A Winter Flounder Habitat Index for Connecticut

Blackback Flounder and Oyster Habitat Associations: A Historical Perspective

By Wayne Castonguay and Timothy C. Visel

The University of Connecticut Sea Grant College Program 1988

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"The areas of study we propose have been researched by others in response to a special problem (mitigation for example) or were mainly concerned with a single species (Bousfield, 1969). Studies have been conducted on the oyster community by Korringa (1951) and also Hedgpeth (1953) both of whom give a comprehensive description of oyster associations. In a 1957 paper, Hedgpeth asserts that oyster reefs (beds) are the most significant aggregations in estuaries since they are a major factor governing patterns of sedimentation and, at the same time, provide habitats for a variety of smaller organisms.

In a study of the oyster community in Delaware, Maure et al (1973) provided strong evidence to support the premise that any increase in abundance is associated with a gradual increase in clean, hard shell substrate. MacKenzie (1983) reported that seed oyster beds occupy from 1 to 10 percent of the bottom area of estuaries and that these beds harbor much more algae and many more invertebrates and fish than the remaining bottom. Thus, MacKenzie concludes "rehabilitation of seed oyster beds produces an increase in the abundance of oysters and associated species."[1.]

[1.] Excerpted from a Research Proposal to the Connecticut Sea Grant Program, Edward C. Monahan, Director. Titled: Response of Macro-Organisms to Restoration of Degraded Tidal Salt Marsh Habitats. Submitted May 18, 1987 by John S. Barclay, Principal Investigator, Department of Renewable Natural Resources, UCONN; Robert B. Whitlatch, Associate Investigator, Department of Marine Sciences, UCONN; Timothy C. Visel, Associate Investigator, Sea Grant Marine Advisory Program, UCONN. Amount requested (2 years): $96,000. Funding Interval: July 1, 1988 to June 30, 1990.

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A Winter Flounder Habitat Index for Connecticut Blackback Flounder and Oyster Habitat Associations: An Historical Perspective

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A Winter Flounder Habitat Index - Wayne Castonguay

Abstract

Young winter flounder, Connecticut's most important salt water finfish, spend the first year of their lives in our shallow estuaries, coves and rivers. Within these areas, they seem to prefer very shallow water (less than four feet), with a flat, hard, and clean bottom protected by waves and currents. It is not clear why they prefer these particular areas, but young flounder will rarely be found within marsh creeks or in areas with mud, rock, or algae.

Each cove and estuary along the Connecticut shoreline from Pawcatuck to Fairfield, and in Greenwich was examined and evaluated for juvenile winter flounder habitat in 1986 and 1987. Very productive areas were found to be near the mouth of the Pawcatuck, Poquonnock, Niantic, and Connecticut Rivers and in Jordan, Morris, and Greenwich Coves.

However, the majority of our estuaries were found to have little or no young flounder habitat. It is obvious that many of these areas once had suitable habitat, but are now unavailable to young flounder due to filling, dredging, and build-up of fine silt and mud. In addition, literally hundreds of acres of otherwise good flounder habitat were covered with sea lettuce, Ulva lactua, which has been found to kill juvenile winter flounder in the laboratory. These algae, which thrive in polluted areas, were especially abundant in the Clinton, Branford, New Haven, and Bridgeport harbors.

There has been a lot of recent discussion about declines in winter flounder abundance. Based on these observations, any serious inquiries into the declines should take into consideration what is being done to our estuaries and how it is affecting juvenile winter flounder habitat.

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Winter Flounder Habitat Index
By Wayne Castonguay

Before describing each area, I'd like to summarize what I have seen and read pertaining to YOY flounder habitat. I have references for everything stated here.

Simply put, O+ WFL is extremely habitat specific. In general, the YOY prefer very shallow ((6' - 12' best), low energy, flat, clean areas. Highest densities seem to be found on sand or sand-mud flats with low to moderate tidal amplitude near the opening of an estuary; usually behind a barrier beach or sand spit. O+ are found in these areas because they require salinities below 25o/oo (15-20 preferred), their high degree of photo taxis, and their obvious lack of strong swimming ability. It is not clear why they prefer a hard, sandy or sandy-mud bottom, but presumably it has to do with food habits sand an inability to deal with a soft, muddy substrate (which may interfere with respiration, ion-osmoregulation, or sighting food). The young of the year will remain extremely localized (e.g. the same flat) until the cold of winter drives them into deeper areas in or near the estuary. They will tend to remain in these deeper areas throughout their 1+ year because of a photonegative responses and a continued preference for low salinities. The evolutionary "driving force" behind these adaptations seems to reduce interspecific competition. Since it also prefers low salinities and inhabits inshore areas as well, these adaptations would serve to separate age groups.

