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Lake Trout Spawning Habitat in the Great Lakes

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LAKE TROUT SPAWNING HABITAT IN THE GREAT LAKES[1]

Wilbert C. Wagner

Abstract

Substrate where lake trout spawned and fry were produced or only fry were found is described and illustrated. Rounded or angular rock about 5 to 50 cm diameter with interstice depths of 30 cm or more gave the best protection for eggs and fry. Thus, future lake trout stocking should be made over this type of substrate, and artificial structures should duplicate these conditions.

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[1] Contribution from Dingell-Johnson Projects F-31-R and F-35-R, Michigan

Introduction

There is much interest in the spawning habitat of planted lake trout in the Great Lakes. Millions of young lake trout have been planted, many of which have survived to maturity and spawned, yet production of young has been disappointingly low. One reason suggested for this reproductive failure is that mature hatchery trout home to planting sites where suitable spawning substrate is lacking (Rybicki and Keller 1978). If we could recognize suitable spawning substrate, future plants could be directed to sites possessing that substrate. Parameters of suitable substrate are needed for the construction of artificial spawning reefs and also, commercial development, such as rock breakwalls or water pipe overburden, could be designed to include rock suitable for lake trout reproduction.

The objective of this report is to describe and illustrate examples of substrate where lake trout spawned and fry were produced or fry were found.

Methods

Examples of lake trout spawning substrate have been gleaned from numerous studies of lake trout reproduction conducted in the upper Great Lakes by the Marquette Fisheries Research Station, since 1973. Some information used in preparation of this report was unpublished but much was from the following documented sources: Peck (1979), Stauffer (1981), Stauffer and Wagner (1979), and Wagner (1981). The spawning reefs are classified as: (1) natural reefs identified by commercial fishermen as reefs used prior to decimation of native lake trout stocks by commercial fishing and sea lamprey predation or not identified as traditional but where hatchery lake trout spawned; and (2) artifical spawning reefs unintentionally created by rock used for construction of breakwalls, cribs, and water pipe overburden. In most cases, the reefs were selected for study because a large number of lake trout were observed or captured there during the spawning season. The abundance of spawners on some reefs is indicated by CPE (number caught in overnight sets of 11.4 cm stretched mesh gill nets 305 m long). Peck (1979) judged the potential for natural reproduction based on CPE as: excellent (CPE $\geq$ 50), good (CPE = 25-49), fair (CPE = 10-24), or poor (CPE < 10). On a traditional reef, where eggs were to be seeded by scuba divers, the presence of spawning lake trout was not desirable.

The presence of eggs or fry was determined by pumping and fishing with egg traps, fry traps, and trawls. Egg deposition proved that lake trout had spawned and indicated that the substrate might be suitable for lake trout reproduction. However, the ultimate test was recovery of fry indicating that the reef afforded protection during the 5-6 month incubation period.

Location of the reefs is shown in Figure 1. Reef numbers correspond to those preceding reef names in the text. Physical description was based on measurements and photographs made by scuba divers. Composition of the substrate was classified based on diameter according to Wentworth in Welch (1948): boulder > 256 mm, cobble = 64-256 mm, pebble = 4-64 mm, and granule = 2-4 mm. At four reefs, scuba divers determined the depth of interstices.

Results

Natural Reefs

1. Drummond Island--The reefs along the southwest shore of Drummond Island in upper Lake Huron were examined while searching for a lake trout egg planting site. The CPE of mature lake trout caught during the spawning season in 1979-1981 was 0.8. Swim-up fry that hatched from seeded lake trout eggs were collected from this reef. The substrate is similar to a major lake trout spawning ground at Cockburn Island

(Smith 1968) which is 27 km to the east. The substrate is mostly honeycombed limestone with rounded cobbles and boulders (Fig. 2). Interstice depth is generally greater than 0.3 m.

2. New Mission Point--This reef is on the north side of New Mission Point in Grand Traverse Bay in water 2 to 15 m deep and is fairly well protected from prevailing winter winds. The CPE of spawners was 126 in 1976. Eighteen lake trout eggs were collected during 0.8 hours of pumping in fall 1976, but no fry were collected during 4.6 hours of pumping, trawling over 16,798 m^2 of substrate or in emergent fry traps fished for 175 trap-days in spring 1977. The substrate is cobbles and small boulders (Fig. 3).

3. Bowers Harbor--This reef is on the north shore of a small bay in Grand Traverse Bay in water 2 to 8 m deep. The CPE of spawners was 46 in 1976. Five eggs were collected during 2.0 hours of pumping in fall 1976, and one dead egg during 5.5 hours in spring 1977. No fry were collected during the spring pumping, trawling over 14,812 m^2 of substrate or fishing emergent fry traps for 148 trap-days. The substrate is cobbles and boulders as large as 0.7 m (Fig. 4). Pebbles and sand are also present, but not shown in the figures. Considerable algae was present on some of the rocks but was absent on others.

4. Cliff-Dow Reef--This small, 6-m deep reef, is in Presque Isle Harbor, Lake Superior. Thirty-three trout were caught during the 1978 spawning season in three 30-m long gill nets, each set for one hour. Eggs were deposited on the reef at a rate of 54 eggs per m^2 as determined by egg sampling pails buried on the reef. No fry were found in seven fry sampling pails in the spring, however, they may have escaped

before the fry traps were in place. No fry were caught in emergent fry traps fished for 108 trap-days. The substrate is angular cobbles (Fig. 5).

5. Presque Isle--This reef is about 0.5 km northwest of Presque Isle in water 6 to 10 m deep. Thirty-four lake trout were caught in 400 m of small mesh gill net fished for one hour during the spawning season in 1981. After the spawning season, two lake trout eggs were found in 24 egg sampling pails that were set on the reef. No sampling for fry was done the following spring. The substrate is large cobbles and small boulders (Fig. 6).

