

## **Hide and Seek in the Grand Canyon? Brown & Rainbow Trout vs. Humpback Chub**

**Original Presentation, “Effects of Sedimentation and Turbidity on Species Interactions in the Colorado River”, by Sean Ehlman February 15, 2017**

Aquatic conditions in the Colorado River through the Grand Canyon have given rise to an ecological version of hide and seek. However, this version doesn't involve children hiding and chasing one another. Rather, it involves a native fish species, the humpback chub, two non-native species, the brown and rainbow trout, and the changed river conditions that have given the “new kids on the block” an unfair advantage.

Native species in the Grand Canyon, in particular fish, face a number of changes to their habitat that hinder reproduction and survival. Most of these changes are a result of the construction of Glen Canyon Dam, just upstream of the Grand Canyon. The timing, magnitude, and ecological makeup of current releases from the dam vary strikingly from historical streamflow conditions. One of the most dramatic changes is the drastically reduced level of sediment in the river below the dam.

Sediment levels of a river are typically correlated with a river's clarity or “turbidity”. Historically the Colorado River through the Grand Canyon had very high sediment and turbidity levels, which left the river a muddy brown color. Turbidity levels were nearly 200 times greater than current conditions, with an average of 1700 FNU (Formazin Nephelometric Unit). Completion of the dam created an impediment to the natural movement of sediment through the river. Today, turbidity levels usually measure less than 10 FNU, with the majority of the sediment in the river downstream of the dam originating from tributaries in the Grand Canyon. Although turbidity levels show small spikes during monsoonal floods and High-Flow Experiments (HFE) from Glen Canyon Dam, measurements never approach historic conditions. As such, the Colorado through the Grand Canyon now typically runs a green, almost emerald, color.

The dramatic flow changes have negatively impacted a native species of fish, the humpback chub. The humpback chub has evolved and adapted to the historically turbid conditions of the Colorado through the Grand Canyon. Not coincidentally, the population of humpback chub has severely declined since completion of Glen Canyon dam. Also not coincidentally, the largest modern-day population of humpback chub in the Grand Canyon is located in the Little Colorado River. The Little Colorado is a largely un-altered tributary of the Colorado River, that maintains flow processes and habitat conditions that the chub has evolved to live in. While a number of other ecological changes have also contributed to the decline of the humpback chub in the mainstem of the Colorado, less turbid water limits the juvenile chub's ability to find refuge from predators and thus succeed in their game of hide and seek.

The new kids on the block, rainbow and brown trout, are non-native fish

species that were introduced into the Colorado after completion of the dam. The trout have thrived in the cold, clear water conditions in the river below the dam, as the less turbid waters allow for optimal hunting conditions. Not surprisingly, rainbow and brown trout have found an easy target in their game of hide and seek in the Grand Canyon: juvenile humpback chub.

However, one study has shown that a relatively small increase in turbidity levels presents humpback chub with significantly improved chances of succeeding in the game of hide and seek. The study analyzed humpback chub survival under different turbidity levels when placed in tanks with brown trout and tanks with rainbow trout. In both instances, chub survival increased as turbidity levels increased, with survival peaking around turbidity levels of 200 FNU. Such a level represents a small increase from current conditions, and somewhat more surprisingly is still only a fraction of historic levels. Accordingly, several management strategies have been proposed to better manage sediment and turbidity levels that would theoretically improve conditions for wild humpback chub survival.

High Flow Experiments (HFE) are one tool water managers have been testing over the last 20 years to better control and increase sediment levels in the Colorado through the Grand Canyon. The more recent HFEs have been timed with sediment pulses in the tributary streams to best manage flow impacts on sediment levels in the river. An additional goal of the high flow experiments is to create sandbar and backwater habitats along the banks of the Colorado. Habitats such as these are ideal for humpback chub as they are typically shallower, warmer, and higher in turbidity. Two other potential ideas to increase sediment and turbidity levels are one, direct input of sediment into the river and two, constructing sediment screens near select riverbank locations in the Grand Canyon. The sediment screens would direct and trap sediment in shallower areas to create refuge locations for juvenile humpback chub. As of this writing, only the high flow experiments have been tested and results have been mixed. The flow experiments were able to initiate sediment movement and sandbar/backwater construction, however the results were short lived and increased sediment/turbidity levels were not maintained.

While the game of hide and seek in the Grand Canyon is not yet completely over for the humpback chub, current flow conditions impose a significant handicap to their success. Some hope exists in the fact that a relatively small increase in turbidity levels can tip the scales back in their favor. Innovations and experiments in the management of stream flow and sediment processes in the Grand Canyon show promise to create a fairer game of hide and seek between trout and the humpback chub.