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FISHERIES RESEARCH INSTITUTE
College of Fisheries
University of Washington
Seattle 5, Washington

Circular No. 120

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MEASUREMENT OF GRAVEL COMPOSITION OF SALMON STREAM BEDS

by

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This work has been done under
Contract No. 14-17-008-96
U.S. Department of the Interior
Fish and Wildlife Service
Bureau of Commercial Fisheries

Approved

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Director

Submitted: April 5, 1960

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INTRODUCTION

In 1959 we began routine measurements of gravel composition of salmon stream beds in Southeast Alaska. Prior to initiation of routine sampling, considerable effort was devoted to development and test of sampling procedures designed to satisfy the following criteria:

1. Samples must be representative of the natural streambed.
2. Samples must be analyzed in the field near collection sites.
3. Collection and analysis must be accomplished simply and must not require more than one man.

This report describes briefly the sampling program, equipment, and procedures developed for routine measurement of streambed composition.

SAMPLING PROGRAM

Our objectives of routine gravel sampling are: (1) to define the average gravel composition of spawning areas, and (2) to measure spatial differences and temporal changes in gravel composition. To achieve these objectives gravel samples are obtained from within defined areas at randomly chosen points. Spatial differences in gravel composition are determined by sampling two or more areas simultaneously. Temporal changes are detected by sampling one area on two or more occasions.

Equipment and procedures used to measure gravel composition are designed primarily to satisfy the requirements of the sampling program. The precision with which the actual composition at a point is determined has been compromised somewhat in favor of a rapid, low-cost procedure for collection and analysis. The methods described in the following section provide, however, samples representative of the streambed and a valid basis for making comparisons.

Sampling effort required to describe the average composition of a sampling area is not excessive. If samples of gravel are divided into 10 size classes and results are expressed as percent by volume of each size class comparising the total sample, differences of 1 to 2 percent within a size class can be detected by making 50 observations (95 percent probability level).

EQUIPMENT AND PROCEDURES

Collection of Samples

Gravel samples are removed from the streambed with the aid of the sampler shown in Figure 1. The tube of the gravel sampler is worked manually to a depth of six inches into the streambed. Contents of the tube are dug by hand and lifted into the basin. Fine materials go into suspension. After gravel, sand, and silt have been removed from the tube, a water-tight cap is inserted to prevent silt in suspension within the basin from escaping.

The only bias in this technique arises because silt in suspension within the tube is lost as the sampler is lifted from the stream. Samples collected during low discharge will have a greater absolute quantity of suspended silt within the tube, on the average, than samples collected during periods of higher discharge. This is a consequence of large fractions of water occurring within the tube during low discharge than during higher discharge. An improved closure is being developed to minimize errors from this cause.

Diameter of the tube can be varied according to the size of gravel sampled. A four-inch diameter tube has been found to be satisfactory for many spawning beds in Southeast Alaska. In areas where coarse rubble predominates, a six-inch tube is better. After removing a sample from the streambed, materials are transferred to 10-quart buckets for ease of handling.

Analysis of Samples

Gravel samples are separated into 10 size classes. Solids are washed and shaken through nine standard Tyler sieves having the following square mesh openings: 26.26 mm, 13.33 mm, 6.68 mm, 3.33 mm, 1.65 mm, 0.833 mm, 0.417 mm, 0.208 mm, and 0.104 mm. Silt passing the finest screen is collected in a vessel. Figure 2 shows arrangement of screens and vessel for separation of the sample.

After having passed the finest screen, water and materials in suspension are placed in a large settling funnel (Figure 3). Ten minutes is allowed for settling. At the end of this period, materials settling into the test tube are removed and measured volumetrically. Silt remaining in suspension within the settling funnel is discarded.

Materials retained by the sieves are measured volumetrically. Each sieve is emptied into the device shown in Figure 4. Water displaced by materials from each screen is collected in a graduate and measured. To assist the removal of fine sands from the small diameter sieves, water may be dipped from the measuring device and used to wash sand from the screen. Care must be taken, however, to avoid loss of this water.

Expression of Results

The actual volume of materials collected with the gravel sampler varies slightly from point to point. To make all observation comparable, results are expressed as percent of total, i.e. the volume of each fraction separated is divided by the total measured volume of the sample.