Artificial Reefs

6. Elmwood Marina--Rock breakwalls form the southern side of Elmwood Marina in Grand Traverse Bay. The breakwalls extend 5 to 8 m from the waters edge into water 4 to 7 m deep. Lake trout spawned on the breakwalls as shown by the presence of eggs and fry. During fall 1977 and 1978, a total of 940 eggs were collected with a pump in 2.0 hours, and 730 fry were collected the following spring in emergent fry traps fished for 2,712 trap-days. The boulder breakwall core is covered with rounded cobbles and small boulders (Fig. 7). Some sand, silt, and algae were on the rocks, except near the marina entrance where the rocks were swept clean by currents. Generally, interstice depth was greater than 0.3 m, but in some cases they were too broad to provide protection to the eggs.

7. Power Plant Crib--Lake trout spawned on and near a rock crib at the end of a cooling water intake of the Traverse City Municipal Power Plant in Grand Traverse Bay in 1977 and 1978. The 2-m high crib is 450 m offshore in water 9 m deep. When the 17-m^2 crib was filled with rock, some spilled over the sides and covered an area of about 55 m^2.

Nearly 2,000 eggs were collected during 39 minutes of pumping in fall 1977 and 1978. In spring 1978, 15 newly hatched fry and 62 eggs about to hatch were collected during 10 minutes of pumping. The substrate on and around the crib is rounded pebbles and cobbles (Fig. 8) and was swept clean by currents. Interstices were greater than 0.3 m deep.

8. Intake Reef--This reef was constructed in 1974 to cover the cooling water intake for the generating plant of the Upper Peninsula Generating Company at Presque Isle Harbor. The reef is 2,800 m^2 and is in water 2 to 8 m deep. Many lake trout spawned here each fall in 1977-1979, and Peck (unpublished) estimated that an average of 89,000 swim-up fry were produced annually. The substrate is primarily angular cobbles with some granules, pebbles, and small boulders (Fig. 9). Interstices were generally greater than 0.3 m deep.

Discussion

I found that lake trout spawned on a variety of rock substrate. I collected eggs and fry from rounded pebbles and small cobbles, 4 to 16 cm diameter (Fig. 8); rounded cobbles and boulders, 14 to 66 cm diameter (Fig. 7); and angular cobbles and small boulders, 14 to 30 cm diameter (Fig. 9). Further, some eyed eggs planted on a reef of honey-combed limestone with rounded cobbles and boulders (Fig. 2) survived to the swim-up stage which indicated that this too was suitable substrate. Eggs were collected from four additional reefs; the substrate on three reefs was cobbles and small boulders (Figs. 3, 4, and 6), and on the fourth it was angular cobbles (Fig. 5). Other workers also have reported that various substrates are used by spawning lake trout. Martin (1955) described the spawning substrate in small lakes in Algonquin Park, Ontario, as being broken rock or rubble varying from 5 to 15 cm and often interspersed with large boulders. DeRoche (1969) reported that lake trout eggs were deposited over sharp, broken rock 2 to 70 cm in diameter but not where the rubble was smooth. In an Ontario lake, Prevost (1956) found large numbers of lake trout eggs in the interstices among sharp angular rocks (artificial substrate, size not given), some as deep as 0.3 m. He found no lake trout eggs on rounded boulders and gravel.

The available information does not completely explain why some substrate is suitable for successful reproduction and other substrate is not. However, suitability appears to be related to depth of interstices. Deeper interstices should protect eggs and fry from predation and dislodgment by water turbulence. Prevost (1956) inferred that fish predation was responsible for the absence of eggs on the smooth rubble bottom. Horns and Magnuson (in press) found that crayfish predation on eggs was inversely related to the protection afforded by the substrate. Finally, Stauffer and Wagner (1979) found that little predation on eggs occurred on Intake Reef where interstices were deep. No information is available on the effect of turbulence, although severe storms have cast windrows of lake trout eggs on the shore (Dorr III et al. 1981). For successful reproduction, I conclude that substrate interstices must be deep enough to protect the eggs from predation and prevent dislodgment by turbulence.

Lake trout plants should be made over large pebble, cobble, and small boulder substrate (5 to 50 cm diameter) with interstice depths of at least 30 cm. Future artificial structures should incorporate this type of substrate.

Acknowledgments

The manuscript was reviewed by Thomas M. Stauffer, J. W. Peck, and William C. Latta. Alan D. Sutton drafted Figure 1.

