NORTHEAST
UTILITIES
SERVICE
COMPANY

Turners Falls

Downstream Fish Passage Studies

Downstream Passage of Juvenile Clupeids, Fall 1991

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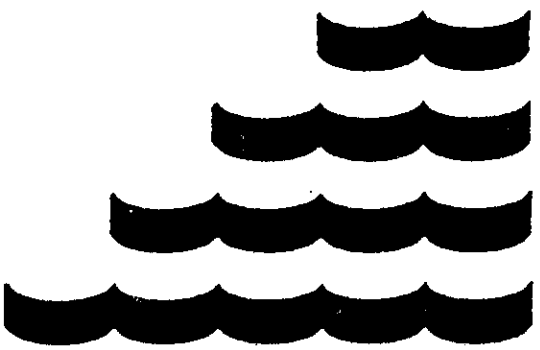

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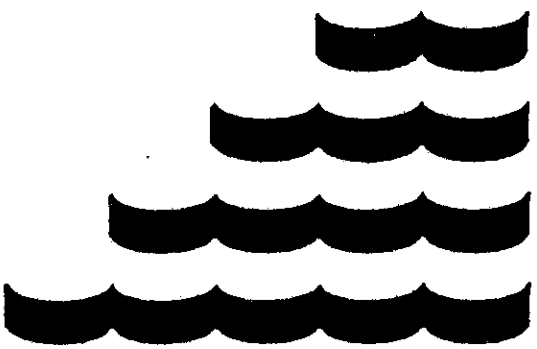

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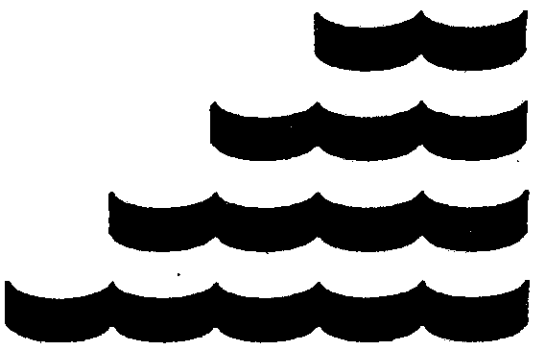

SUMMARY

The Turners Falls juvenile clupeid study conducted during the fall of 1991 was the first evaluation of the effectiveness of the log sluice and slots in the ice and trash sluice for bypassing juvenile American shad and blueback herring around Cabot Station. The study was oriented toward meeting two objectives:

1) Estimate the proportions of emigrating juvenile clupeids bypassed around and entrained through Cabot Station.

2) Estimate the total number of juvenile clupeids bypassed around Cabot Station during the emigration period.

To collect the data required to meet these objectives six fyke nets were installed in three turbine intake bays and an inclined-plane screen was installed in the log sluice. The inclined-plane screen was used to collect fish passing down the log sluice and by way of the ice and trash sluice. The fyke nets were operated from September 17 through October 18; the inclined-plane sampler was operated between October 2 and October 18.

To determine the number of fish entrained through Cabot Station, three sets of two fyke nets each were installed in the middle bay of the three-bay intakes of units 1, 4 and 6. The two-net set covered approximately 95 percent of the middle intake bay area or

32 percent of the intake area of one unit. In addition to the fyke nets, two nets 3.3 feet long by 2.3 feet deep were attached to the top of the net frame as "closure nets" to minimize the gap between the top of the upper fyke net and the top of the turbine intake.

The retention percentage for fish entering each fyke net was determined by releasing known numbers of marked fish into the intakes immediately upstream from the nets. Net retention rates were determined for each of the six nets and were found to vary from 24% to 64%. Retention percentages differed significantly between depths but not among units. The bottom nets captured and retained significantly higher percentages of fish than the top nets.

The log sluice sampling device consisted of a framed inclined-plane screen that diverted fish into a trough leading to a sorting table. The sampler intercepted the entire discharge of the log sluice and, when in operation, the ice and trash sluice. The surface of the sampler was covered with a flat-woven, stainless steel, 1/4-inch mesh screen having a rated porosity of 50%.

To estimate the efficiency of the log sluice sampler, two groups of marked fish were released immediately downstream of the log sluice gate. On October 12, 72 clupeids were released and 69 (96%)

were recaptured. On October 16, 105 fish were released and 94 (90%) were recaptured. The pooled efficiency for the two tests was 92%. Therefore, the log sluice catch was divided by 0.92 to estimate the number of fish bypassed.

To determine the proportion of fish bypassed, the number of fish collected in the fyke nets was extrapolated into the unsampled units to estimate the total number of entrained fish. This total was then compared to the estimated number of fish bypassed. Based on netting conducted in the middle bays of units 1, 4 and 6, the entrainment rates were not uniform across the face of the intake. The estimated average entrainment rates (fish per minute) in units 1 (3.15) and 6 (2.77) were approximately three times as high as the estimated entrainment rate in Unit 4 (1.04). Because entrainment rate was not uniform among the units, linear interpolation was used to estimate entrainment for the unsampled units.

Daily estimates of the percent of fish bypassed varied from nearly zero to 83 percent. The average bypass rates, weighted by estimated total passage, were 58% for all juvenile clupeids taken together, 65% for blueback herring and 54% for American shad.

There was no clear explanation why the percentage bypassed varied among nights. There was no clear relationship ($r^2 = 0.22$) between total passage rate and percent bypassed. The two nights when the

highest percentage of fish were bypassed occurred not only at the same time as the highest total passage rate, but also at one of the lowest total passage rates. Neither operating condition, canal flow, nor water temperature caused the observed variation in percent bypassed.

The ice and trash sluice slots were utilized as a bypass route beginning on October 12. Although the overall bypass percent was not noticeably different with the slots open, fish did enter the slots. Prior to opening the log sluice gate, the ice and trash sluice slot was opened, and fish were observed entering the slots and collecting on the log sluice sampler screen. These fish were not separated from the sample for that collection period. However, the number of fish initially entering the slots was observed to be fairly large.

An estimated 201,000 juvenile clupeids were bypassed around Cabot Station between 1700 hours and 2200 hours from October 2 through October 18. The estimated number of fish bypassed was highest in the early part of October and declined noticeably after October 7. Based on fyke net catches in the turbine bays during September, entrainment rates were relatively high prior to October 2, indicating that a large portion of the run occurred before October 2. The log sluice was open, but not sampled, prior to October 2 and presumably bypassed many of these fish.

INTRODUCTION

Background

A joint state and federal effort has been underway for more than 20 years to restore anadromous fishes, specifically American shad, (Alosa sapidissima), blueback herring (Alosa aestivalis), and Atlantic salmon (Salmo salar), to the Connecticut River (NUSCO 1987). Most of the effort prior to 1990 had been expended to provide upstream passage for these species at existing dams on the Connecticut River. Two fish ladders, one at Cabot Station and one at Turners Falls Dam, and a fishway that connects the power canal to Turners Falls pool were completed in 1980 to pass upstream migrating fish around the Turners Falls Project (FERC No. 1889). The number of adult shad returning to spawn in the Connecticut River has risen steadily, indicating the success of these efforts. Attention is now focused on the downstream passage of anadromous fishes at hydroelectric facilities on the river.

In 1990, Northeast Utilities Service Company (NUSCO), in a Memorandum of Agreement (MOA) with the U.S. Fish and Wildlife Service and the Connecticut River Atlantic Salmon Commission, agreed to construct downstream fish passage facilities at the Turners Falls Project (NUSCO et al 1990). The MOA stated that site investigations would be conducted in 1991.

In the Connecticut River, anadromous clupeids (American shad and blueback herring) spawn from early May through mid-June, depending on water temperature. The juveniles remain in the river throughout the summer and usually begin their downstream migration in September. Water temperature is one of the primary environmental parameters associated with the commencement of emigration (O'Leary 1984; O'Leary and Kynard 1986). Emigration begins when water temperature declines to about 19 °C, usually by mid-September, and continues into early November. Marcy (1976) noted that most juveniles had left the river prior to water temperature reaching 6 °C.

Daily movements of juvenile clupeids in the Connecticut River occur primarily in late afternoon and evening, peaking between 1700 hours and 2200 hours (O'Leary and Kynard 1986). Juvenile clupeids appear to migrate in schools (O'Leary and Kynard 1986).

Study Site

The Turners Falls Project, built between 1905 and 1915, is located at river mile 117 on the Connecticut River, Massachusetts and consists of Turners Falls Dam, a canal gatehouse structure, a 2.1-mile long canal, Turners Falls No. 1 Station and Cabot Station (Figure 1).

Turners Falls Dam consists of the Gill Dam and Montague spillway. The Montague spillway has four 120-ft long by 13.5-ft high Bascule gates for pond elevation control. The Gill Dam includes a non-overflow section and three Tainter gates. Water is typically spilled over the dam when river flows exceed approximately 15,000 cfs, the maximum amount of water used for power generation.

The canal gatehouse structure, situated on the east side of the river, directs up to approximately 15,000 cfs into a 2.1-mile long power canal leading to Turners Fall No. 1 Station and Cabot Station.

Turners Falls No. 1 Station is located approximately 0.5 miles downstream from the gatehouse, on a branch canal (Figure 1). The station has five Francis turbines with a total nameplate rating of 5.6 MW at a head of 43 feet. The hydraulic capacity of Turners Falls No. 1 Station is 2,500 cfs. Under normal circumstances, the station only operates when the daily river flows exceed 12,500 cfs.

Cabot Station, an integral-intake powerhouse, is located at the downstream end of the power canal. The Station has six identical Francis turbines with a total nameplate rating of 51 MW at a head of 60 feet. Water is delivered to each turbine through a three-bay intake which is joined to the penstock. The hydraulic capacity of the station is 12,500 cfs. A 16-ft wide by 12-ft high log sluice

gate, located adjacent to the station, is currently used to pass downstream migrating fish.

An ice and trash sluice is located behind the top of the trashracks, and is aligned perpendicular to the flow of water through Cabot Station. Three openings have been cut into the wall of the ice and trash sluice to facilitate the passage of fish. The maximum flow through these openings is determined by the hydraulic capacity of the ice and trash sluice, which is approximately 100 cfs. Each opening can be opened (or closed) independently of the other openings. Each opening can be configured in two ways: 1) narrow and deep (3 feet wide by 6 feet deep), and; 2) narrow and shallow (3 feet wide by 3 feet deep). All configurations result in orifice flow. A depiction of the opening in one location is shown on Figure 2.

Emigrating juvenile clupeids that encounter the Turners Falls Project may pass over Turners Falls Dam (Dam) or enter the Turners Falls Canal system (Canal). Clupeids that enter the canal may travel downstream by way of a) Turners Falls No. 1 Station, b) the canal spillway, c) Cabot station, or d) the log sluice (entered directly, through the log sluice gate, or indirectly, via the openings cut through the wall of the ice and trash sluice). Those routes are illustrated in Figure 1. The canal spillway, located on the northwest side of Cabot Station (Route 2 in Figure 1), was

closed during most of this study.

Prior Studies

As part of a pre-feasibility study, Ruggles (1990) reviewed the existing techniques that have been used at other sites to divert emigrating fish around turbine intakes. A surface discharge above the turbine intakes was identified as a promising technique for bypassing emigrating fish at Cabot Station. To create a surface discharge above the turbine intakes, the three openings described above were cut into the wall of the ice and trash sluice during summer of 1991.

During the spring of 1991, radiotelemetry was used to determine the passage routes of hatchery-reared Atlantic salmon smolts through the Turners Falls Canal system. Ninety-four radio-tagged smolts were released in 12 groups upstream of the Turners Falls gatehouse between April 30, 1991 and May 24, 1991. Fifty-six smolts (61%) passed down the log sluice and 31 smolts (34%) passed through the turbine intakes. The remaining five percent passed through the Turners Falls No. 1 Station, passed over the canal spillway or did not enter the canal after release. For individual tests, the percent bypassed varied from 29% to 100%.

Current Study

This 1991 juvenile clupeid study was the first effort to evaluate the effectiveness of the log sluice in bypassing American shad and blueback herring around Cabot Station. Three objectives were identified in the Plan of Study for the 1991 Turners Falls juvenile clupeid study.

- Estimate the proportions of emigrating juvenile clupeids bypassed around and entrained through Cabot Station.

- Estimate the total number of juvenile clupeids bypassed around Cabot Station during the emigration period.

- Evaluate the effect of different gate configurations at the log sluice on the proportion of juvenile clupeids bypassed around Cabot Station.

The evaluation of different gate openings was eliminated during the field program because flows resulting from planned gate and test slot configurations could not be contained in the log sluice when the log-sluice sampler was in place.

The Plan of Study, agency correspondence, and NUSCO's response to the agency comment are presented in Attachment 1.

METHODS

Methods used in this study are described in three sections: data collection; data reduction and preliminary analyses, and assessment of study objectives.

Data Collection

Two fish collection gears were used: 1) six fyke nets installed in three turbine intake bays; and 2) a framed inclined-plane screen installed in the log sluice.

Turbine Intake Fyke Nets

To determine the number of fish entrained through Cabot Station, fyke nets (Figure 3) were installed in the middle intake bay of units 1, 4 and 6 (Figure 4). The six nets were identical, each having a mouth 8.1 feet wide and 6.8 feet deep and a length of 26 feet. The nets were constructed of 1.5-inch stretch mesh nylon netting. The posterior 10 feet of the net contained a fyke and a 1/2-inch stretch mesh inner liner. The nets were reinforced along the length and width by 3/8-inch gore lines. The cod end of each net was tied shut with 1/4-inch rope. The nets were attached to the net frames with 3/8-inch nylon rope. In addition to the two fyke nets, two nets, 3.3 feet long by 2.3 feet deep, constructed of

1/4-inch ace mesh were attached to the top of the main net frame. These closure nets minimized the size of the opening between the top of the net frame and the head gates, given the physical constraints of the gate slots (Figure 5).

Tubular steel frames held the nets in fishing position in the intake bay. Each frame held two nets (Figure 3). Steel frame guides were bolted into the concrete of the intake bay just upstream of the stop log slots to guide and hold the frame in fishing position. The frames were raised and lowered into fishing position using the jib hoist on the headworks travelling crane. Ropes attached near the cod end of each net, and to the safety cable on the stop log deck, were used to manually lift the nets out of the penstocks as the jib hoist lifted the frame. The ropes also served as precautionary safety tethers to prevent a net from entering the turbine in the event that it tore away from the frame. Because the nets were occasionally ripped while being raised or lowered, each net was inspected for tears and mended, if necessary, prior to being put into fishing position. Approximately five to 10 minutes were required to pull and re-set each pair of nets.

Net sampling time varied depending on debris load. Typically, nets were fished for 20 to 60 minutes. At the end of a fishing period, the net frames were lifted and all fish and debris were removed

from the cod end of each net. Fish that were caught in the small closure nets were included with the catch of the top net. All fish collected were enumerated. A randomly selected subsample of 50 juvenile clupeids was taken from each net, and the fish from each subsample were identified according to species and measured.

Because some juvenile clupeids entering the nets may not be retained, it was necessary to estimate the percentage of retention. Separate estimates were derived for each net. The net retention tests were conducted using fish that were collected by seine at the Turners Falls Rod and Gun Club or from the Holyoke Canal bypass collection facility (Table 1). The fish were held in a holding facility until they were used in a test. Although the number of mortalities was not recorded, mortality resulting from holding was minimal. Fish remaining in pools after completion of the study were released into the Connecticut River.

Test fish were marked by staining with Bismark Brown Y biological stain at a concentration of approximately 1:18,750. Two hundred test fish were placed in the stain bath for a period of 20 minutes and then injected into the net. The test fish were easily distinguished from unmarked fish by the acquired yellow coloration.

An induction system was used to introduce the test specimens into the net mouths. The system consisted of a staining and holding

tank (20 gallons), a flush tank (200 gallons, later replaced by a pump), and an appropriate length of 4-inch diameter flexible hose (Figure 6). The physical layout of Cabot Station headworks and the need for the travelling crane to have unobstructed passage along the length of the headworks limited the locations in which the induction system could be set up. Seventy feet of hose were required to reach some of the injection locations, resulting in occasional air locks. To eliminate air locks in the hoses, the flush tank was replaced by a pump.

The tests were conducted by injecting replicate lots of known numbers of marked clupeids into the immediate vicinity of the net mouth while it was in the fishing position. The nets were left in fishing position between 30 and 75 minutes to simulate typical sampling times (Table 2). Three replicates of 200 clupeids each (on one occasion 201 fish were used) were included in a test. One test was conducted for each of the six nets. Tests were conducted when the unit was operating between 7.0 and 8.8 MW, which was typical of the generation during normal sampling.

The percent of fish retained in the net was then computed using the following equation:

$$P_R=(R/M)*100\%$$

where P_R is the percent of fish retained, R is the number of fish remaining in the net, and M is the total number of marked fish

released into the net. The pooled retention percentages in individual nets were used to adjust observed catch rates in subsequent analyses.

The six nets differed in the percentage of fish retained. When the three replicates for each net were pooled, retention rates varied from 24% to 64% (Table 2). The percentages retained by the six nets were compared using two-way ANOVA, with unit (Unit 1, Unit 4, and Unit 6) and depth (top net and bottom net) as the two factors and three replicates for each combination of factors (Table 3). Retention percentages differed significantly between depths ($p = 0.01$) but not between units ($p = 0.19$). The bottom nets retained a significantly higher percentage of fish than the top nets.
The reason the bottom nets were more efficient than the top nets may have been related to flow patterns. There was a strong upwelling into the gate slots creating a turbulent flow at the top of the intake compared to the more uniform flow that would be expected at the bottom of the intake. A non-uniform flow could force fish through the large, 1.5-inch stretch, mesh in the front of the net. In addition, there was a small gap above the net where fish could pass over top of the net into the turbine.

The amount of time the net was left in fishing position did not appear to effect the net retention percentages. Retention percentages overlap between nets fished for more than 60 minutes

and nets fished for approximately 30 minutes (Table 2). The fact that fishing time did not seem to influence the percentage of retention suggests that most of the fish that were not recaptured passed through the larger mesh in the front of the net and did not escape through the cod end during the fishing period.

Log Sluice Sampler

The log sluice sampling device consisted of a framed inclined-plane screen that diverted fish into a trough leading to a sorting table (Figure 7). The sampler intercepted the entire discharge of the log sluice. The downstream end of the sampler was at a fixed height and was attached to a pivot point so that the upstream end of the screen could be lowered for sampling, or lifted above the log sluice to allow clear passage of water under the sampling device.

The framework of the sampler was constructed of steel beams with 3-ft high steel plate sides. The surface of the sampler was covered with 1/4-inch mesh flat-woven, stainless-steel screen that had a rated porosity of 50%. Throughout the study, minor modifications were made to the screen (such as covering part of the area with plexiglass to reduce the porosity) to enhance the survival of fish that were collected by the sampler. An 8-inch diameter pipe was attached to the collection trough at the downstream end of the

sampler to convey the fish to a sorting trough (Figure 7). The water and fish that entered the log sluice from the ice and trash sluice were also intercepted by the sampler.

During most sampling periods, all fish that were bypassed were counted. However, during certain sampling periods, the number of fish collected in the sampler was large, precluding the counting of every individual fish. During these high-passage periods, numbers of fish were estimated volumetrically using a bucket that was calibrated (number of clupeids per bucket) daily. For each sampling period, a subsample of 50 clupeids was taken, identified to species and measured.

Although 100% of the flow into the log sluice was intercepted by the sampler, the location at which the water came in contact with the sampler was very turbulent. At some of the test flows, water splashed over the sides and around the front of the sampler. In addition, not all of the fish that came into contact with the sampler reached the sorting trough. As a result, some fish utilizing the log-sluice bypass could have been excluded from the sample. To estimate the efficiency of the log sluice sampler, two groups of marked fish were released just downstream of the log sluice gate. The test fish were obtained from previous samples and were dead. On October 12, 72 clupeids were released with 69 (96%) being recaptured. On October 16, 105 fish were released with 94

(90%) being recaptured. The pooled efficiency for the two tests was 92%. Based on these tests, the observed catch in the log sluice sampler was divided by 0.92 to estimate the number of fish bypassed in a given sample.

Data Reduction and Preliminary Analyses

Certain preliminary analyses were needed prior to directly addressing the objectives of the study. The preliminary analyses were directed toward a) data reduction, b) assessment of the horizontal and vertical distributions of fish entering Cabot Station, c) determination of whether or not fish length was related to location of capture, and c) assessment of the diel pattern of fish passage.

Data Reduction

For each collection, the catch rate (fish per minute) was determined. The term "collection" refers to the fish caught in the log sluice sampler during a designated time period or caught in an individual net during one set. Catch rates in nets were divided by the appropriate estimated net retention percentage (Table 2) to yield the adjusted catch rates used in all analyses. Adjusted catch rates for the log sluice sampler were determined by dividing the catch by the estimated efficiency of that device (92%). Catch

rates for all juvenile clupeids are listed in Table 4.

Separate catch rates for blueback herring and American shad were determined, as well as catch rates for all juvenile clupeids combined. In order to develop separate estimates of passage for American shad and blueback herring, the proportions of shad and herring in each collection were determined. For each collection, the catch of each species was then estimated by multiplying the total number of clupeids by the observed (or estimated) proportion of that species.

Horizontal and Vertical Distributions of Entrained Fish

The pattern of catch rates in concurrent collections was the basis for assessing the horizontal and vertical distributions of passage through the Cabot Station. In Table 4, the ending time of each collection is rounded to the nearest hour. Catches with the same ending time, so defined, were considered to have occurred concurrently.

On 11 occasions, from September 24 through October 6, collections were made concurrently in the three pairs of nets during a period when all six units of Cabot Station were operating. Data from those collections were the basis for assessing horizontal and vertical distributions of fish passing through Cabot Station.

Observed catch rates (clupeids per minute) on those occasions were adjusted to account for differences in retention by the six nets, by dividing each observed catch rate by the appropriate pooled retention rate (Table 2). The 11 adjusted catch rates were then averaged for each net. Mean adjusted catches in the deep nets were lower than those in the shallow nets for all three units (Table 5). This was true for all clupeids combined, as well as for each species individually. Further, adjusted catch rates in unit 4 were lower than those in unit 1 and unit 6 (Table 5).

The occurrence of larger catches in the top nets (compared to those in the bottom nets) can be explained by the physical layout of Cabot Station and the shallow depth distribution of emigrating clupeids. The top of the turbine intakes at Cabot Station are located approximately 15 feet below the water surface, with the top nets intercepting the flow from 15 feet to approximately 22 feet deep and the bottom nets intercepting the flow from approximately 22 to 30 deep. Therefore, for a fish to enter the bottom net, it would have to be at least 22 feet deep in the water column.

The reason the catch rates were lower in the nets in Unit 4 can also be explained by the physical layout and by the behavior of emigrating clupeids. Large schools of juvenile clupeids were sometimes observed swimming back and forth across the entire width of the forebay near the trashracks, turning only when they reached

the concrete abutments on each side. When they encountered the abutments, these fish may have been more likely to dive and encounter strong flow into the adjacent intakes. In addition, fish emigrating down the west bank of the canal may have been led by the abutment into Unit 6. Unit 1 is located adjacent to the log sluice, where large numbers of clupeids were observed to aggregate. Radio-tagged salmon smolts have also been observed to aggregate in that area (Harza and RMC 1991).

In the subsequent analyses to estimate total passage through Cabot Station, catch rates in the nets would be extrapolated from the three bays used for netting. It was thus necessary to estimate the distribution of fish passage through all 18 bays. To accomplish this, mean adjusted catch rates in the pair of nets mounted in each unit were summed to give an estimate of the mean passage rate through the center bay of that unit. In this way, passage rates through three of the 18 bays were estimated. Those values are plotted in Figure 8. Because of the non-uniform distribution of fish across the intake, passage rates through the other 15 bays were then estimated by linear interpolation (Table 6, Figure 8).

Lengths of Herring and Shad

Mean lengths of blueback herring and American shad were usually computed from subsamples of collections. For each date, unweighted means of these average lengths were determined for each net and for the log sluice sampler. Those means are displayed in Figures 9 through 12. Figures 9 and 10 allow visual comparison of the mean lengths of fish passing through Cabot Station and fish bypassing the Station. In Figures 9 and 10, mean lengths are only shown for the shallow nets and for the log sluice sampler. There is no clear pattern of differences in length between entrained fish and bypassed fish. Figures 11 and 12 allow visual comparison of the mean lengths of fish collected in deep and shallow nets. There is also no clear pattern of difference in length between fish caught in deep nets and those caught in shallow nets. Because length was not clearly related to place of capture, it was disregarded in subsequent analyses.

Diel Patterns

Samples were collected from approximately 1800 hours to 0800 hours on three nights to determine the diel pattern of fish passage. On two of the three nights, catch rates declined to nearly zero by 2100 hours, but on one night high catch rates continued until after midnight (Figure 13). Consequently, the diel patterns were not

deemed sufficiently repeatable to justify extrapolation of estimated numbers of clupeids bypassed between 1700 hours and 2200 hours to other hours of the day.

Assessment of Study Objectives

The foregoing preliminary analyses provided the bases for addressing the objectives of the study.

Percentage of Juvenile Clupeids Bypassed

A fish was considered bypassed if it passed down the log sluice rather than through Cabot Station. Percentage bypassed was defined as the number bypassed divided by the total number bypassed and entrained.

Estimates of the percentage of clupeids bypassing Cabot Station via the log sluice were based on concurrent collections in the log sluice and either a) all three pairs of nets, or b) two pairs of nets mounted on units 1 and 4, 4 and 6, or 1 and 6. For this purpose, collections in the log sluice and in nets were considered concurrent if they were completed within the same hour.

Estimates of entrainment and bypass rates (fish per minute) during each concurrent set of collections were derived from adjusted catch rates.

Entrainment Rates

When data from nets on all three units were available, the summed adjusted catch rate in the three units was divided by 0.175 to estimate total entrainment rate. That fraction (0.175) was the estimated fraction of entrained fish passing through the three nets (Table 6). When data were only available concurrently for two pairs of nets, different factors were applied (see Table 6 for derivation of factors used to expand catch rates from different combinations of nets). When data were only available from nets on units 1 and 4, the summed adjusted catch rate was divided by 0.106; when data were only available from nets on units 4 and 6, the summed adjusted catch rate was divided by 0.096; and when data were only available from nets on units 1 and 6, the summed adjusted catch rate was divided by 0.149. Estimated entrainment rates from the same day were averaged. The daily estimated entrainment rates are listed in Table 7.

