NCRL subject guide 2018-05
doi:10.7289/V5/SG-NCRL-18-05

Northeast Multispecies Fishery Management Plan Resource Guide: Windowpane Flounder (Scophthalmus aquosus)

Bibliography

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February 2018

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
Office of Oceanic and Atmospheric Research
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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 windowpane 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), Fishery, and Management.

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

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

Section III – Fisheries
Section three is intended to provide an overview of the windowpane flounder fishery. It covers reports on fish stock status over the last fifteen years and includes one source on historical groundfish fisheries in the Northeast United States.

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

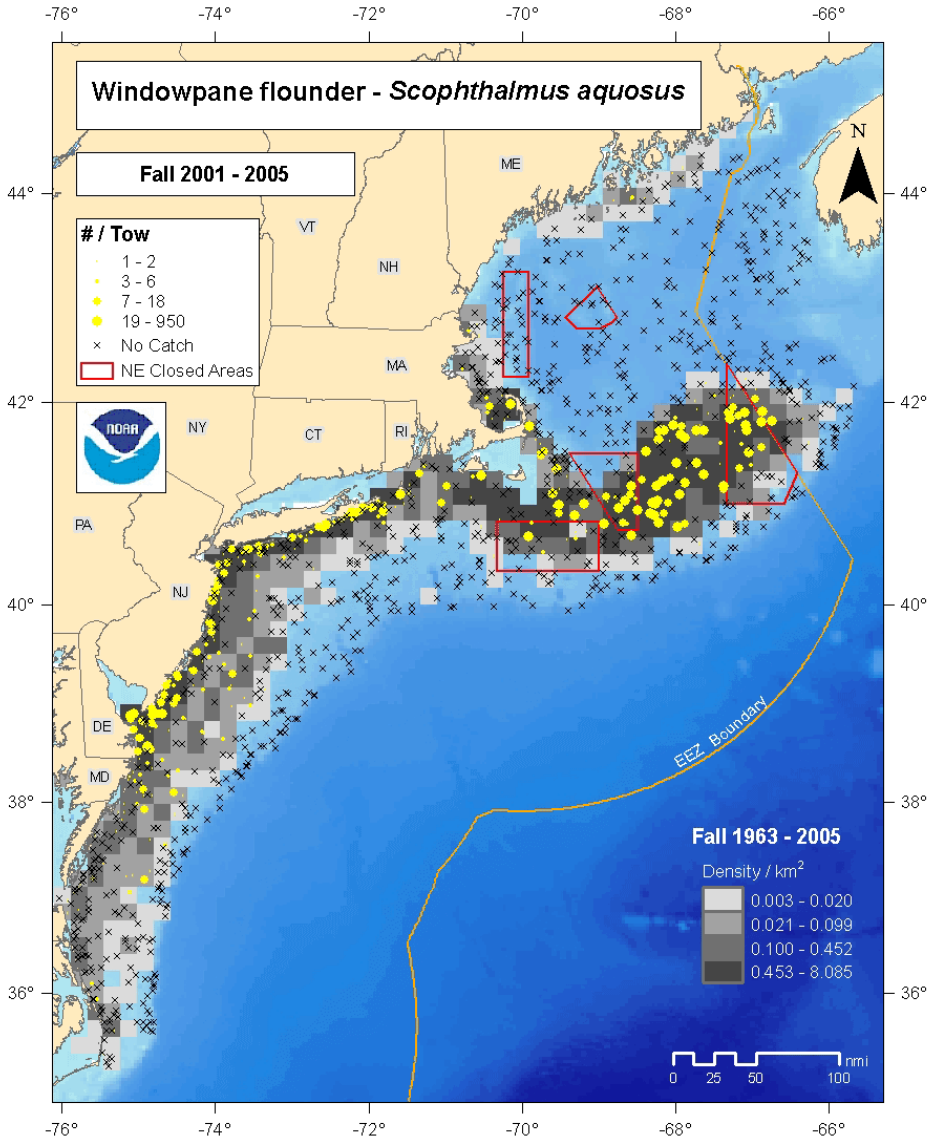
Sources Reviewed
Along with a web search for news items and other relevant materials the following databases were used to identify sources: Clarivate Analytics' Web of Science: Science Citation Index Expanded, Nexis.com, ProQuest's Science and Technology, and JSTOR. Only English language materials were 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 the NEFSC Photo Gallery

Also known as: Sand Dab, Sand Flounder, Papermouth.