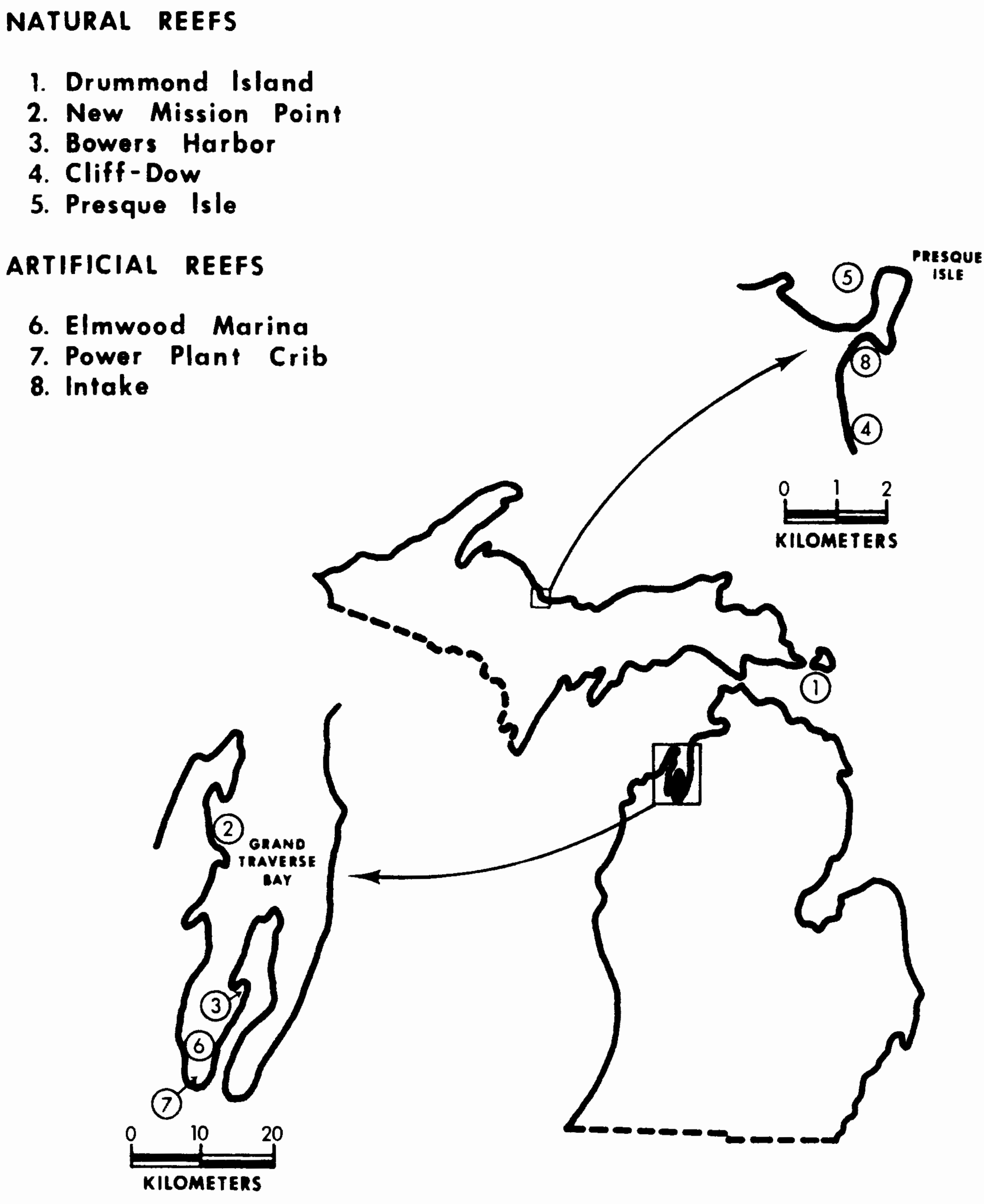

Figure 1.--Locations of lake trout spawning reefs.

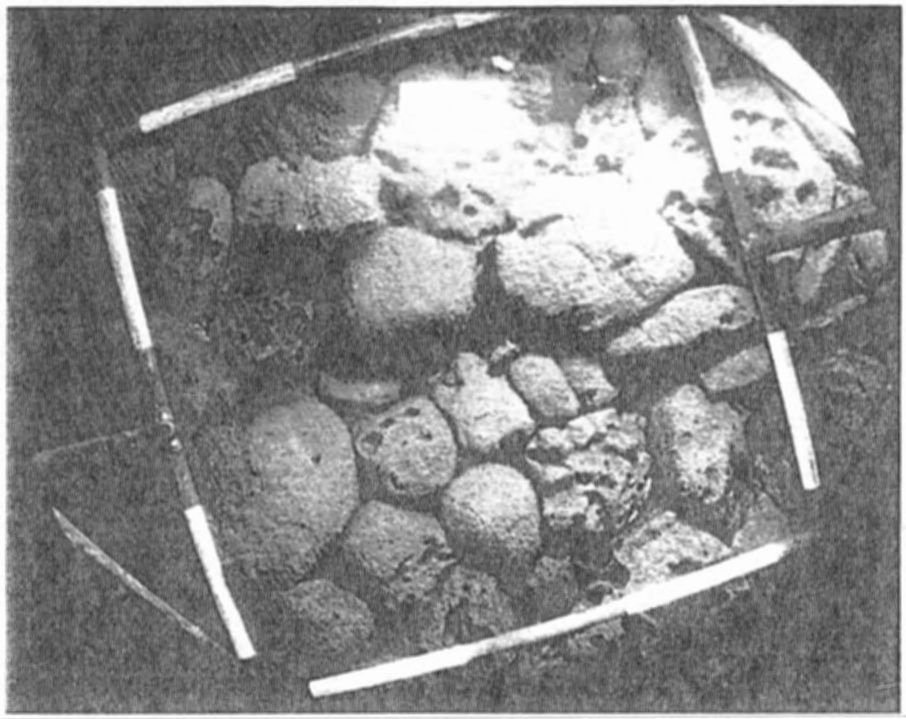

Figure 2.--Drummond Island. The black and white segments of the frame are 20 cm long.

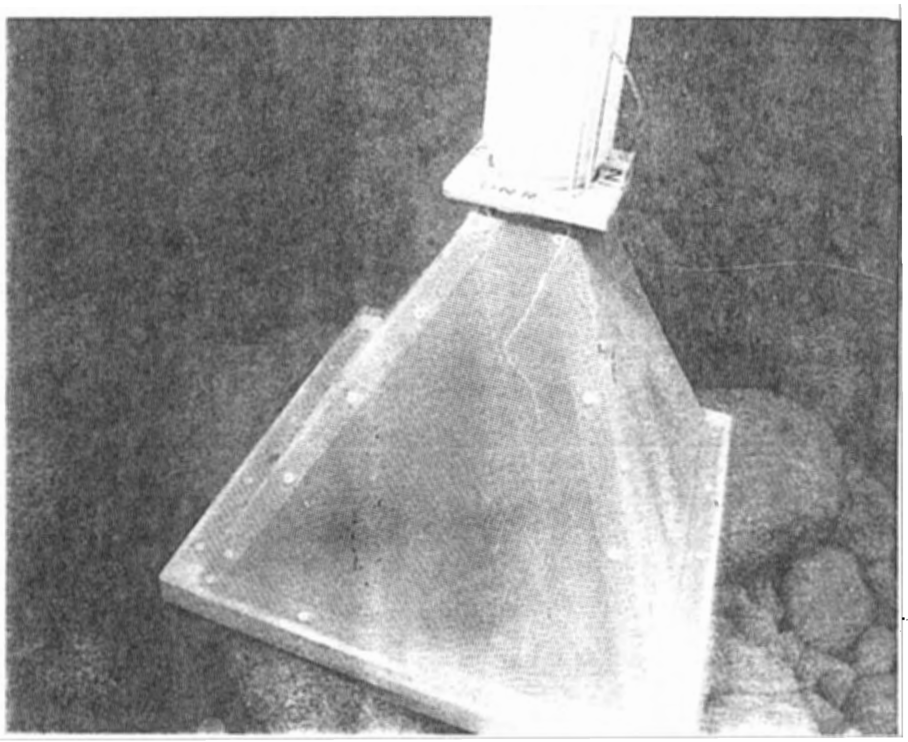

Figure 3.--New Mission Point. The base of the fry trap is 60 cm square.

