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# Collecting Gear for Lake Trout Eggs and Fry

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# COLLECTING GEAR FOR LAKE TROUT EGGS AND FRY [1]

By Thomas M. Stauffer

## Abstract

Gear were developed to sample eggs and fry of lake trout planted in the Great Lakes. Various types of gear were tested in Presque Isle Harbor in Lake Superior near Marquette and in Grand Traverse Bay, Lake Michigan during 1973-1979. Pails set in spawning substrate before lake trout spawned, and lifted after spawning, were used to estimate number of eggs deposited. Fry production was also estimated by leaving the pails until spring when traps installed on the top of the pails caught fry that hatched from eggs previously deposited in the pails. Centrifugal pumps, which sucked up water and organisms from the bottom, were effective in sampling eggs and sac fry on spawning areas. Pyramidal wire-mesh traps, set on lake trout spawning areas, were very effective in catching fry in May and June. Plastic minnow traps also caught fry on spawning areas. A 1.2-m beam trawl with "ticklers" was moderately effective for fry on rough-bottomed spawning areas and on smooth, hard bottom nearby during May-July. On moderately smooth bottom, a 5-m otter trawl was very effective for fry at night in June and July.

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[1] Contribution from Dingell-Johnson Project F-35-R, Michigan.

## Introduction

Millions of fin-clipped lake trout (Salvelinus namaycush) have been stocked in the Great Lakes since 1958 (Great Lakes Fisheries Commission 1976) to bolster the nearly extinct native lake trout. The principal objective of the stocking was to create self-perpetuating populations. Early efforts to find progeny of planted trout included: (1) bottom trawling for age-0 or for age-I to III trout, (2) netting with multi-sized mesh gill nets to catch age-III and older trout and (3) netting with 112-mm gill nets to catch mature trout on the spawning reefs. More efficient and quicker methods were needed to determine if lake trout were reproducing successfully. In particular, gear was needed to sample young lake trout on the rough bottom that characterized the spawning area.

The objective of this study was to develop, refine and test gear that would catch lake trout eggs and fry. Prior studies suggested gear to be tested. Mackey (1972) described the use of an air lift pump to sample benthos. Collins (1975) developed a fry trap that caught emerging lake whitefish (Coregonus clupeaformis). Minnow traps for young lake trout were used unsuccessfully by Royce (1951) but my 1978 study of lake trout behavior in the laboratory indicated that minnow traps also might be effective for fry. A small electrified beam trawl (McLain and Dahl 1968) caught larval lampreys and small bottom-dwelling fish. Eschmeyer (1956), Rupp and DeRoche (1960), and Hatch (1976) used otter trawls to catch juvenile lake trout.

## Methods and results

The principal area of testing was Presque Isle Harbor on the south shore of central Lake Superior (Table 1). Lake trout spawned successfully in 1975-1978 on rubble covering the intake and discharge pipes of the Upper Peninsula Power Company. The spawning areas and most other collecting sites are protected from severe wave action except that caused by easterly winds. The fish of the harbor were typically coldwater species such as cottids, salmonids, rainbow smelt (Osmerus mordax), burbot (Lota lota), and ninespine sticklebacks (Pungitius pungitius). Smaller amounts of testing were done in northern Lake Michigan on a rock-rubble intake crib of the Traverse City Municipal Power Plant, on a boulder and rock breakwall of Elmwood Marina at Traverse City, and on natural reefs. Lake trout spawning had occurred at all these locations.

Egg and fry trap pail

The use of steel pails to determine egg deposition and fry production was tested on areas where lake trout had spawned. The steel pails were 26 cm high, 28 cm in diameter, open at the top and with a wire mesh (2-mm square aperture) bottom (Figure 1). Rectangular openings (about 30% of the pail area) were cut in the sides of the pails and covered with 2-mm aperture mesh to facilitate water circulation. Finally, the entire assembly was painted with brown primer to blend with the substrate.

To set a pail, scuba divers excavated a hole in the substrate and the pail was placed in the hole so the top rim was flush with the surface. The pail was then filled with substrate that the divers had removed. After lake trout spawned, divers attached a cover to the pail and the pail was lifted to the surface for a count of eggs deposited. Pails not lifted immediately after spawning remained in the substrate until the following spring when they were fitted with a fry trap cover (Figure 1) to capture fry that would soon hatch in the pail. The cover was an inverted screen cone with a bottle trap at the top that was attached to the pail by a locking ring. The 0.9-liter bottle was of opaque white plastic with a copper screen (2-mm aperture) funnel at the open end. The 2-mm holes in the bottom of the bottle allowed air to escape when the traps were attached to the pails. The bottle was attached to the screen funnel by rubber bands and a lifting frame was bolted to the base of the screen cone (not illustrated). Fry emerging from the pails swam up through the bottle funnel and were trapped. The trapping assembly was lifted in late June or early July after fry had emerged.

The pails were used to collect eggs and fry on the rubble covering the intake pipe in Presque Isle Harbor during the 1977-1978 and 1978-1979 spawning and incubation periods. Average catch and 95% limits were (number of pails in parentheses): 1977, eggs, 31 ± 21 (98); 1978, fry, 3 ± 1 (96); 1978, eggs, 8 ± 3 (93); and 1979, fry, 1 ± 1 (93).

Eggs and fry pump

I first tested a pump that operated on the "air-lift" principle. Compressed air was injected into the bottom of a rigid (6-cm, outside diameter) pipe that extended from the substrate to a boat; water was drawn up the pipe by the vacuum created by the rising air. At a 3-m depth, the pump delivered water at 0.2 $m^3$ per minute and more at deeper depths. For sampling, the rigid pipe was moved over the substrate by hand from the surface. I sampled at Station 6 in Presque Isle Harbor and on natural reefs in northern Lake Michigan in November 1973. Twenty eggs were collected from 13 $m^2$ of substrate at Station 6 and 10 eggs from 39 $m^2$ at northern Lake Michigan reefs.

