1 fish per 1000 m^2 depending on the site. Of the variables analyzed, benthic community is the best indicator of juvenile winter flounder abundance. Catch data of other organisms fluctuated, but no one species was a strong predictor of winter flounder abundance and distribution.

It appears that during late summer and early fall, the Hampton-Seabrook Estuary is used primarily by YOY winter flounder, suggesting that this estuary functions as a nursery ground. The scarcity of adults may indicate that spawning occurs outside the estuary.

Recent Trends in Weight at Age and Growth of New England Flatfishes

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A 2005 population assessment of many New England groundfish stocks detected a systematic reduction in weight at age for a number of stocks within the past decade. Such a decrease could affect not only fishery yields, but could also increase the amount of time necessary to rebuild overfished stocks. Investigations into the extent and possible causes of these changes may improve future stock assessments.

This study sought to determine whether recent changes have occurred in weight at age (WAA), length at age (LAA), and growth rates among five of the commercially-important flatfishes in the region. Species studied were winter flounder (*Pseudopleuronectes americanus*), summer flounder (*Paralichthys dentatus*), yellowtail flounder (*Limanda ferruginea*), American plaice (*Hippoglossiodes platessoides*), and witch flounder (*Glyptocephalus cynoglossus*).

Length, weight, and age data collected on NEFSC survey cruises were used to generate estimates of growth, WAA, and LAA within stocks for each species. Sex ratios were also examined, as flatfishes typically exhibit dimorphic growth. Trends within these measures were evaluated, and comparisons were made between various stocks and species. Furthermore, an attempt was made to correlate these trends with possible biotic and abiotic causes.

Design and Function of Flatfish Feeding Mechanisms

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Unlike most fishes, flatfishes exhibit bilateral asymmetry of the muscles and bones of the head. This morphological difference between ocular and blind sides of the head can contribute to functional differences in feeding performance. Feeding mechanisms for eleven species of flatfish from five families and ten genera were compared. Quantitative assessment of feeding mechanisms consisted of determining the mechanical advantage for lower jaw depression and elevation from measurements of in-lever and out-lever arms. From mechanical advantage, it was possible to determine whether a particular design was optimized for speed or strength.

For nearly all species, mechanical advantage of both lower jaw depression and elevation was greater on the ocular side (left in sinistral species and right in dextral species) than the blind side. This would result in a lower jaw capable of moving with greater speed on the ocular side while generating greater force on the blind side. When coupled with a flexible mandibular symphysis, this bilaterally asymmetrical design is expected to contribute to the lateral jaw protrusion exhibited by some flatfishes.

Interspecific comparison of lower jaw opening and closing mechanical advantage revealed that the feeding mechanism of less derived flatfishes (e.g., species of Psettodidae and Paralichthyidae) generates greater force while more derived flatfishes (e.g., species of Pleuronectidae, Achiridae and Cynoglossidae) moves more rapidly. Furthermore, the less derived flatfishes primarily feed on fish while the more derived flatfishes feed on benthic invertebrates. This may indicate a phylogenetic pattern where there is a shift in design from force-generating piscivores to velocity-generating invertebrate feeders. This pattern also corresponds with the degree of intraspecific asymmetry between ocular and blind sides where the asymmetry of mechanical advantage is smaller in less derived flatfishes and greatest in more derived flatfishes.

Predator-Prey Interactions Between Summer Flounder (*Paralichthys dentatus*) and Longfin Squid (*Loligo pealeii*) in the Northwest Atlantic Ecosystem

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In the Northwest Atlantic, longfin squid (*Loligo pealeii*) constitute an important component of the seasonal diet of summer flounder (*Paralichthys dentatus*) as well as a variety of other finfish, elasmobranchs, and marine mammals. However, little is known about predator-prey interactions between squid and their predators. Predator and prey length data collected as part of the National Marine Fisheries Service long-term ecosystem monitoring program were analyzed using least squares and quantile regression techniques to characterize absolute and relative body size (RBS) relationships. Out of ten predators, summer flounder was the only species where the average absolute size of squid consumed increased significantly with predator size and at a significantly greater rate in comparison to prey fish. While the majority of other predators examined foraged on squid that were relatively small (< 20% body size), summer flounder primarily consumed squid in the 20 – 30% RBS range. To further evaluate behavioral factors mediating squid's vulnerability to predation, three sets of feeding trials were conducted under laboratory conditions quantifying size-selection, profitability, and prey-type selectivity. Atlantic silversides *(Menidia menidia)* and mummichogs (*Fundulus sp.*) were offered as alternate prey species to squid in prey-type selectivity trials. Digital video was used to capture events for analysis of handling times, attack rates, percent survival, capture success, and time-dependent mortality. The results of this study will provide an in-depth description of squid's role as a principal prey resource and give insight into how changes in community structure may impact squid populations and primary predators such as summer flounder in the Northwest Atlantic ecosystem.