Region: Found in the Northwest Atlantic from the Gulf of St. Lawrence to Florida. The Northeast Multispecies Fishery Management Plan divides the windowpane into two stocks, northern and southern, based on their location relative to Georges Bank.



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

Image source:

Hendrickson, L. (2006, December 2006). "Windowpane flounder (Scophthalmus aquosus)." Status of Fishery Resources off the Northeastern US 2018, from https://www.nefsc.noaa.gov/sos/spsyn/fldrs/window/.

This shows relative windowpane flounder stock weight and location. Yellow circles indicate windowpane flounder are present, larger circles indicate more windowpane flounder, plus sign (+) indicates sampled area where no windowpane flounder were found.

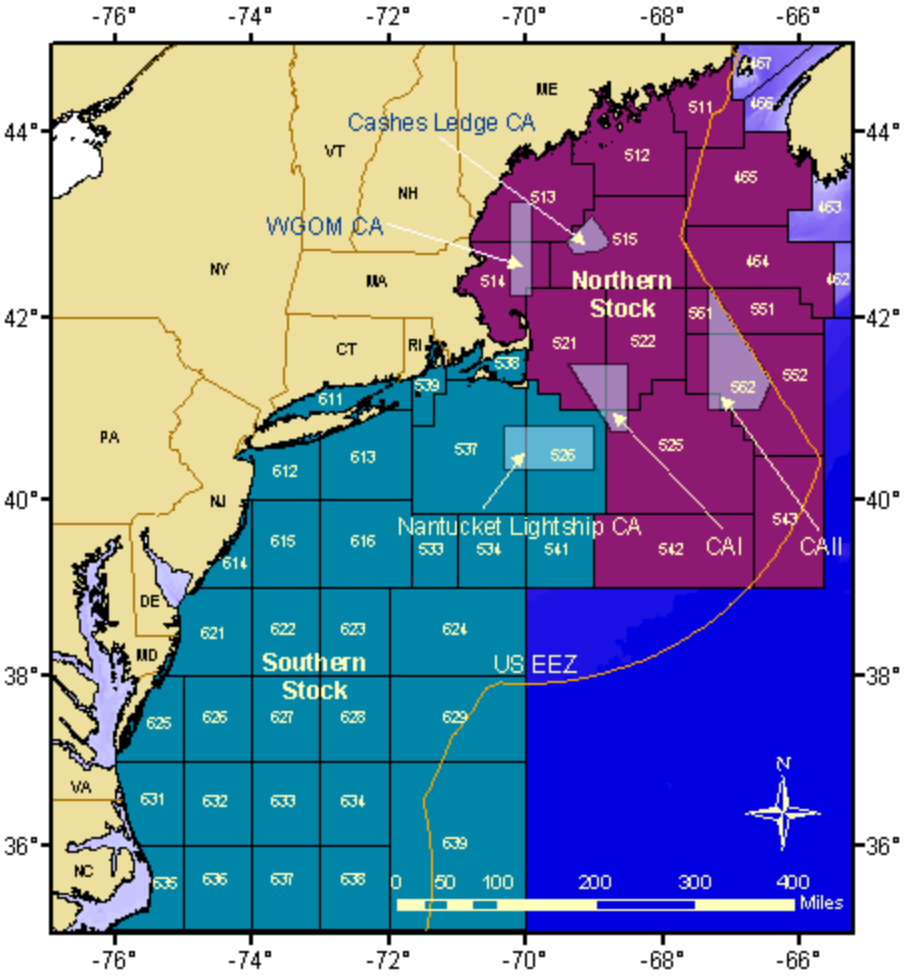


Figure 12.1. Statistical areas used to define the northern and southern windowpane flounder stocks.

Image source:

Hendrickson, L. (2006, December 2006). "Windowpane flounder (Scophthalmus aquosus)." Status of Fishery Resources off the Northeastern US 2018, from https://www.nefsc.noaa.gov/sos/spsyn/fldrs/window/.

Habitat: Windowpane flounder prefer sandy and muddy bottoms of bays and estuaries, at depths that range from the shoreline to 60 meters. They are most abundant from Georges Bank to Chesapeake Bay.

