

**AN OYSTER BED RESTORATION PROGRAM FOR THE EAST RIVER
TOWN OF GUILFORD, CONNECTICUT**

MITIGATION OF DREDGING IMPACTS
TO OYSTER POPULATIONS

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Abstract: Maintenance and extensive dredging in coastal areas along the Northeast and Mid-Atlantic coasts have altered the population dynamics of oysters. In most instances, oyster production has been reduced by removing shell bases and reefs upon which spat could set. Mitigation of dredging impacts can be made through a variety of re-shelling programs. For example, in Guilford, Connecticut, periodic maintenance dredging since 1957 continues to increase mortality of seed oysters and removes the shell base upon which seed oysters set. In 1983, plans for increased dredging were questioned by the newly formed Guilford Shellfish Commission as well as local oystermen. In 1984, taking into account the Army Corps dredging schedule and emplacement of private moorings, the Shellfish Commission acted upon a Sea Grant proposal and made an agreement with a local oyster company to manage oyster bed restoration in this area. The oyster company was required to maintain the depth of the channel by cultivating and removing oysters with oyster dredges. Eight thousand bushels of crushed oyster and clamshell were planted in 1985 to form a shell base. In July 1986, 8,000 bushels of shell were planted over the shell base, which obtained a set of 0-year oysters. A harvest of several thousand bushels of seed oysters is anticipated in 1987. Mitigation agreements which are small in scale and do not interfere with other coastal activities can be expanded to improve oyster resources.

The earliest settlers of New England found vast "natural beds" of oysters, which became a stable and reliable food for many shore communities.¹ These natural beds have also been described by Ingersoll² and Brooks.³ In Connecticut, the natural oyster beds were

located in or near river mouths. Often these beds flourished in this brackish environment protected from the severe effects of full salinity predators such as the starfish. Initially valued as a source of winter sustenance, these settlements eventually depended upon coastal trade for economic survival. Thus, greater attention would soon be placed upon building wharfs and piers. Often it was precisely the same areas first utilized for fish and shellfish resources that were later developed for commercial wharfs. Research on specific changes in utilization of these estuarine areas indicated that a discussion of oyster ecology and its impacts upon navigation should be included. An example of this is the lower East River in Guilford, Connecticut. The East River contains a natural oyster bed that was dredged to create a mooring and anchorage area in 1957.

At the turn of the century, Connecticut's public natural oyster beds were important producers of seed and adult oysters, not only for itself, but also for neighboring states.⁴ The East River borders the towns of Guilford and Madison and is frequently mentioned in the historical literature, including a detailed description by George Goode.⁵ Depending upon recruitment of seed, local oystermen would tong 2,000 to 4,000 bushels of adult oysters in the 1930's. It was commonly stated that "Guilford oysters, taken from the channel of East River, are noted as among the best in Connecticut. In this paper, I report on a study in which a natural oyster bed in the East River continues to reseed itself and in which procedures have been adopted to mitigate damage caused by navigation projects.

Study Site

The East River is located in the eastern part of the Town of Guilford, Connecticut. Formerly known as the "Kattawo" by local Native Americans, the East River today forms much of the boundary between Guilford and the western edge of Madison. The East River is inter-tidal and communicates freely with Long Island Sound around a barrier spit called "Grass Island," also in the Town of Guilford. Its drainage lies

mainly to the north and west, consisting of salt marsh, bogs and wetlands. The East River also receives fresh water from the Neck River to the east and from a small tidal creek to the west. The mean tidal range at the mouth of the East River is about 5.4 feet. The river is tidal for approximately four miles upstream and a long sand bar at the river's mouth identifies it as an ebb channel. In 1940, a channel 6 to 12 feet deep and up to 100 feet wide was at the river's mouth.⁷ The East River salt marsh estuary is one of the largest estuaries in the State still remaining undisturbed. In 1957, 1,500 feet of the lower East River was dredged to create a mooring area 200 feet wide and six feet deep at mean low water. This mooring area has been maintenance dredged in 1964, 1974 and 1981.⁸

