

Impacts to river biota studied in Zion Narrows

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Of all the recreational opportunities provided by Zion National Park (Utah), hiking the Virgin River Narrows (fig. 1) is among the most popular activities. Annually, thousands of people wade into the waters of the North Fork Virgin River to enjoy its scenic steep-walled canyon, commonly known as The Narrows. The Narrows is not only a favored hotspot for river recreation, but also a biological oasis within the upper Colorado River system that contains critical habitat for a number of riverine species. While visitors enjoy the canyon experience, their wading activity disrupts the riverbed, altering the habitat of benthic (bottom-dwelling) organisms and potentially reducing populations.

Concern over the potential impacts of wading on river biota in the North Fork Virgin River led to a cooperative study by the National Park Service and researchers from the University of Montana, Flathead Lake Biological Station. In spring 1996, we began a study to characterize zoobenthic biomass at different locations in the river corridor. Recreational river use varied among sites and we expected to observe an impact gradient where low biomass was associated with intensive visitor use (trampling).

Visitors can enter the Narrows canyon from both an upstream and downstream location. To gain access from the upstream location, hikers are required to obtain a backcountry use permit. We relied upon the permit data to estimate hikers traveling downstream, and monitored wading activities on six separate days in August and September 1996 to estimate hikers traveling upstream from the downstream access point. Using this information, we were able to determine the average number of hikers per day passing each of our seven benthic sampling sites, providing an estimate of trampling impact at these locations. Three replicate samples were collected from each sampling site to determine zoobenthic biomass, using ash-free dry mass (g/m^2) and density (individuals/ m^2).

Estimates of trampling impact within the river corridor revealed a gradient of decreasing impact upstream for all six days of the study. Trampling impact was the greatest at the most downstream site, located at the end

of the Riverside Walk trail (mean = 2,006), but decreased rapidly with less than 30% of the waders continuing a mile upstream to the next site at Orderville Canyon (mean = 609). Levels of trampling were very low at sites deep within the canyon. Less than 5% (mean = 125) continued to the next upstream site at Big Springs and the least amount of wading activity occurred at the uppermost site (mean = 95).

With the trampling gradient established, we determined that sites with any trampling exhibited reduced benthic biomass when compared to their reference sites (no trampling), with the greatest decline occurring where trampling impact was most intense. The impact of hikers heading upstream from Riverside Walk resulted in a substantial decrease in biomass, but less than one-third of the waders actually hiked one mile upstream. Therefore, the heavy impact directly associated with the number of hikers is limited, with less than 70% of waders hiking just a short distance upstream from Riverside Walk.

A complicating factor in this kind of analysis is the longitudinal change of the river itself. Although trampling impact was lowest at the most upstream site, the river is very narrow there (a few meters) and confined in spots by the canyon, forcing hikers to walk in the riverbed for long stretches. The size of the stream and lack of a riparian zone results in the riverbed being thoroughly disturbed by wading activity and a significant reduction in zoobenthic biomass, even though the trampling impact was quite low by comparison.

In the Virgin River Narrows, we found the level of recreational river use and site characteristics to be clearly associated with zoobenthic biomass throughout the river corridor. Our study illustrates that the trampling impact of hikers creates a serious habitat disturbance where the severity of the

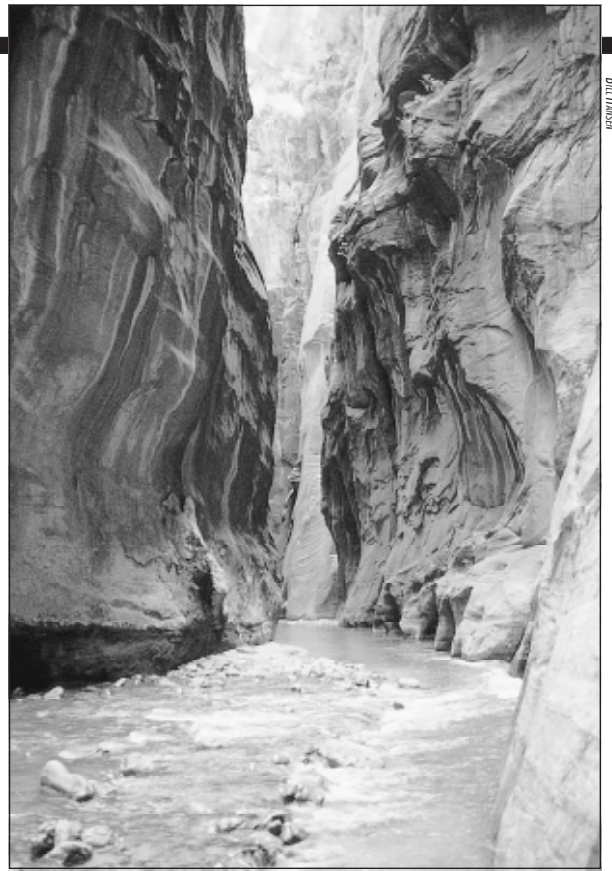


Figure 1. The Zion Narrows is a spectacular river corridor that is very popular among hikers at various times of the year. The study examined the relationship between trampling of the aquatic environment and impacts to the organisms that live in the riverine habitat.

impact is dependent upon the level of trampling and river characteristics.

The North Fork Virgin River in Zion National Park is critical habitat for a number of desert fishes, which have experienced a steep decline in numbers throughout the Southwest and now exist only in isolated populations. Similarly, the stonefly, *Isogenoides zionensis*, is considered rare throughout its range; however, it thrives in the canyons of Zion National Park and can be found there in very high numbers. Many other important species also exist within this riverine habitat. The impact from intense recreational river use may threaten the viability of these populations due to habitat disturbance and the disruption of a healthy riverine food web based on benthic organisms. **P₅**

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