Size: Adult windowpane flounder grow to about 22 cm TL though they have been found up to 45 cm TL.

Physical Description: Windowpane flounder are a flatfish with both eyes on the left side of the body, and the mouth points to the left. They have an arched lateral line and tend to be more round than other flatfish. It is possible to see through the fish when it is held to the light, hence the name

“windowpane.” These fish are light brown to olive green in color, with irregular dark and some white spots on the length of the body and on the fins. The blind side is colorless.

Lifespan: Windowpane may live up to eight years of age, and females reach maturity between three and four years. Due to a split spawning season for most populations of windowpane, spring-spawned fish may have longer life expectancies than the autumn-spawned cohort.

Diet: Most windowpane feed on small crustaceans, small fishes and various fish larvae, including those of their own species.

Neuman, M. J. and K. W. Able (2003). "Inter-cohort differences in spatial and temporal settlement patterns of young-of-the-year windowpane (Scophthalmus aquosus) in southern New Jersey." *Estuarine, Coastal and Shelf Science* 56(3-4): 527-538. https://doi.org/10.1016/S0272-7714(02)00203-2

The timing and location of settlement of two cohorts (spring and fall) of windowpane (Scophthalmus aquosus) were identified based on collections from 64 sampling locations along a corridor from the lower estuary, through the inlet, and on to the adjacent inner continental shelf in southern New Jersey. Spatio-temporal patterns of settlement during 1989–1998 were determined based on capture location and timing, and eye migration stage. Spring-spawned windowpanes were collected in estuarine, inlet and ocean habitats as larvae, during settlement, and after settlement. Densities of spring-spawned larvae (~2–10 mm standard length (SL)) peaked in May in all habitats (estuary, inlet, and ocean). Initial settlement of spring-spawned windowpane occurred during May in the inlet and ocean when fish had grown to ~7–8 mm SL (mid-point of eye migration), but fish did not appear in demersal estuarine collections until June when they were larger and more developmentally advanced (~24–32 mm SL; post-eye migration). A transitional settlement period, comprised of a progressive habitat shift from pelagic to demersal habitats, is proposed for the spring cohort to explain the observed patterns. Fall-spawned fish of all developmental stages and sizes were virtually absent from estuarine collections. Fall-spawned larval (~2–10 mm SL) densities peaked in October in inlet and ocean habitats and fish began settling there during the same month at sizes similar to the spring cohort (~7–8 mm SL). This research confirms that there are important cohort-specific and life-stage dependent differences in young-of-the-year (YOY) windowpane habitat use in southern New Jersey and perhaps in other east coast US estuaries. These differences may affect the overall contribution that each cohort makes to a given year class and thus, may have an important role in determining the recruitment dynamics of this species.

Chang, S. and N. F. S. C. (U.S.) (1999). "Essential Fish Habitat Source Document: Windowpane, Scophthalmus aquosus, Life History and Habitat Characteristics. ." NOAA Technical Memorandum NMFS-NE-137. Retrieved from https://repository.library.noaa.gov/view/noaa/3127

The windowpane, Scopththalmus aquosus, is an eurythemal, euryhaline, and fast-growing fish with a thin body. It inhabits estuaries, near-shore waters, and the continental shelf in the northwest Atlantic. Windowpane is not a target of the commercial fishing industry, but is mainly caught as bycatch in bottom trawl fisheries. It is managed by the New England Fishery Management Council

under the Multispecies Fishery Management Plan (NEFMC 1993). This Essential Fish Habitat source document provides information on the life history and habitat characteristics of windowpane.

Neuman, M. J. and K. W. Able (1996). "Experimental evidence of sediment preference by early life history stages of windowpane (Scophthalmus aquosus)." *Journal of Sea Research* 40(1-2): 33-41. https://doi.org/10.1016/S1385-1101(98)00009-4

