A Method for Measuring Stream Flows in Rivers

The use of hydraulic simulation models is becoming increasingly acceptable in predicting the changes in riverine fish habitat caused by altered flow regimes. Because information about practical field methods is relatively scarce and the field work can be difficult—even dangerous—we here describe some methods we believe will be useful to personnel preparing for flow studies.

We have collected data for use with the U.S. Fish and Wildlife Service's instream flow incremental methodology. Bovee and Milhous (1978) recognized that hydraulic simulation with this methodology was often made difficult by site-imposed constraints upon the collection of field data. We found that extremely long transect distances, unwadable depths, and high velocities caused difficulties in maintaining precise and repeatable sounding positions along our transects. Attachment of a boat directly to the tagline that designated the transect for depth and velocity measurements tended to bend the tagline downstream. This sometimes resulted in measurements being taken several yards away from the actual transect. Our method worked well for measuring stream flows in the Nisqually, Skokomish, and Elwha rivers of western Washington.

Our Method

A 14-ft Lavro fiberglass drift boat was equipped with a steel davit and hand winch manufactured by Kolstrand Supply Company for salmon trolling. The davit was mounted in the bow of the boat with two cast iron, quick-release clamps for ease in disassembly. The davit assembly was used to suspend a 30-lb Scientific Instruments sounding weight on a rubber-coated steel cable directly ahead of the bow. The davit extended this sounding cable far enough ahead of the boat to prevent the influence of bow wake on depth and velocity measurements. A portable water current meter sensing probe (Marsh-McBirney Model 201) was attached to the sounding cable 0.5 ft above the sounding weight (Fig. 1).

Two 200-ft lengths of 3/8-in manila line were attached to the bow and used by a worker on either bank to maneuver or steady the boat laterally. In especially strong currents, a small outboard motor aided the lateral movement. The boat was maintained in the proper upstream and downstream position using a 1/2-in bow line connected to a 3/16-in, plastic-coated wire cable stretched tightly across the river.

The wire cable usually was clamped to trees 10–20 ft upstream of the tagline to allow for downstream bending of the cable. The end of the bow line was attached to the cable by a 4 × 1 1/2-in stainless steel snap-hook that allowed the bow line to slide freely along the cable (Fig. 1). The bow line was attached to the boat by a cleat so that the operator could adjust the line length and thus position the boat and sounding cable exactly at the desired transect interval.

Thus rigged, accurate depth and velocity measurements were obtained relatively quickly and easily at any point along the transect. Three operators were required to accomplish the task—two to control the lines from shore and one to operate the boat and the davit/sounding cable assembly. The boat was more stable in swift currents, however, with a fourth person in the stern who also could operate the motor and serve as recorder.

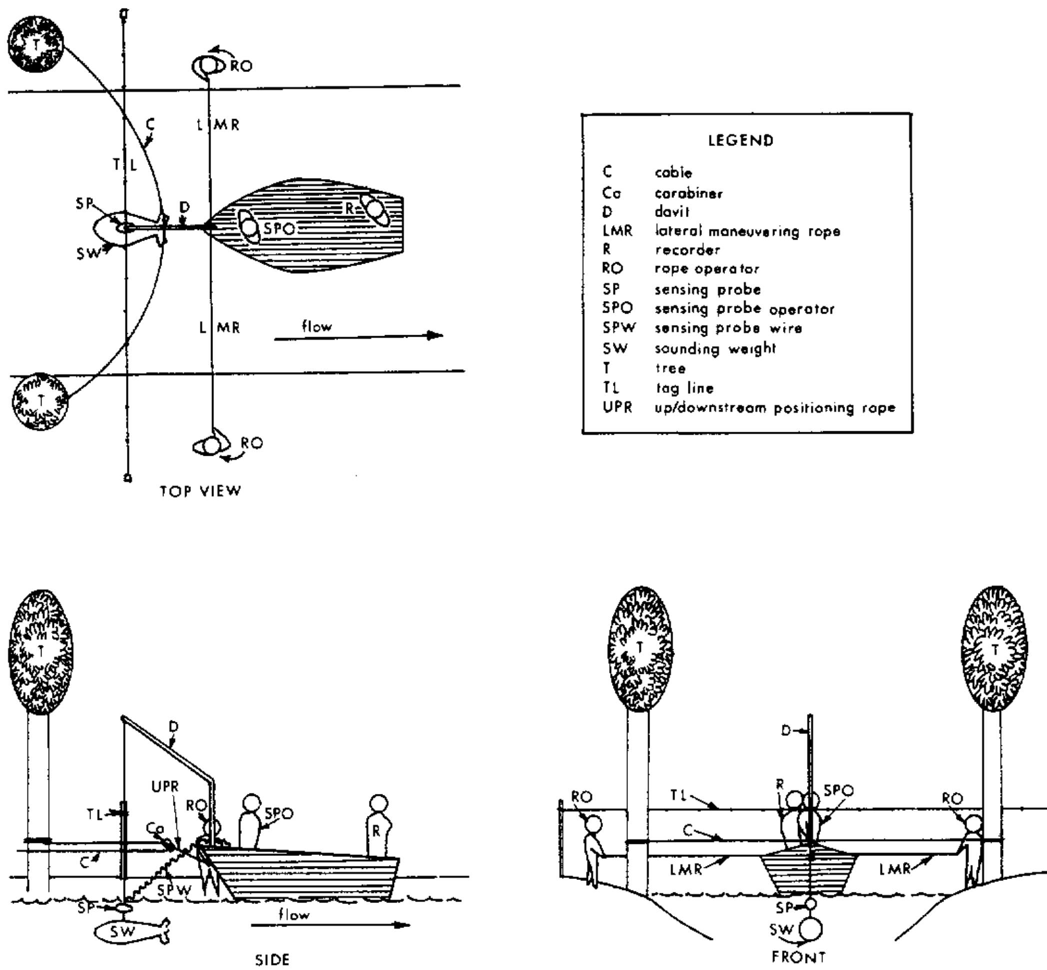

Figure 1. Arrangement of equipment and personnel for accurate and repeatable flow-study measurements.

Discussion

The maximum conditions under which we used this method were a discharge of 3,500 cfs, a stream width of 250 ft, and a velocity of 9.5 ft per second. The method should work well in larger rivers, depending on the configuration and gradient of the river bed. From our experience, configuration and gradient were important because as the width of the river increased the transects became longer, increasing the length of the lateral tending lines beyond practicality. Also, as velocity increased the downstream force of the bow line against the cable increased, making lateral movement more difficult. Thus, at the same discharge, it was easier to obtain more accurate measurements on a low gradient, U-shaped channel than on a steep, wide channel.

Acknowledgments

We want to thank Don Chapman and Phil Wampler for their invaluable guidance. We also appreciate Ms. Michelle LaGory's artwork and Jeff Davenport's efforts on the rivers.

Reference

Bovee, K. D., and R. Milhous. 1978. Hydraulic simulation in instream flow studies: theory and techniques. Instream Flow Information Paper 5, FWS/OBS-78/33. U.S. Fish and Wildlife Service, Fort Collins, Colorado, USA.