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Northeast Multispecies Fishery Management Plan Resource Guide: Winter Flounder (Pseudopleuronectes americanus)

Bibliography

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Background & Scope

The Northeast Multispecies Fishery Management Plan (FMP) was implemented in 1986 to reduce fishing mortality of heavily fished groundfish stocks and to promote rebuilding to sustainable biomass levels. Thirteen species are managed through plan amendments and framework adjustments to the original plan, including: Atlantic cod, haddock, yellowtail flounder, American plaice, witch flounder (grey sole), winter flounder (black back), Acadian redfish, white hake, Pollock, windowpane flounder, ocean pout, Atlantic halibut, and the Atlantic wolffish. This bibliography focuses on winter flounder, and is intended as a primer and reference resource for staff of the National Marine Fisheries Service, Greater Atlantic Regional Fisheries office. It is organized into four sections: Biology (life history), Ecology (interaction with the environment), Fisheries, and Management.

Section I – Biology

Section one is intended to provide an overview of the life history of winter flounder. The research in this area is a compilation of basic facts including diet, lifespan and habitat as well as current research on winter flounder biology.

Section II – Ecology

Section two is intended to provide an overview of how winter flounder interacts with the environment. The citations in this area focus on how temperature, food resources, and other environmental factors impact winter flounder.

Section III – Fisheries

Section three is intended to provide an overview of the winter flounder fishery. It covers reports on fish stock status over the last fifteen years.

Section IV – Management

Section four is intended to provide an overview of the management of winter flounder. It includes news articles and research concerning plans and policies intended to protect winter and other flounder stocks.

Sources Reviewed

Along with a web search for news items and other relevant materials the following databases were used to identify sources: Clarivate Analytics' Web of Science: Science Citation Index Expanded, LexisAdvance, ProQuest's Science and Technology, and JSTOR. Only English language materials were included. There was no date range specification in order to cover any relevant research, although priority was given to publication in the last twenty years.

Section I: Biology

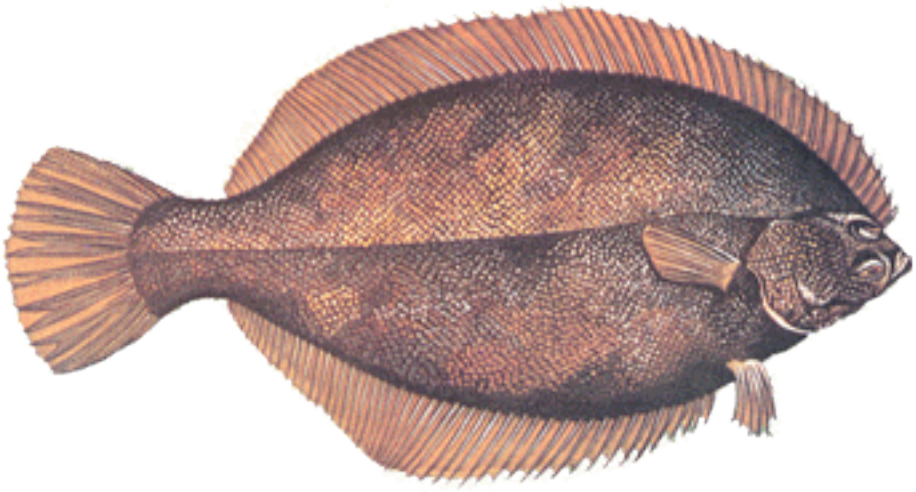


Image from:
https://www.greateratlantic.fisheries.noaa.gov/nero/fishermen/images/Multispecies/pages/Winter Flounder.html

Also known as: Blackback, lemon sole.

Region: Winter flounder are found in the Northwest Atlantic from Labrador to Georgia. US commercial fisheries range from the Gulf of Maine to the Mid-Atlantic Bight and are managed as three stocks: Gulf of Maine, Southern New England/Mid-Atlantic Bight, and Georges Bank.

