A NANFA CONSERVATION RESEARCH GRANT REPORT

The Mexican Blindcat (*Prietella phreatophila*): Research and Exploration in the Groundwater

Jean K. Krejca
4806 Savorey Lane, Austin, TX 78744
creature@mail.utexas.edu

My dive buddy and I were beached on a muddy slope, tired and weighed down with around 70 pounds of dive gear. The plan was to wait until the first team came back with news of how long the unexplored sump (a section of cave passage that is entirely filled with water) was, and what the passage was like on the other side. After some time had passed and they had not returned, it began to sink in that the sealed-off chamber we were waiting in, while fairly roomy (approximately 20 m in diameter), was entirely full of bad air.

A slightly elevated level of carbon dioxide and a sufficiently low level of oxygen give the feeling of climbing at a high altitude. We found ourselves panting with every little movement, and developing increasingly severe headaches. In this kind of bad air it is possible to breathe and survive for a long time, but judgment gets blurred and the physiological effects increase with each breath. After about an hour (or two? or three?) I crawled up onto the flat top of the mud slope and vomited. At that point we finally put two and two together and decided to kit up for an exit. With hindsight it was remarkable that it took us that long to make this decision.

There would be no more searching for the Mexican blindcat (Fig. 1) today—it was time to measure how close we were to a potentially dangerous situation and get out of there.

The trip out involved putting the tanks and equipment back on, and sliding into the now-murky water with a careful thumb and forefinger looped around the dive line. After a fairly steep descent to about 10 m, my side-mounted tanks hit the smooth bedrock ceiling. Soon after my stomach came to lie against the cobble floor, and I began a body-length squirm through the tight passage. Once out of this place, the rest of Thanksgiving Sump is a fairly easy sloping ascent to another section of air-filled passage (Fig. 2).

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By now the clear air from the tanks had caused my headache to begin subsiding. We were ready for the long slog through 600 m of ankle- to knee-deep mud to reach Catfish Parlour Sump, the final sump that separated us from a warm campfire underneath the stars. The water here was also murky by now (no more blindcats were spotted), and we uneventfully passed through its twists and turns (Fig. 3).

Researching a rare species that lives in remote places can be full of days like this. Many person-hours are spent gaining access into the rare portal that provides human passage into an elusive desert aquifer. Then it takes a combination of persistence and luck to actually encounter your target species.

The Mexican blindcat, *Prietella phreatophila* (Carranza, 1954), dwells in the groundwater below the desert of Northern Coahuila, México (Fig. 4). Groundwater is usually a place we don't think of as fish habitat, since most of it is trapped in tiny pores in rocks or spaces between gravels. However, in karst areas (which are typified by subterranean drainage, including features such as sinkholes, caves and springs), the groundwater takes on the characteristics of surface streams, except that they travel through underground passages rather than valleys on the surface. The trick is to find access points to these passages, which can come in the form of cave entrances, spring orifices, and wells. A recent article by Hendrickson et al. (2001) summarizes the work our research team has done to find additional access points to the aquifer, and, therefore, additional localities

Fig. 1.
Mexican blindcat (*Prietella phreatophila*). Photo by the author.

for this rare fish. Of over 50 caves, wells and springs we visited, only 10 of them proved to be localities for the only two known species of this genus (*P. phreatophila* and *P. lundbergi*). The latter species occurs in only two locations, and only five specimens have ever been seen.

The most recent trip to study the Mexican blindcat took place in November of 2001, and was funded by the North American Native Fishes Association Conservation Research Grant. The objectives that were accomplished during this trip can be used to outline some of the ongoing research on this species.

Mark-Recapture Study

On the November 2001 trip, we accomplished the first re-capture of a marked fish in a different pool than where it had been marked. Marked in June 1998 at Catfish Parlour Sump, this fish was found on the other side of Sump Three in a passage that was discovered on this trip. The day after the exasperating day described above, we returned to push through Sump Three and map the new section of unexplored passage. During the survey, I noticed a blindcat and stopped to examine it. I was thrilled to note that it had the bright pink "tattoo" that had been placed on it three years prior!