History of Oyster Fishery

During the last two centuries, the East River was a renowned source of oysters. The first regulation concerning the oyster fisheries was enacted by the Town of Guilford in December of 1753, requiring that no person shall export from the Town any oysters unless culled and "the dead shells upon which the young oysters grow' is thrown back into the River."⁹ In 1842, the Town of Guilford acted to protect these natural oyster beds from private grants of leases. In that year, the East River was declared a public fishery and all oysters laid down after March 1, 1842, unless brought from outside the State, should be free for the inhabitants.¹⁰ The Neck River in the Town of Madison was declared a public natural oyster bed on April 6, 1829.¹¹ The East River is mentioned as an important source of "spawners" in a program to restore the New Haven setting grounds.¹²

Robert Ketchale, former commercial oyster tonger and recent Chairman of the Guilford Shellfish Commission, recalled that 15 to 20 commercial oyster tongers worked in the East River in the middle 1930's.¹³ Catches averaged 10 to 15 bushels per day, bringing a price of \$2.50 to \$3.00 per bushel. By the late 1930's, oystering declined to only a few tongers due to the poor catches and relatively low price.

Oysters continued to be harvested by tongs in the 1950s producing one to four thousand bushels annually.¹⁴ A former oysterman, Mr. Nathan Walston, in a January 30, 1985 letter also states that he and his father, John Walston, tonged in the lower East River up to mid-1960 when the river became polluted.¹⁵ At that time, the East River was closed to oystering due to the high bacterial counts in the river and was no longer certified by the State Department of Health.¹⁶

Navigation Improvements

In an 1877 history of Guilford, the harbor is described at the mouth of the East River as one that "affords but an indifferent state for vessels, it has six feet of water on the bar at its entrance at low, and twelve feet at full tide."¹⁷ The earliest record of the existence of commercial wharfs and shipyards were at East River Bridge at the head of sloop navigation.¹⁸ These shipyards and wharfs prospered and served as an important trading center for coal, building materials and agriculture products.

The lack of good deep-water harbors has long been a concern to coastal communities, especially when marine transportation was critical to the well-being and prosperity of a community. This is the case with Guilford, and adequate harbor facilities have long been a concern to its residents. As early as 1810, efforts were made to improve the lower East River at its mouth.¹⁹ On April 9, 1810, the proprietors of Farmers Wharf were permitted to take gravel and make a wharf and causeway across salt marsh to the mouth of the East River.²⁰ During the period 1860-1880, Captain Jim Frisble straightened East Creek and "deepened the new channel to admit all craft."²¹ Today, this area contains the Town Marina and is now known as the Sluice Basin.

In 1891, Guilford lost some opportunities for navigation and commercial uses of its tidal rivers. It was not uncommon for wharfs and shipyards to utilize land adjacent to riverbanks inland that were only sufficient for tidal navigation, but provided the necessary

sheltered mooring and protection from wind and waves. Guilford, lacking any substantial harbor, especially depended upon these inland wharfs and shipyards. However, plans to upgrade the railroad tracks and remove drawbridges restricted or eliminated these industries during this period.²²

At this point, the interest of improving navigation was directed to the mouths of the rivers, where oyster populations had been left relatively undisturbed. The Town continued to oppose the railroad at special town meetings on January 19, 1891, and June 13, 1891, but on July 2 of that year, Guilford accepted \$5,000 for the interest and subsequent removal of the drawbridge on the West River.²³ With the two drawbridges removed, three large shipyards and five commercial wharfs ceased to exist.²⁴ Later, a much greater emphasis focused upon developing the lower sections of the East River for navigation, wharfs and anchorage areas.

On September 22, 1922, the House of Representatives Committee on Rivers and Harbors authorized a preliminary examination of Guilford Harbor.²⁵ The Committee requested the report under Section 3 of the River and Harbor Act of June 13, 1902, concerning possible improvements to Guilford harbor. The report considered a channel through the harbor to the wharf in Sluice Creek and was dated January 31, 1923. The Secretary of War submitted it to Congress on February 5, 1923. At that time, improvement of Guilford Harbor was deemed to be inadvisable.

