FINAL COMPLETION REPORT

ANADROMOUS FISH PROJECT

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ABSTRACT

One hundred and forty-seven Massachusetts coastal streams and salt ponds were surveyed to determine the suitability for restoration or improvement of anadromous fish populations. Emphasis was placed on alewives, shad and smelt.

Eighty-five fishways were inspected and their condition noted. A priority list for fishway construction and improvement was developed. Construction of 17 fishways and improvement of 19, utilizing more efficient designs, was recommended. It was recommended that alewife propagation be continued, based on an annual evaluation of needs. Eight rivers have potential for shad restoration. Restoration of shad in the Taunton River system was initiated through the planting of fertilized eggs. It was felt that propagation of smelt, while feasible, was not of high priority because of limited utilization of the resource. It was proposed that the closed season for smelt be repealed on several streams and that a regulated fishery be conducted on an experimental basis to determine the possibility of increasing the utilization of this species.

Management of alewife fisheries is primarily the responsibility of the Commonwealth. Due to the large number of runs and the inherent maintenance and enforcement problems, local control of the fishery, with approval of the Division, would be more efficient. It was recommended that towns assume control under Section 94 of Chapter 130 of the General Laws.

I INTRODUCTION

Anadromous fishes have declined drastically in abundance since early settlement of Massachusetts. The requirements of a growing human population were in conflict with those of salmon, shad, alewives, smelt and other anadromous species. Impassable dams, gross pollution and overfishing eliminated or reduced anadromous fish populations with amazing suddenness. The severity of this loss was overlooked by a rapidly growing industrial society which did not foresee the value or importance of such natural resources.

Early attempts to restore anadromous fishes were generally unsuccessful because population dynamics of the species and technical factors of fish passage were poorly understood. While our knowledge of these subjects is still not complete, it is sufficient to attempt restoration of many anadromous species but first, it is necessary to ascertain the status of existing runs and to determine suitability of coastal streams and ponds for restoration of anadromous fishes. It is to these points that this report is directed.

Specific objectives of this study are to: Evaluate water use, water quality, impediments to fish passage and extent and quality of spawning area in Massachusetts coastal rivers and streams and their headwaters; determine status of existing runs; evaluate the possibility of establishing new anadromous fish populations. The species emphasized are alewife, *Alosa pseudoharengus* (Wilson); blueback herring, *Alosa aestivalis*

(Mitchell); American shad, *Alosa sapidissima* (Wilson) and rainbow smelt, *Osmerus mordax* (Mitchell). Comments on other species are included where pertinent. Since *Alosa pseudoharengus* and *Alosa aestivalis* are commonly found together, the term alewife will refer to both species unless a distinction is warranted by the data.

II METHODS

All rivers and streams flowing into Massachusetts coastal waters were considered. Most were surveyed from mouth to headwaters. General physical characteristics were noted and data of specific importance to anadromous fish were obtained.

Obstructions and fishways were noted and photographed. Dissolved oxygen, carbon dioxide, pH, alkalinity, iron and turbidity were measured with a Hach Model Dr-El field chemistry kit. Stream length was determined with a map rotometer. Surface area was computed with a planimeter or dot grid. Salinities were measured with a GM wide range hydrometer set. Stream flows were obtained from U.S. Department of the Interior Geological Survey Reports.

Egg-collecting trays were placed in some streams to locate smelt populations and delineate spawning areas. The trays contained sphagnum moss held in 22 inch by 13 inch wooden frames by 1 inch mesh chicken wire. When trays were not available burlap sacks stretched over reenforcing rod frames were used. A 60 foot by 4 foot, 1/4 inch bar mesh nylon haul seine, with a 1/8 inch bar mesh bag and a dip net with 1/4 inch mesh were used for fish sampling. Bottom samples were taken with a 9 inch Eckman dredge and depths were measured with a sounding line.

Areas suitable for shad spawning were determined by classification of bottom type. Bottom types other than mud and silt were considered suitable for shad. Although the validity of this technique is questionable, it does provide an index in estimating potential productivity. Projected populations of shad for the Taunton and Charles Rivers were based on a ratio of 2.3 adult fish per hundred square yards of spawning area (unpublished data, Technical Committee for Fisheries Management of the Connecticut River Basin).

III STATUS OF ANADROMOUS FISHES IN MASSACHUSETTS

The decline of anadromous fishes on the Atlantic Coast from colonial settlement to present, is well documented. Construction of dams without fish passage facilities, deterioration of water quality and overfishing were the primary factors in the reduction of this resource.

Alewife:

The annual alewife catch in Massachusetts average between 4 and 5 million pounds from 1880 to 1896, but dropped to an average of 1 million pounds between 1933 and 1943 (Rounsefell and Stringer, 1943). While this reduction may reflect reduced demand, especially in later years, an overall decline in abundance is indicated. In 1921, 46 streams supported commercial fisheries while public fisheries existed in many others.

However, the fisheries in most streams have been discontinued because of reduced catches. In 1970, only five streams were fished commercially, yielding a catch of 44,319 pounds. The major cause for the recent decline in alewife populations can be attributed to inadequately designed or deteriorated fish passage facilities.

Shad:

American shad underwent an even more drastic decline than the alewife. The rapid settlement and industrialization in the state during the 1800's and resulting dam construction and deterioration of water quality eliminated a once flourishing fishery. The fishways that were constructed were not capable of passing shad and overharvesting depleted the remaining populations.

The decline of Massachusetts shad populations is typified by the Merrimack River fishery. Shad originally ascended the river for 125 miles. Construction of a dam at Lawrence in 1848 eliminated approximately 100 miles of spawning area and a drastic decline in catch occurred. An annual catch averaging 500,000 pounds fell to 30 pounds in 1896. Today only a few individuals of this population remain (Walburg and Nichols, 1967).

There is no longer a commercial fishery for shad in Massachusetts. The sport fishery, while intense, is generally limited to two coastal streams, the Palmer and North Rivers. Shad are occasionally caught in the Merrimack, South and Runnings Rivers, but the fishing pressure is relatively light.

Smelt:

Very little is known about the early Massachusetts smelt fishery. Kendall (1927) states that smelt were abundant in early times and still plentiful in the 1880's, but began to decline in the 1890's. As early as 1874, the taking of smelt was limited to hook and line. In spite of this attempt at conservation, the decline continued. Kendall (1927) noted the continuing decline and attributed it to inaccessibility or degradation of spawning areas rather than to excessive and untimely fishing.

An attempt was made to restore or establish smelt runs through widespread stocking between 1910 and 1920. While the overall success of this work is questionable, it may have been responsible for the continuance of many smelt runs.

Presently, there is a good fall sport fishery for smelt in the bays and estuaries. There is also an excellent winter fishery in areas where estuaries freeze solidly for extended periods. Among the more important winter fishing areas are the Parker, Rowley, Essex and Mill River estuaries, all north of Boston.

IV REGULATION AND MANAGEMENT OF ANADROMOUS FISHES

Anadromous fishes are subject to the Special Acts and General Laws of the Commonwealth. Chapter 130 of the General Laws establishes specific laws for management of alewives, shad and smelt, and empowers the Director of the Division of Marine Fisheries to take certain measures to protect anadromous fish in general. Numerous Special Acts give communities the right to control or regulate anadromous fisheries in the waters of the community. In many cases, these regulations are not biologically sound and conflict with those of Chapter 130.

Complete town control has often proven to be detrimental to a fishery. Apathy on the part of local officials has led to neglect of fishways and ineffective regulation. Changing administrations cause fluctuating interest and knowledge of the fishery. Conversely, it is not presently possible for state authorities to carry out maintenance programs, regulation of fishways and enforcement of the laws for all alewife runs in the Commonwealth. A reasonable solution to this problem is to have local governments regulate and manage their fishery based on recommendations from and with approval of the Division of the Marine Fisheries. Section 94 of Chapter 130 allows the Selectmen, if so authorized by their town, to petition the Director of the Division of Marine Fisheries for the right to control and regulate the alewife fisheries within the town. After a public hearing and submission of proposed regulations, the Director may grant or deny local authority to control the fishery, whichever is in the public interest. Where a town has created an alewife run by opening new spawning area or by propagation, Section 93 of Chapter 130 authorizes the town to exercise complete control of the fishery.

Chapter 130 establishes several other measures for the protection of anadromous fishes. Section 19 gives the Director power to order removal of obstructions to fish passage or order construction of passage facilities at the expense of the owner of the obstruction, and further requires the owner to maintain and regulate the fishway as prescribed by the Director. Section 95 establishes a fine for anyone who molests or hinders passage of fish in a created fishery or a locally controlled fishery in a manner contrary to the regulations established for that stream. This section, if strictly enforced, would result in improvement of many existing runs and enable restoration of others.

Section 97 sets a closed season for alewives from June 15 to March 1, and limits the method of capture on Sundays, Tuesdays and Thursdays of the open season to hook and line only. Section 97A establishes a minimum length of four inches for alewives taken in the waters of Plymouth Harbor, Kingston Bay and Duxbury Bay. Section 34 makes it illegal to take or sell smelt from March 15 to June 15 while Section 36 empowers the Director to close smelt spawning grounds to entrance for as long as 60 days. Section 35 limits the method of capture during the open season to hook and line. A size limit of 14 inches fork length is established for shad under Section 100. Section 100C prohibits the taking of shad by any means other than hook and line or fish trap (as authorized in Section 29) providing the trap is not specifically designed for the taking of shad.

Section 17A provides the Director with certain powers for the management of marine fisheries in general. The Director, with approval of the Marine Fisheries Advisory Commission, may adopt, amend or repeal rules and regulations pertaining to the manner of taking fish, legal size limits of fish, seasons and hours during which fish may be taken, the number of fish which may be taken and the opening and closing of fishing areas.

When Section 19 is to be applied to new dam construction, a functional fishway plan should be provided by the Division of Marine Fisheries to the owner or contracting firm to insure that the most efficient design is utilized and that biological factors are taken into consideration. Structural design of fishway and dam are the responsibility of the owner. Final plans should be submitted to the Director of the Division of Marine Fisheries for approval and the Division should follow up to insure that construction and operation of the fishway is in adherence with the Division's order. There are many dams in Massachusetts which were originally used to supply power sources and industrial water reservoirs for small mills. These dams still exist, often in poor condition, though the mills are no longer operating. In such cases, breaching of the dam should be considered as an alternative to fishway construction.

V STREAM SURVEY

The following rivers and streams are listed in the order in which they were surveyed. The study began at the Rhode Island-Massachusetts boundary on Narragansett Bay and followed the coastline to the New Hampshire border. Rivers were surveyed in an upstream direction. Tributaries were usually surveyed as they were encountered on the main branch of the river.

RUNNINS RIVER

The Runnins River is the main tributary to the Barrington River in Rhode Island. The river originates in swamp areas of northern Seekonk. It flows southward for 8 miles, forming the boundary of Massachusetts and Rhode Island for much of its course. Two impoundments totaling 8 acres are in the town of Seekonk.

Alewives, blueback herring and shad ascend the river to the base of the 15-foot dam at the first impoundment. No fish passage facilities are recommended here or at the 12-foot dam at the second impoundment as they would not significantly add to the spawning area.

It is recommended that the section of stream below the first dam be brushed out and cleaned of debris to improve access and possibly increase shad spawning area. An assessment of angling pressure for shad should be made. If angling pressure is significant, an interstate management program should be considered.

PALMER RIVER

The Palmer River drains swamp lands in northern Rehoboth. It flows in a southerly direction for 11 miles and empties into Narragansett Bay. The lower section of the stream in Rhode Island is called the Warren River. A 12-foot dam forms a 23 acre impoundment in Rehoboth called Shad Factory Pond. Access to the pond is provided by a 300-foot weir-pool fish ladder.

The pond is used as a spawning ground by alewives. The river below the dam supports a shad run and some shad are reported to ascend the fishway. Smelt and a large set of smelt eggs were observed in the river during the survey, although there are no records of a smelt run occurring here. The lower portion of the river is noted for its excellent perch fishing.

The Palmer River's greatest resource is its shad sportfishery. In 1964, the Rehoboth Conservation Commission purchased 8 acres of land with 3100-foot frontage on the river and developed a multiple use recreation area. This land encompasses most of the prime shad fishing spots and a permit is required to enter the conservation area.

The efficiency of the fishway would be improved by regular cleaning of pools, providing additional attraction water and dredging out the ladder entrance. This would provide greater attraction and increase the numbers of shad and alewives which utilize the fishway.

The impoundment is used as an auxiliary water supply and summer and fall water levels are often low and hinder juvenile and adult downstream migration. Water regulation should be coordinated with fish migration in order to insure maximum production.

A survey of potential spawning should be made above the first impoundment. If significant spawning area exists, consideration should be given to construction of a fishway better suited to shad passage. This would result in a larger population and increased angler access. The Massachusetts Division of Fisheries and Game is presently conducting a creel census on the river's shad fishery and no decision on further development of the run should be made until data from the creel census have been evaluated.

Rocky Run:

Rocky Run is a tributary to the Palmer River. Its source is swamp areas in eastern Rehoboth. The stream flows southwesterly and empties into the tidal section of the Palmer River.

Alewives, blueback herring and smelt have been observed in Rocky Run and occasionally shad have been reported. There are no headwater ponds, impoundments or obstructions to fish passage. The stream has little potential for further development of anadromous fishes.

Bad Luck Brook:

The source of Bad Luck Brook is Upper Warren Reservoir (105 acres) in Rehoboth. The stream flows northwesterly 1.6 miles to the Palmer River. No anadromous fish are known to ascend it and a dam at the reservoir would block passage of alewives. Despite the large potential spawning area, stocking and fishway construction is not recommended because of lack of sufficient flow during summer and fall months.

KICKAMUIT RIVER

The Kickamuit River flows from Lower Warren Reservoir (75 acres) through the town of Swansea to Mount Hope Bay. There is no regulatory device at the reservoir dam and little water ever flows over it. Although alewives spawn in the lower section of the river, lack of flow from the reservoir and shallowness of the stream makes establishment of a population in the reservoir unlikely.

COLE'S RIVER

The Cole's River drains large swamp areas in Rehoboth and Dighton. It flows for 11 miles through three impoundments in Swansea and empties into Mount Hope Bay. A 40-foot fish ladder provides fish passage to the first impoundment, Milford Pond. Although this pond is only 9 acres, it has supported an alewife fishery. The town of Swansea leases the fishing rights annually at public auction. In 1970, 57 barrels were harvested by the lessee.

The size of the run could be increased by constructing fishway facilities at the second impoundment, thereby opening the 34-acre impoundment to spawning alewives. The design of the fishway at Milford Pond should be modified to provide greater attraction flow, and flow through the fishway must be regulated in a more efficient manner to insure maximum production. Both fishway design and flow regulation are the responsibility of the Montaup Electric Company, the owner of the dam. Section 19 of Chapter 130 should be enforced on this river.

Although the town of Swansea has control of the fishery under a Special Act of 1882, no regulations have been established in recent years. Repeal of this Special Act, through the Director's powers under Section 17A, would be in the best interest of the fishery. The town should be given the opportunity to regain control under Section 94.

LEE'S RIVER

The Lee's River flows 6 miles from its source in Swansea through two unnamed impoundments with a combined area of 16 acres to Mount Hope Bay. Dams at these impoundments obstruct fish passage. The larger and uppermost impoundment (10 acres) is deep and steep-sided, providing little spawning area.

Because of limited spawning area available above the dams, an important fishery could not be developed and will be limited to alewives that are reported to spawn in tidal waters below the first dam.

TAUNTON RIVER

The Taunton River drainage system is one of the largest watersheds in the Commonwealth. With its large, unimpounded main stem, many tributaries and numerous headwater ponds, it offers potential for many species of anadromous fish. The river once supported an extremely large alewife fishery and shad were present in good numbers. While alewives are still numerous, the production is far below the system's potential and shad have virtually disappeared.

The causes of the decline in anadromous fish populations were pollution and obstructions on tributaries. Pollutants in the form of industrial and domestic wastes are present in great amounts in the main river and many of its tributaries.

Of particular concern are wastes entering the river from industries and sewerage discharges in the city of Taunton. These have created an area of low dissolved oxygen and high ammonia-nitrogen content downstream from the city. Minimum dissolved oxygen of 0.3 mg/l and maximum ammonia-nitrogen of 1.22 mg/l were recorded during the latter part of July, 1970. (Massachusetts Water Resources Commission, 1971A). Ammonia has a high oxygen demand and increases the oxygen requirement of fish. The majority of alewives spawning in the Taunton River system must pass through this area to reach spawning grounds. Concentrations of dead juvenile alewives have been observed within the area during the spring and its effect on adult alewives is not known.

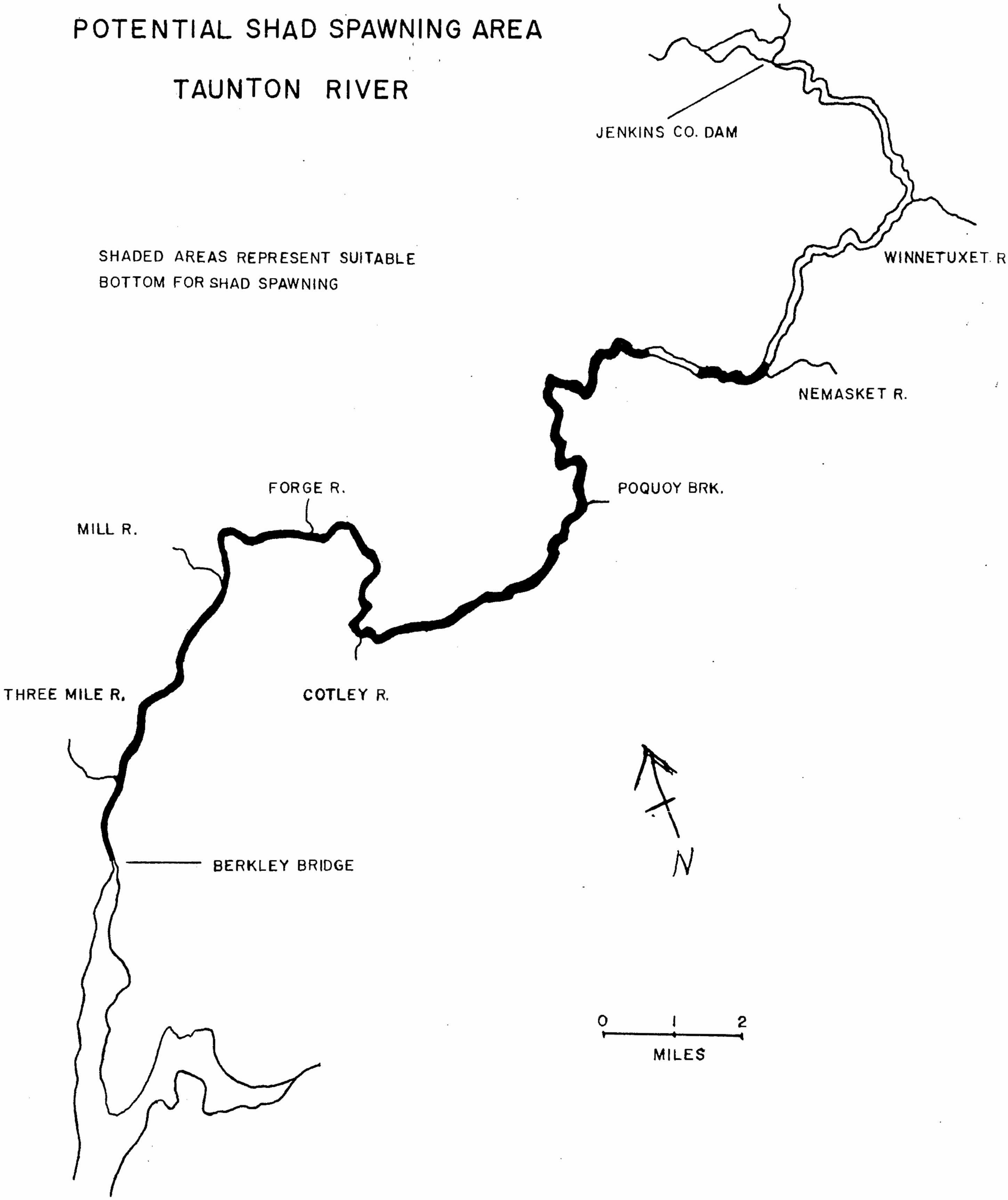
The Massachusetts Water Resources Commission has given this section of the river an SB classification. Under this classification water quality must be improved to the point that dissolved oxygen is not less than 5.0 mg/l and ammonia-nitrogen does not exceed an average of 0.2 mg/l during any month. (Massachusetts Water Resources Commission, 1971A). It is anticipated that water quality will be improved to eventually meet these standards and will no longer be a detriment to anadromous fishes.

Bottom sampling was conducted on the Taunton River in order to determine potential shad spawning area. The sampling area extended from the Berkley Bridge, Dighton to the Jenkins Leatherboard Company dam in Bridgewater, a total of 28 river miles. Berkley Bridge was selected as the lowermost station

POTENTIAL SHAD SPAWNING AREA

TAUNTON RIVER

SHADED AREAS REPRESENT SUITABLE BOTTOM FOR SHAD SPAWNING



because it marks the limit of salt water intrusion during the spring. The upper limit of the sampling area is at the dam blocking further upstream migration.

Suitable spawning area was interpreted as all areas of the river with bottom types other than mud or silt. The section of the Taunton River sampled, contained 1,154,481 square yards of potential spawning area with a minimum potential adult population of 26,553 shad. (Fig. 1).

The Division is now trying to restore shad to the Taunton River system. An egg stocking program was initiated in 1969 and will continue for at least four years. Eggs are being stripped and fertilized from Connecticut River shad and are being planted in the Nemasket River, a major tributary to the Taunton River

TRIBUTARIES TO THE TAUNTON RIVER

Labor in Vain Creek:

This small stream in Somerset has been impounded for a domestic water supply. Outflow from the reservoir is extremely low. Establishment of alewives in the reservoir is impractical due to insufficient flow. The stream has no potential for development of shad or smelt populations.

Assonet River:

The Assonet River flows 9 miles from Great Cedar Swamp in Lakeville to its junction with the Taunton River at Assonet Neck. Three impoundments are formed, the largest being Forge Pond (50 acres). This is the only potential alewife spawning area of any significance and it is made inaccessible by three dams. Although some alewives have been observed above the first dam, the majority spawn just below it. Extension of the alewife run to Forge Pond is not considered feasible at this time due to the cost of constructing three large fishways. If the dams, which are in poor condition, are breached or rebuilt, further development of the alewife run should be reconsidered.

The section of stream between tidal water and the first dam, approximately 75 yards in length, is used as a spawning area by smelt. Since this small population has quite probably reached its potential size, there are no recommendations for its enhancement.

Rattlesnake Brook:

Rattlesnake Brook is a small tributary to the Assonet River in the town of Freetown. Alewives spawn in the stream just above tidal water. A 100-foot underground culvert and remnants of an old dam prevent further upstream migration. The dam once formed a small mill pond but does not presently hold back water. No significant alewife spawning areas exist in the stream. Smelt eggs were observed in the stream above tidal water; however, the spawning area is small.

No recommendations are made for development of the smelt or alewife runs.

Muddy Cove Brook:

Muddy Cove Brook flows from a small impoundment in Dighton for 0.5 miles to the Taunton River. The impoundment is used as a water supply and outflow is intermittent. The stream is grossly polluted by I.C.I. America, Inc., a dye manufacturing firm. The waste effluent from the company is highly discolored, odorous and extremely acidic with pH recorded as low as 1.7. This stream has no potential for anadromous fish at present and it is doubtful that an alewife run of any significance could be established, even if the pollution was abated because of lack of flow from the reservoir during downstream migration periods.

Segreganset River:

The Segreganset River drains swamp lands in the towns of Dighton and Taunton. Four impoundments are formed along its course and a dam at each one blocks fish passage.

The first obstruction is a 3-foot wooden plank dam which created an industrial water supply for I.C.I. America, Inc. Above this point is a 4-foot concrete dam and pump house used by the town of Somerset for flood skimming to augment their water supply. A third dam at Briggs Road creates a 2-acre impoundment.

Alewives spawn in the stream below the first dam and above it if water flow and tidal conditions permit passage. The second dam blocks any further passage. At this writing, I.C.I. America, Inc. is in the process of constructing a fishway at their dam which would insure uninterrupted passage. A fishway at the Somerset dam would greatly increase the available spawning area. Section 19 of Chapter 130 should be applied in this situation. Although no significant pond spawning grounds are located on the river, observations indicate that this is a stream spawning population and production can be increased by making the stream above the Somerset dam available to alewives.

Smelt spawn below the first dam and the size of the run appears to be at its maximum potential. Shad have been reported in the river. An investigation to determine the potential shad production, based on bottom type, should be conducted. If ample spawning area exists, fishways suitable for shad passage should be constructed at the first two dams and a shad stocking program should be initiated.

<u>Three Mile River</u>:

Three Mile River is formed by the convergence of the Rumford and Wading Rivers. These rivers drain the northwestern section of the Taunton River system. Many small impoundments exist on the three rivers, creating over 400 acres of potential alewife spawning area. At least 10 dams block passage to these impoundments.

The river system receives industrial wastes and treated and raw sewerage. Water quality improves considerably in the lower portion of Three Mile River. The Massachusetts Water Resources Commission has given the Three Mile and Rumford Rivers a B classification, a water quality suitable for anadromous fish (Massachusetts Water Resources Commission, 1971B).

Alewives spawn in Three Mile River below the first obstruction, a 4-foot dam at the Harodite Finishing Company in Taunton. A fishway should be constructed at this obstruction and at a 2-foot dam further upstream, ~~but~~ owned also ~~at~~ by the Harodite

Company. There is an 8-foot dam at the Raytheon Corporation in Dighton which must also be laddered to allow passage to a 38-acre impoundment.

Mill River:

The Mill River flows four miles from Lake Sabbatia (186 acres) to the Taunton River. The stream runs through the center of Taunton where it receives considerable industrial waste. There are four dams which prevent fish passage to Lake Sabbatia.

A good alewife fishery once existed and alewives still ascend to the first dam. In view of the spawning grounds available, Mill River has the potential to maintain a large fishery. The Water Resources Commission has set water quality standards for Mill River which are adequate for an alewife population. The feasibility of providing fishway facilities at all obstructions should be determined. With improved water quality and adequate passage to Lake Sabbatia the alewife run can be greatly increased.

Forge River:

Forge River drains Johnson, Tracey, Hewett, Kings and Wilbur Ponds. Of these, Johnson and King Ponds are suitable for alewife spawning. Fishways at both these ponds would provide 20 acres of spawning area.

Cotley River:

The source of the Cotley River is swamp lands in South Taunton. It flows northerly 5.5 miles to the Taunton River forming Barstows Pond (8 acres) along its way. A wooden dam blocks access to this impoundment. A fishway should be constructed at this site. In addition to the 8 acres in Barstows Pond, the river itself would provide good spawning area and should be stocked with fish from a stream spawning population.

Richmond Pond:

Richmond Pond is an impoundment of 3.6 acres on an unnamed stream in Taunton, arising in bogs and small ponds in East Taunton. Flow is intermittent and access to headwaters is blocked by a dam with a 2.5-foot spillway height. The pond is too small to support a significant alewife population.

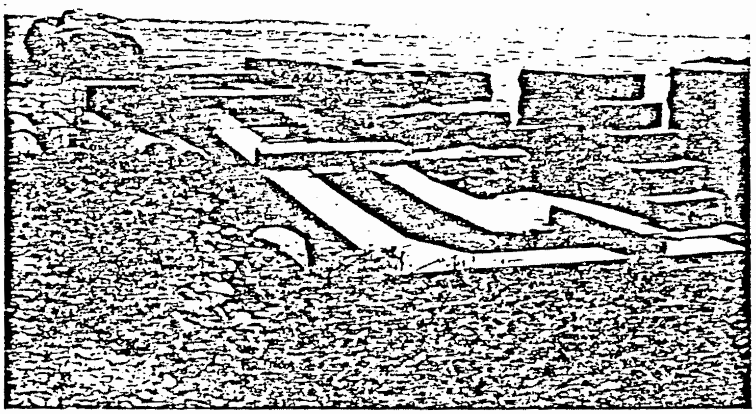
Poquoy Brook:

Poquoy Brook drains a number of swamps and a 34-acre cranberry bog reservoir. It flows 2.5 miles through the town of Lakeville to the Taunton River and is obstructed by brush, stones and three concrete bog dams.

Alewives are reported to run in the stream, although no substantial spawning grounds are available. Stream clearance and construction of passage facilities to the reservoir would produce a larger alewife population. Before such a program is undertaken, an investigation of stream flow, water rights and possible water usage conflicts should be made.

Nemasket River:

The Nemasket River is the largest tributary to the Taunton River. From its headwaters, Assawompsett, Long, and Great Quitticas Ponds, it flows 11 miles to the Taunton River. Three dams are located on the river, including one at the outlet of Assawompsett Pond.



Assawompsett Pond, Lakeville - 1968

The first fishway is at a reconstructed mill site known as Oliver Mills. The dam at Oliver Mills was formerly bypassed by a ditch, but a fishway was incorporated into the restoration area in 1969. Although the new ladder is not operating adequately at this writing, it is expected that the necessary corrections will be made shortly. Presently, fish are still able to utilize the old bypass.

The second fishway allows alewives to surmount an 11-foot elevation created by a bascule dam at Wareham Street, Middleboro. The fishway at this site did not operate efficiently because of debris in the pools and inadequate attraction flow. In 1969, the ladder was rebuilt and a barrier dam was constructed to guide fish into the fishway.

A dam at Assawompsett Pond was the final obstruction to passage. Alewives could enter the pond only when water levels were extremely high. To compound the problem, the pond is used as a water supply for the cities of Taunton and New Bedford and is subject to great fluctuations in water level. Therefore, in 1968 a Denil fishway, the first in Massachusetts, was constructed adjacent to the dam. The Denil design was chosen for its ability to pass fish under a wider range of water levels than the weir-pool type.

The three headwater ponds, with a total area of 5,145 acres, give the river a tremendous production potential. Since adequate passage has been provided, the limiting factor is the availability of water in the fall for downstream migration of juveniles.

The Nemasket River was chosen as a prime area for shad restoration because of its suitable water quality and spawning area. In 1969, 579,750 fertilized shad eggs, collected from the Connecticut River, were broadcast in the stream at two locations below Assawompsett Pond. In 1970, 1,530,300 eggs were released below the second dam. Stocking will be continued until a self-sustaining population has been established or evaluation studies show that such a technique is not practical.

Fall Brook:

Fall Brook, in Middleboro, flows 4 miles from Tispaquin Pond to the Nemasket River. Tispaquin Pond (195 acres) provides an excellent potential spawning ground for alewives. Presently, two dams block passage to the pond. Plans are being formulated for construction of fishways at the dams and the pond has been stocked for three years with adult alewives in anticipation of fishway completion. Upon attaining maximum production, Fall Brook will add significantly to the fishery in the Nemasket River. see next page

Matfield River:

The Matfield River is formed by the confluence of the Satucket and Salisbury Plain Rivers in the town of Bridgewater. The Satucket River is impounded by an 11-foot dam at the Carver Cotton Gin Company. A fishway at this location would allow passage of alewives to Robbins Pond (125 acres). Another 545 acres of spawning area could be made available by providing passage from Robbins Pond to Monponsett Pond by way of Stump Brook which passes through a large system of cranberry bogs, Fall Brook Stream, Middleboro 1973-74

During 1973, two sections of a prototype wooden Denil fishway were installed in a concrete culvert under Rte. 28 on Fall Brook Stream, Middleboro. These sections are constructed of 3/4" plywood and are 18" wide, 30" high and 8' long (Figure 11). If successful, these plywood sections will enable us to ladder small dams, such as those used on cranberry bogs, and easily remove them when they are not needed.