Around 12 more blindcats were marked on this trip, bringing the total to nearly 40 marked fish. Several others from previous trips were also recaptured. We used an injectable tag consisting of fluorescent and brightly colored latex microbeads that are inserted at different places on the fish's body to track individuals. The fish are captured and anesthetized using clove oil, measurements are taken, including length (Fig. 5) and volume, and then they are marked in one or two places and the marks are photographed. Our objectives are to estimate the populations of the various pools in the cave, and to track the species' growth and movement through the cave system. We also downloaded information from a data logger that sits in the first cave pool and tracks temperature fluctuations in their habitat.

Cave Survey

Thanks to an experienced team of cave divers and vertical cavers (Fig. 6), the frontiers of exploration in Sótano de Amezcua were pushed to an exciting new discovery during the November 2001 trip. In the upstream direction, the virgin Sump Three was penetrated to reveal a very large new section of passage. This new passage doubles the length of the cave from 600 m to its current length of over 1300 m. The new passage is spectacular, with gravel-floored passages from five to 15 m in diameter, and full of large galleries.

In the downstream direction, two dives were made and approximately 150 m of new underwater passage was explored, but not surveyed.

Fig. 2.
Map of Sótano de Amezcua, updated with new survey from 2001. Note that none of the passage between Sump Three and Sump Four was previously explored or surveyed.