Effect of Deoxycorticosterone on Renal Inorganic Sulfate Secretion by Winter Flounder, *Pseudopleuronectes americanus*

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Teleosts that tolerate varying salinities must regulate renal excretion. The glucocorticoid, cortisol, has been assigned a pivotal role in adaptation of teleosts to seawater; indeed, it has been termed the "seawater-adapting" hormone. Its influence is seen in gill, gut and kidney ion transport processes. Our previous work showed that renal secretion of SO_4^{2-} by seawater-acclimated winter flounder is stimulated by cortisol, both *in vivo* and *in vitro*. Its major action appears to be on a renal proximal tubule apical membrane SO_4^{2-}/HCO_3^- exchange process and carbonic anhydrase activity. One troubling aspect of the coritsol effect is the extreme *in vivo* variability in serum levels (winter flounder range: 8.4×10^{-9} to 3.5×10^{-7} M). Recently, mineralocorticoid receptors (MR) were demonstrated in all tissues of trout, including kidney (Prunet et al., *GCE* 147:17-23, 2006). Aldosterone, the agonist for the MR in mammals, is not detectable in fish; however, 11-deoxycorticosterone (DOC) is present in fish plasma and has a high affinity for teleost MR. The present study was aimed at assaying the effect of DOC on the component of renal SO_4^{2-} secretion that is cortisol-sensitive. Active transepithelial transport of SO_4^{2-} was determined in winter flounder renal proximal tubule primary monolayer cultures mounted in Ussing chambers. Usual culture medium is supplemented with 13.8×10^{-7} M cortisol (Control). The effects of removal of cortisol, exposure to DOC (2.4×10^{-8} M) only and addition of DOC to usual culture medium were compared to controls following 5 days exposure in the absence of serum. In the absence of cortisol and DOC, transport was reduced to ~33% of control transport. DOC alone restored transport to ~75% of control. Control cortisol exposure together with DOC stimulated transport to about 125% of control. The presence of the MR in flounder kidney remains to be demonstrated. However, it appears possible that a mineralocorticoid may participate in control of renal sulfate transport. (Supported by NSF)

Trends in Distribution and Abundance of Age-0 Winter Flounder, *Pseudopleuronectes americanus*: 31 Years of Seine-Survey Observations on the Estuaries of Nantucket Sound

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The Massachusetts Division of Marine Fisheries (MADMF) began investigating winter flounder biology in Nantucket Sound during the late 1960's and early 1970's. A feature of that earlier work that has endured and grown since 1975 is the annual estuarine seine survey for young-of-the-year winter flounder (*Pseudopleuronectes americanus*). Currently, six estuaries that border Nantucket Sound are sampled annually. Preliminary data suggest that shifts in distribution and abundance have occurred within individual estuaries and throughout the survey area. Using GIS to investigate emerging trends and enhancing the monitoring of physical and environmental variables, factors that potentially coerced changes were evaluated. Sediment analyses were conducted for each station during the 2005 survey. Environmental parameters such as temperature, salinity, chlorophyll-a, and dissolved oxygen were also monitored. Preliminary evidence suggests a habitat preference for finer-grained sediment. Changes in distribution may also be explained by a decrease in abundance of spawning fish from local waters, causing a decrease in larval supply. A correlation of abundance indices between the seine survey and the MADMF Spring Bottom Trawl Survey provides evidence that this factor may also be contributing to shifts in distribution and decline in juvenile abundance.