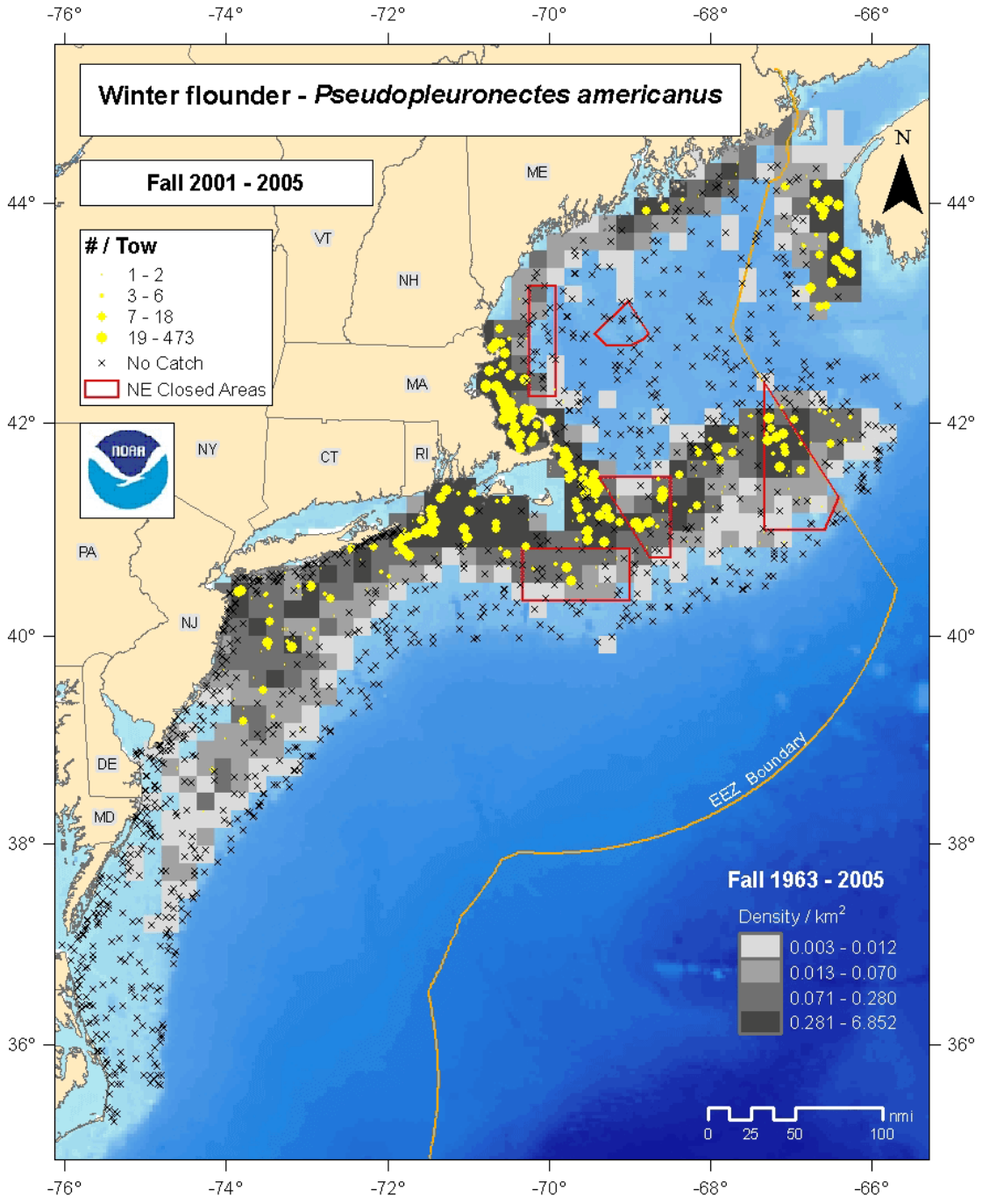
Habitat: Winter flounder migrate inshore, to shallower bays and estuaries, in the fall and early winter, and leave inshore areas for deeper waters following spawning in the early spring. Adults prefer a habitat temperature of 12-15˚ C.

Size: Growth and maturity vary by stock. Georges Bank fish tend to be the largest and fastest-growing, while fish in the Gulf of Maine are the smallest and slowest growing. Across the stocks, winter flounder may be up to 58 cm long.

Physical Description: Winter flounder are a small-mouthed, right-eyed fish.

Lifespan: Winter flounder may live up to 15 years and attain maturity at 6-7 years. Fish in the northern stocks reach maturity later than southern stocks.

Diet: Winter flounder consume a wide variety of prey, including polychaetes, crustaceans, bivalves, and other fish, depending on what is available. However, Annelids and amphipods dominate their diet.



Relative species abundance and distribution from NEFSC bottom trawl survey by time block and relative species density for the full time series.