Obviously, there are no absolutes when dealing with this species. For example, a few 0+ can be found on mud, shell, gravel, or outside of estuaries (in L.I.S.). However, these areas must be protected, shallow, and flat as well. Hence these three requirements are obviously the most important. But since densities are many, many, many times greater in the preferred habitat, the other areas are more than likely comparably insignificant producers (in a given estuary area). The big problem here is what if an area doesn't have an area of "good looking" habitat, e.g., the majority of the area between Branford and Saybrook? My impression thus far is that theses areas aren't significant producers, although a closer look would be the only way to be sure.

If an area meets the requirements of the fish, that area may hold flounder - other factors could determine if the fish will actually be there. However, from what I have seen, an identifiable "flounder spot" usually has fish. At this point, I am confident areas that aren't at least shallow, flat and protected will hold any flounder whatsoever. In addition, areas that do not have a hard, clean bottom can be considered insignificant. I would recommend searching a given area (first with a map then visually) for potential habitat, and quantifying that while ignoring other habitat. To determine how productive the area is, would require sampling of the potential habitat, at least initially. This sounds like a lot of work, but very little potential habitat usually exists within an estuary.

Poquonnock River

I have covered every inch of this estuary and believe it to be a very large producer of flounder-potentially the largest of my sites. Proportionately, much of the bottom (up to 40%) ranges from good to excellent habitat. The entire lower third of the river is flat, firm, shallow, with a maximum 2' tide. The entire flat inside Bush Point beach is a high-density area. In addition, the west side of the river from the park's parking lot to the mouth has moderate densities. The upper and middle-east side of the river is muddy or deep and is insignificant flounder habitat. All potential habitat is seinable. I am currently sampling behind the beach near the outflow of the salt pond. Access via dirt road to within 100' of the lower river high density area is possible with DEP permission-

otherwise, a 2-3 mile walk from the parking lot is necessary. I am currently taking a boat across from Project Oceanology. 1+ blackfish have been captured in the deeper areas, otherwise just the “usuals” (usuals from here on refer to mummi’s, killi’s, pipefish, stickleback’s, tomcod, and silversides).

Jordan Cove

Although one area of this estuary is extremely productive, I feel this area is only a moderate producer overall (for it’s size). The entire cove beyond the bridge has been examined closely. Much of the western half of the cove outside the bridge is sandflat, while the eastern half is silty mud. Flounder inhabit only the western half of the cove. In this part of the cove, the only high-density area is within the tide pool just east of the entrance channel and inside the sand spit (a sandbottom area 75’ X 10’ - closed off at low tide). Otherwise, a few fish are scattered on the sand and mud flats near the entrance, but are limited in habitat by heavy channelization and currents through and over the flats. The pool is the only easily seinable area. Just the usually species have been caught. Access to the pool is a short walk along the beach (that creates the cove) from a road just south of the boat launch on Dock Road.

Griswold Point

The sand flat behind the barrier beach at Griswold Point has, by far, the highest density of my sites (probably the state and even the world!) I have only examined the area near the outflow of the pond behind the beach, but expect similar densities to be found along the approximate mile stretch to the CT River. If this is so, this would probably make this area one of the major producer’s in the state. This stretch is entirely seinable. The shoreline across the channel and within the marsh further up the Black Hall could also be important, but has not been looked at, although areas within marshes (i.3. rivers and creeks) are usually uninhabited by YOY flounder. Besides the usually species, the deeper water at the edge of my site is loaded with 1+ flounder, as well as small fluke (approx. 150mm in June and July). Access is a 2-mile walk from the Old Lyme town beach (Hawk’s Nest).

Clinton Harbor

The majority of the harbor (from the point the Hammonasset River turns into the harbor area, to the sand flats at the outer harbor) has been examined closely. The large spring recreational. fishery here suggests the harbor is a major spawning area. Although several areas appears to be good to excellent habitat, YOY flounder have been found only at the area adjacent to the south side of Clinton town beach. This area is quite unique when compared to my other sites. This area is a very shallow ((1’ at low tide), sandy-mud eelgrass bed. Although the density of fish here is moderate at best, the most fish seem to be along the edge of the eel grass. Other species include the usuals and an occasional small fluke. Access is a 200’ walk from the beach lot. The habitat, but has been found to be nearly devoid of fish. I suspect there is too much wave and current action at high tide. On the other hand, the entire north shore inner harbor area is either marina or shallow “black mayonnaise” - hence also devoid of flounder. Otherwise, the North Shore of Cedar Island, a 3/4 mile sand/gravel flat is typical of other highly productive areas. However, sampling has turned up nothing (except a clogged net!). I am convinced the worst-ever algae bloom; currently clogging the entire harbor (except Clinton beach) has killed or driven the flounder out of this area. I’m confident this particular area is important in non-bloom years. Access to Cedar Island is a 2 -mile walk from Hammonasset.