Bypass Rates

Bypass rates were derived in a manner similar to that for entrainment rates. Observed catch rates were divided by 0.92, the estimated efficiency of the log sluice sampler. Those adjusted bypass rates were averaged within days. Daily estimated bypass rates are also listed in Table 7.

For all clupeids combined, and for each species individually, the percentage bypassed during each concurrent collection period was computed directly from each daily entrainment and bypass rate pair:

$$P_b = 100\% * B/(B+C)$$

where P_b is the percentage bypassed, B is the estimated bypass rate and C is the estimated entrainment rate.

Number of Juvenile Clupeids Bypassed

The numbers of blueback herring and American shad bypassing Cabot Station via the log sluice were estimated for each day of sampling in the log sluice. Those estimates were based on the adjusted catch rates in the log sluice listed in Table 4, together with estimates of the species composition of each collection. For each day of sampling, catch rates (fish per minute) in the log sluice

for collections ending between 1700 and 2200 were averaged and multiplied by 300 minutes to estimate total numbers bypassed during that five-hour period (Table 8). Separate estimates were derived for all clupeids, and for blueback herring and American shad, respectively.

RESULTS AND DISCUSSION

Individual catches of clupeids in the six nets and in the log sluice are listed in Appendix A. Although non-alosid species were caught, catches of these other species were low (Table 9).

To understand these results in relation to the study objectives, several important findings pertaining to the pattern of entrainment and methods used to estimate entrainment (presented in the preliminary analyses section of this report) were identified. Based on netting conducted in the middle bays of units 1, 4, and 6, the entrainment rates are not uniform among the six units. The estimated average entrainment rates in units 1 (3.15) and 6 (2.77) were approximately three times as high as the estimated average entrainment rate in Unit 4 (1.04). If the observed pattern of entrainment were uniform among the sampled units, the average entrainment rate would have been used to estimate entrainment for the unsampled units. However, because the entrainment rate was not uniform among the units, linear interpolation was used to estimate entrainment for the unsampled units. Linear interpolation provides a method to make estimates in non-uniform distributions.

The nets sampling the upper half of the turbine intake captured significantly more fish than the nets sampling the bottom half of

the turbine intake. This result is not surprising given that a fish would have to be at least 22 feet deep in the water column to enter the bottom net. The net retention percentages, as determined by releasing known numbers of marked fish into the nets, were higher for the bottom nets. One explanation for this is that the flow at the bottom portion of the intake is more uniform than the flow at the top of the intake and fewer fish would be forced through the large mesh in front of the net. Net retention percentage was not different for nets fished for 20 minutes or 60 minutes, indicating that fish did not escape through the cod end of the net over the fishing period. Most of the fish that escaped probably passed through the large mesh in front of the net. The net retention percentage was lower (24% to 64%) than anticipated, and may be due to the inducted fish being forced into the net rather than passively entering as a natural migrating fish would. If the estimated net retention is lower than the actual net retention for wild fish, the percent bypassed is underestimated. However, there is no way to determine if the estimated net retention is representative of wild fish; therefore, the estimated retentions were used. In other studies where similar size mesh was used and similar size fish were inducted into the nets, Harza and RMC have observed net retention rates of approximately 50% to 60% at projects in Wisconsin and Pennsylvania.

Percentage Bypassed

Daily estimates of percent of clupeids bypassed are plotted in Figure 14. Values range from nearly zero to 83 percent. Because the estimated total number of fish (bypassed plus entrained) varied greatly from night to night, average bypass rates, weighted by estimated total passage, were computed as follows:

$$R = \frac{\Sigma B_i \times R_i}{\Sigma B_i}$$

where:

R = Weighted Average Bypass Rate in percent,

B_i = Nightly Total Passage Rate in fish per minute, and

R_i = Nightly Bypass Rate in percent.

Average bypass rates (weighted by estimated number bypassed) for all dates shown in Table 7 and Figure 14 were 58% for all clupeids, and 65% for blueback herring and 54% for American shad.

Figure 15 illustrates the relationship between the estimated percent bypassed and estimated total passage rate. There was no clear relationship (r^2 = 0.22) between total passage rate and percent bypassed. The two nights when the highest percent of fish were bypassed occurred not only at the highest passage rate but

also at one of the lowest passage rates (Figure 15, Table 10). On October 7, there were no concurrent samples between the nets and the log sluice so those data were excluded from the analyses. However, a very large number of fish passed over the log sluice during the first hour on October 7. It is likely that if concurrent samples were collected and the resulting data point plotted on Figure 15, that data point would fall in the upper right hand corner of the plot. This would strengthen the positive relationship between percent bypassed and total passage rate.

There is no clear explanation as to why the percentage bypassed varied so greatly among the different nights. During most nights all units were operating near capacity (Table 7), indicating that generating condition did not cause the observed variation in percent bypassed. Because canal flow is directly related to generator output, canal flow did not cause the variability in percent bypassed. Water temperature declined during the sampling period from 15 °C to 12 °C. However, the percent bypassed did not increase or decrease consistently during the same period.

Table 10 summarizes the unweighted estimated entrainment rates and bypass rates for the 15 days of sampling for which a bypass rate was estimated. The average estimated bypass rate was 11.6 fish per minute , with a coefficient of variation (standard deviation divided by mean times 100%) of 205 percent. The average estimated

entrainment rate was 23.0 fish per minute with a coefficient of variation of 73 percent. Hence, the daily bypass rate is more variable than the daily entrainment rate.

Operation of the test slots in the front wall of the ice and trash sluice began on October 12. The delay in operation, relative to the log sluice, resulted from difficulties in keeping the combined flows of the log sluice and the ice and trash sluice on the inclined-plane sampler. The slots that were fished from October 12 through the end of the study are listed in Table 11 with the unweighted bypass rates for all days sampled. Inspection of the unweighted bypass rates suggests that the slots had little apparent effect on the bypass rates.

Although the overall bypass percent is not noticeably different with one slot open, fish did enter the slots. Prior to opening the log sluice gate, the ice and trash sluice slots were open and fish were observed entering the slots and collecting in the sampler. The number of fish entering through the slots was not quantified separately from those passing over the log sluice; therefore, the contribution of these slots to the total number of fish bypassed for a given night is unknown. However, when the slots were first opened, a rather large group of fish would collect in the sampler, indicating that there was probably a group of fish in the direct vicinity of the slot before it was opened. This pattern was

evident for both the slots located over Unit 1 and Unit 4. The slot over unit 6 was only open one night and fish were seen entering it, but not at the rate as the other slots. However, there are insufficient data to determine which slots perform the best.

The horizontal distribution of entrained fish indicated that the slots on the two ends of the intake (unit 1 and unit 6) would be the most likely to pass large numbers of fish. Juvenile clupeids were observed congregating at these locations and the estimated entrainment rates through those units was higher than through the remaining units. However, there is a large trash buildup in front of unit 6 which interferes with, and largely clogs, the opening.

Number Bypassed

Daily estimates of numbers bypassed are listed in Table 8 and plotted in Figure 16. The estimated number of juvenile clupeids bypassed between 1700 hours and 2200 hours from October 2 through October 18 was 201,000. The estimated number of fish bypassed varies greatly among nights. The rate on October 7 is artificially inflated because of the high passage in the first hour of sampling and lack of additional samples (Table 4). Net sampling on October 7 was restricted to a single collection because of gear problems. If the planned additional samples had been collected, the estimated

number bypassed would probably be similar to that of October 3.

The variation in the nightly bypass rates cannot be explained by generation because generation was similar among all the nights (Table 7). The two highest estimated number of juvenile clupeids bypassed occurred at water temperatures of 15°C and 15.5°C (Figure 16). The estimated number of juvenile clupeids bypassed declined dramatically after October 7, and the water temperature also declined during this period. There was an increase in fish passage during October 16 and 17, after which no fish (or fish activity) were observed in the forebay. Entrainment rates were relatively high during the end of September, indicating that some portion of the run may have passed prior to the start of sampling. However, the log sluice was open during this period and a large portion of those fish presumably were bypassed.

CONCLUSIONS

1) From October 2 through October 18, 1991, an estimated 58% of the juvenile clupeids approaching Cabot Station were bypassed via the log sluice.

2) An estimated 201,000 juvenile clupeids were bypassed around Cabot Station between 1700 hours and 2200 hours from October 2 through October 18.

3) Juvenile clupeids entered the slots cut in the wall of the ice and trash sluice, but the relative effectiveness of this bypass route is unquantified.

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Tables

Table 1. Juvenile clupeids collected for use in net retention tests at Cabot Station, Fall 1991.

Date	Collection location(1)	Water Temperature (C)	Number collected	Transport mortalities	Number released
09/17/91	Rod & Gun Club	17	200	0	200
09/18/91	Rod & Gun Club	21	675	3	672
09/20/91	Rod & Gun Club	21	400	2	398
09/24/91	Rod & Gun Club	18	230	2	228
10/11/91	Transferred	13	900	0	900
10/13/91	Transferred	---	800	0	800
10/15/91	Transferred	---	700	0	700
		Totals -	3905	7	3898

(1) "Transferred" refers to fish collected at Hadley Falls Bypass and transported to Cabot Station.

Table 2. Net retention tests of juvenile clupeids during sampling at Cabot Station, September - October, 1991.

Release date	Net	Replicate	Minutes fished	Generator output (megawatts)	Number of fish released	Number of fish captured	Pooled retention (3 replicates)
09/24/91	Unit 6, deep net	1	62	7.0	200	133	64%
		2	70	7.0	200	165	
		3	62	7.0	200	87	
09/26/91	Unit 6, shallow net	1	75	8.8	200	68	36%
		2	68	8.8	200	82	
		3	65	8.8	200	65	
09/27/91	Unit 4, deep net	1	62	8.8	200	97	53%
		2	68	8.8	200	112	
		3	64	8.8	200	108	
10/14/91	Unit 4, shallow net	1	31	7.6	200	86	39%
		2	33	7.6	200	84	
		3	33	7.6	200	61	
10/16/91	Unit 1, deep net	1	30	8.2	201	46	44%
		2	31	8.2	200	110	
		3	37	8.2	200	108	
10/18/91	Unit 1, shallow net	1	30	8.8	200	98	24%
		2	30	8.8	200	17	
		3	30	8.8	200	29	
				Totals -	3601	1556	

Table 3. ANOVA assessing differences in retention rates(1) of nets mounted at two depths in front of three units of Cabot Station.

Source of variation	Sum of squares	Degrees of freedom	Mean square	F	Significance of F
Main effects	0.279	3	0.093	4.354	0.027
Unit (1,4,6)	0.082	2	0.041	1.932	0.187
Depth	0.196	1	0.196	9.197	0.010
2-way interactions	0.015	2	0.007	0.349	0.712
Explained	0.293	5	0.059	2.752	0.070
Residual	0.256	12	0.021		
Total	0.549	17	0.032		

(1) Retention rate is the fraction of 200 juvenile clupeids retained by the nets for 20 to 60 minutes.

Table 4. Catch rates (catch per minute, adjusted for net-retention) of juvenile clupeids in shallow and deep nets in front of units 1, 4, and 6 at Cabot Station during 1991.

Date Hour (1)	power (2)	unit 1 top	unit 1 bottom	unit 4 top	unit 4 bottom	unit 6 top	unit 6 bottom	log sluice
September 17								
18.00	42.00	.00	.00					
19.00	42.00	.00	.00	.00	.00	.00	.00	
20.00	42.00	.00	.00	.00	.00	.00	.00	
21.00	28.00	.00	.00	.00	.00	.20	.04	
September 18								
18.00	42.00	.00	.00	.00	.00			
19.00	38.50	.00	.00			.00	.00	
20.00	35.00			.00	.00	.00	.00	
21.00	35.00	.00	.00	.00	.00	.00	.00	
September 19								
12.00	42.00					.00		
15.00	42.00					.00		
17.00	42.00					.00		
19.00	42.00			.00	.00	.04	.00	
20.00	42.00	.00	.00					
21.00	42.00					.20	.03	
22.00	42.00	.00	.02	.00	.00			
September 20								
17.00	52.80					.00	.00	
18.00	52.80			.00	.00			
19.00	52.80	.00	.00			.00	.03	
20.00	52.80	.20	.00	.00	.00			
21.00	52.80			.28	.03	.59	.08	
22.00	52.80	1.08	.29					
September 21								
18.00	35.00			.00	.00	.00	.00	
19.00	35.00	.00	.00					
20.00	42.00	.10	.00	.00	.00	.00	.00	
21.00	21.00			.00	.00	.03	.00	
22.00	21.00	.00	.00					
September 24								
18.00	42.00					.00	.00	
19.00	42.00	.00	.00	.00	.00			
20.00	42.00			.15	.00	.09	.00	
21.00	42.00	.55	.10	2.63	.00	.27	.00	
22.00	42.00	.07	.00					
September 25								
18.00	52.80			.04	.00	7.59	.01	
19.00	52.80	.00	.00					
20.00	52.80	2.98	.32	.34	.08			
21.00	52.80			.78	.47	.57	.07	
22.00	52.80	4.06	.85					

(1) Ending times of the collections are rounded off to the nearest hour.
(2) Sum of power production by six generating units (megawatts).

(continued)

Table 4. Catch rates (catch per minute, adjusted for net-retention) of juvenile clupeids in shallow and deep nets in front of units 1, 4, and 6 at Cabot Station during 1991.

Date Hour (1)	power (2)	unit 1 top	unit 1 bottom	unit 4 top	unit 4 bottom	unit 6 top	unit 6 bottom	log sluice
September 26								
16.00	52.80					2.17	.00	
18.00	52.80					3.15	.00	
19.00	52.80	.26	.05	.14	.02			
20.00	52.80			1.03	.41	6.22	.29	
21.00	52.80	4.85	.59			3.46	.26	
22.00	52.80			.36	.17			
September 27								
12.00	52.80			.23	.22			
14.00	52.80			.12	.08			
16.00	52.80			.04	.00			
18.00	52.80			.00	.03	5.38	.03	
19.00	52.80	.67	.00	.51	.03			
20.00	52.80	4.04	.70			2.08	.27	
21.00	52.80	.54	1.51	1.35	.26	1.19	.13	
September 28								
19.00	52.80	1.28	.00	.00	.00	4.95	.05	
20.00	52.80	3.08	.59	1.59	.28	2.04	.20	
21.00	52.80	9.51	1.07	.75	.11			
22.00	52.80					.95	.02	
October 1								
18.00	52.80			.13	.03	3.85	.19	
19.00	52.80	1.33	.00			4.41	.37	
20.00	52.80	8.50	.96	2.12	.55			
21.00	52.80	12.65	1.14	1.32	.25	.43	.12	
October 2								
18.00	42.00	.07	.00					
19.00	42.00			.00	.00	1.46	.10	8.12
20.00	52.80	2.63	.94	1.10	.60	8.14	.46	6.29
21.00	52.80	5.71	.94	.25	.15			36.39
22.00	52.80					7.68	.70	
October 3								
17.00	46.00							564.27
18.00	46.00	.20	.00					
19.00	46.00			.08	.00	2.96	.05	229.96
20.00	46.00	.67	.40	.32	.06	2.25	.08	30.44
21.00	46.00	2.43	.34	.05	.00	1.31	.06	24.96
October 4								
18.00	49.10	.00	.03					3.20
19.00	49.10			.04	.00	1.49	.00	19.84
20.00	49.10	.63	.04	.39	.12	3.53	.21	7.64
21.00	49.10	3.05	.36					
22.00	49.10			.14	.04	3.62	.13	16.67

(1) Ending times of the collections are rounded off to the nearest hour.
(2) Sum of power production by six generating units (megawatts).

(continued)

Table 4. Catch rates (catch per minute, adjusted for net-retention) of juvenile clupeids in shallow and deep nets in front of units 1, 4, and 6 at Cabot Station during 1991.

Date Hour (1)	power (2)	unit 1 top	unit 1 bottom	unit 4 top	unit 4 bottom	unit 6 top	unit 6 bottom	log sluice
October 5								
17.00	34.20							2.17
18.00	34.20	.00	.00	.04	.00	.18	.00	21.72
19.00	34.20					1.48	.07	
20.00	34.20	.66	.07	.00	.00			14.74
21.00	34.20	.43	.08	.00	.00	1.19	.00	10.83
22.00	34.20							51.87
23.00	34.20							21.20
October 6								
.00	8.10							9.60
1.00	8.10							56.78
4.00	8.10							.02
5.00	8.10							.02
6.00	8.10							.00
7.00	8.10							.04
8.00	14.90							.02
18.00	48.40							2.99
19.00	48.40	.06	.00	.43	.03	3.03	.06	11.26
20.00	48.40	4.30	.79	.35	.32	1.88	.11	10.43
21.00	48.40	5.06	1.04	.29	.12			16.30
22.00	48.40					5.21	.19	6.88
October 7								
18.00	40.60							371.06
21.00	40.60			4.25	.51	.17	.05	
October 8								
18.00	40.40	8.06	.15			.13	.07	12.31
19.00	40.40			6.46	.77			2.55
20.00	40.40	19.20	1.68					
21.00	40.40	1.68	.73	.94	.75			.79
October 9								
18.00	44.20	5.42	.00	1.18	.00			.05
19.00	44.20	4.53	.79	.21	.15			.25
20.00	44.20	3.13	.34	1.32	.19			1.13
21.00	44.20	1.67	.23	.39	.09			.62
October 10								
19.00	46.80	.57	.21	.92	.09			4.96
20.00	46.00	4.38	.00	.13	.00			1.04
21.00	46.13	.57	.10	.00	.00			2.04
22.00	46.80							.45
23.00	46.80							.34
24.00	46.70							.24
October 11								
1.00	46.70							.18
2.00	46.70							.25

(1) Ending times of the collections are rounded off to the nearest hour.
(2) Sum of power production by six generating units (megawatts).

(continued)

Table 4. Catch rates (catch per minute, adjusted for net-retention) of juvenile clupeids in shallow and deep nets in front of units 1, 4, and 6 at Cabot Station during 1991.

Date Hour (1)	power (2)	unit 1 top	unit 1 bottom	unit 4 top	unit 4 bottom	unit 6 top	unit 6 bottom	log sluice
3.00	46.70							.40
4.00	46.70							.16
5.00	46.70							.07
6.00	46.70							.29
7.00	47.90							.18
8.00	47.90							.94
18.00	45.80	.00	.00	.00	.00			.05
19.00	45.80	.72	.49	.13	.00			.23
20.00	45.80	1.39	.09	.12	.09			.92
21.00	45.80	.81	.32	.22	.00			.46
October 12								
18.00	47.40	.00	.00	.00	.00			.98
19.00	47.40	.16	.17	.08	.06			.09
20.00	47.40	1.79	.19	.08	.00			1.05
21.00	47.40	2.68	.11	.08	.00			1.81
October 13								
18.00	46.70			.22	.00			.06
19.00	46.70	.18	.00	.00	.00			.76
20.00	46.70	2.03	.39	.25	.00			2.10
October 14								
13.00	47.20			.00	.00			
15.00	47.20			.00	.00			
16.00	47.20			.00	.00			
18.00	46.67	.37	.07	.35	.00			1.82
19.00	46.67	.00	.00	.00	.00			.94
20.00	46.67	1.01	.14	.08	.00			1.96
21.00	46.68	1.22	.39	.08	.06			4.48
October 15								
19.00	46.64	.58	.25	.00	.00			.00
20.00	46.53	.83	.11	.11	.00			.84
21.00	46.40			.00	.00			.82
22.00	46.80	1.50	.05					
October 16								
14.00	47.00	.00	.00					
16.00	47.00	.00	.00					
17.00	47.00	.11	.18					
18.00	47.00			.13	.00			14.55
19.00	47.00	.20	.11					3.49
20.00	47.00	1.34	.29	.08	.00			9.70
21.00	47.00	.75	.17	.14	.05			4.65
22.00	47.00	.51	.14	.11	.00			3.37
October 17								
18.00	46.60	.00	.00			.00	.00	4.50
19.00	46.60	.23	.06			.00	.00	20.68

(1) Ending times of the collections are rounded off to the nearest hour.
(2) Sum of power production by six generating units (megawatts).

(continued)

Table 4. Catch rates (catch per minute, adjusted for net-retention) of juvenile clupeids in shallow and deep nets in front of units 1, 4, and 6 at Cabot Station during 1991.

Date Hour (1)	power (2)	unit 1 top	unit 1 bottom	unit 4 top	unit 4 bottom	unit 6 top	unit 6 bottom	log sluice
20.00	46.60	.71	.13			.09	.00	14.11
21.00	46.60	.54	.07					7.84
22.00	46.60							.94
23.00	46.60							.27
October 18								
.00	46.60							.97
1.00	46.60							.18
2.00	46.60							.18
3.00	46.60							.07
4.00	46.60							.20
5.00	46.60							.16
6.00	24.90							.02
7.00	49.40							.00
8.00	49.40							.00
11.00	49.40	.00	.00					
12.00	49.40	.00	.00					
13.00	49.40	.00	.00					
17.00	49.10			.00	.00			
18.00	49.10	.00	.00					.05
19.00	49.10	.12	.00	.08	.00			.25
20.00	49.10	1.14	.05	.00	.00			.62
21.00	49.10	1.73	.09	.00	.03			.88

(1) Ending times of the collections are rounded off to the nearest hour.
(2) Sum of power production by six generating units (megawatts).

Table 5. Mean adjusted catch rates (+/- standard error of the mean) in nets mounted at two depths(1) in front of three units of Cabot Station(2).

	UNIT 1		UNIT 4		UNIT 6	
	Shallow	Deep	Shallow	Deep	Shallow	Deep
all clupeids----------	2.62 +/- 2.16	0.53 +/- 0.30	0.86 +/- 0.48	0.18 +/- 0.11	2.64 +/- 1.38	0.13 +/- 0.08
blueback herring------	0.67 +/- 0.57	0.08 +/- 0.10	0.24 +/- 0.16	0.04 +/- 0.03	0.40 +/- 0.30	0.03 +/- 0.02
American shad---------	1.95 +/- 1.62	0.45 +/- 0.24	0.62 +/- 0.44	0.13 +/- 0.09	2.23 +/- 1.19	0.10 +/- 0.06

(1) Two nets were mounted in front of each unit. The designations "shallow" and "deep" indicate the relative positions of the two nets.

(2) Catch rates shown were derived by dividing mean observed catch rate in 11 concurrent samples by the estimated retention rate of the net.

Table 6. Estimated and interpolated passage rates of juvenile clupeids through 18 bays of Cabot Station during 1991.

Unit number	Bay number(1)	Passage rate (fish/minute) estimated(2)	interpolated(3)	percentage(4)
1	1		3.38	8.53
1	2	3.15	3.15	7.94
1	3		2.92	7.35
2	4		2.68	6.76
2	5		2.45	6.16
2	6		2.21	5.57
3	7		1.98	4.98
3	8		1.74	4.39
3	9		1.51	3.80
4	10		1.27	3.21
4	11	1.04	1.04	2.62
4	12		1.33	3.35
5	13		1.62	4.07
5	14		1.91	4.80
5	15		2.19	5.53
6	16		2.48	6.25
6	17	2.77	2.77	6.98
6	18		3.06	7.71
		Total =	39.69	100.00

(1) The intake for each unit is divided into three bays. The bays are numbered sequentially here, starting from the southeast end of the station.

(2) Adjusted catch rates in the two nets of each pair were summed. Those sums were averaged over 11 concurrent sets of collections in the three net pairs located in bays 2, 11, and 17. The averages are shown here. They are given as estimates of passage rates through the three bays.

(3) Passage rates through bays without nets were derived by linear interpolation and extrapolation from the estimated values (see Figure 7).

(4) The estimated percentage passing through individual bays was the basis for estimating total entrainment from net catches. The combined percentages in groups of nets were as follows:

units 1, 4, and 6 :	17.5%
units 1 and 4 :	10.6%
units 1 and 6 :	14.9%
units 4 and 6 :	9.6%

Table 7. Entrainment and bypass rates of juvenile clupeids (fish per minute) at Cabot Station during 1991.

Date	average power (mw)	estimated clupeid entrainment rate (1)	estimated clupeid bypass rate (2)	estimated percent of clupeids bypassed	percent shad (3)	estimated herring entrainment rate (4)	estimated herring bypass rate (4)	estimated percent of herring bypassed	estimated shad entrainment rate (4)	estimated shad bypass rate (4)	estimated percent of shad bypassed
October 2	49.20	54.02	16.93	23.86	82.59	8.30	3.69	30.77	45.72	13.24	22.46
October 3	46.00	25.92	95.12	78.59	80.77	2.53	38.46	93.82	23.39	56.66	70.78
October 4	49.10	28.35	14.72	34.17	86.19	3.45	1.16	25.11	24.91	13.56	35.26
October 6	48.40	42.10	12.67	23.13	83.53	4.30	1.27	22.84	37.80	11.39	23.16
October 8	40.40	47.56	6.55	12.10	93.92	3.92	.56	12.41	43.64	5.99	12.07
October 9	44.20	46.31	.51	1.09	82.76	2.61	.13	4.80	43.70	.38	.86
October 10	46.31	21.91	2.68	10.90	91.71	1.31	.24	15.25	20.60	2.44	10.61
October 11	45.80	10.34	.42	3.86	88.42	1.58	.03	2.07	8.76	.38	4.17
October 12	47.40	12.74	.98	7.17	85.17	4.62	.11	2.24	8.12	.88	9.76
October 13	46.70	13.45	1.43	9.59	88.87	1.83	.14	7.08	11.62	1.29	9.98
October 14	46.67	8.86	2.30	20.59	85.28	1.64	.19	10.23	7.23	2.11	22.61
October 15	46.59	8.88	.42	4.53	88.67	.55	.07	11.62	8.34	.35	4.03
October 16	47.00	11.31	5.91	34.32	88.18	1.46	.29	16.51	9.85	5.62	36.33
October 17	46.60	2.75	13.10	82.66	93.77	.15	.33	69.54	2.60	12.77	83.06
October 18	49.10	10.18	.58	5.41	76.09	1.65	.08	4.70	8.53	.50	5.55

(1) Estimates of entrainment rates are based on catches in nets set in units 1, 4, and 6.

(2) Observed bypass rates of all clupeids are daily averages of catch rates in the log sluice sampler, after dividing by 0.92, the estimated sampling efficiency.

(3) Estimated percentage of clupeids that were American shad.

(4) Estimates of herring and shad entrainment and bypass rates are based on daily estimates of the proportions of each species in the river.

Table 8. Estimated (1) numbers of juvenile clupeids bypassed via log sluice of Cabot Station between 1700 and 2200 hours on 17 days in October, 1991.