Image from https://www.nefsc.noaa.gov/sos/spsyn/fldrs/winter/animation/fall/

Fairchild, E. A. (2017). Indications of Offshore Spawning by Southern Gulf of Maine Winter Flounder. *Marine and Coastal Fisheries*, 9(1), 493-503. doi:10.1080/19425120.2017.1365786

This is the first study to document quantitatively that Gulf of Maine (GOM) Winter Flounder Pseudopleuronectes americanus spawn offshore. Three sites (southern Jeffreys Ledge, Bigear [an area southwest of Tillies Bank], and a portion of Stellwagen Bank National Marine Sanctuary) were sampled during spring 2016 to determine whether Winter Flounder are spawning in non-coastal, deep waters in the southern GOM. In total, 1,384 Winter Flounder were caught by trawl, measured, sexed, and assessed for reproductive stage during the peak spawning season (March-May). These fish showed clear signs that spawning was occurring either at or very near to all three sites surveyed. In all sites, a shift from prespawn to postspawn females occurred. Running ripe females were caught at both Jeffreys Ledge and Stellwagen Bank on multiple occasions, and ripe and recently spawned females were caught at Bigear. Given that these sites are over 15 km from the coast, it is not energetically likely that fish in such advanced reproductive condition are migrating to shore to spawn. Essential fish habitat (EFH) for GOM Winter Flounder is categorized as waters with depths of 5 m or less. The present study clearly shows that this depth range is incomplete and thus inaccurate for southern GOM Winter Flounder. Although it is irrefutable that GOM estuaries and shallow bays are important as nursery grounds for juvenile Winter Flounder and as postspawn feeding grounds for adults, the current GOM EFH designation warrants reclassification.

Winter Flounder. (2017, Mon, 10/09/2017 - 14:24). Retrieved from https://www.fisheries.noaa.gov/species/winter-flounder

U.S. wild-caught winter flounder is a smart seafood choice because it is sustainably managed and responsibly harvested under U.S. regulations.

Fairchild, E. A., Siceloff, L., Howell, W. H., Hoffman, B., & Armstrong, M. P. (2013). Coastal spawning by winter flounder and a reassessment of Essential Fish Habitat in the Gulf of Maine. *Fisheries Research*, 141, 118-129. https://doi.org/10.1016/j.fishres.2012.05.007

With the exception of fish in the Georges Bank stock, it is widely believed that adult winter flounder (Pseudopleuronectes americanus) in US waters move inshore into estuaries and coastal embayments to spawn. However, there have been many indications that this paradigm may not apply to populations in the Gulf of Maine. To understand winter flounder spawning movements and habitat use more clearly, 40 ripe, pre-spawning adult fish were tagged with acoustic transmitters offshore and tracked in 2009 in the western Gulf of Maine. In addition, winter flounder collected by bottom trawl in the offshore study area were tagged with conventional tags, examined to quantify how the reproductive status of the general population changed over time, and released.

Fairchild, E. A., Sulikowski, J., Rennels, N., Howell, W. H., & Gurshin, C. W. D. (2008). Distribution of Winter Flounder, Pseudopleuronectes americanus, in the Hampton-Seabrook Estuary, New Hampshire: Observations from a Field Study. *Estuaries and Coasts*, 31(6), 1158-1173. Retrieved from http://www.jstor.org/stable/40663507

From July to October 2004, five sites in the Hampton-Seabrook Estuary in New Hampshire were sampled with beam and otter trawls. The goals were to describe winter flounder (1) abundance in

the estuary, (2) size class distributions, (3) spatial distribution by different size classes, and (4) distribution patterns. Of the 19 species caught, winter flounder was the most abundant and was dominated by young-of-the-year (YOY) fish. The five sites were fairly homogenous in depth, bottom type, salinity, and temperature. However, YOY abundance ranged from 2.1 to 32.1 fish 1,000 m-2 depending on the site. Benthic community was 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. During late summer and early fall, the estuary is used primarily by YOY winter flounder, indicating that this estuary functions as a nursery ground.

Buckley, L., Collie, J., Kaplan, L. A. E., & Crivello, J. (2008). Winter Flounder Larval Genetic Population Structure in Narragansett Bay, RI: Recruitment to Juvenile Young-of-the-Year. *Estuaries and Coasts*, 31(4), 745-754. https://doi.org/10.1007/s12237-008-9065-4

The genetic population structure of winter flounder larvae was examined in Narragansett Bay, RI. Winter flounder larvae collected from 20 stations within Narragansett Bay and one station outside of the Bay were analyzed for six microsatellite loci. When analyzed by geographic collection sites, there were 16 distinct genetic populations of winter flounder larvae (R ST values from 0.1 to 0.6). The presence of distinct genetic populations was supported by assignment of individual larvae to populations by Bayesian analysis. Bayesian analysis resulted in 14 distinct genetic populations that overlapped with the geographically distributed populations (R ST values from 0.1 to 0.6). Young-of-the-year juveniles collected in the same year as the larvae were also analyzed at the same six microsatellite loci. Juveniles were assigned to larvae populations by both a Bayesian approach and a neural network approach. Juveniles collected from within Narragansett Bay were found to arise from geographically adjacent Narragansett Bay winter flounder larval populations (>99%), suggesting no widespread movement of juveniles away from spawning grounds. These results are discussed in the context of winter flounder population biology in Narragansett Bay, RI.

