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A LOW-COST IMPROVEMENT FOR ALEWIFE (HERRING) PASSAGEWAYS

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SEA GRANT PROGRAM

Administrative Statement

While once most of the Atlantic coast waterways between Nova Scotia and North Carolina supported annual alewife spawning runs, at present the sight of alewives making their way inland is often limited to those streams in which wooden or concrete fish ladders have been constructed. The alewives' population has declined as many smaller brooks became too shallow, through natural sedimentation, overgrowth, and man-made obstacles, for the fish to swim upstream to the spawning ponds. To help rebuild the alewife populations, a joint advisory services project of the M.I.T. Sea Grant Program and the University of Massachusetts Aquacultural Engineering Laboratory has designed an inexpensive, portable, sheet plastic dam, easily installed to restore shallow streams as alewife runs.

This project was supported in part by the NOAA Office of Sea Grant, U.S. Department of Commerce, by the Massachusetts Institute of Technology, by the University of Massachusetts, and by the Town of Eastham, Massachusetts.

Ira Dyer
Director

April 1975

ROOM 1-211 (617) 253-7041

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A Low-Cost Alewife Run

A member of the herring family (Clupeidae), and often itself called a herring in coastal Massachusetts towns, the alewife, Alosa pseudoharengus, is a plump silvery fish, measuring from 10 to 15 inches long when grown. Schooling in northwest Atlantic waters over the continental shelf, alewives feed on plankton and small fishes, and serve as food for commercially valuable finfishes. Alewives have also been an excellent food fish for man, a prime source of bait, and, in colonial days, fertilizer for settlers' crops.

Remaining at sea until mature, at three to four years of age, the alewives begin swimming up coastal streams and brooks in spring (late March and early April) when the water temperature has warmed to between 50° and 55° Fahrenheit. Spawning occurs in freshwater ponds, in the pools behind barrier beaches, and in quiet reaches of streams. In June the upstream run has slackened, and the adult fish return to the ocean. By the middle of the month the fry have begun traveling back down the brooks toward the sea, a migration that continues until the autumn.

Often the alewives travel up small brooks that may be very shallow, or may have been altered by man in such a way as to impede their migration. Brooks too shallow for passage cause the alewives to ground out and die, or expose them to predation by herring gulls and other natural enemies. Fewer fish are able to spawn, and the numbers of alewives available as food for larger fishes and for man decrease.

Traditionally man has helped the alewives to overcome these obstacles by building fish ladders, and traditionally these ladders, consisting of a series of small dams, have been constructed of wood and/or concrete. Under certain conditions it becomes very practical to use flexible plastic or canvas sheets to build a dam or ladder instead of the more expensive wood and concrete. Plastic fish ladders are inexpensive, easily installed, flexible relative to their location, and may be easily "tuned," or adjusted to existing conditions of water level and stream bed. These plastic or canvas dams are most practical for relatively small shallow brooks with very small gentle bed slopes, conditions quite common in southeastern Massachusetts.

Materials Required

Consider a brook that has a cross section as indicated in Figure 1. The objective is to take a rectangular sheet of flexible plastic or canvas and to construct a dam with this material. For this particular cross section the plastic sheet should be about 10 feet wide. This allows four feet for the stream bed, three feet for the two banks, and about three feet of excess material for staking out on the brook's banks.

The plastic sheet's length should be about 20 feet, which will allow eight feet upstream of the dam, eight feet downstream, and four feet for the formation of the dam itself. The length of material upstream and downstream of the dam is not critical, as long as there is enough plastic upstream to give the dam stability. As a rule of thumb, this length is at least five times the intended depth of the water. The plastic downstream

CROSS SECTION OF BROOK
TO BE DAMMED

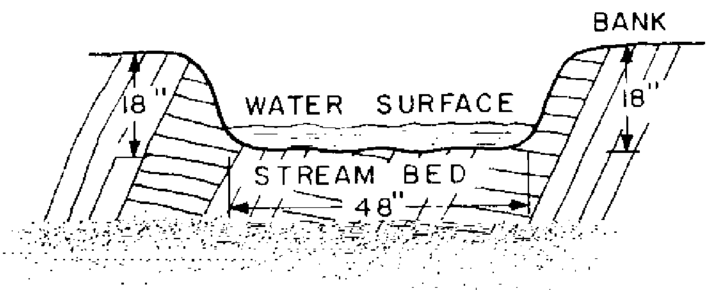

Figure 1

prevents erosion of the stream bed as the water flows over the dam.

