10-31-1989

Impact of cattle on two isolated fish populations in Pahranagat Valley, Nevada

Frances R. Taylor
University of Nevada, Las Vegas

Leah A. Gillman
University of Nevada, Las Vegas

John W. Pedretti
University of Nevada, Las Vegas

Follow this and additional works at: https://scholarsarchive.byu.edu/gbn

Recommended Citation
Available at: https://scholarsarchive.byu.edu/gbn/vol49/iss4/3

This Article is brought to you for free and open access by the Western North American Naturalist Publications at BYU ScholarsArchive. It has been accepted for inclusion in Great Basin Naturalist by an authorized editor of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.
IMPACT OF CATTLE ON TWO ISOLATED FISH POPULATIONS IN PAHRANAGAT VALLEY, NEVADA

Frances R. Taylor, Leah A. Gillman, and John W. Pedretti

ABSTRACT.—The presence of cattle at Brownie Spring and Ash Springs in Pahranagat Valley, Nevada, impacted fish populations by causing an increase in ammonia (NH₃) and nitrite (NO₂) levels, an increase in Pseudomonas aeruginosa and Aeromonas hydrophila, and increased mortality and morbidity. One of the affected fishes, the White River springfish, is listed as endangered by the Department of the Interior. After removal of the cattle from Ash Springs, NH₃ and NO₂ levels decreased and fish populations increased. At Brownie Spring the NH₃ and NO₂ levels are chronically elevated, cattle are still present, and the speckled dace population has not recovered.

As spring systems diminish and human use of land and water increases, endemic fish populations increasingly live precariously between threatened and extinct status. In Pahranagat Valley and elsewhere in the West, a prominent cause of this situation involves the management of water for use by cattle with unrestricted access. Urine and feces from cattle elevate ammonia and nitrites in the water, causing an increase in oxygen needed by nitrifying bacteria and a decrease in oxygen for fish. In addition, ammonia and nitrites are toxic to fish in chronic amounts (Lewis and Morris 1986, Thurston et al. 1986, Sheehan et al. 1986). Direct cattle access to spring systems also results in increases in ubiquitous bacteria such as Pseudomonas aeruginosa, Aeromonas hydrophila, and coliforms.

This paper examines the effect of cattle on two fish populations in Pahranagat Valley and discusses possible management strategies for spring systems with cattle access problems.

STUDY AREAS

Pahranagat Valley, approximately 18.6 km long and 2 km wide, is about 100 km N of Las Vegas in Lincoln County, Nevada. The valley, bounded by the Pahranagat Mountains on the west and the Hiko Mountains on the east, is drained by the pluvial White River (Hubbs and Miller 1948).

Archaeological data suggest that an aboriginal group presumed to be Shoshonean/proto Numic, probably ancestors of the Numic-speaking Southern Paiutes, entered the valley sometime after 1000 A.D. Caucasians, primarily Latter-day Saints (Mormons), settled the valley in 1865 for the purpose of mining. By 1866, farmers with livestock were moving into the rich farmlands of Pahranagat Valley (Fowler 1973).

Brownie Spring (T5S, R60E, Sec. 26, SE 1/4) is situated at the base of a cliff behind a cattle pasture between Ash Springs and Crystal Springs west of Highway 93 in Pahranagat Valley. The spring headpool measures approximately 8 m by 5 m by 1 m deep with an outflow approximately 50 m long by .5 m wide and less than 10 cm deep. Water temperature fluctuates between 17 C and 21 C, and pH ranges from 7.1 to 7.8. The spring is home to Pahranagat speckled dace, Rhinichthys osculus ssp. No exotic fish are found in the spring, although bullfrog tadpoles have been collected occasionally. A native snail, Physella gyrina ssp. has been collected. Aquatic vegetation consists of Nasturtium, Spirogyra, and floating algal mats.

Ash Springs (T6S, R61E, Sec. 6), Pahranagat Valley, Nevada, is south of Brownie Spring. It is a warm-water spring with temperatures varying from 33 C at the outflow to 35 C at the headpool. The outflow is on private property, but the headpool is situated on Bureau of Land Management (BLM) land and is developed for recreational camping. One of the two source springs on BLM land is utilized as a “hot tub.” There are three endemic fishes in Ash Springs: White River spring fish (Crenichthys baileyi baileyi), Pahranagat

1Department of Biological Sciences, University of Nevada, Las Vegas, Las Vegas, Nevada 89154
roundtail chub (*Gila robusta jordani*), and Pahranagat speckled dace (*Rhinichthys osculus velifer*). The White River spring fish and Pahranagat roundtail chub are endangered species pursuant to the Endangered Species Act. The outflow previously supported White River desert suckers (*Catostomus clarki intermedins*) and Pahranagat spine dace (*Lepidomeda alivelis*). Several exotic species, gambusia (*Gambusia affinis*), mollies (*Poecilia mexicana, P. latipinna*), and cichlids (*Cichlasoma nigrofasciatum*) have become established in the spring.

**METHODS**

Brownie Spring was initially evaluated as a site for a study of population dynamics. It became apparent through the initial eight-month study during 1986 that there were some major problems with the spring system. The system was seined on a monthly basis, and sex ratios, total lengths, and volumes were measured on the fish collected. As the study progressed, the population declined. Because cattle use was obvious, ammonia and nitrite readings were taken and were found to be quite high (Table 1). Live fish brought to our laboratory were in poor health and appeared to be oxygen deprived.