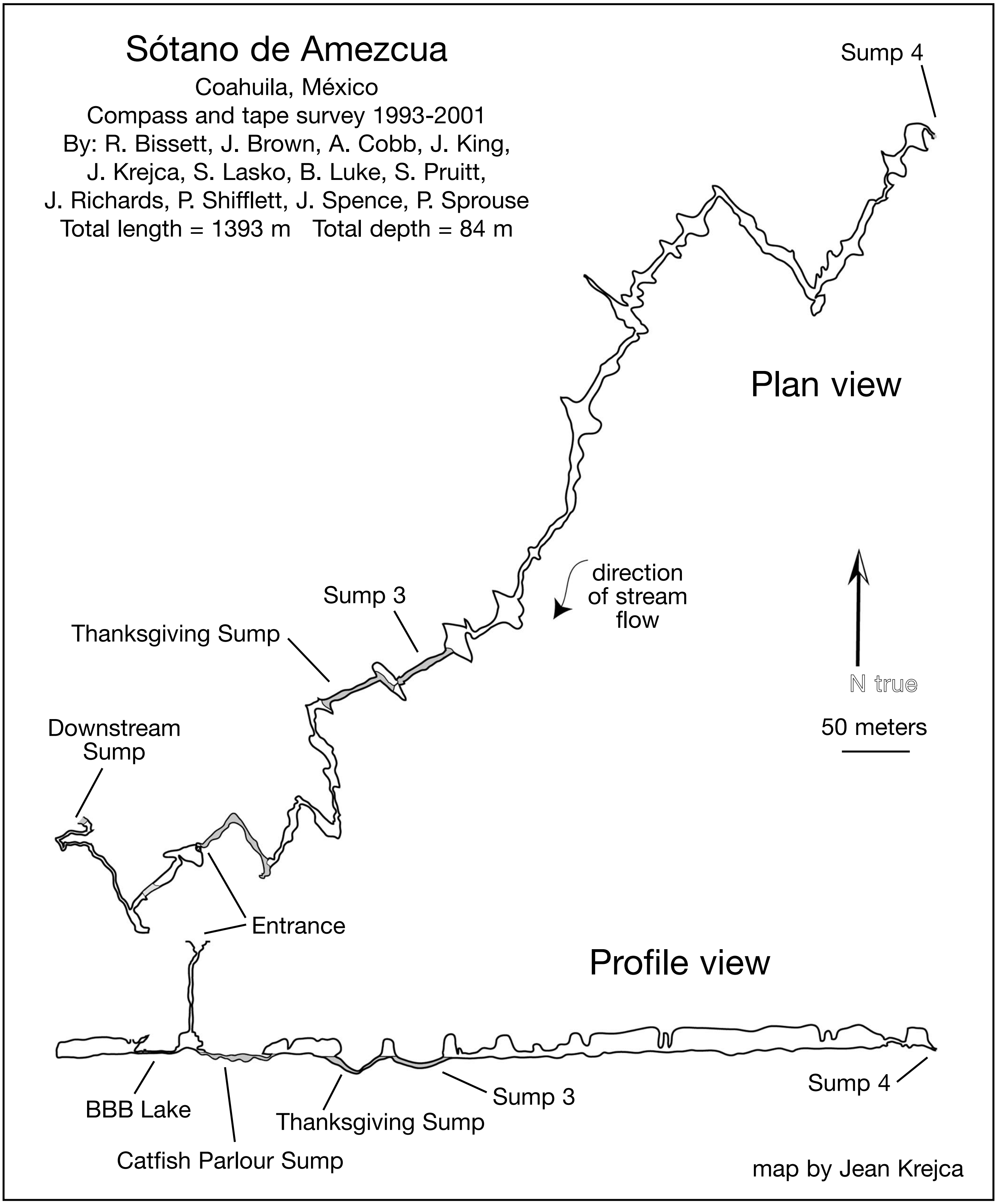


Fig. 3.
Diver James Brown, in one of only four photographs taken on the far side of Catfish Parlour Sump. Note the murky water, stirred up by the divers, and the mud-covered walls and ceiling that tell of flood events that at times entirely submerge this passage. Photo by the author.

On the cave map (Fig. 2), none of the passage between Sump Three and Sump Four was entirely known or explored prior to this trip. An article by Krejca et al. (2000) summarizes other cave discoveries and explorations made while searching for blindcats, and also shows the historic map of Sótano de Amezcua before this new section was discovered.

Invertebrate Study

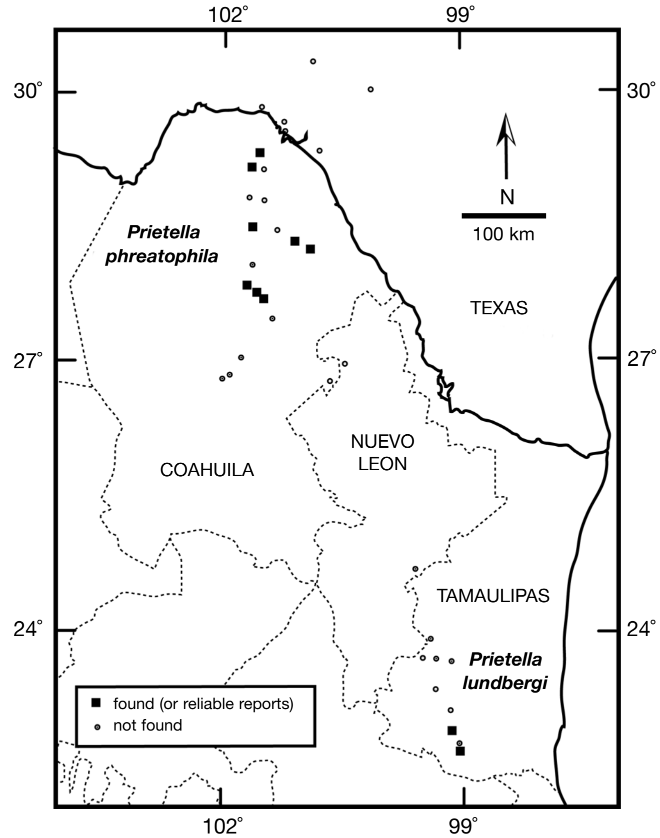
A cirolanid isopod, *Cirolanides texensis* (Fig. 7), was also found in the new section of passage. These isopods, in addition to several other groups of isopods, including the asellid *Lirceolus cocytus* (Fig. 8), and an amphipod, are probably the food source for the blindcats. The isopods are also entirely adapted to the subterranean environment, sharing the fish's eyelessness and lack of pigment.

In addition to inventorying the species that co-occur with the blindcats, we are working on a broader scale study testing the idea of whether genes of aquifer-adapted invertebrates can be used as an indicator of groundwater connections. The problem with studying groundwater flow in karst is that very infrequently can a researcher travel through the subterranean passages. So in order to learn where groundwaters flow, remote sensing techniques are used. Typically, hydrologists use techniques such as dye tracing and potentiometric surface mapping to make inferences about subterranean flowpaths. The idea that we are testing is that the genetic relatedness of these aquifer organisms will follow the hydrologic relationships of these sites, and therefore genetic studies can be an additional tool for hydrologists to answer connectivity questions in karst. Once the subterranean flowpaths are better understood, anthropogenic impacts such as well drilling and contaminant spread can be better predicted in these environments. An extended abstract describing this work was presented by Krejca (2002).