I next tried a sampling device powered by an 8-cm centrifugal trash pump with a capacity of 1.4 $m^3$ per minute. The intake of the pump was connected to the posterior end of a 39-kg iron sled (Figure 2) by an 8-cm hose. The sled was towed along the bottom at about 1 km per hour. A 4-cm pump pumped water through a garden hose into the anterior portion of the sled which dislodged bottom organisms that were then sucked up by the intake. These passed through the 8-cm pump and were deposited in a screen (2-mm aperture) box where bottom organisms and material were retained for examination. The sled was kept upright by a 5,400-$cm^3$ buoy at the upper end of a 1.3-m long rod attached to the posterior end of the sled.

A smaller pump was also tried. In this test, water was pumped by a 4-cm centrifugal pump with a capacity of 0.5 $m^3$ per minute, while a scuba diver used a 3.7-cm screened (1.0-cm aperture) intake hose to probe crevices in the substrate.

The 8-cm pump was tested on a simulated lake trout spawning habitat (rubble of 5-15 cm) in which a known number of live lake trout eggs had been placed. In two tests, where eggs were no deeper than 15 cm in the substrate, recovery of eggs was 11 and 16%. In two tests where eggs were 15-30 cm deep, recovery was nil. Recovery of eggs 0-30 cm deep was about 1% in two tests.

In field tests, both pumps took substantial numbers of eggs (Table 2). The 8-cm pump with the sled took up to 8 eggs per minute and the 4-cm pump with a diver-wielded probe took as many as 85 eggs per minute. The 8-cm pump was effective for fry (1 per minute) and the 4-cm pump took 1.5 fry per minute at one location.

Emergent fry trap

The emergent fry trap described by Collins (1975) was modified and then tested on the rough bottom of lake trout spawning areas. Essentially, the fry trap was a screened pyramid open at the base with a catch bottle at the apex. Although the trapping principle remained the same, my emergent fry trap differed from the design of Collins (1975). First, I used heavy wire mesh[2] (0.5-mm galvanized wire, 2-mm mesh opening) for the sides of the pyramid. This mesh overlapped at the corners and was pop-riveted together which provided enough rigidity so angle-iron corners were unnecessary. Second, a metal plate at the apex was attached to folded over extensions of the wire mesh (Figure 3). Third, the bottle fitted into a recessed hole of a plywood plate on top of the metal plate and was secured to the plate by large rubber bands attached to the plywood plate and a strap-iron retainer. Fourth, the 1.9-liter bottle was opaque plastic with two 2-mm holes in the top. Fifth, the predator screen (8-mm aperture) was placed on the apex of the bottle funnel. Sixth, the bottle guard had two arms and an iron loop was welded to the top for attachment of a lifting line.

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[2] Although galvanized and spray painted, the wire mesh rusted out after three seasons of use. Rebuilt traps have aluminum wire (0.6-mm) mesh.

The fully assembled trap could be set by lowering it from the surface or it could be positioned by scuba divers. For examination, the entire trap could be lifted to the surface via a lifting line or scuba divers could remove the catch bottle for transport to the surface.

Emergent fry traps proved to be very effective in catching fry on spawning areas in May and June (Table 3). At first, clear glass 1.9-liter catchment bottles were used but later I used white, opaque plastic bottles of the same size which were more durable. To determine relative efficiency of the two types of bottles, six traps were fished at the same location from 19 May to 14 June 1977. Fry were removed on 1 June and 14 June. The three traps with glass bottles were fitted with opaque bottles on June 1 and vice-versa. Regardless of their location, opaque bottles caught about four times as many fry as glass bottles. However, this difference was not significant, probably because of small sample size and extreme variability in catch (see below).

Because use of divers to set traps was expensive and time consuming, efficiency of diver-set traps was compared with that of traps lowered to the substrate from a boat. Two comparisons of 12 pairs of traps each were made; one member of a pair was lowered from the surface, the other was positioned by divers on the best appearing location within 2 m of the surface-set trap. In the 1978 test on the discharge pipe, diver-set traps caught more fry than did surface-set, but the small numbers of fry involved precluded a conclusion (Table 3). A much better test during 12 June-9 July 1979 on the intake pipe, when many fry were caught, showed that there was no significant difference between average catches (with 95% confidence limits) of traps set by divers ($8.9 \pm 13.1$) and from the surface ($8.5 \pm 9.5$).

The catch of lake trout fry was extremely variable among traps. One example was the catch of three traps on the intake pipe during 19 May-17 June 1976. One trap caught 78% of the 106 fry caught. A second example occurred during the 1979 testing of diver- and surface-set traps when 1 of the 12 pairs caught 56% of the total catch.

Minnow trap

The plastic traps tested were 45 cm long, 22 cm in diameter in the middle, 15 cm in diameter at the ends, and had inverted funnels at both ends. For field tests, traps were lined with fiberglass window screen (1-mm aperture) because the standard 4-mm trap mesh would not retain lake trout fry. Traps were weighted and 14 to 36 were fished on strings of lead-core lines for periods of 24 hours or more.

Minnow traps were successful in catching lake trout fry on the intake and discharge pipes but were unsuccessful at stations 7 and 8 (Table 4). Lake trout fry were present at stations 7 and 8 as indicated by other gear. On the discharge pipe, the low catch was throught due to the scarcity of fry (indicated by other gear).