We evaluated sediment choice by young-of-the-year (YOY) windowpane, Scophthalmus aquosus, in the laboratory. We gave transitional (8-18 mm SL) and larger juvenile windowpane (32-89 mm SL) a choice of sediment mixtures, all of which were within the range observed in the field (tested range: sand-<1% silt/clay; mud-40-45% silt/clay). Observations (n = 1619 in four 48-h trials) were of three kinds: location, burial behaviour, and pigmentation pattern (transitional or juvenile pigmentation). We also tested the effects of food availability and light level on sediment preference. Windowpane of all sizes preferred sand over mud in 65-84% of all observations, but there were differences in sediment preference, burial behaviour, and pigmentation pattern between the transitional and juvenile stages. Transitional windowpane were observed on sand less frequently, buried less often, and exhibited larval pigmentation more often than juveniles. Further analyses showed that transitional fish had a higher probability of moving from the preferred sediment (sand) during hours of darkness, and both stages had a higher probability of moving onto mud n hen food was absent. Juveniles were also more active when food was absent, but to a lesser extent than transitional fish. We believe that habitat selection may play a crucial role in determining: the distribution of YOY windowpane under natural conditions and will aid in our interpretation of post-settlement distribution patterns of field populations in near-shore and estuarine environments in the Middle Atlantic Eight, USA.

Morse, W. W. and K. W. Able (1995). "Distribution and life history of windowpane, Scophthalmus aquosus, off the northeastern United States." *Fishery Bulletin* 93(4): 75-93. Retrieved from https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1995/934/morse.pdf

The windowpane, Scophthalmus aquosus, is a shallow water (<110 m), resident species of the Middle Atlantic Bight (and adjacent estuaries) and Georges Bank, although it may undergo short (both inshore-offshore and alongshore) migrations in response to seasonal temperature changes. Spawning occurred throughout the Middle Atlantic Bight during the period from 1977 to 1987 but was most pronounced on Georges Bank. The timing of spawning, determined from the collection of 2-4 mm larvae, varied with location; and a split spawning season (April-May and October-November) was evident in the Middle Atlantic Bight. Spawning on Georges Bank peaked in August. Although spawning occurred over a broad temperature range (5-23 C), the optimal temperature was 16-19C on Georges Bank. Larval development occurred in areas of spawning and was most prolonged on Georges Bank, where the largest larvae (13-20 mm) were consistently found. Few larvae >8 mm were captured in the Middle Atlantic Bight. On the basis of samples from southern New Jersey, settlement probably occurs on the continental shelf and in adjacent estuaries of the Middle Atlantic Bight. The growth patterns of young of the year varied with the timing of spawning and subsequent settlement. In the first six months, fish of the spring-spawned cohort grew to 11-19 cm TL whereas those of the fall-spawned cohort grew to just 4-8 cm TL within that time. These data contribute to our understanding of the distribution and early life history of windowpane on the continental shelf, though the role of estuaries in the Middle Atlantic Bight is incompletely known.

Dawson, M. A. (1990). "Blood Chemistry of the Windowpane Flounder Scophthalmus aquosus in Long Island Sound: Geographical, Seasonal, and Experimental Variations." *Fishery Bulletin* 88(3): 429-437. Retrieved from https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1990/883/dawson.pdf

This study represents an attempt to distinguish between normal seasonal variations and pollutant-related changes in the blood chemistry of the windowpane flounder Scophthalmus aquosus . Three stations in Long Island Sound, USA, were chosen to provide a pollutant gradient. Windowpane flounder were collected from the three stations monthly, when possible, over a period of three years. Seasonal variations were noted in hematocrit, plasma osmolality, sodium, potassium, and calcium. Station-related differences were demonstrated in osmolality, hematocrit, and hemoglobulin. The same species was subjected to 60-day laboratory exposures to mercury, cadmium, or copper. Neither copper nor cadmium produced a significant difference in any variable measured. Following exposure to mercury, there were significant differences between controls and exposed animals in plasma sodium and calcium.

Pereira, J. J. (1988). "Morphological effects of mercury exposure on windowpane flounder gills as observed by scanning electron-microscopy." *Journal of Fish Biology* 33(4): 571-580. http://dx.doi.org/10.1111/j.1095-8649.1988.tb05500.x

Windowpane flounder, Scophthalmus aquosus Mitchill, were exposed for 60 days to 5 or 10 μg 1^{-1} mercury and gill samples were examined by scanning electron microscopy. The response of the gill epithelium was different at the two levels of mercury exposure. The number of chloride cell apical pits and gill filaments bearing 'cratered' epithelial cells increased at the 5 μg 1^{-1} level and decreased at the higher exposure level. Focal swellings demonstrated a dose dependent relationship, their numbers being greatest at the higher exposure level. Marked fragmentation of pavement cell microridge patterns and swelling of the respiratory epithelial cells was evident at the 10 μg 1^{-1} exposure level.

