C O L O R A D O P A R K S & W I L D L I F E

Whitewater Park Studies

RESEARCH RESULTS AND DESIGN GUIDELINES

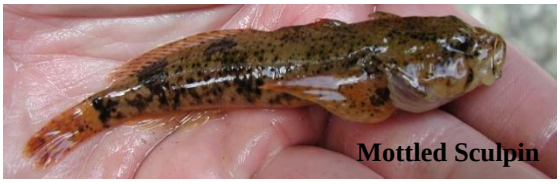
Whitewater Park Research

With over 30 whitewater parks (WWPs) either completed or in the planning phases, Colorado is the epicenter for WWP development in the United States. Although WWPs provide economic and recreational benefits for local communities (Hagenstad et al. 2000; Loomis and McTernan 2011), they may have unintended impacts on instream biota and stream functions, particularly when the hydraulic conditions formed by the WWP are different from those naturally found in the surrounding river. The impact of WWPs on habitat connectivity and instream habitat quality have been the focus of several recent studies. Although these studies have primarily focused on fish passage and habitat, impacts to aquatic insects and sediment transport may also occur at WWPs.

Fish Passage Impacts

The elements that create a desirable surf wave (increased velocity, decreased depth, a hydraulic jump, and a stable, often grouted stream channel) create conditions that can impede fish movement. Swimming speeds and jumping ability vary greatly between fish species. Suppression of upstream trout movement has been documented at WWP structures, but the degree of impact varied by fish size and characteristics of the individual structure (Stephens et al. 2015; Fox et al. 2016). As trout are among the strongest swimming and jumping fish species in Colorado, small-bodied and weaker-swimming fish native to Colorado streams are even more susceptible to habitat fragmentation associated with WWP development.

Brown Trout



Mottled Sculpin

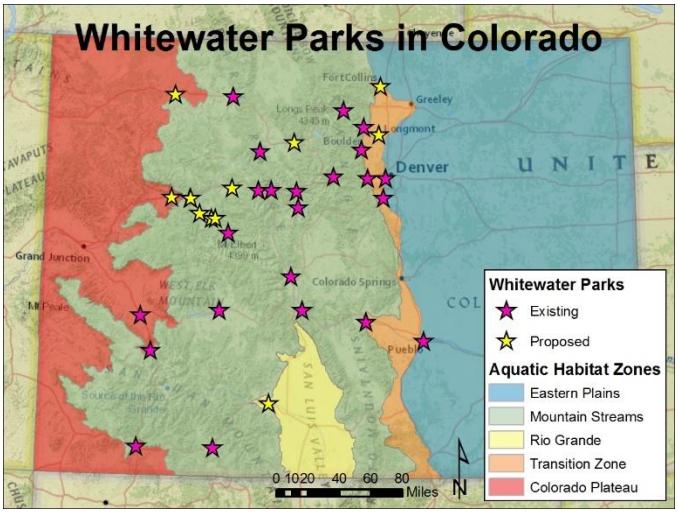
Fish Habitat Impacts

Although WWPs create deep pools, observed fish densities were significantly higher in natural pools than in WWP pools (Kolden et al. 2015; Kondratieff et al. *in preparation*). Habitat degradation in WWPs was associated with the unnatural hydraulics created by the recreational features and conversion of riffle habitat to drops over the wave structures.

Design Guidelines

CPW recommends that adequate environmental safeguards be included in the design and construction of WWPs to ensure that stream functions, fisheries, and recreational fishing are not adversely impacted. Each structure must be examined on a case-by-case basis, and monitoring and adaptive management should be included in the proposed project budget.

Site Selection



- Design and construction of WWPs should preserve the natural aesthetic qualities of the river. WWPs should be located in degraded reaches when possible and should aim to improve the natural functions of the reach rather than maintain degraded conditions. WWPs should not be constructed in natural, un-modified river channels (American Whitewater 2007).
- WWP sites should be selected to minimize recreational conflicts with anglers. There is increased potential for boaters to displace anglers at WWP sites, especially during the summer months. If WWP construction affects a popular fishing location, mitigation such as new fishing access or habitat improvements should be considered.

Ecological Design Considerations

- WWP structures must be designed to allow upstream fish passage for all life stages of native and sport fishes present throughout the annual hydrologic cycle. Fish passage is dependent on water velocity, water depth, vertical height of structures, linear distance of the passage corridor, surface roughness, and attraction flow.
- Hydraulic characteristics at WWP features generally conflict with ideal conditions for fish passage. Therefore, a fish passage channel separate from the WWP structure may be necessary. The passage channel should meet hydraulic design criteria for target species across a range of flows.
- Hydraulic modeling of the proposed structure should be conducted during the initial design phase to evaluate potential impacts to fish passage and habitat.
- Streambed and bank disturbance due to construction activities should be scheduled for a time of year when egg incubation is not occurring. An increase in fine sediment to the stream during incubation can suffocate developing embryos. Erosion control and revegetation plans utilizing native riparian species should be required for each project.
- WWP structures should not cause sediment deposition upstream or downstream of the structure. Sediment deposition can eliminate fish and benthic macroinvertebrate habitats, create favorable conditions for the spread of whirling disease in trout, and increase flooding risk if sediment deposition decreases channel capacity.
- Recreational In-channel Diversion (RICD) water rights can be acquired for WWPs to provide recreational experiences in and on the water. These protected flows should be managed to benefit boating recreation as well as conservation and management of native and sport fish. Flows deviating from the natural flow regime, such as water calls during spawning periods, could have adverse impacts on stream ecology (Poff et al. 1997).

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