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FISHERIES DIVISION

TECHNICAL REPORT

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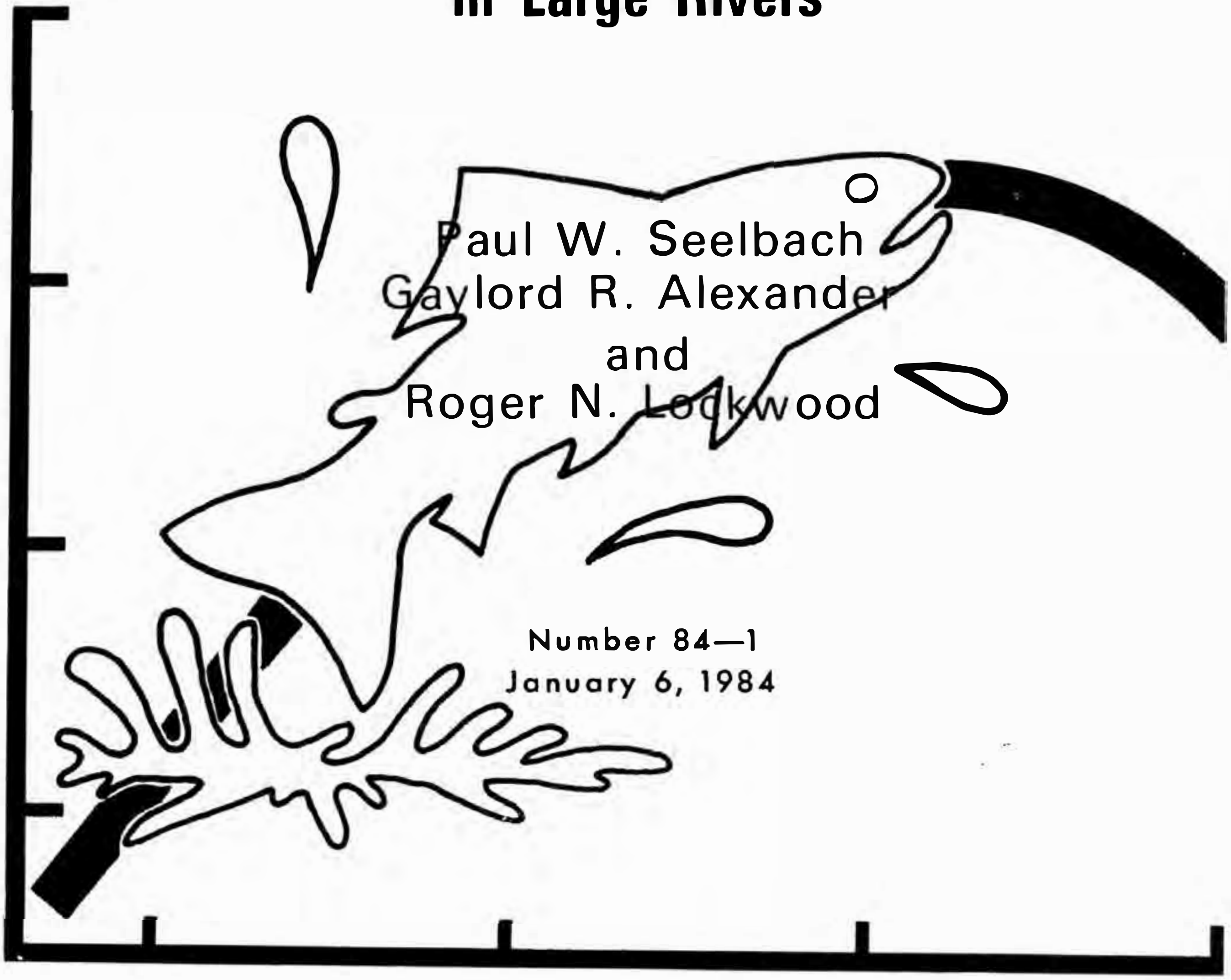

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AN INCLINED-SCREEN TRAP FOR SALMONIDS IN LARGE RIVERS

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ERRATA

Page 2, Abstract, last sentence, should read: It was estimated our trap caught 42% of the total downstream migration of steelhead, 31% chinook (*Oncorhynchus tshawytscha*), and 22% coho smolts (*O. kisutch*).