The plastic sheet should be thick enough to maintain structural integrity but thin enough to be very pliable. PVC (polyvinyl chloride) plastic about 12 mils thick, reinforced with nylon, has been used with satisfactory results. Figure 2 shows the minimum required thickness of plastic as a function of the water's depth.

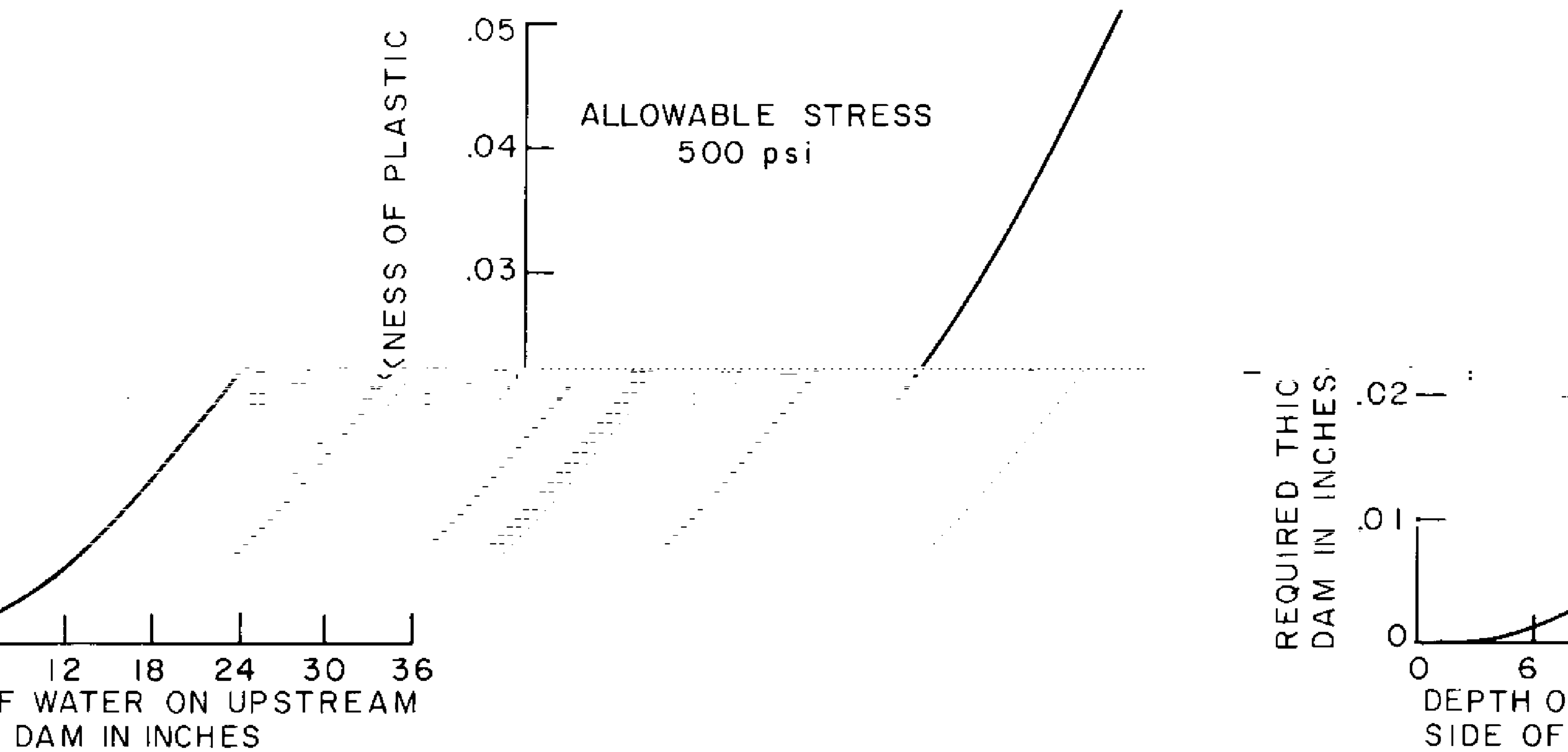

Figure 2

Besides the plastic sheet, th ne only other materials required are:

a)The support member, which consists of a pole, log, or piece of lumber long en ough to span the brook and strong enough to support the dan n. A round pole of about six inches diameter has been used suc ccessfully to span the brook.

b) The support line, a rope about 10 feet longer than the width of the plastic and strong enough to support the dam. Three-eighths inch polypropylene rope is adequate.

c) Six or eight tie-down stakes, wooden, such as surveyor stakes, which will be used to tie down the plastic that will rest on the brook's banks.

Preparation of the Rectangular Plastic Sheet

Prior to installation, the plastic sheet should be prepared as indicated in Figure 3. A hem is formed in the plastic sheet, midway between what will be the upstream and downstream faces, by folding the sheet and then sewing or clipping the hem along the entire width of the sheet. This hem should be large enough to accommodate the support line, which is threaded through, leaving about five feet of line free at each end of the hem. About four grommets may be spaced along each of the edges that will rest on the stream banks. The plastic dam is now ready for installation.

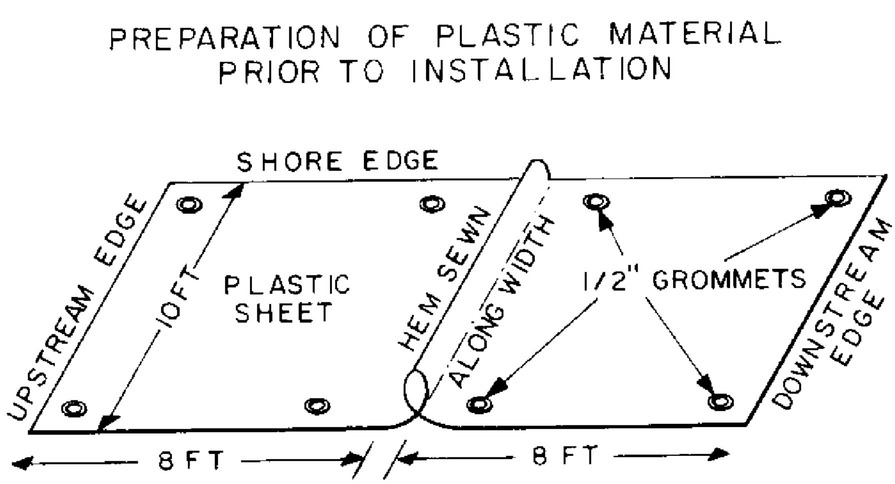

Figure 3

Installation Procedure

The installation of a dam is accomplished by following these steps:

a) Span the stream with the support member at the point where the dam is to be formed.

b) Beginning with the upstream face, spread the plastic sheet in the bottom of the stream with the hem directly under the supporting pole.

With the bank edges of the plastic sheet in place, and the center flat in the stream bed, hold the sheet in this position by placing rocks or sand-bags on the upstream edge. Make sure that the water is flowing over the plastic, and do not let the sandbags obstruct the center course of the stream.

c) By lifting up on the support line, cause the center portion of the plastic sheet to rise, forming a dam. Secure the two ends of the line to the support member. The weight of the water that accumulates behind the dam holds the plastic firmly in place, as indicated in Figure 4.