Sediments from Jamaica Bay New York Cause Endocrine Disruption in Young-of-the-Year Winter Flounder – Nonylphenol Implicated as Causative Agent

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Jamaica Bay NY has long been considered a "sewage" estuary, receiving most of its freshwater inputs from sewage effluent. Previous work at Stony Brook has demonstrated extraordinarily high concentrations of the estrogen mimic nonylphenol in sediments from portions of this estuary, and elevated levels of the egg yolk precursor protein, vitellogenin (Vtg), female-biased altered sex ratios, and the presence of the presence of ovo-testes in young-of-the-year (YOY) flounder collected from multiple locations in Jamaica Bay in collections spanning 4 years. The present study was undertaken to determine if sediments from Grassy Bay, the most contaminated area of Jamaica Bay, and reference sediments dosed with nonylphenol could cause similarly elevated Vtg expression and altered sex ratios in newly settled YOY flounder spawned in the laboratory from parents collected near the entrance to New York Harbor. Data revealed 10 to 100 fold induction of Vtg and what appeared to be female-biased sex ratios in the treated fish, although some fish had not yet developed identifiable gonads. These data clearly demonstrate that sediments from Grassy Bay, and likely nonylphenol in particular, are contributing to the endocrine disruption observed in wild caught fish from Jamaica Bay.

Parental and Environmental Influences on Variation in Winter Flounder Early Life-Stages

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The role of parental and environmental influences on variation in fish life histories is key to understanding phenotypic plasticity and the potential for response to selection. We provide estimates of the absolute and relative contributions of these influences on growth and development of winter flounder, *Pseudopleuronectes americanus*, through the early life-stages. Adult winter flounder were collected from Raritan Bay on the New York-New Jersey border. Adults were stripped spawned in a 5 × 4 factorial mating design (males × females). Size at hatching and time to hatching and post-hatching starvation were measured for all families. Subsequently, larvae were reared in triplicate at two temperatures (8 or 13 ºC) until eye migration and settlement. All such metamorphosed individuals were scored as to their larval period duration and size at settlement. Some of the metamorphosed individuals from a subset of initial families were reared into early juvenile life (~ 40 mm TL) in order to assess post-settlement growth rates and evidence of bias in gender expression. These results provide evidence of the role of maternal, paternal, and thermal influences on a suite of life history characters.

Occurrence and Distribution of Two Diminutive Flatfishes, *Citharichthys gymnorhinus* and *C. cornutus* (Paralichthyidae), on the Continental Shelf of the Eastern United States

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Citharichthys gymnorhinus (anglefin whiff) and *C. cornutus* (horned whiff) are poorly-known, diminutive flatfishes inhabiting relatively deep waters on the middle to outer continental shelf in the western North Atlantic. *Citharichthys gymnorhinus* is the smallest (to 55 mm SL) member of the genus and among the smallest of flatfishes. Throughout its range, this species is captured infrequently and seldom is taken in abundance. Consequently, its biology is poorly known. It usually occurs between 30-90 m, and has been recorded as deep as 200 m. Recent literature synthesizing information on this species indicates the northernmost limit for adults as the northwestern Bahamas. However, based on specimens captured during recent field studies and re-examination of specimens listed in previously published studies as well as catalogued museum specimens, including some collected 92 years ago, we document the occurrence of adult *C. gymnorhinus* as far north as the continental shelf off North Carolina.

Even less is known concerning the biology, abundance and distribution of *C. cornutus* (to 89 mm SL) off the southeast US coast. This species has been reported to occur from North Carolina to Brazil (generally between 130 and 370 m), but no voucher specimens have been identified in the literature to support the range records from off North Carolina. Although infrequently reported from off the southeast US, we identify a variety of specimens that voucher this species from shelf waters off North Carolina. Information gleaned from recent fish collections; including one of 313 individuals in a single trawl haul taken off NC, provide insights into the biology and ecology of this species including observations on sex ratio, size frequency, sexual maturity, and juvenile and adult habitats.

Assessing Habitat Suitability of Mount Hope Bay and Narragansett Bay using Growth, RNA:DNA, and Feeding of Caged Juvenile Winter Flounder

