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“Investigation of the Effects of Whitewater Kayak Parks on Aquatic Resources in Colorado”

Abstract

Whitewater kayak parks (WWPs) provide a valuable recreational and economic resource rapidly growing in popularity throughout communities in the United States, with Colorado being a leader in WWP design and construction. WWP structures are constructed in order to create a hydraulic jump that is desirable to kayakers. WWPs were originally thought to enhance aquatic habitat; however, recent studies have shown that the hydraulic conditions required to meet recreational needs serve as a partial barrier to upstream migrating salmonids and lower densities of fish were recorded in WWP pools compared to natural pools. Additionally, these studies are limited to a single WWP and do not account for the large variability in size, hydrologic regime, and geomorphic setting across the large number of WWPs in Colorado. There is limited knowledge concerning the direct effects of WWPs on fish passage. Managers and policy makers are forced to make decisions and review designs regarding WWPs without sound scientific evidence. It is difficult to make design recommendations for future WWPs and determine if modifications need to be made to existing WWPs to allow for successful fish passage without a direct understanding of the factors contributing to suppression of movement in WWPs. Without this understanding making informed management and policy decisions regarding WWPs will continue to be difficult. This study will utilize fish movement data (Fox, 2013), and the hydraulic results (Kolden, 2013) from 3-D computational fluid dynamics (CFD) software, FLOW-3D® v10.0 (FLOW-3D) to statistically exam the effect of multiple hydraulic parameters on fish passage in three dimensions at a WWP in Lyons, Colorado. Survey measurements will be made at additional WWP sites to determine the range of velocities that are required to produce a hydraulic jump favorable to kayakers across all WWPs in Colorado. The objectives of this study are to: 1) Use a three-dimensional CFD model to provide a more continuous and spatially explicit description of velocity, vorticity, and TKE along the flow field to compare the magnitudes of velocity, vorticity, and TKE among the Lyons WWP structures. 2) Determine the relationship between velocity, vorticity, and TKE on the suppression of movement of upstream migrating fishes through statistical analysis. Further investigate the magnitude of this relationship on different size classes of fish at the Lyons WWP structures 3) Qualitatively describe the spatial pattern and interaction of velocity, vorticity, and TKE at each of the Lyons WWP structures relative to their design and configuration. 4) Determine if similar magnitudes and patterns of velocity exist at additional WWP’s of varying scales. The expected outcomes of this project are scientific evidence of the hydraulic factors contributing to the suppression of movement of upstream migrating salmonids at the Lyons WWP, design recommendations for future WWPs and the modification of current WWPs, the range of velocities that occur at WWPs in Colorado, and the transferability of the Lyons WWP results to other WWPs.