Section II: Ecology

Wilber, D. H., et al. (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. http://dx.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 b1 °C) winters.

Sagarese, S. R., et al. (2011). "Diet Composition and Feeding Habits of Common Fishes in Long Island Bays, New York." *Northeastern Naturalist* 18(3): 291-314. Retrieved from http://www.jstor.org/stable/41315963

Developing models in support of ecosystem-based knowledge of trophic dynamics of ecologically important these dynamics for Long Island finfish is hindering development required by recent legislation. In this study, we analyzed fishes collected from Port Jefferson Harbor, Great South tween May and October of 2007 and 2008. General diet composition percent by number (%N), percent by weight (%W), percent (%0), and percent index of relative importance (%IRI) for dentatus (Summer Flounder), young-of-the-year (YOY) Pomatomus Prionotus evolans (Striped Searobin), Stenotomus chrysops sus (Windowpane Flounder), Raja eglanteria (Clearnose Skate), (Striped Bass). Temporal diet composition was estimated for YOY Bluefish, Summer Flounder, and Scup, where most «large catches of YOY Bluefish and Scup led to investigation cluster sampling. Important prey included Crangon sp. (sand (Rock Crab), and forage fishes. Pseudopleuronectes americanus a common prey item in stomachs of piscivorous Long Island and < 1.6 %W to the diets of Summer Flounder, Striped Searobin, Bluefish. These changes may be due to shifts in the abundance in spatial overlap of predator and prey.

Walsh, H. J., et al. (1999). "Habitat Utilization by Small Flatfishes in a North Carolina Estuary." *Estuaries* 22(3B): 803-813. http://doi.org/10.2307/1353113

Distribution and abundance of flatfish species (< 150 mm standard length) were related to habitat characteristics in the Newport River and Back Sound estuaries in North Carolina. Salinity, turbidity, depth, distance from marsh edge, benthic composition, and grain size were used to describe the different shallow water habitats from April through October 1994. One Scophthalmidae, seven Paralichthyidae, one Achiridae, and one Cynoglossidae species were collected during the study including juvenile Paralichthys albigutta (gulf flounder), P. dentatus (summer flounder), and P. lethostigma (southern flounder) along with multiple age classes of Citharichthys spilopterus (bay whiff), Etropus crossotus (fringed flounder), Symphurus plagiusa (blackcheek tonguefish), and Trinetes maculatus (hogchoker). Incidental catches of Ancylopsetta quadrocellata (ocellated flounder), C. macrops (spotted whiff), and Scopthalmus aquosus (windowpane) were also made. Flatfish distributions among habitats varied by species, size within species, and season. Regardless of season, the highest densities of flatfishes were found in the upper estuary. All habitats were used by one or more species and most species occurred at several habitats. Some species were significantly more abundant at specific habitat types. Ontogenetic shifts in habitat utilization were found for several species. High densities of small P. lethostigma, C. spilopterus, S. plagiusa, and T. maculatus occurred in the upper estuary on muddy substrates. Large P. dentatus, C. spilopterus, S. plagiusa, and T. maculatus utilized sand flats and channels in the lower estuary.

Greig, R. A., et al. (1983). "Metals and PCB concentrations in windowpane flounder from Long Island Sound." *Bulletin of Environmental Contamination and Toxicology* 31(5): 257-262. https://doi.org/10.1007/BF01608695

PCBs and metals are pollutants of concern in Long Island Sound… Analyses of seawater is one way of determining the distribution of these pollutants; however, the analyses for these pollutants are quite complex and the results are often ambiguous because of the dynamic nature of seawater. We therefore chose to examine a fish, windowpane flounder (Scophthalmus aquosus), to gain an understanding of the distribution of metals and PCBs in the Sound. The windowpane flounder was selected because of its availability throughout the year, and because it is relatively non-migratory (Bigelow & Schroeder 1953). Three stations in the Sound were selected based on historical data that showed a pollution gradient for metals in bottom sediments (Greig et al. 1977) and represented the "best", "worst", and "moderate" conditions (Stations 90, 9, and 54). PCBs and metals were measured in livers, whereas only PCBs were measured in the stomach contents of these fish.