Laboratory Studies

Since 1992, individuals of *P. phreatophila* have been maintained in captivity, where many observations have been made (Hendrickson et al., 2001). Some of the more atypical

Fig. 4.
Area map showing localities for *P. phreatophila* and *P. lundbergi*, adapted from Hendrickson et al. (2001).



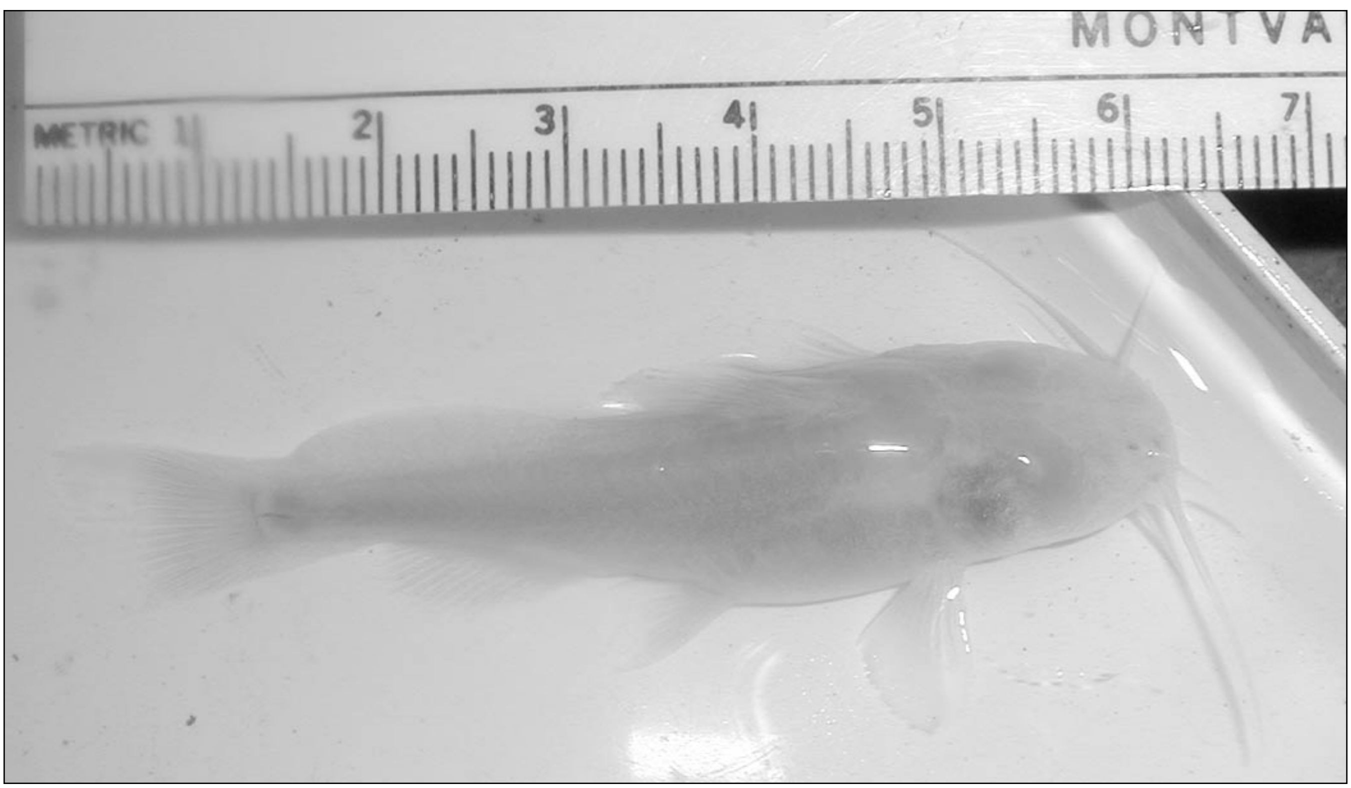
behaviors they exhibit include periods of jaw-locking and inactivity. The jaw-locking always takes place soon after individuals are re-arranged into different tanks, and involves two individuals (thought to be males) biting each other's head and maintaining a grip for anywhere from a couple minutes to over 12 hours. During most of this time they are relatively motionless, but occasionally one will pull the other individual around and they may let go for a few seconds and change position. After the initial encounter, they do not seem to repeat the procedure.