New Haven Harbor - Morris Cove

Nearly every area within the harbor and its two tributaries (that I would consider potential YOY habitat) has been examined. As a result, I feel the New Haven harbor is a minor producer for an area of that size. Although many acres of bottom appear very promising, substantial numbers of flounder (2 per haul) have only been located within Morris Cove. These highly promising areas include both sides of a mile long spit jutting out from the new sewage plant, much of the western shoreline, and the area between the power plant and coast guard station. Other (less promising areas) examined include the area between Long Wharf and the old sewage plant, the West River and within the Quinnipiac. All of these areas are covered with Ulva and may explain the lack of fish (Ulva has been found to kill juv. Wfl in the lab). On the other hand, Morris Cove is relatively free of Ulva. Moderate densities may be found

along the southern beachfront nearest the New Haven Yacht Club. The remainder of the cove is an otherwise low-density area, probably because it's unprotected from the prevailing winds. Since this site is a beachfront, several species other than the usuals have been seen. These include YOY blackfish, fluke, spot, snappers, and 1+ flounder. Access via a beach maintenance entrance just before the yacht club to within 100' of the sample area.

Lewis gut

The entire south shore of the gut - from the Stratford town beach to the bridge in Bridgeport has been sampled. While the extreme eastern end is soft and muddy, the substrate is progressively harder and sandier towards the bridge. Potential flounder habitat extends from about 1/2 the length of this shoreline (about 3/4 mile). However, the only areas to produce (moderate densities) seems to be the sandy stretch nearest the pilings. This is the only area lacking massive beds of Ulva on the substrate - I can't help but think the Ulva is responsible for the lack of fish in the other areas. Since the fish are found in decent numbers in areas without Ulva, I feel this area would be much more important without the algae. Access to this area is the road leading to the houses from Pleasure Beach Park. Several areas on the opposite (north)(shore of the gut also appear promising, although access may be a problem. In addition to the usuals, substantial amounts of 1+ wfl and small fluke (150mm) were caught in June.

Greenwich - Greenwich Point Park

This site is a sandy "basin" just north of the bell tower at the northwestern corner of the park. The basin is formed by an island and blue mussel beds adjacent to the point. Densities are moderate. Seining is possible only on the island side of the basin. The sandy-shell shallow area just west of the mussel beds is also fairly productive habitat. Flounder were not found in other areas within the park. Access (only at low tide) is a 100' walk from the small parking lot at the bell tower. This particular area also seems to be important 1+ wfl and bkf habitat. Although the only areas sampled were within the park, the overall Greenwich - Captains Harbor area is probably an important nursery area. Large expanses are protected, sandy, shallow and flat. There is also a surprising lack of macro algae in this area.

Comments on other areas

Stonington - The entire shoreline of Fisher's Island sound from the state line to the mouth of the Mystic River is important habitat. This area is characterized by shallow, sandy areas protected by large rocks, eelgrass beds, and small enclaves in the otherwise bedrock shoreline. The inlet's and coves of this area, especially Little Narraganset Bay, Quaumbog Cove and the Mystic River have large areas of nursery habitat.

New London - Obviously, the Thames River must produce a lot of fish. However, the location of nursery areas is difficult to pinpoint. The several private beaches along the west side of the river along Pequot Avenue are good candidates. Some YOY flounder have also been found in the sandy areas just inside the entrance to Alewife Cove.

Connecticut River - The Lieutenant River, South Cove and the west ban of the river was sampled with the shad trawl in 1986. All of these areas have a soft bottom and are likely insignificant nursery areas (very few YOY were caught and only at the west bank site), young fluke, on the other hand (20 mm) were common in these areas. I suspect the majority of nursery habitat within the river is south of the railroad bridge since many years of sampling at an otherwise good location just upstream of the 95 bridge has never turned up a YOY flounder. The flats along the eastern shoreline south of the railroad bridge may be a nursery area.

Saybrook to New Haven - The Oyster River, Westbrook harbor, creeks at Webster Point and Seaview Beach (Madison), East River at Grass Island, Joshua Cove and Morris Creek have been looked at. I feel these areas are unimportant, even as a whole, since each of these areas contains little, if any identifiable nursery habitat. The sandy area outside of the Mud creek (Saybrook) and Branford harbor offers the best potential outside of Clinton Harbor in this section of the state, although neither area has been looked at.

Fairfield/Bridgeport - Although it hasn't been looked at, the area off Fairfield Beach and along the sand spit to Penfield Reef is more than likely a major nursery area. It is characterized by many acres of shallow sand, well protected from the prevailing winds by the spit and rocks

near Penfield reef. Very high densities of it have been documented by the lobster crew just offshore of this area.