Beam trawl

A beam trawl was designed and constructed to sample lake trout fry on rock, rubble and boulder substrate. In 1976-1977, construction of the trawl frame was 2.5-cm (outside diameter) thin-wall conduit except for a 5-cm pipe located 7 cm below the bottom of the trawl mouth that rode on the bottom. The mouth of the trawl was 1.2 m wide and 0.6 m high. A rectangular towing frame, welded to the center of the sides of the net mouth, extended forward at an upward angle of 15 degrees (from horizontal) for a distance of 1.8 m. Nine guard bars (to allow the trawl to ride over rough bottom) 1.2 m long and spaced 12 cm apart extended from the 5-cm pipe below the bottom of the net frame at an angle of 30 degrees to a cross brace on the towing frame. A brace (1.1 m) extended from each upper corner of the trawl mouth to the towing frame at the cross brace. "Ticklers" (lead-filled conduit, 15 cm long) were suspended from the front and cross brace of the towing frame in a row of four to eight at each location. The ticklers dragged on the bottom to cause fry to emerge from the bottom. A 1.2- × 0.6-m screen (2-mm aperture) was bolted to the top of the trawl mouth and the posterior 0.6-m portion of the top braces. The front 3.7 m of the catching net was of Ace 5-mm mesh and the 1.2 m long cod end was Ace 3-mm mesh. To protect the net from rough substrate, chafing gear (1.2 × 4.9 m, 0.6 kg/m$^2$) was attached to the bottom of the net frame. The final model (Figure 4) of the trawl was used in 1978 and 1979. Major differences from the earlier model were as follows: (1) the towing frame with its row of ticklers was removed, (2) screening was installed on the side frames, and (3) the 5-cm conduit at the bottom of the trawl was replaced with lead-filled 5-cm iron pipe.

The trawl was tested during 1976-1979 (Table 5) to roughly evaluate its efficiency over different bottom types and times within a 24-hour period and the effect of ticklers on the catch. Tows were made at 1-3 km per hour at a warp (tow line length/water depth) of about 2:1. No attempt was made to evaluate the effect of speed or warp.

When used in 1976, the beam trawl was effective in catching lake trout on a rough bottom (intake pipe) and on a smooth bottom (Station 4) both during day and night hours. In 1977, experimental trawling was done at two sites to test effectiveness at different hours and the effect of ticklers. Two day tows (one with ticklers, one without) and two night tows (one with ticklers, one without) within a 24-hour period were made on three occasions on the intake pipe and on ten occasions at Station 7. On the intake, day trawling was fruitless, but night trawling was very productive (Table 5). Conversely, at Station 7, slightly more fry were caught during the day than at night but the difference was not significant. The average catch with ticklers was greater than without ticklers on the intake pipe at night (26 ± 21 vs 13 ± 10 fry per tow) and at Station 7 in the day (1.0 ± 0.9 vs 0.3 ± 0.4 fry per tow) and at night (0.4 ± 0.5 vs 0.3 ± 0.4 fry per tow). However, the differences were not significant.

In 1978, trawling was done on the discharge pipe to determine the effectiveness of the trawl at different hours and the effect of ticklers. Two tows (one with ticklers, one without) were made each hour from 1830 to 2230 hours on four dates. The trawl was effective at all times. Average fry catch per tow at different hours ranged from 2.0 ± 1.0 (2030 hours) to 4.7 ± 3.1 (2230 hours); there was no significant difference in catch among hours nor between day and night tows (Table 5). The trawl caught more fry per tow with ticklers (3.8 ± 1.6) than without ticklers (3.0 ± 1.2) although this difference was not significant. In 1978, the trawl was again tested to determine the best time of day to sample and effectiveness of ticklers. Trawling was done on the discharge pipe (four dates) and Station 7 (two dates) at 0.5-hour intervals from 1400 to 1830 hours. Ticklers were used on alternate tows. The catch of fry was so low (Table 5) that I could not compare catch among hours. I do not believe that the low catch was due to ineffectiveness of the trawl, rather fry were scarce. For both testing areas, the trawl with ticklers caught 0.2 fry per tow as compared to 0.1 fry per tow without ticklers.

Otter trawl

The 5-m four-seam trawl tested had 38- × 75-cm trawl doors, a 15-m bridle length, mud rollers on the foot rope, a 3-cm No. 12 nylon body mesh, a 2.5-cm No. 15 cod mesh and a 2-mm mesh Ace nylon cod end liner. A warp of about 4:1 was used at all stations. This gear was tested in Presque Isle Harbor at seven stations in May-August 1976. Usually, a 10-minute night tow between 2230-0100 hours was made weekly at each station. Periodically, some stations were sampled during day hours to compare day and night catches. Trawling speed was about 8 km per hour so each tow was about 1300 m long.

The trawl was effective at night in catching lake trout fry on mixed bottom (stations 1, 2, 3, 4, 6) near the spawning reef from early May to mid-July. Average catch of fry was three per tow. At stations (7, 8) with sand bottom that were further away from the spawning reefs, trawling at night was productive from late May to late July. Average catch of fry was six per tow. Day trawling was ineffective. In day hours, 11 tows produced only 0.5 ± 0.8 fry per tow as compared to 7.0 ± 3.9 fry per tow produced by 11 night tows during the same 24-hour periods. The difference was highly significant.

## Discussion

### Egg and fry trap pail

These traps were the only devices tested that could be used both for qualitative study and quantitative estimates of eggs and fry. Because of the high variability in numbers of eggs and fry per pail, relatively large numbers of pails must be set to obtain quantitative estimates. Estimates of fry production are also plagued by the question, "Is survival in the pails the same as on the reef?"