Middleboro

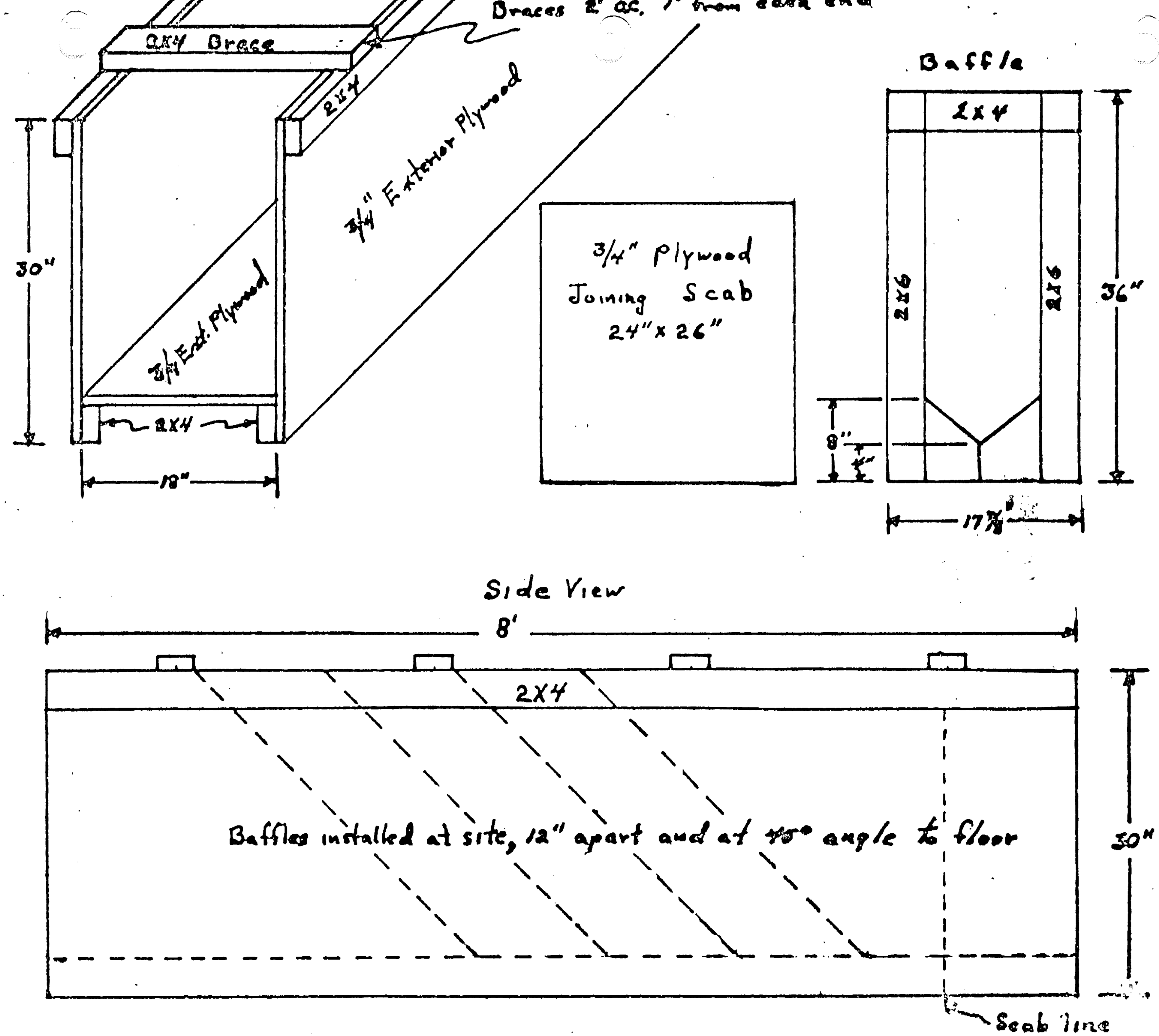


Figure 11

bog dams and culverts. Both Robbins Pond and Monponsett Pond were formerly utilized by alewives for spawning. Restoration of these populations is recommended and the feasibility of opening these ponds to alewives should be investigated.

Beaver Brook:

Beaver Brook, a tributary of the Salisbury Plain River, has potential for alewife restoration. From its headwater, Cleveland Pond (87 acres), it flows southward 7 miles to join the Salisbury Plain River. The brook has a small impoundment called Hunts Pond. Dams at both ponds are small and could easily be bypassed by fish ladders. With stream clearance, stocking and construction of two fishways, an alewife run could be established.

Town River:

Town River is a continuation of the Taunton River. It flows 8 miles from Lake Nippinicket to the center of Bridgewater where it becomes the Taunton River. Three dams obstruct the river. The first, at the Jenkins Leatherboard Company, is 16 feet high and is surmounted by a 95-foot fish ladder. Effluent from the mill and runoff from a dump enter the stream just below the fishway entrance. The second dam is at the Bridgewater Foundry Company where a 140-foot fish ladder overcomes the 20-foot elevation. Effluent from the factory enters the fishway by way of an overflowing settling pool on the bank of the river. The last dam at Bennett's Corner, is bypassed by a 50-foot fishway. Water regulation is the only problem at

Now barrier dam + crest planks etc by Bridgewater firemen 1990 this site and recommendations for more efficient regulation have been made.

Town River has a high production potential with 370 acres of spawning area available in Lake Nippinicket. Presently, this potential is unrealized. Pollution abatement, reconstruction or alteration of fishways, and efficient water regulation is necessary.

RICHMOND POND

Richmond Pond is a 65-acre lagoon in Westport, connected to the ocean by a short ditch. Alewives enter the pond only on very high tides. Salinities in the pond are low (1.5 parts per thousand) and alewives can spawn successfully. The run provides a very small fishery for lobster and sportfish bait and a large white perch population is reported to exist in the pond.

COCKEAST POND

Cockeast Pond (96 acres), in Westport, is connected to the lower portion of the Westport River by a 200-foot tidal creek. The pond supports an alewife run and a limited fishery. A number of factors are restricting productivity and threaten continuation of the run. Alewives enter the creek only at night on high tidal phases. This peculiarity and the narrowness of the creek make migrating fish extremely vulnerable to capture. Although only a 5% to 7% escapement of adult population may be necessary to maintain a fishery (Baird and Gordon, 1964), the unique nature of this run makes it highly susceptible to overfishing.

The run is an important source of bait for local lobstermen and strict management must be maintained. State regulations concerning fishing methods and periods closed to fishing, must be strictly enforced. Such restrictions can only be adequately enforced by local officials. It is recommended that the town petition for local control under Section 94 of Chapter 130.

WESTPORT RIVER

West Branch:

The west branch of the Westport River flows 4 miles from Gray's Mill Pond (3 acres) in Adamsville, Rhode Island, to its junction with the east branch. Alewives have been observed in the stream below the pond and further passage is prevented by a small wooden dam. A short fishway could easily provide passage, but because of the small size of the pond it is doubtful that the population could be increased substantially. It is suspected that a smelt run exists in the west branch but attempts to locate an egg set were unsuccessful.

East Branch:

The east branch of the Westport River flows southward from Lake Noquochoke (150 acres) to Forge Pond (4 acres), and from there 10 miles to its junction with the west branch. Concrete dams over 10 feet high block passage at Forge Pond and Lake Noquochoke. While the latter impoundment offers a sizable

East Branch - Westport River
Westport, Massachusetts

The east branch of the Westport River flows southward from Lake Noquachoke (165 acres) to Forge Pond (5 acres) then to its junction with the west branch and into Rhode Island Sound. This river branch has a length of 7.9 statute miles, maximum width 1.0 statute miles, mean width 0.4 statute miles, maximum depth 19-22 feet and a mean depth of 3.1-6.1 feet.

Major obstructions (> 10 feet height), block upstream migration at the outlets of Forge Pond and Lake Noquochoke. Fiske, et al. 1968 calculated the harvestable alewife potential, of Lake Noquochoke, to be 89,000 pounds per year. While the sizable spawning area offered by this impoundment is recognized, the economic feasibility of providing fish passage may be questionable. Construction of the two fishways would be costly due to size and location. In addition, Lake Noquochoke experiences wide water level fluctuations when the city of Fall River diverts water to augment its domestic supplies.

On 9 July a field inspection and routine water chemistry was conducted at 5 locations along the East Branch of the Westport River system:

Noquochoke Lake	Station 1
Route 6 Noquochoke Lake	Station 2
Forge Pond Dam	Station 3
Head of Westport	Station 4
Hix Bridge	Station 5

Water temperatures were seasonal, water color light brown, turbidity low and pH circumneutral (6.4-6.8) at Stations 1-4. Testing for total hardness revealed soft water at all stations above the Hix Bridge. Alkaline water pH 8.3 was collected at Station 5 (Hix Bridge). Hix Bridge is approximately 6 miles upstream, is tidal, salinity was 17.5 °/₀₀ at the time of sampling.

TABLE 1.

1985 - East Branch Westport River

Station	Time (hr)	Water Temp. °C	Color Standard Units	Turbidity FTU Units	pH Standard Units	Alkalinity Total mg/1 $CaCO_3$
1	7:05	22.5	140	22	6.4	16
2	7:31	23.5	130	20	6.6	12
3	7:40	22.3	110	20	6.8	8
4	7:58	20.7	148	22	6.6	10
5	8:26	23.7	65	13	8.3	72

Station	Hardness mg/1 $CaCO_3$	Dissolved Oxygen ppm	% Saturation
1	24	6.6	71
2	18	7.2	86
3	16	8.3	96
4	16	8.7	97
5	> 200	8.3	99

This station produced the greatest number of alewives during a 1968 DMF haul seine program on the Westport River. Dissolved oxygen levels were good and saturation levels excellent.

Assessment:

1) East branch of the Westport River presently supports a population of river spawning alewives.

2) Lake Noquochoke has a potential to add substantially to the total alewife productivity of the Westport River.

3) Water quality appears favorable to a wide variety of species including the alewife.

Recommendations:

1) Minimize impediments to fish passage.

2) Periodically evaluate water quality and use.

3) Conduct preliminary cost analysis on fish passage construction at Forge Pond and Lake Noquochoke.

spawning area, the economic feasibility of providing fish passage is questionable. The two fishways would be costly due to construction problems involved. In addition, the city of Fall River diverts water from Lake Noquochoke to augment its water supply, resulting in wide water level fluctuations.

The stream below Forge Pond offers approximately one mile of potential shad spawning ground. The bottom is comprised of gravel and sand, and salinity is generally absent throughout this stretch. The area is now under consideration for shad stocking. A more comprehensive study of bottom type to determine population potential, should be undertaken.

Smelt spawning is suspected in the east branch, but no egg sets have been found. Records from the Massachusetts Division of Fisheries and Game state that 5,325,000 eggs and 450,000 fry were stocked between 1917 and 1924.

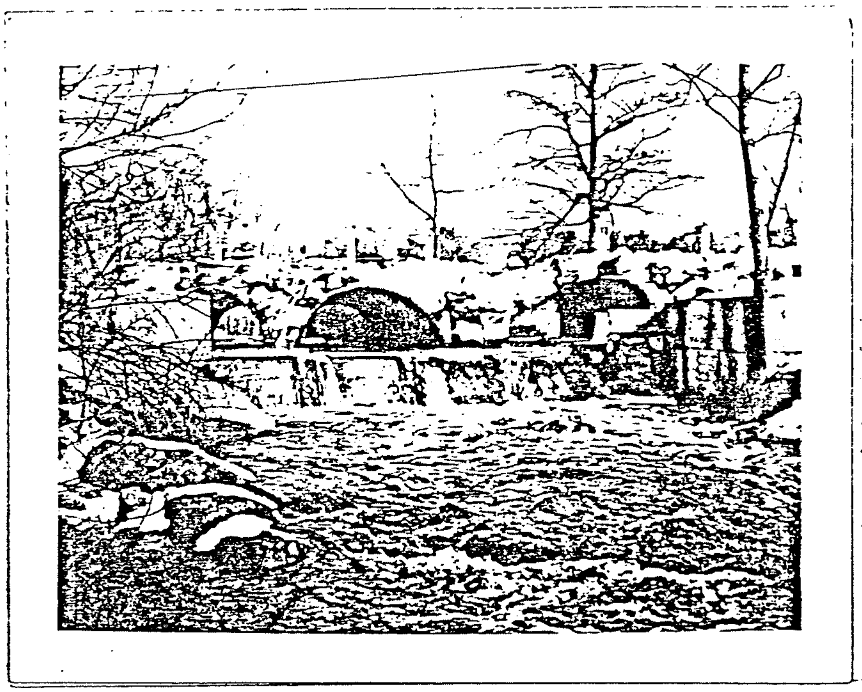
PASKAMANSETT (SLOCUM) RIVER

The Paskamansett River flows 10 miles from Turner Pond (59 acres) through the town of Dartmouth to Buzzards Bay. Two small impoundments are formed along its course. The uppermost Smith Mills Pond (10 acres), is formed by a 3.5-foot stone and concrete dam and the lower impoundment Russell's Mills Pond (1.5 acres), by a 7-foot concrete dam. The latter dam has a 60-foot fishway.

Since 1968, the fish ladder has not operated because of new road construction and inefficient fishway design. Alewives

Paskamanset River, Dartmouth 1973-74

Due to technical and personnel problems, only the excavation and foundation of this fishway was completed by July of 1974. All construction was completed on September 25, 1974 (Figure 9).



Paskamanset River, Dartmouth

Figure 9

Turner Pond - Paskamanset River
(New Bedford - Dartmouth)

The Paskamanset River flows 10 miles from Turner Pond (62 acres), through the town of Dartmouth, into the head of Slocums River (Figure 1). Two small impoundments, Smith Mills Pond (10 acres) headed by a 3.5 foot stone and concrete dam, and Russells Mills Pond (1.5 acres) with a 7 foot concrete dam, are formed along its course. A 60 foot fishway provides passage at the Russells Mills dam site.

In June 1981, a field team of the Massachusetts Division of Fisheries and Wildlife assessed Turner Pond as an infertile, mud bottomed, warmwater pond with a mean and maximum depth of 4 feet and 20 feet respectively. The pond is bisected by High Hill Road, where a submerged culvert (18-20 inches below water surface) links the two sections. Emergent vegetation covered 40 percent of the pond surface area and the 2.3 miles of shoreline was undeveloped.

Pond water was brown in color with poor transparency. At the time of sampling pH was 4.2, and total alkalinity was exhausted. Vegetation and sediment conditions determined the pond unsuitable for liming. The prognosis for the sparse fisheries population, dominated by yellow perch in poor condition, was not good.

Responding to Dartmouth Conservation Commission inquiries of possible alewife or blueback herring restoration efforts by the town and the Division of Marine Fisheries, Division personnel reassessed the Turner Pond - Paskamanset River system on 2 November, 1984.

Total alkalinity in the pond remained completely exhausted and pH is essentially unchanged. Readings of 4.4, 4.5, and 4.2 were recorded at the three sampling locations (Figure 2). Water color was dark-brown and moderately turbid 120-130 formazin turbidity units (FTU), classifying it as a muddy pond.

Dissolved oxygen was 6.5 ppm and percent saturation only 65. Saturation levels of 60% or below are considered poor.

Water quality of the Paskamanset River improved with pH values from 5.5-6.0 for the six sample sites. These levels are approximately 10 to 100 times less acidic than that of the head pond. Water color was light brown (apparent color units 425) and turbidity declined to an intermediate level (70-80 FTU). Human debris, plastic bags, paper, cans, and bottles was most evident at river stations 6 and 8.

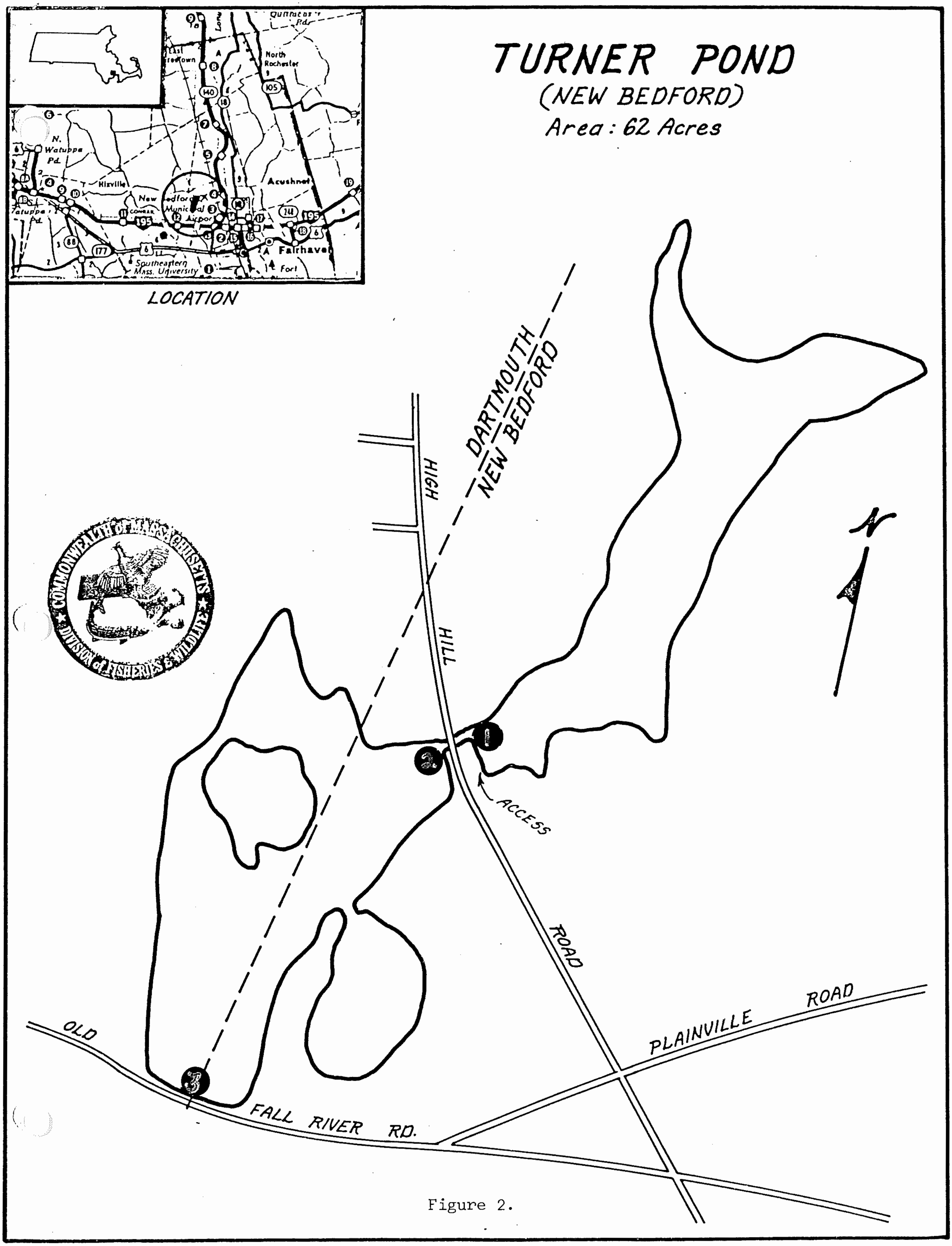
Three additional area stations (9, 10, and 11) were checked: stations 9 and 10 on Destruction Brook where pH values were 5.9 and water color light brown, and station 11 the Slocums River head with a pH of 6.3 and brown water. Station 11 is an area of tidal influence and though no salinity was measured, tide was low at the time of sampling, it is believed that salt intrusion does reach this station mediating any water quality or pH problems.

Assessment:

(1) No stocking of either alewife (Alosa pseudoharengus) or blueback herring (Alosa aestivalis) be undertaken for Turner Pond.

(a) The Pond has a low pH (4.2-4.5), alkalinity of 0.0, is mud bottomed, unlimeable, and moderately high turbidities (120-130 FTU).

(b) The submerged culvert at High Hill Road could pose a problem for fish access to the ponds upper half.



TURNER POND
(NEW BEDFORD)
Area : 62 Acres
LOCATION
North Rochester
Acushnet
N. Watuppa Pd.
Hixville
New Bedford Municipal Airport
Southeastern Mass. University
COMMONWEALTH of MASSACHUSETTS
DIVISION of FISHERIES & WILDLIFE
DARTMOUTH
NEW BEDFORD
HIGH HILL ROAD
ACCESS
OLD FALL RIVER RD.
PLAINVILLE ROAD
N

Figure 2.

1

TURNERS POND

(NEW BEDFORD)

SUMMARY

THIS REPORT SUMMARIZES DATA COLLECTED JUNE 23,, 1981, BY FISHERIES PERSONNE OF THE MASSACHUSETTS DIVISION OF FISHERIES AND WILDLIFE TO ASSESS THE FISH POPULATION AND MAKE APPROPRIATE MANAGEMENT RECOMMENDATIONS.

THE FISH SAMPLING OPERATIONS WERE CARRIED OUT BY THE FISHERIES CREW FROM THE SOUTHEAST WILDLIFE DISTRICT UNDER THE DIRECTION OF JAMES KENNEDY , DISTRICT FISHERIES MANAGER.

I. LAKE ASSESSMENT: THIS INFERTILE, 133, ACRE WARM WATER POND IS LOCATED OFF HIGH HILL ROAD WHICH BISECTS THE POND. ACCESS IS OFF HIGH HILL ROAD, . A DIRT LAUNCH IN POOR SHAPE IS PROVIDED BY TOWN OF NEW BEDFORD, AND I SUITABLE TO CAR TOP LAUNCHING, A UNPAVED PARKING AREA CAN ACCOMODATE APPROXIMATELY 2, CARS.

THE POND IS CHARACTERIZED BY BROWN WATER COLOR, TRANS-PARENCY OF 2,FT., PH OF 4,2, TOTAL ALKALINITY: 0,PPM,, TOTAL HARDNESS OF 12,PPM AND A SPECIFIC CONDUCTANCE OF . UMHOS/CM. THE MEAN AND MAXIMUM DEPTH ARE 4, FEET AND 20,FT, RESPECTIVELY, THE BOTTOM IS MUD THE 2,3 MILES OF SHORELINE ARE 0, PERCENT DEVELOPED, THERE ARE 0, RESIDENTIAL DWELLINGS, THE EMERGENT AQUATIC VEGATATION COVERS APPROXIMATELY 40, PERCENT OF THE SURFACE AREA.

II. FISH STOCK ASSESSMENT: THE FISH POPULATION WAS SAMPLED ON JUNE 23,,1981, USING GILL NETS AND SHOCKBOAT, THE 7 SPECIES OBSERVED, LISTED IN ORDER OF ABUNDANCE INCLUDED: YELLOW PERCH, BR, BULLHEAD, PUMPKINSEED, CHAIN PICKEREL BLACK CRAPPIE AND GOLDEN SHINER AND AMERICAN EELS.

A TOTAL OF 5, CHAIN PICKEREL WERE COLLECTED (1,8 TO 2,7 INCHES) REPRESENTING 5.9 % OF THE TOTAL FISH SAMPLE BY NUMBER AND 1,4% BY WEIGHT. MOST FISH ATTAINED THE LEGAL SIZE OF 1 ,0 INCHES AT YEARS OF AGE; A GROWTH RATE WHICH IS COMPARED TO THE STATE AVERAGE FOR THIS SPECIES. CONDITION FACTORS WERE . THE GAME FISH LISTED IN ORDER OF SAMPLE ABUNDANCE ARE: CHAIN PICKEREL ONLY.

NON-GAME FISH, IN ORDER OF ABUNDANCE INCLUDED: YELLOW PERCH,BROWN BULLHEAD,PUMPKINSEED,BLACK CRAPPIE AND GOLDEN SHINER. A TOTAL OF 52, YELLOW PERCH WERE COLLECTED (3.5 TO 8,2 INCHES) REPRESENTING 61.9 PERCENT OF THE TOTAL FISH SAMPLE BY NUMBER AND 40,0 PERCENT BY WEIGHT. THE GROWTH RATE IS BELOW AVERAGE COMPARED TO THE STATE AVERAGE. THE SAMPLE'S MEAN CONDITION FACTOR OF 29, IS VERY POOR .

PUMPKINSEEDS (8, COLLECTED) RANGED IN SIZE FROM 4.7 TO 6.6 INCHES. ANALYSIS OF GROWTH RATES INDICATED GOOD GROWTH COMPARED TO THE STATE AVERAGE FOR THIS SPECIES. THE MEAN SAMPLE CONDITION FACTOR OF 49, IS VERY POOR . PUMPKINSEEDS REPRESENTED 9.5 PERCENT OF THE TOTAL SAMPLE BY NUMBER AND 8.6 PERCENT BY WEIGHT.

BLACK CRAPPIE (1, COLLECTED) RANGED IN SIZE FROM 9.8 TO 9.8 INCHES AND ACCOUNTED FOR 1.2 PERCENT OF THE SAMPLE BY NUMBER AND 4.3 PERCENT BY WEIGHT. THE GROWTH RATE IS . CONDITION FACTORS ARE FOR THIS SPECIES.

GOLDEN SHINERS (1, COLLECTED) RANGED IN SIZE FROM 8.3 TO 8.3 INCHES AND ACCOUNTED FOR 1.2 PERCENT OF THE TOTAL SAMPLE BY NUMBER AND 2.9 PERCENT BY WEIGHT THE GROWTH RATES ARE .

THE FISH POPULATION IS OUT OF BALANCE DOMINATED BY STUNTED YELLOW PERCH. INTERESTINGLY, A 1972 SURVEY ENCOUNTERED SMALL BULLHEAD BUT ONLY ONE LARGE FISH WAS SAMPLED IN 1981. THE L/F SHEET SUGGESTS BLACK CRAPPIE BULLHEAD AND GOLDEN SHINERS HAVE POOR RECRUITMENT BUT AN INTENSIVE SURVEY WOULD BE NEEDED TO ESTABLISH THIS. THE LOW TOTAL ALKALINITY AND PH WOULD SUGGEST THIS POND AS AN EVENTUAL CASUALTY OF ACID DEPOSITION. YELLOW PERCH APPEAR TO DOMINATE ACID PONDS, ALTHOUGH THE CONDITION FACTORS INDICATE EVEN THIS SPECIES IS NOT DOING WELL HERE. THERE IS STILL EVIDENCE OF CHAIN PICKEREL REPRODUCTION. THE LONG TERM PROGNOSIS IS NOT GOOD CONSIDERING THE LOW ALKALINITY.

13.47.41.UCLP, AAT1P3014, 0.090KLNS.

Management Objectives:

(1) No management objectives will be set.

(a) The pond has a pH of 4.2, alkalinity of 0.0 and is unlimeable.

(b) If the pH remains as is, the fisheries will deteriorate.

Management Recommendations:

(1) Resurvey in four-five years to investigate effects of acid rain.