Goldberg, R., Phelan, B., Pereira, J., Hagan, S., Clark, P., Bejda, A., Able, K. W. (2002). Variability in Habitat Use by Young-of-the-Year Winter Flounder, Pseudopleuronectes americanus, in Three Northeastern U. S. Estuaries. *Estuaries*, 25(2), 215-226. Retrieved from http://www.jstor.org/stable/1353311

We compared distribution and abundance by habitat for age-0, young-of-the-year (YOY) winter flounder, Pseudopleuronectes americanus, in three estuaries (Hammonasset River, Navesink River, and Great Bay-Little Egg Harbor) in the northeastern United States to better define essential fish habitat (EFH). Two replicates of five representative habitats were sampled in most estuaries: eelgrass (Zostera marina), unvegetated areas adjacent to eelgrass, macroalgae, (primarily Ulva lactuca), unvegetated areas adjacent to macroalgae, and tidal marsh creeks. Fish were sampled every two weeks, May through October 1995 and 1996, with a beam-trawl (1-m width, 3-mm mesh net). Abundance of YOY winter flounder was highest in the Navesink River estuary and similar between years, but was significantly lower and differed between years in the Great Bay-Little Egg Harbor and Hammonasset River estuaries. Annual temperature differences appear to influence estuary use by YOY. In the years and estuaries studied, where habitat-related differences in abundance were significant, YOY were found in higher densities in unvegetated areas adjacent to eelgrass. The exception was in the Hammonasset River in 1995 when densities were higher in eelgrass. We conclude that the type of habitat most important to YOY winter flounder varies among estuaries and as a result, care should be taken in defining EFH, based only on limited spatial and temporal sampling.

Stehlik, L. L., & Meise, C. J. (2000). Diet of Winter Flounder in a New Jersey Estuary: Ontogenetic Change and Spatial Variation. *Estuaries*, 23(3), 381-391. https://doi.org/10.2307/1353330

Juvenile and adult winter flounder, Pseudopleuronectes americanus Walbaum (Pleuronectidae), from the Navesink River and Sandy Hook Bay, New Jersey, U. S., were examined for ontogenetic, seasonal, and spatial variation in dietary content. Fish (n = 1291 non-empty) were placed by cluster analysis of dietary content into three size groups: 15-49, 50-299, and ≥300 mm total length. Clear ontogenetic patterns were revealed, in particular the disappearance of calanoid copepods from the diet as fish grew >50 mm and an increase in number of taxa in the diet with growth. Fish in size group 1 fed upon spionid polychaetes, the calanoid copepod Eurytemora affinis, and ampeliscid amphipods. Fish in size group 2 added various species of polychaetes, amphipods, and siphons of the bivalve Mya arenaria to their diets. Size group 2 was present during all months of the survey, but only minor seasonal differences in their diet were apparent. One obvious change was the increase in consumption of the shrimp Crangon septemspinosa in summer and fall. Size group 3 fish, collected mainly in fall, ate large volumes of M. arenaria and glycerid polychaetes. Cluster analysis showed a large-scale spatial pattern in diet among fish of size group 1, related to the presence of E. affinis in winter flounder diets in the river and a marsh cove in the bay. Small-scale spatial differences in diets of fish in size group 2 were possibly related to prey distribution.

Pereira, J., Goldberg, R., Ziskowski, J. J., Berrien, P. L., Morse, W. W., & Johnson, D. L. (1999). Essential Fish Habitat Source Document: Winter Flounder, Pseudopleuronectes americanus, Life History and Habitat Characteristics. (NMFS-NE-138). NOAA NEFSC Retrieved from https://www.nefsc.noaa.gov/nefsc/publications/tm/tm138/

The winter flounder, Pseudopleuronectes americanus, a small-mouthed, right-eyed flounder (Figure 1), is a valuable commercial and recreational species. It is distributed along the northwest Atlantic coast as far north as Labrador (Kendall 1909; Backus 1957) and as far south as North Carolina and Georgia (Hildebrand and Schroeder 1928; Klein-MacPhee, in prep.). One of the more familiar fishes in the Gulf of Maine (Klein-MacPhee, in prep.), winter flounder are common on Georges Bank and in shelf waters as far south as Chesapeake Bay and are ubiquitous in inshore areas from Massachusetts to New Jersey.