### Egg and fry pump

Centrifugal pumps can be used to collect eggs and early fry from spawning areas. The 8-cm centrifugal pump and sled were especially suitable for egg and early sac fry sampling when relatively large areas were to be sampled and where the exact location of spawning was unknown. Limitations of this gear were that it did not recover eggs deep in the substrate and it was cumbersome requiring the use of a powered boom and a 5-m or larger boat. The less cumbersome and more efficient 4-cm pump should be used when a diver is available and where the area of spawning is rather precisely known. Also, the probes used with the small pump penetrate deeper into the substrate than the sled used with the larger pump. For both pumps, sampling for fry should be done in the spring as soon as possible after ice-out before fry become mobile enough to escape the gear.

I do not recommend use of the "air lift" pump. It was unwieldly, limited to shallow water, and an inordinately large amount of time was required to sample a significant amount of substrate.

Emergent fry trap

These traps were very efficient gear for collecting fry. Fry up to 38 mm (TL) were caught and larger fry would have been caught had they been present because yearling lake trout were caught when the predator screen was not used. Best results were obtained by fishing traps with durable opaque catch bottles on spawning areas from mid-May through June. The traps required little effort to set and lift, especially if bottom topography was flat enough for setting from a boat without diver assistance. The traps could be fished for several weeks without lifting and were able to withstand at least moderate wave action. The traps had two disadvantages. First, catches of adjacent traps were quite variable, so I recommend that 20-30 traps be used per spawning area to assess reproduction. Second, trap catches cannot be used for accurate quantitative studies because they very likely attract fry from surrounding areas.

Minnow trap

My brief study suggests that minnow traps were effective only when fry were emerging and abundant on the spawning reef. Although the best catch per individual trap-day was only 0.1 fry, a string of 20 would catch 2.0 per day which was comparable to the catch per day for an emergent fry trap. More study of the minnow-trap type of gear may be profitable.

Beam trawl

Both the original and final version of the beam trawl were moderately efficient in catching fry. Fry 39 mm long were caught and it is likely that larger fry would have been caught if they had been present because yearling lake trout were taken. The trawls caught fry on a varied bottom type near the spawning area from late May through most of June and in July on a hard bottom some distance away. Trawling at twilight and night (2100-2400 hours) usually produced the largest and most consistent catches of fry on the spawning areas (intake and discharge pipes). Results of day trawling on the spawning sites were inconsistent. Large numbers were caught in 1976, but in later years few fry were caught. Conversely, day trawling was more productive than night trawls on areas away from the reefs. In each of three comparisons, trawling during the day was more productive than trawling at night. Ticklers should be used because they increased the catch whenever they were used.

Sampling with the beam trawls required a power boom and a 5-m or larger boat. If possible, in substrate small enough to pass through the guard bars, trawling should be done down-slope. In areas with very large boulders, it was necessary to trawl in a straight line and use a low warp ratio. The trawls could not be used on a soft bottom or in heavily vegetated areas.

Otter trawl

I recommend the otter trawl for sampling lake trout fry at night in June and July. The use of mud rollers is essential and enabled the trawl to be used both on a smooth sand bottom and on a small sized (<350 cm) rubble bottom. It was difficult to use the trawl on rougher bottom with large crevices and boulders. The trawl caught fry up to 55 mm long and would have caught larger fry if they had been present because yearling lake trout were caught. Use of this trawl requires a power boom and a 6-m or larger boat.

Catch of other fish

The gear that was tested also caught fish other than lake trout fry. Other fish caught are listed in Appendix A.

## Acknowledgments

P. R. Hannuksela, J. W. Peck, and W. C. Wagner performed the field work. D. S. Greenleaf identified the fish collections. The manuscript was reviewed by J. W. Peck, W. C. Wagner, and W. C. Latta. The figures were prepared by W. C. Wagner, A. Sutton, and the Northern Michigan University Cartographic Laboratory.

Table 1.--Characteristics of sampling areas in Presque Isle Harbor, Lake Superior, and in Grand Traverse Bay, Lake Michigan, where lake trout egg and fry collecting gear were tested.

| Location and area | Distance from principal spawning areas (× 100 m) | Depth (m) | Bottom type[a] |
|---|---|---|---|
| Presque Isle Harbor | | | |
| Intake pipe | 0 | 2-8 | Mostly angular RR, 12-38 cm |
| Discharge pipe | 0 | 2-9 | Crushed dolomite RR, 5-45 cm |
| Station 1 | 0-3 | 3-7 | Mostly S, some RR |
| Station 2 | 4-6 | 9-12 | Mostly RR, some M and WD |
| Station 3 | 0-5 | 4-12 | M,S,WD,RR |
| Station 4 | 6-12 | 3-6 | Mostly S, some G |
| Station 6 | 2-5 | 2-11 | M,S,WD,RR |
| Station 7 | 15-21 | 4-7 | S |
| Station 8 | 24-30 | 2-7 | S |
| Grand Traverse Bay | | | |
| Rock Crib (and surrounding area) | 0 | 9-11 | RR, 5-15 cm |
| Elmwood Marina | 0 | 0-3 | RR, 8-30 cm; B, 90-180 cm |

[a] M = mud
S = sand
WD = woody debris
G = gravel
RR = rock-rubble
B = boulders

Table 2.--Catch of lake trout eggs and fry by pumping in Presque Isle Harbor, Lake Superior, and in Grand Traverse Bay, Lake Michigan, 1975-1979.

| Location, area, and pump size[a] | | Minutes of pumping | Lake trout | |
|---|---|---|---|---|
| | | | Eggs | Fry |
| Presque Isle Harbor | | | | |
| Intake pipe (8 cm) | 10 Dec 1975 | 30 | 240 | |
| | 10 Dec 1975 | 12 | 104 | |
| | 12 Apr 1976 | 25 | 25 | 38 |
| | 23 Apr 1977 | 29 | 6 | 15 |
| Grand Traverse Bay | | | | |
| Rock crib (4 cm) | 8 Nov 1977 | 17 | 527 | |
| | 6 Dec 1977 | 12 | 589 | |
| | 19 Apr 1978 | 10 | 150 | 15 |
| | 28 Nov 1978 | 10 | 852 | |
| Elmwood Marina (4 cm) | | | | |
| | 8 Nov 1977 | 20 | 76 | |
| | 6 Dec 1977 | 16 | 264 | |
| | 28 Nov 1978 | 85 | 600 | |
| | 1 May 1979 | 82 | 9 | 0 |

[a] The 8-cm pump was used with the sled except for the 12-minute period of 10 December when two divers wielded 4-cm probes. The 4-cm pump was used with a single diver-wielded probe.