In the summer of 1986, a collection of *C. b. baileyi* from Ash Springs, brought into the laboratory for rearing, was found to be in extremely poor health. Cultures and histopathology showed hyperplasia of the gill lamellae and the presence of *Pseudomonas aeruginosa* and *Aeromonas hydrophila*. Routine evaluation of the spring system revealed cattle at the headpool and elevated ammonia and nitrite levels (Table 1). A culture of the water revealed heavy growth of *Pseudomonas aeruginosa, Aeromonas hydrophila,* and an *Enterobacter* sp. Both *Pseudomonas* and *Aeromonas* are considered pathogenic to many species, including humans and fish. *Enterobacter* are common intestinal bacteria. A period of three months was necessary for the fish in the lab to recover and attain reproductive condition.

Population estimates were made of springfish, mollies, gambusia, and cichlids from the summer 1986 through the summer 1988 by seining, marking and recapturing, and snorkeling.

**Table 1.** Ammonia (NH\(_3\)) and nitrite (NO\(_2\)) levels (ppm) at two springs in Pahranagat Valley, Nevada**.

<table>
<thead>
<tr>
<th>Date</th>
<th>Brownie Spring</th>
<th>Ash Springs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NH(_3)</td>
<td>NO(_2)</td>
</tr>
<tr>
<td>7-86</td>
<td>.28</td>
<td>.7</td>
</tr>
<tr>
<td>8-86</td>
<td>.25</td>
<td>.5</td>
</tr>
<tr>
<td>9-86</td>
<td>.28</td>
<td>.8</td>
</tr>
<tr>
<td>2-87</td>
<td>.25</td>
<td>.2</td>
</tr>
<tr>
<td>4-87</td>
<td>.25</td>
<td>.2</td>
</tr>
<tr>
<td>6-88</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>9-88</td>
<td>.25</td>
<td>.2</td>
</tr>
</tbody>
</table>

**Fig. 1.** Population estimates of *Rhinichthys osculus* at Brownie Spring, Pahranagat Valley, Nevada, in 1986.

**RESULTS**

The effect of cattle on the fish populations of both spring systems appears significant. Within a seven-month period in 1986, the
Fig. 2. Population estimates of Crenicthys baileyi baileyi, Gambusia affinis, Poecilia mexicana, and Cichlasoma nigrofasciatum at Ash Springs, Pahranagat Valley, Nevada, from summer 1986 through summer 1988.
Brownie Spring population declined from about 284 individuals, including 102 subadults, to 32 individuals with only 14 subadults. The decline was perhaps exacerbated by stress induced by seining (Fig. 1). Since 1986, the population has increased to roughly one hundred individuals. Cattle are still present at Brownie Spring.

Between summer 1986 and spring 1987 when cattle were on the headpool at Ash Springs, there was a marked decline in springfish, gambusia, cichlids and both mollies (Fig. 2). Springfish were least affected, possibly because of their ability to survive conditions of low oxygen concentrations (Hubbs and Hettler 1964). The molly population dropped by over 50%, from approximately 45,000 to about 22,000. Gambusia dropped from 5,000 to 550, and cichlids dropped from 4,500 to 1,300. Cattle were removed in 1987, and by the fall of that year populations of all fishes increased to nearly their 1985 numbers.

**Discussion**

Cattle at both springs caused an increase in ammonia and nitrites, an increase in bacteria, a possible decrease in oxygen available to the fish, and an increase in fish mortality and morbidity. Removal of cattle at Ash Springs quickly reversed these conditions.

Health of fish collected from springs or streams with unrestricted livestock access should always be suspect. Transporting and holding such fish may require increasing aeration of the water, minimizing stressful factors such as handling and poor water quality (i.e., ammonia and nitrite levels in the water), and instituting antibiotic therapy. We found that fish responded well to Chloramphenicol 250 mg/19 L daily for 7–10 days. It is important to monitor ammonia and nitrite levels daily and change water as needed to maintain low levels.

In a U.S. General Accounting Office report (Duffus 1988), it was found that many riparian areas are overgrazed and in degraded condition because of poor livestock management. These areas provide water, food, shade, and cover for fish and wildlife, which are in some cases threatened or endangered species. Livestock, when unrestricted, tend to congregate in riparian zones for extended periods, eat most of the vegetation, trample the streambanks, and contaminate the aquatic system with urine and feces, all of which increase the mortality and morbidity of aquatic species and degrade water quality. Improved livestock management by fencing or herding can permit seasonal or geographical restrictions.

The Bureau of Land Management has authority and must take the lead in controlling degradation of riparian zones on public lands. They did so at Ash Springs, once the problem was identified. In the frequent instances in which BLM does not require maintenance of an undegraded riparian corridor on public lands, conservation organizations and individuals can speed the process of restoration by invoking the provisions of the Clean Water Act to force BLM to discharge its responsibilities (Braun 1986).

**Acknowledgments**

Peter Tuttle provided the population data on Ash Springs. James Deacon critically reviewed the manuscript and provided many helpful suggestions.

**Literature Cited**