Abstract

A modification of the inclined-screen trap was designed to capture and facilitate processing of runs of salmonid smolts in large rivers. Modifications included a hanging inclined screen, a floating catch barge and a fish sorter. Two such traps, operating in a large river, caught and held up to 2,500 steelhead (*Salmo gairdneri*) smolts per night. It was estimated our trap caught 42% of the total downstream migration of steelhead, 31% chinook (*Oncorhynchus kisutch*), and 22% coho smolts (*O. tshawytscha*).

Introduction

Various traps have been designed to capture salmonid smolts. Most smolt trapping is done in small streams, where low flow rates and shallow water make installation, maintenance, and operation of the traps relatively easy. Trapping in larger, deeper rivers has been difficult. Methods such as fyke nets (Davis et al. 1980) and modified inclined-screen traps (Lister et al. 1969) have been used to sample rivers, but fyke nets quickly clog in debris-laden waters (Davis et al. 1980) and Lister's traps were not designed to cope with changes in river stage.

We designed a modified inclined-screen trap (Wolf 1951) which can be used in medium- to large-sized rivers, provided a low-head dam can be established. The trap can be installed in deep water, will hold large numbers of captured smolts, and is easy to operate. In addition, while trapping a sizable portion of the smolt run, the trapping method allows for safe passage of both upstream and downstream migrating adult salmonids.

Methods

Traps were installed at the Little Manistee River weir, an egg-taking facility operated by the Michigan Department of Natural Resources. The Little Manistee River is tributary to Lake Michigan of the Great Lakes system. The weir was not constructed with smolt trapping in mind. It has six 9-foot wide concrete bays, each intended to pass one-sixth of total stream flow. The Little Manistee River, at the weir site, has an average flow of about 190 cfs, with spring peak flows reaching 450 cfs. A discharge of 300 cfs was typical during the smolt run. Since our traps would not operate efficiently with flows greater than 15 cfs, only one-tenth (30 cfs) of the flow was passed through the two bays fitted with traps. Stop-logs in the other four bays were manipulated to maintain flows through the traps at about 15 cfs and the remainder of the river flow was passed through these four bays.

Migrating smolts were directed toward the traps using pipe weirs (1-inch gap), hanging chain-link fence and iron grates (Fig. 1). Smolts had three alternatives during downstream movement: 1. to pass over stop-logs (10-12 inches of water) and into the traps; 2. to pass through the pipe weir; or 3. to pass through or under the chain-link fence and over the top edge of the iron grates (1-6 inches of water). The pipe and chain-link fence guides were set at an angle to the current, causing the flow to be divided, with some going through and some deflected along the guide.

Downstream migrating adult salmonids were directed toward the traps and safely passed by means of fish sorters described below. Upstream migrating adults were passed during daylight hours through a door in the iron grates.

A trap consisted of a hanging inclined screen and a floating catch barge (Fig. 2).

Hanging inclined-screen

An inclined screen was hung from the dam (Fig. 2) at approximately a 5 degree angle. The screen was galvanized with a wire size of 0.047 inches, four openings per inch, and was bolted to a 1.5-inch angle aluminum frame. The upstream edge was hung on a stop-log and then two additional 6-inch stop-logs were set to hold the screen in place and to create a 12-inch waterfall. The downstream edge of the screen was supported by chains attached to the walkway above the dam.

Pipe legs (1 3/4 inch diameter) also helped support the downstream edge. Flexible sidescreens assured a snug fit of the inclined screen to the cement bay walls and helped funnel water and fish toward the barge. Stop-logs in adjacent bays without traps were adjusted so that 10 to 12 inches of water flowed over the stop-logs with traps.