Length-Frequency Sheet

Date: 6/23-6/25/81 Location: Turners Pond Remarks: ______

Length (mm)	BB	BC	CP	GS	P	YP	Length (mm)
50–59			2				50–59
60–69			2				60–69
70–79							70–79
80–89			1 at 40-49				80–89
90–99						1	90–99
100–109						6	100–109
110–119						14	110–119
120–129					1	3	120–129
130–139						4	130–139
140–149					3	13	140–149
150–159					2	2	150–159
160–169	3				2	4	160–169
170–179						1	170–179
180–189	1						180–189
190–199	1					1	190–199
200–209	8					3	200–209
210–219	2			1			210–219
220–229	2						220–229
230–239							230–239
240–249							240–249
250–259		1					250–259
260–269							260–269
270–279							270–279
280–289							280–289
290–299							290–299
300–309							300–309
310–319							310–319
320–329							320–329
330–339							330–339
340–349							340–349
350–359							350–359
360–369							360–369
370–379							370–379
380–389							380–389
390–399							390–399
400–409							400–409
410–419							410–419
420–429							420–429
430–439							430–439
440–449							440–449
450–459							450–459
460–469							460–469
470–479							470–479
480–489							480–489
490–499							490–499
500–509							500–509
510–519							510–519
520–529							520–529
530–539							530–539
Total No.	17	1	5	1	8	52	
Weight: Kg.							
Lbs.	3.02	0.31	Trace	0.19	0.65	2.81	

American EELS Present

Length-Frequency Sheet

Date: 6/23/81 Location: Turner Pond Remarks: 10 min. shock

Length (mm)	CP	P	YP		Length (mm)
50-59					50-59
60-69	/				60-69
70-79					70-79
80-89					80-89
90-99			/		90-99
100-109			/		100-109
110-119					110-119
120-129		/			120-129
130-139					130-139
140-149			/		140-149
150-159			/		150-159
160-169			2		160-169
170-179					170-179
180-189					180-189
190-199					190-199
200-209			/		200-209
210-219					210-219
220-229					220-229
230-239					230-239
240-249					240-249
250-259					250-259
260-269					260-269
270-279					270-279
280-289					280-289
290-299					290-299
300-309					300-309
310-319					310-319
320-329					320-329
330-339					330-339
340-349					340-349
350-359					350-359
360-369					360-369
370-379					370-379
380-389					380-389
390-399					390-399
400-409					400-409
410-419					410-419
420-429					420-429
430-439					430-439
440-449					440-449
450-459					450-459
460-469					460-469
470-479					470-479
480-489					480-489
490-499					490-499
500-509					500-509
510-519					510-519
520-529					520-529
530-539					530-539
Total No.	1	1	7		
Weight: Kg.					
Lbs.	trace	0.01	0.65		

Selective Pickup

Length-Frequency Sheet
Turners Pond (A)

Date: 6/23/81 **Location:** New Bedford **Remarks:** Shock

Length (mm)	BB	BC	CP	GS	YP	Length (mm)
50-59			2			50-59
60-69			1			60-69
70-79						70-79
80-89			1 at 40-49mm			80-89
90-99						90-99
100-109						100-109
110-119					1	110-119
120-129						120-129
130-139					1	130-139
140-149					1	140-149
150-159					1	150-159
160-169						160-169
170-179					1	170-179
180-189						180-189
190-199	1				1	190-199
200-209	1				2	200-209
210-219	2			1		210-219
220-229						220-229
230-239						230-239
240-249						240-249
250-259		1				250-259
260-269						260-269
270-279						270-279
280-289						280-289
290-299						290-299
300-309						300-309
310-319						310-319
320-329						320-329
330-339						330-339
340-349						340-349
350-359						350-359
360-369						360-369
370-379						370-379
380-389						380-389
390-399						390-399
400-409						400-409
410-419						410-419
420-429						420-429
430-439						430-439
440-449						440-449
450-459						450-459
460-469						460-469
470-479						470-479
480-489						480-489
490-499						490-499
500-509						500-509
510-519						510-519
520-529						520-529
530-539						530-539
Total No.	4	1	4	1	8	
Weight: Kg.						
Lbs.	0.56	0.31	Trace	0.19	0.91	

Length-Frequency Sheet

Date: 6/22/81 **Location:** Turner Pond New Bedford **Remarks:** Gill Net

Length (mm)	BB		Length (mm)
50-59			50-59
60-69			60-69
70-79			70-79
80-89			80-89
90-99			90-99
100-109			100-109
110-119			110-119
120-129			120-129
130-139			130-139
140-149			140-149
150-159			150-159
160-169			160-169
170-179			170-179
180-189			180-189
190-199			190-199
200-209	/		200-209
210-219			210-219
220-229			220-229
230-239			230-239
240-249			240-249
250-259			250-259
260-269			260-269
270-279			270-279
280-289			280-289
290-299			290-299
300-309			300-309
310-319			310-319
320-329			320-329
330-339			330-339
340-349			340-349
350-359			350-359
360-369			360-369
370-379			370-379
380-389			380-389
390-399			390-399
400-409			400-409
410-419			410-419
420-429			420-429
430-439			430-439
440-449			440-449
450-459			450-459
460-469			460-469
470-479			470-479
480-489			480-489
490-499			490-499
500-509			500-509
510-519			510-519
520-529			520-529
530-539			530-539
Total No.	1		
Weight: Kg.			
Lbs.	0.15		

Length-Frequency Sheet

Date: 6/24/81 Location: Turners Pd. [G] Remarks: Day Shocking
Selective Pickup

Length (mm)	BB	P	VP		Length (mm)
50-59					50-59
60-69					60-69
70-79					70-79
80-89					80-89
90-99					90-99
100-109			3		100-109
110-119			6		110-119
120-129			2		120-129
130-139			1		130-139
140-149		1	4		140-149
150-159		1			150-159
160-169	2	1	1		160-169
170-179					170-179
180-189					180-189
190-199					190-199
200-209	3				200-209
210-219					210-219
220-229	1				220-229
230-239					230-239
240-249					240-249
250-259					250-259
260-269					260-269
270-279					270-279
280-289					280-289
290-299					290-299
300-309					300-309
310-319					310-319
320-329					320-329
330-339					330-339
340-349					340-349
350-359					350-359
360-369					360-369
370-379					370-379
380-389					380-389
390-399					390-399
400-409					400-409
410-419					410-419
420-429					420-429
430-439					430-439
440-449					440-449
450-459					450-459
460-469					460-469
470-479					470-479
480-489					480-489
490-499					490-499
500-509					500-509
510-519					510-519
520-529					520-529
530-539					530-539
Total No.	6	3	17		
Weight: Kg.					
Lbs.	1.06	0.25	0.53		

Length-Frequency Sheet

Date: 6/25/81 Location: Turners Pond [B] Remarks: N TE Shock

Selective Pickup

Length (mm)	BB	P	YP		Length (mm)
50-59					50-59
60-69					60-69
70-79					70-79
80-89					80-89
90-99					90-99
100-109			2		100-109
110-119			7		110-119
120-129			1		120-129
130-139			2		130-139
140-149		2	7		140-149
150-159		1			150-159
160-169	1	1	1		160-169
170-179					170-179
180-189	1				180-189
190-199					190-199
200-209	3				200-209
210-219					210-219
220-229	1				220-229
230-239					230-239
240-249					240-249
250-259					250-259
260-269					260-269
270-279					270-279
280-289					280-289
290-299					290-299
300-309					300-309
310-319					310-319
320-329					320-329
330-339					330-339
340-349					340-349
350-359					350-359
360-369					360-369
370-379					370-379
380-389					380-389
390-399					390-399
400-409					400-409
410-419					410-419
420-429					420-429
430-439					430-439
440-449					440-449
450-459					450-459
460-469					460-469
470-479					470-479
480-489					480-489
490-499					490-499
500-509					500-509
510-519					510-519
520-529					520-529
530-539					530-539
Total No.	6	4	20		
Weight: Kg.					
Lbs.	1.25	0.31	0.72		

SPECIES COMPOSITION PERCENT BY NO. [illegible]

TURNERS POND, NEW BEDFORD

SPECIES	NUMBER	PERCENT BY NO.	WEIGHT LBS.	PERCENT BY WT.
YP	52.	61.90	2.8	40.00
BB	17.	20.24	3.0	42.86
P	8.	9.52	.6	8.57
CP	5.	5.95	.1	1.43
GS	1.	1.19	.2	2.86
BC	1.	1.19	.3	4.29
	84.		7.0	

P

AVERAGE LENGTH AT EACH ANNULUS

	I	II	III	IV	V	VI	VII	VIII	IX	X
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	54.	116.	0.	0.	0.	0.	0.	0.	0.	0.
	69.	118.	152.	0.	0.	0.	0.	0.	0.	0.
AVE GROWTH,MM	62.	117.	152.	0.	0.	0.	0.	0.	0.	0.
AVE GROWTH,IN	2.4	4.6	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD,MM	10.5	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SD,IN.	.4	.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEAN WT,LBS.	0.0	.1	.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAP. LENGTH	0.	125.	165.	0.	0.	0.	0.	0.	0.	0.
C FACTOR	0.	52.	46.	0.	0.	0.	0.	0.	0.	0.
SD OF CF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OVERALL C 49.

NO. OF FISH EACH AGE CLASS

0	1	1	0	0	0	0	0	0	0

COEFICIENT OF VARIATION

0.00	.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

IF THE COVAR. VALUES DIFFER GREATLY, RECHECK AGING

CONDITION FACTORS C BY ORDER OF INCREASING AGE CLASS

AGE CLASS 2

52.

AGE CLASS 3

46.

YP

AVERAGE LENGTH AT EACH ANNULUS

	I	II	III	IV	V	VI	VII	VIII	IX	X
	89,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	50,	77,	0,	0,	0,	0,	0,	0,	0,	0,
	76,	113,	132,	0,	0,	0,	0,	0,	0,	0,
	81,	128,	147,	164,	0,	0,	0,	0,	0,	0,
	68,	113,	127,	145,	162,	0,	0,	0,	0,	0,
	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	75,	111,	129,	143,	156,	165,	175,	0,	0,	0,
	90,	104,	120,	143,	155,	167,	181,	194,	0,	0,
	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
	71,	137,	161,	170,	185,	193,	207,	218,	230,	236,
AVE GROWTH,MM	73,	110,	133,	149,	161,	171,	183,	206,	230,	236,
AVE GROWTH,IN	2,9	4,3	5,2	5,9	6,4	6,7	7,2	8,1	9,1	9,3
SD,MM	17,1	21,6	17,7	17,0	17,4	20,3	22,3	17,0	0,0	0,0
SD,IN,	,7	,9	,7	,7	,7	,8	,9	,7	0,0	0,0
MEAN WT,LBS,	,0	,0	,1	,1	,1	0,0	,1	,2	0,0	,2
CAP, LENGTH	105,	120,	144,	168,	168,	0,	184,	205,	0,	245,
C FACTOR	44,	31,	28,	22,	27,	0,	27,	30,	0,	24,
SD OF CF	0,0	10,7	9,3	0,0	6,0	0,0	1,0	0,0	0,0	0,0

OVERALL C 29,

NO, OF FISH EACH AGE CLASS

1	2	3	1	2	0	3	1	0	1

COEFICIENT OF VARIATION

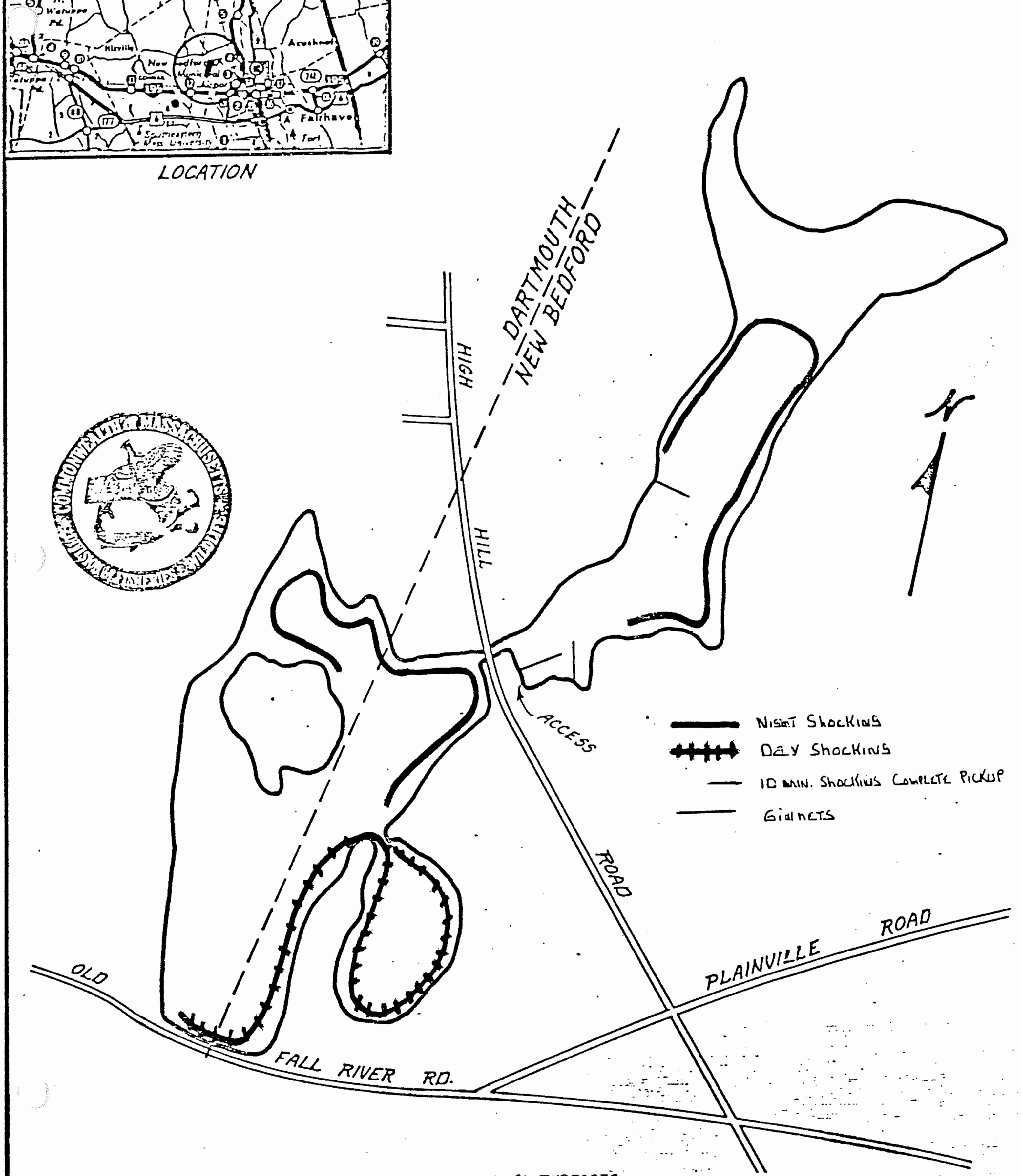
,92	,78	,52	,45	,42	0,00	,48	,32	0,00	0,00

IF THE COVAR, VALUES DIFFER GREATLY, RECHECK AGING

CONDITION FACTORS C BY ORDER OF INCREASING AGE CLASS

AGE CLASS 1
44.
AGE CLASS 2
38.
23.
AGE CLASS 3
19.
29.
37.
AGE CLASS 4
22.
AGE CLASS 5
23.
31.
AGE CLASS 7
28.
26.
27.
AGE CLASS 8
30.
AGE CLASS 10
24.

TURNER POND
(NEW BEDFORD)
Area: 62 Acres



2-82

NOT TO BE USED FOR NAVIGATIONAL PURPOSES

MASSACHUSETTS DIVISION OF FISHERIES & GAME
Biological Survey of Waters; Chemical Analysis

Name: TURNER 1 Lake (Pond) Reservoir Township: NEW BEDFORD No.___

Data by KENNEDY COMICK NELSON Air Temp.: 70 °F. Date 6/22/81

Station:________ Time:________ Transparency 1/2 M.

Depth (ft.)	Temp. (°F)	Sample No.	Time	D.O. (ppm)	pH				HARD	Total Alk.
SURF	68				4.2				10	0

Weather: CLOUDY & WINDY

Other Remarks: SHALLOW WEEDY POND
DEPTH ≅ 6ft MUD BOTOM
NO HOUSES
WATER COLOR VERY DARK

MASSACHUSETTS DIVISION OF FISHERIES & GAME
Biological Survey of Waters; Chemical Analysis

(B)

Name: TURNERS Lake / (Pond) / Reservoir Township: NB No.

KENNEDY, CORMICK

Data by Nelson Air Temp.: 71 °F. Date 6/29/81

Station: Time: Transparency 1/2 M

Depth (ft.)	Temp. (°F)	Sample No.	Time	D.O. (ppm)	pH				HARD	Total Alk.
SUR	70				4.2				12	0

Weather: WARM, WINDY + PARTLY CLOUDY

Other Remarks: WATER VERY DARK – MUD BOTTOM
HEAVY AQUATIC WEEDS AROUND SHORE LINE
DEPTH – 4-6 ft
NO HOUSES

continue to spawn either below the dam or in a small tributary called Destruction Brook. The town of Dartmouth has gained local control of the fishery under Section 94 of Chapter 130, and has adopted regulations to protect the population until upstream access has been reestablished.

In order to provide adequate passage to Russell's Mills Pond, the fishway must be altered and a barrier dam constructed. Fishways should also be constructed at Smith Mills and Turner Ponds. This would provide 79 acres of potential spawning area.

A short section of the river below Russell's Mills dam is a smelt spawning area. Adult smelt and eggs have also been observed in Destruction Brook.

ACUSHNET RIVER

The Acushnet River flows southward from New Bedford Reservoir (200 acres) for 8 miles to Buzzards Bay. Water condition is poor throughout most of its length, being turbid, discolored and polluted. As the river passes through the city of New Bedford, pollution due to domestic and industrial wastes increases greatly.

Three dams form impoundments on the stream. The first (7 acres), at the Acushnet Sawmill, has been equipped with a concrete fishway. Alewives ascend the river to this point annually, and some have used the fishway since its construction in 1969. The second dam, forming a 7-acre impoundment at Hamlin Street, and the third at the New Bedford Reservoir, block any further migration.

Further development is dependent on pollution abatement and provision of passage facilities to New Bedford Reservoir. Water quality in the lower section of the river must be improved before fishway construction is considered.

MATTAPOISETT RIVER

The Mattapoisett River originates in Snipatuit Pond (735 acres) and flows 12 miles through the towns of Rochester and Mattapoisett to Buzzards Bay. The alewife run supports a fishery which is shared by the towns of Rochester, Mattapoisett and Marion. In 1970, 80 barrels were harvested.

The first obstruction to fish migration is a stone and concrete dam with wooden flashboards. Boards are removed for at least three days each week during the alewife run, allowing free passage. On fishing days the boards are replaced, making fish susceptible to netting from a platform below the dam.

The second obstruction on the river is a collapsed dam at what was formerly Hartley Mill Pond. Although alewives do manage to ascend the small raceway, its removal or replacement with a fish ladder would facilitate passage. Another obstacle is a culvert at Snipatuit Road. In early spring, the culvert is completely filled with water and alewives do not enter it. When water levels fall and an air space is created, fish pass through readily. Replacement with a larger culvert or culverts in order to decrease drainage time and provide an air space over a longer period is the only practical solution to this problem.

Mattapoisett River - Rochester & Mattapoisett
Massachusetts

The Mattapoisett River originates from Snipatuit Pond and flows 12 miles through the towns of Rochester and Mattapoisett to Buzzards Bay. This relatively large (710 acre) warm water pond has a maximum depth of 6 feet and an average depth of five feet. Due to its shallowness, the pond does not thermally stratify during summer months. Water is highly colored and transparency only 2 feet. The bottom type is predominantly mud and the aquatic vegetation is moderate to heavy along the shoreline. Approximately 20% of the pond's shoreline is developed with cottages and cranberry bogs. Long Pond also contributes to the Mattapoisett River drainage.

Concurrent with the large alewife spawning grounds, the pond supports such game fish as pickerel, largemouth bass, white perch and chain pickerel. A small number of American shad (*Alosa sapidissima*) were experimentally introduced into the river proper in 1968 and 1969.

The alewife fishery of the Mattapoisett River is shared by the towns of Rochester, Mattapoisett, and Marion. In addition to the benefits of the spring fishery, the juvenile alewives provided excellent forage for the gamefish sought throughout the river and its headwater ponds.

Several obstacles are encountered by migrating fish in the Mattapoisett River. The first of these is a stone and concrete dam with flashboards at the Route 6 catching pool. Boards must be removed for successful fish passage. The second obstruction is a collapsed dam at Hartley Mill Pond which fish ascend with some difficulty. Additional obstacles are: submerged culverts under Snipatuit Road, and aquatic vegetation which chokes stream flow between the pond outflow and Snipatuit Road.

TABLE 1. APRIL 1985

SNIPATUIT POND - MATTAPOISETT RIVER

ROCHESTER - MATTAPOISETT

Station	Air Temp. °C	Water Temp. °C	Color Standard Units	Turbidity FTU Units	pH Standard Units	Alkalinity Total mg/l $CaCO_3$
1	4.5	7.5	140	28	6.8	4.2
2	4.5	6.4	110	20	6.4	3.0
3	6.0	7.6	100	18	6.6	3.0
4	6.0	7.9	130	22	6.7	3.4
5	10.0	7.9	130	20	6.4	3.1
6	8.0	7.8	140	20	6.1	2.9

Responding to requests from local officials, a field inspection at six locations (Figure 1) and routine water chemistries (Table 1) were conducted within the system:

1. Snipatuit Pond Causeway
2. Snipatuit Road Culvert
3. Hartley Road Bridge
4. Rounseville Road Bridge
5. Manuel R. Nunes Bridge
6. Route 6 Weir Pool

Water temperatures were seasonal, pH values circumneutral (6.1-6.8) and water color rusty brown (100-140 APHA apparent color). Turbidity readings, formazin turbidity units (FTU), were characteristic of clear water in the river samples and intermediate (clear - muddy) for Snipatuit Pond. Total alkalinity readings ranged from 2.9 mg/l to 4.2 mg/l $CaCO_3$. Alkalinity levels at all six sampling stations fall under the Commonwealth's endangered classification in regard to the effects of acid precipitation. The highest reading, 4.2 mg/l, was seen in Snipatuit Pond. Pond buffering capacity, however, has declined from the level found in a 1978 Fish & Wildlife survey when alkalinity was 6 mg/l and classified as "highly sensitive".

Morphoedaphic index indicates Snipatuit Pond is moderately productive with a calculated annual value of 5,8 lbs/acre/year (4,153 lbs/year total). Preliminary calculations estimate, with suitable spawning substrate, an alewife population of between 350,000 to 700,000 fish could be supported by Snipatuit Pond.

Assessment

1) Water quality appears adequate to support river herring migrations, spawning and survival.

2) Pond and river total alkalinity levels indicate classification under the Commonwealth's "endangered" category.

3) Present buffering capacity appears to be declining.

4) Potential spawning acreage is sufficient to sustain a substantial alewife population.

Recommendations

1) Minimize river blockages and obstructions.

2) Maintain adequate water levels for migrating adults and emigrating juvenile alewives.

3) Periodically evaluate water alkalinity levels.

The Massachusetts Division of Fisheries and Game has initiated a shad stocking program in the Mattapoisett River under the Anadromous Fisheries Restoration Act, Project AFS 6. Adult shad obtained from the Palmer River have been transplanted and released below the dam at Hartley Mill Pond. Fifty males and 28 females were released in 1968. Forty-six males and 34 females were transferred in 1969. The program is expected to continue for at least four years after which the results will be compared with those of an egg planting program being carried on in the Agawam River.

SIPPICAN RIVER

The Sippican River drains swamp lands in the town of Rochester. There are numerous impoundments used for cranberry bog irrigation on both branches of the river. The branches converge and form Leonards Pond (42 acres). The river flows 1 mile to Hathaway Pond (18 acres). Nine miles below Hathaway Pond, the Sippican River joins the Weweantic River and enters Buzzards Bay.

Alewives have access to Hathaway Pond through a 110-foot fishway bypassing a 5-foot dam. The fishway needs repair, is poorly located and lacks necessary attraction flow. A new ladder should be built and since there is no passage past the 5-foot dam at Leonards Pond, a fishway should be constructed here also. This would triple the available spawning area for alewives.

The Sippican River may be capable of supporting a shad population. Bottom sampling should be conducted to determine the spawning area available and calculate the size of a potential population.

Smelt are believed to spawn in the stream, although no egg sets have been observed. Records indicate that over 3 million fry were stocked in 1918. Attempts to ascertain the existence of a smelt run should be continued.

WEWEANTIC RIVER

The source of the Weweantic River is several ponds and swamps in the towns of Carver and Plymouth from where it flows 14 miles through a myriad of cranberry bogs and small impoundments to Buzzards Bay. The first obstruction to fish passage is a 10-foot dam at Horseshoe Pond (85 acres), Wareham, 4 miles from the river mouth. Some alewives manage to reach the pond during high tidal phases through a bypass at an abandoned mill site. The present run is highly dependent on yearly stocking and possibly some natural spawning in the river. During the period from 1964 to 1967, 15,600 adult alewives were stocked in the pond.

A 20-foot dam in the Tremont area of Wareham prevents further upstream migration. According to Belding (1921), alewives formerly ascended the river as far as Wareham and Sampson Ponds. Today numerous bog dams and poor water regulation prohibit fish passage to these ponds. Thus, Horseshoe Pond is the only available spawning area for alewives. A fishway or or modification of the existing bypass should be constructed to insure adequate passage.

The river below Horseshoe Pond supports an excellent smelt fishery. The fishery is unique in that the General Laws which prohibit fishing during the spawning season, do not apply. Under a Special Act of the legislature passed in 1931, the town of Wareham may grant permits to residents of the towns of Wareham, Rochester, Marion and Mattapoisett authorizing them taking smelt from March 1, to April 1, by means of nets of not more than 5 ft^2.

The continued success of this fishery raises doubts concerning the biological validity of the regulations in the General Laws which are based on the premise that the smelt are too vulnerable both as adults and in the egg stage during the spawning season to support a sustained fishery. It is recommended that a study of the effects of more liberal harvests of smelt be undertaken to determine if greater utilization can be made of smelt populations in our coastal streams.

Bottom sampling should be conducted to determine the potential shad spawning area below Horseshoe Pond.

WANKINCO RIVER

The Wankinco River flows 7 miles from East Head Pond in Plymouth and Carver to its junction with the Agawam River in Wareham. The river runs through cranberry bogs and impoundments. Tihonet Pond (90 acres) in Wareham has a 6-foot wooden dam. Two

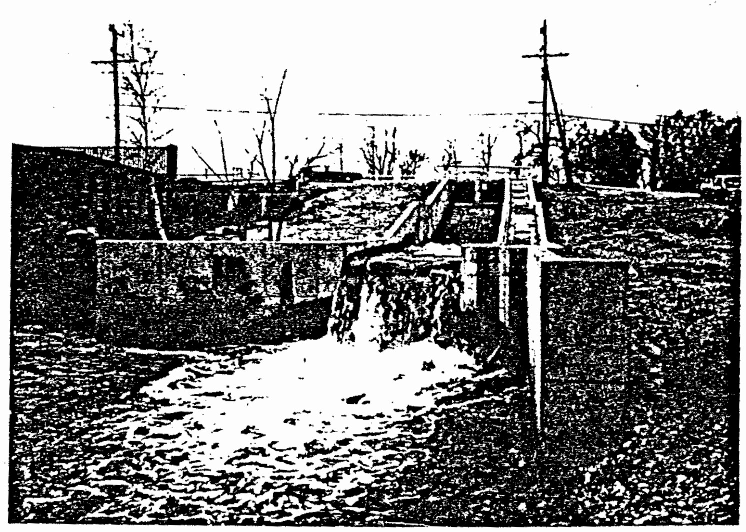
Job No. 1 Construction and Improvement of Fish Passage Facilities - 1975-76

Parker Mills Pond, Wareham: During AFCS-14-2 a three foot wide Denil fishway was constructed at Parker Mills Pond, Wareham. This ladder and sluiceway overcomes an elevation of 15', is 16' wide, 130' long and is constructed of reinforced 3,000 lb. air entrained concrete.

The old fishway had deteriorated beyond use and competed for water with another sluiceway.

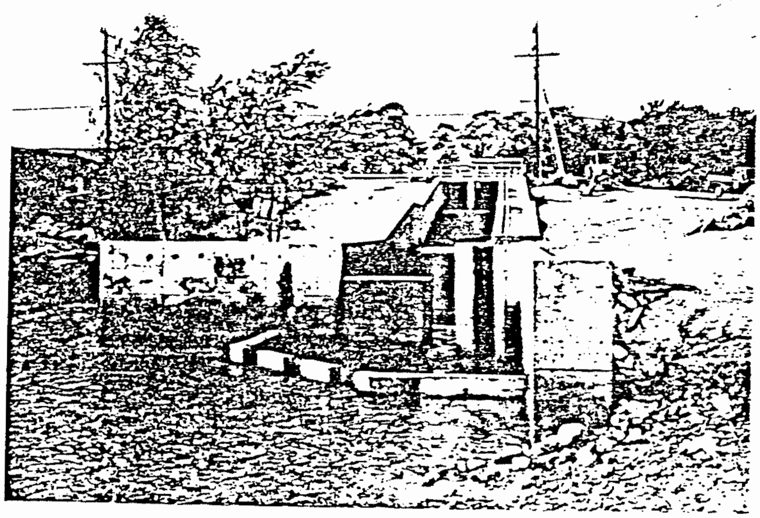
The new facility handles all the water (except during flood conditions) through an adjoining sluice which places the entire flow adjacent to the fishway's entrance (Figure 1).

During the recent migration season, the new ladder passed a great number of fish. However, it was evident that since the stream bed is almost dry at low tide, alewives have a problem entering the ladder at less than 1/3 tide. Fish and Wildlife hydraulics engineer, Benedetto Rizzo, visited the facility and made some recommendations. During the coming construction season, the fishway entrance and pad will be modified to allow better fishway access.



1976-77

Parker Mills Pond, Wareham: While monitoring the new facility constructed at this site during the last project segment, it was noted that alewives had difficulty negotiating the fishway entrance during lower tidal stages. Corrective modifications were undertaken as an alternative to the Agawam River project. Based upon a site visit and recommendations by Ben Rizzo, US Fish and Wildlife Service, the splash pad below the fishway and barrier dam was extended and a 15" dam constructed along its edge to increase water depth in front of the fishway entrance. A pool was excavated below the dam to provide a resting or schooling area at low tide. As a result of this modification, alewife passage was markedly improved during the 1977 season.



Parker Mill Pond, Wareham

(Modified entrance)

Job No. 1. Construction and Improvement of Fish Passage Facilities - 1977-78

1977-78

Tihonet Pond, Wareham: A Denil fishladder was constructed on the east side of Tihonet Pond, Wareham.

Construction consisted of modifying a 45' long wooden sluice to include six weirs and allow water adjustment and fish passage beneath Tihonet Road through three 30" culverts. Directly below these culverts and adjacent to the stream a 76' Denil ladder and barrier dam was constructed of reinforced 3000 lb, air entrained concrete. The ladder is 2' wide and overcomes 10' ± in elevation. It includes two 30'+ Denil sections and a 10' resting pool with a depressed floor.

The entrance to the ladder includes a 4' high, 12' long barrier dam and two retaining walls totalling 27' in length. Construction also includes the capability of bypassing excess water without disrupting fish passage.

other outlets exist but have larger obstructions. Below Tihonet Pond is Parker Mills Pond (95 acres) which is the primary spawning area for alewives.

Fish reach the pond by way of a 110-foot weir-pool fishway at the Tremont Nail Factory in Wareham. The fishway is in poor condition ~~and should be reconstructed.~~ completed 1976-77 A barrier dam should also be built to increase the efficiency of the ladder. A fishway should also be built at Tihonet Pond under the provisions of ~~Section 19.~~ completed 1977-78

AGAWAM RIVER

The Agawam River flows from Halfway Pond, Plymouth, 10 miles to meet the Wankinco River, Wareham, and at their confluence becomes the Wareham River which empties into Buzzards Bay. There are four large impoundments, totaling 570 acres, on the river. Each is equipped with a fishway and alewives are able to ascend the river to its headwaters. The largest impoundments are Halfway Pond (203 acres), Glen Charlie Pond (163 acres), and Mill Pond (160 acres).

The first fishway is at Mill Pond and is 100 feet long, surmounting a 10-foot elevation. The upper portion runs through a culvert under Route 28 and must be cleaned of debris regularly. A catching platform is located at the base of the fishway. The town of Wareham operates a commercial fishery here. In 1970, the alewife catch was 12.4 barrels. The second fishway overcoming a 20-foot elevation at Glen Charlie Pond is

1000 feet long, but only 14 inches wide. Most of the ladder is constructed of wood and requires continual maintenance. A new concrete fishway of shorter length should be constructed at this location. A similar problem exists at the third fishway at the upper end of Glen Charlie Pond. Its location is adequate but it is constructed entirely of wood and subject to vandalism and deterioration. It should be reconstructed with concrete. The last fishway is at the outlet of an unnamed bog reservoir. It is also constructed of wood and the entrance is poorly located. A new concrete fishway should be constructed at this site also.

A smelt population exists in the river and spawning occurs just below Mill Pond. During late winter and early spring, smelt as well as white perch and tomcod, are caught by snagging in the estuarine portion of the river. The feasibility of opening the river to smelt fishing during the closed season on an experimental basis should be considered. At present, the smelt resource is under utilized and could withstand increased harvest.

In the spring of 1968, the Division of Fisheries and Game initiated a shad propagation program in the Agawam River. Fertilized eggs, obtained from the Connecticut River, were broadcast into the stream at a number of locations in an effort to establish a self-sustaining population. A total of 420,200 eggs were planted in 1968 and another 399,300 were planted in 1969. As stated earlier, the results of this type

Agawam River, Wareham

The second fishway on the Agawam River is a 600-foot long wooden structure buried to ground level over most of its length. It had become badly deteriorated and washed out in several locations. It was necessary to replace several baffles, sections of side walls, and clean out and regrade the entire ladder in order to enable fish to pass during 1972.

Job No. 1 - Construction and Improvement of Fish Passage Facilities - Completed during 1978-79

Agawam River, Wareham: Construction of the fishway on the Agawam River at Glen Charlie Pond was not undertaken as scheduled due to refusal of one of the landowners to sign the project agreement. Under state law, the Director of Marine Fisheries is authorized to determine fish passage needs and provide the necessary facilities. The case has been referred to the Attorney General's office and is currently awaiting resolution.

Manpower resources programmed for this project were subsequently directed toward performing additional maintenance, propogation and biological investigations as noted on the approved amendment dated June 21, 1977. These additional activities are identified and elaborated upon in this report along with scheduled accomplishments.

introduction will be compared with the stocking of adults in the Mattapoisett River as part of AFS 6.

GIBBS BROOK

Gibbs Brook is a small stream in Wareham, draining Dicks Pond (41 acres). It is less than 0.5 mile in length and empties into Buzzards Bay. Alewives utilize Dicks Pond for spawning and support a small fishery. Although the stream passes through a 4-foot underground culvert for nearly 200 yards beneath the Ocean Spray Cranberry Company on U.S. Route 6, alewives pass through quite readily. This is unique since, in most cases, alewives are reluctant to enter culverts, especially those of small diameter and great length.