Date	water temperature (C)	estimated number of bypassed clupeids	estimated number of bypassed herring	estimated number of bypassed shad
October 2	15.00	5078.90	1106.87	3972.03
October 3	15.50	63722.36	16295.52	47426.84
October 4	15.50	3551.51	283.50	3268.01
October 5	16.00	6126.66	427.04	5699.62
October 6	16.00	2858.68	140.30	2718.38
October 7	15.00	111316.77	.00	111316.77
October 8	14.00	1564.36	183.90	1380.47
October 9	14.00	153.73	39.45	114.29
October 10	13.50	453.62	49.85	403.77
October 11	13.28	103.56	19.63	83.93
October 12	13.50	295.11	31.69	263.42
October 13	12.50	291.61	30.93	260.68
October 14	12.50	689.40	56.03	633.37
October 15	12.00	166.35	29.23	137.12
October 16	12.00	2145.90	194.42	1951.47
October 17	11.00	2417.23	83.31	2333.93
October 18	11.47	82.47	14.74	67.73

(1) Total number bypassed each day was estimated by, first, averaging bypass rates (fish per minute) estimated in several collections each day and, second, multiplying the average by 300 minutes.

Table 9. Non-Alosids captured in log sluice sampler and turbine intake nets.

Species	Log sluice Sampler	Turbine intake nets
American eel	19	150
Gizzard shad	46	55
Common carp	---	1
Spottail shiner	12	10
Swallowtail shiner	1	---
Notropis spp.	---	1
Fallfish	1	---
Yellow bullhead	2	4
Brown bullhead	---	5
Ictalurus spp.	---	4
Banded killifish	---	1
White perch	100	192
Rock bass	14	11
Pumpkinseed	1	3
Bluegill	21	27
Smallmouth bass	35	6
Largemouth bass	8	4
Black crappie	14	---
Lepomis spp.	---	12
Yellow perch	1	---
Walleye	4	1
Sea lamprey	1	6
	280	493

Table 10. Estimates of total passage rate of juvenile clupeids in fish per minute at Turners Falls, Fall 1991.

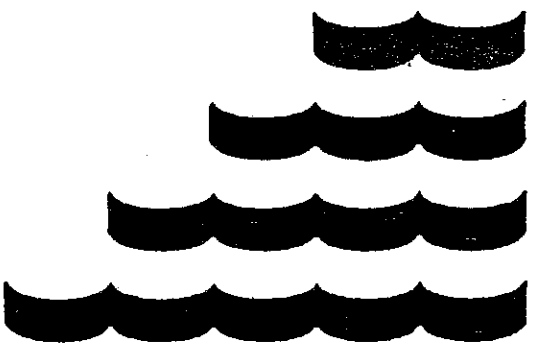
Date	Total Passage rate	Entrainment rate	Bypass rate
02-Oct	71.0	54.0	16.9
03-Oct	121.0	25.9	95.1
04-Oct	43.1	28.4	14.7
06-Oct	54.8	42.1	12.7
08-Oct	54.1	47.6	6.5
09-Oct	46.8	46.3	0.5
10-Oct	24.6	21.9	2.7
11-Oct	10.8	10.3	0.4
12-Oct	13.7	12.7	1.0
13-Oct	14.9	13.5	1.4
14-Oct	11.2	8.9	2.3
15-Oct	9.3	8.9	0.4
16-Oct	17.2	11.3	5.9
17-Oct	15.9	2.8	13.1
18-Oct	10.8	10.2	0.6
Average --	34.6	23.0	11.6
Standard deviation --	31.3	16.9	23.8

Table 11. Estimated percent of juvenile clupeids bypassed as related to the ice and trash sluice openings.

Date	Slot open*	Unweighted bypass rate (%)
02-Oct	---	23.86
03-Oct	---	78.59
04-Oct	---	34.17
06-Oct	---	23.13
08-Oct	---	12.1
09-Oct	---	1.09
10-Oct	---	10.9
11-Oct	---	3.86
12-Oct	Unit 4	7.17
13-Oct	Unit 4	9.59
14-Oct	Unit 4	20.59
15-Oct	Unit 6	4.53
16-Oct	Unit 1	34.32
17-Oct	Unit 1	82.66
18-Oct	Unit 1	5.41

* In each case the narrow/shallow slot (3' X 3') was open.

Figures



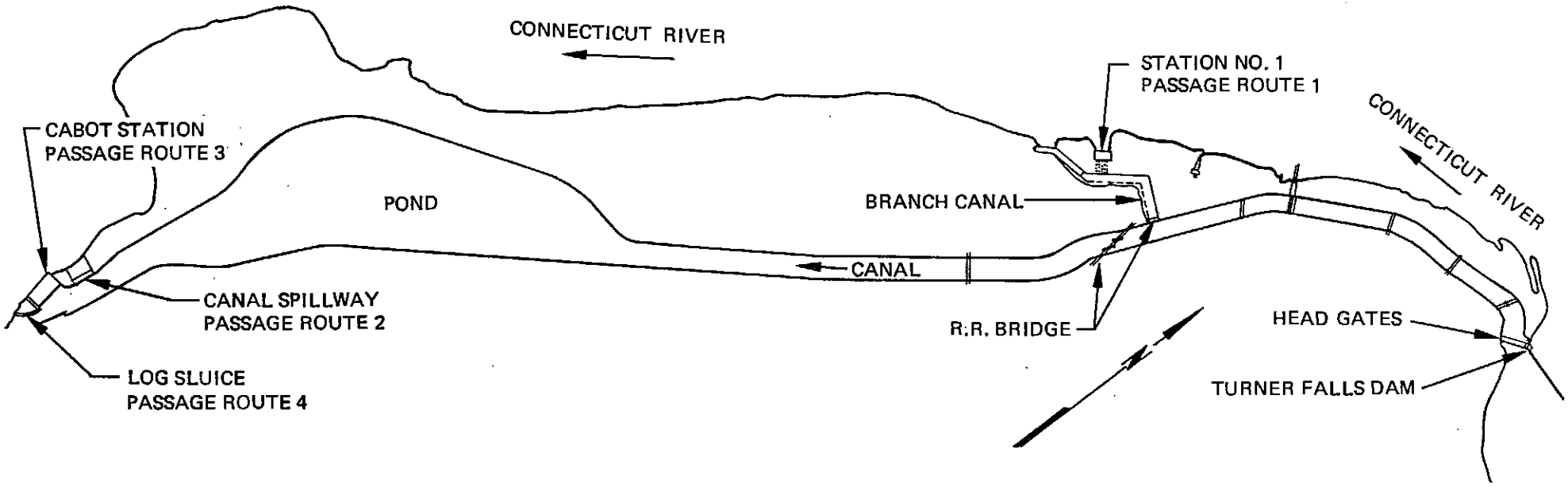
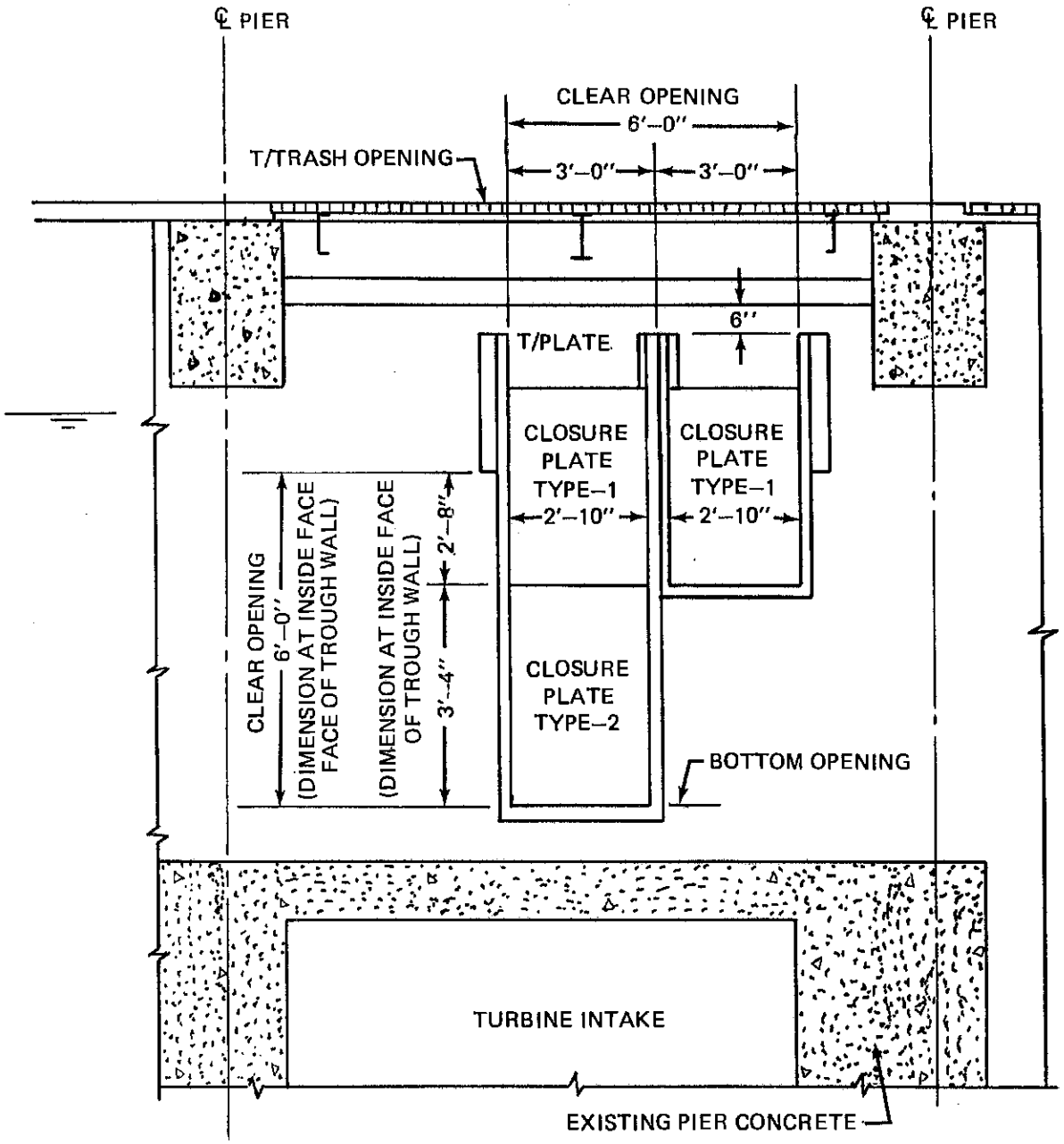


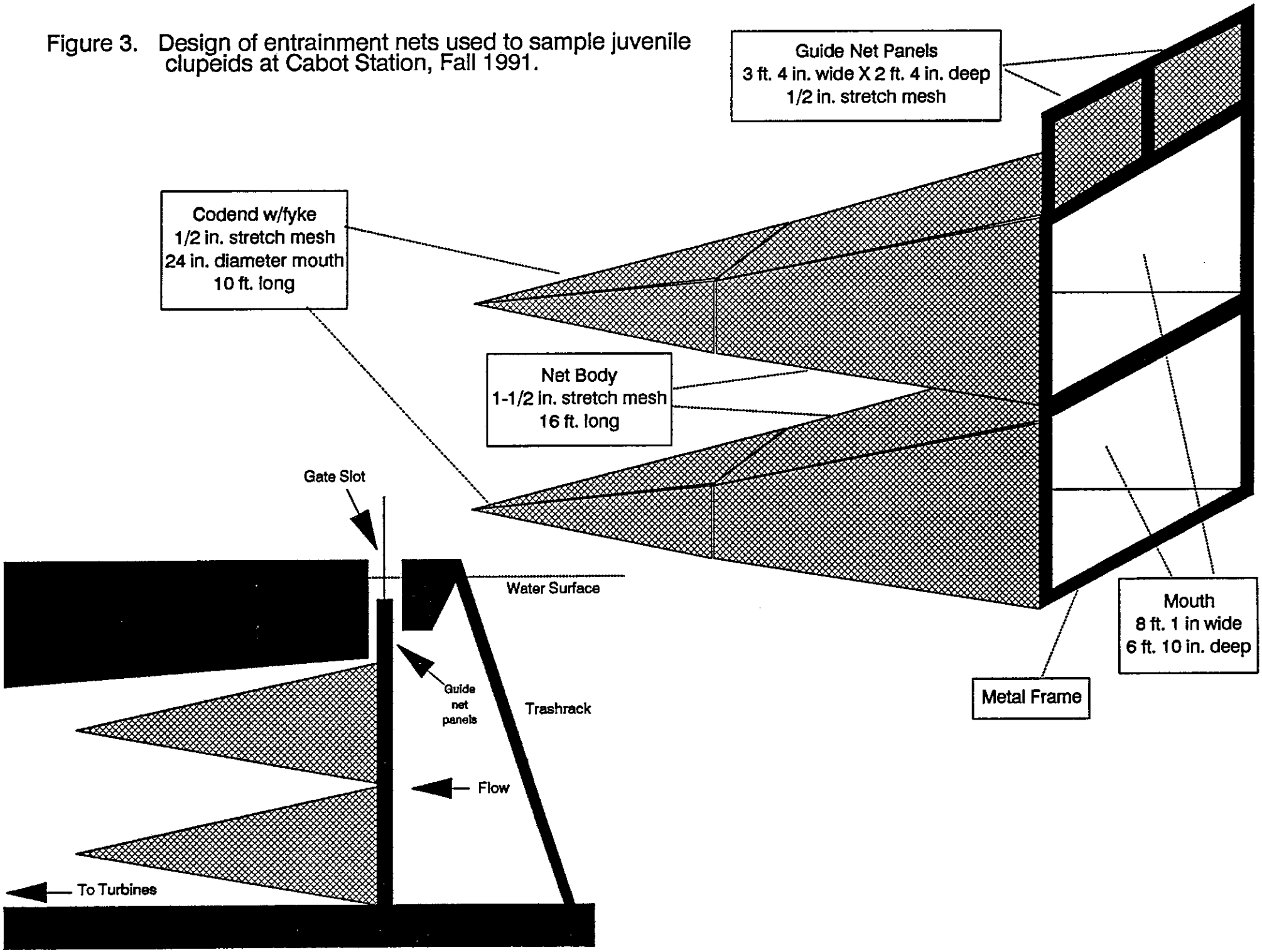
FIGURE 1. PLAN OF CANAL

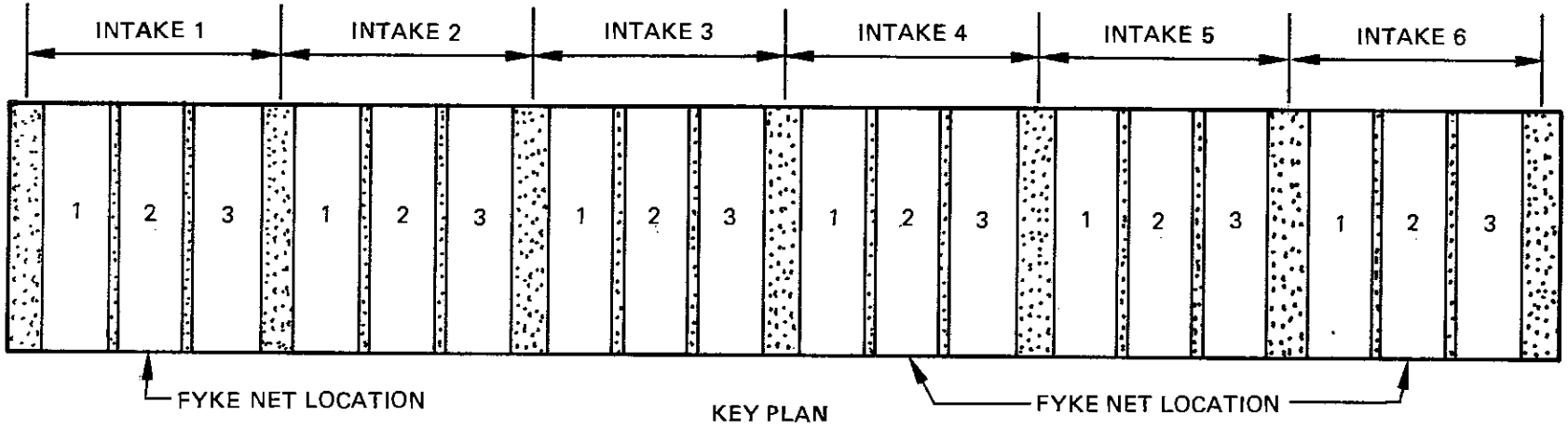


N.T.S.

FIGURE 2.
CONFIGURATION AND LOCATION OF ICE AND TRASH SLUICE SLOTS

Figure 3. Design of entrainment nets used to sample juvenile clupeids at Cabot Station, Fall 1991.





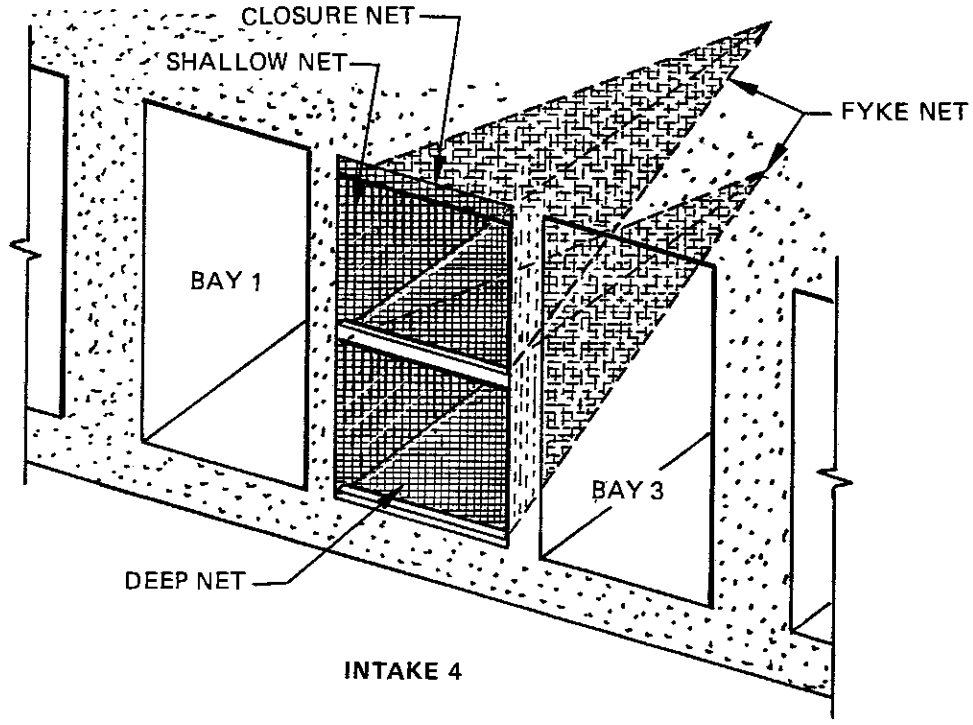
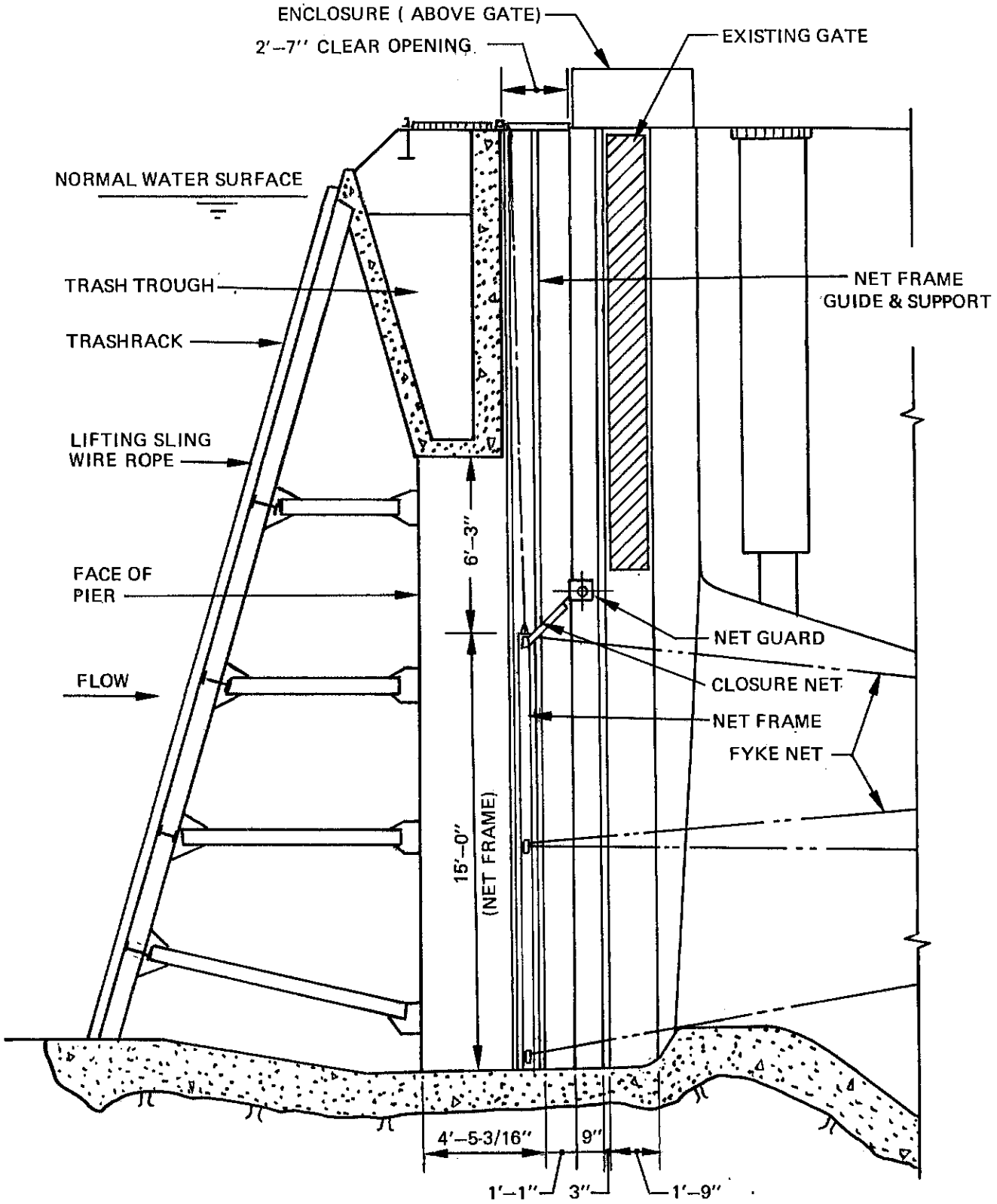


FIGURE 4.
LOCATION OF FYKE–NET SETS



SCALE 1/4" = 1'–0"

FIGURE 5.
SIDE VIEW OF NET FRAME ILLUSTRATING SAMPLING LOCATION IN THE TURBINE INTAKE

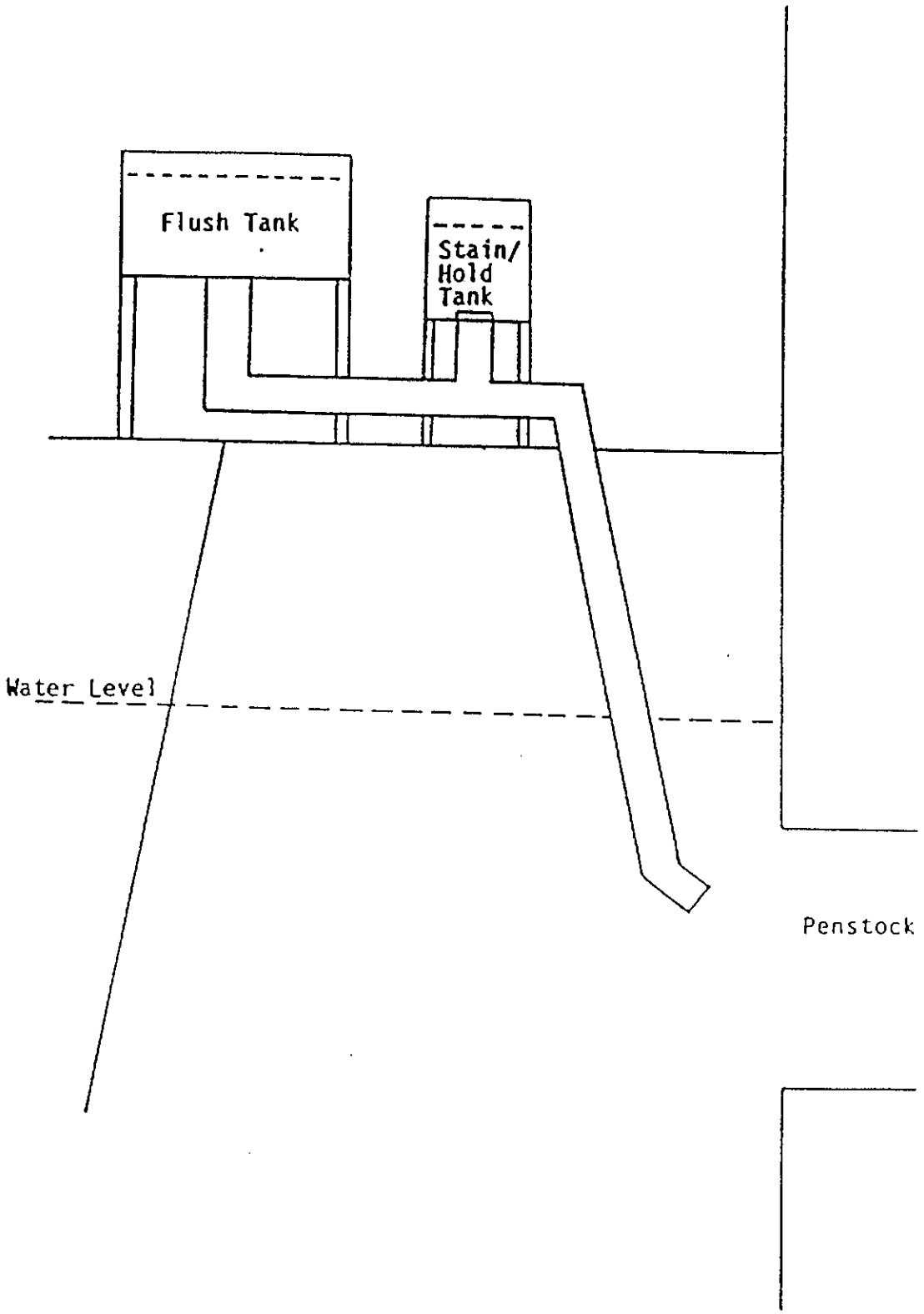


Figure 6. Conceptual sketch of the induction system used for introduction of juvenile clupeids into the Cabot Station turbine intakes