Floating catch barge

The upstream edge of the catch barge floated just beneath the downstream edge of the inclined screen (Figs. 2 and 3). The barge was held in position by chains, one to each leg of the inclined screen (Fig. 4). Flexibility of the chains and sliding rings allowed the barge to move up or down as water levels changed or torque with turbulence variation. Floatation was maintained by adding high-density foam to the barge and by current pushing up against the front of the barge.

Fish sorters were built of parallel PVC pipes (1/2 inch diameter), spaced 2 inches apart and fitted above the mouth of each barge (Fig. 5). Pipes were set higher at the center of the barge and sloped toward the water on each side. Smolt-sized fish fell through the slots into the traps while larger fish, such as adult steelhead, slid off into the river. A stop-board set vertically behind the sorter pipes (Fig. 2) prevented fish from flopping off the pipes and becoming stranded atop the barge doors. This board could be eliminated if the doors were built with an incline to the outside of the barge.

Each barge was divided into two separate holding areas. If more fish were caught then could be processed readily, either one of the two holding areas could be opened and the number of released fish estimated. Each barge was equipped with two sets of doors--one set was located on top for netting of fish; the other set was located at the downstream end and could be opened for easy release of fish without netting.

The traps were operated from a workboat positioned at their downstream edge, as water was about 10 feet deep beneath the barges. Top doors were opened, fish were concentrated using a hand-held crowder and removed using a rectangular scap net.

Results

Traps were operated throughout April-June of 1982 and 1983 during the steelhead and salmon smolt migrations. Migrating smolts were observed drifting passively downstream. Upon encountering the pipe weir and chain-link fence at the weir, they appeared to be directed toward the bays containing the smolt traps.

Efficiency of the traps in catching smolts, which actually passed over the stop-logs onto the inclined screens, is believed to be 90%-100%. Some smolts slid off the sorter pipes and escaped similar to adult fish.

The weir design permitted trap operation in only two bays, thus a measure of the proportion of the smolt run captured was needed. To determine the efficiency of our capture scheme, we made the following tests. First, we returned migrating smolts caught in the traps upstream. The fish were marked by clipping a fin and released 100 yards above the traps. The recapture proportions were considered an estimate of the efficiency of our system to trap all migrating smolts. One test each was run for steelhead, coho salmon, and chinook salmon in 1982 and two additional tests for steelhead in 1983. The estimated percentages of smolts captured by the above techniques are given in Table 1. Estimated capture efficiencies were 42% for steelhead, 31% for chinook salmon, and 22% for coho salmon.

As the above technique used migrating smolts that had "trap experience", which might alter their behavior, we made comparative tests for trapping efficiency of steelhead in 1983. The first test was identical to that used in 1982.

The second test involved catching smolts by electrofishing immediately upstream of the weir, marking them by fin clipping, releasing them 100 yards upstream of the weir, and recording the percentage caught as they passed downstream through the trapping system. It was assumed that fish used in this test were migrants and that they would all move downstream through the trapping system following release.

Results of this second test were similar to the results from the first test for steelhead. Forty-one percent of the smolts were captured, compared to 43% for the first test. Apparently the experience of capture in traps had little effect on subsequent trapping rates.

Overall, our traps captured 42% of the migrating steelhead smolts in 1982 and 1983. As many as 2,500 steelhead smolts were held overnight in two traps.

Acknowledgments

The authors are indebted to the following persons for their assistance. Janice Fenske, Jack Rodgers, Floyd Simonis, Alan Sutton, and Otis Williams helped with the design and construction of the traps. Field installation was carried out by James Allen, William Erber, Ludwig Frankenberger, Elbert Hamilton, Steven Lazar, and David MacLean. Craig Clevidence and Carl McMorran also helped with installation and spent many months aiding field operations. Jack Rodgers and James Ryckman helped with trap evaluation. Photography was provided by Eric Lampinen. William C. Latta reviewed the manuscript.