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Somatic growth rates, RNA:DNA, and feeding habits of juvenile winter flounder (*Pseudopleuronectes americanus*) were used to asses small-scale spatiotemporal variations in the habitat suitability of Mount Hope Bay and Narragansett Bay, Rhode Island. Successive caging experiments (14-16 days each) were conducted with flounder (initial size = 25-35 mm total length) in June and July 2003 in shallow water habitats (<1 m) near Spar Island, Common Fence Point, and Hog Island: the first two sites located in Mount Hope Bay and the latter in Narragansett Bay. The average growth rate of flounder across experiments ranged between 0.66 and 0.75 mm/d^{-1} and was significantly greater at Spar Island relative to Hog Island. Growth rates also declined from 0.79 to 0.59 mm/d^{-1} during the summer in association with increased incidences of hypoxic conditions (i.e., amount of time dissolved oxygen was ≤ 4.0 mg/l^{-1}). RNA:DNA, a surrogate measure of growth and feeding condition, corroborated somatic growth trends, and therefore exhibited similar spatiotemporal variability. In contrast to somatic growth, however, water temperature was the most important factor affecting flounder condition, such that RNA:DNA was inversely related to average temperature. Benthic core samples indicated that food availability was greatest at Spar Island and was attributable to the numerical dominance of the slipper shell, *Crepidula fornicate*, during the early summer. Moreover, stomach contents of flounder reflected differences in prey species composition, whereby individuals from Spar Island consumed a higher percentage of mollusks relative to the other sites where the preferred prey item was harpacticoid copepods. Despite the observed discrepancies in feeding habits across sites, the extent of stomach fullness for flounder did not vary spatially (mean fullness = 44-49% across sites). It is concluded that the growth, RNA:DNA, and feeding behavior of juvenile flounder in Mount Hope Bay and Narragansett Bay varies significantly across small spatiotemporal scales in response to changes in dissolved oxygen and thermal conditions.

Geographic Variability in Habitat Use by Paralichthyid Flounders in Florida

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The Fisheries-Independent Monitoring (FIM) program of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute currently monitors seven estuarine habitats throughout the state. The FIM program relies upon a multi-gear approach to effectively target a variety of habitats and fish life-history stages. For this presentation we have summarized catch data from 21.3-m center bag seines that primarily target juveniles (< 100 mm SL) as well as 183-m haul seines that primarily target larger sub-adults and adults (> 100 mm SL). This gear was used consistently in all estuaries sampled from 2001 to 2005. Four species of paralichthyid flounder were collected within estuarine habitats of Florida: gulf Flounder (*Paralichthys albigutta*), southern flounder (*P. lethostigma*), broad flounder (*P. squamilentus*), and summer flounder (*P. dentatus*). Distributional patterns of these flounders followed known geographical ranges. Along the Gulf coast, both *P. albigutta* and *P. lethostigma* were commonly collected within northern estuaries although *P. squamilentus* also occurred. *P. albigutta* was the only species of flounder encountered within southern Gulf estuaries. Along the Atlantic coast, *P. albigutta* and *P. lethostigma* were equally abundant in southernmost estuaries. In northeast Florida, all four species occurred, with *P. lethostigma* being the most abundant. This estuary also contained the only occurrence of *P. dentatus*, previously reported to be the most abundant species. Differences in habitat selection among species and life-history stages will also be discussed.

Experimental Assessment of the Effects of Contaminated Sediments from Raritan Bay, New Jersey, on Young Winter Flounder

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Winter flounder, *Pseudopleuronectes americanus*, is unique in that it spawns in estuaries and produces adhesive, negatively buoyant eggs. This negative buoyancy creates the potential for embryonic exposure to toxic sediments in winter flounder nursery habitats, which can result in lethal and sub-lethal effects. These effects threaten the sustainability of this popular fishery. We found that embryos and larvae of winter flounder had decreased survivorship, and displayed a variety of sub-lethal effects (morphological variants, time to hatch and metamorphosis) following an embryonic exposure to sediments from Raritan Bay, New Jersey. Survival to hatch decreased, and time to hatch and size at hatch increased with increasing sediment concentration. Survival to metamorphosis tended to decrease and size at metamorphosis increased with increasing sediment concentration. Histological responses of early life-stage flounder to these sediments did not show differences among treatments, nor was gender affected by sediment exposure.

Ecological Factors Influencing Abundance and Distribution of *Etropus microstomus* in Lower Chesapeake Bay and Tributaries

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Etropus microstomus (smallmouth flounder) is a common and abundant species present in the lower Chesapeake Bay during all four seasons, with highest abundances recorded during late summer and fall. This relatively small-sized species (to approximately 170 mm TL) ranked fourth in numerical abundance among the eight species of flatfishes collected during the Virginia Institute of Marine Science juvenile finfish bottom trawl survey conducted from 1979 to 2006 in lower Chesapeake Bay and its major tributaries (James, Rappahannock and York Rivers). Though commonly encountered during each year, both frequency of occurrence and relative abundance of smallmouth flounder varied across years. Overall, smallmouth flounder were found throughout most of Virginia's portion of The Bay and its tributaries, however, this species occurred in greater frequency and in higher abundances at stations located along southern and eastern regions of The Bay in close proximity to the bay mouth or near downstream ends of tributaries. Multivariate analysis will be used to assess the importance of selected variables including temperature, salinity, depth, dissolved oxygen, location and season and their influence on the distribution of smallmouth flounder in the lower Bay and its tributaries.