BLACKBACK FLOUNDER AND OYSTER HABITAT ASSOCIATIONS, A HISTORICAL PERSPECTIVE

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For over a century, Connecticut, Rhode Island and New York oyster growers cleaned, shelled and modified bottom habitat to support shellfish aquaculture, especially for the eastern oyster. Aquacultural practices included shell base (cultch) planting, recultivation schedules and transplanting of seed shellfish. Commercial oyster growers soon noticed increases in flounder on or near recently prepared and shelled areas indicating a habitat association or preference. Adult and pre-spawned flounder were also observed to seek out mature oyster beds. The oyster industry in New England developed quickly in winter from 1870 to 1910. This period marked large acreages of planted and prepared oyster bottom, cultivation and harvest from near shore natural oyster beds and seed oystering from tidal rivers. Much later, a second although much smaller increase in oystering activity occurred in Connecticut between 1975 and 1990.

Two specific time periods are examined for oyster production and increases in flounder landing (catch statistics) for 1890 to 1920 and young of the year recruitment for 1985 to 1998. Both time periods appear to show increases in oyster cultivation followed by increases in flounder. The role of oyster culture and habitat enhancement for the oyster reef community is also discussed.

Introduction

The decline of Black Back Flounder pseudopleuronectes americanus in Connecticut has been reviewed for nearly three decades. Auster (1980) detailed high incidences of fin rot in New Haven Harbor flounder. This was followed by research on egg viability (Pereira, et al, 1994) and spawning area (Pereira, et al, 1994), and in 1999 distribution of flounder by Habitat type (Howell, et al, 1999). A series of winter flounder seminars, hosted by the National Marine Fisheries Service for nearly two decades, invited papers on a wide range of topics – key to gathering a complete picture of what was impacting our winter flounder populations here in Connecticut.

My interest in black back flounder dates back to 1972. I was very fortunate to meet with and discuss oyster aquaculture with J. R. Nelson, retired president of Long Island Oyster Farms which operated out of New Haven Harbor. Mr. Nelson was part of a family of famous oyster biologists that included Thurlow Nelson and Julius Nelson. What

caused the meeting was my request for employment. While I did not obtain a job, he did arrange for a few trips aboard the Quinnipiac, a hydraulic dredge boat for removing drills Urosaphinx cinera and starfish Asterias forbesi from lot 151, a very productive seed oyster recruitment area in New Haven Harbor. The experience would guide my interest in flounder/oyster habitat associations from then on.

The Quinnipiac was a rectangular steel powered barge. It purpose was to clean, by hydraulic, section material from the seed oyster beds. A dredge head was utilized and any light objects (shells, oysters drills, starfish, crabs, etc.) would come up, be dewatered and transported by convey or belt to the center deck. About every 20 minutes, a pail of hydrated lime water was dumped over the pile to kill the starfish and drills. Eventually that would become part of my "job." The following morning, we would steam outside the New Haven Breaker and dump the pile away from any oyster beds.

During my brief tour as a deckhand, I observed what came up in the dredge material and that included all sizes of flounder but mostly juvenile flounder. I was sensitive to this, having purchased a 30-foot Wilcox flat otter trawl to catch flounder off Madison – the town in which Mr. Nelson and I both lived. Otter trawling involved towing a net over sandy bottom to catch them. In the process, all the undersized small flounder were released alive and large ones iced for market. Seeing hundreds of small ones in the pile and liming them became a topic of discussion during the follow-up visit. (I had a series of trips aboard production and starfish boats as well and a second series on the same vessels during graduate school research while attending the University of Rhode Island.)

Mr. Nelson acknowledged the problem but countered that the oyster industry had provided the habitat in which they thrived, "We built the homes and they moved in." He then continued with a description of flounder seeking out the habitat to spawn and grow. He felt the oyster shells provided both cover and a source of food. All the oyster growers knew about this habitat relationship. Mr. Nelson was sensitive to this issue and stated that when the small flounders were most prevalent, – especially after a good oyster set in the fall he would not use the Quinnipiac but sent in the "mop" boats to control starfish instead. My observations and Mr. Nelson's comments about "home

building” would begin an investigation that continues today did we or the oyster industry provide the homes for enhanced flounder harvests and was an oyster shell environment a positive indicator for flounder habitat, especially if related to a predator/prey relationship so often mentioned by Mr. Nelson?

He also reviewed some of the habitat history. As more shell (cultch) was put out, more flounder arrived, and flounder in general became more prevalent in New Haven Harbor. Mr. Nelson also felt that New Haven Harbor flounder returned to New Haven Harbor to spawn, so the oyster industry considered them to be “home grown.” He doubted that such a huge flounder population could be sustained without the “cover” the oyster shell habitat the oyster industry had provided. He summarized by stating that what I saw on deck was just a fraction of what had been near the dredge head, most claimed swim away from the danger. He also felt that the neighboring states of Rhode Island and New York had similar situations. He commented that recreational flounder fishermen also realized this. He said several people he knew sought out and followed oyster dredge boats because that is were the big flounder would be. Mr. Nelson believed that the oyster industry provided a habitat in which flounder could live and escape most prey. Did flounder prefer shell bottoms or did the presence of this habitat favor the flounder? Was it possible that the fast rise of the Connecticut oyster industry created or enhanced increased flounder landings in the commercial fishery? These are some of the research questions that continue today.