A contribution from Dingell-Johnson Project F-35-R, Michigan.

Table 1. Efficiency of smolt traps with 95% confidence limits.

Year	Species	Method of initial capture	Fish marked and released	Fish captured	Trapping efficiency (%)
1982	Coho salmon	Trap	67	15	22.4 ± 0.1
1982	Chinook salmon	Trap	287	88	30.7 ± 0.1
1982	Steel-head	Trap	307	104	42.6 ± 0.1
1983	Steel-head	Trap	441	191	43.3 ± 0.1
1983	Steel-head	Electro-fishing	99	41	41.4 ± 0.1

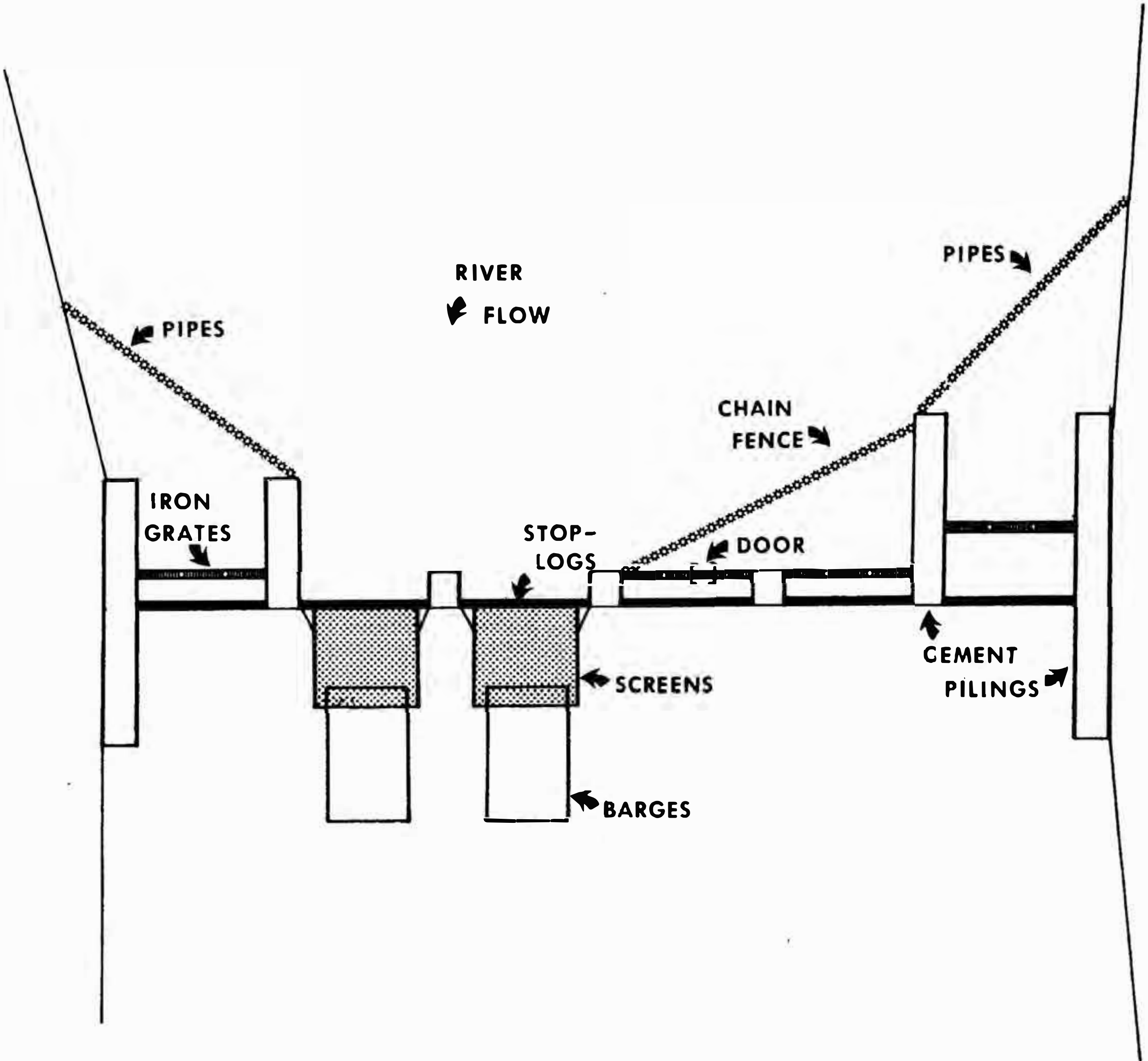

Figure 1. Top view of weir and traps.

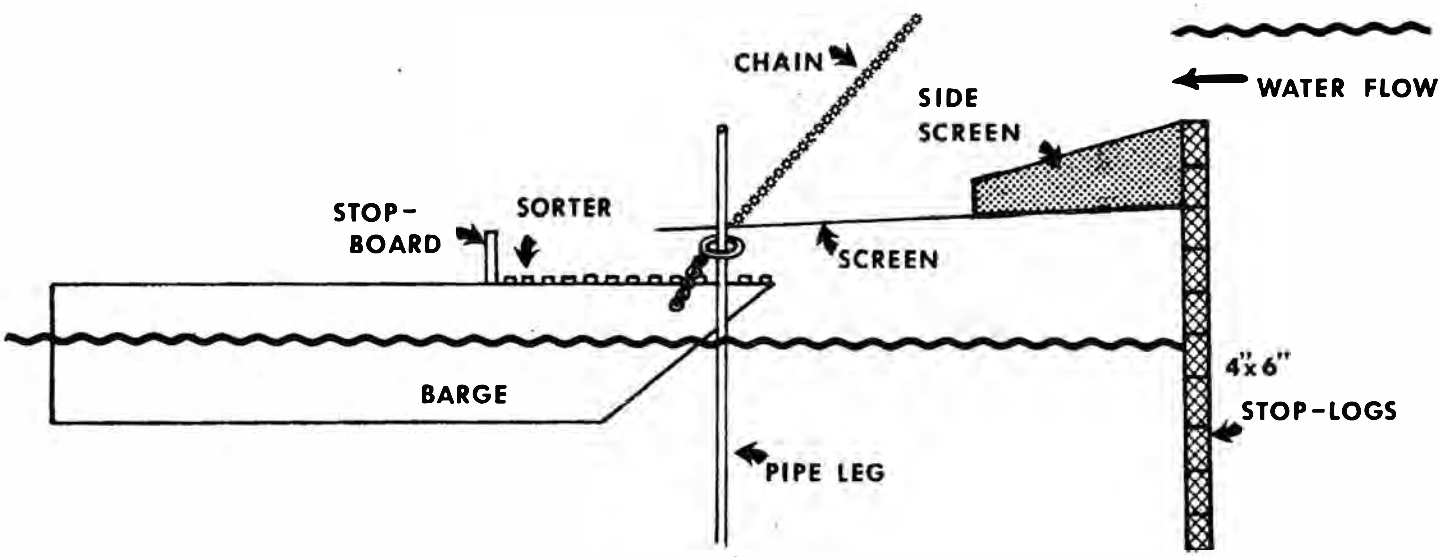

Figure 2. Side view of hanging screen and barge.