Table 3.--Catch of lake trout fry in emergent fry traps in Presque Isle Harbor, Lake Superior, and in Grand Traverse Bay, Lake Michigan, 1976-1979.

| Location, area, and inclusive dates | Catch bottle [a] | Setting methods [b] | Number of traps | Catch of fry: Number per trap per day | Catch of fry: Total |
|---|---|---|---|---|---|
| Presque Isle Harbor | | | | | |
| Intake pipe | | | | | |
| 19 May-17 June 1976 | G | D | 3 | 1.2 | 106 |
| 17-21 June 1976 | G | D | 2 | 0.5 | 4 |
| 19 May-1 June 1977 | G | D | 3 | 0.1 | 4 |
| 19 May-1 June 1977 | P | D | 3 | 0.4 | 14 |
| 1-14 June 1977 | G | D | 3 | 0.5 | 21 |
| 1-14 June 1977 | P | D | 3 | 2.4 | 95 |
| 12 June-9 July 1979 | P | D | 12 | 0.3 | 107 |
| 12 June-9 July 1979 | P | S | 12 | 0.3 | 102 |
| Discharge pipe | | | | | |
| 28 Apr-26 June 1978 | P | D | 12 | < 0.1 | 9 |
| 28 Apr-26 June 1978 | P | S | 12 | 0.0 | 0 |
| Grand Traverse Bay | | | | | |
| Elmwood Marina | | | | | |
| 18 May-28 June 1978 | P | D | 8 | 0.4 | 133 |
| 2 May-2 July 1979 | P | D | 32 | 0.3 | 572 |

[a] G = clear glass
P = opaque white plastic

[b] D = set by divers
S = set from water surface

Table 4.--Catch of lake trout fry in plastic minnow traps, Presque Isle Harbor, Lake Superior, 1976-1978.

| Location, and date fished | Number of trap days | Catch of fry | |
|---|---|---|---|
| | | Number per trap per day | Total number |
| Intake pipe | | | |
| 12 May-25 June 1976 (8 days in period) | 141 | 0.128 | 18 |
| Discharge pipe | | | |
| 13 May, 18 June 1976 | 41 | 0.024 | 1 |
| 26 May-12 June 1978 | 680 | 0.001 | 1 |
| Stations 7, 8 | | | |
| 8, 14, 15, 16, 27 July 1976 | 125 | 0.000 | 0 |

Table 5.--Catch of lake trout fry in a 1.2-m beam trawl in Presque Isle Harbor, Lake Superior, 1976-1979.

| Location, dates and hours[a] of collection | | Length of tow (m) | Number of tows | Number of fry per tow and 95% confidence limits |
|---|---|---|---|---|
| Intake pipe | | | | |
| 24 May 1976 | 1300-1600 | 180 | 4 | 22.0 ± 30.7 |
| 21 June 1976 | 1100-1400 | 180 | 5 | 0.4 ± 1.1 |
| 21-22 June 1976 | 2200-2400 | 180 | 8 | 1.8 ± 1.2 |
| Station 4 | | | | |
| 10, 21 June 1976 | 1400-1600 | 440 | 7 | 1.3 ± 1.3 |
| 14, 16 June 1976 | 2100-2400 | 510 | 9 | 0.4 ± 0.6 |
| Intake pipe | | | | |
| 16-23 June 1977 | 900-1200 | 180 | 6 | 0 |
| 16-23 June 1977 | 2200-2400 | 180 | 6 | 17.2 ± 8.8 |
| Station 7 | | | | |
| 5-19 July 1977 | 900-1200 | 640 | 20 | 0.6 ± 0.5 |
| 5-19 July 1977 | 2200-2400 | 640 | 20 | 0.4 ± 0.3 |
| Discharge pipe | | | | |
| 24 May-1 June 1978 | 1830-2030 | 150 | 24 | 2.9 ± 1.1 |
| 24 May-1 June 1978 | 2130-2230 | 150 | 16 | 4.2 ± 1.7 |
| 22 May-7 June 1979[b] | 1400-1600 | 250 | 17 | 0.1 |
| 22 May-7 June 1979[b] | 1630-1830 | 250 | 18 | <0.1 |
| Station 7[b] | | | | |
| 11-12 July 1979 | 1400-1600 | 500 | 9 | 0.4 ± 0.6 |
| 11-12 July 1979 | 1630-1830 | 500 | 10 | 0.2 |

[a] Darkness occurred at about 2200 hours.

[b] One to three trawls were not included because they were aberrant.

