

## Southwest Biological Science Center

# Research Brief for Resource Managers

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**Contact:**Chris O'Brien<sup>1,2</sup>, Dean W. Blinn<sup>2</sup>, and  
Charles van Riper III<sup>1,2</sup>**Phone:**

928-523-6162

**Email:**

chris.o\_brien@nau.edu

<sup>1</sup>Southwest Biological Science Center, Northern Arizona University, P.O. Box 5614, Flagstaff, AZ 86011-5614

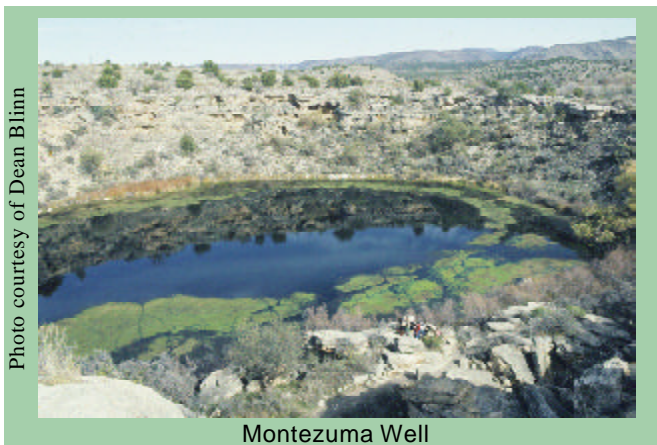
<sup>2</sup>Department of Biological Sciences, Northern Arizona University P.O. Box 5640, Flagstaff, AZ 86011-5640

## Waterfowl, Acanthocephalans, and Amphipods at Montezuma Well, Arizona - What is the Role of a Parasite?

Montezuma Well, a National Park Service unit, is located in the Verde Valley of central Arizona. Wintering waterfowl utilize this park and infect an endemic amphipod with a parasite that alters the amphipod's appearance. This parasitic interaction may have major effects on the ecology of this aquatic ecosystem. Because of its isolation and few species, Montezuma Well is an ideal system to study ecological interactions between parasites and hosts. The U.S. Geological Survey, Southwest Biological Science Center, in cooperation with Northern Arizona University, is studying this interesting interaction.

### Montezuma Well

Montezuma Well, a collapsed spring mound, is a unique aquatic system. The Well is 100 meters wide, 17 meters deep, and is surrounded by a travertine wall that rises ~20 meters above the water surface and a nearshore shallow zone that supports a dense stand of the aquatic plant, Illinois pondweed (*Potamogeton illinoensis*).



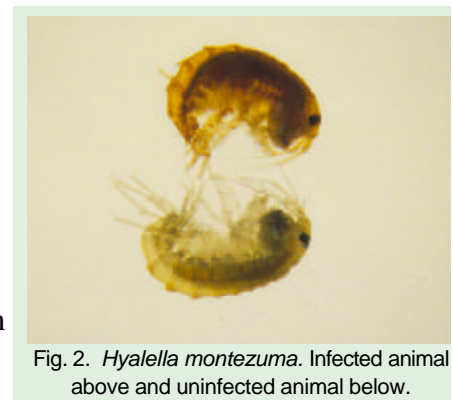
Spring water enters through deep subterranean vents at the bottom of the Well and water temperature and discharge are constant year round. This water is high in alkalinity and the concentration of dissolved carbon dioxide exceeds 500 milligrams per liter. These qualities chemically isolate Montezuma Well from nearby Wet Beaver Creek. This aquatic environment excludes fish but is home to several species of invertebrates that are found nowhere else, including the amphipod or freshwater scud (*Hyaella montezuma*).

### Acanthocephalan Parasite

In Montezuma Well, these amphipods are infected by an acanthocephalan (thorny-headed worm) parasite. This parasite has an indirect life cycle, which means that it needs more than one host to complete its life cycle. In this case, reproduction in the parasite's life cycle is completed in waterfowl (definitive host) and growth in the amphipod (intermediate host).