It is recommended that the town of Wareham petition for control of its alewife fishery under Section 94 of Chapter 130.

RED BROOK (WAREHAM)

The source of Red Brook is White Island Pond (288 acres) in the towns of Plymouth and Wareham. It flows south 4.5 miles to Buzzards Bay. Although White Island Pond offers an excellent spawning ground for alewives, attainment of maximum production is hindered by many obstructions on the stream. The first is a small wooden dam at Red Brook Road which is passable only on flood tides. Above this point, the stream passes through a complex of cranberry bogs. The many bog dams necessitate careful water regulation by the bog owners to insure adequate passage. Although the bog owners endeavor to control water flow so fish are able to pass, the run will not reach its potential until upstream and downstream migration of both juveniles and adults is completely unimpeded.

BOURNE POND BROOK

Bourne Pond Brook flows 400 yards from Bourne Pond (11 acres) to the Cape Cod Canal. An alewife run once existed here. Wooden baffles placed in the stream are in disrepair and the stream runs through two culverts, one of which is at the stream's outlet to the canal. Restoration of the run is not recommended due to limited spawning area and poor location of the stream outlet.

HERRING (MONUMENT) RIVER

The Herring River begins in Little Herring and Great Herring Ponds in Plymouth. While it formerly flowed directly into Buzzards Bay, construction of the Cape Cod Canal eliminated the lower section of the river and it now flows directly into the canal. The river is 1 mile in length and drops 34 feet in elevation.

Three fishways enable alewives to reach the upper spawning grounds. The first fishway is a series of ladders and pools which pass fish from the canal to a catching pool 700 feet from the entrance. The second fishway, 60 feet in length, provides passage from the catching pool to Foundry (Benoit's) Pond and the third fishway enables fish to reach a small unnamed

White Island Pond - Red Brook

(Wareham-Plymouth)

The Red Brook of Wareham flows 4.5 miles from White Island Pond (288 acres), its source, into Buttermilk and Buzzards Bay. Stream width varies from approximately 3 to 20 feet at sampling locations.

Spawning alewives and blueback herring ascending the run are hindered by a number of obstacles: a concrete bridge culvert at Red Brook Road; remains of a small wooden dam; a sluiceway at the Route 495 overpass; and a large complex of cranberry bogs along the greater part of its length.

White Island Pond's shoreline is heavily developed and no public access currently exists. As the waters are essentially private, little historical data is available for study and comparison.

On 26 November 1984, Division personnel conducted a base line evaluation of the water quality at four locations (Figure 1) along Red Brook:

Headwater - White Island Pond	-	Station 1
Bartlett Pond	-	Station 2
Interstate 495 overpass	-	Station 3
Red Brook road bridge	-	Station 4

Red Brook water was clear in color with high transparency and low turbidity. Water was soft and circumneutral with pH values of 5.6 to 6.3 (Table 1). Total alkalinity ranged from 1.5 mg/l to 30 mg/l $CaCO_3$ with lowest buffering in Bartlett Pond (station 2) and Red Brook's headwater (Station 1). Both these areas are classified as critical in regard to the effects of acid precipitation. Station 3 meets the

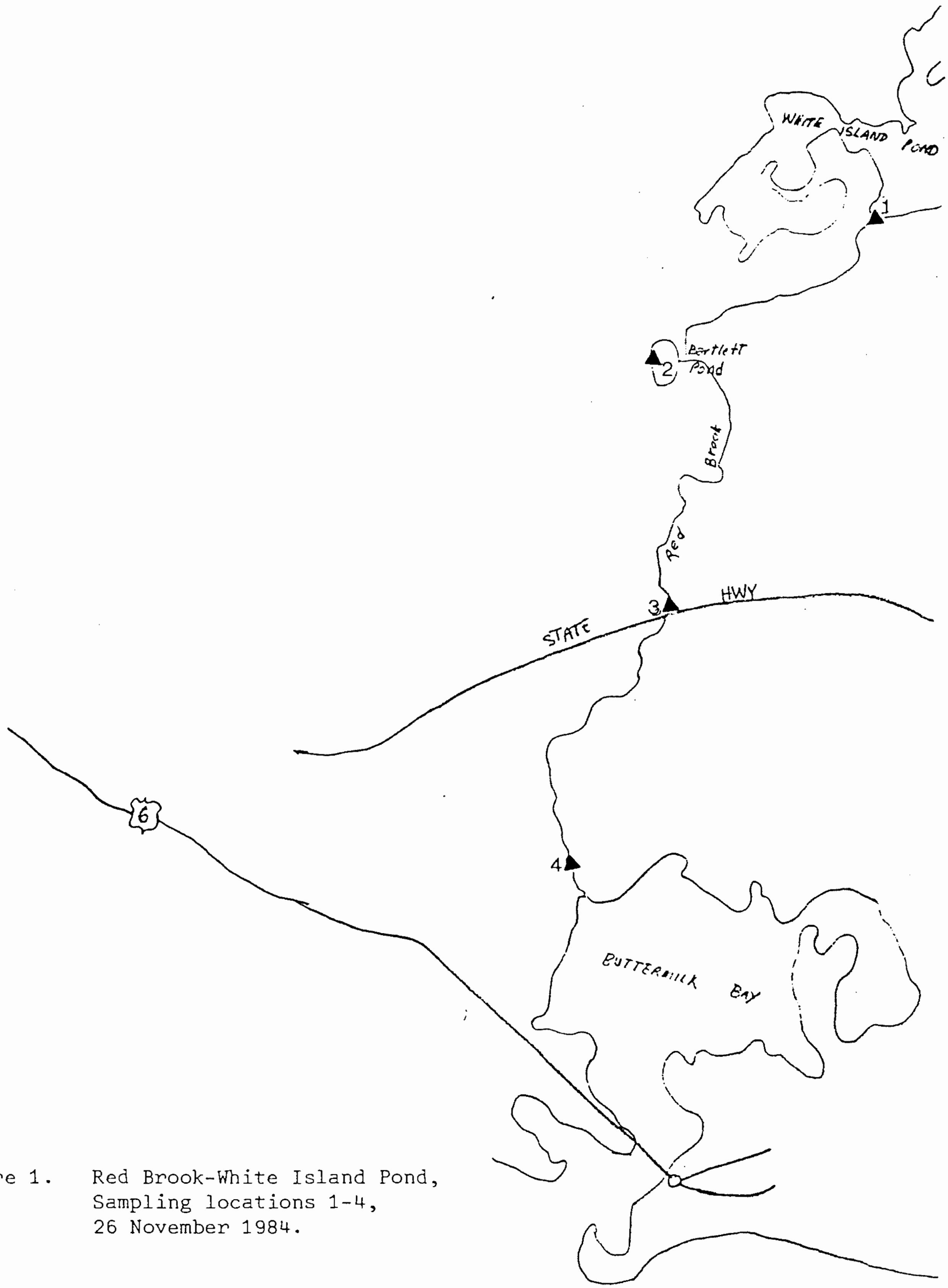


Figure 1. Red Brook-White Island Pond, Sampling locations 1-4, 26 November 1984.

TABLE 1

1984 RED BROOK
WAREHAM

TIME-TEMPERATURE-COLOR-TURBIDITY-pH-ALKALINITY

Station	Time (hr)	Water Temperature °C	Color Standard Units	Turbidity FTU Units	pH Standard Units	Alkalinity Total mg/l
1	1200	5	50	12	6.3	2.0
2	1115	5	5	5	5.6	1.5
3	1030	7	5	5	5.7	4.6
4	1000	7	12	8	6.2	30.0

endangered criteria while station 4 was not sensitive to acid deposition. The higher alkalinity at station 4 is most likely due to the tidal nature of the area and the additional buffering capacity from salt water intrusion. Salinity was 5 $^{o}/_{oo}$ at the time of sampling.

Red Brook currently supports a known river herring run. Large numbers of fish were observed this spring at and above station 3. Preliminary calculations estimate a run of between 150-200 thousand fish could be supported by White Island Pond, given acceptable spawning substrate. Information on numbers and condition of native freshwater predators is unavailable.

Assessment:

1) Present pH levels within Red Brook are sufficient for river herring migration and spawning.

2) Total alkalinity levels are such that waters may be subject to pH pulses from acid deposition.

3) If further buffering is lost and/or pH declines, future river herring runs may be seriously impacted.

Recommendations:

1) Resurvey Red Brook and White Island Pond in the spring to evaluate water conditions during the spawning run.

2) Minimize all obstructions throughout the brook.

3) Work cooperatively with cranberry bog owners to insure the most advantageous water levels for adult and juvenile movements into and out of White Island Pond.

White Island Pond
Wareham August 1985

Responding to a request of the Anadromous Fisheries Management program routine field water chemistries were performed on 23 August at five sites in White Island Pond, Wareham (Figure 1).

White Island Pond, a 294 acre unstratified body, is the headwater source of the 4.5 mile Red Brook stream which empties into Buttermilk Bay. Two fish kills, involving several fish species including river herring, were reported in this pond during the spring and summer of 1985.

At the time field work was conducted, observed conditions appeared normal. A fair-sized largemouth bass was landed by a local fisherman at Station 1, and forage fish were observed in numbers moving along the pond shallows. Surface water temperatures were seasonal and typical of regional ponds and lakes during the summer months.

Dissolved oxygen levels, parts per million (ppm), ranged from 7.2 ppm 0_2 to 10.5 ppm 0_2 and oxygen saturations of 91-130 percent were recorded (Table 1). Percent saturation was high and exceeded the 125% levels at 2 of the five stations. Long-term saturations exceeding 125% may be detrimented to some fish populations. Stickney (1968) induced gas disease in sea herring in air-supersaturated water at saturations of 120 percent nitrogen and 130 percent oxygen. However, he noted that, "gas disease can occur only when the total gas pressure in the water exceeds the combined hydrostatic and atmospheric pressures". Other reports state that carp suffered high disease levels in ponds where saturation levels reached 150 percent.

Local residents reported heavy algal blooms during the month of July along with large numbers of fresh-water mussel shells washing onto the windward shores.

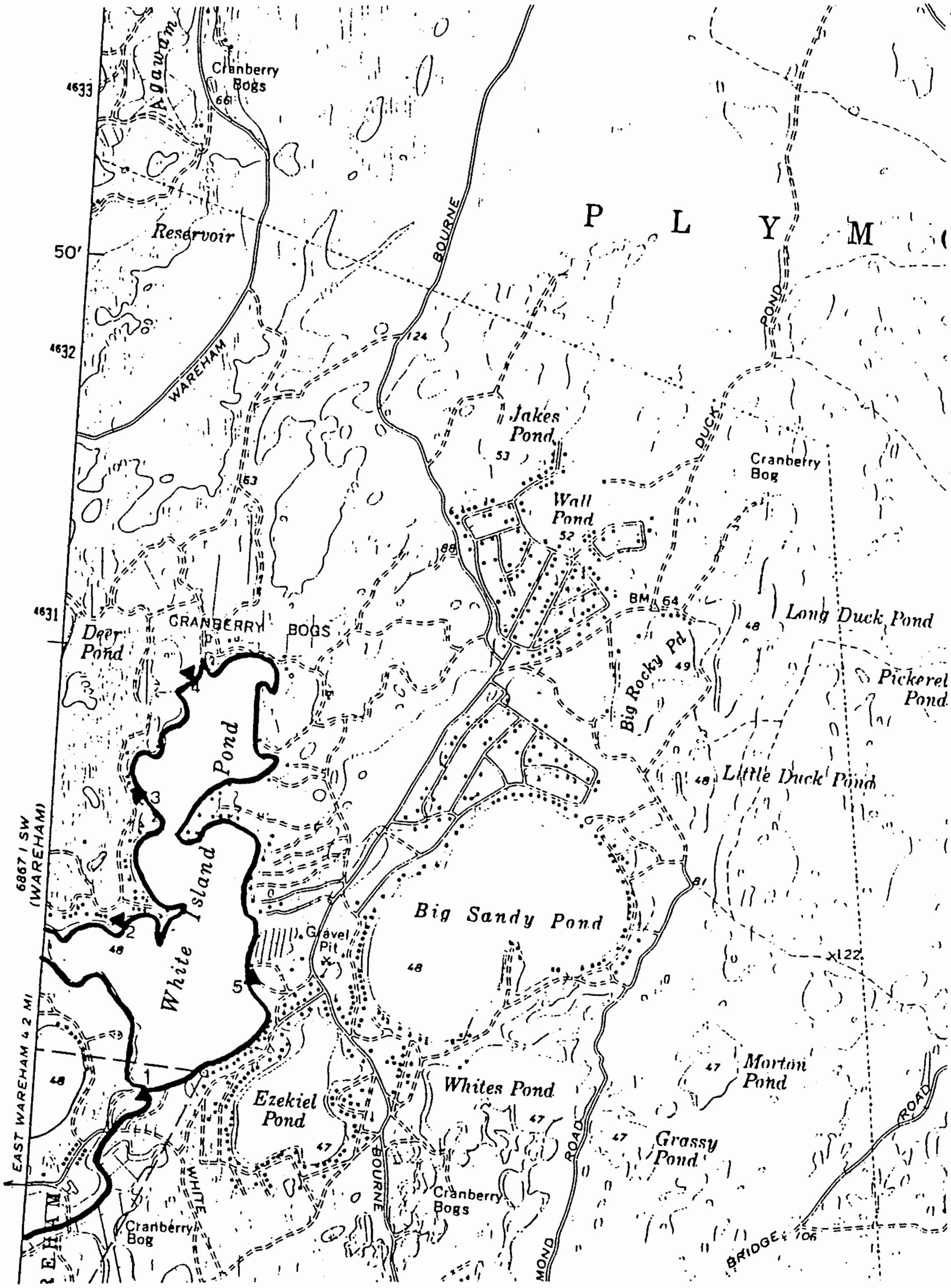


Figure 1. Location of sampling stations, White Island Pond, August 1985.

TABLE 1

WHITE ISLAND POND

WAREHAM - AUGUST 1985

TIME - TEMPERATURE - FIELD pH - DISSOLVED OXYGEN

STATION	TIME (hr)	WATER TEMP °C	FIELD pH (Standard Units)	DISSOLVED OXYGEN (mg/l)	PERCENT SATURATION
1	1230	25.0	8.0	9.9	122
2	1350	26.1	6.7	7.2	91
3	1400	26.6	8.0	9.6	122
4	1420	26.6	7.7	10.4	131
5	1455	25.4	8.2	10.5	127

The appearance of these mussels made pH levels in the pond of particular interest. Tolerance to acidity varies greatly in aquatic life, with freshwater mussels being highly sensitive to pH levels below 6. Below this level calcium needed for shell development is removed from the water.

At the time of sampling, pH levels did not appear problematic as four of the five water samples were classified alkaline (> 7.4) and one circumneutral (5.5-7.4) Table 1.

However, two 1984 readings in the pond's outlet, Red Brook, were below pH 6 and water buffering capacity is classified as critical in regard to the effects of acid precipitation. Periodic monitoring of the parameter for temporal trends and pulse fluctuations would be prudent.

Initial assessment of the effect of pH levels on the pond's freshwater mussel population are inconclusive. Other environmental factors, alone or in conjunction, may be influencing environmental conditions within the White Island Pond system.

Nutrient loading in the form of nitrates and phosphates from area development, could be speeding natural eutrophication. Siltation from shore runoff could also be affecting pond water quality and productivity.

Recommendations:

1) Periodic evaluation of water quality in White Island Pond and Red Brook.
2) Encourage cooperation of all investigating agencies, public & private, for dissemination of pertinent environmental assessment information.

impoundment 0.5 mile upstream. Fish then have direct access to Great Herring Pond (378 acres) and Little Herring Pond (75 acres).

Construction of the canal and resulting fishway problems caused a serious decline in the fishery (Belding, 1921). Fishway improvements and stocking have improved the run and it is now one of the most productive in the state and because of its location on the Cape Cod Canal, attracts great numbers of tourists as well as providing fish for lobster and sportfish bait. In 1970, 703 Bushels ~~60 barrels~~ were caught by the town of Bourne, most of which were sold to local lobstermen.

Herring River is also a source of alewives for the Division of Marine Fisheries and Division of Fisheries and Game stocking programs. The run is ideal for this purpose, as alewives are abundant over a long period of time and the large catching pool below Foundry Pond concentrates fish for easy capture. The fish are also in extremely good condition as they have not traveled far upstream before capture.

For the past few years, there has been concern that the run is again declining. Future catches should be closely monitored and if, in fact, there is reduction in the population, measures to conserve the fishery should be employed. This may involve a catch quota or increase in non-fishing days. In view of the value of this fishery, every effort should be made to maintain its productivity.

BOURNE POND BROOK

Bourne Pond Brook flows 400 yards from Bourne Pond (11 acres) to the Cape Cod Canal. An alewife run once existed here. Wooden baffles placed in the stream are in disrepair and the stream runs through two culverts, one of which is at the stream's outlet to the canal. Restoration of the run is not recommended due to limited spawning area and poor location of the stream outlet.

HERRING (MONUMENT) RIVER

The Herring River begins in Little Herring and Great Herring Ponds in Plymouth. While it formerly flowed directly into Buzzards Bay, construction of the Cape Cod Canal eliminated the lower section of the river and it now flows directly into the canal. The river is 1 mile in length and drops 34 feet in elevation.

Three fishways enable alewives to reach the upper spawning grounds. The first fishway is a series of ladders and pools which pass fish from the canal to a catching pool 700 feet from the entrance. The second fishway, 60 feet in length, provides passage from the catching pool to Foundry (Benoit's) Pond and the third fishway enables fish to reach a small unnamed impoundment 0.5 mile upstream. Fish then have direct access to Great Herring Pond (378 acres) and Little Herring Pond (75 acres).

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1969	778	Bushels
1970	703	Bushels
1971	653	Bushels
1972	559	Bushels
1973	987	Bushels

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RED BROOK (BOURNE)

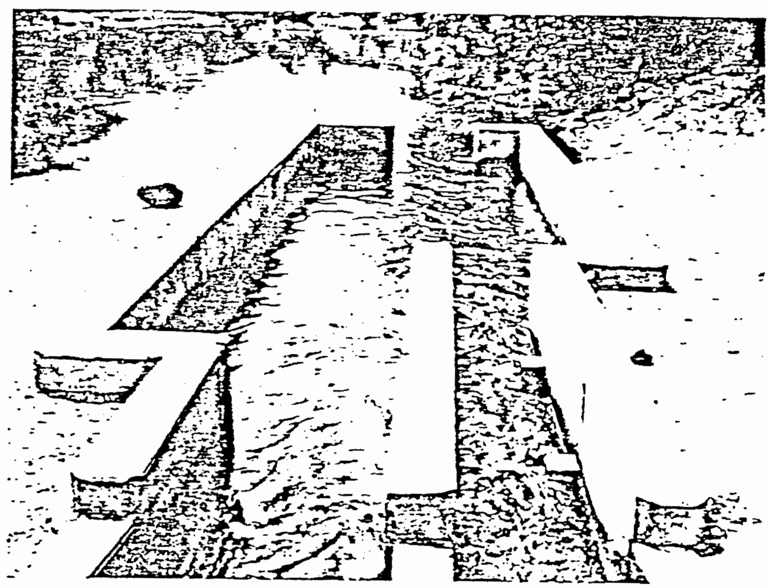
Red Brook, in Bourne, is a tidal stream which empties into Red Brook Harbor. The source of the stream is Red Brook Pond (17 acres).

The fish ladder at the outlet of Red Brook Pond was repaired for the town by a private contractor in 1968. During 1973 the Div. of Marine Fisheries improved the ladder by adding 2 steps and a new catching pool, allowing better fish access during low tide. There is still need for further improvement of the ladders exit.

Red Brook is used to suppliment the family use of alewives by local residents. During 1973 approximately 35 bushels were caught for this purpose.

Red Brook, Bourne 1973-74

The catching pool and entrance to the Red Brook fishway was completely rebuilt (Figure 8). Two new pools and a larger catching pool were constructed of reinforced 3,000-pound air entrained concrete. The new catching pool includes a stop log dam which prohibits alewives from bypassing the ladder and entering an impassable sluice. The new pools now permit fish to enter the fishway at low tide.



Red Brook, Bourne

Red Brook, Bourne: A new exit was constructed at Red Brook, Bourne. The fishway built in 1968 ended at the end of a square culvert beneath Shore Road. The pond side of this culvert contained a narrow opening which created an obstruction to fish passage because of excessive velocity and elevation. 1974 1975

The end of the culvert was completely opened and a 5' X 9' concrete structure (Fig. III) was built containing two slotted gates and an auxiliary baffle slot. This re-enforced concrete structure will control up to a 24" differential elevation between the fishway and Red Brook Pond.

RED BROOK (BOURNE)

Red Brook, in Bourne, is a tidal stream which empties into Red Brook Harbor. The source of the stream is Red Brook Pond (17 acres). The fish ladder at the outlet of Red Brook Pond was repaired and modified in 1968 and restocking is underway.

CEDAR LAKE DITCH

Cedar Lake Ditch is a tidal stream in Falmouth, draining Cedar Lake (18 acres). Entrance to the pond is gained through a 75-foot fishway which is in poor condition. The ladder should be rebuilt and the stream cleaned and enlarged.

WILD HARBOR RIVER

Wild Harbor River is a tidal creek which drains Dam Pond (6 acres). Alewives have been observed attempting to enter the pond and the occurrence of juveniles in the river indicates successful spawning. Access to the pond is limited to an underground culvert at the pond outflow. Improved access would increase the run, but is not justified due to the small size of the area.

HERRING BROOK

Herring Brook is a salt creek which begins in Wings Pond, (21 acres), Falmouth, and flows for 0.75 mile to Buzzards Bay. The pond supports an alewife run; however, it is necessary to regulate water flow to maintain this population.

Herring Brook, Falmouth: A total of nine stream baffles were constructed in Herring Brook to overcome a 76" difference between Wings Pond and the tidal marsh (Fig. II). Each baffle is constructed of re-enforced concrete 8" thick and varies in width from eight to twelve feet. The baffles are a notched weir design which maintains uniform water flow over each baffle as well as maintaining an approximate 20" stream depth.

1974
1975

OYSTER POND

Oyster Pond (61 acres) is a salt pond in Falmouth, emptying into Vineyard Sound through a tidal creek. A culvert at the outlet of Oyster Pond is fitted with a tide gate, which has a section of the circular valve plate cut out to allow fish passage through the culvert.

Shoaling at the stream outlet has been a constant problem and the town maintains the alewife run by annual dredging. A study of the effectiveness of the existing groins at the outlet should be undertaken. The run supports a fishery for lobster bait and an effort to prevent shoaling should be considered.

SALT POND

Salt Pond (66 acres) is a brackish water pond in Falmouth which drains into Vineyard Sound. The pond supports a moderate population of alewives which enter the pond through a culvert at the pond's outlet to the Sound. Salinities ranging from 19 parts per thousand to 32 parts per thousand were recorded, indicating that spawning probably occurs in areas of the pond which receive heavy runoff or spring water.

Shoaling is a problem at both the upstream and seaward ends of the culvert. The town dredges the outlet annually to insure alewife passage. The possibility of improving the groins should be studies. However, the shoaling which occurs in the winter may be an important factor in reducing salt water intrusion, helping to maintain low salinities during the spring spawning period and should be considered in such a study.

SIDERS POND

Siders Pond (38 acres) is located in the center of the town of Falmouth. It is connected to Vineyard Sound by a 2,000-foot tidal creek with a culvert at its mouth. Shivericks Pond (8.3 acres) drains into Siders Pond through an 800-foot culvert with a 4-foot diameter. Alewives enter Siders Pond and pass through the culvert into Shivericks Pond, surmounting a 1-foot barrier at the pond outlet. Passage can be facilitated here by providing a step and pool at the base of the wooden dam.

Shoaling occurs at the outlet to Vineyard Sound and the town maintains passage by annual dredging. The possibility of redesigning the groins should be studied.

LITTLE POND

Little Pond (48 acres) is a salt pond in Falmouth. Two 3-foot culverts allow intrusion of salt water. The lowest salinity recorded was 7.5 parts per thousand but is no doubt lower in the spring, and a small stream enters the pond at its upper end. Shoaling occurs at the pond outlet and the town must dredge the outlet to insure passage of alewives. A study should be made to determine if the effectiveness of the groins can be improved

COONAMESSETT RIVER

The Coonamessett River flows from Coonamessett Pond (137 acres), 3.4 miles to Great Pond, a salt pond in Falmouth.

Coonamessett Pond - Coonamessett River
Rainbow smelt (Osmerus mordax) assessment
Falmouth - Mass.

The Coonamessett River of Falmouth flows 3.4 miles from its headwaters Coonamessett Pond (158 acres) to Great Pond, a tidal saltwater body which opens into Nantucket Sound.

This 158 acre warm headwater pond with a mean depth of 19' and maximum of 34' exhibits temperature stratification during summer months. Water is soft and total alkalinity averaged 12 parts per million (ppm), classifying it as sensitive to impacts from acid precipitation.

Assessment of loaal fish population by the Division of Fisheries and Wildlife in 1979 found 12 species present. Recorded game fish were small-mouth bass, largemouth bass and chain pickerel. Non-game species, in order of abundance, were: alewives, yellow perch, bluegill, white perch, killifish, brown bullhead, pumpkinseed, golden shiner and white sucker. Alewife, the most abundant single species, accounted for 20% by number and 23% by weight of all fish collected.

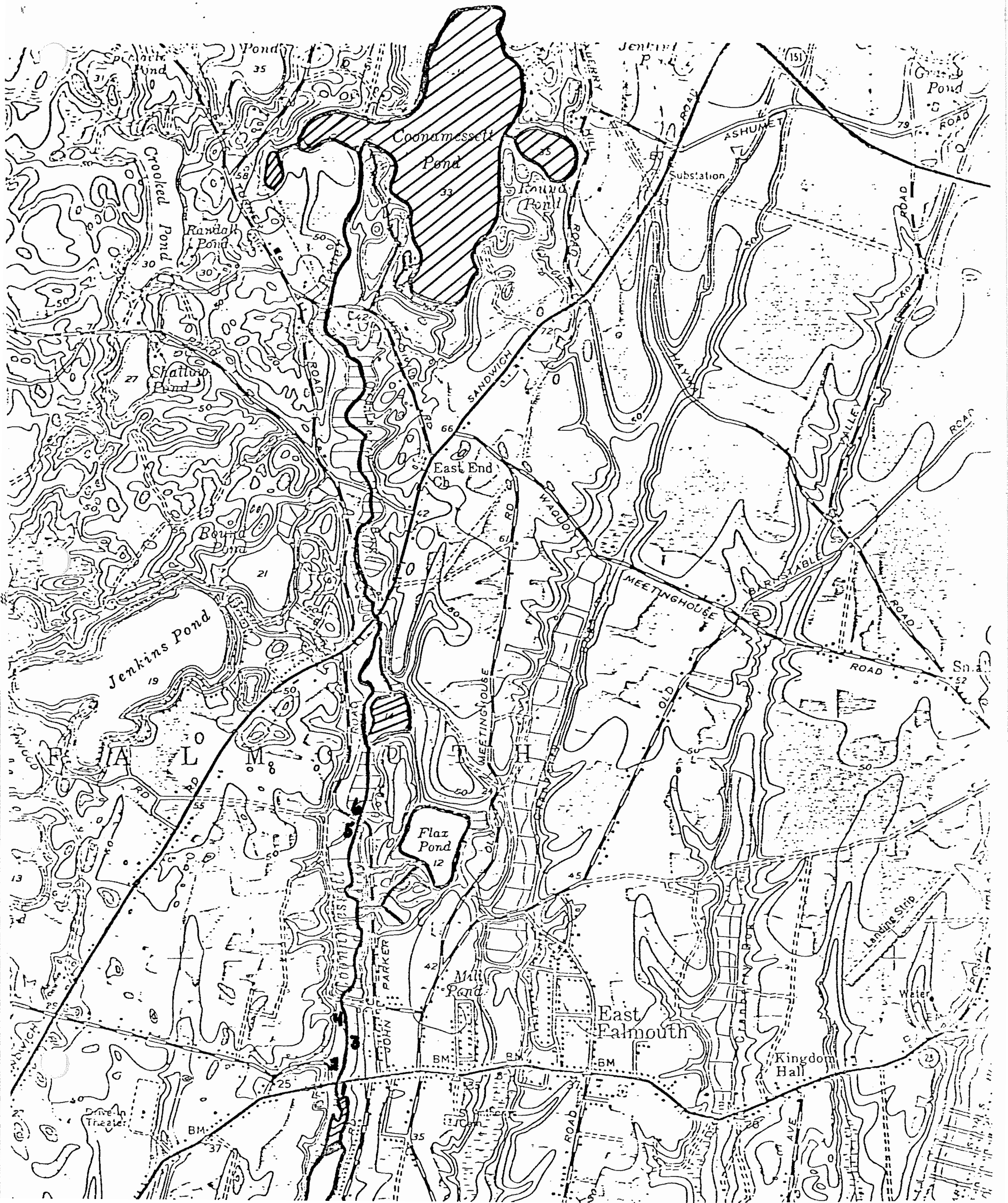
Stocking records note a number of species have been introduced to the Coonamessett system during the last fifty years, Chinook salmon, smallmouth bass, horned pout and yellow perch to name a few. During the past decade the Division of Marine Fisheries has attempted to introduce the Rainbow smelt (Osmerus mordax) into the Coonamessett River system on several occasions.

In an effort to document the spatial and temporal parameters of any smelt spawning in the Coonamessett River, egg-collecting traps were placed in a 3/4 mile stretch of riverbed beginning at the Rte. 28 bridge in Falmouth and ending where the John Parker Road also crosses the Coonamessett River. System classification is upper perennial riverine, with a permanently flooded water regime, an unconsolidated sand-gravel bottom and fresh circumneutral water chemistry. The river

Table 1. Summary of sample data collected from Coonamessett, Falmouth. Rainbow smelt (*Osmerus mordax*) assessment. 1984.

Date	Time	Air Temp. °C	Water Temp. °C	pH
3/14	1315	1.5	5.0	5.5
3/26	1210	4.0	11.0	6.2
4/2	1030	12.0	11.0	6.0
4/9	1000	0.5	7.5	6.4
4/19	1150	6.5	11.0	5.9
4/26	1245	11.0	13.0	6.1

Figure 1. Established sampling locations, Coonamessett River drainage. Rainbow smelt assessment.



flows through cranberry bogs for nearly its entire length. Because of passage difficulties caused by bog dams and water regulation problems, all anadromous species encounter difficulty utilizing this system. Indeed, spawning smelt may be confined to an area bracketed by tidal influence of Great Pond and a culverted dike in the first bog on the system. It is currently felt that Rainbow smelt are unable to surmount this river obstacle.

Egg collectors consisted of a 14 x 18 inch wooden frame with a chicken wire top and bottom. Steel bars attached to the frames weighted the units assisting in holding them in place.

Four traps were filled with sphagnum moss and two covered with burlap cloth providing egg depositional surfaces. Sampling sites 1-6 were marked by a rod driven into the stream bottom (Figure 1).

Units were placed in the river during the second week in March as water temperatures reached the level at which mature fish generally begin their upriver movements.