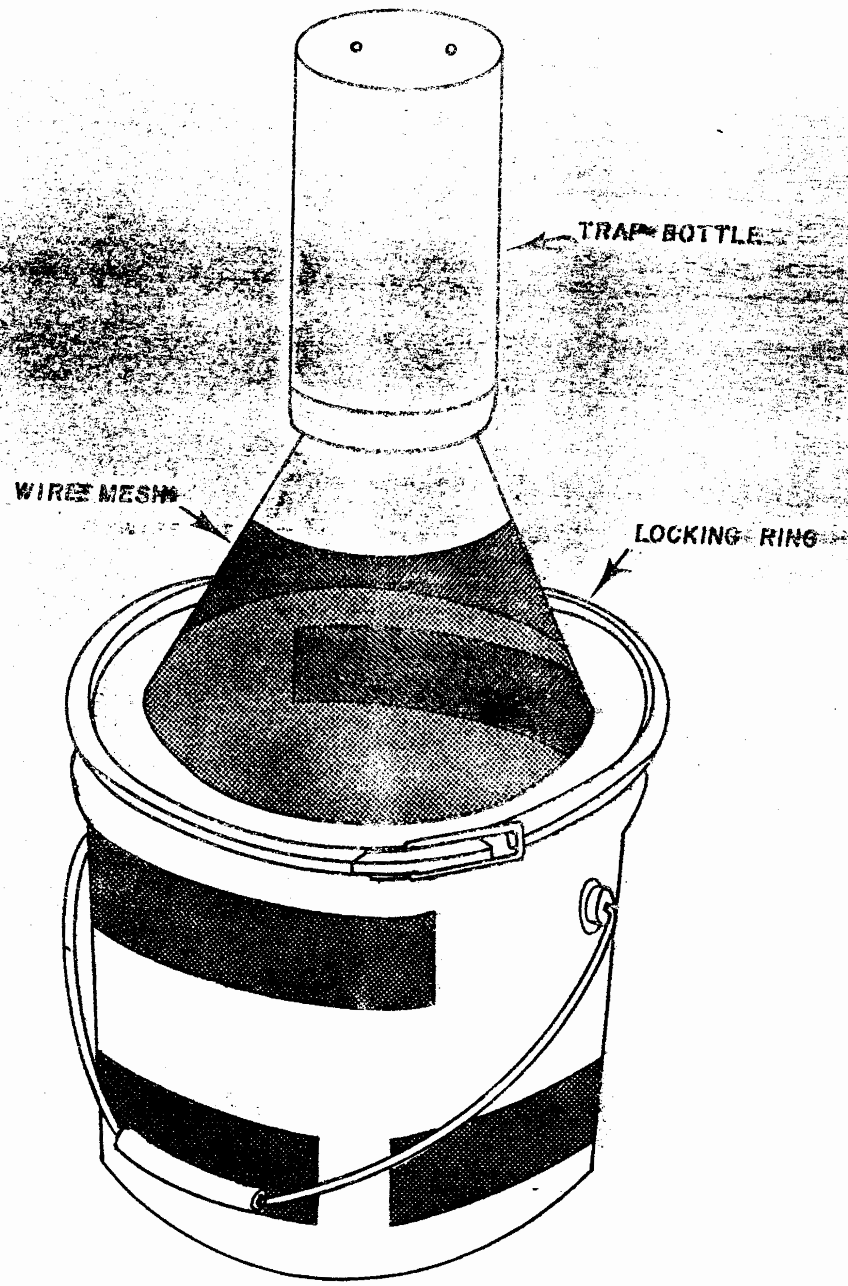


Figure 1.--Perspective view of egg and fry trap pail. Trap is assembled to catch fry emerging from the pail. The device is 58 cm high.