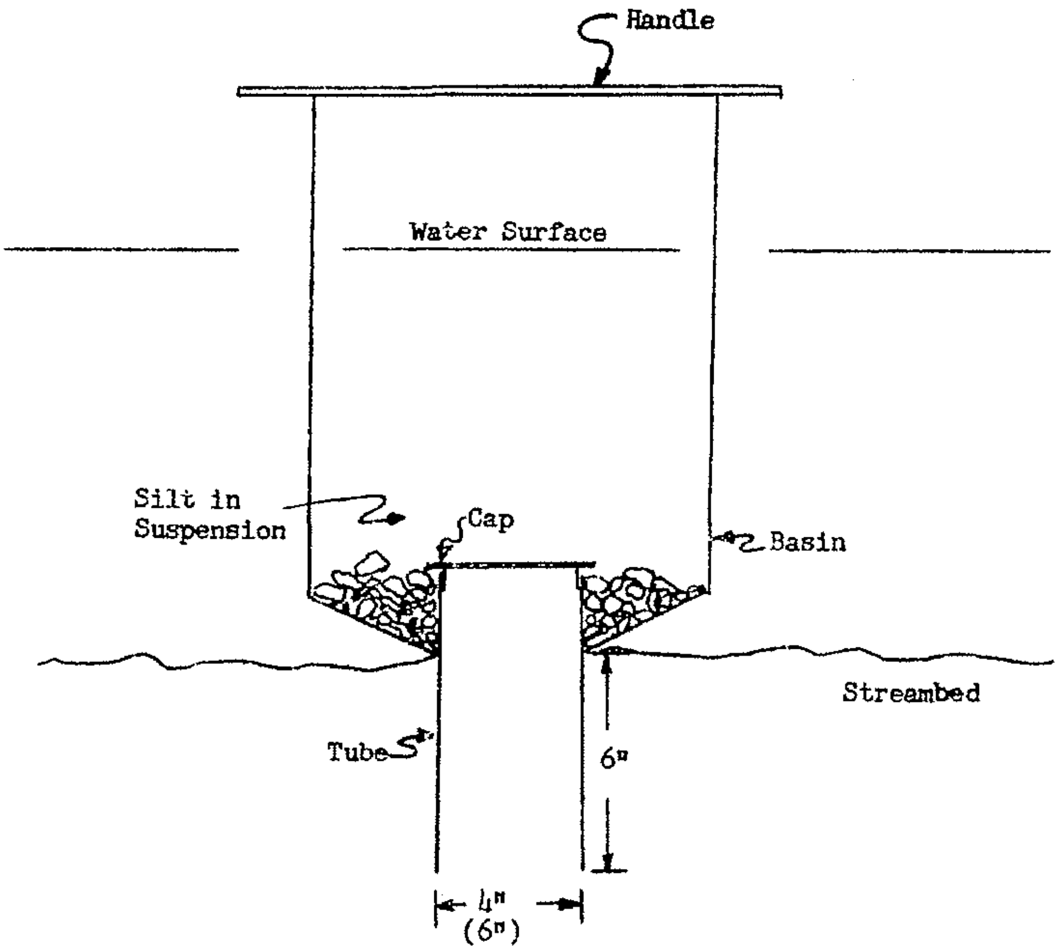

Figure 1. Gravel sampler.