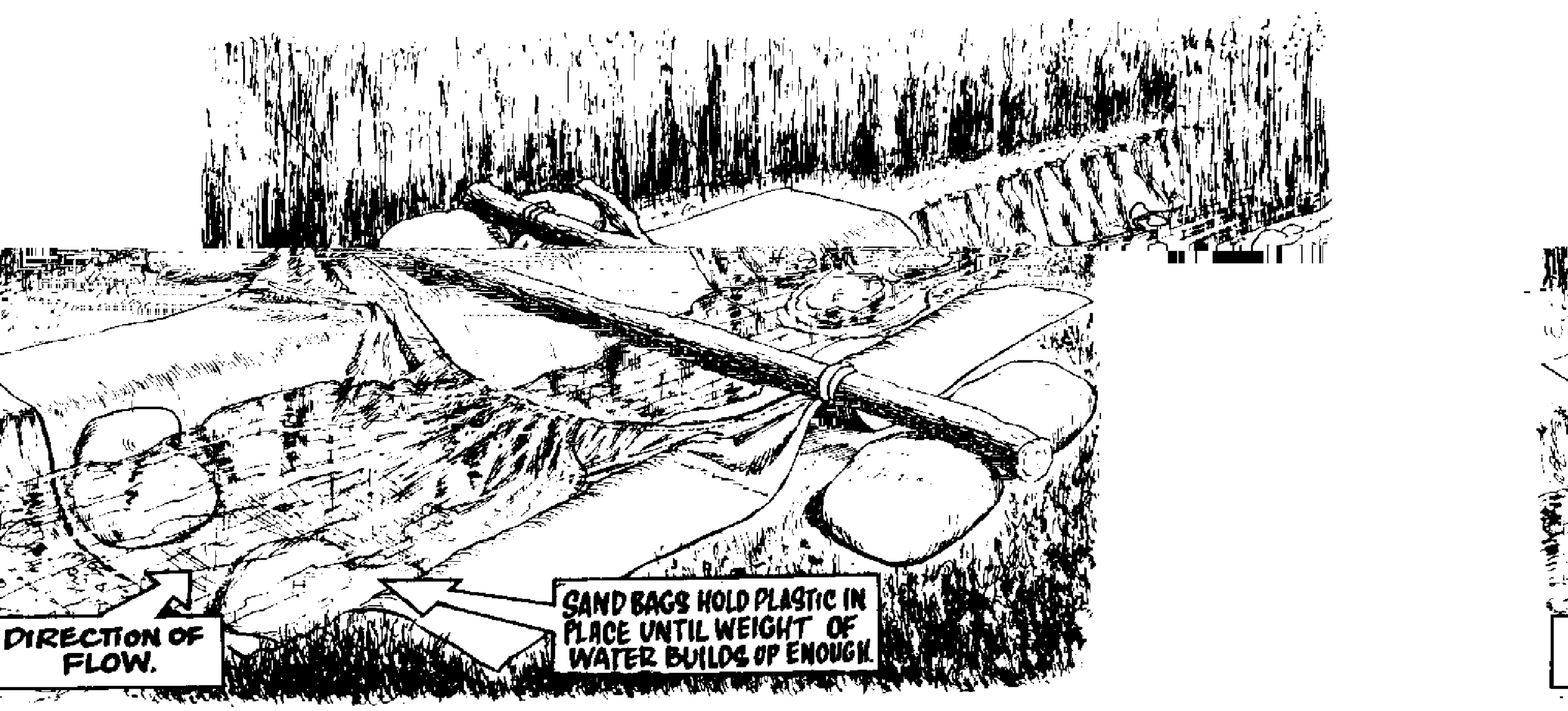

Figure 4

d) The downstream face of the plastic sheet should be weighted with sandbags or stones, or staked down to the stream bed, again without obstructing the water's flow.

e) Final adjustments should be made. Adjust the height of the dam by altering the length of the support line. Adjust the shape of the dam by changing the points at which the support line is tied to the support member.

f) Stake out the sides of the sheet on the stream banks by using the tie-down stakes, some small lengths of line or twine, and the grommets. An alternate method is to gather some of the plastic sheet around small rocks and tie these in place; spaced along the edge of the sheet, the tied rocks function in in the same way as the grommets. This step completes the installation of a dam.

If the dam is placed in an intertidal zone, care should be taken to treat both sides of the dam as if they were upstream faces. This will ensure that the dam will function properly when the water flow changes direction.