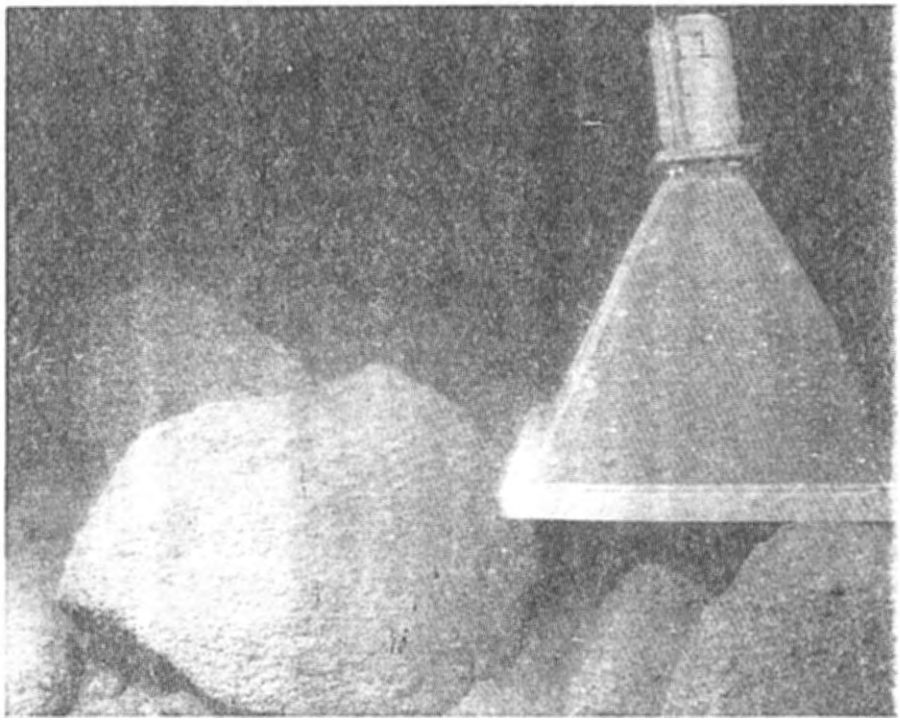

Figure 4.--Bowers Harbor. The base of the fry trap is 60 cm square.

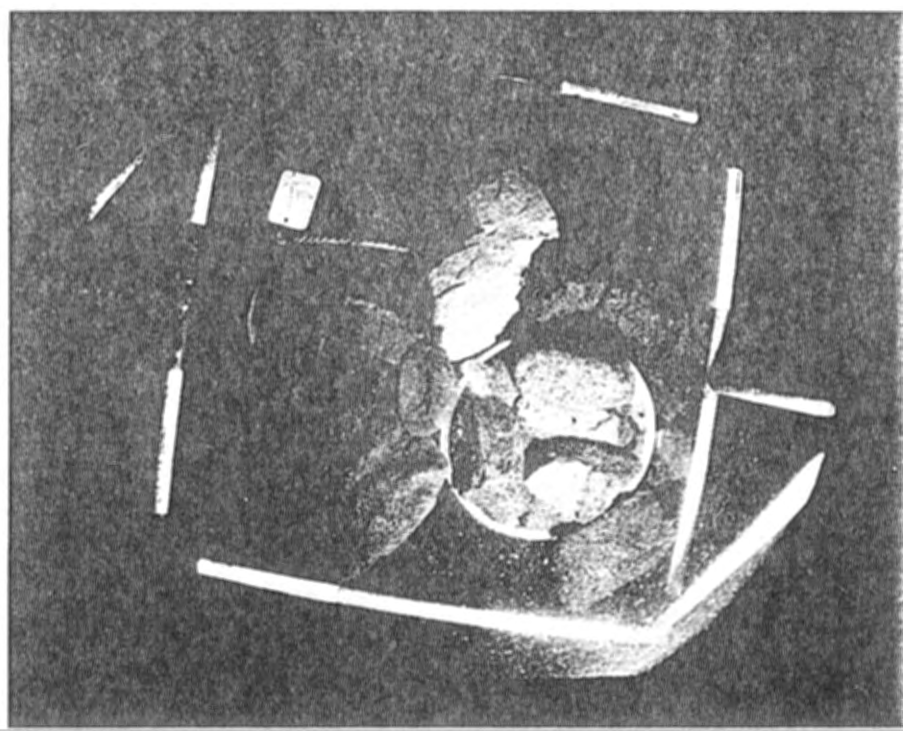

Figure 5.--Cliff-Dow. The black and white segments of the frame are 20 cm long.