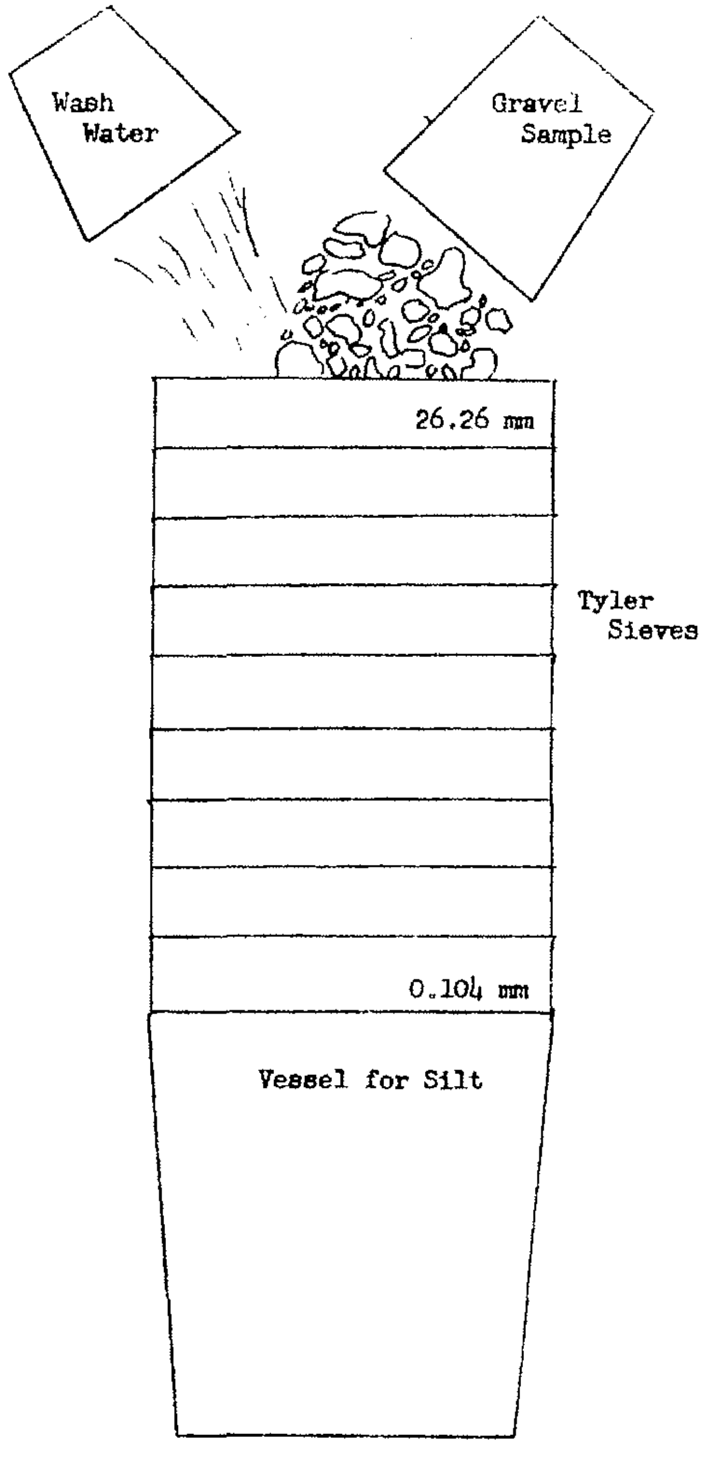

Figure 2. Arrangement of sieves and basin for separation of gravel sample.