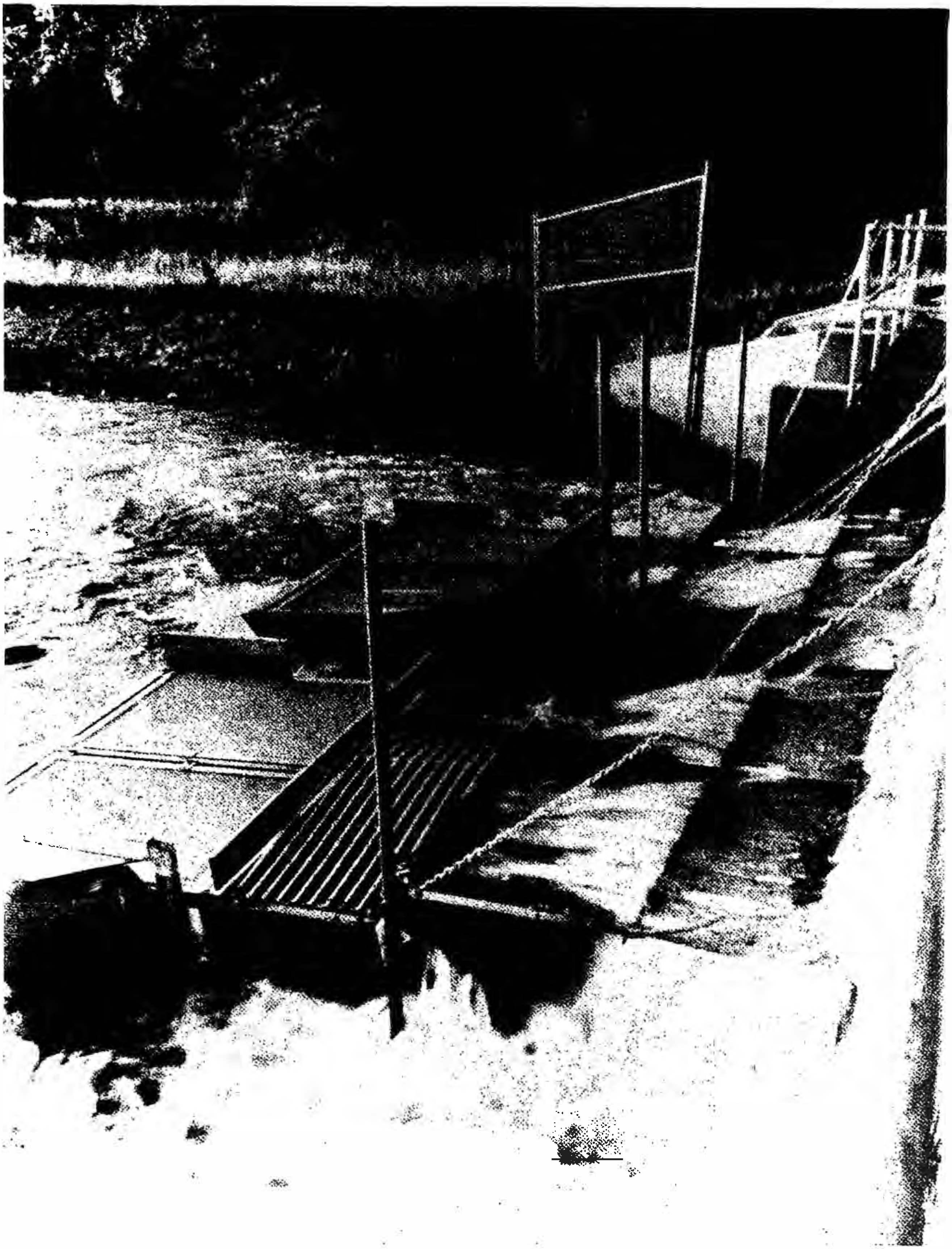

Figure 3. Hanging screens and barges in operation on the Little Manistee River.

