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THE CURRENT STATUS AND HABITATS OF THE ILLINOIS CAVE AMPHIPOD, *GAMMARUS ACHERONDYTES* HUBRICHT AND MACKIN (CRUSTACEA: AMPHIPODA)

D.W. WEBB, L.M. PAGE, AND S.J. TAYLOR
Center For Biodiversity, Illinois Natural History Survey, 607 East Peabody Drive, Champaign, IL 61820 USA
J.K. KREJCA
Department of Zoology, University of Texas, Austin, TX 78712 USA

Gammarus acherondytes *is a rare amphipod endemic to Illinois subterranean streams. It previously was recorded from five cave streams in Monroe and St. Clair counties, Illinois. An examination of 164 caves from 1986 to 1995 produced only one new record, Madonnaville Cave, in Monroe County. These recent collections have documented a large population of* G. acherondytes *in Illinois Caverns, a moderate-sized population in Fogelpole Cave, and a small population in Krueger-Dry Run Cave. Pautler Cave, a previously known locality, has been bulldozed shut by the landowner. No specimens of* G. acherondytes *have been collected in Stemler Cave since 1965, and no specimens were collected in Madonnaville Cave in 1995 although a single specimen was collected in 1986.*

Gammarus acherondytes Hubricht and Mackin is a rare endemic amphipod found in the subterranean streams of Monroe and St. Clair Counties, Illinois (Bousfield 1958; Cole 1970a, 1970b; Holsinger 1972; Hubricht & Mackin 1940; Nicholas 1960; Page 1974; Peck & Lewis 1978; Webb 1993, 1995; Webb *et al.* 1993). It originally was recorded from Illinois Caverns [as Morrisons Cave], Monroe County, and Stemler Cave, St. Clair County (Hubricht & Mackin 1940). Holsinger (1972) reported it from four caves in Monroe County and one cave in St. Clair County, but did not specify which caves. Peck and Lewis (1978) reported it from Fogelpole Cave, Krueger-Dry Run Cave [as Fruths Spider Cave], Illinois Caverns and Pautler Cave, all in Monroe County. These are the four caves from Monroe County referred to by Holsinger (1972) (J.R. Holsinger, personal communication, 1996). Eighty caves were searched in 1992 and 1993 for *G. acherondytes* (Webb 1993; Webb *et al.* 1993) including four of the five caves from which it was previously recorded. The entrance to the only other previously recorded site, Pautler Cave, has been bulldozed shut.

During this time (1992-1993), it was collected only in Fogelpole Cave and Illinois Caverns. In addition, material collected during a study of 84 Illinois caves by Oliver and Graham (1988) was examined. A single specimen from Madonnaville Cave (Monroe County) was found in this material and constitutes a new locality record for this species.

Gammarus acherondytes is on the Illinois list of threatened and endangered species (Herkert 1992), and is now listed as a federally endangered species (U.S. Department of the Interior, Fish & Wildlife Service, 1998). In 1993 and 1995, the Fish and Wildlife Service requested a status report from the Illinois Natural History Survey (INHS) on this species that included a reexamination of all known localities in Illinois as well as other subterranean streams. The request called for examination of the species' habitat, its association with, and population size in relation to, other amphipod species, and evaluation of environmental conditions that might impact the species.

The following is an assessment of the current status of *Gammarus acherondytes* in Illinois caves.

FOGELPOLE CAVE (MONROE COUNTY)

This is the longest cave in Illinois (Bretz & Harris 1961; Frasz 1983; Webb *et al.* 1993). It passes under a broad area of upland karst containing crops and livestock farmland, rural dwellings, and several small communities. Throughout the area, small woodlots containing sinkholes receive runoff from fields, residential land, and roads. This runoff eventually drains into the main cave stream of Fogelpole Cave. The passage over the main cave stream is 10 m high by about 12 m wide, with the stream 3-6 m wide and 0.3-1.2 m deep. Both upstream and downstream of this area are several side passages. The main cave stream is characterized by deep pools, shallow riffles, and raceways, with large gravel bars and breakdown blocks. The cave is in excess of 24 km long (J. Sherrill, personal communication, 1996). A wide variety of other habitats are found in this cave.

Fauna: Aquatic organisms recorded from this cave (Peck & Lewis 1978; Webb *et al.* 1993) are Platyhelminthes: Turbellaria: *Sphalloplana hubrichti* (Hyman); Mollusca: Gastropoda: *Physa halei* Lea; Arthropoda: Crustacea: Amphipoda: *Bactrurus brachycaudus* Hubricht and Mackin, *Crangonyx forbesi* (Hubricht and Mackin), *Gammarus acherondytes*, *G. troglophilus* Hubricht and Mackin; Isopoda: *Caecidotea brevicauda* (Forbes), *C. packardi* Hubricht and Mackin; Chordata: Pisces: *Cottus carolinae* (Gill).