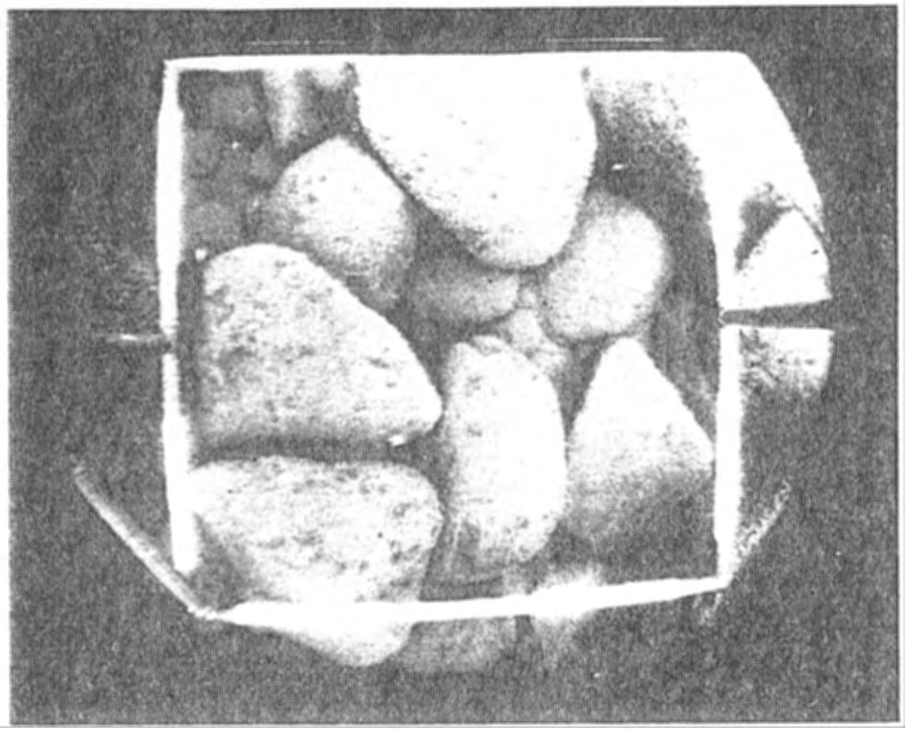

Figure 6.--Presque Isle. The black and white segments of the frame are 20 cm long.

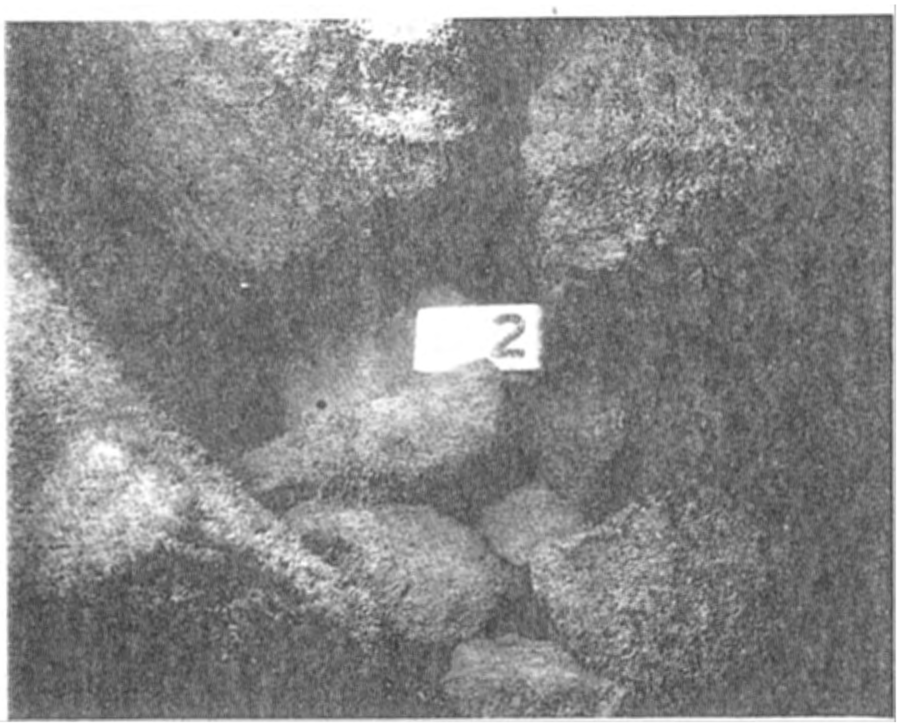

Figure 7.--Elmwood Marina. The white rectangle is 7.6 by 12.7 cm.

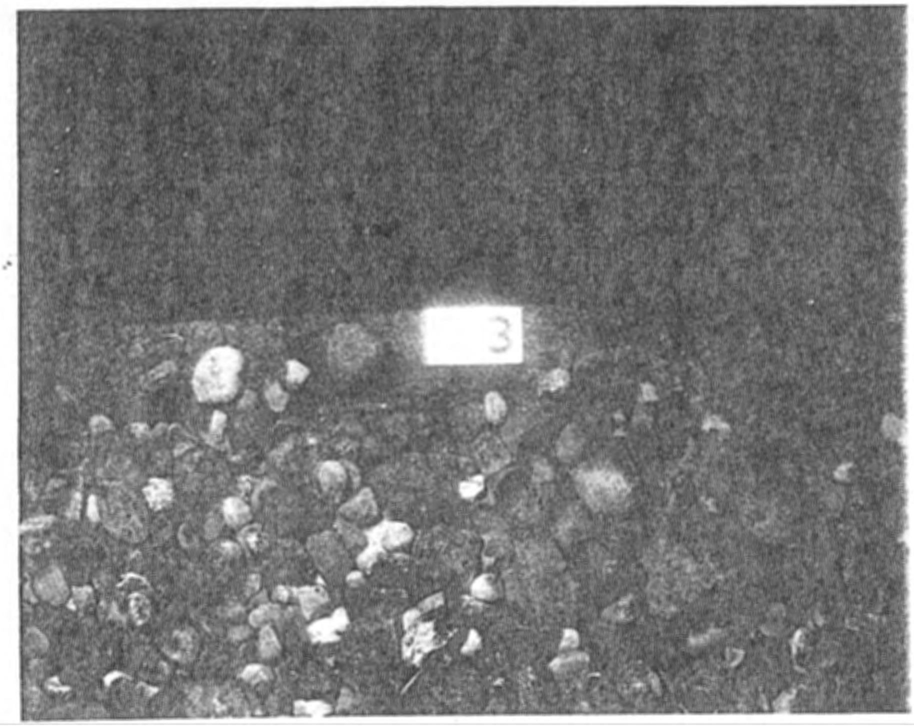

Figure 8.--Power Plant Crib. The white rectangle is 7.6 by 12.7 cm.