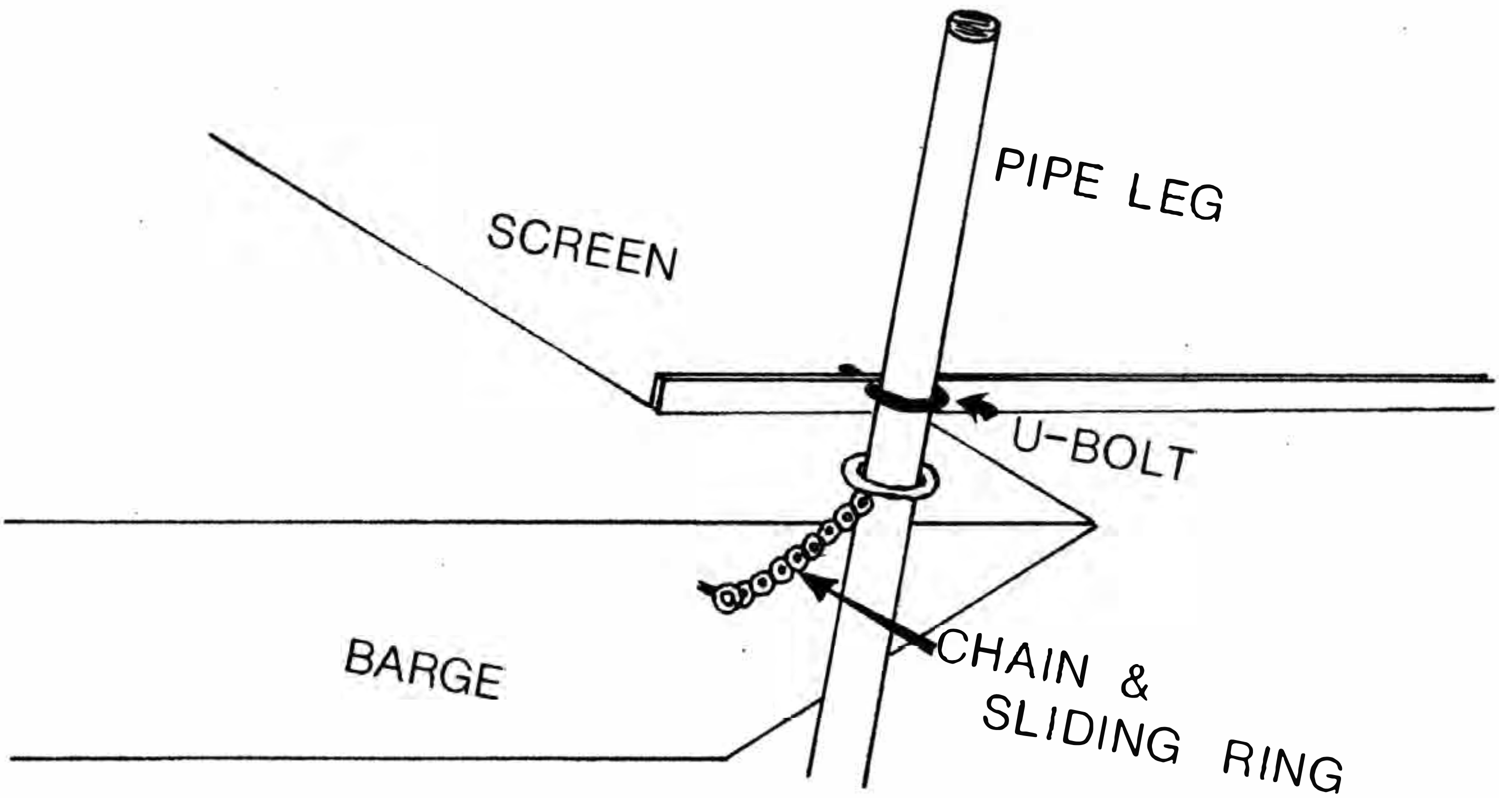

Figure 4. Attachment of barge to hanging screen.