In 1995, five sites in this cave were examined for amphipods (Table 1).

Current Status: The two main entrances of Fogelpole Cave

Table 1. The abundance and habitat of *Bactrurus brachycaudus, Crangonyx forbesi, Gammarus acherondytes,* and *G. troglophilus* collected from five sites in Fogelpole Cave, Monroe County, Illinois on 24 August 1995.

Habitat Type	Width	Depth	Substrate	*Bactrurus brachycaudus*	*Crangonyx forbesi*	*Gammarus acherondytes*	*Gammarus troglophilus*
mainstream riffles, pools	6 m	8-10 cm	limestone rocks, breakdown, gravel, organic debris	0	27	14	140
stagnant side channel	0.6 m	up to 1 m	silt overlying bedrock	0	1	0	1
overflow channel	8 cm-5 m	1-90 cm	silt overlying bedrock	1	57	0	21
small rivulet	15-60 cm	1-10 cm	sand & gravel overlying bedrock	0	2	0	61
sidestream riffle, pool	0.3-1.2 m	<15 cm	calcite gravel, sand, rubble, silt, bedrock	0	6	19	13
			TOTAL	1	93	19	236
			%	0.3	26.6	5.4	67.6

are closed with welded steel grates that allow for the passage of bats, and the other entrances are protected by landowners or difficult passages. Thus, human visitation is not a major threat to the cave and its life. Surface runoff from a heavy rainstorm in 1995 was observed to pour down a previously dry streambed and into this cave through the lower of the two main entrances. This runoff was heavily laden with silt from nearby agricultural fields.

Gammarus acherondytes was collected in association with *G. troglophilus* and *Crangonyx forbesi* (Table 1) in gravel-cobble riffles in the main cave stream and in the calcite-gravel-sand-silt riffles and pools of a small lateral stream. Of 349 amphipods collected from the five sites, *G. acherondytes* made up 5.4% of the specimens. In the two riffle sites where collected it made up 9.3% of the amphipods. *Gammarus acherondytes* was collected in Fogelpole Cave in 1965 (1 specimen, J. Holsinger collection), 1986 (1 INHS), 1993 (10 INHS), and 1995 (19 INHS).

A nitrate nitrogen concentration of 4.14 ppm was detected in a water sample taken February 24, 1992, which is below the U. S. Environmental Protection Agency maximum contaminant level (USEPAMCL) (USEPA 1988, 1990, 1991) of 10 ppm. The pesticides o,p-DDE, p,p'-DDE, o,p-DDD, Dieldrin, Aldrin, Heptachlor, Heptachlor epoxide, DDT, and Aroclor 1254 as well as PCBs were not detected in water samples collected February 24, 1992 and September 29, 1992. No mercury was detected in water samples collected on those dates, but concentrations of 658 ppb and 327 ppb were measured in the bioassay of amphipods and isopods, respectively, collected in Fogelpole Cave on February 24, 1992 (Webb *et al.* 1993). Amphipod samples from this same collection were too small for pesticide and PCB bioassays, but Dieldrin and the persistent breakdown products of DDT were detected in the isopods from this cave (Webb *et al.* 1993).

ILLINOIS CAVERNS (MONROE COUNTY)

This is one of the largest cave systems in Illinois (Bretz & Harris 1961; Frasz 1983; Webb *et al.* 1993). It passes under an area of upland karst supporting crops and livestock farmland and rural dwellings. Throughout the area are small woodlots containing sinkholes that receive runoff from fields, residential land, and roads. The main entrance is located in a moderate-sized wooded sinkhole that has been modified to allow easy but controlled access to the cave. The cave contains 8.8 km of mapped passages (Frasz 1983) and carries a significant amount of water. The passages show evidence of flooding, and often have an accumulation of surface organic debris such as large logs and leaves.

Fauna: Aquatic organisms recorded from this cave (Peck & Lewis 1978; Webb *et al.* 1993) are Platyhelminthes: Turbellaria: *Sphalloplana hubrichti*; Mollusca: Gastropoda: *Physa halei*; Bivalvia: *Musculium* sp.; Arthropoda: Crustacea: Amphipoda: *Bactrurus brachycaudus*, *Crangonyx forbesi*, *Gammarus acherondytes*, *G. troglophilus*; Isopoda: *Caecidotea brevicauda*, *C. packardi*.

In 1995, 19 sites in this cave were examined for amphipods (Table 2).

Current Status: This cave is open to the public and access is controlled by the Illinois Department of Natural Resources. Anyone may visit the cave during daytime when it is open, provided that they sign a liability release. Due to the heavy human visitation it receives, many speleothems are broken, and graffiti and human trash are common. Even so, this cave supports a diverse terrestrial and aquatic fauna.