Section II: Ecology

Pruell, R. J., Taplin, B. K., & Miller, K. M. (2017). Trends in nitrogen isotope ratios of juvenile winter flounder reflect changing nitrogen inputs to Rhode Island, USA estuarine systems. *Marine Pollution Bulletin,* 118(1-2), 41-47. https://doi.org/10.1016/j.marpolbul.2017.02.009

Nitrogen isotope ratios (delta N-15) in juvenile winter flounder, Pseudopleuronectes americanus, were used to examine changes in nitrogen inputs to several Rhode Island, USA estuarine systems. Fish were collected over two three-year periods with a ten-year interval between sampling periods (2002-2004 and 2012-2014). During that interval numerous changes to nutrient management practices were initiated in the watersheds of these estuarine systems including the upgrade of several major wastewater treatment facilities that discharge to Narragansett Bay, which significantly reduced nitrogen inputs. Following these reductions, the delta N-15 values of flounder in several of the systems decreased as expected; however, isotope ratios in fish from upper

Narragansett Bay significantly increased. We believe that low delta N-15 values measured in 2002-2004 were related to concentration-dependent fractionation at this location. Increased delta N-15 values measured between 2012 and 2014 may indicate reduced fractionation or that changes in wastewater treatment processes altered the nitrogen isotopic ratios of the effluents.

Wilber, D. H., Clarke, D. G., Alcoba, C. M., & Gallo, J. (2016). Windowpane flounder (Scophthalmus aquosus) and winter flounder (Pseudopleuronectes americanus) responses to cold temperature extremes in a Northwest Atlantic estuary. *Journal of Sea Research*, 107, 23-30. https://doi.org/10.1016/j.seares.2015.04.005

The effect of climate variability on flatfish includes not only the effects of warming on sensitive life history stages, but also impacts from more frequent or unseasonal extreme cold temperatures. Cold weather events can affect the overwintering capabilities of flatfish near their low temperature range limits. We examined the responses of two flatfish species, the thin-bodied windowpane (Scophthalmus aquosus) and cold-tolerant winter flounder (Pseudopleuronectes americanus), to variable winter temperatures in a Northwest Atlantic estuary using abundance and size data collected during a monitoring study, the Aquatic Biological Survey, conducted from 2002 to 2010. Winter and spring abundances of small (50 to 120 mm total length) juvenile windowpane were positively correlated with adult densities (spawning stock) and fall temperatures (thermal conditions experienced during post-settlement development for the fall-spawned cohort) of the previous year. Windowpane abundances in the estuary were significantly reduced and the smallest size class was nearly absent after several consecutive years with cold (minimum temperatures < 1 °C) winters.

Howell, P. T., Pereira, J. J., Schultz, E. T., & Auster, P. J. (2016). Habitat Use in a Depleted Population of Winter Flounder: Insights into Impediments to Population Recovery. *Transactions of the American Fisheries Society*, 145(6), 1208-1222. https://doi.org/10.1080/00028487.2016.1218366

The distribution and demographics of a population of Winter Flounder Pseudopleuronectes americanus were examined for changes related to habitat quality over a fishery-independent survey period of 29 years, encompassing an 82% decline in abundance. We tested for spatial and temporal variation in indicators of fitness to determine whether they revealed likely processes that resulted in the observed patterns of habitat use. We also assessed temporal changes in fitness and inferred changes in habitat quality associated with population decline. We focused on the condition of postspawn (resting) mature and immature fish of both sexes during a critical period of spring feeding prior to summer migration.

Bailey, D. S., Fairchild, E. A., & Kalnejais, L. H. (2015). Microchemical Signatures in Juvenile Winter Flounder Otoliths Provide Identification of Natal Nurseries. *Transactions of the American Fisheries Society,* 144(1), 173-183. https://doi.org/10.1080/00028487.2014.982259

Variation of otolith microchemical signatures between natal nurseries from young-of-the-year (age 0) Winter Flounder Pseudopleuronectes americanus were evaluated. Fish were collected in summer 2012 from 12 nursery areas from New Jersey to New Hampshire, spanning >500 km. Nursery specific microchemical signatures were developed using element : Ca ratios, which were determined with solution-based inductively coupled plasma-mass spectrometry on the whole

otolith. Age-0 flounder microchemical signatures showed significant nursery-specific differences and varied on a small spatial scale (about 12 km) based on elemental (Li, Na, Mg, Mn, Sr, Cd, and Ba) ratios. Via quadratic discriminant function analysis, fish were classified back to natal nursery areas with 73% average cross-validation classification accuracies. Based on this preliminary study, otolith microchemistry has the potential to be an effective tool to assess the connectivity between the inshore nursery areas and the offshore adult populations of Winter Flounder; however, further baseline studies are needed. In particular, between-year and within-year variation in the otolith elemental concentrations must be quantified. These elemental analyses need to be linked to specific management needs to be useful to fisheries managers; for Winter Flounder, the ability to rank estuaries by the yield of recruits may help solve estuary-specific anthropogenic challenges.

