The backbone-less community of the Grand Canyon: a story of diversity
by Nicole Tanner

Based on the presentation "Aquatic invertebrates of the Grand Canyon" by Kelsey Lyberger

It takes backbone to raft the Colorado River in the Grand Canyon, but it doesn't take any backbone to live there. Tens of thousands of the Grand Canyon's inhabitants have no backbone…biologically speaking, that is! Invertebrates are organisms that do not have a vertebral column, also known as the backbone or spine, and these organisms are an essential part of the Colorado River's ecosystem, providing a major food source for prey animals such as fish, lizards, and birds. The health of an ecosystem depends on biodiversity, and it is well known that the biodiversity of any river is affected by modification of the river. The construction of the Glen Canyon Dam on the Colorado River and experimental floods after the construction of the dam saw effects on the diversity of invertebrates in the Grand Canyon. Kelsey Lyberger, a graduate student in the ecology graduate group at the University of California, Davis, elaborated on these effects during her talk "Aquatic invertebrates of the Grand Canyon" February 15th.

Prior to the construction of the Glen Canyon Dam on the Colorado River, the Grand Canyon contained a diverse population of native invertebrates including mayflies, dragonflies, caddisflies, backswimmers, scuds, damselflies, black flies, and waterboatmen. Before the completion of the dam in 1963, further species were introduced into the ecosystem below where the dam was being built. These species included 10,000 New Zealand mud snails, 50,000 more scuds, 10,000 more mayflies, and 5,000 leeches. Different species of invertebrates prefer different conditions. For example, scuds love cold water, while mayflies prefer warm water. When a dam is constructed, water pools on the upstream side of the dam and is let out of the reservoir at a pre-determined rate downstream. The water at the bottom of the reservoir is cooler than that at the top of the reservoir since heat rises. Therefore, the water that comes out from the bottom of the dam is much cooler than the surface water. The cold water loving scuds were able to survive the building of the dam, whereas warm water lovers such as mayflies have mostly vanished.

The construction of the Glen Canyon Dam not only caused a difference in general numbers of invertebrate species within the Grand Canyon, but it also caused a differentiation of invertebrate communities at different parts of the river. Just below Glen Canyon Dam, scientists saw a prominence of New Zealand mud snails, scuds, and non-biting midges. Farther downstream, there was a prominence of black flies and scuds. This difference was primarily caused by a difference in invertebrate food sources. These species of invertebrates feed on two types of algae that thrive in different conditions. One of the types of algae grows in clear water, just below the dam. This part of the river is comprised of clear water due to sediment being trapped on the upstream side of the dam, rather than releasing normal amounts of sediment downstream. The other type of algae thrives in turbid water, which is caused from the entrance of smaller streams and rivers into the Colorado River.

The natural water level of a river is higher than the level of water allowed to flow from a dam, and flooding events that naturally occur periodically do not occur with the steady release from a dam. This causes disruptions to the river's ecosystem. Scientists attempted to emulate natural flooding events using experimental floods, in which a larger volume of water was allowed to pass through the Glen Canyon Dam over a short period of time, although not quite as much as would flow in a flood. Experimental floods occurred in 1996 and 2008. The diversity of aquatic invertebrates was monitored before and after these experimental floods. It was thought that the experimental flooding would increase biodiversity within this delicate and intricate ecosystem. The first of the experimental floods in 1996 caused a decrease in biomass, the amount of organisms in the river, but an increase in diversity. This experimental flood caused the most diverse fauna ever recorded during a six-year monitoring program! The 2008 experimental flood, however, caused an immediate reduction in biomass directly below the dam, mostly the dominating species (scuds and New Zealand mud snails), but no change farther downstream.

The diversity of the backbone-less invertebrate community of the Grand Canyon has fluctuated over time due to human involvement, both from intentional placement of other species into the Colorado River and from construction of the Glen Canyon dam. Attempts to restore the natural diversity within the invertebrate community with flooding experiments have flushed out some of the dominating species, increasing the diversity within the community. The Grand Canyon invertebrate community is very diverse and complex, but it seems that the diversification of the Grand Canyon is far from the natural community that was there before the Glen Canyon dam was constructed.