Gammarus acherondytes was collected only in the gravel-cobble riffles and pools of the main cave stream (Table 2) in association with *G. troglophilus* and *Crangonyx forbesi*. *G. acherondytes* made up 25.1% of the 223 amphipods collected, and comprised 30.6% of the amphipods in the two riffle-pool sites where it was collected. *Gammarus acherondytes* has been collected in this cave in 1938 (25 plus specimens, U.S. National Museum [USNM]), 1965 (14 specimens, J. Holsinger collection), 1974 (6 INHS), 1992 (20 INHS), 1993 (1 INHS), and 1995 (56 INHS).

A nitrate nitrogen concentration of 5.89 ppm was detected in a water sample taken February 24, 1992, but at concentrations below the USEPAMCL of 10 ppm. Mercury, PCBs, and the pesticides o,p-DDE, p,p'-DDE, o,p-DDD, Dieldrin, Aldrin, Heptachlor, Heptachlor epoxide, DDT, and Aroclor 1254 were not detected in water samples collected February 24, 1992 (Webb *et al.* 1993).

KRUEGER-DRY RUN CAVE (MONROE COUNTY)

The two main entrances of this cave (Frasz 1983; Webb *et al.* 1993) are located in adjacent wooded sinkholes, each about 12 m in diameter, surrounded by farmland. A third entrance is

Table 2. The abundance and habitat of *Bactrurus brachycaudus, Crangonyx forbesi, Gammarus acherondytes,* and *G. troglophilus* collected from 19 sites in Illinois Cavern, Monroe County, Illinois on 7 June 1995.

Habitat Type	Width	Depth	Substrate	*Bactrurus brachycaudus*	*Crangonyx forbesi*	*Gammarus acherondytes*	*Gammarus troglophilus*
mainstream riffles, pools	1.5-3 m	5-60 cm	gravel, cobblestone	2	2	39	43
small rivulet	13 cm	2.5 cm	pea gravel	0	0	0	16
small rivulet	3.8 cm	1.3 cm	bedrock, silt, gravel	0	0	0	3
rimstone pool			bedrock	0	0	0	0
mainstream			leaf pack	0	0	0	0
small rivulet				0	2	0	1
rivulet				0	0	0	0
drip pool			bedrock	0	0	0	0
mainstream riffle, pools		60 cm	gravel, cobble, silt & sand	0	1	17	79
Drip pool & rivulet			bedrock	0	0	0	0
pools			bedrock	0	0	0	0
rimstone dam pool	60 cm	1.3-8 cm	silt overlying bedrock	0	0	0	8
rivulet	10 cm	2.5 cm	bedrock	0	0	0	0
drip pool	1 m	2.5-5 cm	bedrock	2	0	0	2
rivulet	5-10 cm	2.5 cm	gravel, silt overlying bedrock	0	0	0	0
rivulet	20 cm	5 cm	gravel	0	0	0	0
several small pools		<2.5 cm	bedrock	0	0	0	0
rivulet	2.5-25 cm	0.5 cm	bedrock	0	0	0	0
drip pool & rivulet	0.6 m	<5 cm	silt overlying bedrock	0	0	0	6
			TOTAL	4	5	56	158
			%	1.8	2.2	25.1	70.9

Table 3. The abundance and habitat of *Crangonyx forbesi, Gammarus acherondytes,* and *G. troglophilus* collected from 2 sites in Krueger-Dry Cave, Monroe County, Illinois on 25 August 1995.

Habitat Type	Width	Depth	Substrate	*Crangonyx forbesi*	*Gammarus acherondytes*	*Gammarus troglophilus*
mainstream riffle	1.8 m	1.3-90 cm	gravel, cobble	22	2	11
upper level side stream	0.3 m	5-60 cm	silt overlying bedrock	4	0	25
			TOTAL	26	2	36
			%	40.1	3.1	56.3

in a wooded sinkhole surrounded by farmland that is heavily used by cattle. This cave contains approximately 11 km of mapped passages (J. Sherrill, personal communication 1996), ranging from belly crawls to a mainstream passage up to 3 m high by 6 m wide, with water up to 1.8 m deep. There is evidence that the cave frequently floods to the ceiling. The stream substrate is mainly gravel, sand, or silt. Kelly Spring is the resurgence of the cave stream.