Time of day, air temperature, water temperature and pH were recorded weekly from 14 March to 26 April 1984 (Table 1).

Field results were disappointing; no egg deposition was noted on any of the collecting trays or natural substrate and no spawning smelt were observed within the sampling area.

River herring were sighted, however, progressing upstream during the third week of April. River herring migrations chronologically follow that of smelt in their spring movements.

Reasons for program results not meeting anticipated success are presently unknown. DMF's smelt stocking efforts in the Coonamessett watershed are undergoing further evaluation.

The river flows through cranberry bogs for nearly its entire length. The alewife fishery here was the most important in the town of Falmouth (Belding, 1921). Because of passage difficulties caused by bog dams and inadequate water regulation the run has declined in past years.

Belding (1921), reported a 300-yard ditch was dug from the pond to allow alewife passage. While adults are able to reach the pond in the spring, the ditch is often dry in the fall preventing juveniles from descending. In 1968, the town deepened the ditch and improved passage facilities at the pond outlet. The cooperation of cranberry bog owners is necessary to keep the stream open during alewife migrations and the flow from Coonamessett Pond must be regulated to insure sufficient water for downstream movement of juveniles.

MILL POND

Mill Pond (13 acres) is an impoundment which empties into a salt pond called Green Pond. Alewives enter Mill Pond by way of a culvert bypass under Route 28 in Falmouth. The culvert is approximately 80 feet long and 2 feet in diameter. The small size of the culvert restricts passage and debris in the culvert often compounds the problem. During periods of low water the upstream end of the culvert is above water level. This run can only be improved by construction of a fishway within the main culvert under Route 28. The economic feasibility of this is questionable and further development of the run is not recommended.

CHILDS RIVER

The Childs River originally flowed from Johns Pond (317 acres) in Mashpee, 2.8 miles to Eel Pond, a salt pond in Falmouth. The outlet of Johns Pond is now filled in and the river is fed by surface runoff and groundwater discharge. Alewives spawn in a 4-acre impoundment at Old Main Road in Falmouth. A 50-foot fishway provides access to the pond. In 1968, the Falmouth Rod & Gun Club rebuilt the ladder and cleaned the stream of debris.

Further development of this run is dependent upon the opening of Johns Pond to spawning alewives. The reason for filling in of the pond outlet is not clear, but is probably associated with the opening of a second outlet which drains into the Quashnet River. This was done to provide water for cranberry cultivation on that stream. An attempt should be made to determine who is responsible for blocking the outlet, under what jurisdiction they acted and whether Section 19 should be applied to reopen the pond.

QUASHNET RIVER

The source of the Quashnet River was originally a swamp in Mashpee. In order to augment their water supply, cranberry bog owners opened a ditch to Johns Pond (Belding, 1921). The river now flows 5 miles from Johns Pond to Waquoit Bay, running through cranberry bogs for most of its length. Two large bog dams block access to Johns Pond. Alewives spawn in the stream below the first dam which forms a small impoundment. Since the ditch to

Johns Pond is an artificial waterway, the bog owners disclaim any responsibility for providing passage to the pond.

Legality of the bog owner's action should be ascertained and, if they have exceeded that authority, Section 19 should be enforced to insure adequate passage to the pond.

The Division of Fisheries and Game maintains a public fishing area in the lower section of the stream and sea run trout are commonly caught. Shad have been reported in the stream, but further development of this resource is unlikely because of insufficient spawning area.

MASHPEE RIVER

The Mashpee River flows 4.8 miles from Mashpee-Wakeby Pond to Popponesset Bay and has a large run of alewives. A public fishery exists here and alewives are netted for sport fish and lobster bait and, to some extent, for home consumption. The stream is used for cranberry bog irrigation and two small bog dams impound the stream. Alewives have little trouble surmounting these obstructions in the spring but water control is essential in the fall when bogs are being flooded to insure passage of downstream migrants. The only major obstruction to migration is a 7-foot dam at a small mill pond on Route 130 in Mashpee. This is bypassed by a 75-foot concrete fishway. From here alewives pass to Mashpee-Wakeby Pond (720 acres).

It is recommended that an additional pool be constructed on the downstream side of Route 130 to facilitate passage through culvert when stream level is low. It would also be in the best

1976-77

<u>Quashnet River, Falmouth</u>: A concrete flume that blocked alewife passage on the Quashnet River has been modified into a weir-pool fishway through a joint effort with the Division of Fisheries and Wildlife. Five wooden weirs and a barrier weir were installed by lag bolting timber slots to the sides of the existing concrete flume. These pools allow alewives access to several additional acres of spawning ground and enable them to reach the base of the dam at John's Pond, which is currently being considered for future fishway construction.

Amendment AFCS 14-5 – Constructed in 1978

On the Mashpee River at Rt. 130, Mashpee, a road culvert does not allow alewives easy access to a weir pool fishway. Its floor slopes 18" ± in 50'± and ends 16" ± above stream level.

During this segment a 5' wide, 4' high and 30' long concrete sluice containing the capability of accommodating five weir pool baffles, will be constructed of reinforced 3000 lb air entrained concrete.

This structure will allow for excavation of a pool at the fishway entrance and enable alewives to swim directly through the road culvert without hindrance from the presently excessive current.

interests of the fishery if the town of Mashpee were to assume local control under Section 94 and regulate the fishery with the Division's advice and approval.

SANTUIT RIVER

The Santuit River arises in Santuit Pond, Mashpee (160 acres). It flows 2.2 miles to an inland extension of Popponesset Bay. A number of cranberry bogs are located on the stream. Baffles are placed in the bog flumes to allow passage of alewives. The size of the alewife population is not at its potential level, probably due to inadequate water regulation and juvenile mortality in flooded bogs in the fall. The town of Mashpee should gain control of the fishery under Section 94 and work with the bog owners to develop a plan for coordination of water usage in order to gain maximum alewife productivity.

RUSHY MARSH POND

Rushy Marsh Pond (13 acres) is a brackish water lagoon in Cotuit Village of Barnstable. Alewives enter the pond by way of a large tide gate, which reduces salt water intrusion, or through a 12-inch submerged culvert. This run is significant only in that it may serve to attract predator game fish to this popular fishing spot. White perch also spawn in the pond.

LITTLE RIVER

The headwater of Little River was originally Lovell Pond, (54 acres). Its outlet is now filled in. A number of bog dams block passage and a culvert under Old Post Road creates an obstacle when stream level is low. Because of the difficulty of opening Lovell Pond to alewives, the area has low priority for restoration.

MARSTONS MILLS RIVER

Marstons Mills River flows from Middle Pond (102 acres) 2.5 miles to North Bay in Osterville. The main flow of the river has been diverted to Muddy Pond (23 acres) for cranberry bog irrigation. From Muddy Pond the stream flows into Mill Pond (5 acres). At Mill Pond, two fishways are encountered. The first, overcoming a natural change in elevation, is comprised of large boulders placed to create pools. The second fishway, at the outlet of Mill Pond, is comprised of staggered concrete baffles and a short wooden weir-pool ladder. The third fishway on the stream is adjacent to a bog dam. Under normal flow conditions, fish pass through two culverts under the dam. When culvert flow is shut off to flood the bog, alewives use the fish ladder. The fishway exit is 5 feet above normal stream level making passage impossible until water in the bog rises to the fishway. The stream bed below the dam becomes dry during this period and many fish are stranded. The fourth fishway consists of a 1300-foot wooden sluiceway which passes fish to Middle Pond where four weir-pools surmount the final obstacle. Alewives in Middle Pond can also enter Mystic Lake (130 acres).

The fishway at Mill Pond outlet should be redesigned and constructed entirely of concrete. The ladder at the bog dam should be replaced with a Denil fishway. The Denil design will allow passage under a greater range of water levels, thus shortening the period when fish are unable to utilize the culverts or fishway. In addition, a holding pool should be constructed below the bog dam to hold the fish when the flow has been shut off and the fishway is not operating.

CENTERVILLE RIVER

The Centerville River has Lake Wequaquet (654 acres) as its headwater. A man-made ditch runs from Wequaquet to Long Pond (47 acres) and continues to the Centerville River. At the time the river was surveyed, there was no flow from either pond.

According to records kept by the town conservation officer, alewives entered Lake Wequaquet through the artificial channel in March of 1962 but juveniles were unable to return to the sea because of low water levels. No alewives were able to enter Long Pond or Lake Wequaquet until the spring 1968, when stream clearance and three days of rain made the ditch passable (Daisto Ranta, personal communication). It appears that alewives normally spawning in the upper reaches of the Centerville River took advantage of renewed stream flow to further their migration to the upper reaches of the river system despite an absence of six years. This observation is contrary to Baird's (1956) observation that homing instinct would limit upstream migration of alewives.

Wequaquet Lake would be a valuable spawning area for alewives if sufficient flow for passage can be maintained. It is recommended that the culvert beneath Phinney's Lane be lowered and water levels controlled to insure alewife passage. Only a slight drawdown from Wequaquet would be required to have ample water flow into and from Long Pond.

TRIBUTARIES TO THE CENTERVILLE RIVER

Bumps River:

The Bumps River is a tributary to the Centerville River. Two connected ponds with a combined area of 10 acres form the headwaters. The stream is tidal for most of its 1.2 mile length. A 7-foot steel dam and spillway blocks entrance to the ponds. A fishway should be constructed here and the ponds stocked with alewives to establish a population.

Lake Elizabeth:

Lake Elizabeth is a series of three small ponds which empty into the Centerville River. The ponds have a total surface area of 12 acres. The first two ponds are connected by an 18-inch culvert. Alewives enter Lake Elizabeth by way of a 4-foot wooden fishway. With proper maintenance of the fishway, the alewife run should be at its peak and further development is not needed.

HALL CREEK

Hall Creek flows to Centerville Harbor from four ponds, the largest of which is Simmons Pond (8 acres). Passage is obstructed by a 4.5-foot dam at an impoundment below Simmons Pond. Stream flow is poor and is diverted through a golf course. Because of the small spawning area which would be made available by providing passage facilities, this stream is not considered for alewife restoration.

FAWCETTS POND

Fawcetts Pond (10 acres) flows to Hyannis Harbor by way of an unnamed stream. Entrance to the stream is blocked by a vertical culvert. The ditch from Fawcetts Pond is partially filled and the flow is poor. The area has little potential for anadromous fish.

MILL CREEK

Mill Creek is a tidal stream which drains Mill Pond (6 acres) and Little Sandy Pond in Yarmouth. A 35-foot concrete fishway at Mill Pond gives alewives access to the pond. An additional 10 acres of spawning area is available in Little Sandy Pond, 0.5 mile above Mill Pond. There is no recommendations for improvement of the run.

PARKERS RIVER

Long Pond (50 acres), Yarmouth, is the headwater to the Parkers River in South Yarmouth. The stream flows from Long Pond to Seine Pond (80 acres). Salinities of 15 parts per thousand were reported in Seine Pond and the river is tidal below the pond. Although some alewives may spawn in Seine Pond, Long Pond is the primary spawning area. A 1-foot wooden dam 0.5 mile above Seine Pond obstructs passage. A wooden sluiceway at the dam may pass some fish, but a more efficient fishway is necessary to take full advantage of the spawning area available in Long Pond.

In the past, fish were taken by seining in Seine Pond and it supported a private commercial fishery with an annual harvest of 50 to 100 barrels (Belding, 1921). By replacing the sluiceway above Seine Pond with an efficient fish ladder, the run should increase.

BASS RIVER

Bass River is a tidal stream which forms the boundary line between the towns of Yarmouth and Dennis. The river flows 6.5 miles from its source in Mill Pond to Nantucket Sound. The upper section is a series of bays open to tidal influence. Mill Pond (65 acres) is the only one with salinities low enough (4 parts per thousand) to allow significant alewife spawning. No obstructions to passage exist and the run is at its maximum potential.

SWAN POND RIVER

Swan Pond River flows from Swan Pond (135 acres), Dennis, to Nantucket Sound. In spite of recorded salinities as high as 16.0 parts per thousand in the pond, spawning occurs and a small fishery was carried on in the past. Further development for anadromous species is not practical.

HERRING RIVER

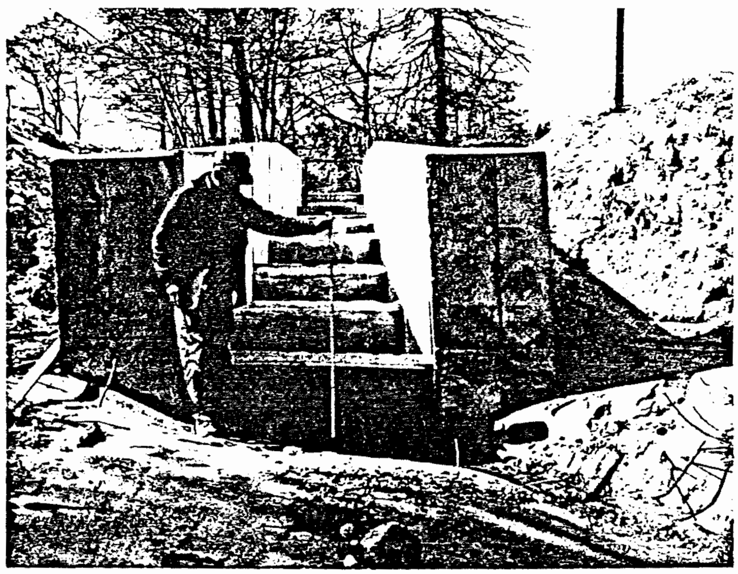
Herring River, Harwich, has three headwater ponds with a total surface area of 1,044 acres. Long Pond (717 acres) and Seymours Pond (168 acres) drain into Hinckleys Pond (159 acres) by way of two streams. From Hinckleys Pond the river flows 7.2 miles to Nantucket Sound and has one 70-acre impoundment, known as the reservoir, along its course.

The first obstruction on the river is at the reservoir. A poor fishway provides limited passage over the dam. A second fishway, also of poor design, passes alewives into Hinckleys Pond. Passage to Seymours and Long Ponds is good in the spring but low water levels in the late summer and fall hinder downstream migrants.

If the potential production of the system is to be realized, the fishway at the first obstruction must be redesigned and relocated. The second fishway at Hinckleys Pond should be rebuilt and the streams between Seymours and Long Pond should be deepened and water control structures should be installed.

ANDREWS RIVER

Andrews River has Grass Pond (24 acres) as its headwater. The river runs from the pond through a number of cranberry bogs to Nantucket Sound. Numerous bog dams presently make passage to the pond impossible for anadromous fish. However, alewives do ascend to the first dam at Hoyt Road, and Section 19 should be enforced to insure passage to Grass Pond.



Herring River, Harwich

RED RIVER

An unnamed stream connects Skinequit Pond (17 acres), Harwich, to Red River. Alewives ascend the stream, generally on higher phases of the tide. A wooden fishway beneath an unused pump house enables fish to reach the pond. Because of its location, the fishway fills with sand and requires constant maintenance. The ladder should be relocated and constructed of concrete to maintain efficiency.

FROSTFISH CREEK

Frostfish Creek empties into Pleasant Bay, Chatham. The stream is impounded to form a 5-acre pond. Saltwater intrusion is prevented by a wooden tidegate. A small alewife run has been reported, but further development is not warranted because of the limited spawning area.

STILLWATER POND, LOVERS LAKE

Stillwater Pond (18 acres) and Lovers Lake (38 acres), Chatham, are connected by a narrow ditch and small culvert under Old Comers Road. A 300-foot stream runs from Stillwater Pond to Ryders Cove, Pleasant Bay. Concrete baffles in the outlet stream enable alewives to overcome the 8-foot rise in elevation from sea level.

The town of Chatham assumed control of the alewife fishery in 1968 under Section 94. This run has considerable value as a source of bait for sport fishermen in the Pleasant Bay area and the commercial fishermen operating out of Chatham, and should be regulated with this mind. The population could be increased by providing better passage to Stillwater Pond. The culvert under Old Comers Road should be cleaned and enlarged and the ditch connecting Stillwater Pond and Lovers Lake should have baffles and control structures to provide alewife water flows to pass juveniles downstream.

MUDDY CREEK

Muddy Creek forms a portion of the boundary between the towns of Chatham and Harwich. Tidegates at the outlet of the creek reduce salt water intrusion and a small alewife run exists. A dam has been proposed by the town of Chatham, but it would not significantly increase spawning area. Muddy Creek is not suitable for anadromous fish development.

PILGRIM LAKE, ORLEANS

Pilgrim Lake (40 acres) flows into Kescayo Gansett Pond, a salt pond opening to Pleasant Bay. A 390-foot weir-pool fishway enables alewives to surmount the 8-foot elevation from sea level to pond. Entrance to the fishway is difficult at low tide and water levels in Pilgrim Lake are often too low for downstream migration of juvenile alewives (Fiske, et al, 1967).

The large spawning area available makes improvement of this run desirable. The feasibility of redesigning the fishway to accommodate a wider range of water levels should be investigated.

PILGRIM LAKE, PROVINCETOWN

Pilgrim Lake is a 350-acre lagoon, connected to Cape Cod Bay by a 500-foot underground culvert. Fish passage is hindered by the culvert and a wooden sluiceway at the pond outlet. The pond was stocked with adult alewives in the spring of 1969. Juveniles had difficulty leaving the pond due to low water and suffered high mortality.

In order to establish a self-sustaining population, the culvert should be replaced with an open ditch. Water levels must be regulated to insure successful juvenile migration and prevent excessive salt water intrusion.

PAMET RIVER

Pamet River cuts across the upper arm of Cape Cod in Truro. It flows to the west for 4.5 miles to Cape Cod Bay. A tidegate at Castle Road prevents intrusion of salt water beyond that point. The stream has no impoundments and spawning area for anadromous fish is limited, making it poor for development.

HERRING RIVER, WELLFLEET

Herring River flows from three headwater ponds for 4 miles to Wellfleet Harbor. The alewife fishery was created by digging a ditch from Herring Pond to the river. The owners turned the fishing rights over to the town in about 1700 and in 1893 a ditch connecting Higgins and Gull Ponds to Herring Pond was excavated. The fishery was once very profitable, but in recent years has declined (Belding, 1921).

Herring, Higgins and Gull Ponds, with a combined area of 156 acres, are easily accessible to alewives except for tidegates in a culvert beneath Chequesset Neck Road. Passage is limited to periods when outflow of water will open the gates. Observations made during this survey indicate that the tidegates seriously limit the number of adult alewives which reach the spawning ground. Unimpeded passage to the headwater ponds must be insured to restore the fishery. This would require complete removal or redesign of the tidegates.

HERRING BROOK

Herring Brook, in Eastham, was formed in 1879 when a ditch connecting Great Pond and a small unnamed pond to Cape Cod Bay was excavated. Great Pond offers 109 acres of spawning area and, although extensive tidal flats at the stream mouth limit passage to high tidal phases, an alewife run exists and once yielded an average of 20 barrels annually (Belding, 1921). Passage can only be improved by annual dredging of a ditch across the sand flats. It is questionable whether the population would increase sufficiently to offset the costs involved.

HERRING RIVER, EASTHAM

Herring River flows 1 mile from Herring Pond to Cape Cod Bay. Alewives ascend the stream to spawn in Herring Pond (43 acres). Because of the tidal flats at the stream outlet, passage is possible only on high tides and further development is impractical.

ROCK HARBOR CREEK

Rock Harbor Creek in Orleans, flows from Cedar Pond (17 acres) to Cape Cod Bay. The stream is tidal for its entire length and salinity of 3.0 parts per thousand was recorded in the Cedar Pond. Fish have access to the pond through a culvert at U.S. Route 6. The stream has little potential for further development.

COBBS POND

Cobbs Pond (28 acres), Brewster, drains into Cape Cod Bay through a 500-yard stream. The lower section of the stream is diverted through a culvert which runs under sand dunes and exits on the beach. Flow from Cobbs Pond is poor, especially during summer and fall, making the area poor for anadromous fish development.

STONEY BROOK

Stoney Brook, Brewster, flows 1.5 miles from three headwater ponds to Cape Cod Bay. Two obstructions, a rapid elevation drop and a dam at the first pond, are surmounted by a series of stone and concrete fishways appropriately integrated into the natural surroundings. Upon ascending the fishways, alewives spawn in Lower Mill Pond (52 acres), Upper Mill Pond (254 acres) and Walhers Pond (101 acres).

Although the town of Brewster has not sold the fishing rights in recent years, the run has supported a commercial fishery in the past. A circular catching pool below Lower Mill Pond congregates fish for easy capture. Some alewives are taken for bait and home consumption but the primary value of the alewife run is its tourist attraction.

The town has authority to regulate the fishery under Section 94 and limits the taking of alewives to residents. The source is presently under utilized and the fishery should be opened to nonresidents. Strict enforcement of fishing regulations by the town is essential to prevent abuse of fishing privileges. This is most easily accomplished by appointing a herring inspector whose responsibility is to catch and distribute the fish. A small fee can be charged by the town to cover operating costs.

QUIVETT CREEK

Quivett Creek flows 2.5 miles from a 4-acre, unnamed pond in Brewster. A 30-foot fishway enables alewives to reach the pond. A run exists but cannot be developed further due to lack of additional spawning area.

MATHEWS POND

Mathews Pond (31 acres), Yarmouth, is an impoundment owned by the Bass River Rod and Gun Club. The pond empties into Cape Cod Bay through a series of salt creeks. An earthen dike impounds the water and the only outlet is a culvert 3 feet above stream level. The pond has been stocked with alewives in recent years at the request of the Rod and Gun Club to provide forage for game fish.

With adequate passage facilities an alewife run could be established here. A fishway must be constructed at the dike and outflow from the pond regulated to insure adequate water for both adult and juvenile migration.

MILL POND

Mill Pond (14 acres), Barnstable, drains into Barnstable Harbor by way of Scorton Creek. A wooden, weir-pool fishway at the pond outlet and natural stone pools below, allow alewives to enter the pond. The fishway should be replaced with a concrete structure to minimize maintenance. There is no potential for further development.

SANDWICH (MILL) CREEK

Sandwich Creek flows 2 miles from Upper and Lower Shawme Lakes, through the town of Sandwich to Cape Cod Bay. A dam at Lower Shawme Lake (24 acres) is bypassed by a 75-foot concrete fishway. A 50-foot fishway formerly connected Lower Shawme Lake to Upper Shawme Lake (20 acres) but due to partial breaching of the dam, is no longer passable. Overfishing was the major cause of the decline in the alewife run and it is now closed to fishing of any kind. Its primary value at present is as a tourist attraction.

The first fishway is inadequate. Pools are shallow and a barrier is needed to screen off an adjacent sluiceway which distracts alewives from the ladder. The fishway should be

Mill Creek - Sandwich

Rainbow smelt (Osmerus mordax) assessment

Mill Creek flows approximately 2 miles from Shawme Lakes through the village of Sandwich to Cape Cod Bay. The majority of the creek which meanders through an emergent brackish marsh with a regularly flooded water regime, mineral soil and mixohaline water chemistry, is composed of a sand rubble substrate.

Historical records indicate the presence of a once commercially exploited river herring run and a small local sport fishery for American shad (Alosa sapidissima). In recent years the Division of Marine Fisheries (DMF), Anadromous Fisheries Management Program has attempted to establish a sustaining run of rainbow smelt (Osmersus mordax) in this waterbody. Local residents last reported the presence of smelt in Mill Creek during the spring of 1981 or 1982.

Rainbow smelt are broadcast spawners, depositing demersal, adhesive eggs which attach to the stream substrate. Spawning smelt do not generally journey great distances up stream, frequently going only a few hundred yards above tide water. In Massachusetts, spawning takes place as early as the first week in March and is usually completed by mid-May.

Chen (1970) estimated a range of fecundity from 33,000 to 76,000 eggs for females 2-5 years of age. Others have reported females weighing as little as two ounces capable of producing 50,000 eggs.

In an effort to document the spatial and temporal parameters of smelt spawning in Mill Creek, a combination of burlap bag and sphagnum moss collecting traps were placed along the stream bed. Sampling units consisted of a 14 x 18 inch wooden frame with chicken wire top and bottom. Steel bars attached to the frames provided weight and assisted in holding the units flat on the stream bottom. Four traps were filled with sphagnum moss and two covered with burlap cloth to provide

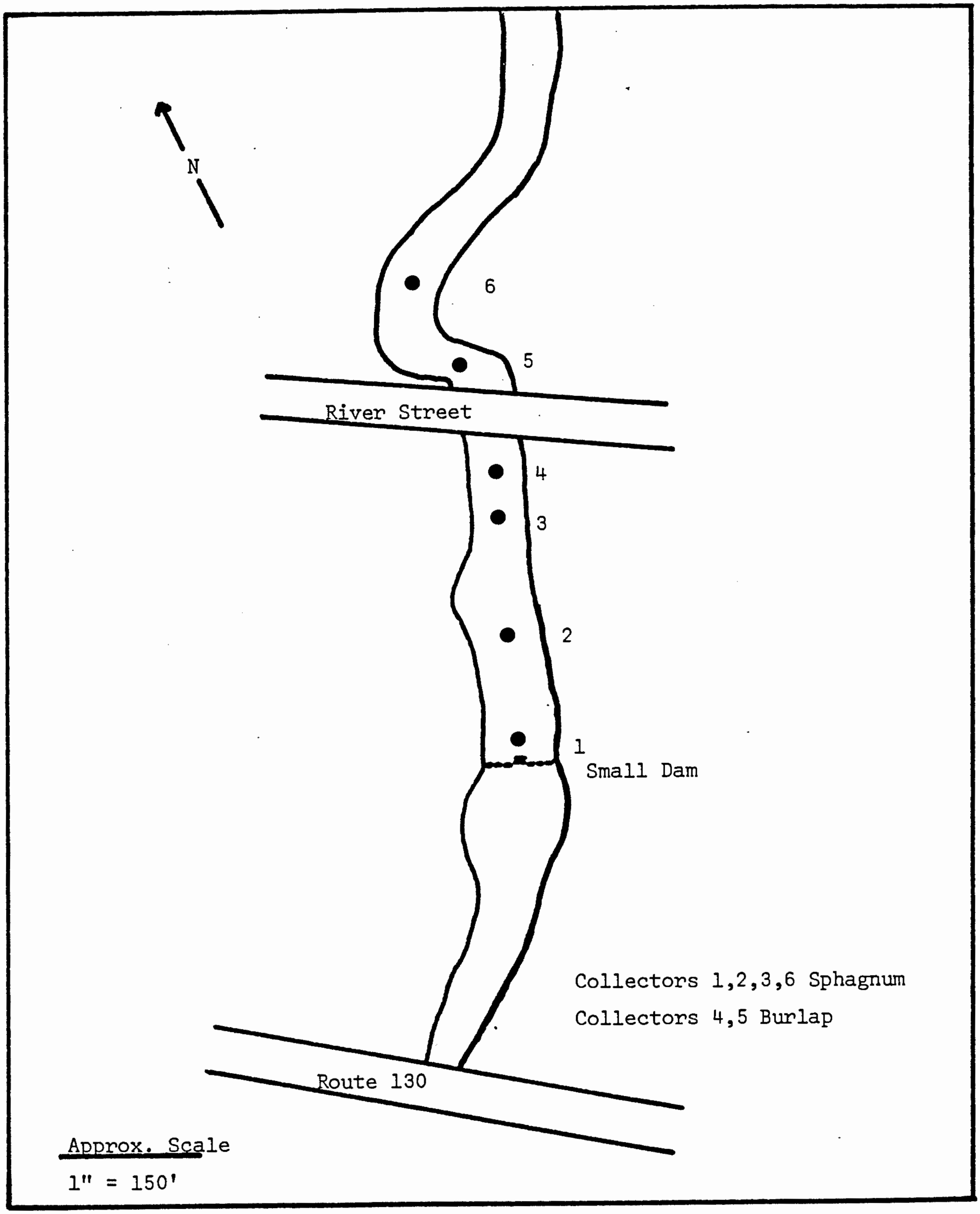


Figure 1. Diagrammatic of Mill Creek, Sandwich smelt sampling locations 1984.

Table 1. Summary of sample data collected from Mill Creek, Sandwich, Rainbow smelt (*Osmerus mordax*) assessment, 1984.

Date	Air Temp. °C	Water Temp. °C	pH	Time	% Cloud	Below Sta. 6 Sal. ‰
3/14	2	4	5.5	1420	75	0
3/26	5	8	6.3	1100	50	2
4/2	13	9	6.5	0900	25	0
4/9	1.5	8	6.2	0900	100	0
4/11	8	7.5	7.4	0715	50	5
4/19	7	11	6.0	1015	100	0
4/27	11	14	5.5	1304	0	0

redesigned and reconstructed. In order to obtain the maximum potential of the available spawning area, a fishway to Upper Shawme Lake must be constructed. The stream should be able to support a significant fishery.

Some shad utilize the stream as a spawning area. This is noteworthy, in view of an apparent lack of suitable spawning area. Most of the creek is highly saline and that portion which is fresh is very narrow and shallow. The run supports a very small, local sportfishery.

SAVERY POND

The outlet stream from Savery Pond (30 acres), Plymouth, flows 1 mile to Cape Cod Bay. Formerly used for bog irrigation, it is blocked by two dams, both concrete with wooden flash boards. One dam is at the pond outlet and the other is located just above Salt Pond, a large salt marsh. Stream flow from the pond is slight and would not be sufficient to maintain a significant alewife run.

INDIAN BROOK

Indian Brook begins in Island Pond (77 acres), Plymouth, and flows 2.2 miles east to Cape Cod Bay. Although Island Pond offers an attractive spawning area, many bog dams and flumes block the stream and it is impounded by a dam at Route 3A. In addition, the stream loses elevation rapidly and lacks a channel where it crosses Manomet Beach making access extremely difficult. Indian Brook has no potential for anadromous fish.

BEAVERDAM BROOK

Beaverdam Brook flows from Fresh Pond (60 acres), through a large cranberry bog system to Bartlett Pond (34 acres) and then to the ocean. Alewives are able to spawn in Bartlett Pond but cannot reach the headwaters because of the numerous bog dams on the stream. In order to increase the population, it is necessary to open Fresh Pond to spawning fish. An excellent run could be restored with the cooperation of the bog owners. Coordination of water usage for bog irrigation and fish migration is required. Application of Section 19 should be considered.

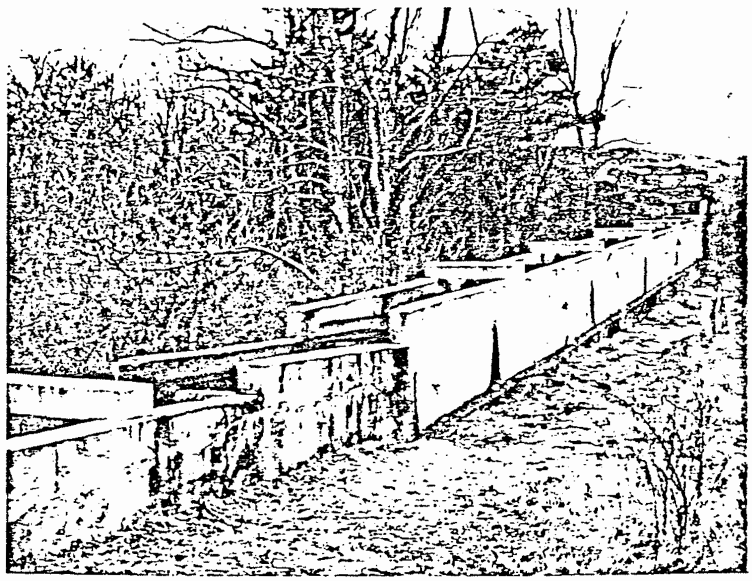
EEL RIVER

The main branch of Eel River flows from Russell Millpond, a 43-acre impoundment in Plymouth, for 3 miles to Plymouth Bay. Below Russell Millpond, a 9-acre impoundment called Haydens Pond is formed. Fishways allow alewives to reach both impoundments. The first fishway consists of two concrete ladders connected by an artificial ditch. This fishway is 180 feet long and surmounts an 11-foot elevation to Haydens Pond. The second fishway is 220 feet long and overcomes a 17-foot elevation at Russell Millpond.