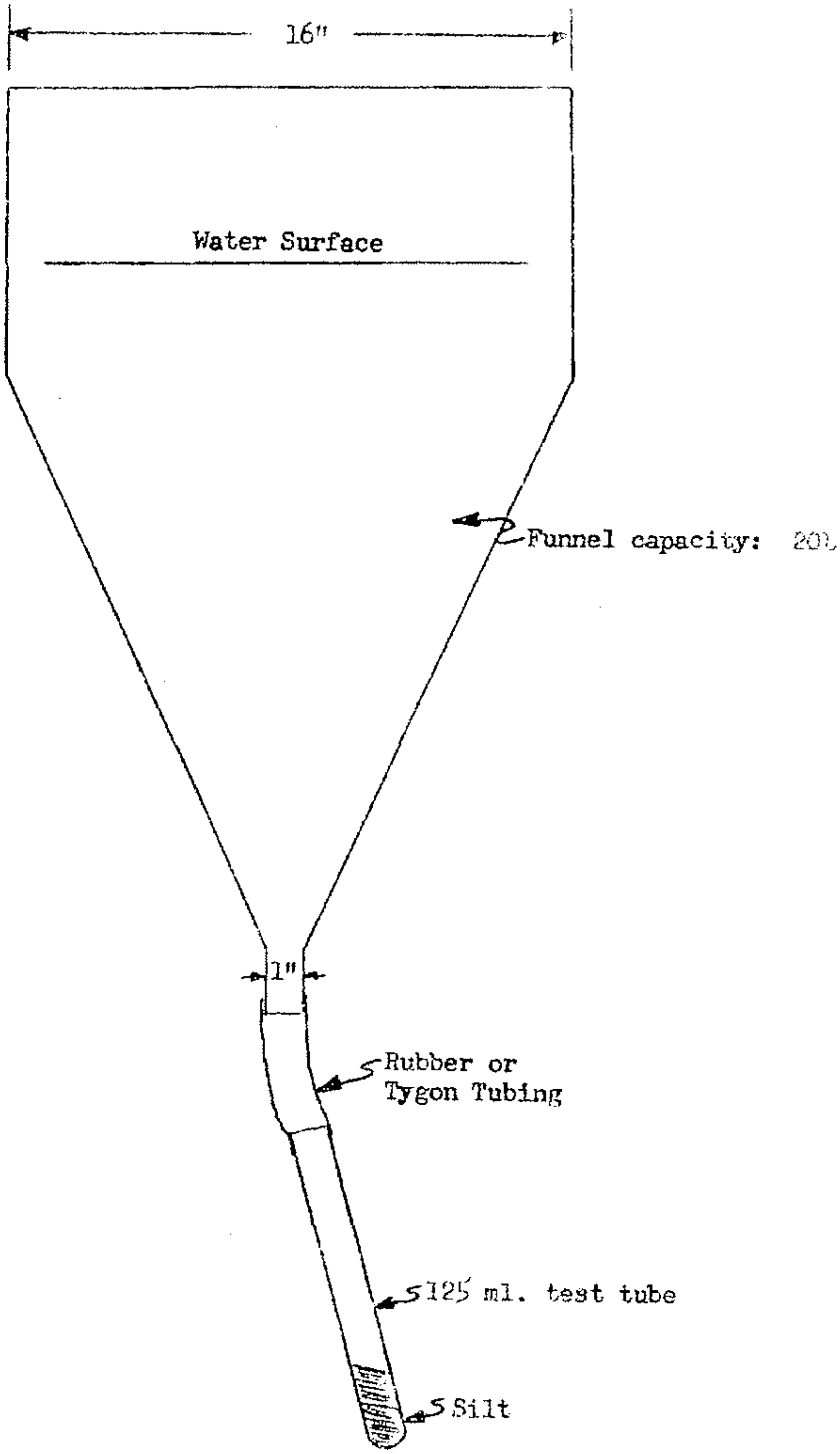

Figure 3. Settling funnel for determination of silt fraction.

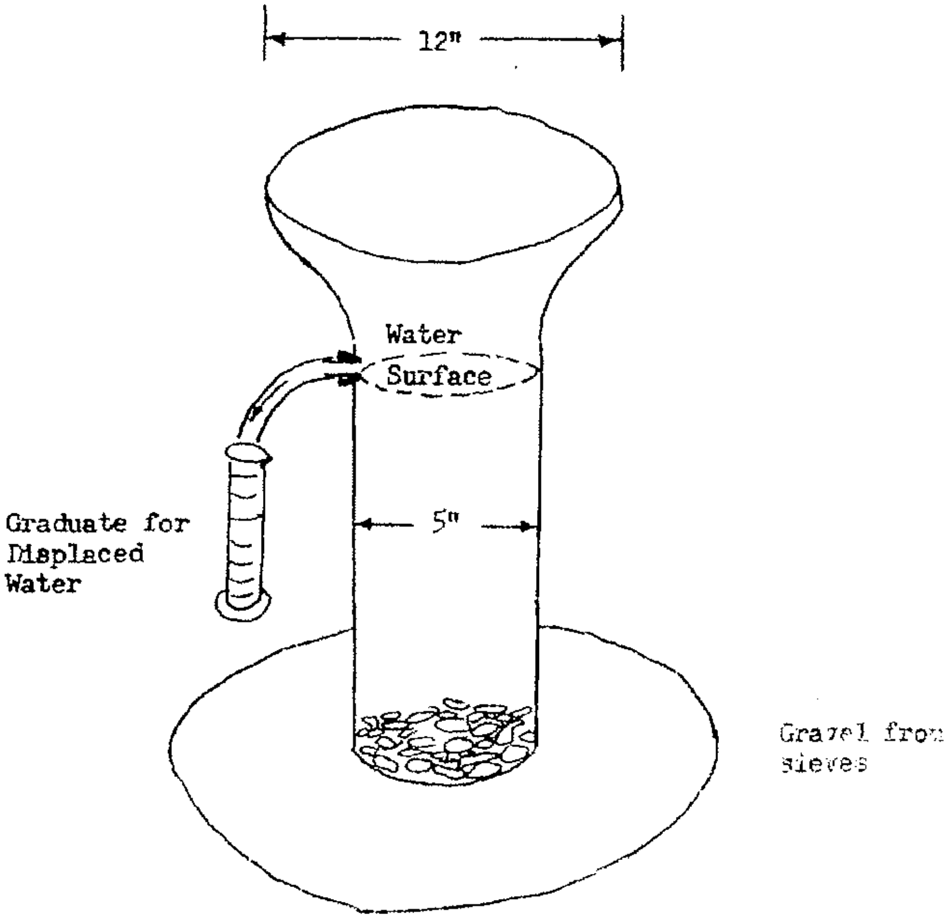

Figure 4. Device for volumetric measurement of gravel and sand fractions by displacement.