Periods of inactivity appear to be a sort of torpor, where the opercular movements are drastically slowed, and the individual may drift around with the current of the tank oriented in any direction. They are also commonly seen laying on their sides or backs on the bottom of the tank, seemingly dead. This behavior may be some indication of the lack of predators in their cave environment.

To date, there have been three spawning events, where courtship behavior has been observed, and eggs have been seen at least twice. Unfortunately in

Fig. 5 (below). *Prietella phreatophila* from Sótano de Amezcua undergoing anesthesia in preparation for being marked. Photo by the author.

Fig. 6 (right). Vertical caver Vivian Loftin rappelling into the entrance of Sótano de Amezcua. Photo by the author.



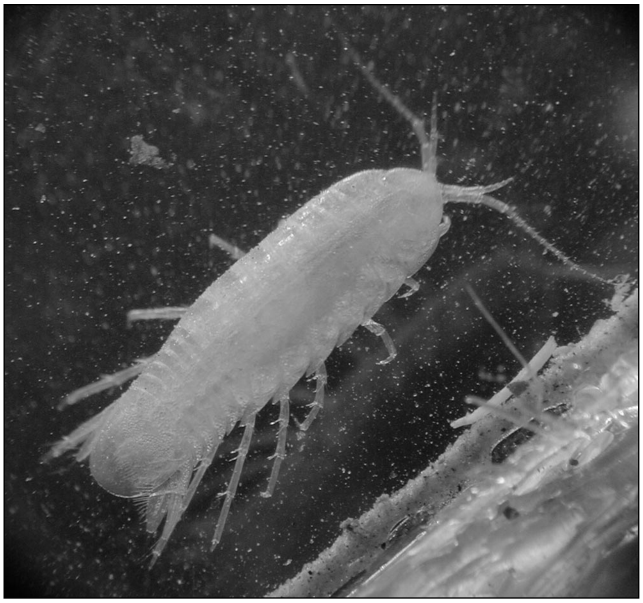


Fig. 7.
A cirolanid isopod (*Cirolanides texensis*) from Sótano de Amezcua. Body length is approximately 8 mm. This species is known throughout Texas and in northern México. Photo by the author.

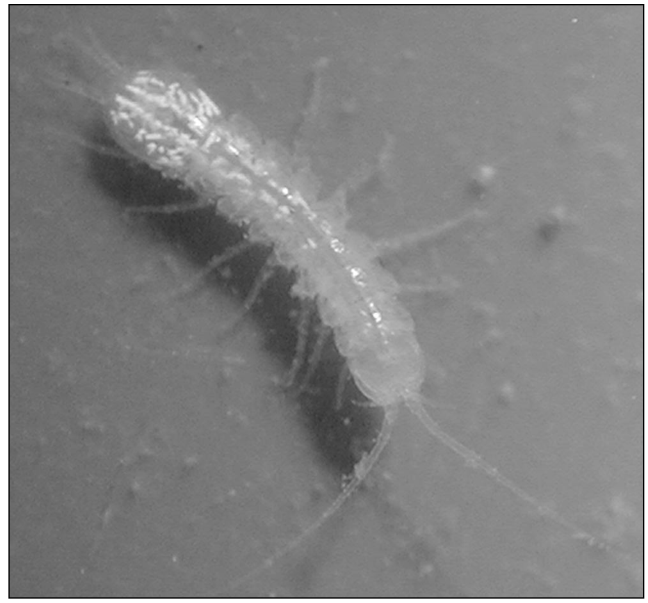


Fig. 8.
An asellid isopod (*Lirceolus cocytus*) from Sótano de Amezcua. Body length is approximately 4 mm. This species is also known from a water-filled cave in Reeves County, Texas. Photo by the author.

both cases the eggs disappeared within 24 hours, presumably having been eaten by other fish in the tank. Efforts to have a successful breeding event by separating eggs and adults after spawning continue.

Other Topics

As reviewed in Hendrickson et al. (2001), laboratory studies on light sensitivity, sensory biology, starvation tolerance, and genetics (phylogenetic relationships and population genetic studies) are also underway. In addition, we continue to look for new localities in México and southern Texas, and to continue to maintain access to known localities to study these species. To see more images and learn more about what is going on, check the following web sites:

`webspace.utexas.edu/deanhend/www/`

`www.inhs.uiuc.edu/~sjtaylor/cave/mexico/mexico.html`

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