Section III: Fishery

(2017). Magnuson-Stevens Fishery Conservation and Management Act Provisions; Fisheries of the Northeastern United States; Northeast Groundfish Fishery; Fishing Year 2017; Emergency Removal of Southern Windowpane Accountability Measures; Federal Register. Commerce. Washington, DC, Federal Information and News Dispatch, Inc. Retrieved from https://advance.lexis.com/api/permalink/de5b13b1-2122-44f3-9716-0110b2be64ed/?context=1000516

This emergency rule removes the 2017 southern windowpane flounder accountability measures for non-groundfish trawl vessels that were triggered as a result of a 2015 quota overage. The rule is necessary because new information indicates 2016 catch did not exceed the quota. This rule is intended to mitigate negative economic impacts to non-groundfish vessels, while maintaining conservation benefits for the southern windowpane flounder stock.

Office, Greater Atlantic Regional Fisheries (2017, 2017-10-11). "FY 2017 Groundfish Landing/Possession Limits; Common Pool Fishery : Greater Atlantic Regional Fisheries Office." 2018, retrieved from https://www.greateratlantic.fisheries.noaa.gov/regs/infodocs/multipossessionlimitsnarrow.html.

From NMFS Greater Atlantic Regional Fisheries, a chart of groundfish landing/possession limits. Notably, the possession of windowpane in any amount is absolutely prohibited. The regulations described can be found at 50 CFR 648.82, 648.83, 648.85, 648.86, and 648.88.

Chute, T. (2017). Gulf of Maine-Georges Bank windowpane flounder. U. S. Dept. of Commerce. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016.: 174-182. Retrieved from https://www.nefsc.noaa.gov/publications/crd/crd1717/gom_gb_windowpane_flounder.pdf

Based on this updated assessment, the Gulf of Maine - Georges Bank windowpane flounder (Scophthalmus aquosus) stock is overfished but overfishing is not occurring (Figures 78-79). Retrospective adjustments were not made to the model results. The mean NEFSC fall bottom trawl survey index from years 2014, 2015 and 2016 (a 3-year moving average is used as a biomass index) was 0.359 kg/tow which is lower than the BT hreshold of 1.030 kg/tow. The 2016 relative fishing mortality was estimated to be 0.222 kt per kg/tow which is lower than the FMSY proxy of 0.340 kt per kg/tow.

Chute, T. (2017). Southern New England - mid-Atlantic windowpane flounder. U. S. Dept. of Commerce. Operational Assessment of 19 Northeast Groundfish Stocks, Updated Through 2016.: 183-191. Retrieved from https://www.nefsc.noaa.gov/groundfish/operational-assessments-2015/Reports/2015_FLW_SNEMA_OPERATIONAL_ASSESSMENT_REPORT_2015_09_03_143753.pdf

Based on this updated assessment, the southern New England - mid-Atlantic windowpane flounder (Scophthalmus aquosus) stock is not overfished and overfishing is not occurring (Figures 82-83). Retrospective adjustments were not made to the model results. The mean NEFSC fall bottom trawl survey index from years 2014, 2015, and 2016 (a 3-year moving average is used as a biomass index) was 0.329 (kg/tow) which is higher than the BT hreshold of 0.126 (kg/tow). The 2016 relative fishing mortality was estimated to be 1.733 (kt per kg/tow) which is lower than the FMSY proxy of 1.918 (kt per kg/tow).

Hendrickson, L. (2006, December 2006). "Windowpane flounder (Scophthalmus aquosus)." Status of Fishery Resources off the Northeastern US 2018, retrieved from https://www.nefsc.noaa.gov/sos/spsyn/fldrs/window/.

This is a webpage from NEFSC describing the biological and fishery information on windowpane flounder, current in December 2006, when the page was last updated. Hendrickson describes the fishery status of both northern and southern stocks of windowpane.