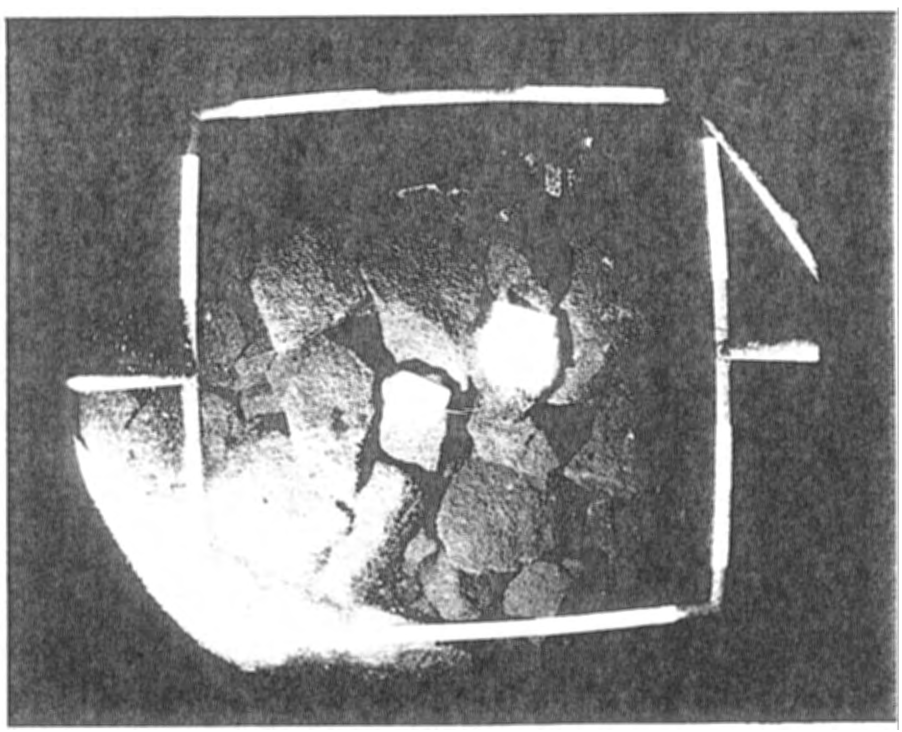

Figure 9.--Intake. The black and white segments of the frame are 20 cm long.

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