On March 9, 1939, the House of Representatives Committee on Rivers and Harbors requested a re-examination of Guilford Harbor. A public hearing was held in Guilford on May 9, 1939, to obtain information on the improvements desired.²⁶ The Guilford Chamber of Commerce sponsored the desired improvements.²⁷ Forty-two people attended the hearing, representing the local government, local fishing and pleasure craft interests. In the final Army Corps of Engineers report, it was stated that many of the improvements suggested at the public

hearing were deemed "excessive in cost in comparison to their advantages and warrant no further consideration." Three plans of improvements were approved for consideration and federal funding, although the report concluded that the general benefits were insufficient to justify the improvements entirely at federal expense. In summary, the report suggested that if the project was adopted, it should be subject to the condition that local interests contribute, in cash, 50 percent of the cost of new work, not to exceed \$25,500.²⁸

On March 17, 1941, Henry L. Stimson, Secretary of War, transmitted the final report from the Chief Engineers dated January 22, 1941, to the Speaker of the House of Representatives. At that time, the Bureau of the Budget advised that authorization of the project would not be in accord with the program of the President at that time.²⁹

The project for improving Guilford Harbor was again resubmitted for consideration and was authorized by Public Law 14, 79th Congress, on March 2, 1945. Evidently, funding was delayed once again, for the improvements were not made.

Documents obtained from the Army Corps of Engineers in December of 1984 detail how the improvements were finally completed in 1957. Research in the Guilford Town Hall revealed that on April 26, 1955, the Board of Finance recommendation for a special appropriation of \$25,500 was passed unanimously at the special town meeting for "channel dredging, jetty construction and necessary work thereto in accordance with studies and recommendations of the Corps of Engineers."³⁰ A press release from the office of then Connecticut Senator Prescott Bush stated that the Army Corps of Engineers had allocated \$110,000 to improve Guilford Harbor.³¹ Earlier that year, House and Senate conferees on the Public Works Appropriation Bill for 1956 had restored \$1 million, enabling the Army Corps of Engineers to proceed with the Hurricane Survey authorized by Public Law 71 of the 84th Congress.³²

Henry A. Whitcomb, Chief of the Operations Division of the Army Corps of Engineers, requested statistics from the First Selectman on the use of Guilford Harbor during 1954.³³

At an annual Guilford town meeting held October 3, 1955, a resolution was approved providing that provisions of Public Act No. 509 of the 1955 Connecticut General Assembly entitled "An Act Concerning Flood Control and Shore Erosion" be adopted and a Flood and Erosion Control Board authorized to exercise the powers delegated under said act.³⁴

On November 7, 1955, the Flood and Erosion Control Board signed an assurance with the Army Corps of Engineers on behalf of the United States of America to perform the river and harbor improvements for Guilford Harbor authorized by Public Law 14, 79th Congress, 1st Session, approved March 2, 1945.³⁵ In July of 1956, four bids were opened ranging between \$157,500 to \$162,500 and dredging started in March, 1957.³⁶ One oysterman personally recalled awaiting the arrival of the dredge, believing that the sluice basin was to be deepened. This anticipation soon turned into dismay as the dredge proceeded up the East River into the oyster beds. He stated that the local oystermen, numbering about a dozen, opposed this dredging and were generally unaware that this East River dredging was scheduled to occur. It was felt that any action would be too late at this time and that the oystermen lacked any public forum to express their concerns.³⁷ The public hearing for the original navigation improvements was scheduled 18 years ago as discussed above.

Natural Bed Restoration

The 1957 improvement of the lower East river, according to local oystermen, eliminated most of the oyster resources in this area. Oyster sets continued to occur on what few shells remained on shallow bank edges.³⁸ These areas supported a small fishery utilizing tongs until 1966, when the river was closed to direct shellfishing.³⁹

A January 30, 1985, written communication to me from Mr. Nathan Walston states:

“In answer to your question of the size of the oyster beds in the East River, Guilford 25 years ago, my father, John Walston and I harvested oysters from all of the area marked out in red on your map. We did this up to the mid-60's when the river became polluted.”

An oyster bed survey of the lower East river was conducted by Mr. Frank Dolan, oysterman, and Mr. Nathan Walston, Chairman of the Guilford Oyster Ground Committee, in the fall of 1979. The survey was conducted aboard Mr. Dolan's oyster boat, the TEAL. Oyster dredge surveys produced two and three year old oysters approximately 200 feet south of the northern edge of the federal anchorage area.⁴⁰

At a September 20, 1979 joint meeting of the Guilford Oyster Ground Committee and the Madison Shellfish Committee, the proposed dredging of the Guilford Harbor and the effect this would have on the oysters, clams and mussels in the East and Neck rivers, as well as the steamer clams on Grass Island, was discussed. The silting effect had caused Nate Walston, the Chairman of the Guilford Oyster Ground Committee, to request an environmental impact study be made to assist in regulating the dredged material.⁴¹

By 1981, according to Mr. Dolan, the oysters had re-established themselves 300 feet below the limit of the anchorage area and were now almost into the boat moorings.⁴² This reappearance of the oyster bed was mentioned in a newspaper article discussing the scheduled maintenance dredging of the anchorage that year. In the article, the Chairman of the Marina Commission suggested that the hydraulic pumping method could also help thin out the oyster beds on the East River which were by then overpopulated.⁴³ The East River anchorage area was dredged in 1981.