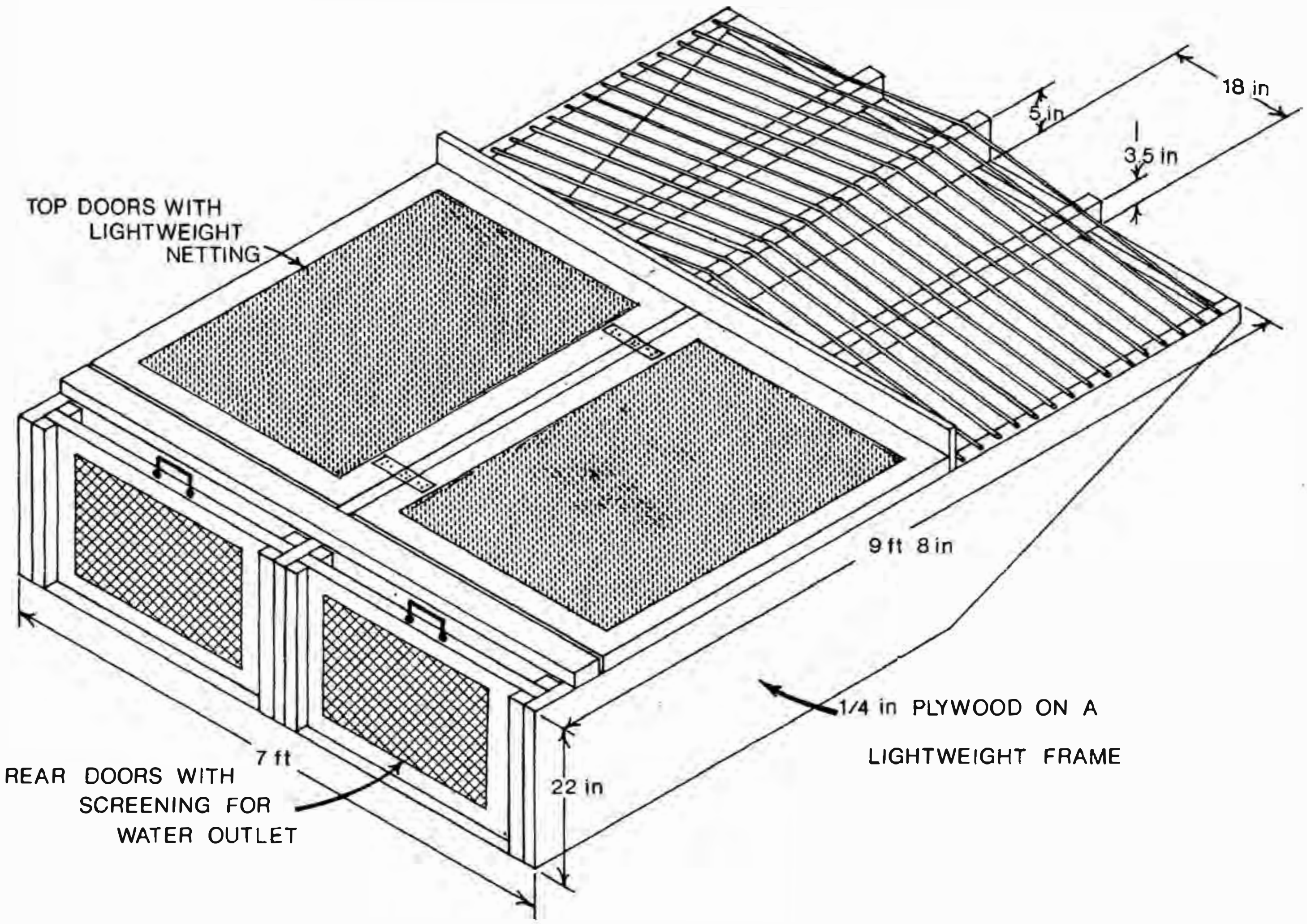

Figure 5. Floating catch barge.

References

David, Stephen K., James L. Congleton, and Richard W. Tyler. 1980. Modified fyke net for the capture and retention of salmon smolts in large rivers. Progressive Fish-Culturist 42(4):235-237.

Lister, D. Brent, Richard A. L. Harvey, and C. E. Walker. 1969. A modified Wolf trap for downstream migrant young fish enumeration. Progressive Fish-Culturist 40:57-60.

Wolf, Philip. 1951. A trap for the capture of fish and other organisms moving downstream. Transactions of the American Fisheries Society 80:41-45.