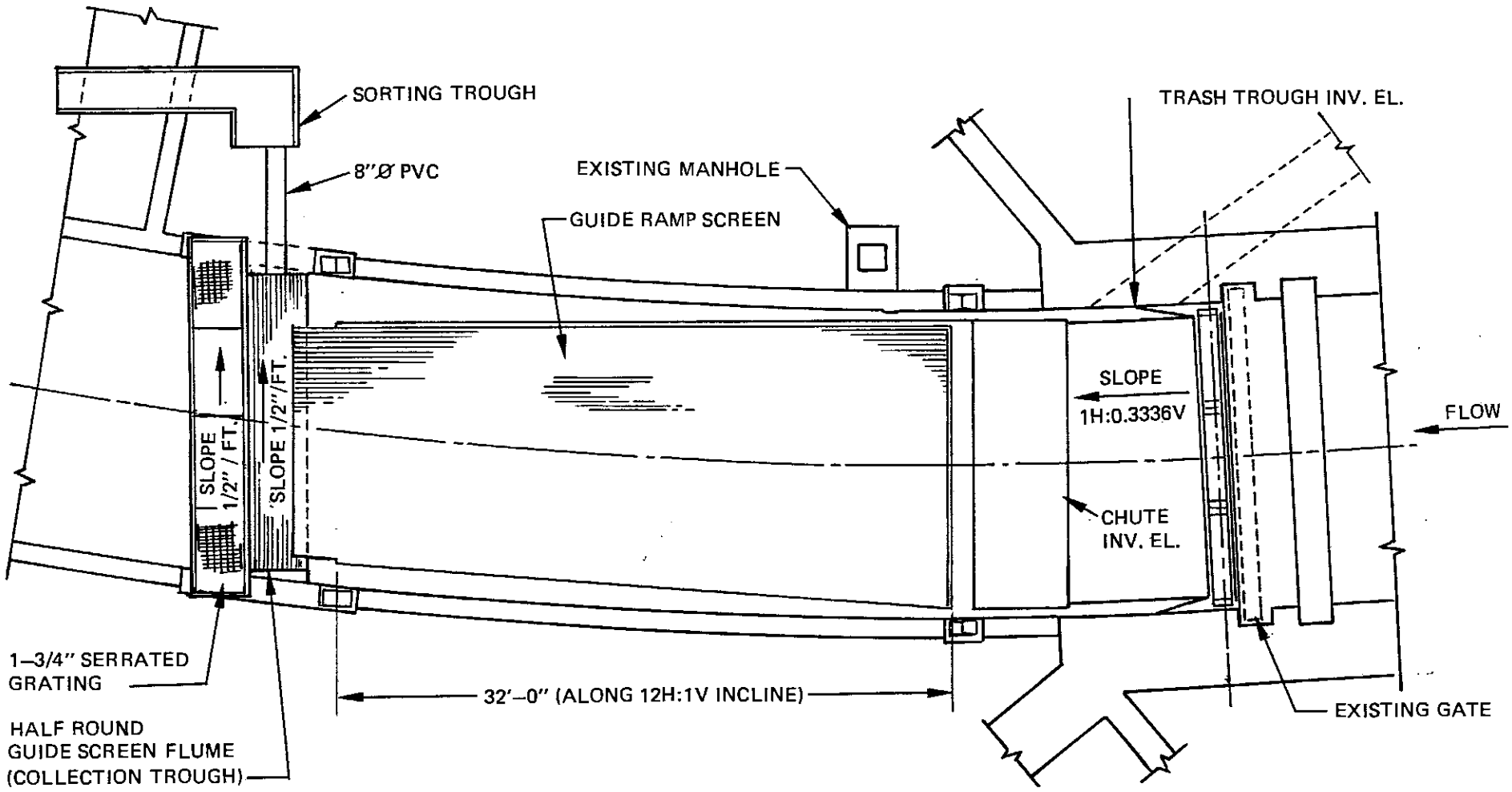


FIGURE 7.
PLAN VIEW OF LOG SLUICE SAMPLER

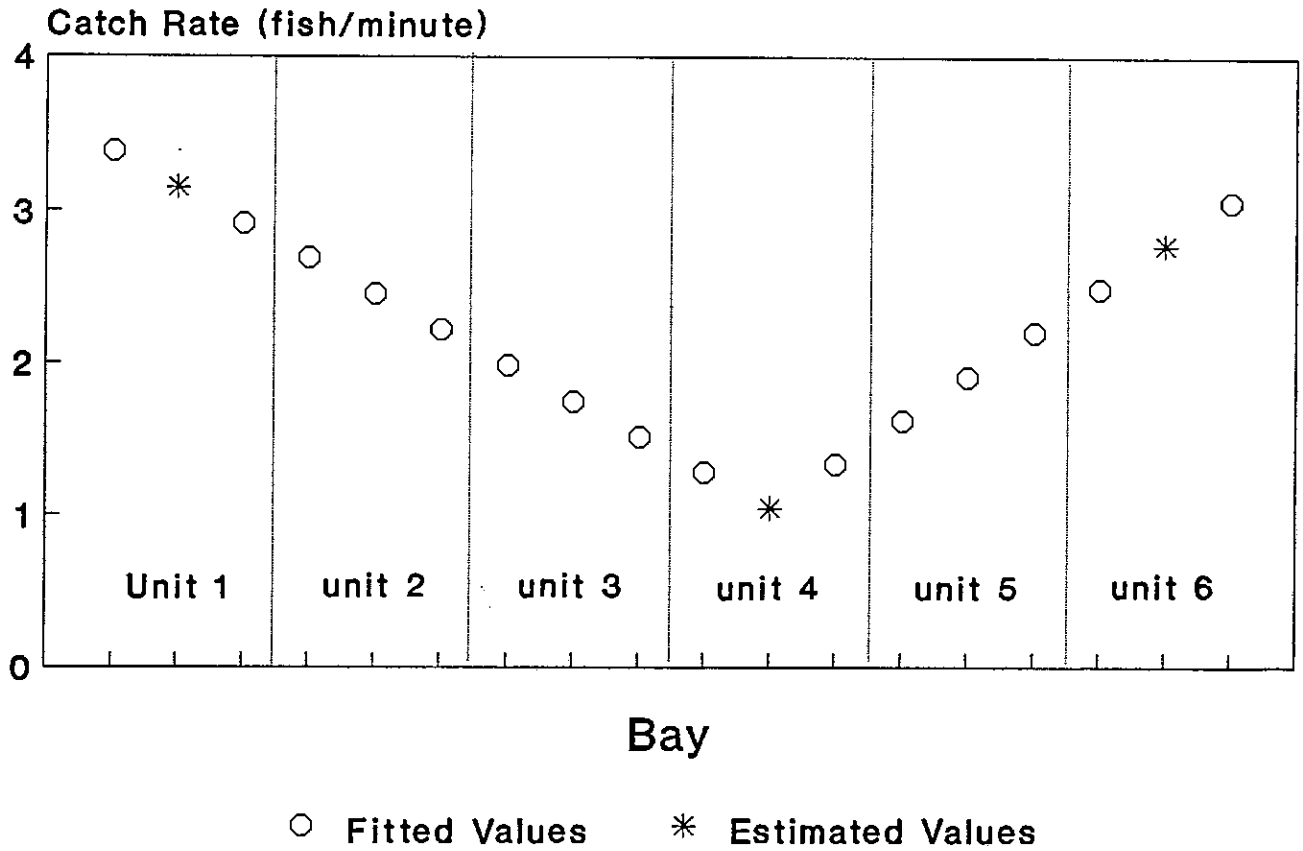


Figure 8. Horizontal distribution of entrained fish, derived from mean values (asterisks) of catch rates from net pairs in the middle bays of units 1, 4, and 6. Values in other bays were derived by interpolation.

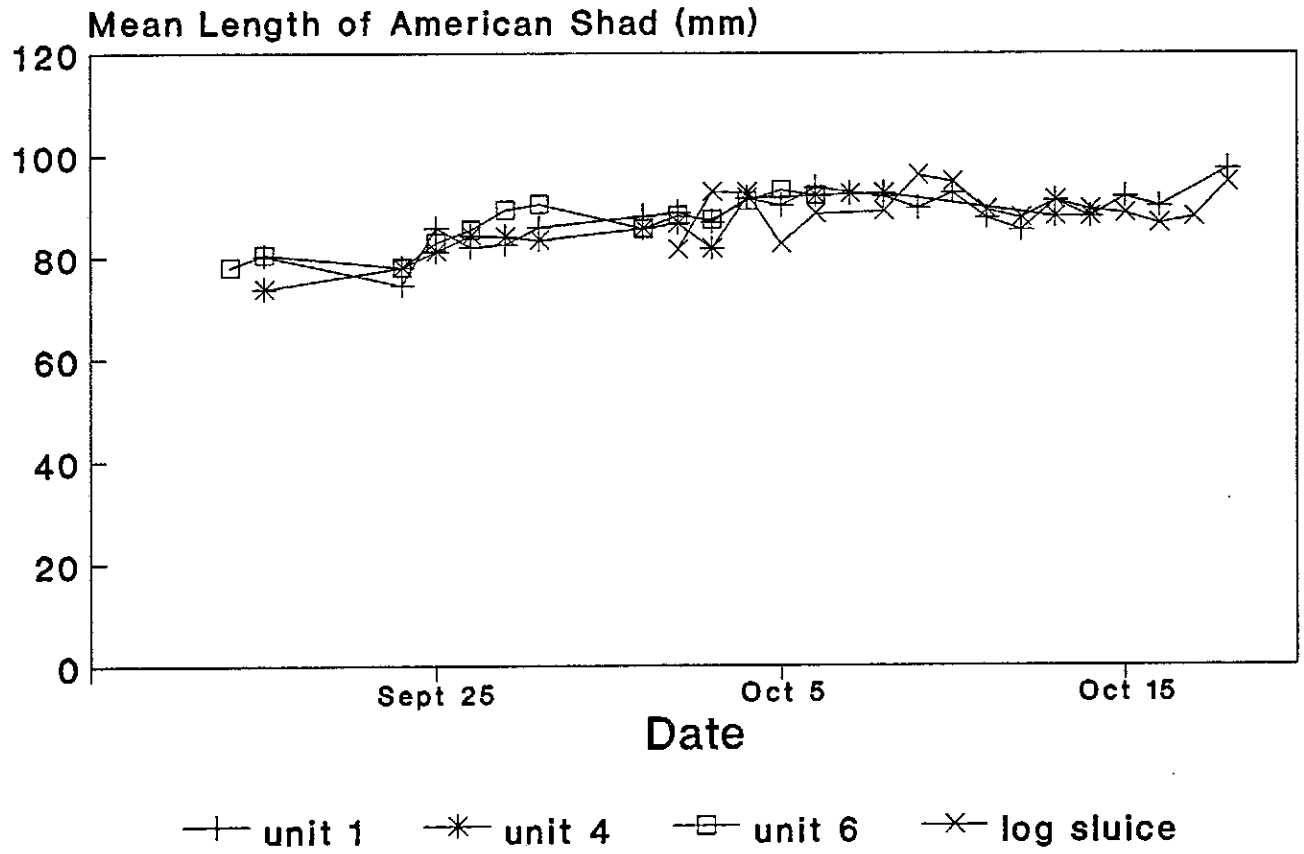


Figure 9. Mean lengths of American shad collected in the log sluice and in the shallow nets in three units of Cabot Station.

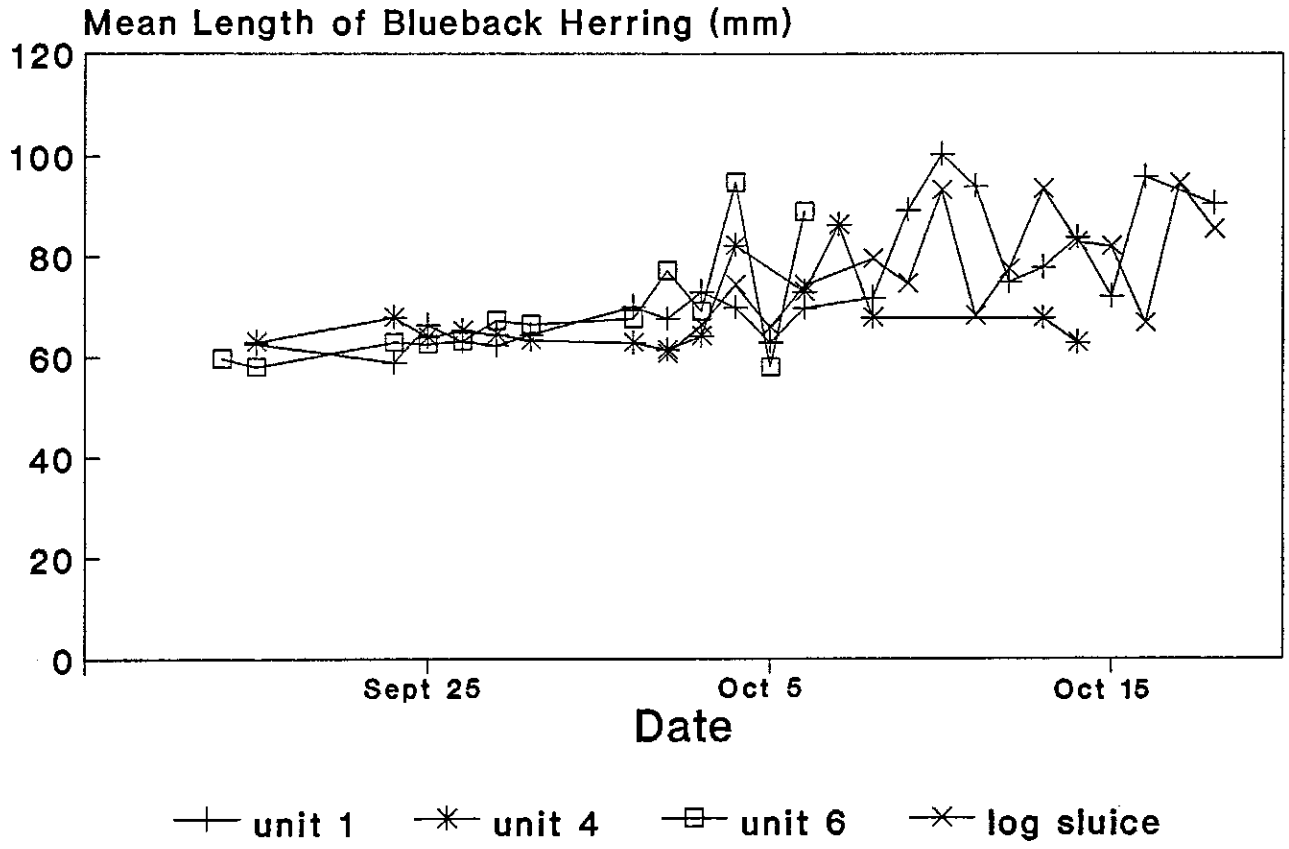


Figure 10. Mean lengths of blueback herring captured in the log sluice and in the shallow nets in three units of Cabot Station.

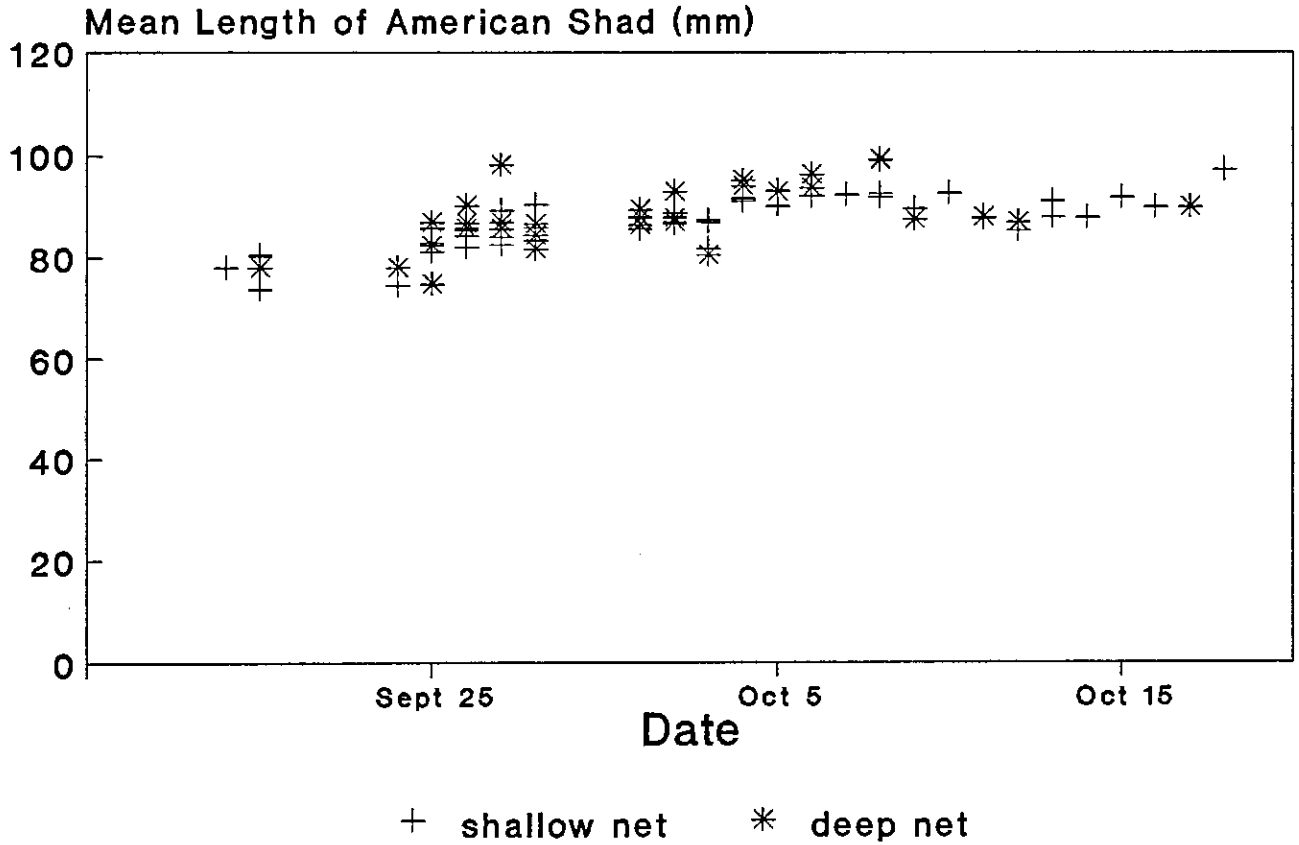


Figure 11. Mean lengths of American shad collected at two depths behind the trashracks of Cabot Station.

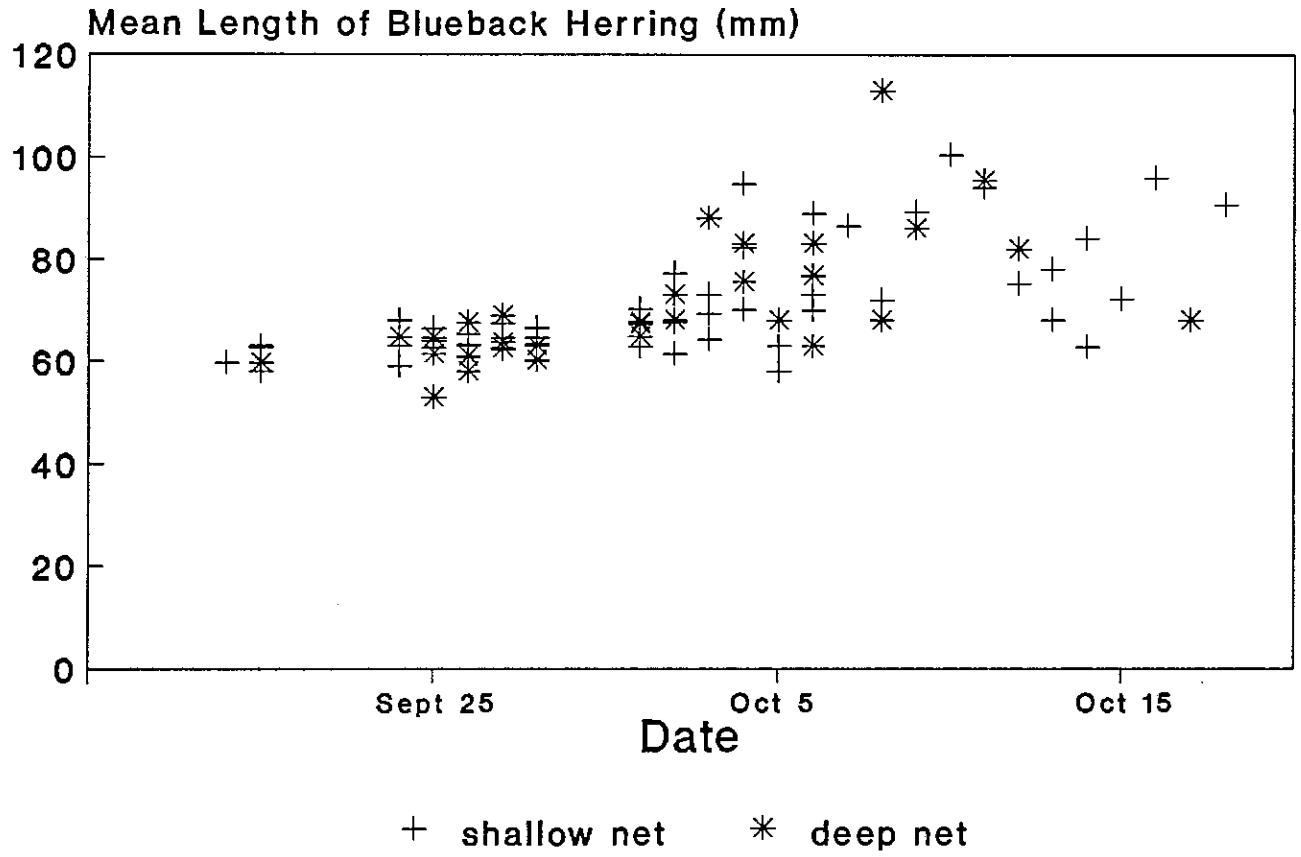


Figure 12. Mean lengths of blueback herring collected at two depths behind the trashracks of Cabot Station.

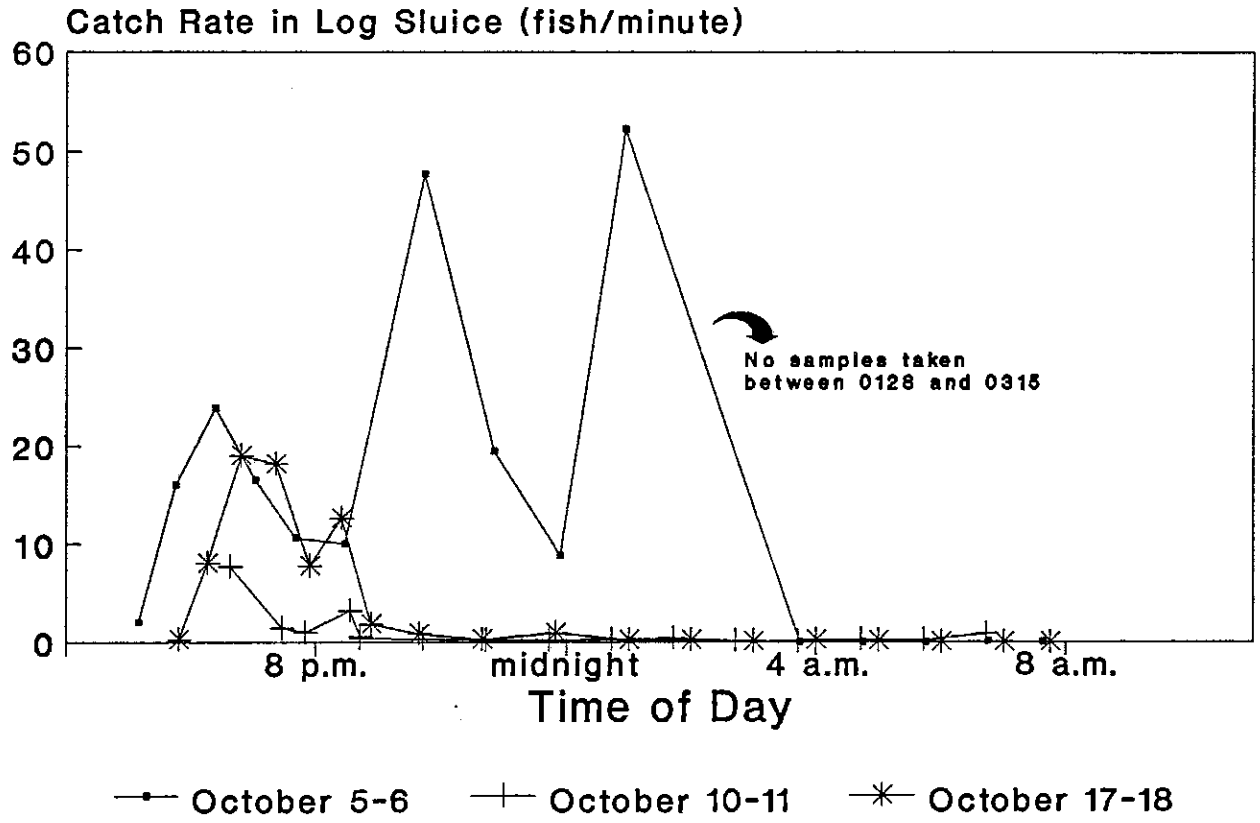


Figure 13. Catch rates in the log sluice sampler during three all-night sampling series. Catch rate is plotted above the midpoint of the sampling interval.