Manderson, J. P., Jeffrey, P., Patricia, S., & Francis, J. (2006). Dynamics of early juvenile winter flounder predation risk on a North West Atlantic estuarine nursery ground. *Marine Ecology Progress Series*, 328, 249-265. https://doi.org/10.3354/meps328249

In an effort to determine the characteristics of estuarine habitats suitable for early juvenile winter flounder Pseudopleuronectes americanus survivorship, we examined piscivorous fish distributions and diets, and flounder predation risk along estuarine gradients in the Navesink River/Sandy Hook Bay estuarine system, New Jersey, USA. Demersal fish, striped searobin Prionotus evolans and summer flounder Paralichthys dentatus, were more important predators of winter flounder than pelagic fish (Pomatomus saltatrix, Cynoscion regalis, Morone saxatilis) based on diet analysis of 4 yr of gill (1998 and 1999) and trammel net (2001 and 2002) fish collections. From April through June newly settled winter flounder <20 mm standard length (SL) were eaten by striped searobin that were common in habitats with salinities ≥ 20‰. Fish >20 mm standard length (SL) were consumed by summer flounder in shallow habitats in June and July. In May and June tethering experiments, Age-0 winter flounder predation risk was high in habitats with salinities >19‰ and temperatures >20°C. In 3 yr, salinities were <20‰ in the upstream reach of estuary which probably served as a predator refuge for settling flounder. During 2002, however, historically low freshwater discharge associated with a spring drought produced high salinities ≥20‰ in upstream habitats where searobins ate large numbers of settling winter flounder and predation risk was high. These results suggest that the volume of estuarine habitat suitable for early juvenile flounder survivorship is determined, in part, by predator and prey responses to spatially dynamic physico-chemical gradients. Because gradient dynamics are controlled by climate forcing, climate variation may cause nursery habitat volumes to contract or expand resulting in variation in the local production of Age-0 recruits.

Manderson, J. P., Pessutti, J., Hilbert, J. G., & Juanes, F. (2004). Shallow water predation risk for a juvenile flatfish (winter flounder; Pseudopleuronectes americanus, Walbaum) in a northwest Atlantic estuary. *Journal of Experimental Marine Biology and Ecology*, 304(2), 137-157. https://doi.org/10.1016/j.jembe.2003.12.004

Many small fish, including several juvenile Atlantic flatfish, are most abundant in shallow areas presumable because these habitats enhance survivorship and/or growth. In this study, we investigated size-dependent depth distributions and the role of shallow habitats as predator refuges for age-0 winter flounder (Pseudopleuronectes americanus) in a northwest Atlantic estuarine nursery. Analysis of trawl surveys performed during the larval settlement period throughout the Navesink River and Sandy Hook Bay, New Jersey, showed that as fish increased in

size, depth of occurrence gradually decreased, so that individuals >35 mm standard length (SL) were concentrated in habitats ~1 m deep. Tethering in structurally simple and adjacent shallow and deep habitats showed that predation risk for flounder (30–50 mm SL) was low in shallow water (<1 m) and increased rapidly with depth. Summer flounder (Paralychthys dentatus), which were more abundant in trammel nets in deep habitats and included winter flounder in their diets, appeared to be important consumers of tethered fish. Our results indicate that following larval settlement, winter flounder emigrate from or suffer high mortality in deeper water to become concentrated in shallow habitats that can serve as predator refuges even when they lack complex physical structures. These results highlight the potential for functional habitat loss when natural and/or anthropogenic factors make shallow habitats unavailable to young fish.

Phelan, B. A., Manderson, J. P., Stoner, A. W., & Bejda, A. J. (2001). Size-related shifts in the habitat associations of young-of-the-year winter flounder (Pseudopleuronectes americanus): field observations and laboratory experiments with sediments and prey. *Journal of Experimental Marine Biology and Ecology*, 257(2), 297-315. https://doi.org/10.1016/S0022-0981(00)00340-3

Field surveys and laboratory studies were used to determine the role of substrata in habitat selection by young-of-the year winter flounder. A synoptic field survey of winter flounder and sediments in the Navesink River–Sandy Hook Bay estuarine system in New Jersey demonstrated that winter flounder distribution was related to sediment grain size. Analysis using a generalized additive model indicated that the probability of capturing 10–49 mm SL winter flounder was high on sediments with a mean grain diameter of ≤0.5 mm, while fish 50–95 mm were least likely to be collected on fine sediments and most commonly on sediments with a grain-size near 1.0 mm. In the laboratory, sediment preferences and the burying ability of winter flounder (15–69 mm SL) were tested by exposing fish in 10-mm size groups to a choice of azoic sediments of different sediment grain sizes. Smaller individuals (<40 mm SL) preferred fine-grained sediments while larger individuals (≥40 mm SL) preferred coarse-grained sediments. Burying ability increased with size and all flounders avoided sediments that prevented burial. Subsequent laboratory experiments revealed that the presence of live prey (Mya arenaria) can over-ride sediment choice by winter flounder (50–68 mm SL) indicating the complexity of interrelated factors in habitat choice.