Oviatt, C., et al. (2003). "A Century of Fishing and Fish Fluctuations in Narragansett Bay." *Reviews in Fisheries Science* 11(3): 221-242. https://doi.org/10.1080/10641260390244413

Fish and shellfish abundance for Narragansett Day and coastal Rhode Island waters from landing data and surveys were compared over the past century using the originally abundant species. The first quantitative data became available in the late 1800s as conflicts developed between the hook-and-line fishermen and the fish trap fishermen with the hook-and-line fishermen claiming a reduction in the availability of fish. Subsequent data were available from the state of Rhode Island

and National Marine Fisheries Service landing data, and from the Graduate School of Oceanography and Rhode Island Department of Environmental Management surveys. In the early records, several anadromous fish species were abundant which are no longer abundant or not reported in recent surveys such as alewife, shad, and smelt. Changes in shellfish include the disappearance of soft-shell clam, cultured oyster, and scallop and a replacement by quahog although the landing of quahog is recently down. Lobster was abundant in the early record and has increased in abundance in the recent records. Several species of fish that once dominated the catch have decreased. Boreal species like winter flounder have decreased with increasing water temperature over the past 30 years. Migratory fish like menhaden and food fish like scup have decreased to low levels in the late 1900s compared to the 1800s. Predictions of fish yield from primary production indicate that migratory populations sustained the fishery in the late 1800s but in the late 1900s these populations no longer exist to sustain such a fishery. Survey data indicate these waters without fish have become prime habitat for crabs and lobsters.

Section IV: Management

Office, Greater Atlantic Regional Fisheries (2017). NOAA Fisheries Removes the Southern Windowpane Flounder AMs for all Trawl Vessel : Greater Atlantic Regional Fisheries Office. A. Szumylo, NOAA Fisheries, Greater Atlantic Region. Retrieved from https://www.greateratlantic.fisheries.noaa.gov/mediacenter/2017/08/31_noaa_fisheries_removes_the_southern_windowpane_flounder_ams_for_all_trawl_vessel.html

Effective tomorrow, September 1, 2017, until February 28, 2018, non-groundfish trawl vessels fishing with a codend mesh size of 5 inches or greater are no longer required to use approved selective trawl gear (haddock separator trawl, rope separator trawl, or Ruhle trawl) in the large southern windowpane flounder Accountability Measure (AM) areas. For more information, read the permit holder bulletin and the emergency rule as filed in the Federal Register. Through a previous action, groundfish vessels may also fish in the AM areas without selective gear, effective September 1 2017 through April 30, 2018. While we were able to remove the accountability measures for the groundfish vessels through existing regulatory processes, an emergency rule was required to remove the accountability measures for non-groundfish trawl vessels. This emergency rule is intended to minimize economic harm to the fluke and scup fisheries.

Peros, J. M., et al. (2014). Addressing Bycatch in New England's Groundfish Sectors: The Development of a Fishing Area Selectivity Tool. *29th Lowell Wakefield Fisheries Symposium, Anchorage, AK,* Alaska Sea Grant, University of Alaska Fairbanks. http://doi.org/10.4027/fbgics.2015.10

A lack of real-time data on which to base fishing behavior has significant implications for avoiding bycatch in New England's groundfish fishery. Groundfish sectors-fishing cooperatives created through a transition to catch share management-are subject to time lags in management decisions on bycatch as information is gathered and analyzed. Through support from the NOAA Fisheries Northeast Cooperative Research Program, the Gulf of Maine Research Institute has developed a near real-time spatial/temporal fishing area selectivity tool (FAST) in partnership with the groundfish industry. The project has developed a web-based data portal and mapping tool that enables industry-led bycatch avoidance efforts outside of the regulatory process for harbor

porpoise, Atlantic halibut, and windowpane flounder. The tool allows near real-time catch data to be presented with historical catch data, oceanographic information, and management information. The initial project focus in 2010, of providing fishermen with a tool to share individual catch data with other fishermen in order to target allocated species and avoid others, was met with resistance. Initial allocations varied widely among fishermen-and one boat's target species was another's "choke" stock. Many lessons were learned, and the project focus shifted to reduce bycatch on species the entire fleet has a vested interest in avoiding. In New England, bycatch can lead to time/area closures of prime fishing grounds and gear restrictions, severely restricting the fishing industry's ability to fully access the annual catch limits (ACL) of allocated stocks. Work is ongoing, and our fleet-wide approach brings new opportunities and challenges to bycatch avoidance.