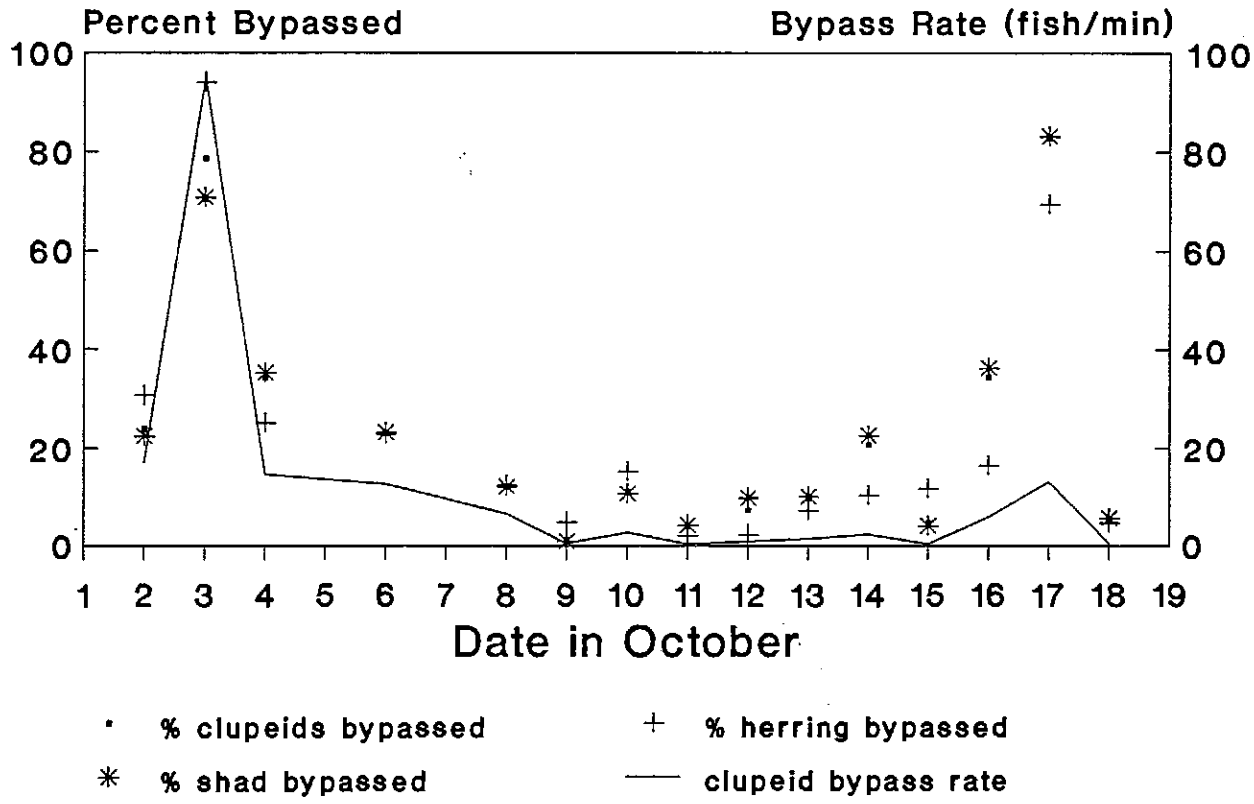


Figure 14. Estimated percentages of clupeids (together and by species) bypassed and estimated bypass rates for all clupeids at Cabot Station on several dates in October, 1991.

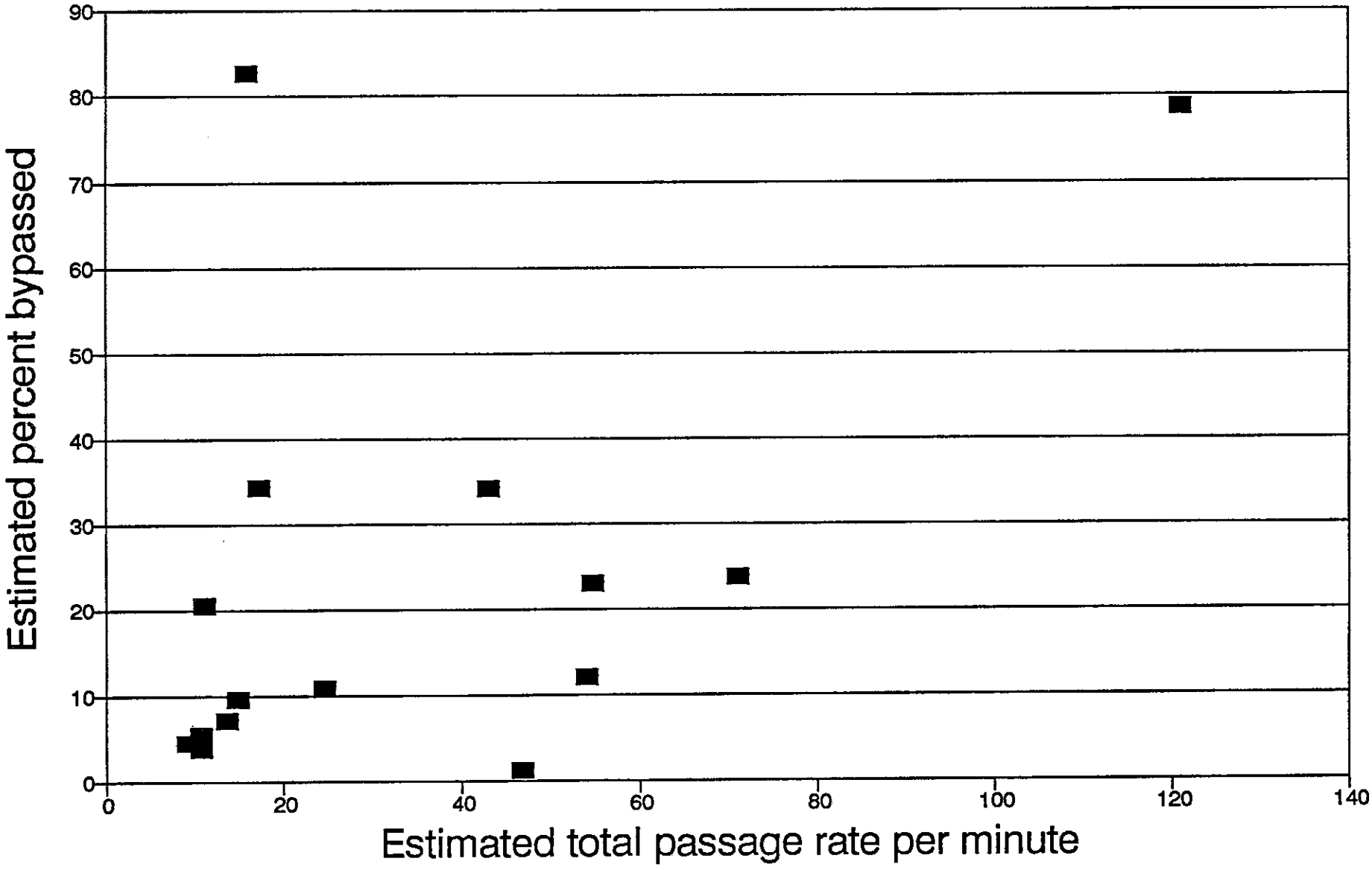


Figure 15. Relationship between estimated total passage rate and estimated percent bypassed at Turners Falls, Fall 1991.

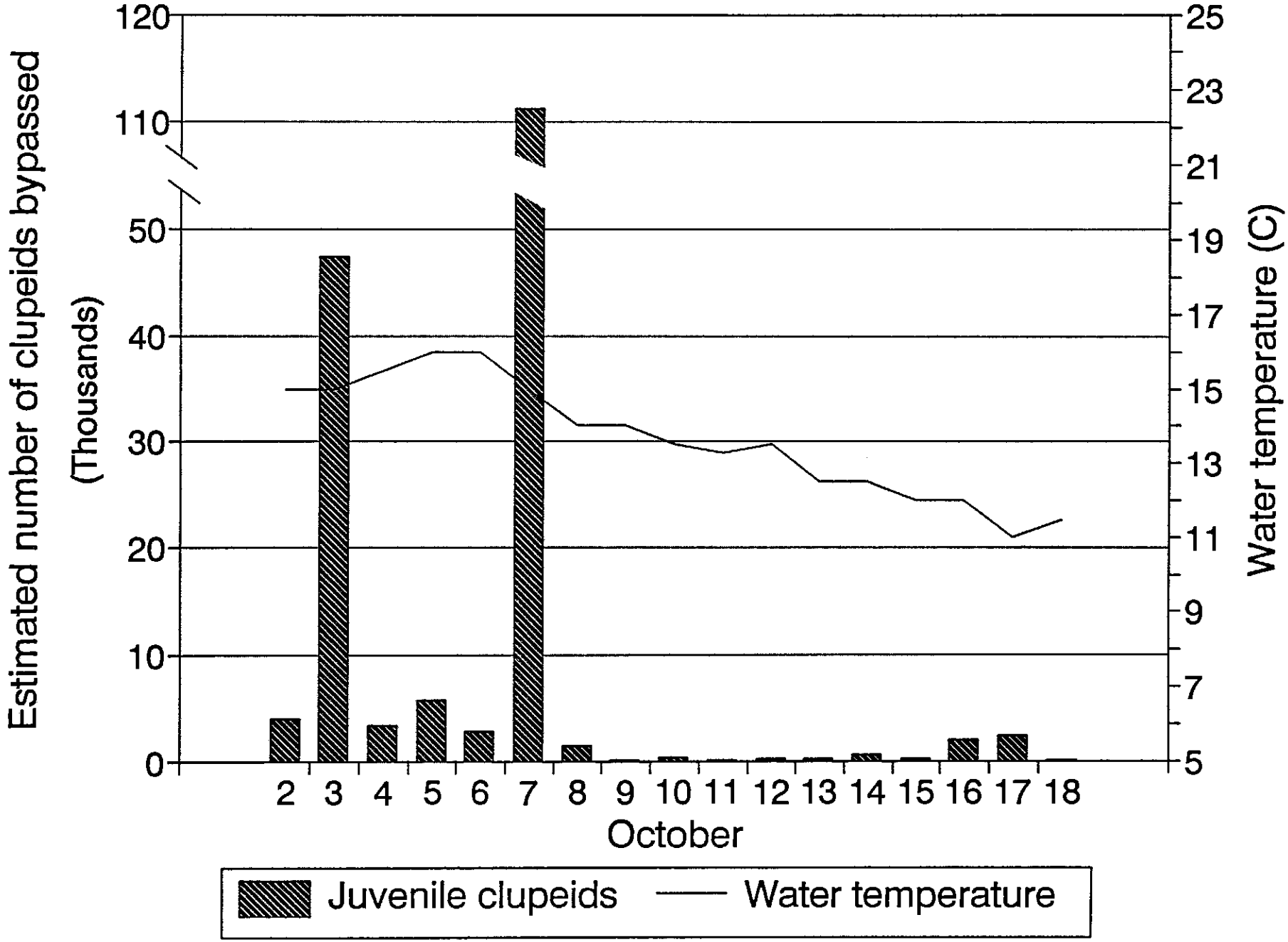
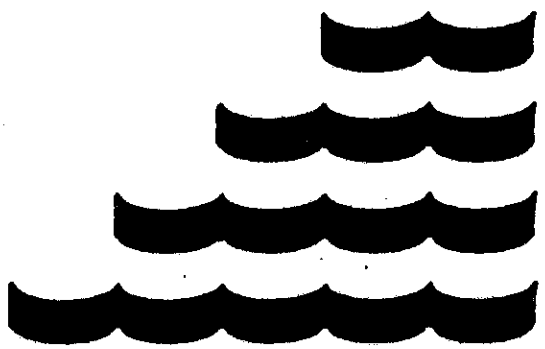


Figure 16. Estimated number of juvenile clupeids bypassed vs. water temperature at Turners Falls, Fall 1991.

Appendix A

SUMMARY OF DAILY CATCHES



APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=17SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:25:00	0:37	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:40:00	0:40		FIRST QUARTER	22.0	.	.	.	.	.
19:35:00	0:40		FIRST QUARTER	.	.	.	.	.	.
20:28:00	0:48		FIRST QUARTER	.	.	.	.	.	.
STAT. TOTAL	2:45				0	0	0	0	0

DATE=17SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:25:00	0:37	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:40:00	0:40		FIRST QUARTER	22.0	.	.	.	.	.
19:35:00	0:40		FIRST QUARTER	.	.	.	.	.	.
20:28:00	0:48		FIRST QUARTER	.	.	.	.	.	.
STAT. TOTAL	2:45				0	0	0	0	0

DATE=17SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:42:00	1:03	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:59:00	0:41		FIRST QUARTER	22.0	.	.	.	.	.
19:52:00	0:41		FIRST QUARTER	.	.	.	.	.	.
20:47:00	0:43		FIRST QUARTER	22.0	.	.	.	1	1
STAT. TDTAL	3:08				0	0	0	1	1

DATE=17SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:42:00	1:03	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:59:00	0:41		FIRST QUARTER	22.0	.	.	.	1	1
19:52:00	0:41		FIRST QUARTER	.	.	.	.	.	.
20:47:00	0:43		FIRST QUARTER	22.0	.	.	.	.	.
STAT. TOTAL	3:08				0	0	0	1	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=17SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:58:00	1:07	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
19:19:00	0:36		FIRST QUARTER	22.0	.	.	.	.	.
20:09:00	0:41		FIRST QUARTER	.	.	3	.	.	3
STAT. TOTAL	2:24				0	3	0	0	3

DATE=17SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:58:00	1:07	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
19:19:00	0:36		FIRST QUARTER	22.0	.	.	.	.	.
20:09:00	0:41		FIRST QUARTER	.	.	1	.	1	2
STAT. TOTAL	2:24				0	1	0	1	2
DATE TOTAL	16:34				0	4	0	3	7

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=18SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:03:00	1:00		FIRST QUARTER	22.5	.	.	.	.	.
18:15:00	1:02		FIRST QUARTER	22.5	.	.	.	.	.
19:30:00	1:09	OVERCAST	FIRST QUARTER	22.5	.	.	.	.	.
STAT. TOTAL	3:11				0	0	0	0	0

DATE=18SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:03:00	1:00		FIRST QUARTER	22.5	.	.	.	.	.
18:15:00	1:02		FIRST QUARTER	22.5	.	.	.	.	.
19:30:00	1:09	OVERCAST	FIRST QUARTER	22.5	.	.	.	.	.
STAT. TOTAL	3:11				0	0	0	0	0

DATE=18SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:16:00	1:01		FIRST QUARTER	.	.	.	.	.	.
18:31:00	1:02		FIRST QUARTER	22.5	.	.	.	.	.
19:50:00	1:01		FIRST QUARTER	22.5	.	.	.	1	1
STAT. TOTAL	3:04				0	0	0	1	1

DATE=18SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:16:00	1:01		FIRST QUARTER	.	.	.	.	.	.
18:31:00	1:02		FIRST QUARTER	22.5	.	.	.	.	.
19:50:00	1:01		FIRST QUARTER	22.5	.	.	.	.	.
STAT. TOTAL	3:04				0	0	0	0	0

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=18SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:07		FIRST QUARTER	22.5	.	.	.	.	.
18:48:00	1:05	OVERCAST	FIRST QUARTER	22.5	.	.	.	.	.
20:08:00	0:56		FIRST QUARTER	22.5	.	.	.	.	.
STAT. TOTAL	3:08				0	0	0	0	0

DATE=18SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:07		FIRST QUARTER	22.5	.	.	.	.	.
18:48:00	1:05	OVERCAST	FIRST QUARTER	22.5	.	.	.	.	.
20:08:00	0:56		FIRST QUARTER	22.5	.	.	.	.	.
STAT. TOTAL	3:08				0	0	0	0	0
DATE TOTAL	18:46				0	0	0	1	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=19SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:30:00	1:18	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
20:01:00	1:50	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
STAT. TOTAL	3:08				0	0	0	0	0

DATE=19SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:30:00	1:18	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
20:01:00	1:50	OVERCAST	FIRST QUARTER	23.0	.	1	.	.	1
STAT. TOTAL	3:08				0	1	0	0	1

DATE=19SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:22:00	1:02	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
19:44:00	1:49	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
STAT. TOTAL	2:51				0	0	0	0	0

DATE=19SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:22:00	1:02	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
19:44:00	1:49	OVERCAST	FIRST QUARTER	23.0	.	.	.	1	1
STAT. TOTAL	2:51				0	0	0	1	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=19SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:53:00	1:05	OVERCAST	FIRST QUARTER	23.0	.	1	.	.	1
19:18:00	1:52	OVERCAST	FIRST QUARTER	23.0	6	2	.	.	8
STAT. TOTAL	2:57				6	3	0	0	9

DATE=19SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:53:00	1:05	OVERCAST	FIRST QUARTER	23.0	.	.	.	.	.
19:18:00	1:52	OVERCAST	FIRST QUARTER	23.0	.	2	.	1	3
STAT. TOTAL	2:57				0	2	0	1	3
DATE TOTAL	17:52				6	6	0	2	14

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=20SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:18:00	1:27	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:55:00	1:24	CLEAR	FIRST QUARTER	22.0	3	1	.	3	7
20:39:00	1:02	CLEAR	FIRST QUARTER	22.0	6	10	.	1	17
STAT. TOTAL	3:53				9	11	0	4	24

DATE=20SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:18:00	1:27	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:55:00	1:24	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
20:39:00	1:02	CLEAR	FIRST QUARTER	22.0	3	5	.	2	10
STAT. TOTAL	3:53				3	5	0	2	10

DATE=20SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:12:00	1:18	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:40:00	1:08	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
20:13:00	1:15	CLEAR	FIRST QUARTER	22.0	1	7	.	.	8
STAT. TOTAL	3:41				1	7	0	0	8

DATE=20SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:12:00	1:18	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:40:00	1:08	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
20:13:00	1:15	CLEAR	FIRST QUARTER	22.0	.	1	.	.	1
STAT. TOTAL	3:41				0	1	0	0	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=20SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:07:00	0:03	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:25:00	1:01	CLEAR	FIRST QUARTER	22.0	.	.	.	1	1
19:42:00	1:20	CLEAR	FIRST QUARTER	22.0	9	8	.	1	18
STAT. TOTAL	2:24				9	8	0	2	19

DATE=20SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIOS **	OTHER SPECIES	TOTAL
17:07:00	0:03	CLEAR	FIRST QUARTER	22.0	.	.	.	.	.
18:25:00	1:01	CLEAR	FIRST QUARTER	22.0	.	1	.	.	1
19:42:00	1:20	CLEAR	FIRST QUARTER	22.0	.	4	.	6	10
STAT. TOTAL	2:24				0	5	0	6	11
DATE TOTAL	19:56				22	37	0	14	73

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=21SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:20:00	1:18	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
18:46:00	1:23	CLEAR	FIRST QUARTER	21.0	.	2	.	.	2
20:19:00	1:19	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
STAT. TOTAL	4:00				0	2	0	0	2

DATE=21SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:20:00	1:18	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
18:46:00	1:23	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
20:19:00	1:19	CLEAR	FIRST QUARTER	21.0	.	.	.	1	1
STAT. TOTAL	4:00				0	0	0	1	1

DATE=21SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:06:00	1:13	PARTLY CLOUDY	FIRST QUARTER	21.0	.	.	.	.	.
18:29:00	1:24	CLEAR	FIRST QUARTER	21.0	.	.	.	1	1
20:01:00	1:26	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
STAT. TOTAL	4:03				0	0	0	1	1

DATE=21SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:06:00	1:13	PARTLY CLOUDY	FIRST QUARTER	21.0	.	.	.	.	.
18:29:00	1:24	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
20:01:00	1:26	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
STAT. TOTAL	4:03				0	0	0	0	0

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=21SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
16:54:00	1:09	PARTLY CLOUDY	FIRST QUARTER	21.0	.	.	.	.	.
18:14:00	1:23	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
19:47:00	1:26	CLEAR	FIRST QUARTER	21.0	.	1	.	4	5
STAT. TOTAL	3:58				0	1	0	4	5

DATE=21SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
16:54:00	1:09	PARTLY CLOUDY	FIRST QUARTER	21.0	.	.	.	.	.
18:14:00	1:23	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
19:47:00	1:26	CLEAR	FIRST QUARTER	21.0	.	.	.	.	.
STAT. TOTAL	3:58				0	0	0	0	0
DATE TOTAL	24:02				0	3	0	6	9

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=24SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:25:00	1:40	CLEAR	FULL	19.0	.	.	.	.	.
19:12:00	1:31		FULL	19.0	5	7	.	.	12
20:52:00	1:00	CLEAR	FULL	19.0	.	1	.	.	1
STAT. TOTAL	4:11				5	8	0	0	13

DATE=24SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:25:00	1:40	CLEAR	FULL	19.0	.	.	.	.	.
19:12:00	1:31		FULL	19.0	3	1	.	.	4
20:52:00	1:00	CLEAR	FULL	19.0	.	.	.	.	.
STAT. TOTAL	4:11				3	1	0	0	4

DATE=24SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:12:00	1:34	CLEAR	FULL	19.0	.	.	.	.	.
18:58:00	1:29	CLEAR	FULL	19.0	2	3	.	.	5
20:38:00	0:03	CLEAR	FULL	19.0	.	3	.	.	3
STAT. TOTAL	3:06				2	6	0	0	8

DATE=24SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:12:00	1:34	CLEAR	FULL	19.0	.	.	.	.	.
18:58:00	1:29	CLEAR	FULL	19.0	.	.	.	2	2
20:38:00	0:03	CLEAR	FULL	19.0	.	.	.	.	.
STAT. TOTAL	3:06				0	0	0	2	2

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=24SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
16:32:00	1:02	CLEAR	FULL	19.0	.	.	.	.	.
18:30:00	1:05	CLEAR	FULL	19.0	.	2	.	.	2
19:55:00	1:23	CLEAR	FULL	19.0	7	1	.	1	9
STAT. TOTAL	3:30				7	3	0	1	11

DATE=24SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:30:00	1:05	CLEAR	FULL	19.0	.	.	.	1	1
19:55:00	1:23	CLEAR	FULL	19.0	.	.	.	1	1
STAT. TOTAL	2:28				0	0	0	2	2
DATE TOTAL	20:32				17	18	0	5	40

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=25SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:10	OVERCAST	FULL	18.5	.	.	.	4	4
18:48:00	1:10	PARTLY CLOUDY	FULL	18.5	14	36	.	8	58
20:12:00	1:20	PARTLY CLOUDY	FULL	18.5	12	40	26	12	90
STAT. TOTAL	3:40				26	76	26	24	152

DATE=25SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:10	OVERCAST	FULL	18.5	.	.	.	2	2
18:48:00	1:10	PARTLY CLOUDY	FULL	18.5	2	8	.	13	23
20:12:00	1:20	PARTLY CLOUDY	FULL	18.5	4	26	.	23	53
STAT. TOTAL	3:40				6	34	0	38	78

DATE=25SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:15:00	1:08	OVERCAST	FULL	18.5	.	1	.	.	1
18:31:00	1:09	PARTLY CLOUDY	FULL	18.5	3	6	.	.	9
19:51:00	1:28	PARTLY CLOUDY	FULL	18.5	21	5	.	1	27
STAT. TOTAL	3:45				24	12	0	1	37

DATE=25SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:15:00	1:08	OVERCAST	FULL	18.5	.	.	.	1	1
18:31:00	1:09	PARTLY CLOUDY	FULL	18.5	1	2	.	2	5
19:51:00	1:28	PARTLY CLOUDY	FULL	18.5	10	12	.	.	22
STAT. TOTAL	3:45				11	14	0	3	28

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=25SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:02:00	1:02	OVERCAST	FULL	18.5	7	22	.	.	29
18:18:00	0:04	PARTLY CLOUDY	FULL	18.5	.	20	.	.	20
19:36:00	1:27	PARTLY CLOUDY	FULL	18.5	9	9	.	1	19
STAT. TOTAL	2:33				16	51	0	1	68

DATE=25SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:02:00	1:02	OVERCAST	FULL	18.5	.	1	.	.	1
18:18:00	0:04	PARTLY CLOUDY	FULL	18.5	.	.	.	.	.
19:36:00	1:27	PARTLY CLOUDY	FULL	18.5	1	3	.	5	9
STAT. TOTAL	2:33				1	4	0	5	10
DATE TOTAL	19:56				84	191	26	72	373

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=26SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:47:00	1:35	CLEAR	FULL	16.8	1	5	.	3	9
19:33:00	1:13	OVERCAST	FULL	16.8	25	24	36	4	89
STAT. TOTAL	2:48				26	29	36	7	98

DATE=26SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:47:00	1:35	CLEAR	FULL	16.8	.	2	.	4	6
19:33:00	1:13	OVERCAST	FULL	16.8	5	14	.	8	27
STAT. TOTAL	2:48				5	16	0	12	33

DATE=26SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:31:00	1:36	CLEAR	FULL	16.8	2	3	.	1	6
19:16:00	1:14	PARTLY CLOUDY	FULL	16.8	11	18	.	1	30
20:41:00	1:05	OVERCAST	FULL	16.8	7	2	.	.	9
STAT. TOTAL	3:55				20	23	0	2	45

DATE=26SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:31:00	1:36	CLEAR	FULL	16.8	.	1	.	2	3
19:16:00	1:14	PARTLY CLDUDY	FULL	16.8	8	8	.	1	17
20:41:00	1:05	OVERCAST	FULL	16.8	3	3	.	1	7
STAT. TOTAL	3:55				11	12	0	4	27

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=26SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
15:05:00	1:13	PARTLY CLOUDY	FULL	16.8	11	46	.	.	57
17:03:00	1:14	CLEAR	FULL	16.8	8	44	32	.	84
18:49:00	1:11	PARTLY CLOUDY	FULL	16.8	6	43	110	3	162
20:26:00	1:01	PARTLY CLOUDY	FULL	16.8	17	33	26	2	78
STAT. TOTAL	4:39				42	166	168	5	381

DATE=26SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
15:05:00	1:13	PARTLY CLOUDY	FULL	16.8	.	.	.	.	.
17:03:00	1:14	CLEAR	FULL	16.8	.	.	.	1	1
18:49:00	1:11	PARTLY CLOUDY	FULL	16.8	.	13	.	7	20
20:26:00	1:01	PARTLY CLOUDY	FULL	16.8	2	8	.	5	15
STAT. TOTAL	4:39				2	21	0	13	36
DATE TOTAL	22:44				106	267	204	43	620

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=27SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	1:08	PARTLY CLOUDY	FULL	17.0	3	8	.	.	11
18:45:00	1:08	PARTLY CLOUDY	FULL	17.0	11	39	16	4	70
20:00:00	1:17	PARTLY CLOUDY	FULL	17.0	6	4	.	.	10
STAT. TOTAL	3:33				20	51	16	4	91

DATE=27SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	1:08	PARTLY CLOUDY	FULL	17.0	.	.	.	1	1
18:45:00	1:08	PARTLY CLOUDY	FULL	17.0	4	17	.	2	23
20:00:00	1:17	PARTLY CLOUDY	FULL	17.0	18	33	.	6	57
STAT. TOTAL	3:33				22	50	0	9	81

DATE=27SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
11:05:00	1:10		FULL	17.0	.	6	.	.	6
13:00:00	1:08	PARTLY CLOUDY	FULL	17.0	1	2	.	.	3
14:55:00	1:08	PARTLY CLOUDY	FULL	17.0	.	1	.	.	1
17:03:00	0:59	PARTLY CLOUDY	FULL	17.0	.	.	.	1	1
18:12:00	1:07	PARTLY CLOUDY	FULL	17.0	3	10	.	.	13
19:30:00	1:20	PARTLY CLOUDY	FULL	17.0	18	23	.	1	42
STAT. TOTAL	6:52				22	42	0	2	66

DATE=27SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
11:05:00	1:10		FULL	17.0	7	1	.	.	8
13:00:00	1:08	PARTLY CLOUDY	FULL	17.0	.	3	.	.	3
17:03:00	0:59	PARTLY CLOUDY	FULL	17.0	1	.	.	2	3
18:12:00	1:07	PARTLY CLOUDY	FULL	17.0	.	1	.	.	1
19:30:00	1:20	PARTLY CLOUDY	FULL	17.0	5	6	.	3	14
STAT. TOTAL	5:44				13	11	0	5	29

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=27SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:17:00	1:02	PARTLY CLOUDY	FULL	17.0	.	50	70	2	122
18:31:00	1:04	PARTLY CLOUDY	FULL	17.0	4	44	.	1	49
19:48:00	1:15	PARTLY CLOUDY	FULL	17.0	13	19	.	2	34
STAT. TOTAL	3:21				17	113	70	5	205

DATE=27SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:17:00	1:02	PARTLY CLOUDY	FULL	17.0	1	.	.	.	1
18:31:00	1:04	PARTLY CLOUDY	FULL	17.0	2	9	.	.	11
19:48:00	1:15	PARTLY CLOUDY	FULL	17.0	3	3	.	2	8
STAT. TOTAL	3:21				6	12	0	2	20
DATE TOTAL	26:24				100	279	86	27	492

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=28SEP91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:30:00	1:05	PARTLY CLOUDY	FULL	15.0	11	9	.	2	22
18:45:00	1:05	PARTLY CLOUDY	FULL	15.0	17	31	.	.	48
20:02:00	1:04	PARTLY CLOUDY	FULL	15.0	27	23	96	2	148
STAT. TOTAL	3:14				55	63	96	4	218

DATE=28SEP91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:30:00	1:05	PARTLY CLOUDY	FULL	15.0	.	.	.	.	.
18:45:00	1:05	PARTLY CLOUDY	FULL	15.0	1	16	.	2	19
20:02:00	1:04	PARTLY CLOUDY	FULL	15.0	6	24	.	5	35
STAT. TOTAL	3:14				7	40	0	7	54

DATE=28SEP91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:45:00	1:05	PARTLY CLOUDY	FULL	15.0	.	.	.	1	1
18:59:00	1:08	PARTLY CLOUDY	FULL	15.0	16	25	.	3	44
20:14:00	1:10	PARTLY CLOUDY	FULL	15.0	13	7	.	.	20
STAT. TOTAL	3:23				29	32	0	4	65

DATE=28SEP91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:45:00	1:05	PARTLY CLOUDY	FULL	15.0	.	.	.	.	.
18:59:00	1:08	PARTLY CLOUDY	FULL	15.0	3	7	.	.	10
20:14:00	1:10	PARTLY CLOUDY	FULL	15.0	2	2	.	.	4
STAT. TOTAL	3:23				5	9	0	0	14

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A .