The entrance of the first fishway is poorly located and many fish bypass it. A new fishway should be constructed at a location closer to the dam or a barrier dam should be built at the entrance to the existing ladder. The fishway at Russell Millpond is poorly constructed and has structural deficiencies. It should be replaced.

Eel River, Plymouth

Reconstruction of a damaged section of the Eel River fishway was undertaken during 1972. The new portion of fishway is 80 feet long, 3 feet wide and has ten pools, overcoming an elevation of 90 inches. All new construction was of 3,000-pound air entrained reinforced concrete. To further strengthen the fishway, collar ties were incorporated every 24 feet over the length of the 160-foot fishway (Figure 5).



Eel River, Plymouth

Figure 5

The east branch of Eel River is 2 miles long and drains two impoundments and two ponds. Construction of fishways at the impoundments would make 35 acres of spawning area available. In view of the demand for alewives as lobster bait in the Plymouth area, development of the east branch is recommended.

TOWN BROOK

Town Brook flows from Billington Sea (250 acres) for 1.5 miles through the center of Plymouth to Plymouth Harbor. The mouth of the river is obstructed by a dam which reduces intrusion of salt water. Fish are able to enter the stream only on high tide. Five dams obstruct fish passage. Each is equipped with a concrete, weir-pool fishway and require regular cleaning and maintenance. Some of the ladders have poorly located entrances which need barrier dams. In the past, Town Brook supported an alewife fishery, but fishing rights have not been sold since 1967.

In order for the alewife population to reach the potential indicated by the spawning area available in Billington Sea, all fishways must be redesigned to provide maximum efficiency. This will include relocation, enlargement and basic design changes. Reconstruction would be costly but enhancement of this resource would be of great value to the community and the Commonwealth. The alewives would provide an important source of bait for the local commercial and sport fisheries and represent a great tourist attraction.

Town Brook, Plymouth

Job No. 1 Construction and Improvement of Fish Passage Facilities - 1974-75

Town Brook, Plymouth: A new barrier dam was constructed at the Jenny Grist Mill fishway on Town Brook, Plymouth

The new dam is 2'-4 1/2" high and contains a stop log gate adjacent to the fishway. Water will be directed through a staggered plank gate allowing very little to flow over the dam.

The dam is constructed of re-enforced 3,000 lb air entrained concrete capped with flat stones. It is 24" thick, 30' long and sets on a 10" X 8' X 38' pad. The stream bed below the dam was lowered in order to increase water depth and allow maximum use of the dam's 2'-4 1/2" height.

Smelt have been increasing in the lower section of the stream. Chapter 130 regulations should be enforced to protect this population and modifications of passage facilities at the first dam should take the requirements of the smelt into consideration.

JONES RIVER

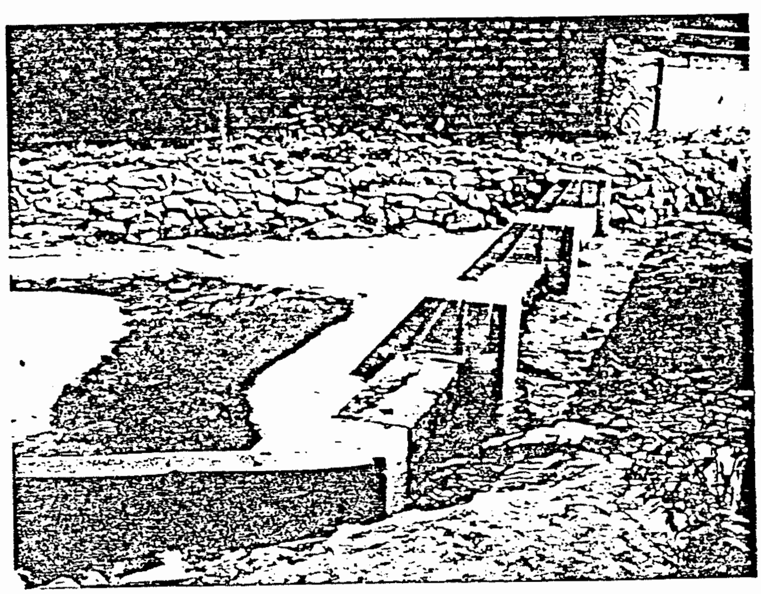
The headwaters of the Jones River are Silver Lake (605 acres), in Pembroke, and swamp lands in the towns of Kingston and Plympton. Silver Lake is used as a water supply by the town of Brockton. Many small tributaries, most of which are impounded, augment the river's flow. The main branch of the river has two impoundments. The first is accessible by means of a 50-foot concrete fishway at Elm Street. There is no fishway at the second impoundment.

Above the first dam, alewives enter Furnace Brook which drains three impoundments totaling 20 acres. Four fishways on the brook provide passage to Russell Pond (10 acres). Russell Pond and the smaller impoundments below it provide the spawning area for most of the alewives in the Jones River.

The Jones River has the potential to support a large population of alewives. Although most tributaries are obstructed and offer little spawning area, construction of two fishways on the north branch would allow alewives to reach Silver Lake. Since Silver Lake is a water supply, water level fluctuations could be a problem. However, in view of the large potential

Jones River, Kingston 1970-71

A barrier dam was constructed to improve alewife passage at the first fishway on the river. The barrier is approximately 40 feet long and consists of four concrete piers and stop logs. The stop logs are staggered to allow water to flow vertically between them but still prevent fish from passing over the dam (Figure 1). This arrangement maintains a pool depth considerably less than the 2-foot effective height of the barrier, reducing the possibility of flooding an adjacent building.



Jones River, Kingston

Figure 1

Jones River, Kingston - First Ladder

Alewives have had considerable difficulty ascending the first fishway on this river because of poor flow characteristics and excessive turbulence in the pools. We corrected this by constructing 9-inch wings on the sides of the baffles creating a 1-foot wide notch which limited flow and reduced turbulence.

Jones River - Fourth Ladder

Four baffles were damaged at this site by winter ice. Two baffles were completely replaced with reinforced concrete and the other two repaired.

spawning area available, the feasibility of opening Silver Lake to alewives should be evaluated. If sufficient flow for adult and juvenile migration can be maintained, fishways should be constructed at the dam at Wapping Street and at the outlet of Silver Lake.

Smelt spawn in the Jones River below the first dam and in Smelt Brook, a small tributary. Small numbers of shad have been observed in the river. The amount of shad spawning area should be determined, and if substantial, a shad restoration program should be initiated.

ISLAND CREEK

Island Creek begins at Island Creek Pond (40 acres) and flows 1.5 miles to Kingston Bay. The stream has an 8-acre impoundment called Mill Pond along its course. In 1968, a fishway was constructed at Mill Pond. Adult alewives were stocked in 1967 and 1968 and Island Creek Pond was stocked in 1969. A fishway should be constructed at Island Creek Pond to take advantage of the available spawning area. Smelt are reported to spawn in the lower section of the stream.

WEST BROOK (DUCK HILL CREEK)

West Brook flows from North Hill March Reservoir (37 acres), Duxbury, for 4.5 miles to Back River which empties into Duxbury Bay. The estuarine portion of the stream is called Duck Hill Creek. A 5-acre impoundment, used by the Duxbury Water Department, is formed on the stream. Passage could be improved by providing a notch in the wooden flash board at the impoundment spillway. A 25-foot dam at North Hill Marsh Reservoir prevents access to that pond. An alewife run once existed in West Brook and could be restored by stocking the Water Department pond and by improving passage at that point.

GREEN HARBOR RIVER

Green Harbor River in Marshfield flows 4 miles from a cranberry bog system to Green Harbor. No spawning area is available to alewives except in the river itself. Wooden tidegates at the mouth of the river prevent intrusion of sea water and impede fish passage. Removal of the gates would make most of the potential spawning area unsuitable due to high salinity. There is no potential for anadromous fish.

SOUTH RIVER

The South River flows from Keene Pond for 11 miles through the towns of Duxbury, Scituate and Marshfield to Massachusetts Bay. The stream has a common outlet to the Bay with the North River. Four impoundments are formed along the river. Of these, only Chandlers Pond (10 acres) could provide adequate spawning area for alewives.

At the present time, alewives cannot reach Chandlers Pond due to a 2.5-foot dam at the pond outlet. A fishway could be readily constructed at this site and is recommended if the alewife population is to be increased. A fishway exists at a 4-foot dam in Marshfield Village, but it is of improper design.

Fish use the ladder but the construction of an additional step at the lower end is needed to increase its efficiency.

Shad are present in the South River. The size of the population is unknown.

Smelt spawn in the river below Marshfield Village. The size of the run is unknown and further investigation is needed to determine if propagation is warranted. The river was heavily stocked with smelt from 1918 to 1920.

NORTH RIVER

The North River is formed by the convergence of the Indian Head River and Herring (Barker's) River. It flows for 12 miles through the town of Hanover, Pembroke, Norwell, Marshfield and Scituate to Massachusetts Bay. Many tributaries enter the river along its course and those of importance to anadromous fish are treated individually.

TRIBUTARIES TO THE NORTH RIVER

First Herring Brook (Herring River):

First Herring Brook is 7 miles long with headwaters in a large swamp in Scituate. A third impoundment was recently constructed between the other two impoundments. A fishway was built at the new dam, providing access to the 82-acre reservoir.

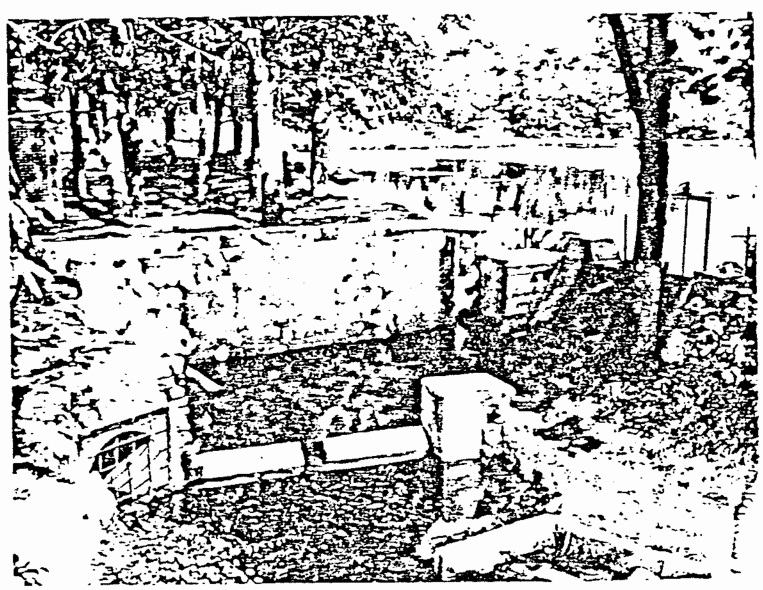
The lower impoundment, Old Oaken Bucket Pond (11 acres), has a poorly designed, dilapidated, concrete fishway. The upper impoundment, Tack Factory Pond (7 acres), has a fishway

First Herring Brook, Scituate 1970-71

The deteriorated weir pool fishway at Old Oaken Bucket Pond was replaced with a new fishway of like design (Figure 3).

The new fishway is 54 feet long with six pools. Construction is of 3,000-pound air entrained concrete and the structure is fully reinforced with steel. In addition to the fishway, four stream baffles were constructed, approximately 20 feet apart, downstream from the fishway. Each baffle is 2 feet high and is anchored 2 feet into the stream bed.

This new fish ladder provides access to 11-acre Old Oaken Bucket Pond and a newly constructed water supply reservoir. There is a weir pool fishway at the new reservoir dam providing the fish access to another 82 acres of spawning habitats.



Old Oaken Bucket Pd.

Figure 3

which is not needed since the new reservoir has raised the water level above the spillway, allowing free passage to the pond.

In order to bring alewife production up to its potential, a new fishway should be constructed at Old Oaken Bucket Pond.

Second Herring Brook:

Second Herring Brook flows from a cranberry bog reservoir in Norwell for 2 miles to its junction with the North River. Four impoundments are formed along its course. Only two of these, Turner Pond and Torrey Pond with a combined area of 18 acres, offer any significant spawning area. Four barriers block passage to Turner Pond, two of which are 10-foot dams. In view of the small spawning area, construction of passage facilities does not appear warranted.

Third Herring Brook:

This stream flows 5 miles from Jacobs Pond (54 acres) through the towns of Norwell and Hanover, to the North River. Three impoundments are formed on the stream. The first has a 6-foot dam. The second and third impoundments each have 10-foot dams. A 3-foot dam and 5-foot drop in elevation block access to Jacobs Pond. While Jacobs Pond offers considerable spawning area, the necessity of constructing four large fishways makes the economic feasibility of restoring this run questionable. A cost/benefit study should be made.

Robinson's Creek:

Robinson's Creek is a small stream which flows 0.5 mile from Howards Pond (5 acres) to the North River. Spawning area is not sufficient to justify construction of fish passage facilities. Bluebacks have been observed in the stream above Route 139.

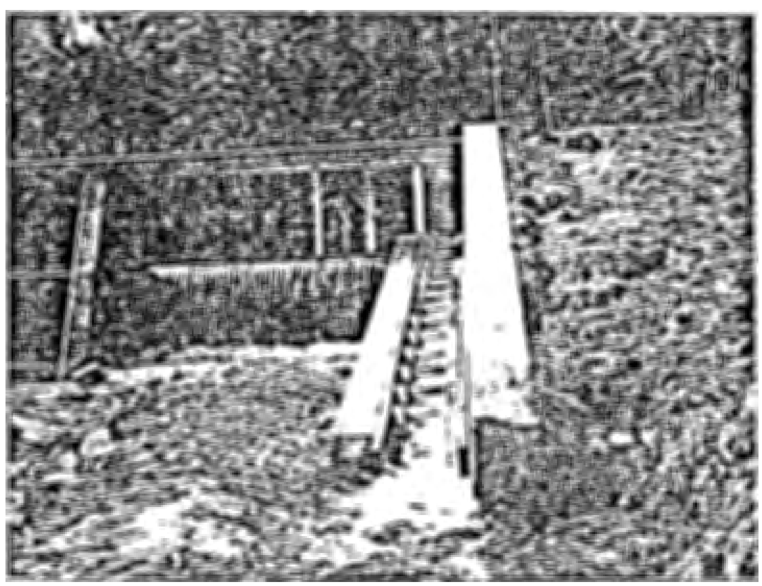
Herring Brook (Barker's River):

Herring Brook originates in Oldham and Furnace Ponds, with a total surface area of 240 acres, and flows for 4.5 miles through the town of Pembroke to the North River. In the past, this stream had the most productive alewife run in the North River system. As late as 1960, Pembroke sold alewives taken at the catching area on Barker Street. Since that time, the fishery has declined and alewives are no longer harvested.

The reasons for the decline are numerous and varied and together pose a complex problem for restoration. The five fishways on the stream are small and limit the number of fish reaching the ponds. Access to spawning areas was further impeded by beaver dams which have increased in numbers since introduction of beaver to the watershed in 1956. These dams are also a serious impediment to downstream migration of juveniles. Drought in 1965 dried up the connecting ditch between Oldham and Furnace Ponds, and juveniles were trapped in Oldham Pond. Another problem is the diversion of water from Furnace Pond to Silver Lake, a water supply for the City of Brockton which can hinder juvenile migration by lowering water levels and by drawing juveniles into the diversion intake. It is possible, however, to delay diversion until most juveniles have left Furnace Pond. Cranberry bogs along the stream pose still another threat to juvenile alewives. When bogs are

Barker's Brook-Furnace Pond, Pembroke

The Division is investigating the feasibility of using prefabricated fishway sections as an alternative to some on-site construction. A prototype Denil ladder, made from 3/4" plywood and dimension lumber, was built during the winter. In the spring of 1973, two fishway sections were installed in an inoperative concrete weir pool ladder on Barker's Brook at Furnace Pond, Pembroke (Figure 11). The baffles of the old fishway were removed and the new sections were fitted within the sluice of the old fishway (Figure 10). Total construction time at the site was three days.



Barkers Brook, Pembroke

Figure 10

flooded to prevent frost damage, the fish are often stranded on the bogs. Although stocking has been carried on since 1965, the run has not recovered. It is obvious that the lack of success is due to insufficient juvenile escapement.

In order to restore the fishery, a comprehensive management program must be implemented. Annual stream clearance by the town of Pembroke is necessary to remove beaver dams. The cooperation of the Brockton Water Department and cranberry bog owners is required to coordinate water usage and flow with downstream migrations. Screening of bog irrigation intakes would reduce juvenile mortality.

If adequate juvenile escapement is insured and results in a substantial adult migration, fishways should be redesigned to provide better attraction flows and accommodate larger numbers of fish.

Pudding Brook:

A tributary to Herring Brook, Pudding Brook flows 2 miles from a 112-acre cranberry bog reservoir in Pembroke. Dams at the reservoir outlet and at Route 53 block fish passage. Because of its large potential spawning area, an alewife run should be established in the brook. However, the beaver dams on Herring Brook also restrict passage to and from Pudding Brook and must be removed before an alewife population can be established. Fishways should be constructed at the 8-foot dam at Route 53 and at the 3-foot dam at the reservoir outlet. The reservoir should be stocked with adult alewives for at least three years.

Indian Head River:

The Indian Head River flows 2 miles from Factory Pond to the North River. In addition, the stream is impounded at State Street in South Hanover by a small but impassible stone dam and at Elm Street by a large concrete and stone dam with fishway.

Alewives ascend the stream to the South Hanover dam. Spawning occurs in the first impoundment, which is deep and steep-sided. The spawning area is small and the alewife population in the river is not large. Factory Pond (56 acres) offers the only potential spawning area of significance. When surveyed, the pond had no outflow over its 10-foot dam. If flow from the pond during migration periods is adequate for passage, a fishway should be constructed here and at the 4-foot dam at State Street.

The river supports a shad run and an excellent sport fishery exists. Shad spawn in the river below the dam at Elm Street. Fishing pressure is heavy during the run and access points are limited. The Division of Fisheries and Game is presently conducting a creel census of the shad fishery under AFS-6.

There is an excellent potential for improving shad population. The fishway at Elm Street is badly in need of repair and its location requires construction of barrier dams to obtain maximum efficiency. Repair and modification of the ladder using a design which would pass shad in substantial numbers and construction of barrier dams, would more than double the available spawning area. Besides the benefit of increased population size, opening the area above Elm Street to shad would provide many new access points for fishermen.

The Indian Head River has been selected for an experimental introduction of coho salmon into Massachusetts waters. One hundred thousand (100,000) eggs from the state of Washington will be hatchery-raised to smolt stage and released in the river below the Elm Street dam. Returning adults will be used as a source of eggs for continued propagation. A self-sustaining population could not be developed due to lack of sufficient spawning area. The goal of the program is to determine the feasibility of establishing a coastal and estuarine sport fishery. Initial stocking of smolt will take place in the spring of 1971. Precocious males are expected to return in fall of 1971, and mature adults in fall of 1972.

The Indian Head River and many other tributaries in the North River system possess great potential for smelt populations. Although some smelt were sampled in the watershed, it was not possible to determine the location and size of spawning areas or to estimate the magnitude of the run. Further study should be made to determine the size of the smelt population, the potential for enhancing the population and the best utilization of this resource.

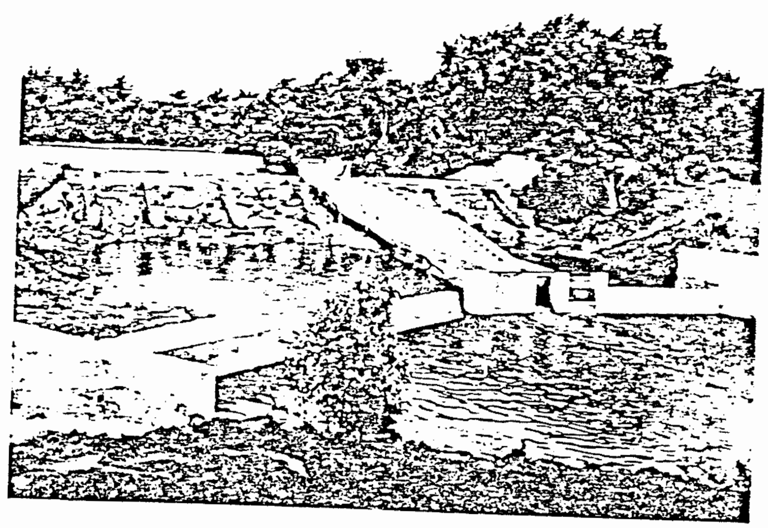
Indian Head River, Pembroke-Hanover 1970-71

The old weir pool fishway on the river was replaced with a Denil design facility, utilizing some portions of the walls, floor and supports of the old ladder (Figure 2). The exit was cut deeper into the face of the dam to improve passage during periods of low water. In addition, a barrier dam was constructed across the river at the entrance to the fishway.

The new fishway is 96 feet long, 3 feet wide on a 1:5 slope. The barrier dam is 5 feet high consisting of two sections, 50 feet and 12 feet on either side of the fishway, with a 10-foot wide apron. All new construction (65% of the fishway, all of the barrier dam and apron) is 3,000-pound air entrained, reinforced concrete. Baffles were constructed with 2-inch construction grade fir. They have 21-inch openings and are placed 24 inches apart. Baffle slots were preformed in the new construction, but in the old section they were made by nailing fir studs (2" X 4") to the side walls.

During construction, the upper portion of the dam was found to be porous and deteriorating. In order to secure the fishway and seal the dam, a 5-foot high concrete section was incorporated into the stone, gravel and wood core across the width of the dam.

The reconstructed fishway has improved access to the first impoundment for spawning alewives and has created an additional 1.6 miles of shad spawning area and fishing area.



Weir River – Access to Triphammer Pond should be improved (Accord Brook) fishway should also be constructed on Crooked Meadow River at entrance to Cushing Pond (maps 39A - 39B)

Broad Cove – unnamed stream smelt ok (map 39A)

Back River – 2nd ladder (by Broad St - Jackson Square (39A) should be redone

Fore River – 4 fishways need to be built to Provide passage to ~~great pond~~ Sunset lake and a fifth to Great Pond. Water quality and low flow from Great Pond ~~also~~ are problems which first must be overcome (maps 32B - 39A)

Town River smelt spawning grounds near mouth - ok (38C

Furnace Brook smelt spawning grounds - ok (31D)

Neponset River – Many dams, pollution - Both industrial and Domestic and poor water quality ~~negate~~ prohibit restoration of anadromous fish in this River (31D)

Charles River – fishway at Charles River Dam has been designed, fishway at Watertown dam has been built, fishway at Moody st dam is under design (31D - 31C)

Mystic River - fishway should be constructed between upper and lower Mystic lakes (31 A)

BOUND BROOK

Bound Brook flows 4.5 miles from Bound Brook Pond in Norwell through the towns of Hingham, Scituate, and Cohasset to the Gulf, an arm of Cohasset Harbor. Herring Brook is a major tributary to the stream, draining Lily Pond (50 acres) in Cohasset.

A 6-foot dam at Hunters Pond in North Scituate was breached in 1969 and when flow is sufficient alewives enter the pond. Lily Pond offers the largest spawning area and has been stocked with alewives in the past. However, the run has not reached its potential, probably because of passage difficulties and poor water regulation. With the dam breached, passage should be better. Stream clearance of Herring Brook and stocking of Lily Pond for three years should be conducted.

WEIR RIVER

Weir River originates in swamp lands in the town of Hingham and flows 7 miles to Hingham Harbor. Accord Brook, Crooked Meadow River and Fulling Mill Brook are tributaries. The first obstruction on the stream is a 10-foot dam at Forge Pond near the mouth of the river. An 88-foot concrete fishway bypasses the dam. After reaching Forge Pond most alewives apparently leave Weir River and enter Accord Brook where they ascend a 50-foot fishway to spawn in Triphammer Pond (14 acres). Upstream from Triphammer Pond is Accord Pond (100 acres). Accord Pond is used as a water supply by the town of Hingham and flow is insufficient for fish passage. A similar situation exists at Fulling

Mill Pond on Fulling Mill Brook. A fishway should be constructed at Cushing Pond (19 acres) on Crooked Meadow River. This would double the spawning area available for alewives and significantly increase the size of the run.

Smelt spawn in Weir River below Forge Pond. This is a large run and has been used as a source of smelt eggs and adult fish for propagation programs in the State.

BROAD COVE

Broad Cove is an inland extension of Hingham Harbor. A small, unnamed stream drains into the cove. A smelt run exists in the stream. Because of the size of the stream, spawning smelt are subject to easy capture and harassment. Chapter 130 regulations regarding the closed season on smelt should be more rigorously enforced in this case. There is no potential for further development.

BACK RIVER

Back River begins in Great Pond (300 acres) in Weymouth and flows 3.5 miles by Mill River to Whitmans Pond (188 acres). Below Whitmans Pond the stream is called Back River and continues for 3 miles to Hingham Bay.

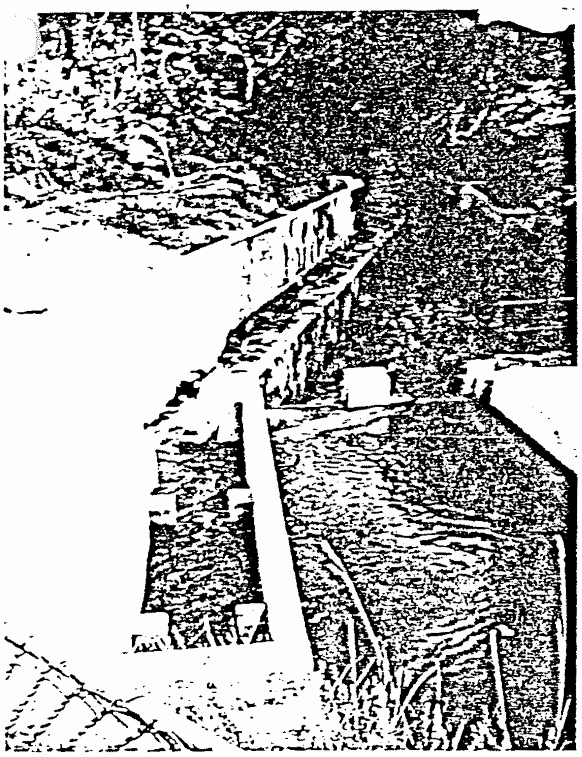
Whitmans Pond affords the major spawning area for alewives. Five fishways provide access to the pond. Originally, all fishways were of weir-pool design but the fourth and fifth fishways at Iron Hill and Whitmans Pond were rebuilt as part of

Back River, Weymouth - 3rd Fishway 1972-73 — also Constructed 4th + 5th ... during 1971

Extensive modification of this facility was carried out during the final segment of this project. Two noncontrollable, narrow, shallow exit pools were replaced with three pools the same width as the rest of the fishway (Figure 6). The crests of the new baffles were constructed at the same elevation but contain slots to provide control at varying water levels.

Constant erosion of the banking adjacent to the fishway adversely affected its use. This was corrected by constructing a 110-foot long retaining wall.

The entrance to the fishway was modified by the addition of a 32" high, 16' long barrier dam. A 4' X 20' retaining wall was constructed along the shore, furthest from the entrance, to anchor the dam and reduce erosion at this point (Figure 7).



Back River, Weymouth

Figure 6

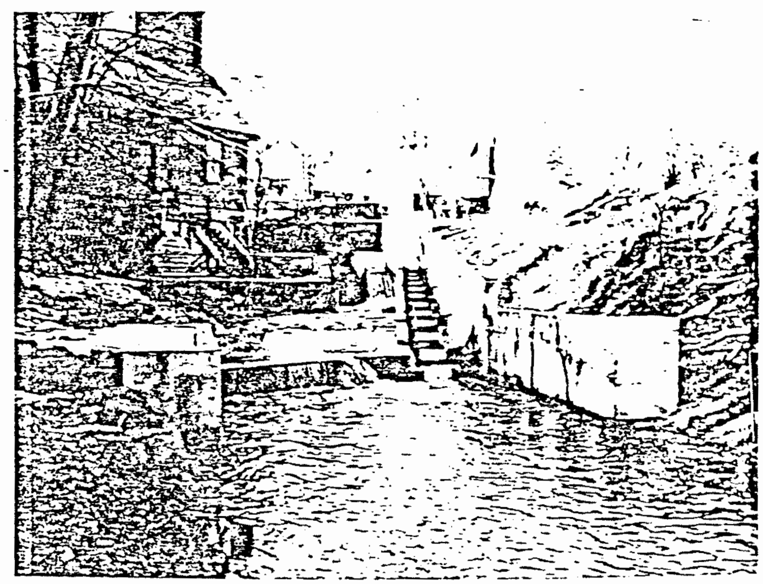
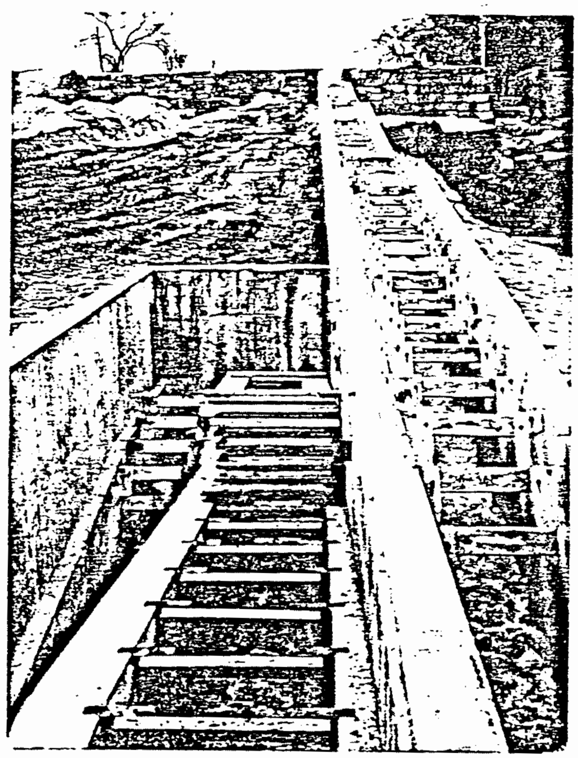


Figure 7

All construction is of steel reinforced 3,000-pound air entrained concrete.

The new barrier dam and fishway modification should improve fish passage through this facility allowing a greater number of fish to reach the two new Denil fishways located upstream.



Fourth fishway, Back River, Weymouth

Back River

Back River begins in Great Pond (300 acres) in Weymouth and flows 3.5 miles by Mill River to Whitmans Pond (188 acres). Below Whitmans Pond the stream is called Back River and continues for 3 miles to Hingham Bay.