Parasites can have many different effects

upon their hosts, ranging from changes in host survivorship and fecundity to alterations in host behavior, size, appearance, and habitat preferences. Parasites that need two different hosts to complete their life cycle are especially interesting. The way in which these parasites affect their alternate host often



acts to increase transmission back to the definitive host so that the odds of life cycle completion are increased. For example, in other terrestrial and aquatic systems, acanthocephalan parasites have been shown to alter the behavior of their intermediate hosts, and these behavioral alterations can increase predation by the definitive host. We hope to see if this is the case at Montezuma Well.

### The Amphipod (The Alternate Host)

In the absence of fish, the amphipod in Montezuma Well has evolved an unusual free-swimming habit, migrating into the surface waters at dusk to feed on an organic surface film of microbes. These amphipods are followed to the surface by their primary predator, *Motobdella montezuma*, an endemic free-swimming leech. Soon after dark, amphipods move into the nearshore vegetation to escape predation from this leech. In the nearshore vegetation, amphipods are subject to predation from several invertebrate predators, including a water bug (*Belostoma bakeri*) as well as from waterfowl that also forage in the nearshore vegetation. This migration pattern occurs every day of the year.

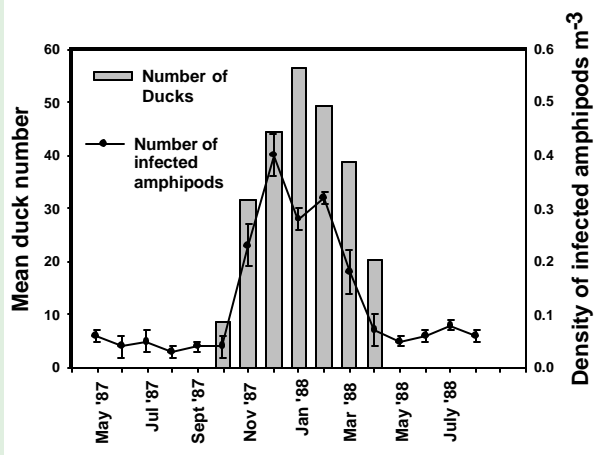


Fig. 1. Infected amphipod densities and mean duck numbers at Montezuma Well, 1987-88

### Waterfowl (The Definitive Hosts)

High duck numbers at the Well are strongly correlated with the rate of amphipod parasitism. (Figure 1). Three to five percent of amphipods are parasitized during the winter compared to less than one percent during the summer and fall. Waterfowl at Montezuma Well fluctuate seasonally in abundance, with highest numbers present during the winter period from October through April. The most common waterfowl during this period are American Widgeons

and American Coots. The only waterfowl present during the rest of the year are Pied-billed Grebes, which likely breed at the Well. The effects of the acanthocephalan parasite on waterfowl are unknown.

### Preliminary Results

In Montezuma Well, the body of an infected amphipod turns completely orange, in contrast to its normal gray-green color (Figure 2). It is unusual for an acanthocephalan to affect its host color so completely. Preliminary observations suggest that infected amphipods also are more likely to be found in the nearshore vegetation of Montezuma Well, and past investigations have documented much higher densities of amphipods in the nearshore zone during the winter. Initial observations suggest that infected amphipods are more lethargic and slower swimmers than uninfected individuals. These observations need to be quantified.

### Implications of Parasitism

The acanthocephalan parasite in Montezuma Well could have strong effects on invertebrate interactions in this aquatic ecosystem. Altered behavior of amphipods could affect energy flow between the open water and nearshore regions. Predator-prey interactions could also be affected because there is a community of invertebrate and vertebrate predators that consume amphipods in both regions. Finally, varying yearly densities of waterfowl, resulting in differing year-to-year rates of parasitism could mediate all of these interactions. There is considerable opportunity for research at Montezuma Well that would help us understand how parasites can play a role in the ecology of aquatic ecosystems.

### Additional Information

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