Technical Tips

Techniques for Boulder Transport and Placement in Instream Watershed Restoration Projects

Boulders have a number of uses in watershed restoration projects. When placed in clusters of three to seven boulders in mid- to downstream portion of riffle sections, they provide rearing habitat for salmonids, particularly yearling and older rainbow or steelhead trout (Ward 1997). Water velocity slows just downstream of boulder placements and within the cluster thus providing feeding, resting, holding and overwintering areas for fish. In time, scouring occurs around the boulders, further improving the quality of this fish habitat, especially for juvenile coho salmon.

In addition, boulders are frequently used as ballast to maintain the position of instream structures comprised mainly of pieces of large woody debris (LWD). This technical tip reports on two methods used within the Watershed Restoration Program (WRP) to move boulders by helicopter to stream work sites. A comparison of costs for transporting and placing boulders by ground equipment and helicopter was completed by Ward and Slaney (1979). Costs were very similar for boulders up to 500 kg, but the latter becomes increasingly expensive for heavier boulders.

The Chain (Tsumura) Sling

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We have been using a chain sling (Tsumura sling) to transport boulders by helicopter into inaccessible areas of rivers on Vancouver Island since 1981 (Tsumura and Ward 1987). The sling has proven to be fast, easier and less expensive to use than other methods for lifting boulders, such as chain nets or bolts drilled into the rock. A similar sling has also been utilized to lift boulders from trucks using a hyab crane. The obvious advantage is that disturbance of sensitive stream channels by operating equipment instream can be avoided using this technique (P. Slaney, pers. comm.).

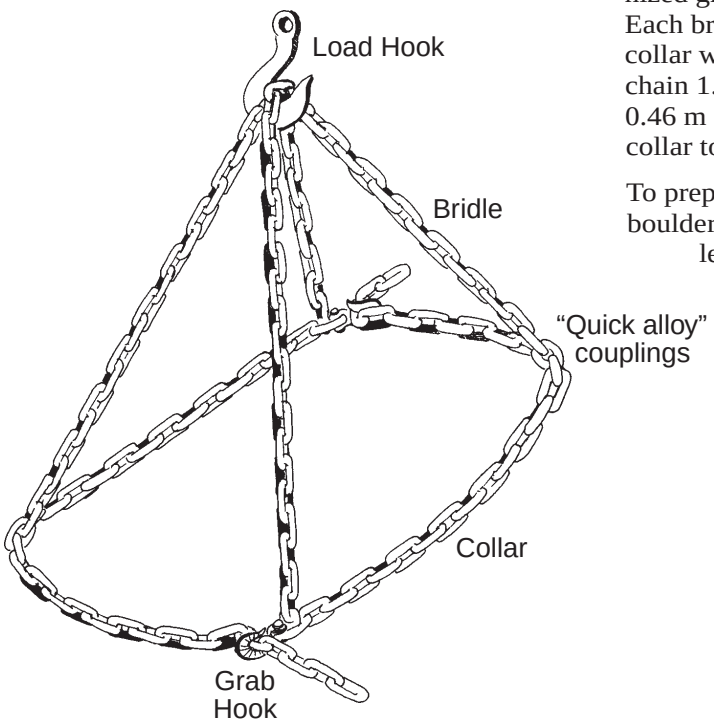

Figure 1. Chain sling used to transport boulders by helicopter to instream restoration sites (adapted from Tsumura and Ward 1987).

The sling consists of 5/16" GR 80 chain, 5/16" GR 80 galvanized grab hooks, and 7/32" Quick-Alloy couplings (Figure 1). Each bridle is approximately 3 m long and is attached to the collar with the couplings. The collar comprises two pieces of chain 1.22 m long, each piece with a grab hook on one end and 0.46 m of free chain on the other. This arrangement permits the collar to be adjusted for boulders of various sizes.

To prepare for lifting, place the collar around the base of a boulder (0.5-2.0 m in diameter) and adjust it so that the length is less than the circumference of the boulder. Do not use a chain sling that is not properly fitted or installed (Figure 2). When hoisted, the boulder (maximum weight, 800 kg) is cradled between the lifting chain and collar for safe transport to the placement site (Figure 3). The boulder is positioned in the stream, normally in the mid- to downstream half of riffle sections, and the helicopter returns to the boulder source. The chain link may then be released from the sling by undoing a grab hook, then either hauling up on the main line manually or with the helicopter when it returns, keeping back from the boulder and sling during the lift. If a grab hook cannot be released, remove one bridle from the load hook and then haul up the main line.

Several slings should be used at the lifting site to have the boulders ready for hauling. This will minimize or eliminate helicopter waiting time, and more boulders can be installed per unit of time. With several slings in use, approximately 300 boulders were placed in the Keogh River at an average rate of one boulder every

Technical Tips

Figure 2. The collar has been placed around the base of the boulder and adjusted. Next, the load hook from the helicopter will be attached to the sling. Notice the appropriate safety gear being worn by the restoration worker.

Figure 3. A helicopter carries a boulder in the chain sling and approaches the restoration site. Note the large boulders already placed in the foreground.

two minutes with a round trip distance of l km.

The load capacity of the sling, and the size and weight of boulders should be predetermined to maintain safe working conditions during the rock placement operation. It is necessary to stand several metres back from the site once the collar has been adjusted, and the helicopter initiates lifting. Loads must not be lifted over roads (which must be posted, or blocked if carry over a road is unavoidable), or anywhere people may be working. Work around helicopters requires good communication and attention to safety, including hard-hats, fluorescent vests, steel-toed boots and all other necessary precautions.

As additional tips, it should be noted that: companies that specialize in heli-lifting may provide the ground crew and spare lift lines, and that a competitive contract price is often a more cost-effective option than an hourly rate.

References

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The Epoxy-Cable or 'Pigtail' Method

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The epoxy method for attaching cable to boulders has been previously described (see *Streamline Vol. 2 No. 1*). We have adapted this method in order to lift and transport boulders by helicopter. A short piece of cable is attached to a knob which together form the choker (Figure 2). Depending on availability (ask the helicopter company), the knob may hook directly onto a hook at the end of a long line, or onto bells attached to chokers which in turn attach to a long line. Multiple bells and knobs may fit onto a particular system, permitting several boulders to be lifted simultaneously by a larger helicopter. The maximum number depends on their total weight and is ultimately determined by the helicopter's capacity.

It is first necessary to obtain the required hook dimensions for the knob on the end of the pigtail. (We used 3/4" knob but it may be specific to the helicopter company). The knob was pressed onto an approximately 1 m length of 1/2" galvanized cable. This length allows for re-use of the pig-tail the following year since the cable is cut from the boulder in the field. We drill a 9/16" diameter hole in the boulder to a depth of 9". It