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=10OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:28:00	0:20	CLEAR	NEW	13.5	1	50	103	1	155
18:48:00	0:40	CLEAR	NEW	13.5	.	.	57	.	57
19:28:00	0:22	CLEAR	NEW	13.5	4	17	.	4	25
19:50:00	0:43	CLEAR	NEW	13.5	.	.	138	.	138
20:33:00	0:20	PARTLY CLOUDY	NEW	13.5	2	9	.	2	13
20:53:00	1:00	PARTLY CLOUDY	NEW	13.5	4	21	.	5	30
21:53:00	1:00	OVERCAST	NEW	13.5	6	13	.	2	21
22:53:00	1:00	PARTLY CLOUDY	NEW	13.5	6	7	.	6	19
23:53:00	1:00	PARTLY CLOUDY	NEW	13.5	3	7	.	2	12
STAT. TOTAL	6:25				26	124	298	22	470
DATE TOTAL	10:33				28	161	298	29	516

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=11OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	0:25	LIGHT RAIN	NEW	13.0	.	.	.	1	1
18:49:00	0:23	HEAVY RAIN	NEW	13.0	1	3	.	1	5
19:51:00	0:24	HEAVY RAIN	NEW	13.0	1	7	.	2	10
20:54:00	0:36	HEAVY RAIN	NEW	13.0	1	6	.	4	11
STAT. TOTAL	1:48				3	16	0	8	27

DATE=11OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	0:25	LIGHT RAIN	NEW	13.0	.	.	.	1	1
18:49:00	0:23	HEAVY RAIN	NEW	13.0	2	3	.	2	7
19:51:00	0:24	HEAVY RAIN	NEW	13.0	.	1	.	3	4
20:54:00	0:36	HEAVY RAIN	NEW	13.0	.	5	.	9	14
STAT. TOTAL	1:48				2	9	0	15	26

DATE=11OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:43:00	0:22	LIGHT RAIN	NEW	13.0	.	.	.	.	.
18:46:00	0:20	LIGHT RAIN	NEW	13.0	.	1	.	.	1
19:47:00	0:22	HEAVY RAIN	NEW	13.0	.	1	.	.	1
20:50:00	0:24	HEAVY RAIN	NEW	13.0	.	2	.	.	2
STAT. TOTAL	1:28				0	4	0	0	4

DATE=11OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:43:00	0:22	LIGHT RAIN	NEW	13.0	.	.	.	.	.
18:46:00	0:20	LIGHT RAIN	NEW	13.0	.	.	.	.	.
19:47:00	0:22	HEAVY RAIN	NEW	13.0	.	1	.	.	1
20:50:00	0:24	HEAVY RAIN	NEW	13.0	.	.	.	.	.
STAT. TOTAL	1:28				0	1	0	0	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=11OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
0:53:00	1:00	PARTLY CLOUDY	NEW	13.5	7	7	.	1	15
1:53:00	1:00		NEW	13.5	14	8	.	3	25
2:53:00	1:00		NEW	13.5	4	5	.	1	10
3:53:00	1:00		NEW	13.5	.	4	.	2	6
4:53:00	1:00		NEW	13.5	6	10	.	2	18
5:53:00	1:00		NEW	.	1	9	.	.	10
6:53:00	1:00		NEW	.	1	51	.	4	56
17:43:00	0:22	LIGHT RAIN	NEW	13.0	.	1	.	3	4
18:05:00	0:41	LIGHT RAIN	NEW	13.0	.	.	3	.	3
18:46:00	0:20	LIGHT RAIN	NEW	13.0	.	7	.	.	7
19:06:00	0:41	LIGHT RAIN	NEW	13.0	.	.	32	.	32
19:47:00	0:22	LIGHT RAIN	NEW	13.0	.	20	.	1	21
20:04:00	0:46	LIGHT RAIN	NEW	13.0	.	.	20	.	20
20:50:00	0:24	LIGHT RAIN	NEW	13.0	.	10	.	.	10
STAT. TOTAL	10:36				33	132	55	17	237
DATE TOTAL	17:08				38	162	55	40	295

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=12OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:10:00	0:33	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
18:12:00	0:26	PARTLY CLOUDY	NEW	13.5	.	1	.	.	1
19:13:00	0:35	PARTLY CLOUDY	NEW	13.5	6	9	.	6	21
20:16:00	0:42	PARTLY CLOUDY	NEW	13.5	11	16	.	3	30
STAT. TOTAL	2:16				17	26	0	9	52

DATE=12OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:10:00	0:33	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
18:12:00	0:26	PARTLY CLOUDY	NEW	13.5	1	1	.	3	5
19:13:00	0:35	PARTLY CLOUDY	NEW	13.5	1	2	.	6	9
20:16:00	0:42	PARTLY CLOUDY	NEW	13.5	.	2	.	5	7
STAT. TOTAL	2:16				2	5	0	14	21

DATE=12OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:06:00	0:32	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
18:07:00	0:32	PARTLY CLOUDY	NEW	13.5	.	1	.	1	2
19:09:00	0:34	PARTLY CLOUDY	NEW	13.5	.	1	.	1	2
20:12:00	0:33	PARTLY CLOUDY	NEW	13.5	.	1	.	1	2
STAT. TOTAL	2:11				0	3	0	3	6

DATE=12OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:06:00	0:32	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
18:07:00	0:32	PARTLY CLOUDY	NEW	13.5	.	1	.	.	1
19:09:00	0:34	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
20:12:00	0:33	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
STAT. TOTAL	2:11				0	1	0	0	1

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A .

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=12OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:06:00	0:32	PARTLY CLOUDY	NEW	13.5	1	16	.	1	18
17:38:00	0:29	PARTLY CLOUDY	NEW	13.5	.	.	37	.	37
18:07:00	0:32	PARTLY CLOUDY	NEW	13.5	.	3	.	8	11
18:39:00	0:30	PARTLY CLOUDY	NEW	13.5	.	.	2	.	2
19:09:00	0:34	PARTLY CLOUDY	NEW	13.5	1	11	.	6	18
19:43:00	0:29		NEW	.	.	.	46	.	46
20:12:00	0:33	PARTLY CLDUDY	NEW	13.5	3	47	5	2	57
STAT. TOTAL	3:39				5	77	90	17	189
DATE TOTAL	12:33				24	112	90	43	269

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=13OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:54:00	0:37	PARTLY CLOUDY	NEW	12.5	.	.	.	1	1
18:55:00	0:34	PARTLY CLOUDY	NEW	12.5	.	3	.	1	4
19:49:00	0:41	PARTLY CLOUDY	NEW	12.5	3	17	.	4	24
STAT. TOTAL	1:52				3	20	0	6	29

DATE=13OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:54:00	0:37	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
18:55:00	0:34	PARTLY CLOUDY	NEW	12.5	.	.	.	8	8
19:49:00	0:41	PARTLY CLOUDY	NEW	12.5	.	7	.	8	15
STAT. TOTAL	1:52				0	7	0	16	23

DATE=13OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:50:00	0:36	PARTLY CLOUDY	NEW	12.5	.	3	.	2	5
18:50:00	0:33	PARTLY CLOUDY	NEW	12.5	.	.	.	2	2
19:46:00	0:32	PARTLY CLOUDY	NEW	12.5	1	2	.	.	3
STAT. TOTAL	1:41				1	5	0	4	10

DATE=13OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:50:00	0:36	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
18:50:00	0:33	PARTLY CLOUDY	NEW	12.5	.	.	.	3	3
19:46:00	0:32	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
STAT. TOTAL	1:41				0	0	0	3	3

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=13OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:51:00	0:35	PARTLY CLOUDY	NEW	12.5	1	1	.	6	8
18:26:00	0:24	PARTLY CLOUDY	NEW	12.5	.	.	8	.	8
18:50:00	0:33	PARTLY CLOUDY	NEW	12.5	4	31	.	13	48
19:23:00	0:23	PARTLY CLOUDY	NEW	12.5	.	.	42	.	42
19:46:00	0:32	PARTLY CLOUOY	NEW	12.5	4	46	15	5	70
STAT. TOTAL	2:27				9	78	65	24	176
DATE TOTAL	9:33				13	110	65	53	241

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=140CT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:08:00	0:34	CLEAR	NEW	12.5	.	3	.	.	3
18:07:00	0:37	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
19:10:00	0:33	PARTLY CLOUDY	NEW	12.5	2	6	.	1	9
20:01:00	0:41	PARTLY CLOUDY	NEW	12.5	1	11	.	7	19
STAT. TOTAL	2:25				3	20	0	8	31

DATE=140CT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:08:00	0:34	CLEAR	NEW	12.5	.	1	.	.	1
18:07:00	0:37	PARTLY CLOUDY	NEW	12.5	.	.	.	2	2
19:10:00	0:33	PARTLY CLOUDY	NEW	12.5	.	2	.	4	6
20:01:00	0:41	PARTLY CLOUDY	NEW	12.5	.	7	.	3	10
STAT. TOTAL	2:25				0	10	0	9	19

DATE=140CT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:05:00	0:30	CLEAR	NEW	12.5	3	1	.	.	4
18:04:00	0:34	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
19:05:00	0:31	PARTLY CLOUDY	NEW	12.5	.	1	.	.	1
19:58:00	0:34	PARTLY CLOUDY	NEW	12.5	1	.	.	.	1
STAT. TOTAL	2:09				4	2	0	0	6

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=14OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
11:50:00	1:22	CLEAR	NEW	.	.	.	.	.	.
13:24:00	1:07	CLEAR	NEW	.	.	.	.	.	.
14:45:00	1:03	CLEAR	NEW	.	.	.	.	.	.
17:05:00	0:30	CLEAR	NEW	12.5	.	.	.	.	.
18:04:00	0:34	PARTLY CLOUDY	NEW	12.5	.	.	.	.	.
19:05:00	0:31	PARTLY CLDUDY	NEW	12.5	.	.	.	1	1
19:58:00	0:34	PARTLY CLOUDY	NEW	12.5	.	1	.	.	1
STAT. TOTAL	5:41				0	1	0	1	2

DATE=14OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:05:00	0:31	CLEAR	NEW	12.5	3	40	.	3	46
17:36:00	0:28	CLEAR	NEW	12.5	.	.	55	.	55
18:04:00	0:34	CLEAR	NEW	12.5	4	32	.	3	39
18:38:00	0:27	CLEAR	NEW	12.5	.	.	18	.	18
19:05:00	0:31	CLEAR	NEW	12.5	4	45	26	2	77
19:36:00	0:22	CLEAR	NEW	12.5	.	.	26	.	26
19:58:00	0:34	CLEAR	NEW	12.5	4	52	84	6	146
STAT. TOTAL	3:27				15	169	209	14	407
DATE TOTAL	16:07				22	202	209	32	465

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=15OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:40:00	0:36	OVERCAST	FIRST QUARTER	12.0	1	4	.	.	5
19:44:00	0:40	LIGHT RAIN	FIRST QUARTER	12.0	.	8	.	1	9
20:52:00	0:50	LIGHT RAIN	FIRST QUARTER	12.0	4	14	.	2	20
STAT. TOTAL	2:06				5	26	0	3	34

DATE=15OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:40:00	0:36	OVERCAST	FIRST QUARTER	12.0	.	4	.	.	4
19:44:00	0:40	LIGHT RAIN	FIRST QUARTER	12.0	.	2	.	1	3
20:52:00	0:50	LIGHT RAIN	FIRST QUARTER	12.0	1	.	.	.	1
STAT. TOTAL	2:06				1	6	0	1	8

DATE=15OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:23:00	0:42	OVERCAST	FIRST QUARTER	12.0	.	.	.	.	.
19:28:00	0:50	LIGHT RAIN	FIRST QUARTER	12.0	.	2	.	.	2
20:46:00	0:41	LIGHT RAIN	FIRST QUARTER	12.0	.	.	.	.	.
STAT. TOTAL	2:13				0	2	0	0	2

DATE=15OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:23:00	0:42	OVERCAST	FIRST QUARTER	12.0	.	.	.	.	.
19:28:00	0:50	LIGHT RAIN	FIRST QUARTER	12.0	.	.	.	.	.
20:46:00	0:41	LIGHT RAIN	FIRST QUARTER	12.0	.	.	.	.	.
STAT. TOTAL	2:13				0	0	0	0	0

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=15OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:23:00	0:42	OVERCAST	FIRST QUARTER	12.0	.	.	.	.	.
19:05:00	0:34		FIRST QUARTER	.	.	.	17	.	17
19:39:00	0:39	OVERCAST	FIRST QUARTER	12.0	7	34	.	4	45
20:18:00	0:28		FIRST QUARTER	.	.	.	17	.	17
20:46:00	0:41	LIGHT RAIN	FIRST QUARTER	12.0	7	30	.	1	38
STAT. TOTAL	3:04				14	64	34	5	117
DATE TOTAL	11:42				20	98	34	9	161

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=16OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
13:26:00	0:30	PARTLY CLOUDY	FIRST QUARTER	.	.	.	.	.	.
15:20:00	0:31	PARTLY CLOUDY	FIRST QUARTER	.	.	.	.	.	.
16:34:00	0:37	PARTLY CLOUDY	FIRST QUARTER	.	2	.	.	1	3
17:56:00	0:42	PARTLY CLOUDY	FIRST QUARTER	12.0	.	2	.	2	4
19:08:00	0:31	PARTLY CLOUDY	FIRST QUARTER	12.0	1	9	.	.	10
20:13:00	0:39	PARTLY CLOUDY	FIRST QUARTER	12.0	1	6	.	2	9
21:20:00	0:49	PARTLY CLOUDY	FIRST QUARTER	12.0	1	5	.	3	9
STAT. TOTAL	4:19				5	22	0	8	35

DATE=16OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
16:34:00	0:37	PARTLY CLOUDY	FIRST QUARTER	.	.	.	3	.	3
17:56:00	0:42	PARTLY CLOUDY	FIRST QUARTER	12.0	2	.	.	2	4
19:08:00	0:31	PARTLY CLOUDY	FIRST QUARTER	12.0	.	4	.	2	6
20:13:00	0:39	PARTLY CLOUDY	FIRST QUARTER	12.0	.	3	.	6	9
21:20:00	0:49	PARTLY CLOUDY	FIRST QUARTER	12.0	.	3	.	4	7
STAT. TOTAL	3:18				2	10	3	14	29

DATE=16OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	0:42	PARTLY CLOUDY	FIRST QUARTER	.	.	2	.	.	2
19:00:00	0:31	PARTLY CLOUDY	FIRST QUARTER	12.0	.	1	.	.	1
20:08:00	0:38	PARTLY CLOUDY	FIRST QUARTER	12.0	2	.	.	.	2
21:15:00	0:23	PARTLY CLOUDY	FIRST QUARTER	12.0	.	1	.	1	2
STAT. TOTAL	2:14				2	4	0	1	7

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=160CT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	0:42	PARTLY CLOUDY	FIRST QUARTER	.	.	.	.	.	.
19:00:00	0:31	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	.	.	.
20:08:00	0:38	PARTLY CLOUDY	FIRST QUARTER	12.0	.	1	.	2	3
21:15:00	0:23	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	.	.	.
STAT. TOTAL	2:14				0	1	0	2	3

DATE=160CT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:43:00	0:13	CLEAR	FIRST QUARTER	12.0	.	.	174	.	174
17:56:00	0:42	CLEAR	FIRST QUARTER	12.0	14	36	151	6	207
18:38:00	0:30	CLEAR	FIRST QUARTER	12.0	.	.	49	.	49
19:08:00	0:31	CLEAR	FIRST QUARTER	12.0	2	48	342	2	394
19:39:00	0:34	CLEAR	FIRST QUARTER	12.0	.	.	177	.	177
20:13:00	0:39	CLEAR	FIRST QUARTER	12.0	3	45	119	1	168
21:20:00	0:49	CLEAR	FIRST QUARTER	.	.	51	101	.	152
STAT. TOTAL	3:58				19	180	1113	9	1321
DATE TOTAL	16:03				28	217	1116	34	1395

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=17OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:34:00	0:29	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	.	.
18:30:00	0:36	LIGHT RAIN	FIRST QUARTER	11.0	.	2	.	.	2
19:37:00	0:35		FIRST QUARTER	11.0	.	6	.	1	7
20:38:00	0:31		FIRST QUARTER	11.0	.	4	.	1	5
STAT. TOTAL	2:11				0	12	0	2	14

DATE=17OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:34:00	0:29	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	.	.
18:30:00	0:36	LIGHT RAIN	FIRST QUARTER	11.0	.	1	.	1	2
19:37:00	0:35		FIRST QUARTER	11.0	1	1	.	6	8
20:38:00	0:31		FIRST QUARTER	11.0	.	1	.	1	2
STAT. TOTAL	2:11				1	3	0	8	12

DATE=17OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:24:00	0:32	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	.	.
18:25:00	0:33	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	2	2
19:31:00	0:31		FIRST QUARTER	11.0	.	1	.	.	1
STAT. TOTAL	1:36				0	1	0	2	3

DATE=17OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:24:00	0:32	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	.	.
18:25:00	0:33	LIGHT RAIN	FIRST QUARTER	11.0	.	.	.	.	.
19:31:00	0:31		FIRST QUARTER	11.0	.	.	.	.	.
STAT. TOTAL	1:36				0	0	0	0	0

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=17OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:34:00	0:29	LIGHT RAIN	FIRST QUARTER	11.0	.	7	.	1	8
18:03:00	0:27	LIGHT RAIN	FIRST QUARTER	11.0	.	.	217	1	218
18:30:00	0:36	HEAVY RAIN	FIRST QUARTER	11.0	.	50	635	2	687
19:06:00	0:31	HEAVY RAIN	FIRST QUARTER	11.0	.	.	564	.	564
19:37:00	0:35	HEAVY RAIN	FIRST QUARTER	11.0	1	50	221	.	272
20:12:00	0:26		FIRST QUARTER	.	.	.	328	.	328
20:38:00	0:31	LIGHT RAIN	FIRST QUARTER	11.0	6	50	.	.	56
21:09:00	1:00	LIGHT RAIN	FIRST QUARTER	11.0	2	49	1	3	55
22:09:00	1:00	LIGHT RAIN	FIRST QUARTER	11.0	5	10	.	2	17
23:09:00	1:21	LIGHT RAIN	FIRST QUARTER	11.0	4	46	22	.	72
STAT. TOTAL	6:56				18	262	1988	9	2277
DATE TOTAL	14:30				19	278	1988	21	2306

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=18OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:05:00	0:31		FIRST QUARTER	12.0	.	.	.	2	2
18:12:00	0:34		FIRST QUARTER	12.0	.	1	.	1	2
19:11:00	0:44		FIRST QUARTER	12.0	3	9	.	4	16
20:09:00	0:53		FIRST QUARTER	12.0	2	20	.	2	24
STAT. TOTAL	2:42				5	30	0	9	44

DATE=18OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
10:27:00	0:30		FIRST QUARTER	.	.	.	.	.	.
11:48:00	0:30		FIRST QUARTER	12.0	.	.	.	.	.
12:30:00	0:30		FIRST QUARTER	12.0	.	.	.	.	.
17:05:00	0:31		FIRST QUARTER	12.0	.	.	.	.	.
18:12:00	0:34		FIRST QUARTER	12.0	.	.	.	1	1
19:11:00	0:44		FIRST QUARTER	12.0	1	.	.	3	4
20:09:00	0:53		FIRST QUARTER	12.0	.	2	.	2	4
STAT. TOTAL	4:12				1	2	0	6	9

DATE=18OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:00:00	0:30		FIRST QUARTER	12.0	.	.	.	.	.
18:07:00	0:33		FIRST QUARTER	12.0	.	1	.	.	1
19:07:00	0:30		FIRST QUARTER	12.0	.	.	.	1	1
19:53:00	1:00		FIRST QUARTER	12.0	.	.	.	1	1
STAT. TOTAL	2:33				0	1	0	2	3

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=18OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:00:00	0:30		FIRST QUARTER	12.0	.	.	.	.	.
18:07:00	0:33		FIRST QUARTER	12.0	.	.	.	.	.
19:07:00	0:30		FIRST QUARTER	12.0	.	.	.	2	2
19:53:00	1:00		FIRST QUARTER	12.0	1	.	.	1	2
STAT. TOTAL	2:33				1	0	0	3	4

DATE=18OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
0:30:00	1:00		FIRST QUARTER	11.0	1	9	.	2	12
1:30:00	1:00		FIRST QUARTER	11.0	2	8	.	3	13
2:30:00	1:00		FIRST QUARTER	11.0	3	1	.	.	4
3:30:00	1:00		FIRST QUARTER	11.0	6	5	.	1	12
4:30:00	1:00		FIRST QUARTER	11.0	4	5	.	1	10
5:30:00	1:00		FIRST QUARTER	.	1	.	.	.	1
6:30:00	1:00		FIRST QUARTER	11.0	.	.	.	1	1
7:30:00	0:30		FIRST QUARTER	11.0	.	.	.	1	1
17:05:00	0:31	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	.	.	.
17:36:00	0:36	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	3	2	5
18:12:00	0:34	PARTLY CLOUDY	FIRST QUARTER	12.0	.	2	.	5	7
18:46:00	0:25	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	10	1	11
19:11:00	0:44	PARTLY CLOUDY	FIRST QUARTER	12.0	4	27	.	4	35
19:55:00	0:14	PARTLY CLOUDY	FIRST QUARTER	12.0	.	.	6	2	8
20:09:00	0:53	PARTLY CLOUDY	FIRST QUARTER	12.0	5	38	.	4	47
STAT. TOTAL	11:27				26	95	19	27	167
DATE TOTAL	23:27				33	128	19	47	227
GRAND TOTAL	508				1204	14660	63019	773	79656

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=28SEP91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:03:00	1:00	PARTLY CLOUDY	FULL	15.0	1	49	57	2	109
19:16:00	1:04	PARTLY CLOUDY	FULL	15.0	18	29	.	2	49
20:30:00	1:10	PARTLY CLOUDY	FULL	15.0	10	14	.	2	26
STAT. TOTAL	3:14				29	92	57	6	184

DATE=28SEP91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:03:00	1:00	PARTLY CLOUDY	FULL	15.0	.	2	.	.	2
19:16:00	1:04	PARTLY CLOUDY	FULL	15.0	1	7	.	4	12
20:30:00	1:10	PARTLY CLOUDY	FULL	15.0	.	1	.	2	3
STAT. TOTAL	3:14				1	10	0	6	17
DATE TOTAL	19:42				126	246	153	27	552

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=01OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:38:00	1:06	PARTLY CLOUDY	LAST QUARTER	14.0	6	15	.	.	21
18:53:00	1:16	OVERCAST	LAST QUARTER	14.0	12	39	104	4	159
20:21:00	0:56	OVERCAST	LAST QUARTER	14.0	13	38	119	3	173
STAT. TOTAL	3:18				31	92	223	7	353

DATE=01OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:38:00	1:06	PARTLY CLOUDY	LAST QUARTER	14.0	.	.	.	.	.
18:53:00	1:16	OVERCAST	LAST QUARTER	14.0	4	28	.	4	36
20:21:00	0:56	OVERCAST	LAST QUARTER	14.0	5	23	.	.	28
STAT. TOTAL	3:18				9	51	0	4	64