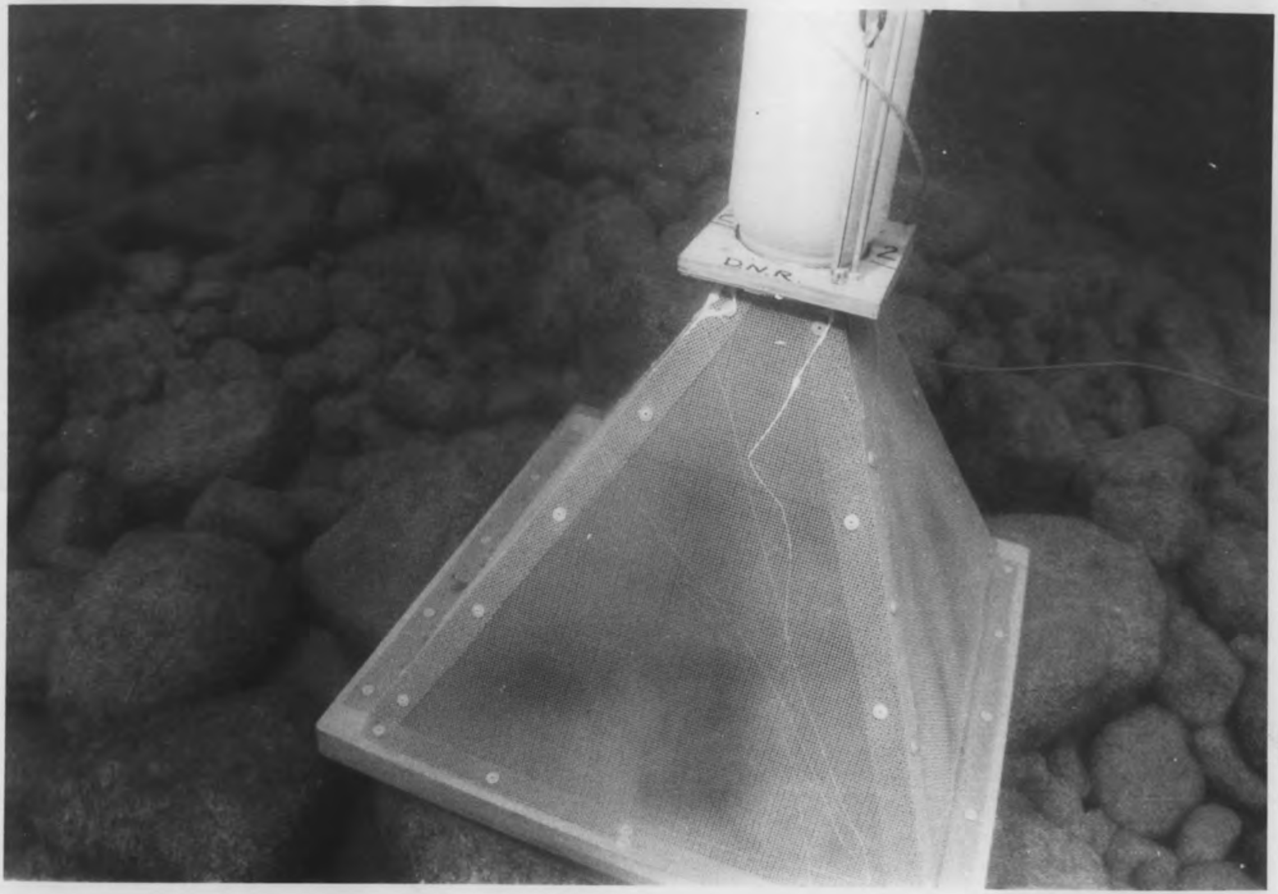
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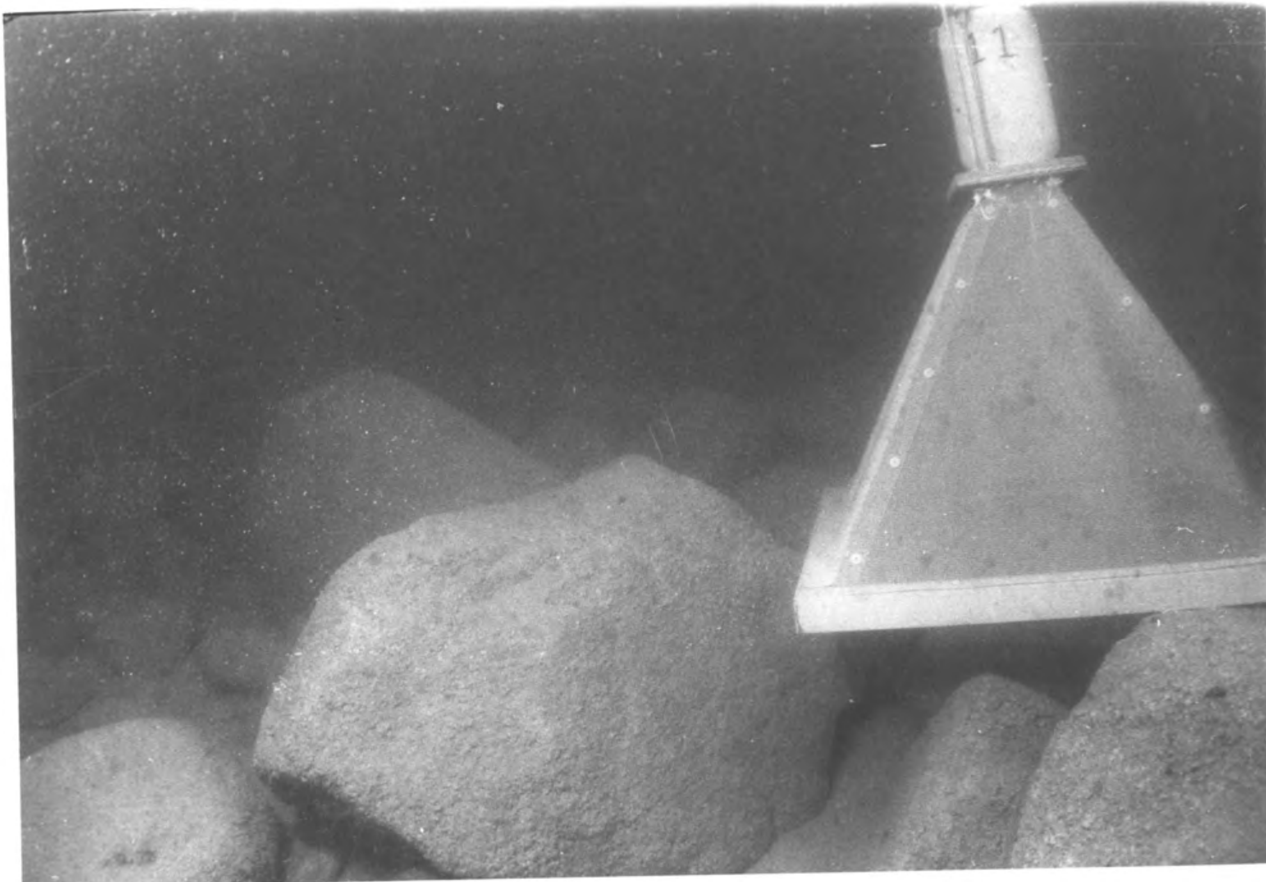