Connecticut’s Second “Oyster Boomlet”

1972 to 1995

In 1968, the National Marine Fisheries Service applied for emergency resource disaster funding for the Connecticut Oyster Industry. Connecticut had not experienced a strong state–wide natural oyster set for a decade (1958-68). Underwater observations conducted by Clyde MacKenzie, a biologist at the NMFS Milford laboratory showed most of the oyster shell base upon which oysters could set was covered by silt or sediment. The resource disaster funding provided for the cleaning and re-shelling of 25 locations along Connecticut's coast. Spawner oysters also were transplanted to each location. Concurrently, the State of Connecticut lifted a century-old ban on hand-dredging changing from tongs to hand hauled "seed oyster dredges." A pressure or wash plate was added to the traditional oyster dredge design. Nicknamed the "Mackenzie Plate," its function was to wash sediment and silt from long covered shell bases and lift oysters into the dredge. The effort worked well. From less than 10,000 bushels of tonged seed oysters in 1969, the Housatonic River would produce 120,000 bushels in 1974 using the modified hand dredges. Connecticut obtained its first strong oyster set in 1973 and additional river systems experienced strong sets in 1975, namely the Farm River, West River, East and Neck Rivers, and the Hammonasset River. Those areas started to produce significant quantities of seed oysters commencing in 1978-79. The Hammonasset would produce some 30 thousand bushels of set and seed oysters in 1978 alone.

By 1984, oyster sets were occurring regularly prompting the State Department of Agriculture-Aquaculture Division led by then Chief John Volk, to ask for and obtain state funding to re-shell portions of the states natural beds in western Connecticut. The Bridgeport natural bed was re-shelled and obtained a strong set. When these seed oysters grew, it was commented that they were the best quality oysters the State had seen in decades. By 1989, the State was producing close to 200,000 bushels of oyster seed and set from natural beds. The number of "natural growth harvesters" seed oyster fishermen also had increased from about 12 full and part-time fishermen to over 50. More areas opened to seed oystering (much of Connecticut's waters for direct harvests were closed from 1966 to 1971), and more shell base was cleaned and recultivated. The peak production year occurred in 1992 at close to one million bushels. The most recent lowest production year was 1972, at 32,468 bushels. It created a second, although much

smaller, “oyster boomlet” here in Connecticut as compared to the one at the turn of the century.

How did this second “oyster boomlet” impact flounder and flounder recruitment? If flounder prefer a mud/shell-littered habitat as confirmed by Howell” et al (1999), then it could be argued that an increase in juvenile flounder recruitment into the flounder fishery also could be anticipated.

More Questions Then Answers

Habitat Creation

Similar to returns of anadromous fish, how did the increase in a flounder spawning population eventually contribute to a combined spawning event created by exponentially larger numbers of healthy adults? Could this explain the explosive growth in Connecticut flounder landings between 1900 and 1930? As fish grew and then spawned along Connecticut’s coastline each year class could reinforce the spawning potential as thousands of newly created habitat acres (oyster aquaculture) was established as the oyster industry grew. If so, this is probably one of the largest case histories of habitat creation in recent times. If what Mr. Nelson felt was true and confirmed by other oyster growers, some fishing practices should be recognizable in the recreational or sports fishing sector. Did sports fishermen actively seek out oyster beds to catch flounder? Commercial trawling over oyster beds is not allowed so larger fish would be captured away from the commercial oyster beds.

Predator/Prey Relationships

Mr. Nelson mentioned “cover” or “homes” in his explanation of why flounder were so prevalent on seed oyster beds. We know that camouflage is critical to winter flounder. Did a shelling habitat assist in this relationship or was a shallow environment needed to escape deeper benthic predators that occupied a different ecological niche? If this niche degraded or was significantly reduced, did it

force flounder to live in areas where it would be subjected to new and potentially worse predator/prey relationships?

The Early Flounder Fisheries

Evidence insists that Native Americans set brush weirs for flounders here in Connecticut. Later, European settlers established a successful flounder fyke net fishery in the 1870's. By the turn of the century, multi-hooked tub trawl flounder hookline fisheries (described as large hook trawls) were in Niantic Bay and other rivers. Although catches were significant, they would become miniscule compared to the catch increase from 1900-1930 from otter (bottom) trawls. If the oyster shell habitat provided critical spawning grounds, did it fuel the large trawl fishery of the 1920's and 1930's from eastern Long Island and Block Island Sounds?