Illustration A shows a dam that was installed in the Cole Brook herring run in Eastham, Massachusetts. Evident in the photograph are the support member, the support line, the hem, and the downstream face of the plastic sheet.

Illustration B is of another dam installed in the same stream. Alewives may be seen approaching the dam downstream of the crest. Since, unlike salmon, alewives must swim (rather than leap) up through the flow of water over the crest of the dam, the height of the dam should be adjusted to ensure adequate depth of water over the crest for swimmable passage.

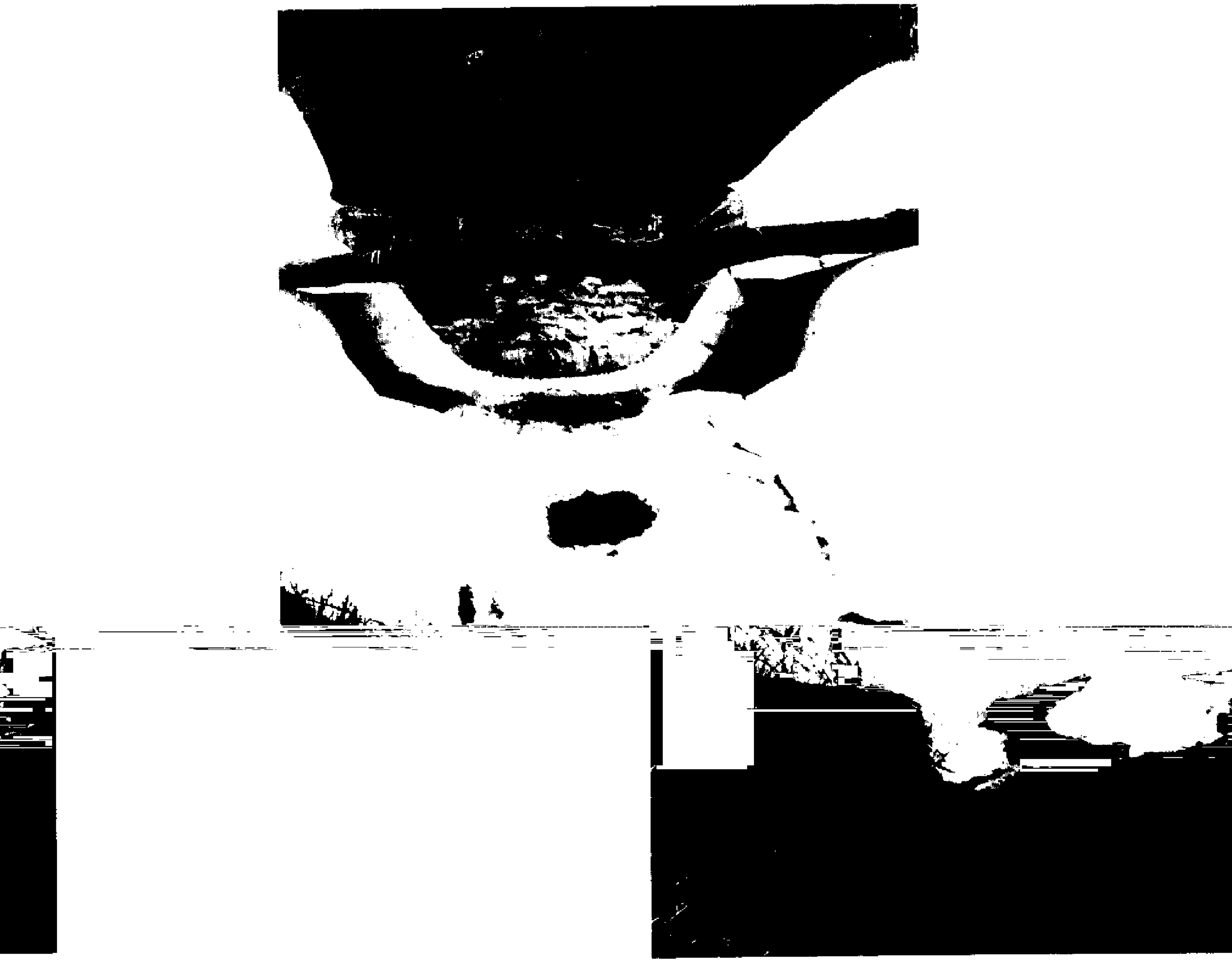

Illustration A

Illustration B

<u>Selection of Sites</u>

Starting where the brook empties into the sea, or into a major river, proceed upstream. At the first point where the brook appears too shallow to provide adequate passage for the alewives, place a dam to remedy the situation. A brook is too shallow if alewives have to break water or to swim on their sides to get upstream.

After the dam has been installed and sufficient time has elapsed for water levels to change, work upstream again and note the next spot that requires increased depth of water. Place a dam here, and repeat this process until the entire stream is navigable for the alewife from sea to freshwater pond. Note that, by observing the effect on the stream, this technique could be used to determine optimum locations for more permanent dams of wood or concrete, if so desired.

The number of dams in a stream will depend on the length of the run, the slope of the stream bed, and the flow of water. Although the best way to determine this is to install the dams and to observe their effect, the number of dams required can be estimated. Figure 5 indicates the distance needed between dams, assuming that the slope of the stream bed is constant and that under normal flow, with no dams, there is insufficient water for the alewives to swim upstream.