Recent Recruitment of Yellowtail Flounder in Southern New England

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A recent increase in recruitment of yellowtail flounder (*Limanda ferruginea*) in the southern New England region was first indicated by incidental bycatch and an industry-based survey, then confirmed using an adaptive modification to routine research surveys. In summer of 2005, commercial fishermen noticed a substantial increase in the incidental catch of small yellowtail flounder off Block Island. Throughout that fall and winter, bycatch of small yellowtail increased throughout southern New England. Cooperative catch sampling indicated that the bycatch was dominated by the 2004 year class. Information from fishermen was used to add supplemental random tows to the winter trawl survey in the southern New England area to confirm the information with routine scientific sampling. This adaptive response included fishermen's knowledge in a way that provided unbiased information for stock assessment.

The recent recruitment event is consistent with previously published relationships between recruitment and climate. Historically, the southern New England fishing grounds for yellowtail flounder were the most productive throughout the species' range. However, after the resource was depleted in the early 1970s, the fishery became dependent on infrequent recruitment events. Several researchers have shown that abundant year classes were produced during cold temperatures and negative phases of the winter North Atlantic Oscillation (NAO) index. Coincidentally, the winter NAO index for 2004 was the lowest value in a decade.

Consideration of fishery-dependent information, cooperative research and adaptive monitoring decisions will help to monitor the dynamics of the 2004 year class. Information from these efforts was considered in fishery management decisions (e.g., revised mesh-size regulations in southern New England). Continued collaboration and monitoring will be used to evaluate rebuilding of the southern New England yellowtail resource.

Sub-Legal Summer Flounder Exhibiting Apparent Site Fidelity at Structure Sites for Significant Warm-Season Periods in Virginia's Chesapeake Bay

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Relative to earlier years, abundance of summer flounder, *Paralichthys dentatus*, has been exceptional in Virginia's recreational fishery in 2005-2006. The Virginia Game Fish Tagging Program (VGFTP), cooperatively operated by the Virginia Institute of Marine Science (VIMS) Sea Grant Marine Advisory Program and the Virginia Saltwater Fishing Tournament office of the Virginia Marine Resources Commission (VMRC), has targeted the species since 2000. Data generated by trained anglers tagging primarily sub-legal flounder (< 419 mm TL) through 2004 suggest that such fish may remain associated with certain structure sites for weeks to months while in Chesapeake Bay during warmer times of year. In 2005-2006 single recaptures, enhanced by numbers of multiple recaptures, show even stronger indications that young flounder are continuing to exhibit this apparent site-fidelity phenomenon. Through 2004 over 20,000 flounder (279-559 mm TL) were tagged using Hallprint T-bar tags (65-mm streamer). Annually, cumulative recapture rates remain consistent at 9 %. In 2005 an additional 6,100 flounder were tagged producing just over 600 recaptures. During 2006, with flounder entering the recreational fishery a few weeks earlier than normal (a relatively mild winter), tagging effort is expected to possibly top that in 2005. Patterns of apparent site fidelity within Chesapeake Bay during 2005-2006 will be compared to earlier results. Coastal dispersal of bay-tagged flounder will also be described. An acoustic tagging project for flounder, recently funded, is currently striving to address site fidelity and movement activity issues not resolved by conventional tagging results.

Habitat Selection by Flatfishes in the Northern Gulf of Mexico: Implications for Susceptibility to Hypoxia

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While fisheries landings in the northern Gulf of Mexico have remained strong throughout recent years, the seasonal formation of hypoxic bottom waters remains a threat to long-term sustainability of regional fisheries production. Because nekton are mobile, the greatest threat is likely the influence of reduced oxygen on habitat quality, potentially forcing movement of individuals away from favorable habitat as well as altering migration pathways. At the population level, these movements often result in altered spatial distribution patterns that reflect selection of resources along gradients of environmental variability. To begin to unravel the potential influence of hypoxia on the distribution of nekton, we examined patterns of resource utilization and selection by several abundant flatfishes based on data collected during summer and fall SEAMAP groundfish surveys. Based on habitat suitability analyses, most flatfishes appear to select a narrow range of depths, temperatures, and salinities, indicating a fairly restricted range of suitable environmental conditions along a bathymetric gradient. Although most flatfishes were tolerant of moderately-low dissolved oxygen concentrations, hypoxic environments (< 2 mg L^{-1}) were generally avoided. Accordingly, the widespread seasonal occurrence of hypoxia may render vast areas unsuitable for these flatfishes, thus initiating movement out of affected regions. Based on observed patterns of habitat selection and avoidance, we hypothesize that the resultant movement of flatfishes in response to hypoxia is likely to be alongshore rather than into deeper or shallower waters.