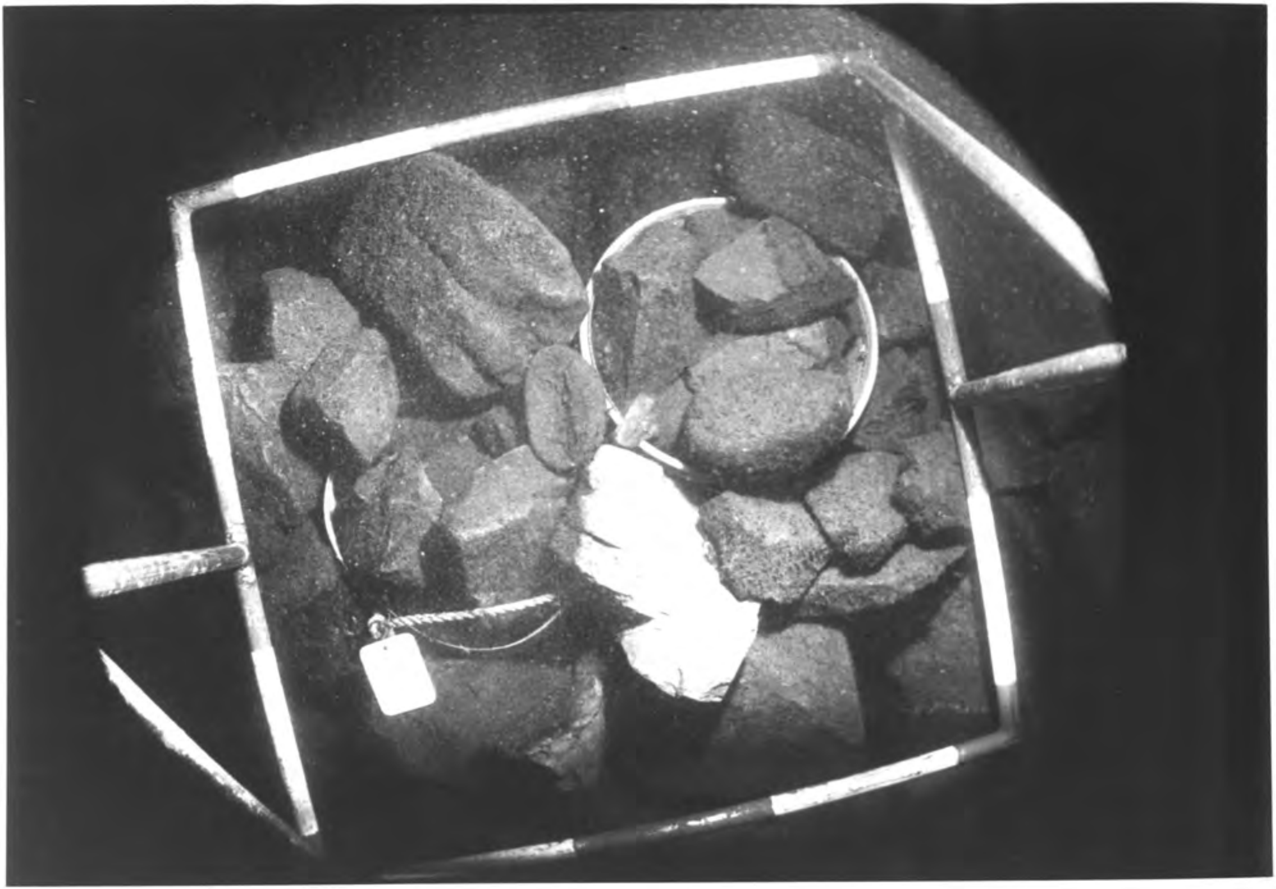


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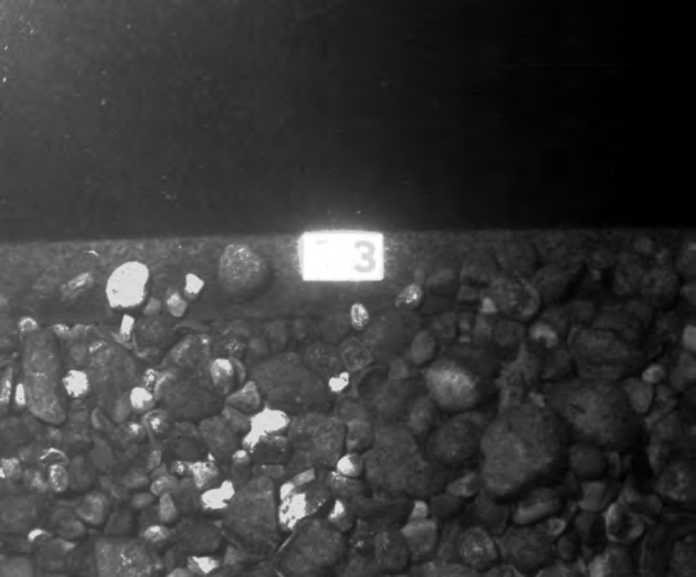

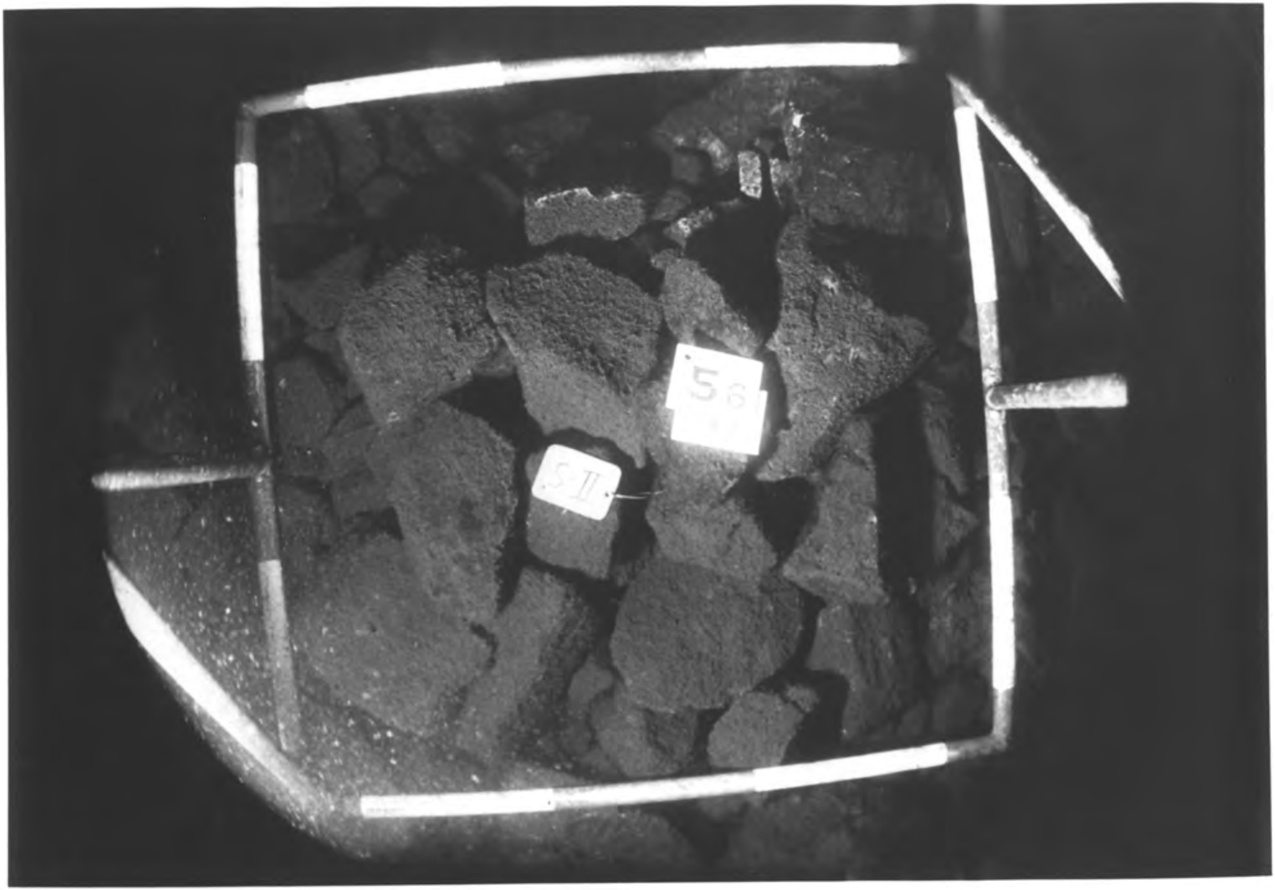
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