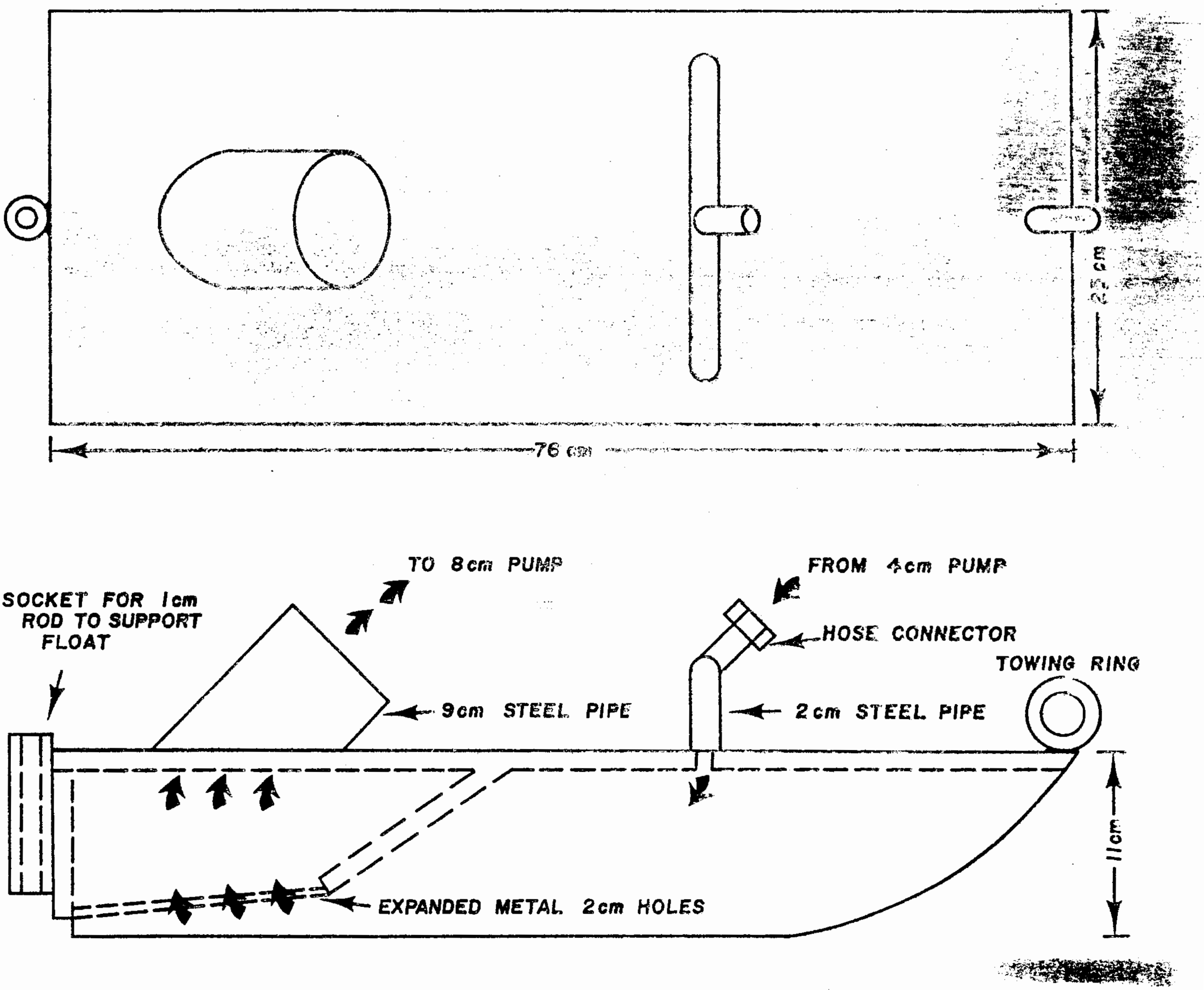


Figure 2.--Top (above) and side view of sled of 1 cm iron stock. Large arrows show direction of water flow when gear is in operation. Measurements to nearest centimeter. Pipe size is outside diameter.

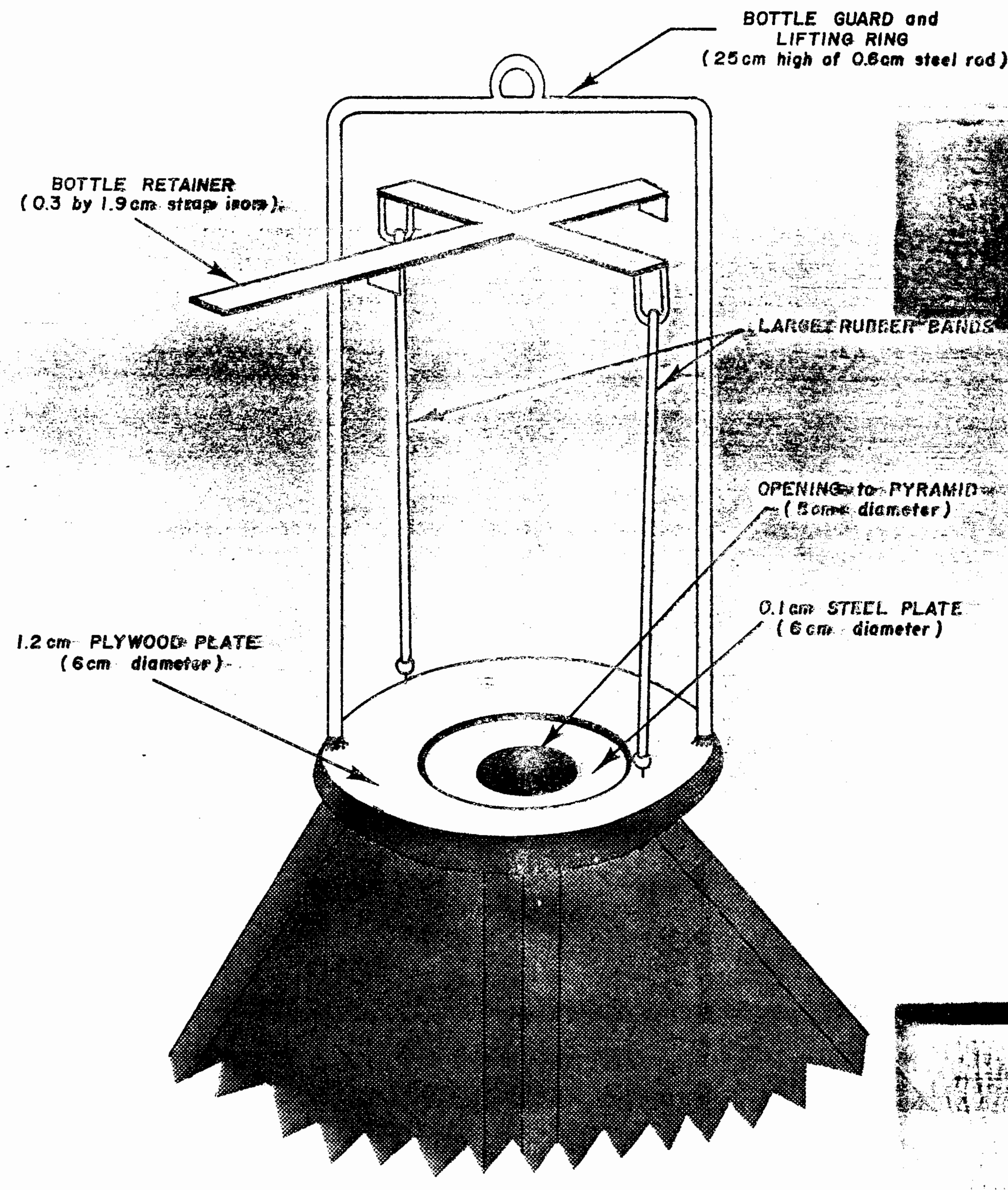


Figure 3.--Perspective of top of emergent fry trap, illustrating lifting apparatus and bottle retainer. The bottle fits under the retainer and between the rubber bands.