Using Bycatch Reduction Panels to Conserve Fishes and Increase CPUE in Weirs

Chris Hager

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Numerous studies have documented a high incidence of undersized fishes in weirs or pound-nets as they are known in the southern fisheries. Retention of undersized fishes is inherent to the gear, due to the reduced mesh size required in the head section where fishes are trapped and held until harvest. Previous investigations proved that this mesh size cannot be increased to augment release without compromising the gears' efficiency. Subsequent release device investigations also failed to provide significant benefits. In the Chesapeake Bay a significant number of undersized summer flounder (*Paralichthys dentatus*) and weakfish (*Cynoscion regalis*) are captured in weirs. From 1998-2001, various investigations were undertaken to create an effective method of active and passive release for these fishes. The first investigations determined the correct size and shape of openings that could provide desired culling characteristics. Rings provide most effective release of fusiform fishes and slots provided improved release for flat fishes. These openings were then incorporated into a panel containing fourteen rings and six slots. Panel placement and number were subsequently examined for effect. Not surprisingly increasing panel number increased release rate, however, panel placement in the four apposing corners provided for adequate release without weakening the head's construction or interfering with traditional harvest procedures. Legal verses illegal ratio comparisons (Chi –Square test) between consecutive days show that panel use provided for significant release of both sublegal flounder and weakfish. Assuming equal percentages of undersized fishes on consecutive days, 73% of sublegal trout and 81% of sublegal flounder were released.

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Abstracts
Poster Presentations

Trends in Abundance, Biomass, and Distribution of Windowpane, *Scopthalmus aquosus,* in Nearshore Massachusetts Waters

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Large changes in the spatial-temporal distribution of Southern New England windowpane, *Scopthalmus aquosus,* have occurred in the MADMF trawl survey. Declines in relative abundance and biomass indices are associated with changes in distribution. From 1998 through 2005, indices remained extremely low and these declines occurred across survey area and depth strata. No relationship is apparent between trends in survey biomass or recruits and survey bottom temperatures or degree-day anomalies. Landings data peaked at 2065 t in 1985, steadily decreased to 200 t in 1994, and have remained low ever since. Discards are unknown. Low survey biomass is associated with above average landings, except in most recent years. Survey SSB, recruitment, mean weight per individual, and maximum length observed all declined. Recruitment has remained near record lows since 2001. A residual pattern from a Beverton-Holt SSB-R model is not discernable and residuals were not correlated with trends in bottom temperature or degree-day anomalies. Recently, recruits-SSB ratio is above average, suggesting that environmental effects may not be a significant factor. No relationship is apparent between survey biomass, recruits, or recruits residuals and mean survey bottom temperatures or WHOI degree-day anomalies. Poor recruitment appears to be a function of low SSB.

Contaminant Analysis of Juvenile *Pseudopleuronectes americanus*: Separating Tissue Levels from Gut Content Load

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In studies on the effects of contaminated habitats on fish, we observed that young-of-the-year (YOY) winter flounder (*Pseudopleuronectes americanus)* ingested sediment while feeding on artemia in laboratory aquaria. For fish held on contaminated sediments (e.g., Sandy Hook Bay, NJ), the polychlorinated biphenyls (PCBs), pesticides and poly aromatic hydrocarbons (PAHs) value in whole fish can be from sediments contained in the gut. We have found that whole YOY winter flounder have higher concentrations of PCBs than ones from which the gut was removed, indicating that PCBs in gut content and surrounding tissues contributed significantly to the overall levels of PCBs in whole YOY fish. Because of the small size of the fish (20-30 mm), analyzing individual tissues is impractical, so the gut as well as surrounding tissues was removed by micro dissection techniques. The external sediment may or may not have any sub-lethal effects on the YOY flounder. Through consumption of the YOY flounder, external sediment is passed along to predator fish. We are interested in advancing methods to ensure inclusion of tissues/contaminants that have been incorporated and can therefore potentially affect fish physiochemistry while excluding materials that are rapidly excreted. While this material is "external" to the YOY winter flounder and may therefore not affect behavior or survival, it will be passed to predators.