Habitat Preference or Index as Related to Recreational Fishing

Did the recreational or sport fishing sector seek out oyster habitat or shell bottoms for flounder fishing? That is the topic of my research at present. If what the oyster growers repeatedly claimed, then sports fishermen would seek them out to hook line fish over oyster beds? Could oyster shells determine biodiversity in some shallow water habitats? In 1987, an attempt was made to study macro fauna responses to oyster shells as proposed in the Dowd's Creek project, but this effort was not completed. Observations made by Wayne Castonguay at the time are available however in part of an uncompleted study. Work by Penny Howell, et al (1999), showed that in this later study, a mud/shell matrix had a higher habitat preference by juvenile flounder.

Methods

As both the Connecticut oyster industry and commercial flounder landings are currently severely depressed, I choose to review the historical catch statistics, and later winter flounder indices-at-age from 1984-2004, developed by the Connecticut Department of the Environmental Protection Bureau of Natural Resources, Marine Fisheries Division. If the species are habitat independent, no correlation in landings should exist. If anthropogenic conditions dictated fisheries health, then specific events should be

discernable, such as the impacts of spills or major anoxia. The use of landing statistics does present problems. The age of flounder recruitment into fishing landings has increased from management/regulatory changes. In addition, juvenile flounder was needlessly wasted as lobster bait as by-catch incidental to commercial fishing during the 1970's. Those fish never made it to be recorded as future landings. I utilized the fishery statistics of the U.S. for flounder landings and Connecticut commercial oyster landings (Blake, et al, 1984), DEP Marine Fisheries, and more recent production figures provided by the Connecticut Department of Agriculture, Aquaculture Division summarized by Holzmen (2005) and David Simpson of DEP marine fisheries provided commercial landings. Seed oyster production was from my own research. According to the CT Dept of Agriculture/Aquaculture, it no longer maintains data on seed oyster production.

Sources for Graphs

Sources for Flounder Landings

1) Study of Means to Revitalize the Connecticut Fisheries Industry pages 3/43 to 3/44 General Dynamics Electric Boat Division 1965.

2) A Marine Resources Management Plan for the State of Connecticut, Blake, et al DEP Marine Fisheries Program 1984 (Figure 11).

3) Landing Statistics Provided by Dave Simpson DEP Marine Fisheries 2006.

Sources for Winter Flounder Indices 1984-2004

1) A Study of Marine Recreational Fisheries In Connecticut - State of

Connecticut Dept of Environmental Protection Federal Aid in Sport Fish Restoration F-54-R-24 Annual Performance Report, March 1, 2004 – February 28, 2005, Pg 110.

Sources for Connecticut Oyster Production

1) A Management Plan for the State of Connecticut, Blake, et al DEP Marine Fisheries Program 1984 (figure 35).

2) Connecticut Oyster and Hard Clam Market Harvest Production 1990 to 2003 CT Dept of Agriculture Bureau of Aquaculture.

3) Connecticut Oyster Production – A review of the Connecticut oyster harvest Hoffman 2005 unpublished.

Source for Seed Oyster Production 1968 to 1988

Visel, T.C. (1988) Shellfish Management Procedures for Southern New England Towns. A Plan Prepared for the Town of Old Saybrook, Connecticut, Connecticut Sea Grant Program CT – SG–88-06 Edited by Margaret Van Patten, Groton, CT.

Other New England Examples

If what oyster growers in Connecticut experienced with oyster shell cultch and seed oysters beds, perhaps planted oyster grounds in Rhode Island and New York also may have been similarly impacted. Although not so extensive as Connecticut's oyster industry growth, sufficient acreage of planted oyster ground may have been locally significant in enhancing flounder populations. Information from New York and Rhode Island areas that had planted or cultivated oyster beds may provide additional confirmation regarding this resource question.

Summary

Blackback Flounder and Oyster Habitat Associations – A Historical Perspective

Two specific time periods are examined, the two periods that show rapid increases in oyster cultch shelling and riverine natural bed harvests: 1890's to 1920 and 1975 to 1990.

Oystermen would report increases in flounder on or near recently shelled areas. Other research indicates a preferred habitat association between oyster shells and juvenile flounder (Howell, et al, 1999). Reports from oyster growers also mention that large pre-spawning females would seek out oyster beds on which to spawn (Castonguay/Visel work in progress).

In 1986-88, the East River natural oyster bed was significantly restored for oyster setting (Journal of Shellfish Research (vd. 7pp 267-270). Dive Team reports from the University of Connecticut as well as under water video documentation showed juvenile winter flounder living among the oyster shells. This evidence was turned over to the US Army Corps of Engineers in 1988. Other river natural beds that were dredged may provide habitat study locations. Evidence of similar oyster shell habitat associations reported on created oyster beds in New York and Rhode Island also would help confirm this theory. Connecticut rivers natural oyster beds may have been an important habitat niche for winter flounder. The rapid growth of the oyster industry in Connecticut and the planting of thousands of bushels of oyster shells in harbors may have created an unprecedented habitat shift for the winter flounder. When the oyster industry collapsed, this habitat would cease to provide key elements of cover, protection and food. A decline in this habitat could also then be expected, reducing flounder recruitment into the commercial and recreational fishery.