During a February, 1984, meeting of the Guilford Oyster Ground Committee, Mr. Dolan recalled his attempts to prevent the hydraulic dredging of these oysters in the northern section of the anchorage area in 1981. We stated that the "last time the Army Corps dredged, we tried to get them to dredge only up to buoy C "7" instead of C "9" (which were approximately 450 feet apart and since have been removed). We even went to local officials but they still dredged up to the black can (C "9"). We took four loads of set up the river so it would not be killed."⁴⁴

At this meeting, various methods to restore this natural oyster bed and manage it so as not to interfere with boating interests were discussed. A proposal was made to try to plant cultch in the area for setting purposes but not to allow the growth of oysters to lessen the channel depth and impact navigation.

At a January 29, 1985, public hearing of the Guilford Harbor Management Commission, again questions were raised regarding continued and increased development of the lower East River. In a letter dated January 30, 1985, Mr. Nathan Walston, in response to questions regarding the East River and oyster setting there, comments:

These areas could and do catch a set every spring and if not disturbed form a beautiful bed of oysters again.

At a June 12, 1985, meeting of the Guilford Shellfish Commission, Mr. Frank Dolan formally requested to plant 2,000 bushels of cultch per acre over 12 acres down to the Guilford launch ramp.⁴⁵ This area encompassed the northern portion of the federal anchorage in the East River. A series of motions were made by the Shellfish Commission in response to this request and are found below:

A motion was made, seconded and passed unanimously that: 1. To determine where the town line is with the Guilford Board of Selectmen, and 2. To determine the rights of Guilford in the East River area.

A motion was made, seconded and passed unanimously that Mr. Dolan would limit the upriver end of the (cultch) planting to 200 feet downstream of the confluence of the Neck and East Rivers, that he would manage the area under the auspices of the Shellfish Commission until the boundaries of the area were determined. Buoys will mark the area of cultch planting and the Marina Commission is to be notified of their presence. In addition, we ask that Mr. Dolan try to get on the agenda of the next meeting of the Marina Commission to explain the management of these grounds. He will use three boats, and will notify both commissions when the work is to be done. If in the future, the Army Corps wishes to dredge the area, he will apply for permission to move the oysters temporarily between the channel and Jacobs Beach.

A conversation with Mr. Frank Dolan in late July 1987, concerned the progress of the joint agreement with the Guilford Shellfish Commission to manage the oyster bed restoration in the lower East River. Mr. Dolan reported that the cultch planting of 1985 and 1986 had caught good oyster sets. To date, approximately 26,000 bushels of mixed surf clams and oyster shell have been planted. At the present time, a "nice crop of oysters" can be found in this planted bed. Mr. Dolan was also optimistic that the 10,000 bushels of cultch he had just finished planting would again catch a set. Permission was obtained from Mr. Dolan to conduct a dredge survey for some surf clams shells containing seed oysters. These were needed to produce photography related to this paper. Random sampling produced many two-year olds and set from last summer on these shells. The oysters all appeared healthy and growing rapidly. Below is a table, provided by Mr. Dolan, recording cultch planting:

Table 2. East River Cultch Plantings

Year	Amount of Cultch	Area Planted
1985	8,000 bushels	200' South of state boat launching ramp
1986	8,000 bushels	Opposite State Boat Launching Ramp
1987	10,000 bushels	Above State boat launching ramp

Discussion

The negative effect of navigation improvements upon oyster resources has been well documented in the scientific literature. Today, social and economic issues often conflict between various coastal user group resources. However, aside from resource allocation decisions, a poor understanding of oyster bed ecology can contribute to reduced oyster production.⁴⁶

In a 1983 Marine Fisheries Review article, Clyde Mackenzie describes natural oyster beds found in estuaries. He states that these natural oyster beds often have deep shell bases, some as deep as 23 feet.⁴⁷ John Volk, Chief of the Connecticut Department of Agriculture – Aquaculture Division, has found shell bases to be over 40 feet deep in the Housatonic River in Connecticut.⁴⁸ These deep shell bases can be attributed to successive oyster generations setting and growing on older oysters, eventually killing them by overgrowth. The elevation of these beds continues to rise and the shells of the dead oysters accumulate underneath forming the base of the natural bed.