Seasonal Use of a Small Tidal Creek by Flatfishes in Georgia

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Flatfishes use estuaries as settlement and nursery grounds, and patterns of habitat use can change seasonally. The purpose of this study was to assess potential essential fish habitat areas for flatfishes in coastal Georgia and to construct a GIS map of the region. Monthly surveys of Wylly Creek were conducted from September 2004-February 2006 using a 1-m beam trawl with 3-mm mesh. Habitat quality was determined indirectly by assessing fish growth. We obtained information on water temperature, salinity, dissolved oxygen, and depth, as well as sediment grain size and organic content. We collected summer flounder, southern flounder, blackcheek tonguefish, fringed flounder, bay whiffs, and ocellated flounder. Most species tended to be more abundant in areas with higher dissolved oxygen and organic content. The bay whiff was the most abundant species; including a pulse of 104 recently-settled individuals in January 2005; however, we did not observe a settlement pulse in 2006. The blackcheek tonguefish was the most consistently collected species. Of the two species tested, bay whiffs grew faster than the blackcheek tonguefish, although both species had relatively slow growth rates. Settlement patterns were not consistent enough nor growth rates high enough for us to conclude that this is an essential fish habitat for flatfish species.

Influence of the Tidal Cycle on the Abundance of Flatfishes in Wylly Creek, Georgia

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Several species of flatfishes are found along the coast of Georgia, and most of these species use estuaries as nursery grounds. The purpose of the present study was to determine the influence of the tidal cycle on the abundance of flatfishes in Wylly Creek, Georgia. Samples were collected during ebb and high tide using a 1-m beam trawl between July and November 2006. Summer flounder was the most abundant species with a total of 27 collected (15 from high tide and 12 from ebb tide), and ranged from 38-73 mm TL. Blackcheek tonguefish was the second most abundant species with a total of 24 individuals (19 from ebb tide and 5 from high tide), and ranged from 24-71 mm TL. The third most abundant species was the fringed flounder with a total of 7 collected ranging from 47-64 mm TL; however, this species was only collected during ebb tide. One southern flounder was also collected during ebb tide. For all sampling dates and species combined, there were more individuals collected during ebb tide (39) than high tide (20). Tidal stage only affected the abundance of fringed flounder and blackcheek tonguefish. Additional sampling will be conducted throughout the fall to better differentiate the influence of the tides on flatfish abundance.

Using Stable Isotopes of Carbon ($\delta^{13}C$) and Oxygen ($\delta^{18}O$) to Differentiate Winter Flounder Nursery Areas: Methodology & Application

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Elemental fingerprinting has become a powerful tool in fisheries science for identifying fish migration patterns, seasonal changes in habitat use, and for delineating the nursery origins of adult fish populations. Stable isotopes of oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) in fish otoliths (earstones) have been used to infer ambient water conditions (temperature and salinity) and to delineate dietary sources. In this study we investigated whether isotopic signatures of oxygen and carbon contained in fish otoliths could be used as natal fingerprints for juvenile winter flounder *(Pseudopleuronectes americanus*) populations.

Juvenile winter flounder (50-70 mm) were collected from different near shore habitats (unvegetated, macroalgae, and eelgrass) and locations within Narragansett Bay, RI, surrounding coastal ponds, and a tidal river system in the summer of 2002 and 2003. Sagittal otoliths were removed, cleaned under a laminar flow hood, and analysed for $\delta^{18}O$ and $\delta^{13}C$ using a ThermoFinnigan MAT Delta Plus XL connected to a GasBench-II carbonate device.

Results from this study showed that salinity measurements were relatively constant from year-to-year at each of the stations (2002 vs 2003: r=0.96). There were significant positive correlations between salinity and mean $\delta^{18}O$ values in otolith carbonate for each year (2002: r=0.93; 2003: r=0.85). Stable isotopes of oxygen in otolith carbonate were more depleted at sites with freshwater inputs compared to sites having higher salinity. In contrast to salinity, recorded temperatures varied from year-to-year at each of the stations (r=0.00). Based on our results (2002: r=0.60, 2003: r=0.00), it is unclear what effect temperature had on $\delta^{18}O$ values.