Today, these in-shore environments have been subjected to wide ranges of negative constraints: pollution, loss of bottom, anoxia, eutrophication and most recently, warmer winter temperatures. Therefore, placing oyster shell in a eutrophic or anoxic environment will not necessarily bring the winter flounder back. It may have been the natural

oyster bed ecology in rivers that provided the original key flounder habitat. The rapid expansion of the oyster industry out of the river areas created additional winter flounder habitat. But in the length of only one century, this aberration of the ecology is perhaps an unprecented opportunity to review the impacts of such a large scale organized habitat creation effort.

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Tim Visel

References

MacKenzie, Jr.,C. L. (1970) Oyster Culture in Long Island Sound, 1966-1969. *Commercial Fisheries Review*, 27- 40.

MacKenzie, Jr., C.L. (1983) How to Increase Oyster Production. *Marine Fisheries Review*, 45 (3), 1-22.

Visel, T.C. (1988) Shellfish Management Procedures for Southern New England Towns. A Plan Prepared for the Town of Old Saybrook, Connecticut, Connecticut Sea Grant Program CT – SG–88-06 Edited by Margaret Van Patten, Groton, CT.

Volk, John, H. (1986) Farming Oysters In An Urban Sea Connecticut Department of Agriculture – Aquaculture Division Newsletter – 6 pages Milford, CT

A Study of Marine Recreational Fisheries In Connecticut (2005), State of Connecticut Department of Environmental Protection Bureau of Natural Resources Marine Fisheries In Connecticut.

Howell, Penelope, T. (1999) Juvenile Winter Flounder Distribution by Habitat Type Estuarine Research Federation pg 1090 1095- Vol. 22 #4.

Pereira, et al, (1994) Utilization of the Quinnipiac River and New Haven Harbor by Winter Flounder (Pleuronectes americanus) As A Spawning Area. Final Report National Marine Fisheries Service, Milford, CT.

Auster, Peter, J. (1980) Incidence of Fin Necrosis in Winter Flounder Pseudopleuronecties americanus (Walbaum) from New Haven Harbor, University of Connecticut Marine Research Laboratory, Noank, CT.

Pereira, et al, (1994) Utilization of the Quinnipiac River and New Haven Harbor As A Nursery Area by Winter Flounder (Pleuronecties americanus – Final Report National Marine Fisheries Service, Milford, CT

Associations of Flounder and Oyster Habitat

Timothy C. Visel, SGMAP/Cooperative Extension Service 1988

To begin, I was very fortunate to meet and talk with many oystermen including JR Nelson of Long Island Oyster Farms, George McNeil of McNeil Oyster Company, Clint Hammond on Cape Cod and Al Hufferton of Warren Oyster Company in Rhode Island. Included in my Sea Grant research were dozens of smaller oyster producers and seed oystermen (natural growers). My own experiences include some modest oyster culture and seed oystering here in Connecticut.

During my employment at three universities, I came to the conclusion that close habitat relationship exists between oyster natural/cultivated habitat and flounder populations. Not much is written about it however, Paul Galtsolf (1964, American Oyster) was the first to mention it; he did a large amount of fieldwork on the issue out of Woods Hole. It would be interesting to see flounder catch statistics against oyster production, say 1880 to 1960 for Connecticut and perhaps Rhode Island.

What I have found is that the statements are all so familiar that one could believe it is more than a coincidence and that both juvenile and adult flounder sought out this habitat. What I am not certain about is, did we create more flounder habitat by building more seed oyster beds? I have noticed flounder in the area when I seed oystered in the early 1970's. We would get large flounder in our seed oyster dredges while working in the East and Hammonasset Rivers. Some of the comments below are generalized but reflect the same association between flounder and oyster beds. Some video filming I did, with the Under Sea Research Program in the lower East River, did show many small flounder on planted oyster shell cultch but I left Sea Grant without a follow up study. Copies of the underwater dive reports and videos survey showing juvenile flounder returning to the East River shelled area were

submitted to the New England Office – Army Corps of Engineers.

Some Histories – Summarized Conversations

George McNeil – owner/operator, McNeil Oyster, New Haven and Clinton, CT (1970's)

1) New Haven - Oyster Beds (Private)
We used to get about 5 to 10 bushel of adult flounder each day in the dredges. They were large and given to the crew; spring started showing in New Haven the first or second week of March, then by fall, we would see small ones. People would fish (with poles) when we dredged;we would see them catch flounder, and sometimes we had to chase them off because they were in the way of our boats.