Howell, P. T., Molnar, D. R., & Harris, R. B. (1999). Juvenile Winter Flounder Distribution by Habitat Type. *Estuaries*, 22(4), 1090-1095. https://doi.org/10.2307/1353086

Shallow embayments in Connecticut were sampled with a 1-m beam trawl for young-of-year winter flounder from 1990-1993 to determine if there are habitat types within nursery areas which consistently yield higher abundances. Initial examination of catch frequencies and all physical measurements indicated that only sediment type correlated with abundance. There was no consistent pattern in winter flounder catch in relation to salinity, water temperature, water column turbidity, depth interval, channel/non-channel, or the presence of sea lettuce (Ulva lactuca). Catch data were then classified into five habitat types defined by a combination of sediment and overlying litter. Analysis of variance in catch among habitat types showed that mean catch was significantly different among four of the five habitat types. Highest densities within a site most often occurred in mud/shell-litter habitat, followed by mud/wood-litter and mud/no litter habitat; sandy sites with or without litter yielded the lowest densities. Independent sampling of new sites corroborated the distributional pattern seen at the original sites, and importance of mud/shell-litter habitat. The distributional pattern seen here can provide a means of assessing which sites would be expected to

support a higher abundance of young-of-year winter flounder, and which sites might provide less, if no other factors intervene.

Augspurger, T. P., Herman, R. L., Tanacred, J. T., & Hatfield, J. S. (1994). Liver Lesions in Winter Flounder (Pseudopleuronectes americanus) from Jamaica Bay, New York: Indications of Environmental Degradation. *Estuaries*, 17(1), 172-180. https://doi.org/10.2307/1352566

Liver sections of winter flounder (Pseudopleuronectes americanus) collected from Jamaica Bay and Shinnecock Bay, New York, in 1989, were examined microscopically to determine the pervasiveness of liver lesions observed previously in Jamaica Bay winter flounder. Neoplastic lesions were not detected in fish from Jamaica Bay or the Shinnecock Bay reference site. Twenty-two percent of Jamaica Bay winter flounder examined (n = 103) had unusual vacuolization of hepatocytes and biliary pre-ductal and ductal cells (referred to hereafter as the vacuolated cell lesion). The lesion, identical to that found in 25% of Jamaica Bay winter flounder examined in 1988, has previously been identified in fishes taken from highly polluted regions of the Atlantic coast (e. g., Boston Harbor, Massachusetts, and Black Rock Harbor, Connecticut). Prevalence of the vacuolated cell lesion in winter flounder from Jamaica Bay was significantly greater ($p < 0.0001$) than in 102 specimens collected from Shinnecock Bay. Current scientific literature indicates vacuolated hepatocytes and cholangiocytes are chronically injured and that the extent of their deformity is consistent with the action of a hepatotoxicant. The high prevalence of vacuolated hepatocytes in Jamaica Bay winter flounder and absence of the lesion in flounder from reference sites strongly supports the hypothesis that this impairment is a manifestation of a toxic condition in at least some portions of Jamaica Bay.

Section III: Fisheries

Northeast Fisheries Science Center (2017). Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016. (17-17). Retrieved from https://www.nefsc.noaa.gov/nefsc/publications/crd/crd1717/.

Assessments for 191 of the 20 groundfish stocks (Table 1) in the New England Fishery Management Council's (NEFMC) Multispecies Groundfish Fisheries Management Plan were updated and reviewed during September 11-15, 2017 at the Northeast Fisheries Science Center (NEFSC), Woods Hole, MA. This represents the fifth assessment of the status of groundfish stocks since 2001. The first three assessments were produced through the Groundfish Assessment Review Meeting (GARM) process (NEFSC 2002, 2005, 2008). Thirteen of the groundfish stocks were updated through the Operational Assessment process in 2012 (NEFSC 2012). All 20 groundfish stocks were updated using operational assessments in 2015 (NEFSC 2015).

Hendrickson, L., Nitschke, P., & Terceiro, M. (2006, December 2006). Winter Flounder - Status of Fishery Resources off the Northeastern US. Retrieved from https://www.nefsc.noaa.gov/sos/spsyn/fldrs/winter/

The winter flounder, blackback, or lemon sole, Psuedopleuronectes americanus, is a demersal flatfish distributed in the Northwest Atlantic from Labrador to Georgia. Important U.S. commercial and recreational fisheries exist from the Gulf of Maine to the Mid-Atlantic Bight. In USA waters, the

resource is assessed and managed as three stocks: Gulf of Maine, Southern New England/Mid-Atlantic Bight (SNE/MAB), and Georges Bank.