Whitmans Pond affords the major spawning area for alewives. Five fishways provide access to the pond. Originally, all fishways were of the weir-pool design but the fourth and fifth fishways at Iron Hill and Whitmans Pond were rebuilt as part of a flood control project at Whitmans Pond. Both ladders were reconstructed using the Denil design. Of the remaining three fishways, the first is in excellent condition and passes alewives adequately. The second ladder should be completely redesigned with its entrance located closer to the base of the dam. The third fishway is currently being lengthened to compensate for a change in water levels due to the flood control project, and a barrier dam is being constructed at its entrance to increase the ladders efficiency.

Access to Great Pond is blocked by three dams and a natural falls on Mill River. The pond is used as a water supply by the town of Weymouth and water level is subject to wide fluctuation.

The pond has an excellent development potential if adequate flows are available during migration periods. A study of water flows and development cost should be undertaken, preferably in conjunction with the Weymouth Conservation Commission.

The section of Back River below the first obstruction supports an excellent smelt run. The run appears to be at maximum production and is probably a significant contributor to the sport fishery in the Boston Harbor area.

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Back River begins in Great Pond (300 acres) in Weymouth and flows 3.5 miles by Mill River to Whitmans Pond (188 acres). Below Whitmans Pond the stream is called Back River and continues for 3 miles to Hingham Bay.

Whitmans Pond affords the major spawning area for alewives. Five fishways provide access to the pond. Originally, all fishways were of the weir-pool design but the fourth and fifth fishways at Iron Hill and Whitmans Pond were rebuilt as part of a flood control project at Whitmans Pond. Both ladders were reconstructed using the Denil design. Of the remaining three fishways, the first is in excellent condition and passes alewives adequately. The second ladder should be completely redesigned with its entrance located closer to the base of the dam. The third fishway is currently being lengthened to compensate for a change in water levels due to the flood control project and a barrier dam is being constructed at its entrance to increase the ladders efficiency.

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a flood control project at Whitmans Pond. Both ladders were reconstructed using the Denil design. Of the remaining three fishways, the first is in excellent condition and passes alewives adequately. The second ladder should be completely redesigned with its entrance located closer to the base of the dam and the third fishway should be lengthened and widened. Construction of a barrier dam at the entrance of the third fishway would increase its efficiency.

Access to Great Pond is blocked by three dams and a natural falls on Mill River. The pond is used as a water supply by the town of Weymouth and water level is subject to wide fluctuation. The pond has an excellent development potential if adequate flows are available during migration periods. A study of water flows and development cost should be undertaken, preferably in conjunction with the Weymouth Conservation Commission.

The section of Back River below the first obstruction supports an excellent smelt run. The run appears to be at maximum production and is probably a significant contributor to the sport fishery in the Boston Harbor area.

FORE RIVER

Great Pond (205 acres) in Randolph and Weymouth is the source of Fore River. From Great Pond to its convergence with the Cochato River it is called Farm River. Below the convergence it is known as the Monatiquot River and it is not until it comes under tidal influence that it is called Fore River.

Sunset Lake (72 acres) drains into the Monatiquot River. Two other impoundments, Ames Pond (3 acres) and Hollingsworth Pond (4 acres), are formed before the stream finds its way to Hingham Bay. Dams at Middle Street in Braintree, Ames Pond, Hollingsworth Pond, Sunset Lake and Great Pond block passage. Great Pond is used as a water supply by the town of Braintree. Much of the river system is highly urbanized and receives industrial and domestic waste discharges. Four fishways would be required to provide access to Sunset Lake and a fifth to Great Pond. Because of the numerous fishways needed, poor water quality and the possibility of inadequate flow from Great Pond, restoration of an alewife fishery should not be undertaken.

Smelt are reported to spawn in the lower section of the stream as well as in Smelt Brook, a tributary to Fore River.

TOWN RIVER

Town River flows through Quincy to Town River Bay. The stream runs underground for much of its length but does have a 0.5 mile section near its mouth which smelt use for spawning. The run is probably at its peak and no further development is feasible. The stream has no potential for alewives due to the lack of spawning area.

FURNACE BROOK

Furnace Brook flows through Quincy to Quincy Bay. The estuarine portion of the stream is called Blacks Creek. Sections of Furnace Brook run underground and only the lower mile of stream is suitable for anadromous fish. Smelt spawn in the stream and in all probability the run is at its peak. There are no recommendations for improvement. Lack of spawning area prohibits alewife restoration.

NEPONSET RIVER

The Neponset River flows from Neponset Reservoir in the town of Foxboro for 28 miles to Dorchester Bay. Numerous dams impound the river. Pollution, both industrial and domestic is gross, especially in the vicinity of urban areas. The river once supported substantial shad and alewife fisheries but obstructions and pollution eradicated them (Belding, 1921).

Although 16 miles of unobstructed stream exists above the dam at the Tilestone and Hollingsworth Paper Company, the difficulties of providing passage facilities here and at the first dam at Milton Lower Mills in combination with poor water quality, prohibits restoration of either shad or alewives at this time.

A bottom sampling program to determine the potential shad spawning area above the second dam should be conducted. If potential spawning area is significant and water quality can be improved, a cost/benefit ratio should be established for construction of fishways suitable for shad passage at the first two dams.

Smelt ascend the river to the base of the first dam. It is not known if the population is presently at its maximum size, since production may be limited by poor water quality. A sport fishery for smelt exists in the lower reaches of the river.

CHARLES RIVER

The Charles River originates in Echo Lake in Hopkinton and flows 79 miles to Boston Harbor. The river has a total drainage area of 300 square miles with numerous tributaries augmenting the flow of the mainstream. Much of the river flows through highly urbanized areas including metropolitan Boston.

Historically, the Charles River supported large runs of alewives, shad and smelt. Because of the early development of the Boston area and the resulting dams and pollution, these fisheries were among the first to be lost in Massachusetts. Only a remnant of the alewife population and a few smelt remain. Shad are no longer present in the river. The alewives and smelt which still spawn in the river must pass through the navigation locks of the Charles River dam. Most spawning occurs between the Charles River dam and the Watertown dam. Although a fishway was incorporated into the Watertown dam in 1967, poor design has prevented any significant alewife passage.

The potential for anadromous fish restoration in the Charles River is excellent. A program of pollution abatement has been initiated by the Federal Water Pollution Control Agency and the Massachusetts Division of Water Pollution Control. The latter has set water quality standards and developed a plan for implementation and enforcement which should bring the quality of river water well above the minimum requirements of anadromous fishes.

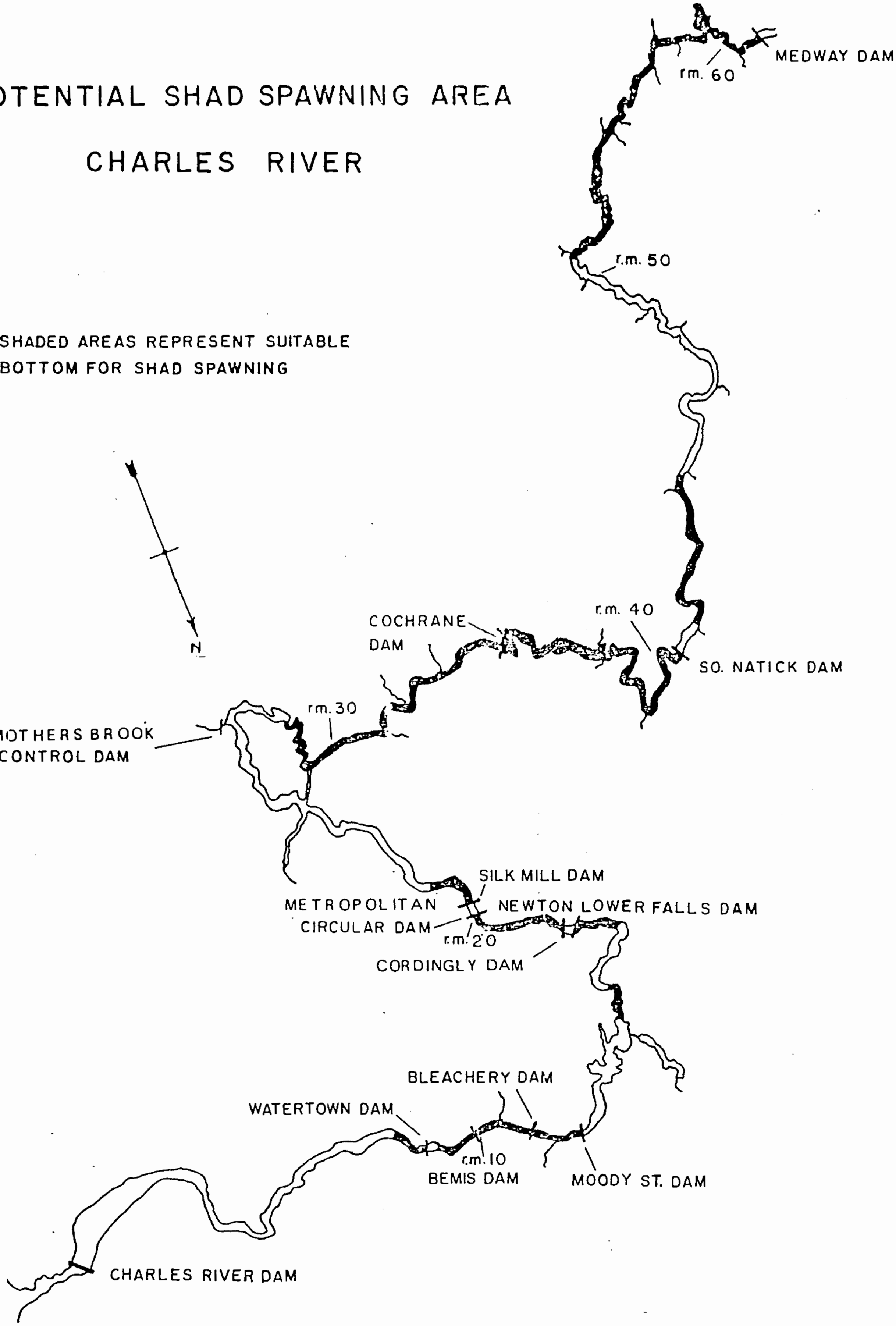
A new dam and lock system is planned by the U.S. Army Corps of Engineers to replace the Charles River dam. A fishway designed to pass alewives and shad will be incorporated into the structure. In addition, a long range comprehensive study of the Charles River system is being carried on by a number of federal and state agencies in order to develop the river as a multiple use resource. Among the factors being considered is anadromous fish restoration. Cost/benefit ratios and fishway designs are being prepared for all dams up to Medway.

In anticipation of fishway construction, the Division of Marine Fisheries has conducted a bottom sampling study to determine the potential shad spawning area available in the river and to estimate potential population size. The river was sampled from the Charles River dam to the Medway dam, a total of 61 river miles. The survey revealed 1,254,066 square yards of potential spawning area with a minimum potential of 28,844 shad (Fig. 2). The Division is planning to stock one million fertilized shad eggs in the river in 1971.

The immediate goals for anadromous fish restoration are construction of adequate fish passage facilities at the proposed Charles River dam and at the Watertown dam, and stocking of shad eggs. Long term plans include improved water quality,

POTENTIAL SHAD SPAWNING AREA
CHARLES RIVER

SHADED AREAS REPRESENT SUITABLE BOTTOM FOR SHAD SPAWNING

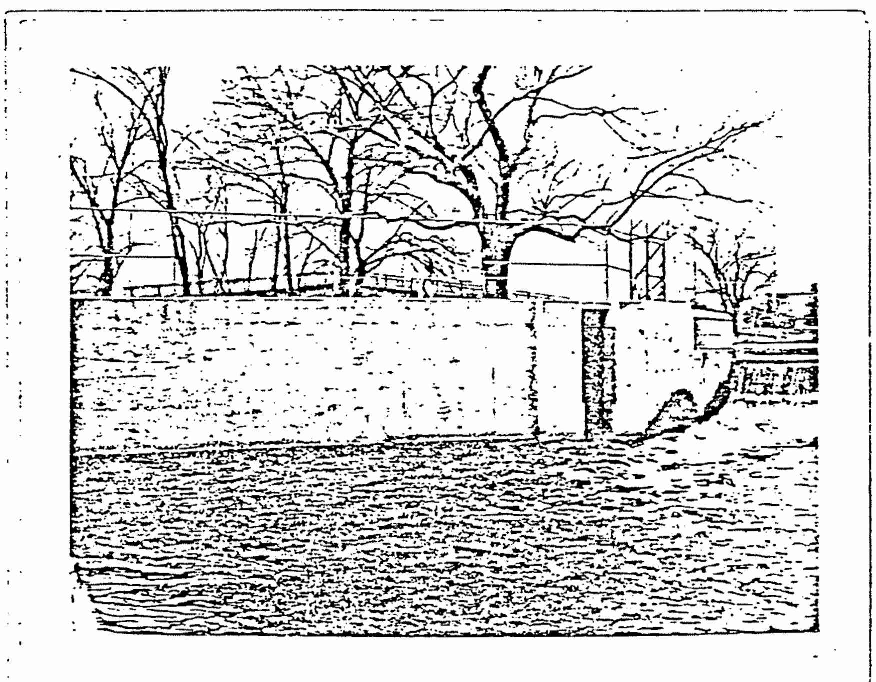


Charles River, Watertown 1970-71 + Moody St, 1978

A nonfunctional weir pool fishway at the Watertown dam was replaced with a Denil-type facility (Figure 4).

The new ladder was constructed under a contract administered by the Metropolitan District Commission. The ladder is constructed with reinforced concrete and has fir baffles. It is 84 feet long and 4 feet wide, surmounting a 6-foot elevation. Baffles have 28-inch openings and are spaced 30 inches apart. The ladder was built adjacent to the shore on the south side of the dam.

This new facility improves passage to the Bleachery dam. Fish passage at this low head dam is possible only during exceptionally high water. Two 3' X 18" slots should be made at both ends of this dam. This would allow fish to pass to Moody Street, 2.72 miles upstream from Watertown.



Charles River, Watertown

Figure 4

construction of fish passage facilities at all dams, and development of tributaries for anadromous fish restoration.

Watertown dam modified & lower half replaced around 1971-72

Moody St. Waltham - New ladder constructed in 1978-79 - Modified - 1985

Bleachery Dam - Breached - 1984
Newton lower Falls - New Denil ladder - 1985
Cordingly Dam - New Denil ladder - 1986
Circular Dam - Denil ladder planned
Silk Mill Dam - Denil ladder planned

construction of fish passage facilities at all dams, and development of tributaries for anadromous fish restoration.

MYSTIC RIVER

The Mystic River flows 7 miles from the Mystic Lakes to Boston Inner Harbor. In recent years, alewives have spawned in lower Mystic Lake (93 acres). A dam near the river mouth hinders migration and passage is available only through the navigation locks. Alewife mortalities, due to oxygen deficiency, have been observed in the locks.

A 10-foot high dam blocks passage from lower Mystic Lake to upper Mystic Lake. A fishway at this point would increase available spawning area by 166 acres.

Alewife Brook, a tributary to the Mystic River, drains Little Pond (18 acres). An alewife run exists here and is probably at its peak productivity.

The Aberjone River, which flows into upper Mystic Lake, forms many small impoundments, each being an obstruction to migration. No spawning areas of significant size exist on the river. Horn Pond (100 acres) flows into the Aberjone River by way of Horn Pond Brook, but obstructions and a rapid elevation drop make it unsuitable for alewife restoration. Development of a large alewife run above upper Mystic Lake is not considered feasible.

SAUGUS RIVER

The Saugus River flows from Lake Quannapowitt (230 acres) for 13 miles through the towns of Wakefield and Saugus to Lynn Harbor. Lake Quannapowitt was formerly a water supply for the town of Wakefield and outflow was kept at a minimum. Now the outlet is silted in and continues to restrict flow. Fortunately, the river drains a large swamp and maintains a good flow, although some water is diverted to Hawkes Pond, a water supply for the town of Lynn.

A 35-foot concrete fishway provides passage over a small dam at the Saugus Iron Works. A dam at the site of Prankers Pond is now breached and the fishway there is no longer needed. A 7-foot dam at a small unnamed impoundment north of Route 28 prevents further migration.

Alewives have been observed in the stream immediately below the dam at the unnamed impoundment. The fishery could be restored and enhanced by construction of fishways here and at Lake Quannapowitt, but before fishway construction is undertaken it should be determined if adequate flow from Lake Quannapowitt can be maintained.

PROCTOR BROOK

Proctor Brook flows from a small swamp for 4 miles through the towns of Peabody and Salem to Beverly Harbor. No significant spawning areas are available on the stream. Pollution, both domestic and industrial, is present in the lower reaches of the stream. Tidegates at the mouth of the stream block passage of fish. There is no possibility for anadromous fish development at present.

CRANE RIVER

Crane River drains swamp lands in the town of Danvers and flows 4 miles to the Danvers River, an inland extension of Beverly Harbor. Alewives formerly spawned in the stream, probably in what is now called Mill Pond (4 acres). Two dams block passage to Mill Pond and because of its small size does not warrant restoration.

PORTER RIVER

The Porter River and its tributary, Frost Fish Brook, flow 3 miles through the town of Danvers to the Danvers River. No significant spawning areas for alewives exist on the stream and development potential is poor.

CHUBB CREEK

Chubb Creek flows from a small swamp for 1 mile through the towns of Manchester and Beverly to Massachusetts Bay. This stream has no potential for alewives. Smelt and smelt eggs were observed in the stream in the area of Hale Street. Because of the small size of the stream, further development of the smelt population is not justified.

TRIBUTARIES TO MANCHESTER HARBOR

A number of small unnamed streams flow into Manchester Harbor, none of which are suitable for alewives. These streams may support smelt runs but no evidence of such was noted during the survey.

WEST POND

West Pond (8.4 acres), in the town of Gloucester, drains into Massachusetts Bay. The outlet stream drops 75 feet in only 500 feet of stream. Resulting high flow velocities and lack of water depth in some areas of the stream could hinder alewife passage. Stream bed modifications necessary to overcome this problem are not warranted.

BUSWELL POND

Buswell Pond (7.5 acres), Gloucester, drains into Gloucester Bay by way of an unnamed stream. The stream loses 63 feet of elevation over a distance of 750 feet. Construction of passage facilities is not justified.

RUM ROCK LAKE

An unnamed stream drains Rum Rock Lake (8 acres) in the town of Rockport and flows 1.6 miles to the sea. Low flow and a rapid loss of elevation preclude any development for anadromous fish.

MILL BROOK

Mill Brook originates in a 2.5-acre pond in the town of Rockport and flows 1 mile to Sandy Bay. Two dams block passage to the headwater pond and entrance to the stream is possible only on high tides. There is little potential for development.

LANGSFORD POND

Langsford Pond (3 acres), in Gloucester, drains into an unnamed stream which flows 0.25 mile to Lobster Cove. The pond is at an elevation of 32 feet, making sections of the stream too steep for alewife migration. This fact and the small size of the pond, limit the development potential.

ALEWIFE BROOK

Alewife Brook flows 3 miles from swamp lands in Rockport and Gloucester to Mill River, a tidal tributary to the Annisquam River. A 35-foot dam creates a 32-acre impoundment called Babson Reservoir. Below this point, Mill Pond (22 acres), is formed by adjustable tidegates. Mill Pond is at sea level and is kept at a high salinity for mosquito control purposes. Babson Reservoir is the only potential spawning area for alewives. However, limited flow and the large dam prohibit establishment of an alewife population.

FERNWOOD LAKE

Fernwood Lake (27 acres) is the largest and uppermost of a series of three impoundments which drain into the Annisquam

River in Gloucester. Dams at each impoundment block passage and the stream grade below the lower two impoundments is too steep for efficient fish passage. The necessary stream modification and fishway construction is not justified by the spawning area that would be made available.

LITTLE RIVER

Little River originates in Dykes Pond (50 acres), Gloucester, and drains into Lily Pond (27 acres). The stream then flows 1.4 miles from Lily Pond to the Annisquam River.

A 100-foot stone fishway near Route 133 overcomes a natural elevation loss. Condition of the fishway was poor but it is presently being replaced in conjunction with a flood control project. There is also a 25-foot concrete fishway at the outlet of Lily Pond.

Alewives spawn in Lily Pond. Lack of outflow and a 50-foot dam negate any development potential for Dykes Pond. The fishway at Lily Pond should be cleaned and fitted with Denil type baffles to obtain maximum efficiency.

Smelt spawn in Little River in the vicinity of Route 133. The available spawning area is small and no further development is possible.

WALKER CREEK

Walker Creek in Gloucester flows 2.8 miles from Haskell Pond (45 acres), a water supply, to Essex Bay. The first obstruction to fish passage is a 5-foot dam forming a 2-acre impoundment. The second obstruction at Haskell Pond is a 35-foot earthen dam. Lack of sufficient flow from Haskell Pond precludes establishment of a significant alewife run.

Smelt are reported to spawn in the lower section of Walker Creek, but this was not confirmed. Sufficient spawning area exists to support a substantial run. Further investigation is required to determine if propagation is needed.

ESSEX RIVER (CHEBACCO BROOK)

The Essex River originates in three natural ponds: Coy Pond (22 acres), Wenham; Round Pond (35 acres), Hamilton; and Chebacco Lake (186 acres) on the boundary line of Hamilton and Essex. The stream flows 5.6 miles from Chebacco Lake to Essex Bay. The estuarine section of the stream is called the Essex River.

The only obstruction to passage on the river is a natural elevation drop at Essex Falls. Stone baffles placed in the stream over a distance of several hundred feet enable alewives to pass this point. Cleaning and brushing of Chebacco Lake outlet and the entire stream between Coy Pond and Chebacco Lake would facilitate passage to the spawning grounds.

Smelt spawn in the lower section of the stream and an excellent winter sport fishery exists in the estuary. The major fishing area is off Main Street near the center of Essex. Fishing is carried on mainly from smelt shantys set on the ice. When the ice cover is poor, the shantys are placed on floats.

IPSWICH RIVER

The Ipswich River begins at the convergence of Lubber Brook and Maple Meadow Brook in Wilmington and flows 20 miles to Ipswich Bay. The river has a large drainage area with many tributaries. The river supported an excellent alewife fishery in the early 1800's. Damming of the main stem and tributaries has drastically reduced the number of alewives entering the river (Belding, 1921).

The first two dams on the river have been breached and the third, a 12-foot dam in Ipswich Center, is equipped with a 75-foot concrete combination weir-pool and vertical slot fishway. The next three dams are impassible. Two of these, adjacent to Bradley Palmer State Park, are within 150 yards of each other, and 3 feet and 4 feet in height respectively. The third obstructing dam is at Main Street in Middleton, and is 10 feet high.

Wenham Lake (224 acres), was the main spawning ground for alewives in the river system. The lake has been taken by the City of Salem for a water supply, and outflow is limited. Other potential spawning grounds in the system, Middleton Pond, Suntaug Lake and Putnamville Reservoir, also are used as water supplies and water flows are not sufficient to maintain runs of anadromous fish. Only Martins Pond (87 acres), North Reading; and Hood Pond (62 acres), Ipswich; have potential as alewife spawning areas. Martins Pond flows into the Ipswich River by way of Martins Brook, and Hood Pond is drained by Howlett Brook.

In order to establish a significant alewife population in the Ipswich River system, fishways must be constructed at the two dams at Bradley Palmer State Park and at the dam in Middleton. The fishway in Ipswich should be modified to provide more attraction either by placing its entrance at the base of the dam or by construction of a barrier dam. Martins Pond should be stocked with adult alewives for three years after completion of the fishways. If a spawning population can be established in Martins Pond, a fishway should be constructed at the dam at Hood Pond.

The large main stem of the river appears to have potential for shad. Bottom sampling to determine potential spawning area and estimate of productivity should be made. New fishways designed for shad passage will need to be built if a shad population is to be established.

Smelt spawn in the lower section of the river and a winter sport fishery is carried on in the estuary. Most fishing is done from smelt shantys placed on the ice in the area of the town landing, off of East Street in Ipswich.

ROWLEY RIVER

The Rowley River begins at the convergence of Dow Brook and Bull Brook and flows 5.6 miles to Plum Island Sound. The name Rowley River, generally, applies to the estuarine portion of the stream and the fresh water section is called Egypt River.

Dow Brook Reservoir (17 acres) and Bull Brook Reservoir (9 acres) are the headwaters of the system. A 20-foot earthen dam at Dow Brook Reservoir and a 6-foot dam at Bull Brook Reservoir prohibit fish passage. In 1965, the town of Ipswich constructed a fishway and a 0.5-acre pond at the site of the municipal electrical generating plant on the Egypt River. The pond is used as an auxiliary cooling reservoir for the plant, and provides a small spawning area for alewives. The fishway is 125 feet long, constructed of stone and concrete. Alewives have been using the fishway and pond in increasing numbers since they were built (Jerome, et al, 1968). Further development of the population would require fishway construction at two reservoirs, and the high cost of construction makes the economic justification for construction questionable.

Smelt spawn in Egypt River and a winter sport fishery is carried on in the estuary (Rowley River). Here, as in other smelt fisheries in the area, fishing is done by hook and line, usually from smelt shantys or other shelters placed on the ice.

PARKER RIVER

The Parker River originates in swamp lands in the towns of Boxford and Georgetown. Two headwater ponds, Rock Pond (51 acres) and Pentucket Pond (87 acres) are in Georgetown. A third headwater, Baldpate Pond (56 acres), drains into the Parker River through Penn Brook. The brook has little flow and is insufficient to maintain a run of alewives. From Pentucket Pond, the Parker River flows 15 miles to Plum Island Sound.

Six dams, each equipped with a fishway, are located on the river. The first fishway at the Woolen Mill Dam in Byfield is 100 feet long and is a combination of concrete walls with wooden baffles and natural stone pools. The fishway could be greatly improved by replacing the lower section with a permanent concrete structure. The second fishway is at Larkin Street in Byfield. It is 125 feet long and surmounts a 7-foot elevation. Alewives use the ladder readily. A 10-foot dam near Main Street in Byfield is bypassed by the third fishway, 105 feet, and in good condition. The fourth fishway located off of Main Street, Byfield, is 335 feet long and allows fish to pass a 6-foot dam and a natural elevation drop. A fifth fish ladder, near Main Street, Byfield, is 55 feet long and surmounts a 4-foot elevation. This fishway should be redesigned and constructed to provide more attraction for fish. The last fishway is located at the outlet of Pentucket Pond. It is 10 feet long and allows alewives to ascend the 4-foot elevation between stream and pond. This ladder is poorly designed and is not easily negotiated by alewives. Modifying the walls of the structure for Denil baffles would greatly increase its efficiency. All of the above fishways require annual maintenance and flow regulation.

The section of river directly below the Woolen Mill Dam is a spawning area for smelt. Smelt also spawn in Cart Creek and Little River, tributaries to the Parker River. An important sport fishery for smelt is carried on during the winter in the estuarine portion of the Parker River. Large clusters of smelt shacks can be found on the ice at Thurlows Bridge and at an area known as South Shore in Newbury.

Parker River, Newbury-Georgetown 1971-72

Fishway #1, Central St., Newbury (Byfield). Originally, this stone fishway had staggered baffles and a wooden floor but after years of neglect the floor had deteriorated and some of the baffles had collapsed.

The first phase of construction involved the removal of all baffles and several large stones, and the cleaning and deepening of the fishway to its original depth. Actual reconstruction involved rebuilding the floor, side walls and baffles in a weir pool design using 3,000-pound air entrained, reinforced concrete. However, most of the exposed stone work was retained in its original state and pointed up because of the aesthetic qualities of the fishway and the historic character of the area.

The gradient of the fishway varies because of rock outcroppings on which part of it is based. Pool lengths vary from 5 to 15 feet and the depth ranges from 24 to 30 inches. The irregular character of the fishway required the baffles to be constructed with wings, leaving 3-foot wide full overflow slots to maintain uniform depth and flow.

The new fishway is 100 feet long and has 12 pools with a vertical rise of 96 inches.

1972-73

Fishway #2, Larkin Road, Byfield. This 125-foot fishway was cleared of brush, sand, stone and gravel; completely pointed up; and the baffles ~~were~~ rebuilt. In addition, a barrier dam was constructed adjacent to the entrance.

1971-73

Fishway #3, Main Street, Byfield. This 105-foot long fishway was also completely repaired. All pools were deepened and improved by adding concrete floors. Several baffles were replaced and the stone work along its entire length was pointed up.

Fishway #5, River Street, Byfield. 1972-73 Work on this 55-foot fishway consisted of deepening, pouring a new concrete floor and replacing all baffles. The stone walls were regrouted, rebuilt and reinforced as needed. A reinforced concrete barrier dam, 2' high and 11' long, was constructed at the entrance of the fishway, skewed downstream to the opposite shore to direct the fish into the facility.

Fishway #6, Pentucket Pond, Georgetown. 1971-72 This small (10 feet), poorly designed weir pool fishway was modified by removing the old baffles and replacing them with five new Denil baffles made of 2-inch construction grade fir.

MILL RIVER

Mill River is a tributary to the Parker River. It begins in swamp lands in the towns of Rowley and Georgetown and flows 14 miles to its junction with the Parker River. Three impoundments are formed along its course. The first at U.S. Route 1 in Rowley is 2 acres and has a 6-foot dam. A 12-acre impoundment at Daniels Road, Rowley, is created by a 7-foot dam and a 19-acre pond is formed by a 6-foot sawmill dam north of Route 133.

Construction of fishways would provide access to spawning areas and an alewife population could be developed. However, it appears that construction at the upper ponds would be very expensive due to inherent problems with the sites, and a complete engineering study should be made before any plans are formulated.

A smelt spawning area exists below the first dam and a winter smelt fishery is carried on in the Mill River estuary. The fishery is located in the vicinity of Wood Island and smelt are taken through the ice on hook and line, generally from smelt shantys or other shelters.

MERRIMACK RIVER

The Merrimack River has a drainage system of 5,010 square miles, 1,210 of which are in Massachusetts. The river originates in the White Mountains of New Hampshire and the main stream flows southward for 60 miles to the Massachusetts border.

At this point it turns easterly, flows for 50 miles and enters the Atlantic Ocean at Newburyport. (U.S. Department of the Interior, Federal Water Pollution Control Administration, 1966).

Historically, the Merrimack River has been one of the most productive rivers for anadromous fishes in Massachusetts. Salmon, sturgeon, shad, alewives and smelt were abundant during the period of colonial settlement. Sturgeon were fished commercially until 1887 and salmon until 1901 (Jerome, et al, 1965). Construction of dams at Lawrence, Lowell and Manchester, New Hampshire, together with increasing pollution from urban areas, caused a decline in all anadromous species and eliminated the salmon and sturgeon fisheries.

The present shad population is small. The U.S. Fish and Wildlife Service has estimated the number of shad utilizing the Lawrence fishway at 1,500 to 3,000 annually. The run is sporadic, and during some years no shad have been reported. (U.S. Department of the Interior, Federal Water Pollution Control Administration, 1966).

The first obstruction on the river is the Essex Dam in Lawrence. The dam is 30 feet high and is equipped with a 112-foot fishway. The fishway is of notched weir-pool design with 47 pools. The lower 36 pools are 8 feet wide and 8 feet long. Upper pools average 6.3 feet in width and are about 10 feet long. Alewives ascend the fishway readily. Although shad are known to use the facility, the U.S. Fish and Wildlife Service estimates the maximum number of shad which the ladder can pass annually to be less than 100,000 fish, with pool size being the limiting factor (Wagner and Jewett, 1970, unpublished). Other deterents to upstream migration at the Lawrence fishway are relatively low attraction flows and the narrow range of tail race elevations within which shad will enter the fishway (Collins, 1951). Downstream migration of juveniles in the Lawrence area is endangered by diversion canals which run through the city for industrial use and power. Further investigation of the diversion canal system is required to determine what steps must be taken to protect downstream migrants.

