Variations in Turbulence Integral Scales around Instream Boulders and Implications for Fish Habitat

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Instream boulders are integral components of river ecosystems, and boulders placement is an effective way to restore degraded streams and enhance fish habitat quality and availability by creating heterogeneous flow conditions. Instream large roughness elements, such as boulders, alter both mean and turbulence flow characteristics on a local scale. This work hypothesized that boulder placement (e.g., rock-ramp arrangement) in a stream affects local flow structures (e.g., turbulence scales) and hence the surrounding instream habitat. Our experimental study investigated variations in streamwise integral time and length scales, which are turbulent eddy features, after placing boulders in a rock-ramp arrangement in a turbulent flow. The variations were assessed for two different submergence ratios by varying the flow rate. The experiments were conducted over a gravel bed to closely mimic natural settings in the Ecohydraulics Flume that is 13.0 m long, 1.0 m wide, and 1.2 m deep, which is a water-recirculating flume located at Clarkson University. An acoustic Doppler velocimeter (ADV) was used to perform velocity time-series measurements. The possible influences of the observed eddy features were discussed in relation to habitat preference of different riverine fish species. The results will benefit projects that utilize the boulder placement technique to ecologically restore degraded streams.