Somers, B. A. and I. University of Rhode (2011). Reducing the capture of flatfish in small mesh bottom trawls using a recessed sweep 30.5 cm (12 in.) drop chain configuration, University of Rhode Island. Retrieved from http://digitalcommons.uri.edu/dissertations/AAI1497493

Several species of flatfish in the Southern New England (SNE) area have been assessed as overfished and in need of rebuilding. These species have some common characteristics in terms of life history patterns, use of habitat, and distribution. Many are targeted species in directed fisheries; others are bycatch/discard species, especially in the small mesh fishery in SNE for squid, (Loligo pealeii), butterfish (Peprilus triacanthus) and scup (Stenotomus chrysops); these species include summer (Paralichthys dentatus), winter (Pseudopleuronectes americanus), yellowtail (Limanda ferruginea) and windowpane (Scophthalmus aquosus) flounders. As a result, there is a need to find gear solutions to prevent capture. A modified fishing net (MFN) was designed using a standard bottom trawl squid net with the addition of 30.5 cm (12 inch) extensions to the headrope and a 30.5 cm (12 inch) drop chain between the sweep and the footrope. It was tested on its ability to reduce the capture of flatfish by creating a space between the sweep and the footrope… The findings of this research indicate the 30.5 cm (12 in.) drop chain trawl net design has the ability to reduce the capture of flatfish while retaining target species in the small mesh fishery of Southern New England.

Palmer, M. C. and S. E. Wigley (2007). Validating the stock apportionment of commercial fisheries landings using positional data from Vessel Monitoring Systems (VMS). N. F. S. Center, National Marine Fisheries Service (NMFS). Retrieved from https://repository.library.noaa.gov/view/noaa/3529/noaa_DS1_3529.pdf

Vessel Monitoring System (VMS) positional data from northeast United States fisheries were used to validate the statistical area fished and stock allocation of commercial landings derived from mandatory Vessel Trip Reports (VTR). A gear-specific speed algorithm was applied to 2004-2006 VMS data from the otter trawl, scallop dredge, sink gillnet, and benthic longline fisheries to estimate the location of fishing activity. Estimated fishing locations were used to allocate the landings of 8 federally managed species to stock areas: Atlantic cod (Gadus morhua), haddock (Melanogrammus aeglefinus), yellowtail flounder (Limanda ferruginea), winter flounder (Pseudopleuronectes americanus), windowpane flounder (Scophthalmus aquosus), goosefish (Lophius americanus), silver hake (Merluccius bilinearis), and red hake (Urophycis chuss). Haul location and catch data from the Northeast Fisheries Observer Program (NEFOP) were used to assess the relative accuracy of both VMS and VTR allocation methods.

DeAlteris, J. T., et al. (2006). "Trends in Fish Abundance in Mount Hope Bay: Is the Brayton Point Power Station Affecting Fish Stocks?" *Northeastern Naturalist* 13(Special Issue 4): 95-116. Retrieved from http://www.jstor.org/stable/4130974

Trends in abundance for winter flounder (Pseudopleuronectes americanus), windowpane (Scophthalmus aquosus), hogchoker (Trinectes maculatus), tautog (Tautoga onitis), and scup (Stenotomus chrysops) in upper and lower Mount Hope Bay were compared to trends in Narragansett Bay to assess the effect of natural and anthropogenic stressors, including Brayton Point Power Station, on Mount Hope Bay fishes from 1972 to 2001… Analysis of covariance and Tukey-Kramer multiple comparison tests were used to evaluate differences in the slopes of transformed abundance indices from 1972-2001 and for two subsets of years, 1972 to 1985 and 1986 to 2001, periods of lower and higher power plant cooling water withdrawals, respectively. Trends in abundance of these species in both upper and lower Mount Hope Bay are not substantively different from those in Narragansett Bay during any of the three time periods evaluated. This is evident through either a high-level visual inspection of the slopes measured for each species, time period, and area or a more detailed inspection of the analysis of covariance results and Tukey-Kramer confidence intervals associated with each slope estimate. Natural and anthropogenic stressors unique to Mount Hope Bay, including Brayton Point Station, have not caused Mount Hope Bay fish stocks to change at rates different from those observed for the same stocks in Narragansett Bay. This supports the conclusion that large-scale factors such as overfishing, climate change, and increased predator abundance are more likely to be the cause of the observed declines in important species such as winter flounder in Mount Hope Bay and Narragansett Bay.