Measured $\delta^{13}C$ values in otolith carbonate followed a similar trend from year-to-year. It is unclear what sources (DIC or metabolic carbon) were responsible for the differences in $\delta^{13}C$ values in otolith carbonate. We speculate that the carbon isotopic composition of the food sources at each of the stations may influence the $\delta^{13}C$ values of the otolith. Based on these results, $\delta^{18}O$ and $\delta^{13}C$ values in otolith carbonate may help differentiate juvenile winter flounder nursery areas.

A Dramatic Influence of Thyroid Hormone on Larval Southern Flounder Otolith Development

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Three pairs of otoliths play critical roles in hearing and balance perception in fish. The largest of these, the saccula, as well as the much smaller lagenae, are thought to be involved in sound perception. The utricles, in contrast, are implicated with postural control. Flatfish metamorphosis is accompanied by a 90º change in swim posture as the bilaterally symmetrical, upright swimming larva transforms into an asymmetrically shaped juvenile that swims on one side. Asymmetric utricle development could, in principle, mediate the transition to lateralized behavior. This study profiles the morphological development of each otolith throughout larval and juvenile development. Intriguingly, the utricles are asymmetrically shaped in adult flounder: in sinistral (left-sided) flounder the left (top) utricle is elongated with a 'comma'-shaped *gibbus maculae*, whereas the right (bottom) utricle is scalloped with oval-shaped *gibbus maculae*. In dextral (right-sided) flounder, the morphologies of the utricles are mirror-image reversals of their sinistral siblings. In contrast, no obvious morphological asymmetries are visible in the adult saccula and lagenae. During pre-metamorphosis (3~23 dph) only the saccula and utricles are present; the lagenae form during metamorphic climax (24~30 dph). The saccula and utricles increase in size by 2-4-fold during metamorphic climax. Interestingly, these increases in otolith size are entirely dependent on thyroid hormone. Pre-metamorphic larvae treated with 0.1M methimazole (an inhibitor of endogenous thyroid hormone production) for 1 week displayed no otolith growth, although the larvae as a whole grew normally. On the other hand, the utricles and saccula tripled in size and lagenae began to develop in pre-metamorphic larvae treated with methimazole + 50 nM triiodothyronine (T3) for 1 week. We have identified *otopetrin-1* as a thyroid hormone direct-response gene of flounder metamorphosis. *Otopetrin-1* has been previously implicated in mediating zebrafish otolith and mammalian otoconia growth during embryogenesis. Our findings suggest that thyroid hormone plays a critical role in otolith growth and development during flounder metamorphosis. Whether asymmetric expression of thyroid hormone responsive genes in the utricles plays a role in the development of utricle asymmetry and lateralized behavior during metamorphosis remains to be determined.

Alteration in Behavioral Responses of Juvenile Winter Flounder Exposed to Sediments from Newark Bay

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Young-of-the-year winter flounder (*Pseudopleuronectes americanus*) that settle in contaminated areas may run a risk of sub-lethal as well as lethal effects. Due to a long history of industrial and shipping activities, the sediments from our study areas in Newark Bay New Jersey contain a wide array of anthropogenic compounds including polychlorinated biphenyls (PCB's). These toxic compounds, which may accumulate through respiration, ingestion, and transdermal uptake, have the potential to reduce the ability of flatfish to perform essential functions. These may be observable as alterations in behavior. In controlled laboratory experiments, we examined behavioral responses including predation. We found that winter flounder (20-30 mm) exposed to Newark Bay sediments had a decreased ability to exploit an available food resource. Reduction in such essential behaviors is expected to reduce growth and survival.

The Prevalence of Axial Skeletal Deformities in American Plaice Collected Near the Massachusetts Bay Sewage Outfall

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Beginning in 1993, the NMFS Northeast Fisheries Science Center Multispecies Trawl Survey has collected samples of American plaice by trawling at a non-random site located 8 km southeast of the Massachusetts Bay sewage outfall at 60 m depth. Collected samples were X-rayed at the NMFS Milford Laboratory. Radiographic analysis identified nine types of axial skeletal deformities. Time series data are presented from before (1993-94, 1997, and 2000) the sewage outfall became operational in fall 2000 and after (2002, 2004, 2005, and 2006). This study is intended to determine whether the prevalence of deformities in American plaice observed before and after the Massachusetts Bay Outfall became operational is significantly different. Deformity data on plaice collected in the Gulf of Maine and on Georges Bank during spring 1997 are also presented for comparison purposes.

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