Cicchetti, G. (2006). Fisheries in Mount Hope Bay: Notes on a Special Symposium from a Session Moderator. *Northeastern Naturalist*, 13, 27-30. Retrieved from: http://www.jstor.org/stable/4130970

This contribution represents a summary of talks presented during the afternoon session of the Mount Hope Bay Symposium, focused directly on issues surrounding observed winter flounder populations, as prepared by the session moderator.

He, P. (2003). Swimming behaviour of winter flounder (Pleuronectes americanus) on natural fishing grounds as observed by an underwater video camera. *Fisheries Research*, 60(2), 507-514. https://doi.org/10.1016/S0165-7836(02)00086-3

Swimming behaviour of winter flounder (Pleuronectes americanus) was recorded near baited hooks on natural fishing grounds using an underwater video camera. Winter flounder were observed to stay on or very close to the seabed, never rising to more than 0.6m off bottom during 1 month of observation. Winter flounder were recorded to take bait actively at temperatures as low as −1.2°C. Movement of winter flounder was characterized by a period of swimming off seabed followed by a period of resting on the seabed. The proportion of time swimming off seabed as opposed to resting on the seabed was positively related to water temperature. Flounder spent an average of 32% of time in swimming when at −1.2°C compared with 67% when at 4.4°C. Voluntary swimming speed of the flounder during the period of swimming was lower at lower temperatures. An average swimming speed of 0.52 body lengths per second (Ls−1) at −1.2°C was recorded compared with 0.95Ls−1 at 4.4°C. Overall rate of movement was reduced by three-fold when water temperature fell from 4.4 to −1.2°C. The reduced rate of movement at lower temperatures is discussed in relation to potential fishing area of fixed fishing gears such as gillnets.

Section IV: Management

Fisheries of the Northeastern United States: Northeast Multispecies Fishery; Possession and Trip Limit Implementation for the Common Pool Fishery. (2017). *US Official News*. Retrieved from https://advance.lexis.com/api/permalink/d047e6e5-53cf-44fc-b0ad-078279e03a4d/?context=1000516

This action sets the initial possession and trip limits for Northeast multispecies common pool vessels for the 2017 fishing year. The regulations authorize the Regional Administrator to implement trip limits for common pool vessels in order to prevent exceeding the pertinent common pool quotas. This action is intended to optimize the harvest of Northeast regulated multispecies.

Walsh, C. (2014, April 27, 2014). Early reports: Winter flounder making a comeback. *Connecticut Post.* Retrived from https://www.ctpost.com/sports/article/Early-reports-Winter-flounder-making-a-comeback-5430957.php

If early indications are any guide, the beleaguered winter flounder may -- I say may -- be making a Bill Clinton-like comeback. Area anglers who refuse to abandon the chase of these tasty flatfish report that the size and frequency of their catches so far this spring are somewhat better than recent years.

Rothschild, B. J., & Jiao, Y. (2011). Characterizing Uncertainty in Fish Stock Assessments: the Case of the Southern New England–Mid-Atlantic Winter Flounder. *Transactions of the American Fisheries Society,* 140(3), 557-569. https://doi.org/10.1080/00028487.2011.581979

The reauthorization of the Magnuson-Stevens Act requires specification of scientific uncertainty associated with stock assessments. The scientific uncertainty associated with stock assessments of southern New England-mid-Atlantic winter flounder Pseudopleuronectes americanus is considered as a case study. Focus is placed upon the uncertainties associated with the assumptions, assertions, and choices (AACs) made in the stock assessment analysis. Two classes of AACs are discussed. The first class involves AACs that characterize the population dynamics of the stock; these AACs include the unit stock assumption, the problem of dealing with retrospective patterns, the method of averaging fishing mortality across cohorts to yield an annual value for fishing mortality, and the equilibrium structure of the stock. The second class of AACs is related to the choice of methods used to determine whether the stock is overfished; these AACs involve focusing on the maximum sustainable yield (MSY) proxy rather than MSY per se to determine overfishing levels. The MSY proxy approach is discussed and compared with heuristic calculations of the MSY approach. Arbitrary choices of instantaneous natural mortality and percent maximum spawning potential in the analysis can lead to an arbitrary decision on whether or not the stock is overfished. We conclude that there is considerable scientific uncertainty on the status of the southern New England-mid-Atlantic winter flounder stock. The uncertainty identifies critical unknowns in winter flounder population dynamics.