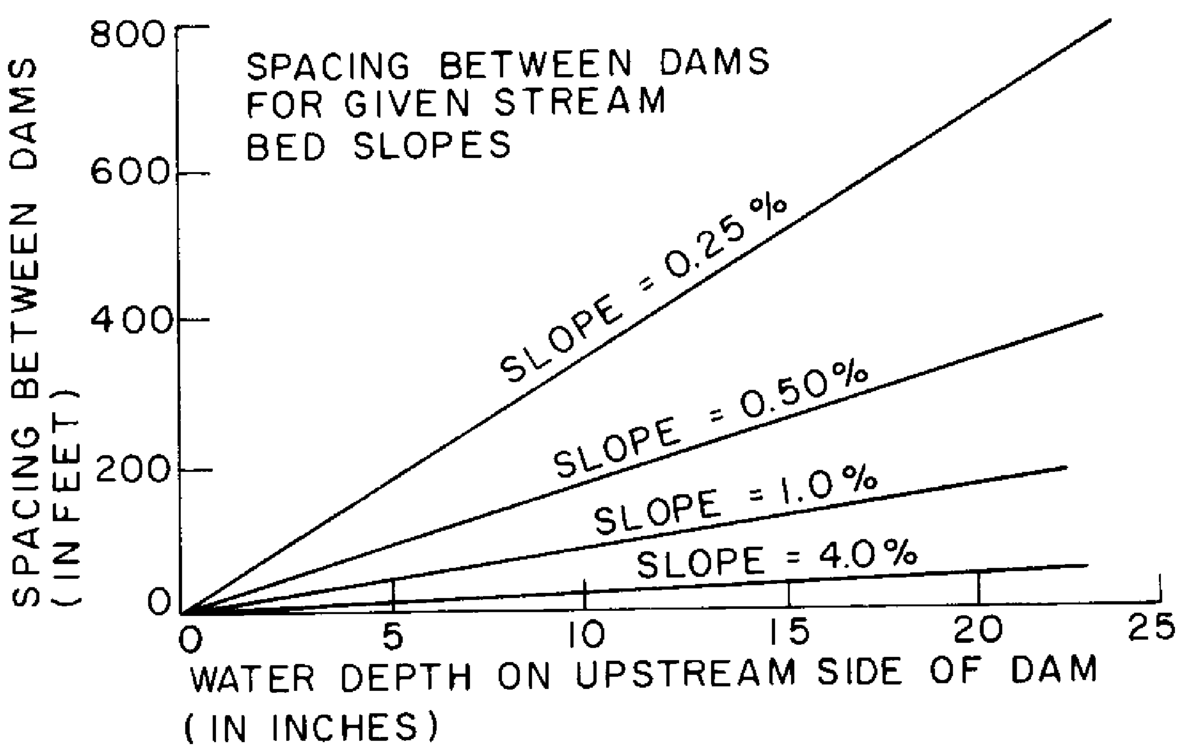

Figure 5

Maintenance of the Alewife Run

Once a sufficient number of dams have been installed, one should periodically observe the performance of the run and adjust the dams to allow for varying water depths and varying stream sediment. After the adult alewives have returned to the sea, the dams may be removed, cleaned, dried, and stored until the following spring. They may also be left in the stream over the winter, but no data have been taken on whether or not the freezing weather and ice will be destructive to the dams. However, data from manufacturers indicate that some plastics should endure temperatures to -40° Fahrenheit without cracking.

The young fingerling alewives find little trouble in making their way to the sea through very shallow water depths, so that under normal summer conditions they would not need the dams.

Determination of Performance

A statistical estimate of the alewives using a given stream may be obtained by counting the number of fish going over a dam during a specific period. Perhaps by observing a dam over short periods of time throughout the tidal cycle for most days during the normal alewife run, information on the number of fish going to, or returning from, a given pond in a given season may be inferred. However, without knowledge of the numbers of alewives that spawned in the same pond prior to the installation of the dams, it is very difficult to determine what improvement in numbers was made. This is usually subjective, and is best judged by those local persons who are most familiar with the stream characteristics.

Cost of a Dam

As of June 1974, the reinforced plastic (PVC, 12 mils thick, reinforced with nylon, 14x14 threads per inch) for a dam, including the sewing and grommeting, averaged about 35 cents per square foot. For the hypothetical dam of this report, total cost would be about $70.00. Add on to this price the cost of the support line, tie-down stakes, and support member. Two men can install a single dam in a small stream in about one hour. Expensive engineering costs are essentially eliminated. Maintenance and evaluation will require some regular schedule of observation and counting.

Summary