DATE=01OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	1:02	PARTLY CLOUDY	LAST QUARTER	14.0	2	1	.	.	3
18:40:00	1:12	PARTLY CLOUDY	LAST QUARTER	14.0	30	28	.	.	58
20:04:00	1:00	OVERCAST	LAST QUARTER	14.0	16	14	.	.	30
STAT. TOTAL	3:14				48	43	0	0	91

DATE=01OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	1:02	PARTLY CLOUDY	LAST QUARTER	14.0	.	1	.	.	1
18:40:00	1:12	PARTLY CLOUDY	LAST QUARTER	14.0	7	14	.	.	21
20:04:00	1:00	OVERCAST	LAST QUARTER	14.0	5	3	.	1	9
STAT. TOTAL	3:14				12	18	0	1	31

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=01OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:17:00	0:57	PARTLY CLOUDY	LAST QUARTER	14.0	19	31	29	.	79
18:27:00	1:03	OVERCAST	LAST QUARTER	14.0	21	29	50	.	100
19:47:00	1:05	OVERCAST	LAST QUARTER	14.0	5	5	.	.	10
STAT. TOTAL	3:05				45	65	79	0	189

DATE=01OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:17:00	0:57	PARTLY CLOUDY	LAST QUARTER	14.0	2	5	.	.	7
18:27:00	1:03	OVERCAST	LAST QUARTER	14.0	9	6	.	4	19
19:47:00	1:05	OVERCAST	LAST QUARTER	14.0	3	2	.	4	9
STAT. TOTAL	3:05				14	13	0	8	35
DATE TOTAL	19:14				159	282	302	20	763

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=020CT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:18:00	1:04	CLEAR	LAST QUARTER	15.0	.	1	.	.	1
18:40:00	1:05	CLEAR	LAST QUARTER	15.0	7	34	.	1	42
19:57:00	1:05	CLEAR	LAST QUARTER	15.0	4	45	40	6	95
STAT. TOTAL	3:14				11	80	40	7	138

DATE=020CT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:18:00	1:04	CLEAR	LAST QUARTER	15.0	.	.	.	.	.
18:40:00	1:05	CLEAR	LAST QUARTER	15.0	2	25	.	2	29
19:57:00	1:05	CLEAR	LAST QUARTER	15.0	.	27	.	2	29
STAT. TOTAL	3:14				2	52	0	4	58

DATE=020CT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:17	CLEAR	LAST QUARTER	15.0	.	.	.	.	.
18:54:00	1:12	CLEAR	LAST QUARTER	15.0	8	22	.	.	30
20:18:00	1:03	CLEAR	LAST QUARTER	15.0	2	4	.	1	7
STAT. TOTAL	3:32				10	26	0	1	37

DATE=020CT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:27:00	1:17	CLEAR	LAST QUARTER	15.0	.	.	.	.	.
18:54:00	1:12	CLEAR	LAST QUARTER	15.0	2	21	.	1	24
20:18:00	1:03	CLEAR	LAST QUARTER	15.0	.	5	.	.	5
STAT. TOTAL	3:32				2	26	0	1	29

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=020CT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:45:00	1:16	CLEAR	LAST QUARTER	15.0	10	30	.	2	42
19:09:00	1:11	CLEAR	LAST QUARTER	15.0	11	39	158	3	211
20:45:00	0:47	CLEAR	LAST QUARTER	15.0	2	49	79	1	131
STAT. TOTAL	3:14				23	118	237	6	384

DATE=020CT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:45:00	1:16	CLEAR	LAST QUARTER	15.0	.	5	.	1	6
19:09:00	1:11	CLEAR	LAST QUARTER	15.0	6	15	.	3	24
20:45:00	0:47	CLEAR	LAST QUARTER	15.0	2	19	.	1	22
STAT. TOTAL	3:14				8	39	0	5	52

DATE=020CT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:32:00	1:00	CLEAR	LAST QUARTER	15.0	30	20	398	5	453
18:32:00	1:46	CLEAR	LAST QUARTER	15.0	3	47	563	9	622
20:18:00	1:03	CLEAR	LAST QUARTER	15.0	8	42	2059	2	2111
STAT. TOTAL	3:49				41	109	3020	16	3186
DATE TOTAL	23:49				97	450	3297	40	3884

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=030CT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:13:00	1:03	CLEAR	LAST QUARTER	15.5	.	3	.	.	3
18:29:00	1:02	CLEAR	LAST QUARTER	15.5	1	9	.	1	11
19:45:00	1:00	CLEAR	LAST QUARTER	15.5	.	35	.	.	35
STAT. TOTAL	3:05				1	47	0	1	49

DATE=030CT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:13:00	1:03	CLEAR	LAST QUARTER	15.5	.	.	.	.	.
18:29:00	1:02	CLEAR	LAST QUARTER	15.5	.	11	.	1	12
19:45:00	1:00	CLEAR	LAST QUARTER	15.5	.	9	.	1	10
STAT. TOTAL	3:05				0	20	0	2	22

DATE=030CT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:23:00	1:10	CLEAR	LAST QUARTER	15.5	2	.	.	.	2
18:43:00	1:05	CLEAR	LAST QUARTER	15.5	4	4	.	2	10
20:02:00	0:57	CLEAR	LAST QUARTER	15.5	.	1	.	.	1
STAT. TOTAL	3:12				6	5	0	2	13

DATE=030CT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:23:00	1:10	CLEAR	LAST QUARTER	15.5	.	.	.	.	.
18:43:00	1:05	CLEAR	LAST QUARTER	15.5	.	2	.	.	2
20:02:00	0:57	CLEAR	LAST QUARTER	15.5	.	.	.	.	.
STAT. TOTAL	3:12				0	2	0	0	2

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=03OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	1:00	CLEAR	LAST QUARTER	15.5	5	45	14	.	64
19:06:00	0:58	CLEAR	LAST QUARTER	15.5	6	41	.	3	50
20:23:00	0:51	CLEAR	LAST QUARTER	15.5	2	22	.	1	25
STAT. TOTAL	2:49				13	108	14	4	139

DATE=03OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:48:00	1:00	CLEAR	LAST QUARTER	15.5	.	2	.	.	2
19:06:00	0:58	CLEAR	LAST QUARTER	15.5	1	2	.	1	4
20:23:00	0:51	CLEAR	LAST QUARTER	15.5	.	2	.	2	4
STAT. TOTAL	2:49				1	6	0	3	10

DATE=03OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:00:00	0:23		LAST QUARTER	15.5	.	.	11940	.	11940
17:23:00	1:09	CLEAR	LAST QUARTER	15.5	35	15	16600	8	16658
18:32:00	0:11	CLEAR	LAST QUARTER	15.5	.	.	2000	.	2000
18:43:00	1:05		LAST QUARTER	.	4	45	2547	8	2604
19:48:00	0:14		LAST QUARTER	.	.	.	225	1	226
20:02:00	0:56		LAST QUARTER	15.5	5	47	1234	8	1294
STAT. TOTAL	3:58				44	107	34546	25	34722
DATE TOTAL	22:10				65	295	34560	37	34957

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=040CT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:14:00	1:06	CLEAR	LAST QUARTER	15.5	.	.	.	1	1
18:36:00	1:00	CLEAR	LAST QUARTER	15.5	.	9	.	1	10
19:48:00	1:22	CLEAR	LAST QUARTER	15.5	5	47	8	1	61
STAT. TOTAL	3:28				5	56	8	3	72

DATE=040CT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:14:00	1:06	CLEAR	LAST QUARTER	15.5	1	.	.	.	1
18:36:00	1:00	CLEAR	LAST QUARTER	15.5	.	1	.	.	1
19:48:00	1:22	CLEAR	LAST QUARTER	15.5	2	11	.	1	14
STAT. TOTAL	3:28				3	12	0	1	16

DATE=040CT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:31:00	1:07	CLEAR	LAST QUARTER	15.5	1	.	.	.	1
18:50:00	1:01	CLEAR	LAST QUARTER	15.5	2	7	.	.	9
20:04:00	1:31	CLEAR	LAST QUARTER	15.5	1	4	.	.	5
STAT. TOTAL	3:39				4	11	0	0	15

DATE=040CT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:31:00	1:07	CLEAR	LAST QUARTER	15.5	.	.	.	.	.
18:50:00	1:01	CLEAR	LAST QUARTER	15.5	.	4	.	1	5
20:04:00	1:31	CLEAR	LAST QUARTER	15.5	.	2	.	.	2
STAT. TOTAL	3:39				0	6	0	1	7

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=04OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:57:00	0:54	CLEAR	LAST QUARTER	15.5	4	25	.	.	29
19:07:00	0:59	CLEAR	LAST QUARTER	15.5	2	47	26	.	75
20:23:00	1:56	CLEAR	LAST QUARTER	15.5	8	42	101	1	152
STAT. TOTAL	3:49				14	114	127	1	256

DATE=04OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:57:00	0:54	CLEAR	LAST QUARTER	15.5	.	.	.	.	.
19:07:00	0:59	CLEAR	LAST QUARTER	15.5	.	8	.	.	8
20:23:00	1:56	CLEAR	LAST QUARTER	15.5	1	9	.	1	11
STAT. TOTAL	3:49				1	17	0	1	19

DATE=04OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:14:00	0:17		LAST QUARTER	.	.	.	50	1	51
17:31:00	1:07		LAST QUARTER	.	9	42	1100	4	1155
18:38:00	0:12		LAST QUARTER	.	.	.	232	2	234
18:50:00	1:01		LAST QUARTER	.	2	48	507	7	564
19:51:00	0:13		LAST QUARTER	.	.	.	64	.	64
20:04:00	1:31		LAST QUARTER	.	1	51	1344	7	1403
STAT. TOTAL	4:21				12	141	3297	21	3471
DATE TOTAL	26:13				39	357	3432	28	3856

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=05OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:23:00	1:07	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
18:41:00	1:09	OVERCAST	LAST QUARTER	16.0	1	10	.	2	13
19:59:00	1:28	OVERCAST	LAST QUARTER	16.0	1	8	.	1	10
STAT. TOTAL	3:44				2	18	0	3	23

DATE=05OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:23:00	1:07	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
18:41:00	1:09	OVERCAST	LAST QUARTER	16.0	.	2	.	1	3
19:59:00	1:28	OVERCAST	LAST QUARTER	16.0	.	3	.	3	6
STAT. TOTAL	3:44				0	5	0	4	9

DATE=05OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:11:00	1:08	OVERCAST	LAST QUARTER	16.0	.	1	.	.	1
18:28:00	1:08	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
19:45:00	1:27	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
STAT. TOTAL	3:43				0	1	0	0	1

DATE=05OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:11:00	1:08	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
18:28:00	1:08	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
19:45:00	1:27	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
STAT. TOTAL	3:43				0	0	0	0	0

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=05OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:02:00	1:03	OVERCAST	LAST QUARTER	16.0	.	4	.	.	4
18:17:00	1:04	OVERCAST	LAST QUARTER	16.0	1	33	.	.	34
19:34:00	1:22	OVERCAST	LAST QUARTER	16.0	.	35	.	.	35
STAT. TOTAL	3:29				1	72	0	0	73

DATE=05OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:02:00	1:03	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
18:17:00	1:04	OVERCAST	LAST QUARTER	16.0	1	2	.	.	3
19:34:00	1:22	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
STAT. TOTAL	3:29				1	2	0	0	3

DATE=05OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:07:00	0:05	OVERCAST	LAST QUARTER	16.0	.	.	10	3	13
17:12:00	1:07	OVERCAST	LAST QUARTER	16.0	8	42	1027	2	1079
18:19:00	0:09	OVERCAST	LAST QUARTER	16.0	.	.	215	.	215
18:28:00	1:08	OVERCAST	LAST QUARTER	16.0	5	44	1078	4	1131
19:36:00	0:09		LAST QUARTER	.	.	.	95	.	95
19:45:00	1:27		LAST QUARTER	.	.	55	812	1	868
21:12:00	1:04	OVERCAST	LAST QUARTER	16.0	3	45	3006	5	3059
22:16:00	1:08	OVERCAST	LAST QUARTER	16.0	4	46	1276	1	1327
23:24:00	1:00	OVERCAST	LAST QUARTER	16.0	1	51	478	.	530
STAT. TOTAL	7:17				21	283	7997	16	8317
DATE TOTAL	29:09				25	381	7997	23	8426

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=060CT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIOS **	OTHER SPECIES	TOTAL
17:26:00	1:07	OVERCAST	LAST QUARTER	16.0	1	.	.	1	2
18:44:00	1:03	OVERCAST	LAST QUARTER	16.0	19	46	.	2	67
20:00:00	1:10	OVERCAST	LAST QUARTER	16.0	.	47	38	8	93
STAT. TOTAL	3:20				20	93	38	11	162

DATE=060CT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:26:00	1:07	OVERCAST	LAST QUARTER	16.0	.	.	.	.	.
18:44:00	1:03	OVERCAST	LAST QUARTER	16.0	.	10	12	7	29
20:00:00	1:10	OVERCAST	LAST QUARTER	16.0	3	29	.	2	34
STAT. TOTAL	3:20				3	39	12	9	63

DATE=060CT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:52:00	0:55	OVERCAST	LAST QUARTER	16.0	1	8	.	1	10
18:58:00	1:16	OVERCAST	LAST QUARTER	16.0	4	6	.	.	10
20:27:00	1:03	OVERCAST	LAST QUARTER	16.0	2	5	.	.	7
STAT. TOTAL	3:14				7	19	0	1	27

DATE=060CT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:52:00	0:55	OVERCAST	LAST QUARTER	16.0	.	1	.	2	3
18:58:00	1:16	OVERCAST	LAST QUARTER	16.0	4	9	.	2	15
20:27:00	1:03	OVERCAST	LAST QUARTER	16.0	.	4	.	.	4
STAT. TOTAL	3:14				4	14	0	4	22

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A .

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=06OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:04:00	0:56	OVERCAST	LAST QUARTER	16.0	4	47	10	.	61
19:05:00	1:14	OVERCAST	LAST QUARTER	16.0	2	48	.	1	51
20:46:00	0:57	OVERCAST	LAST QUARTER	16.0	3	47	57	.	107
STAT. TOTAL	3:07				9	142	67	1	219

DATE=06OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:04:00	0:56	OVERCAST	LAST QUARTER	16.0	.	2	.	1	3
19:05:00	1:14	OVERCAST	LAST QUARTER	16.0	2	3	.	1	6
20:46:00	0:57	OVERCAST	LAST QUARTER	16.0	.	7	.	.	7
STAT. TOTAL	3:07				2	12	0	2	16

DATE=06OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
0:24:00	1:04	OVERCAST	LAST QUARTER	16.0	1	43	3299	.	3343
3:14:00	1:01	OVERCAST	LAST QUARTER	16.0	.	1	.	.	1
4:15:00	1:00	OVERCAST	LAST QUARTER	16.0	.	1	.	.	1
5:15:00	1:00	OVERCAST	LAST QUARTER	16.0	.	.	.	1	1
6:15:00	1:00	OVERCAST	LAST QUARTER	16.0	.	.	2	.	2
7:15:00	0:45	OVERCAST	LAST QUARTER	16.0	.	.	1	.	1
17:40:00	0:12	OVERCAST	LAST QUARTER	16.0	.	.	33	5	38
17:52:00	0:55	OVERCAST	LAST QUARTER	16.0	.	46	959	2	1007
18:47:00	0:11	HEAVY RAIN	LAST QUARTER	16.0	.	.	27	1	28
18:58:00	1:16	HEAVY RAIN	LAST QUARTER	16.0	9	41	520	3	573
20:14:00	0:13		LAST QUARTER	.	.	.	152	2	154
20:27:00	1:03		LAST QUARTER	.	7	43	895	15	960
21:30:00	0:06		LAST QUARTER	.	.	38	.	2	40
STAT. TOTAL	9:46				17	213	5888	31	6149
DATE TOTAL	29:08				62	532	6005	59	6658

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=07OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
20:20:00	0:26		NEW	15.0	6	36	.	1	43
STAT. TOTAL	0:26				6	36	0	1	43

DATE=07OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
20:20:00	0:26		NEW	15.0	.	7	.	2	9
STAT. TOTAL	0:26				0	7	0	2	9

DATE=07OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
20:10:00	1:05	PARTLY CLOUDY	NEW	15.0	.	4	.	.	4
STAT. TOTAL	1:05				0	4	0	0	4

DATE=07OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
20:10:00	1:05	PARTLY CLOUDY	NEW	15.0	.	2	.	.	2
STAT. TOTAL	1:05				0	2	0	0	2

DATE=07OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:25:00	0:35	PARTLY CLOUDY	NEW	15.0	.	9310	2638	2	11950
STAT. TOTAL	0:35				0	9310	2638	2	11950
DATE TOTAL	3:37				6	9359	2638	5	12008

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=08OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:40:00	0:31	CLEAR	NEW	14.0	6	44	10	.	60
19:12:00	0:23	CLEAR	NEW	14.0	3	49	54	4	110
20:42:00	0:47	CLEAR	NEW	14.0	1	17	1	8	27
STAT. TOTAL	1:41				10	110	65	12	197

DATE=08OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:40:00	0:31	CLEAR	NEW	14.0	.	2	.	.	2
19:12:00	0:23	CLEAR	NEW	14.0	.	17	.	2	19
20:42:00	0:47	CLEAR	NEW	14.0	1	14	.	2	17
STAT. TOTAL	1:41				1	33	0	4	38

DATE=08OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
19:00:00	0:22	CLEAR	NEW	14.0	2	52	.	1	55
20:32:00	0:45	CLEAR	NEW	14.0	.	16	.	.	16
STAT. TOTAL	1:07				2	68	0	1	71

DATE=08OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
19:00:00	0:22	CLEAR	NEW	14.0	2	7	.	2	11
20:32:00	0:45	CLEAR	NEW	14.0	.	18	.	1	19
STAT. TOTAL	1:07				2	25	0	3	30

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=08OCT91 STATION=I5

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	0:22	CLEAR	NEW	14.0	.	1	.	.	1
STAT. TOTAL	0:22				0	1	0	0	1

DATE=08OCT91 STATION=I6

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:28:00	0:22	CLEAR	NEW	14.0	.	1	.	.	1
STAT. TOTAL	0:22				0	1	0	0	1

DATE=08OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:33:00	0:31	CLEAR	NEW	14.0	4	52	295	.	351
19:04:00	0:26	CLEAR	NEW	14.0	14	35	12	2	63
20:37:00	0:47	CLEAR	NEW	14.0	10	24	.	10	44
STAT. TOTAL	1:44				28	111	307	12	458
DATE TOTAL	8:04				43	349	372	32	796

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=09OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:47:00	0:20		NEW	14.0	.	26	.	.	26
18:40:00	0:23		NEW	14.0	2	23	.	.	25
19:42:00	0:20		NEW	14.0	2	13	.	.	15
20:41:00	0:20		NEW	.	.	8	.	.	8
STAT. TOTAL	1:23				4	70	0	0	74

DATE=09OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:47:00	0:20		NEW	14.0	.	.	.	1	1
18:40:00	0:23		NEW	14.0	1	7	.	1	9
19:42:00	0:20		NEW	14.0	1	2	.	2	5
20:41:00	0:20		NEW	.	1	1	.	4	6
STAT. TOTAL	1:23				3	10	0	8	21

DATE=09OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:34:00	0:20		NEW	14.0	.	9	.	.	9
18:34:00	0:25		NEW	14.0	.	2	.	.	2
19:34:00	0:20		NEW	14.0	.	10	.	.	10
20:34:00	0:20		NEW	14.0	.	3	.	.	3
STAT. TOTAL	1:25				0	24	0	0	24

DATE=09OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:34:00	0:20		NEW	14.0	.	.	.	.	.
18:34:00	0:25		NEW	14.0	.	2	.	.	2
19:34:00	0:20		NEW	14.0	.	2	.	.	2
20:34:00	0:20		NEW	14.0	.	1	.	.	1
STAT. TOTAL	1:25				0	5	0	0	5

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=09OCT91 STATION=Z1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
17:39:00	0:20	PARTLY CLOUDY	NEW	14.0	1	.	.	1	2
17:59:00	0:40	PARTLY CLOUDY	NEW	14.0	.	.	.	.	.
18:39:00	0:24	PARTLY CLOUDY	NEW	14.0	3	8	.	2	13
19:03:00	0:39	PARTLY CLOUDY	NEW	14.0	.	.	40	.	40
19:42:00	0:20	PARTLY CLOUDY	NEW	14.0	7	14	.	8	29
20:02:00	0:39	PARTLY CLOUDY	NEW	14.0	.	.	23	.	23
20:41:00	0:20	PARTLY CLOUDY	NEW	14.0	4	5	.	2	11
21:01:00	0:15	PARTLY CLOUDY	NEW	14.0	.	.	10	.	10
STAT. TOTAL	3:37				15	27	73	13	128
DATE TOTAL	9:13				22	136	73	21	252

* Individuals identified to species.
** Alosids not identified to species.

APPENDIX A

Summary of the daily catches during sampling for the juvenile clupeid downstream passage study at Turner's Falls, 1991.

* Marked fish not included.

DATE=10OCT91 STATION=I1

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:33:00	0:22	CLEAR	NEW	13.5	.	3	.	.	3
19:36:00	0:20	CLEAR	NEW	13.5	2	19	.	2	23
20:37:00	0:22	CLEAR	NEW	13.5	.	3	.	1	4
STAT. TOTAL	1:04				2	25	0	3	30

DATE=10OCT91 STATION=I2

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:33:00	0:22	CLEAR	NEW	13.5	.	2	.	.	2
19:36:00	0:20	CLEAR	NEW	13.5	.	.	.	.	.
20:37:00	0:22	CLEAR	NEW	13.5	.	1	.	1	2
STAT. TOTAL	1:04				0	3	0	1	4

DATE=10OCT91 STATION=I3

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:28:00	0:20	CLEAR	NEW	13.5	.	7	.	.	7
19:30:00	0:20	CLEAR	NEW	13.5	.	1	.	.	1
20:33:00	0:20	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
STAT. TOTAL	1:00				0	8	0	0	8

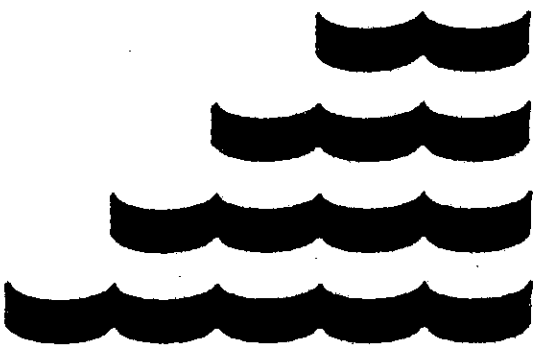
DATE=10OCT91 STATION=I4

START TIME	SAMPLING DURATION	WEATHER	MOON PHASE	WATER TEMP C	BLUEBACK * HERRING	AMERICAN * SHAD	CLUPEIDS **	OTHER SPECIES	TOTAL
18:28:00	0:20	CLEAR	NEW	13.5	.	1	.	3	4
19:30:00	0:20	CLEAR	NEW	13.5	.	.	.	.	.
20:33:00	0:20	PARTLY CLOUDY	NEW	13.5	.	.	.	.	.
STAT. TOTAL	1:00				0	1	0	3	4

* Individuals identified to species.
** Alosids not identified to species.

Attachment 1

PLAN OF STUDY AND CORRESPONDENCE



Attachment 1

Contents

Plan of Study

Transmittal of Turners Falls Request for Comments on Report Entitled 1991 Study Plan: Turners Falls Juvenile Clupeids, Dated June 11, 1992.

Comments on Plan of Study by:
Massachusetts Division of Fisheries and Wildlife, John O'Leary, dated July 22,1991.

Transmittal of Response to Comment Letter, NUSCO dated October 8, 1991.

Transmittal of Request for Comments on Draft Report Entitled Turners Falls Downstream Passage of Juvenile Clupeids, Fall 1991, dated April 9, 1992.

Transmittal of 1991 Juvenile Clupeid Final report, dated August 4,1992.

DOWNSTREAM PASSAGE OF JUVENILE CLUPEIDS AT THE TURNERS FALLS PROJECT, FALL 1991

PLAN OF STUDY

INTRODUCTION

The Turners Falls Hydroelectric Project, located in Turners Falls, Massachusetts, consists of Turners Falls Pond and Dam, Turners Falls Canal, the Cabot Station Powerhouse, a branch canal and the Turners Falls No. 1 Station (Figure 1). The Turners Falls No. 1 Station operates only during system emergencies or when average daily river flows exceed 12,500 cfs. The maximum flows in the Turners Falls Canal utilized for hydroelectric generation are 12,500 cfs at Cabot Station and 2,500 cfs at Turners Falls No. 1 Station, totalling 15,000 cfs.

As part of the effort to develop measures to protect emigrating anadromous fishes (Atlantic salmon, American shad and blueback herring) in Turners Falls Canal, Ruggles (1990) evaluated the potential techniques to pass these fishes from the canal back to the river and recommended a surface discharge above the turbine intakes as a promising technique. During the summer, 1991 several openings will be cut in the wall of the Cabot Station ice and trash sluice to collect and convey fish back to the Connecticut River. Therefore, a fish diversion system will be in place for the 1991 emigration of juvenile clupeids.

American shad and blueback herring in the Connecticut River spawn from early May through mid-June depending on water temperatures. The juvenile clupeids remain in the Connecticut River throughout the summer and usually begin their downstream migration in September. Water temperature is the primary environmental factor determining the commencement of emigration (O'Leary 1984; O'Leary and Kynard 1986). Emigration begins when water temperatures decline to 19°C, usually by mid-September, and continues

into early November. Marcy (1976) noted that most juvenile clupeids had left the river prior to water temperatures reaching 6°C.

Daily movements of juvenile clupeids occur primarily in late afternoon and evening, peaking between 1700 hours and 2200 hours (O'Leary and Kynard 1986). Juvenile clupeids appear to emigrate in schools (O'Leary and Kynard 1986), utilizing the top two meters of the water column (Buckley and Kynard 1985).

OBJECTIVES

There are three objectives of the 1991 Turners Falls juvenile clupeid studies.

Primary Objectives

- Determine the proportion of emigrating juvenile clupeids bypassed around Cabot Station and the proportion passing through Cabot Station.

- Evaluate the effect of different gate configurations at the log sluice on the proportion of juvenile clupeids bypassed around Cabot Station.

Secondary Objective

- Estimate the number of juvenile clupeids bypassed around Cabot Station during the emigration period.