This natural upward pattern of natural bed development is also discussed at length by Galtsoff⁴⁹ and Brooks.⁵⁰ This phenomenon, associated with natural oyster beds in rivers, can significantly lessen channel depths, negatively impacting navigation. In an April 17, 1879, Mystic Press newspaper article, the rapid growth of oysters and potential problems to navigation were discussed.

Oysters appear to lead as a remunerative crop, and judging from the amount of white birch along the riverbank for planting, the business will be well started the coming season. Some of our most enterprising men experimented with bush

planting some 10 months ago and are now gathering from 12 to 20 bushels to the bush. Again, this has its drawbacks. In shipbuilding and navigation, it is feared the enormous growth of oysters will fill the river to its surface.

An article that appeared in the January 30, 1988, Shoreline Times revealed a similar situation regarding navigation in Guilford's West River. The article discussed dredging a channel in the West River to the four-foot depth contour of Long Island Sound, stating that it appears that about four feet of shell would be removed first as an oyster harvesting and development program and that it could be done best by the oystermen.

In an April 26, 1984, Shoreline Times article, again the issue of oyster bed restricting navigation in the West River is discussed:

"They haven't dredged the oysters out of that river in two to three years. We know there's oysters down five or six feet deep. It's been more than once we've sent our workboat out there to remove a sailboat caught on top of the oyster bed," Mrs. Duhaime said.

In 1985, the Guilford Shellfish Commission developed a comprehensive plan to address the management of the natural oyster beds within its jurisdiction.⁵¹ The program to deepen the channel in the West River with increased oyster harvesting and the East River restoration effort reflect new shellfish management policies. These new policies differed greatly from the traditional regulation of bag limits and restrictions upon gathering methods.

It is evident that a greater understanding of natural oyster bed development could provide additional restoration opportunities in many Connecticut municipalities. Shell deposits that could be utilized as a cultch source occur in most estuaries.⁵² In areas of continued oyster setting, on-site re-shelling activities should be evaluated. The suitability of pilot projects requires the careful review of site-specific biological, environmental and social limitations.

It was felt that the East River was a good candidate for a small restoration project. Oyster setting was frequent, the Shellfish Commission and the industry both supported the effort and conflicting uses were seasonal. Under no circumstances was the growth of seed and adult oysters to impact upon navigation.

In this case, implementation of new shellfish management policies could possibly eliminate or reduce the need for continued maintenance

dredging. If removing excess oysters or shell can control channel depths, navigation dredging costs would be reduced and the environmental impacts associated with upland disposal of dredge spoils lessened. Follow-up studies of the East River restoration and bed management programs could provide valuable information to other resource managers. Similar small-scale projects should be investigated and, in my opinion, warrant further research.

¹ John M. Kochiss, Oystering From New York to Boston (Connecticut: Wesleyan University Press, 1974) 8.

² Tenth Census of the United States, The History and Present Condition of the Fisheries Industries (Washington, D.C.:

³ William K. Brooks, The Oyster (Baltimore: John Hopkins University Press, 1905) 209-215.

⁴ Kochiss 15-47.

⁵ George Brown Goode, The Fisheries and Fishery Industries of the United States (Washington, D.C.: the United States Commission of Fish and Fisheries, 1887) 322-23.

⁶ Ralph D. Smith, The History of Guilford (Albany, N.Y.: J. Munsell, 1877) 46.

⁷ House of Representatives, Letter to the Secretary of War (Washington, D.C.: House of Representatives – 77th Congress, Document No. 149, 19 March 1941) 5.

⁸ Mark J. Otis, letter to the author, 30 November 1984.

⁹ Bernard Christian Steiner, History of Guilford and Madison, Connecticut (Connecticut: The Guilford Free Library, 1975) 186.

¹⁰ Steiner 187.