Low-cost plastic or canvas dams cannot solve all the alewife migration problems, but do seem to provide an inexpensive and practical answer to a few of them. Where the alewife run is a shallow brook with a small slope, the plastic dam provides an easily installed, flexible, and practical solution to the problem of the fish grounding out in the shallow water. If a more permanent ladder is desired, the plastic dams may still be useful in determining the optimum location for the concrete or wooden dams. The plastic dams need not be subject to harsh winter conditions for they may be removed during the winter months. In the event of abnormally high water, the worst that may happen is the washing out of the dam, requiring that it be reset when the water recedes. In all probability the materials will be salvageable.

Under severe drought conditions, quick dam installations could salvage a year's alewife spawn. Auxiliary functions envisioned for the plastic dams include their use for the restocking of brooks currently barren of annual alewife runs and for the study of fish behavior. Considering the possible advantages, it seems that the plastic dam should be given a chance to further prove itself in the field.

Acknowledgements

Sources for Further Information

The plastic alewife dams were developed under a joint Massachusetts Institute of Technology - University of Massachusetts Sea Grant Advisory Services project. Investigators were Dr. John W. Zahradnik, Principal Scientist, Aquacultural Engineering Laboratory, University of Massachusetts, and Mr. Arthur B. Clifton, Marine Liaison Officer, Sea Grant Program, Massachusetts Institute of Technology. Patents have been applied for by the dams' inventor, Dr. Zahradnik.

With the cooperation and support of the Town of Eastham, Massachusetts, on Cape Cod, and of Mr. Philip Schwind, Eastham's Shellfish Warden and former head of the town's Conservation Commission, the dams were installed for the 1974 season in the Cole Brook herring run.

The M.I.T. Sea Grant Program has produced a 12-minute, 8mm film demonstrating the dams' success in augmenting the numbers of alewives able to navigate Cole Brook. To borrow the film, "Low Cost Fish Ladders; A Novel Way to Cut Climbing Costs," please write to the M.I.T. Sea Grant Program, Room 1-211, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

For further information and assistance on fabricating and installing the plastic dams, contact:

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Figure 4 was adapted from a Boston Herald-American drawing by the M.I.T. Graphic Arts Service.