The second obstructing dam on the main stem Merrimack and the last in Massachusetts, is the Pawtucket Dam in Lowell. This dam has a weir-pool fishway which surmounts a 20-foot elevation. Although alewives manage to utilize the fishway, (alewives have been observed below the Amoskeag Dam, Manchester, New Hampshire, 73 miles from the river mouth) the small size of the facility and lack of sufficient attraction flow make it inadequate for passage of large numbers of alewives and shad. Downstream migrants in this area are endangered by a canal diversion system similar to that in Lawrence.

Nearly all tributary streams that enter the Merrimack River in Massachusetts are obstructed by dams. In most cases, passage must be provided over several dams before adequate spawning grounds can be reached. One tributary which shows immediate potential for alewife restoration is the Artichoke River which has 170 acres of spawning area in Upper and Lower Artichoke Reservoirs in West Newbury, and flows one mile to the Merrimack.

Fishways should be constructed at the first dam and at the outlets of both reservoirs. Stocking of adults for three years should commence in anticipation of fishway completion.

MARTHA'S VINEYARD

LAGOON POND

Lagoon Pond (550 acres) is a salt pond lying between Tisbury and Oak Bluffs. Salinity of 25.0 parts per thousand was recorded and spawning is not believed to be highly successful. There is headwater pond lying above Lagoon Pond and connected to it by a short stream. It is spring fed and salinities are low despite some salt water intrusion. Alewives utilize this small pond as a spawning area and there is no potential for further development.

FARM POND

Farm Pond (33.5 acres) is a salt pond in Oak Bluffs and is connected to Nantucket Sound by Harts Harbor. Salinity of 15.0 parts per thousand was recorded and alewives were observed in the pond during the survey. A commercial fishery was carried on from 1856 to 1884. The population should be at its peak and further development is not required.

TRAPPS POND

Trapps Pond (45 acres), a salt pond in Edgartown, is connected by a tidal creek to Sengekontacket Pond which is much larger and more saline. Salinity at the outlet of Trapps Pond was recorded at 16.0 parts per thousand. Alewives are known to spawn in the pond but the population is relatively small, possibly due to high salinity.

MATTAKESSETT HERRING BROOK

Mattakessett Herring Brook is an artificial ditch, excavated in 1889, connecting Edgartown Great Pond (877 acres) to Katama Bay. A private fishery was created by opening the ditch and the catch averaged 1,800 barrels annually (Belding, 1921). At present, the run has diminished and it is no longer of commercial importance. In order to insure maximum productivity, the ditch must be kept clean of debris and the connection between Edgartown Great Pond and Crackatuxet Cove must be opened during fish migrations. This stream lies in an unstable zone of shifting sand dunes subject to shoreline changes. Continual maintenance is required to sustain an alewife run in this area.

JOBS NECK POND

This brackish water pond was once connected to Edgartown Great Pond by an artificial ditch. The pond sustained a privately owned commercial fishery. The ditch is now filled in and the pond's 77 acres of former spawning area are no longer available to alewives.

It is recommended that Edgartown gain local control under either Section 93 or 94 of Chapter 130 and restore the run to its former productivity.

OYSTER POND

This 210-acre brackish water pond once supported an alewife fishery which yielded 50 barrels annually. Maintenance of the fishery entailed annual opening of the pond's outlet to the sea. Since the opening would close within a few days, the fishing was not successful (Belding, 1921). In order to maintain a significant alewife run in Oyster Pond it is necessary to stabilize the outlet. The feasibility of constructing groins and a permanent outlet ditch should be investigated.

TISBURY GREAT POND

Tisbury Great Pond (915 acres) is a salt pond lying between the towns of Chilmark and West Tisbury. The pond is fed by two streams, Mill Brook and Tiasquam River. Four small impoundments are formed on Mill Brook and three on Tiasquam River. Fish passage to these ponds is insignificant in view of the large spawning area in Tisbury Great Pond. In the past, the alewife fishery yielded 1200 barrels annually (Belding, 1921). Access to the pond is dependent upon artificial opening in the spring.

BLACK POINT POND

This 64-acre brackish water pond in Chilmark is connected to Tisbury Great Pond by a 1200-foot manmade ditch. Alewives entering Tisbury Great Pond can use Black Point Pond for spawning also.

CHILMARK POND

Chilmark Pond (221 acres) is a brackish water lagoon in the town of Chilmark. The pond once supported a good white perch fishery and a smaller fishery for alewives. The pond outlet is artificially opened in the spring and summer to raise salinity for shellfish and to allow alewife passage.

SQUIBNOCKET POND AND GAY HEAD HERRING CREEK

Squibnocket Pond (596 acres) lies between the towns of Chilmark and Gay Head. Squibnocket Pond is connected to Menemsha Pond by an artificial stream called Gay Head Herring Creek. Alewives enter Menemsha Pond from Vineyard Sound and ascend the 3-foot elevation to Squibnocket Pond by way of the creek. A commercial fishery is presently carried on with a catching station on Gay Head Herring Creek. A catch of 50 barrels was reported for 1970. The town of Gay Head has local control of the fishery under Section 94 of Chapter 130. (1953 Sargent)

JAMES POND

James Pond (37 acres), in the town of West Tisbury, empties into Vineyard Sound through a tidal creek. The pond supports an alewife run. There is little possibility for further development.

NANTUCKET

HITHER CREEK AND LONG POND

Hither Creek flows for 1.8 miles from Long Pond (70 acres) to Maddaket Harbor on the western extremity of the island. Long

Pond represents the primary spawning area for alewives on Nantucket. In the past, the fishery averaged 70 to 100 barrels annually (Belding, 1921). One threat to continuance of the population is the encroachment of vegetation, especially in Head of Long Pond, which may reduce spawning area (Cooperative Ext. Service, University of Mass., 1966). Annual stream clearing is necessary to insure passage. Because of the remoteness of the island, a maintenance program by state personnel is impractical. The town should gain local control under Section 94 of Chapter 130.

HUMMOCK POND

Hummock Pond (150 acres) is located at the western end of the island. In the past, the pond was artificially opened to the sea. The difficulties of maintaining the opening prevented continuance of the fishery which produced 100 barrels annually (Belding, 1921). The possibility of maintaining a permanent outlet should be investigated.

MIACOMET POND

Miacomet Pond (60 acres) is located on the southern shore of Nantucket. This was occasionally opened to the sea but has long since been discontinued because value of the fishery was not sufficient to warrent annual maintenance (Belding, 1921).

SESACHACHA POND

Sesachacha Pond (150 acres) is situated on the eastern shore of the island. Occasional openings to the sea, both natural and artificial have been made. The last recorded opening was in 1963 (Cooperative Ext. Service, Univ. of Mass., 1966). The feasibility of providing and maintaining a permanent outlet structure should be investigated.

VI MANAGEMENT TECHNIQUES

Fishway Design:

Belding's report of 1921 pointed out the lack of adequate fishway facilities throughout the Commonwealth. Since that time a fishway construction and maintenance program has been carried on by the Division. While this program has maintained and restored many alewife runs, nearly all of the fishways are of weir-pool design and were intended to pass only alewives. If shad restoration and introduction of other anadromous species is to be undertaken it will be necessary to build fishways of different design. Also, fishways should be constructed in relation to hydraulic conditions at the site and the ultimate population to be passed.

Where water level fluctuations are great, such as in water supply impoundments, fishways capable of compensating for this fluctuations should be used. Denil fishways are best suited for this situation. The vertical slot or Hells Gate fishway operate under a greater range of fluctuation than the Denil but more water is required, making them undesireable for use at water supplies. The Denil fishway is capable of passing most anadromous species and construction cost is similar to that of the weir-pool type. It operates more efficiently in situations of wide water level fluctuation. Because wooden baffles are commonly used maintenance costs are generally higher than those of the weir-pool fishway and its efficiency is more easily affected by vandalism.

When observation of ascending fish is of prime importance or vandalism is anticipated and where water level fluctuation is not critical, the weir-pool design should continue to be used.

A common fault in many existing fishways is that the entrance is located a considerable distance downstream of the dam. Fish follow the greatest flow of water and pass by the fishway entrance to the base of the dam and are blocked from further migration. This can be avoided by designing the fishway so the entrance is nearer the base of the dam. Where this is not practical, a low head barrier dam can be constructed across the stream at the fishway entrance. A third solution to this problem is providing additional attraction water at the fishway entrance as described by Clay (1961)

<u>Alewife Propagation</u>:

The transplanting of adult alewives between streams is a method of propagation that has been used successfully in Massachusetts. Adult alewives are taken from a productive run before spawning occurs and are planted in areas where populations have been depleted or where new spawning areas have been made available. Spawning is normally successful in the new areas and the juveniles that migrate from the new stream or pond will return in three or four years as mature adults to spawn. Stocking for three or four years provides a continuity of year classes. Using this technique, it is possible to quickly establish or replenish populations.

Shad Propagation:

Although the successful introduction of shad to the Pacific Coast in 1871 proved that it was possible to establish populations of shad in new waters, the propagation techniques have not been developed as a practical management tool. Large scale stocking programs to augment dwindling commercial catches on the Atlantic Coast were carried on between 1848 and 1940, but were generally unsuccessful because of inadequate propagation methods (Walburg and Nichols, 1967).

Because of the difficulty in obtaining and transporting adult shad a stocking program of the same type and magnitude used for alewives is impossible at this time. Shad eggs from the Connecticut River are collected, fertilized and immediately transported to the stocking point where they are broadcast into the stream. An evaluation of the success of this program will be made and further shad restoration attempts will be based on the results.

Smelt Propagation:

Smelt propagation was conducted on a large scale in Massachusetts in the early 1900's. The overall success of the program is not known. Bigelow and Schroeder (1953) mention a report of good smelt fishing in "Poorhouse Brook", Saugus, three years after stocking with eggs and add that similar attempts have been successful on Long Island, New York.

Smelt eggs are collected on trays consisting of sphagnum moss enclosed in 22-inch by 13-inch weighted, wooden frames covered with 1-inch mesh chicken wire. Trays are placed on the stream bottom in spawning areas and after eggs have been deposited in the moss the trays are transported to the new stream and placed in potential spawning areas to hatch.

Many streams offer potential for establishing smelt populations. However, there is little utilization of the species with the exception of the winter sport fishery in the northern areas of the state because of insufficient ice formation in southern areas and the closed season during the spring spawning run. There is evidence that a closed season is not warranted and in some cases may be detrimental. A dip net fishery has been carried on in the Weweantic River during the spawning season with no apparent decrease in the population. In addition, McKenzie (1964) found that larval production decreases greatly when egg density is greater than 12,000 eggs per square foot. This optimum density is exceeded in many Massachusetts smelt runs suggesting that removal of spawning smelt through a controlled fishery would not jeopardize the population and may possibly enhance it.

VII RECOMMENDATIONS

I Towns should be encouraged to gain local control of their alewife fisheries under Section 94 of Chapter 130 and to consult with state authorities on establishing sound management and enforcement programs for specific areas.

II Section 19 of Chapter 130 should be enforced whenever applicable. Conflict between Section 19 and riparian rights of cranberry bog owners should be investigated. All proposals for dam construction on coastal streams should be submitted to the Director of the Division of Marine Fisheries to determine whether or not fishways are desireable.

III The fishway construction program should be continued. Fishways of more advanced design should be employed whenever desireable and biological as well as physical factors should be considered when selecting design and size of fishways.

It is recommended that fishway construction or reconstruction be carried on for the following:

1. Merrimack River - Reconstruction of Lowell fishway using Denil or Ice Harbor design and providing additional attraction water; — Being designed
2. Charles River - Improvement of Watertown dam fishway utilizing a Denil design and construction of fishways at all dams up to South Natick; — (1970-71 Watertown & 1978 Moody St completed)

3. Indian Head River, Pembroke - Reconstruction of fishway using Denil design; —1970—71

4. Herring River, Harwich - Reconstruction of first fishway; — 1971

5. First Herring Brook, Scituate - Reconstruction of fishway at Old Oaken Bucket Pond; 1970-71

6. Parker River - Reconstruction of first fishway and modification of fishway at Pentucket Pond; —1971 - 72-73

7. Ipswich River - Reconstruction of first fishway and construction of fishways at the next three dams, using Denil designs;

8. Town Brook, Plymouth - Reconstruction or improvement of all fishways; Jenny Grist Mill 1975

9. Fall Brook, Middleboro - Construction of two fishways; 1973-

10. Little River, Gloucester - Reconstruction of first fishway and improvement of the second; — 1970-71

11. Wankinco River, Wareham - Repair of fishway at Tremont Nail Company and construction of barrier dam at entrance; —1975-76 Tihonet Pd 1977-78

12. Paskamanset River, Dartmouth - Improvement of fishway and construction of a barrier dam at Russells Mills and construction of fishway at Smith Mills; 1973-74

13. Island Creek, Duxbury - Construction of fishway at Island Creek Pond;

14. Mill Creek, Sandwich - Improvement of first fishway and construction of fishway between upper and lower Shawme Ponds;

Rochester

15. Sippican River, ~~Wareham~~ - Improvement of first fishway and construction of fishway at second dam.

IV Alewife propagation should continue based on a yearly evaluation of stocking needs.

V An attempt to restore shad to the Taunton River system should be undertaken by planting fertilized eggs. One billion eggs should be stocked annually. Hatching success, juvenile age and growth and downstream migration should be evaluated yearly, and the river should be monitored for returning adults. Shad introduction programs should also be undertaken on the following rivers when the necessary improvements have been made:

Merrimack River - Upon improvement of Lowell fishway.

Charles River - After fishway construction.

Indian Head River - Stocking of adult fish above Elm Street dam after fishway reconstruction.

Agawam River - Bottom sampling program should be conducted to determine potential population size.

Ipswich River - Should be stocked if bottom sampling indicates adequate spawning area and suitable fishways are constructed.

Jones River - Potential spawning area should be determined.

South River - Potential spawning area should be determined.

VI Evidence suggests that the present closed season on smelt is not biologically sound. An experimental fishery should be established on several streams. After determining population status prior to harvesting, the stream could be fished at different intensities and by different methods. Several streams should be opened to dip netting during the spawning run on an experimental basis. Based on the results of the experiment, the general law should be repealed and proper harvest be controlled by regulation under Section 17A.

VII Smelt should be introduced into the North River and its tributaries through egg transplants and the stocking of mature adults.

VIII The closed season on alewives (Chapter 130, Section 97 G.L.) should be repealed as it unnecessarily restricts the taking of adults during their post-spawning migration. Section 97A, which sets a minimum length for alewives in the Plymouth-Kingston area, should also be repealed as there is presently no biological or socioeconomic justification for such a law. If size limits are required to meet future management programs, they can be readily established under Section 17A of Chapter 130 G.L.

General Maintenance

The following ladders were cleaned and adjusted:

July 1, 1970 - June 30, 1974

TABLE I

Number of Fishways Cleaned and ~~Regu~~lated, by River, During the Project

River	Number of Ladders Cleaned and Regulated			
	AFCS-9-1 (1971)	AFCS-9-2 (1972)	AFCS-9-3 (1973)	AFCS-9-4 (1974)
Agawam River, Wareham			2	2
Back River, Weymouth	2	2	2	4
Bound Brook, Cohasset			1	1
Cole's River, Swansea				1
Eel River, Plymouth	2	1	2	2
First Herring Brook, Scituate			2	2
Island Creek, Duxbury	1	1		
Indian Head River, Pembroke			1	1
Jones River, Kingston	4	4	2	
Marston's Mills River, Barnstable	1			
Mashpee River, Mashpee	2			1
Mattapoisett River, Rochester	1			2
Merrimack River, Lawrence & Lowell	2		1	2
Monument River, Bourne	3	3	2	2
Mill Creek, Sandwich	1	1	1	1
Nemasket River, Middleboro	2	2	2	2
Parker River, Newbury				6
Pilgrim Lake, Orleans			1	1

Red Brook, Pocasset				1
Sippican River, Rochester	1			
Stony Brook, Brewster			1	1
Santuit Lake, Mashpee				1
Town Brook, Plymouth	6	6	7	7
Town River, Bridgewater	2	2	2	2
Weir River, Hingham	1	1	1	1

Job #3 Propagation

Alewife (*Alosa pseudoharengus*)

During the project period, adult alewives were transported from Herring River, Bourne (131,450) and Nemasket River, Middleboro (12,500) to a total of 22 locations where new runs are being established or depleted runs rehabilitated.

The following table indicates numbers and locations of alewives stocked during the project period:

TABLE 2

Number of Alewives Planted by Location

	Number of Alewives Stocked			
Stocking Site	AFCS-9-1 (1971)	AFCS-9-2 (1972)	AFCS-9-3 (1973)	AFCS-9-4 (1974)
Billington Sea, Plymouth	4,000	1,500	1,500	2,400
Cedar Lake, Falmouth			1,000	1,400
Coonamessett Pond, Falmouth			600	
Dam Pond, Falmouth			1,000	
First Herring Brook, Scituate	4,000	2,850	1,600	3,600
Island Creek, Duxbury	4,000		1,500	2,200

Indian Head River, Pembroke	4,000	3,700	1,500	2,600
Kelly's Pond, Dennis	4,000	2,000	1,000	
Lily Pond, Cohasset	4,000	4,000	1,500	
Lilly Pond, Gloucester				1,200
Leonard's Pond, Rochester	2,000			
Mill Pond, Sandwich				2,600
Oldham Pond, Pembroke	4,000	1,800	1,500	3,800
Russells Mills Pond, Dartmouth	4,000	2,000	1,000	2,000
Russel Pond, Kingston	2,000	2,000	1,500	1,000
Russel Mill Pond, Plymouth	4,000	6,000	1,500	1,400
Red Brook, Bourne				1,400
Skinequit Pond, Harwich	2,000			1,000
Tispaquin Pond, Harwich	6,000		4,500	2,000
Tihonet Pond, Wareham	2,000		2,100	2,300
Wequaquet Lake, Barnstable		3,000	500	
Whitmans Pond, Weymouth	4,000	3,500	1,500	1,400

Shad (Alosa sapidissima)

A total of 13,547,000 fertilized shad eggs were planted in the Taunton (10,174,300) and Charles (3,372,700) rivers.

The eggs were obtained from the Connecticut River where they were stripped from ripe females, fertilized and water hardened. After hardening, the eggs were transported to the two river systems and broadcast released.

TABLE 3

Number of Shad Eggs Planted by River and Year

Charles River		Taunton River	
1971	426,700	1971	1,092,400
1972	946,000	1972	3,160,000
1973	1,000,000	1973	1,666,000
1974	1,000,000	1974	4,255,900

Smelt (Osmerus mordax)

Ten million smelt eggs were transplanted from Weir River, Hingham and Jones River, Kingston to Mill Creek in Sandwich in order to establish a smelt population in this watershed.

In 1973, 88 weighted trays containing excelsior were placed in Weir River, Hingham to collect naturally spawned smelt eggs. The trays were examined daily and transplanted when an appreciable amount of spawn had collected on each tray. A good hatch resulted. In 1974, 20 trays filled with sphagnum moss were placed in Weir River and 59 trays were used in the Jones River. A total set of 8,000,000 eggs were obtained (1,000,000 Weir River; 7,000,000 Jones River) and transplanted to Mill Creek. A good hatch resulted. The creek will be monitored during 1975 and 1976 to see if adult smelt return to the creek to spawn.

TABLE 4

Number of Smelt Eggs Planted in Mill Creek, Sandwich by Year

(AFCS-9-3) 1973	(AFCS-9-4) 1974
2,000,000	8,000,000

Job No. 4 Shad Survey

The Taunton and Charles Rivers were surveyed to determine potential shad spawning areas (Figures 12 & 13). The substrate of both rivers was sampled with an Eckman dredge or determined by visual observation. All areas not covered with mud or silt were considered ~~favorable for~~ spawning. Using a factor of 2.3 adult shad per 100 square yards, it was determined that the rivers could potentially support a spawning population of 26,553 and 28,884 adult shad respectively.

Egg planting success was evaluated on the Taunton River. Egg hatching boxes were utilized to monitor viability and hatching success. In 1973, 5,000 eggs were placed in proximity of one of the stocking areas. Due to an excessive silt accumulation, only 40% of the eggs hatched. In 1974, 5,000 more eggs were used but were tended more frequently. Approximately 80% of these eggs hatched.

Numerous attempts were made to capture juveniles in the river. Methods included use of a 1/3 meter net (mesh .656 mm) towed at random; a 60-ft. beach seine (1/8" mesh); and a 3/4" bar mesh gill net both floated and anchored. Electroshocking and rotenone were also tried, but to no avail. Although juvenile alewives were captured in quantity by all methods, no juvenile shad were taken.

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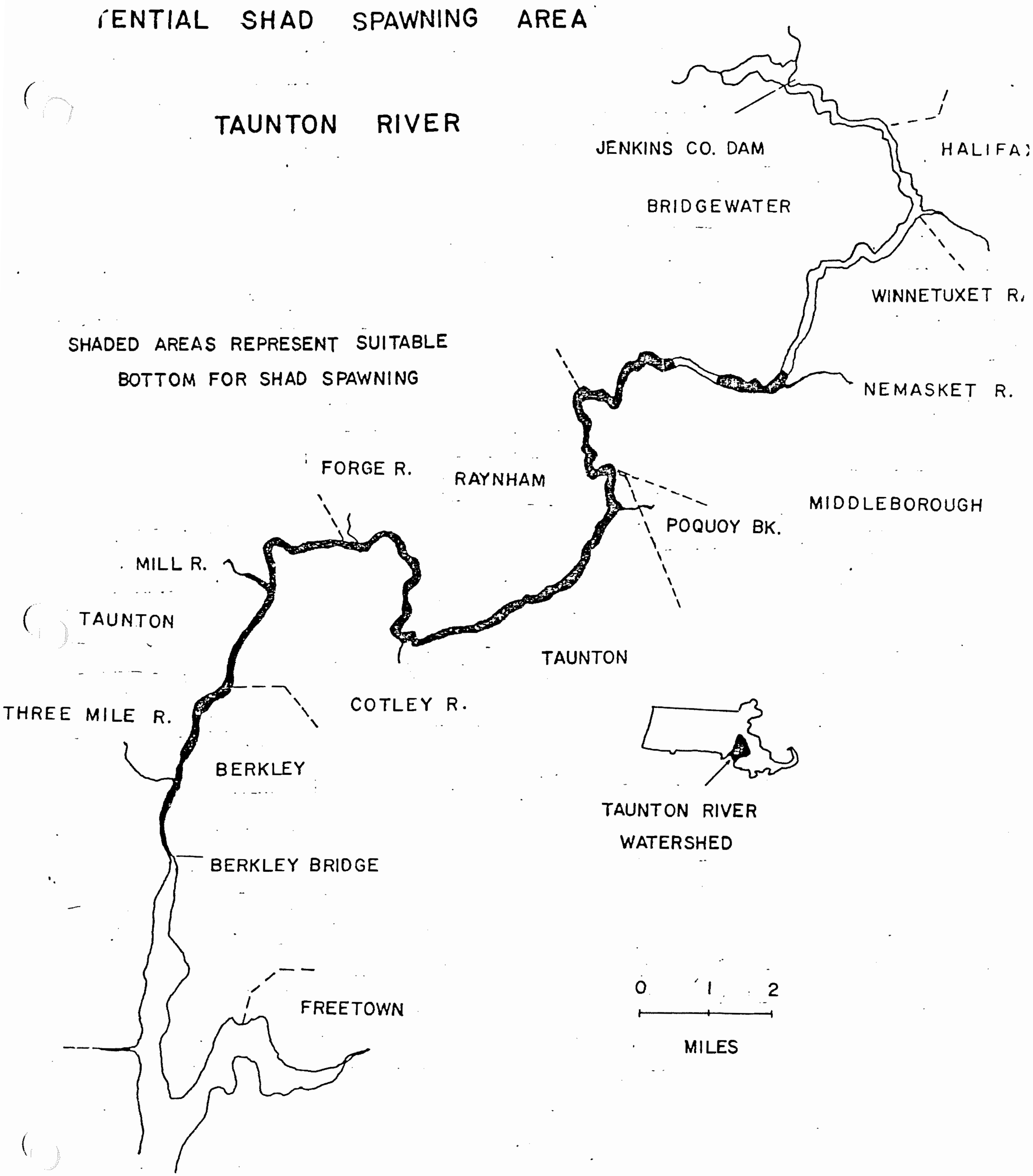
ENTIAL SHAD SPAWNING AREA
TAUNTON RIVER
JENKINS CO. DAM
HALIFA
BRIDGEWATER
WINNETUXET R.
SHADED AREAS REPRESENT SUITABLE
BOTTOM FOR SHAD SPAWNING
NEMASKET R.
FORGE R.
RAYNHAM
MIDDLEBOROUGH
POQUOY BK.
MILL R.
TAUNTON
TAUNTON
THREE MILE R.
COTLEY R.
BERKLEY
TAUNTON RIVER
WATERSHED
BERKLEY BRIDGE
FREETOWN
0 1 2
MILES

Figure 12

OTENTIAL SHAD SPAWNING AREA

CHARLES RIVER

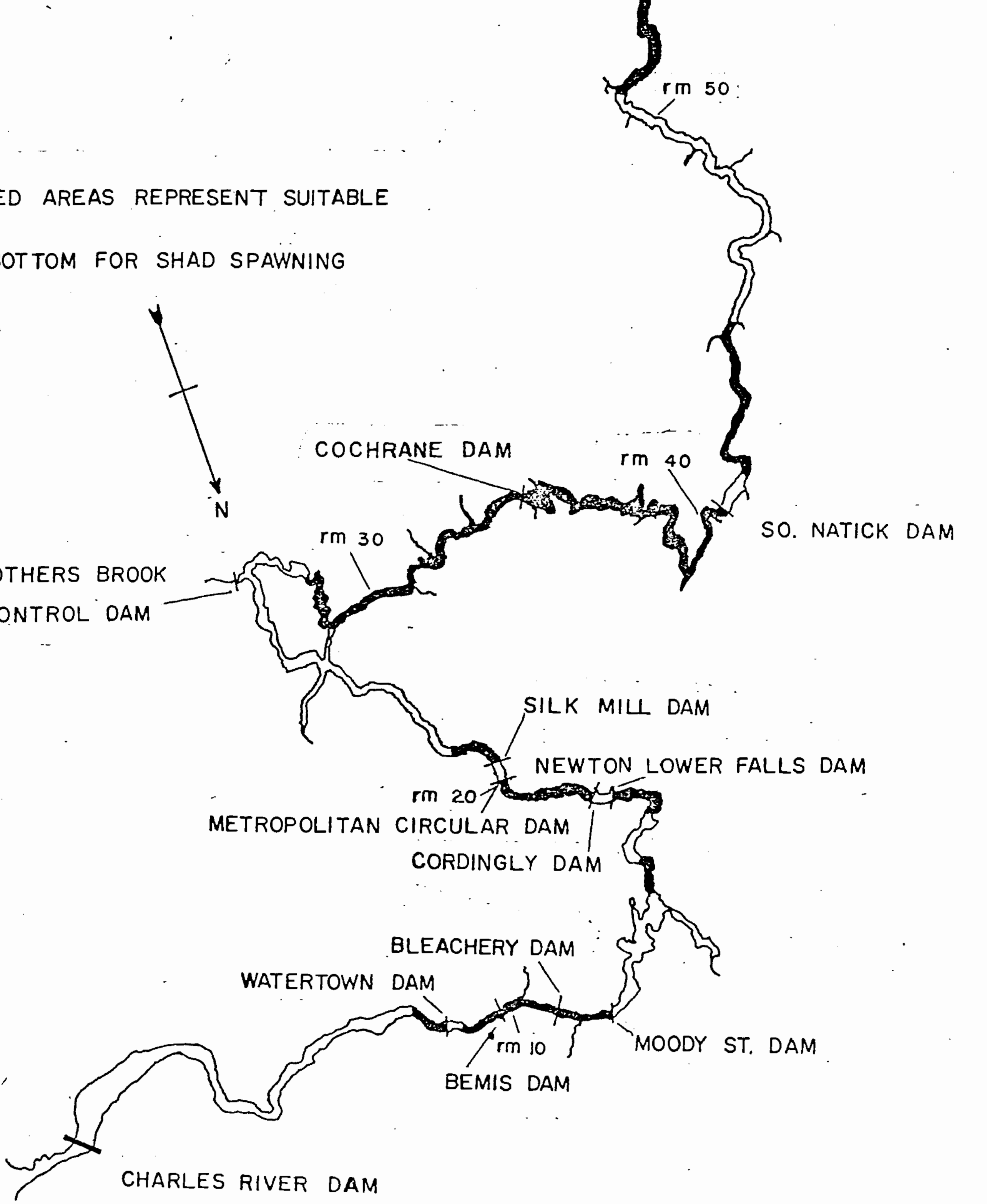

Figure 13

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APPENDIX

Water Discharges for Selected Massachusetts Rivers*

Taunton River, Bridgewater

Calendar Year	Max. CFS	Min. CFS
1962	2,830	47.0
1963	1,790	45.0
1964	2,480	38.0
1965	1,250	17.0
1966	1,400	19.0
1967	2,710	51.0

Charles River, Waltham

Calendar Year	Max. CFS	Min. CFS
1962	1,420	19.0
1963	930	14.0
1964	871	12.0
1965	767	8.0
1966	630	12.0
1967	1,070	24.0

Ipswich River, Ipswich

Calendar Year	Max. CFS	Min. CFS
1962	2,040	9.4
1963	1,100	1.2
1964	758	1.5
1965	474	0.9
1966	476	1.9
1967	1,010	15.0

*Extracted from U.S. Department of Interior, Geological Survey Reports.

Parker River, Newbury

Calendar Year	Max. CFS	Min. CFS
1962	379	1.12
1963	258	0.11
1964	143	0.22
1965	120	0.25
1966	103	0.21
1967	149	2.0

Merrimack River, Lowell
(below confluence with Concord River)

Calendar Year	Max. CFS	Min. CFS
1962	49,500	376
1963	36,700	249
1964	33,500	214
1965	17,400	285
1966	23,600	272
1967	37,500	887

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Andrews River, Harwich	50
Artichoke River, Newbury	90
Assonet River, Freetown	16
Back River, Weymouth	71
Bad Luck Brook, Rehoboth	12
Bass River, Dennis	49
Beaver Brook, Abington	24
Beaverdam Brook, Plymouth	59
Black Point Pond, Chilmark	93
Bound Brook, Scituate	70
Bournes Pond Brook, Bourne	36
Broad Cove, Hingham	71
Bumps River, Barnstable	47
Buswell Pond, Gloucester	80
Cedar Lake Ditch, Falmouth	38
Centerville River, Barnstable	46
Charles River, Boston	75
Childs River, Falmouth	42
Chilmark Pond, Chilmark	94
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Cobbs Pond, Brewster 55
Cockeast Pond, Westport 25
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Coonamessett River, Falmouth 40
Cotley River, Taunton 20
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