¹¹ Town of Madison, Town Meeting Book – Volume I (Madison, CT: Madison Records, 1829) 23.

¹² Biennial Report of the Shellfish Commissioners, State of Connecticut Public Document No. 30 (Hartford: State of Connecticut, 1918) 17.

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- ¹³ Robert Ketchale, personal interview, 10 August 1987.
- ¹⁴ Frank Dolan, personal interview, 7 February 1984.
- ¹⁵ Nathan Walston, letter to the author, 30 January 1985.
- ¹⁶ Susan Spencer, letter to Madison and Guilford Oystermen, 2 December 1966.
- ¹⁷ Smith 45-46.
- ¹⁸ Smith 45.
- ¹⁹ Steiner 218.
- ²⁰ Steiner 218.
- ²¹ Mary Hoadley Griswold, *Shore Line Times* 10 November 1927, 5.
- ²² Joel Helander, "Boating Along the Menunkatuck, *Shore Line Times* 28 February 1984.
- ²³ Myra Dowd Monroe, "East River Drawbridge," (Guilford, CT: The Guilford Keeping Society, November 1955) Drawer 1, Folder 2.
- ²⁴ Lauralee Clayton and Warner P. Lord, *Madison Three Hundred Years by the Sea* (United States: Madison Bicentennial Committee, 1975) 26.
- ²⁵ House of Representatives, No. 149, 2.
- ²⁶ House of Representatives, No. 149, 6.
- ²⁷ House of Representatives, No. 149, 6.
- ²⁸ House of Representatives, No. 149, 13.
- ²⁹ House of Representatives, No. 149, 1.
- ³⁰ Town of Guilford, Town Meeting Book – Volume II (Guilford, CT: Guilford Records, 26 April 1955) 244-45.
- ³¹ Guilford Harbor Improvement Funds Allocated Says Senator Bush," *Shore Line Times* 14 July 1955, 1.
- ³² *Shore Line Times* 14 July 1955, 1.

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- ³³ "To Open Harbor Bids in October," Shore Line Times 25 August 1955, 1.
- ³⁴ Town of Guilford, Town Meeting Book – Volume II (Guilford, CT: Guilford Records, 3 October 1955) 264.
- ³⁵ "Assurance of the Flood Control and Water Policy Board of the Town of Guilford, Connecticut," (Connecticut: Town of Guilford, 7 November 1955).
- ³⁶ "Guilford Harbor Bids Opened," Shore Line Times 26 July 1956, 1.
- ³⁷ Nathan Walston, personal interview, 13 August 1987.
- ³⁸ Nathan Walston, personal interview, 13 August 1987.
- ³⁹ Spencer.
- ⁴⁰ Timothy C. Visel, personal observation, October 1979.
- ⁴¹ Town of Madison, Shellfish Committee Minutes (Madison, CT: Town of Madison, 20 September 1979).
- ⁴² Frank Dolan, personal interview 7 February 1984.
- ⁴³ Karen Berman, "Grass Island Eyed as Harbor spoils Dump," Shore Line Times, 6 September, 1980.
- ⁴⁴ Frank Dolan, personal interview, 7 February 1984.
- ⁴⁵ Town of Guilford, Shellfish Commission Minutes (Guilford, CT: Town of Guilford, 12 June 1985).
- ⁴⁶ Eric M. Smith and Mark Sayre, eds., Proceedings of the 1985 Northeast Fish and Wildlife Conference (Hartford, CT: The Northeast Fish and Wildlife Society, 1985) 292-94.
- ⁴⁷ Clyde L. Mackenzie, Jr., "To Increase Oyster Production in the Northeastern United States," Marine Fisheries Review 45.3 (March 1983): 5.
- ⁴⁸ John Volk, personal interview, 1985.
- ⁴⁹ Paul S. Galtsoff, "The American Oyster," Fishery Bulletin of the Fish and Wildlife Service 64(1964): 20
- ⁵⁰ Brooks, 85-86.

⁵¹ Town of Guilford Shellfish Commission, Guilford Shellfish Commission Management Plan (Guilford, CT: Town of Guilford, 1984) 5-8.

⁵² Clyde L. MacKenzie, Jr., "Development of a Program to Rehabilitate the Oyster Industry of Prince Edward Island, Marine Fisheries Review 37.3 (March 1975): 31.

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