2) Clinton (McNeil) – continued 1980's
Located business to the mouth of the Indian/Hammonasset River, Clinton Harbor - clean water. George told me the "Indian" river supported a fyke net fishery for flounder - very large. Over the natural oyster beds in the Indian River and harbor. People would spear flounder at low tide, always near the oyster beds. When we harvested oysters we always caught flounder in the dredges.

3) J. R. Nelson - Long Island Oyster Farm (1972 about) - We had a dredge boat for drills - called the Quinnipiac - suction dredges to pick up drills and starfish - flounder became a problem, also window (pane) flounder, crew kept them (to eat) small ones just got buried in the pile of starfish and lime water (the lime water would kill the starfish). Some days we would get hundreds of flounder, some much more off the seeds beds. Sometimes so much we just moved off it for awhile so as not to kill them (small flounders).

4) Albert Hufferton - Warren Oyster Co. (1980)
When the Connecticut oyster companies started planting seed oysters, the flounder came. The bottom was often soft, sticky - you couldn't stand in it but the companies in Wickford hardened the bottom with shell - then the oysters on top. Wow we had flounder! I mean in places - no fish, we had fish! (Flounder) lot's of small ones also - sometimes so thick we would catch them in the dredges.

5) Anthony Ronzo - Old Saybrook, CT (1982)

Note Seagrant Oyster River restoration project - cleaned three feet of black mayonnaise off oyster shell base - put down clean clutch. Comments of an Oyster River neighbor - Almost immediately I started catching flounder again where you cleaned, the bottom was shells and small oysters. The last time we caught flounder here was when I fished after the war (WWII) we used to catch flounders on the oyster tongs when we tonged oysters in the river - you could feel them when the tines hit them. If you kept the tongs closed you could spear them, sometimes we caught more flounder than oysters.

6) Clint Hammond Oyster River Chatham Mass 1982
We purchased seed oysters (bedding stock) from Connecticut to plant. We cleared the bottom and planted the seed. This soon became a problem people started flounder fishing over the bed and dragging oysters with anchors. They would make a mess of the oyster bed with anchors - we asked them to stop but they would say this is where they big flounder are - and they were right! The flounders were just over the bed, what could we do, we let them fish.

7) Charles Beebe - East River, Madison (1975)
The river to oystering has been closed for awhile - the oyster beds are covered with leaves and the flounder spot is gone. We used to catch big flounder by the railroad bridge on the oysters. We would rake up some oysters and then fish the spot - sometimes we would smash the oyster and chum them with the oysters pieces, some days we would catch a 12 or more big ones that way. We can't do that (catch oysters) because the river is closed. We used to catch flounders in our seed dredges but that was in 1960's. There hasn't been any river flounder up at the bridge since then.

8) Norm Bender, Sea Grant Education Project

Tim Visel Norwalk Harbor (1986)
Project Oceanology Cruise Micky Weiss Captain
Thaxter Tewksbury crew

We were trawling 30 foot Wilcox flat net on sand near the channel. After 10 minutes we would catch 30 to 40 small flounder 2 to 3 inches in length. Micky was doing some population study so we were trying to come up with some size ranges. I noticed one of Bloom's oyster boats and Dave Hopp was on board. I asked if we could tow close to

his seed bed - he called Hillard and said yes - it is was a short tow. We went inside of the bamboo oyster flags and made a four or five minute tow. The group started hauling - but we needed everyone - a big cod end, we finally got it in - all mostly small flounder 2 inches and up - 5 gallon pails at first but then started to throw as many as we could back overboard, I estimated 2,000 or more. We stopped measuring because it was just too much! Hillard (after) the boat returned asked that not to mention this - he had known that the seed beds had flounder in them - but even was amazed at how many.

9) Louis Bayer - Quiambaug Cove Stonington 1988

We used to catch flounder here by the barrels we have reports that fykes were used here. I used to catch them (flounder) here along time ago. But the bottom is muck the oysters are gone, the clams are gone, it's smells bad, and no flounder in the cove. I gave up trying. The bottom in front of me (home) is soft muck now it used to be shells and sand.

10) Mr. Manwaring Pattagansett River, East Lyme 1988

Tim, we used to fish here (his property abuts the river) and now it is all muck. People would haul seine flounder at night and spear them also - catch them on worms incoming tide. But the river is filled with muck - the oysters are buried. You can find the oyster bed its near the railroad causeway (the Pattagansett was once 1,800 foot wide) it's all muck there now - if you fall overboard you would know. That is where we could catch flounders, over the oysters but you can't do that anymore, I haven't seen a flounder here since the 1950's. It’s all soft muck over the oysters now.

11) Larry Malloy - Oyster Company New London 1988 - Thames River

We could catch oysters and flounder together, they would come in to spawn. I think the dredging released food - they were here alright sometimes 2 or 3 in each oyster dredge - big ones! The oyster bed was alive with flounder, and sometimes we could dredge shell (buried shell for

building a shell base) and get little ones. They were dead and we could watch the sea gulls get them when they went over.

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