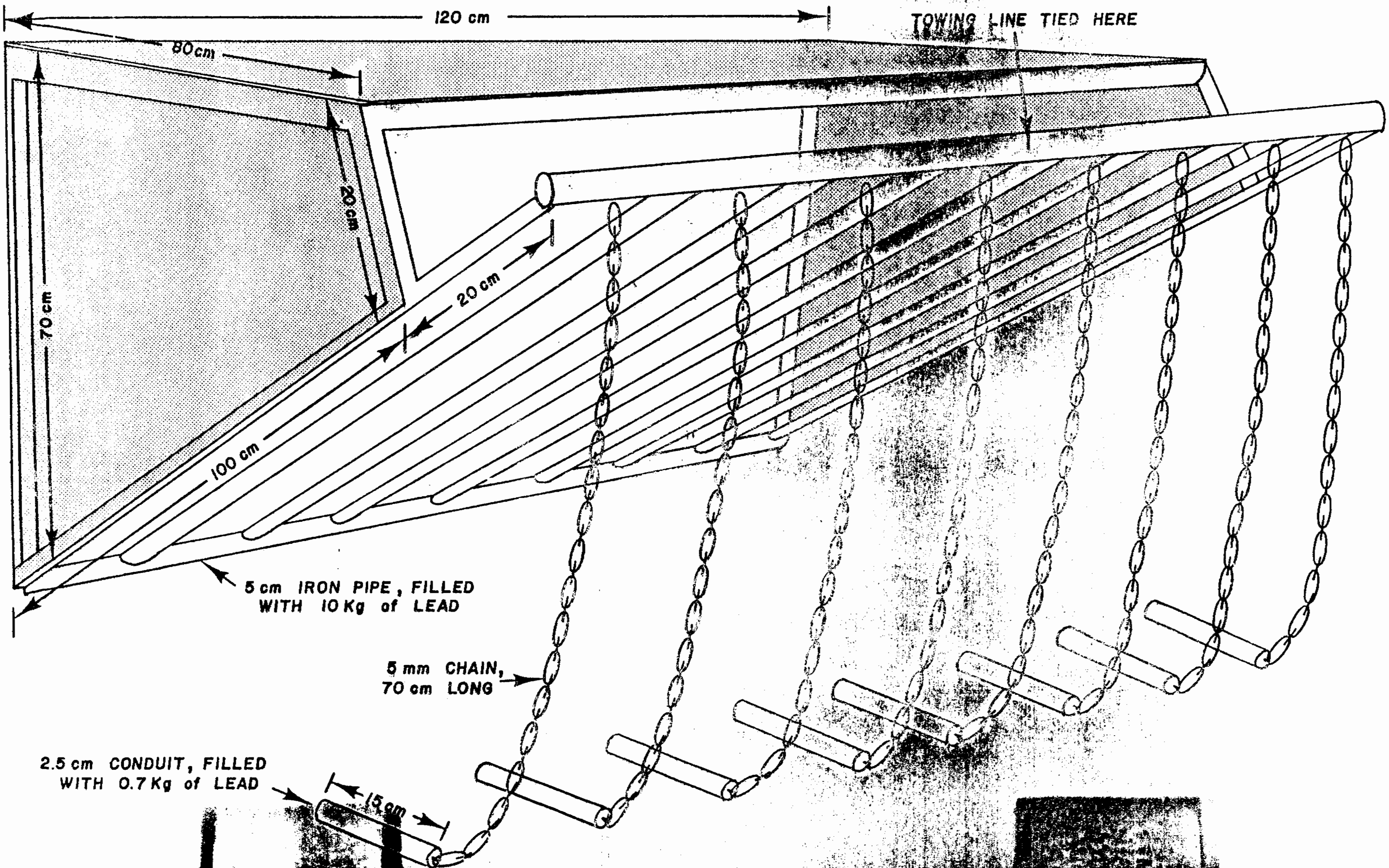


Figure 4.--Perspective view of final model of beam trawl without collecting net or bottom of net frame. Except as indicated, construction is of 2.5-cm conduit, welded at the joints. Strap iron (3 X 25 mm) bolted to the conduit, holds the screens (stipled areas) in place. Length measurements are approximate.

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Report approved by W. C. Latta

Typed by M. S. McClure

Appendix A.--Catch of fish other than lake trout fry in gear used to sample lake trout eggs and fry, Lake Superior and Lake Michigan.[a]

| Species | Gear | | | | | |
|---|---|---|---|---|---|---|
| | Egg and fry trap pail | Pump | Emergent fry trap | Minnow trap | Beam trawl | Otter trawl |
| *Cottus bairdi* or *C. cognatus* | C | C | C | C | A | A |
| *Lota lota* | R | | R | R | C | C |
| *Pungitius pungitius* | | | A | R | C | A |
| *Osmerus mordax* | | | R | R | C | A |
| *Etheostoma nigrum* | | | R | | A | C |
| *Prosopium cylindraceum* | | | | | | C |
| *Coregonus clupeaformis* | | | | | R | R |
| *Catostomus commersoni* | | | R | | R | C |
| *Percina caprodes* | | | | | R | R |
| *Perca flavescens* | | | | R | R | C |
| *Catostomus catostomus* | | | | | | R |
| *Ambloplites rupestris* | | | R | R | R | R |
| *Percopsis omiscomaycus* | | | | R | R | C |
| *Oncorhynchus kisutch* | | | | | | R |
| *Salmo trutta* | | | | | | R |
| *Salvelinus namaycush*[b] | | | R | | R | R |
| *Notropis hudsonius* | | | R | | R | |
| *Micropterus dolomieui* | | | | R | | |

[a] R = rare
C = common
A = abundant

[b] Yearling trout of hatchery origin.