PLAN OF STUDY

Determine the Proportion of Juvenile Clupeids Bypassed Around Cabot Station

The proportion of emigrating juvenile clupeids bypassed around Cabot Station, through the openings in the ice and trash sluice and the log sluice, and through the Cabot Station intakes will be determined using the following equations:

$$P_C = C/(B + C)$$

$$P_B = B/(B + C)$$

where P_B and P_C are the proportions of fish bypassed around Cabot Station and passing through Cabot Station, respectively, and B is the estimated number of fish bypassed and C is the estimated number of fish passing through Cabot Station.

During sampling, a proportion of the fish entering the ice and trash sluice and log sluice will be conveyed to a collection facility where they will be counted and released into the river. The number of fish passing through the Cabot Station intakes will be determined by netting a subset of the six intakes. Each intake consists of three intake bays. The middle bay of two intakes will be sampled. The net will be attached to a frame and lowered through the gatewell slots. The dimensions of the frame and net will be such as to maximize the proportion of the intake bay sampled.

The number of fish passing down the log sluice (Figure 2), including those entering the log sluice from the ice and trash sluice, will be extrapolated based on the area sampled. The efficiency of the collection gear will be assumed to be 100%. The number of clupeids passing through the intakes being sampled will have to be estimated based on the number of fish sub-sampled in the net.

The estimated number of clupeids passing through a sampled intake will be based on net retention and the proportion of the intake sampled. Net retention will be determined by releasing marked juvenile clupeids behind the trashracks of the intake bay being sampled. Net retention will be calculated using the following equation:

$$NR = R/M$$

Where NR is net retention, R is the number of marked fish recaptured and M is the total number of marked fish released. (This procedure and equation are typically used to

determine net efficiency, but, in this case the fish will be released directly into the net and not dispersed throughout the intake being sampled.)

Marked juvenile clupeids will be released into the middle bay of the turbine intake using an injection system (Figure 3) to ensure that all fish enter the intake bay. The nets will be fished for a period of ten minutes prior to release and one hour subsequent to release. After this time period, the nets will be raised and the marked fish will be counted. Three groups of 300 fish each will be used to determine net retention. All releases of marked fish will occur during the peak migration period of 1700 hours to 2200 hours.

Because net efficiency cannot be directly determined, an assumption regarding net efficiency must be made. Net efficiency will be set at 100% because the nets are large and the velocities relatively high. Therefore, net avoidance should be minimal and net retention account for fish escaping after they enter the net.

The number of fish passing through a given intake bay will be estimated based on the following equation:

$$EN = (T/NR) / PS$$

Where EN is the estimated number of clupeids passing through the intake, T is the number of fish collected in the net, NR is net retention and PS is the proportion of the turbine intake sampled.

Because only two of the six turbine intakes will be sampled, the data from the two intakes will be extrapolated to the unsampled intakes. Thus, the total number of clupeids passing through Cabot Station will be estimated by applying the average of the estimated number of clupeids from the two sampled intakes to the four unsampled turbine intakes.

Sampling in the two passage routes (log sluice and ice and trash sluice combined and turbine intakes) will occur concurrently. The duration of the samples will be determined in the field, and will be based on the amount of debris accumulating in the nets and collection facilities. These data will be used to estimate the proportion of juvenile clupeids passing downstream through the two passage routes.

Collection, Holding and Marking of Juvenile Clupeids

The juvenile clupeids for the net efficiency tests will be collected from the Connecticut River upstream of the Holyoke Dam at suitable sites (such as the Oxbow and the Turners Falls Rod and Gun Club) by seine, from the Holyoke Canal bypass collection facility, or from the two sluice collection facilities at Cabot Station. The juvenile clupeids will be held in circular pools with the water maintained between 2 ppt (parts per thousand) and 4 ppt salinity, aerated, filtered and shaded. The fish will be transported to the holding facility from the collection site in 50-gallon tanks. The water in these tanks will be maintained between 8 ppt and 12 ppt salinity and will be aerated. During holding, fish will be fed ground trout chow or frozen brine shrimp ad libitum. All fish used in the net calibration studies will be held for at least 48 hours prior to being marked.

Fish to be marked will be corralled in the holding pool and scooped with water to a small tank (having a capacity of approximately 50 gallons), in which they will be stained with Bismark Brown Y for 15 minutes at a concentration of 1:18,000. The fish will then be water-scooped from the staining tank into a holding tank where they will be held for a minimum of 24 hours before being released. Any fish exhibiting signs of stress after this time will be eliminated from the study.

As part of quality control procedures, temperature, dissolved oxygen, ammonia and pH of each holding pool will be measured and recorded on a daily basis. If any of these parameters exceed the preset standards, the water in the pool will be changed. As an additional water quality precaution, the water in each pool will be changed weekly.

Evaluation of Log Sluice Spill Configuration

Spill through the log sluice can be altered using a series of baffles that will change the dimensions of the opening to the log sluice. The exact baffle configurations to be tested have not been selected at this time but will include a gate opening 2.5 feet, as in past years. Each of the log sluice spill configurations will be designed to pass the same amount of flow. Operating conditions at Cabot Station will remain as constant as possible for all baffle conditions tested.

Because the emigration of juvenile clupeids is not uniform, (O'Leary and Kynard 1986) evaluation of the various baffle configurations must be made by comparing the number of juvenile clupeids passing through the log sluice compared with the number of juvenile clupeids passing through the intake. Each spill condition will be tested on three nights. Analysis of variance will be used to determine if the proportion of juvenile clupeids passing through the log sluice is significantly different among the various baffle configurations and the baffle configurations ranked from most efficient to least efficient.

Estimate of the Number of Juvenile Clupeids Bypassed

As part of the evaluation of the log sluice and the ice and trash sluice the total number of clupeids bypassed during the emigration period will be estimated. A total of five subsamples, one on each of five days, will be taken between 1700 hours and 0800 hours each week. The data from these subsamples will be used to estimate the number of juvenile clupeids passing Cabot Station during the emigration period. The exact duration of each subsample will be determined, in part, by the sampling program used to evaluate the effectiveness of the bypass route and also by the amount of debris accumulating in the collection facility. However, the sample periods will be as long as practical to eliminate the need to extrapolate the data into extensive unsampled periods.

STUDY SCHEDULE

The deployment procedures for the turbine nets will be developed in late July or early August so that a reliable netting system is in place before the emigration period. The collection facility will also be tested in the log sluice prior to the emigration period. The collection of the juvenile clupeids to be used in the net efficiency tests will begin early in September. The study period will begin in mid-September and continue through October.

LITERATURE CITED

Buckley, J. and B. Kynard. 1985. Part I. Vertical distribution of juvenile American shad and blueback herring during the seaward migration in the Connecticut River. Final Report to Northeast Utilities Service Company.

Marcy, J. R., Jr. 1976. Early life history studies of American shad in the lower Connecticut River and the effects of the Connecticut Yankee Plant. In: Merriman, D. and L. M. Thorpe (eds.) 1976. The Connecticut River Ecological Study: The impact of a nuclear power plant. American Fisheries Society Monograph No. 1. 141-168.

O'Leary, J. A. 1984. Characteristics of the downriver migration of juvenile American shad (Alosa sapidissima) and blueback herring (Alosa aestivalis) in the Connecticut. M.S. Thesis, University of Massachusetts, Amherst, Massachusetts.

O'Leary, J. A. and B. Kynard. 1986. Behavior, length and sex ratios of seaward migrating juvenile American shad and blueback herring in the Connecticut River. Trans. Am. Fish. Soc. 114:430-435.

Ruggles, C. P. 1990. A critical review of fish exclusion and diversion from hydroelectric turbine intakes, with special reference to the Turners Falls Project on the Connecticut River. Final Report to Northeast Utilities Service Company.

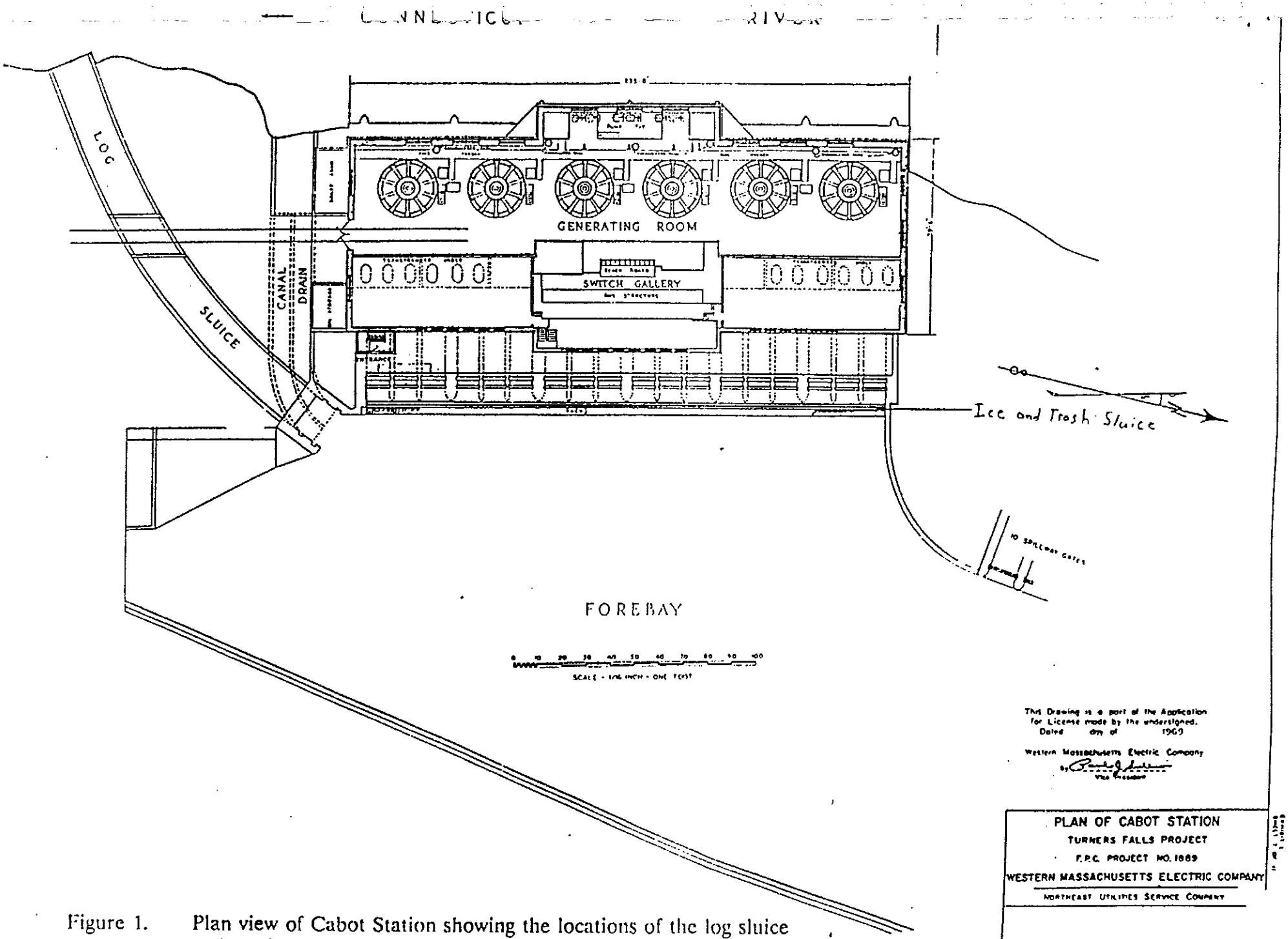
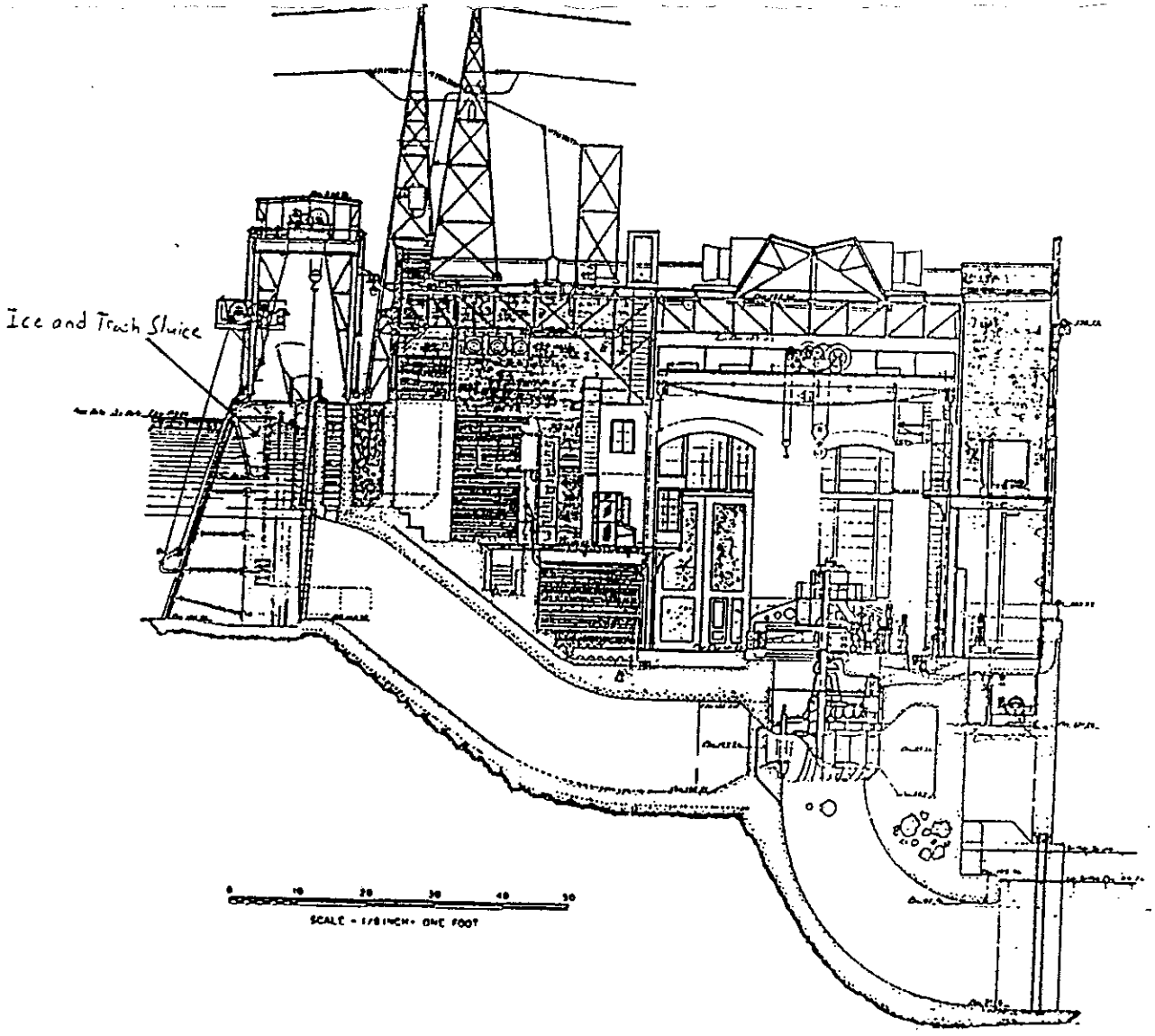


Figure 1. Plan view of Cabot Station showing the locations of the log sluice and the ice and trash sluice.



This Drawing is a part of the Application for License made by the undersigned Dated day of 1969

Western Massachusetts Electric Company

by

Vice President

CROSS SECTION OF CABOT STATION

TURNERS FALLS PROJECT

F.P.C. PROJECT NO. 1889

WESTERN MASSACHUSETTS ELECTRIC COMPANY

NORTHEAST UTILITIES SERVICE COMPANY

Figure 2. Cross section of Cabot Station showing the location and shape of the ice, and trash sluice.

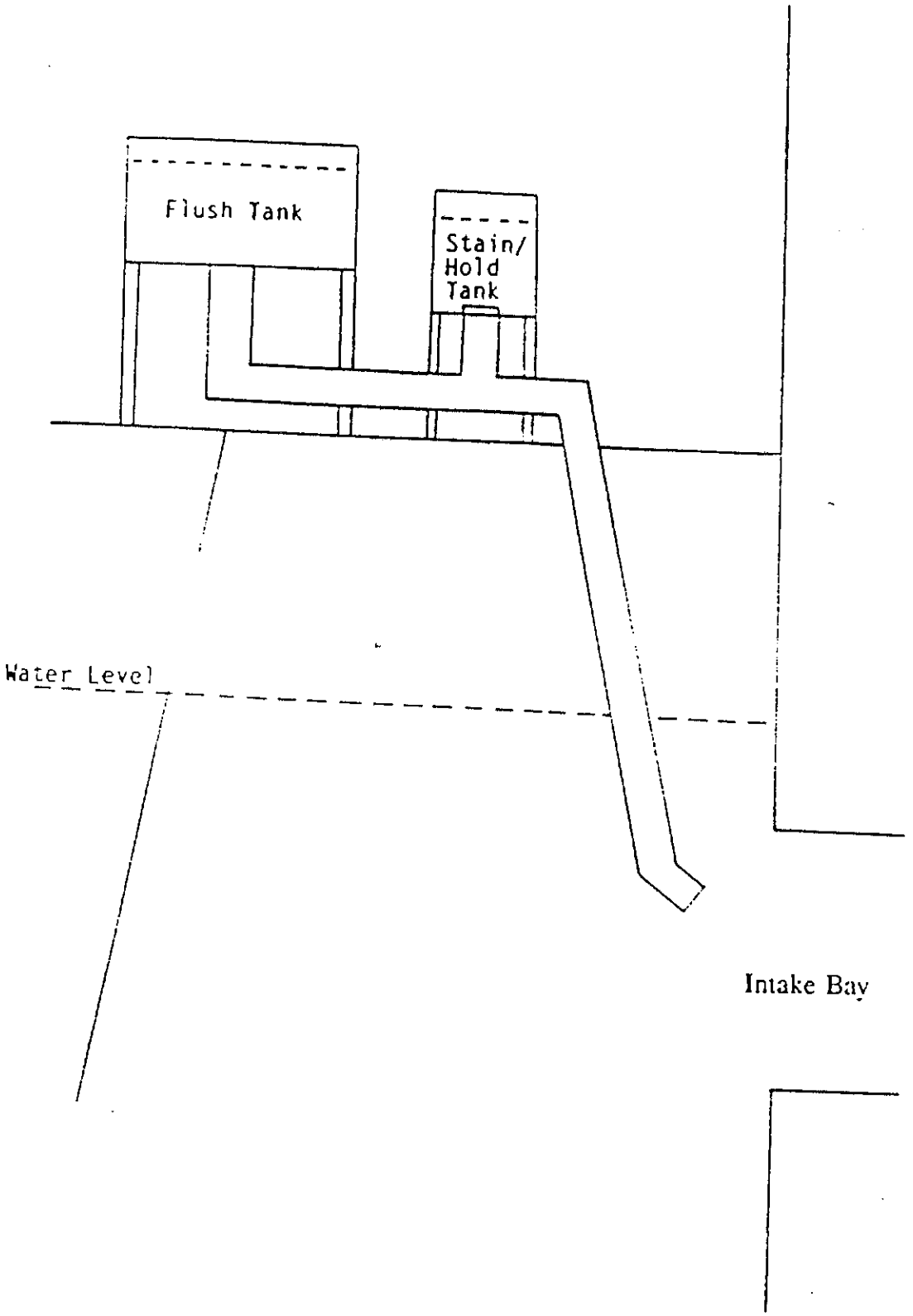


Figure 3. Conceptual sketch of the induction system for introducing juvenile clupeids into the Cabot Station turbine intakes.

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
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June 11, 1991

FERC Project No. 1889--Massachusetts
Turners Falls

D04636

Mr. David F. Egan, Chairman
Connecticut River Atlantic Salmon Commission
One Migratory Way
Turners Falls, MA 01376

Reference: Memorandum of Agreement dated July 26, 1990.

Dear Mr. Egan:

Turners Falls Project
Request for Comments
1991 Study Plan: Turners Falls Juvenile Clupeids

The enclosed study plan is submitted for your review in accordance with the Memorandum of Agreement, reference.

The objectives of the study are to evaluate downstream passage of juvenile clupeids through new openings in the Cabot Station intake racks and through several spill configurations at the Cabot Station log and ice sluice.

Written comments and/or concurrence on the study plan are requested within sixty days.

Should you have any questions, please call Mr. Richard W. Thomas, NUSCO Generation Facilities Licensing, at (203) 665-3719.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for Holyoke Water Power Company

R. A. Reckert
Vice President

Enclosure: 1991 Juvenile Clupeid Study Plan: Turners Falls Project

cc: Mr. Gordon E. Beckett, Supervisor
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Connecticut River Coordinator
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Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

July 22, 1991

RECEIVED
JUL 26 1991
R.A.R.

FERC Project NO. 1889
Turners Falls

Mr. R. A. Reckert/Vice President
Northeast Utilities Service Company
P.O. Box 270
Hartford, CT 06141-0270

Dear Mr. Reckert:

Thank you for giving me the opportunity to comment on the 1991 Study Plan: Turners Falls Juvenile Clupeids FERC Project NO. 1889, submitted in accordance with the Memorandum of Agreement.

As titled in the introduction, this is a Draft Plan of Study and as such does not contain enough detail to allow specific comments to be made at this time. However, I do agree in general with the objectives of the study and will be more than willing to comment on the final study plan when it becomes available.

My only general comment at this time is that the final study plan also address the possibility of juvenile clupeid turbine passage through the Number 1 Station. A review of the plant operation records for the period of juvenile clupeid passage would reveal whether or not this project would have any impact on the downstream passage of these fish.

If you have any questions concerning my comments on this topic please feel free to call me at my office at (508) 792-7270.

Yours Truly,

John O'Leary
Anadromous Fish Restoration
Project Coordinator

cc: Ted Meyers
Angelo Incerpi
Charles Thoits
Peter Minta
Ben Rizzo
John Warner

JO/cmh

Division of Fisheries & Wildlife
Field Headquarters, One Rabbit Hill Road, Westboro, MA 01581 (508) 366-4470
An Agency of the Department of Fisheries, Wildlife & Environmental Law Enforcement

NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
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October 8, 1991

FERC Project No. 1899-MA
Turners Falls

D04951

Mr. John O'Leary
Massachusetts Division of Fisheries
and Wildlife
Field Headquarters
One Rabbit Hill Road
Westboro, MA 01581

Reference: 1. Letter (D04636) R. A. Reckert to G. E. Beckett, et. al., dated June 11, 1991.

2. Letter (C04211) J. O'Leary to R. A. Reckert, dated July 22, 1991.

Dear Mr. O'Leary:

Turners Falls Project
1991 Turners Falls Juvenile Clupeid Study Plan
Response to Comment Letter

On June 11, 1991, Northeast Utilities Service Company (NUSCO) on behalf of Western Massachusetts Electric Company submitted the 1991 Turners Falls Juvenile Clupeid Study Plan for agency review, Reference 1. Your letter of comment on the plan is noted Reference 2 attached.

NUSCO acknowledges your general agreement with the objectives of the study plan. The lack of detail you noted in the study plan was due to the early uncertainty about the types of passage facilities to be evaluated this fall. As you are aware, openings have been constructed in the Cabot Station trash racks and trash sluice.

Your letter does note your related interest in Turners Falls No. 1 station monitoring. We do not plan to monitor this facility this year due to the likely infrequent use of this facility during the clupeid migration and results of the 1991 salmon smolt study which indicated salmon smolts do not tend to be attracted into the Turners Falls No. 1 station forebay.

Studies are presently in progress and we invite you to the site at your convenience.

Should you have any questions, please call Mr. Richard W. Thomas, NUSCO Generation & Environmental Licensing, at (203) 665-3719.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for Western Massachusetts
Electric Company

R. A. Reckert
Vice President

Attachment: Reference 2

cc: Mr. Peter Minta, Chairman
Technical Committee for Fisheries Management
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April 9, 1992

Project No. 1889--Massachusetts
Turners Falls
D05438

Mr. David F. Egan, Chairman
Connecticut River Atlantic Salmon Commission
c/o U.S. Fish and Wildlife Service
One Migratory Way
P.O. Box 71
Turners Falls, MA 01376

Reference: Letter, (D04636) R. A. Reckert to D. F. Egan, dated June 11, 1991.

Dear Mr. Egan:

Turners Falls Project
Request for Comments
1991 Juvenile Clupeid Study Draft Report

Enclosed is a draft report entitled: Turners Falls Downstream Passage of Juvenile Clupeids, Fall 1991. This report was prepared in conformance with the Memorandum of Agreement. A study plan was previously submitted for your review, reference.

We are encouraged by the results of this study which estimated that 58 percent of juvenile clupeids utilized the spill provided at the Cabot Station log sluice. In 1992, testing the effectiveness of spillage at the log sluice will continue and an evaluation of the newly constructed openings for downstream passage will be conducted.

Please review the enclosed report and submit your comments to us within 60 days. Should you have any questions or would like to arrange a meeting, please call Mr. Richard W. Thomas, NUSCO Generation & Environmental Licensing, at (203) 665-3719.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for Western Massachusetts
Electric Company

R. A. Reckert
Vice President

Enclosures: Draft Report, Downstream Passage of Juvenile Clupeids Fall 1991.

cc: See page 2

cc: Downstream Fish Passage Subcommittee

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NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
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August 4, 1992

Project No. 1889--MA
Turners Falls
D05742

Mr. Ronald Lambertson, Chairman
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c/o U.S. Fish and Wildlife Service
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References: 1. Letter, (D04636) R. A. Reckert to D. F. Egan, dated June 11, 1991.

2. Letter, (D05438) R. A. Reckert to D. F. Egan, dated April 9, 1992.

Dear Mr. Lambertson:

Turners Falls Project
1991 Juvenile Clupeid Final Report

Enclosed is the final report entitled: Turners Falls Downstream Passage of Juvenile Clupeids, Fall 1991. This report was prepared as part of studies toward complying with the Memorandum of Agreement (MOA). A study plan and draft report were previously submitted for your review, references. No comments on the draft report were received.

We are encouraged by the results of this study which estimated that 58-percent of juvenile clupeids utilized the spill provided at the Cabot Station log sluice in 1991. Testing the effectiveness of spillage at the log sluice along with an evaluation of the newly constructed trash trough openings for downstream passage will be conducted this fall. It is our hope the 1992 evaluation of the enhanced facilities will show that effective downstream fish passage facilities have been provided in conformance with the MOA.

Should you have any questions or would like to arrange a meeting, please call Mr. Richard W. Thomas, NUSCO Generation & Environmental Licensing, at (203) 665-3719.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for Western Massachusetts
Electric Company

R. A. Reckert
Vice President

Enclosure: Final Report, Downstream Passage of Juvenile Clupeids Fall 1991

cc: Mr. Wayne MacCallum
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