Fauna: Aquatic organisms recorded from this cave (Peck & Lewis 1978; Webb *et al.* 1993) are Platyhelminthes: Turbellaria: *Sphalloplana hubrichti*; Arthropoda: Crustacea: Amphipoda: *Crangonyx forbesi*, *Gammarus acherondytes*, *G. troglophilus*; Decapoda: *Orconectes virilis*; Isopoda: *Caecidotea brevicauda*, *C. packardi*; Chordata: Pisces: *Ameiurus natalis* (Lesueur), *Lepomis cyanellus* Rafinesque.

In 1995, two sites in this cave were examined for amphipods (Table 3).

Current Status: In 1992, scattered human trash that apparently had washed in from sinkholes was present, but little vandalism was visible. Some broken glass and candle wax suggest that humans often visit this cave, but frequent flooding probably keeps the cave relatively free of debris. The biggest threat to this cave appears to be agricultural activity in the watershed.

Gammarus acherondytes was collected in a gravel-cobble riffle of the main cave stream in association with *G. troglophilus* and *Crangonyx forbesi* (Table 3). At this riffle site, *G. acherondytes* made up 5.7% of the sample, but constituted 3.1% of the 64 amphipods collected from this cave. *Gammarus acherondytes* was collected in this cave in 1965 (1 specimen, J. Holsinger collection) and 1995 (2 INHS). It was not collected here in 1986 or 1993 (Webb 1993).

From water samples collected at Kelly Spring on November 16, 1994, February 24, 1995, May 23, 1995, and August 23, 1995, nitrate nitrogen concentrations ranged from 2.97 to 5.16 ppm, below the USEPAMCL of 10 ppm. A mercury concentration of 0.49 ppb, which was below the USEPAMCL of 2 ppb, was detected in the November sample. The herbicide Atrazine was detected in the November (0.45 ppb), February (0.16 ppb), and August (0.31 ppb) samples but not at concentrations above the USEPAMCL of 3 ppb. The herbicide Metolachlor was detected in the May (0.18 ppb) sample but not at concentrations above the USEPA Health Advisory Level (USEPAHAL) of 100 ppb (USEPA, 1988, 1990, 1991; Schock *et al.* 1992). The herbicides Alachlor and Cyanazine were not detected in any of the water samples.

Table 4. The abundance and habitat of *Gammarus minus* and *G. troglophilus* collected from 2 sites in Madonnaville Cave, Monroe County, Illinois on 25 August 1995.

Habitat Type	Width	Depth	Substrate	*Gammarus minus*	*Gammarus troglophilus*
mainstream riffle	0.75	8 cm	gravel	408	15
mainstream riffle	0.75	5-15 cm	gravel	239	11
			TOTAL	647	26
			%	96.1	3.9

MADONNAVILLE CAVE (MONROE COUNTY)

This cave is smaller than the other caves examined in this study. It passes under an area of upland karst containing woodlands and crops. The entrance, which is also the resurgence of the cave stream, is 1.5 m high and 5 m wide, but then narrows to a passage 1.2 m high and 3 m wide. A cave stream 0.3-0.75 m wide and 5-15 cm deep with a gravel substrate flows down the middle of the passage. The passage runs back some 120 m before the ceiling drops to the level of the streambed.

Fauna: Aquatic organisms recorded from Madonnaville Cave (Webb *et al.* 1993) are Arthropoda: Crustacea: Amphipoda: *Crangonyx forbesi, Gammarus acherondytes, G. minus, G. troglophilus*; Isopoda: *Caecidotea brevicauda*.

In 1995, two sites in this cave were examined for amphipods (Table 4).

Current Status: This cave receives little visitation by humans and no sign of vandalism was evident in 1995. Occasional flooding keeps the cave clean of debris. Following heavy rains, a considerable amount of sediment is flushed through the cave. The biggest threat to this cave is probably from agricultural activity in its drainage basin.

Although a single specimen of *Gammarus acherondytes* was collected in 1986 (Webb 1993) in association with two specimens of *G. troglophilus* and one specimen of *Crangonyx forbesi*, no specimens of *G. acherondytes* were collected among the 673 specimens of amphipods collected in 1995. *Gammarus minus* made up 96% of the specimens collected in 1995. This is the only cave of the five examined in 1995 in which *G. minus* was the dominant species of amphipod. *Gammarus acherondytes* has been collected in this cave only in 1986 (1 specimen, INHS).

In water samples collected at Madonnaville Cave on November 16, 1994; February 24, 1995; May 23, 1995; and August 23, 1995; nitrate nitrogen concentrations ranged from 6.72 to 7.64 ppm, which are below the USEPAMCL of 10 ppm, but are higher than the concentrations found in any of the other caves from which *G. acherondytes* has been reported. The herbicide Alachlor was detected in the May sample at 0.15 ppb, which was below the USEPAMCL of 2 ppb. The herbicide Atrazine was detected in the May (1.74 ppb) and August (0.29 ppb) samples but never at concentrations above USEPAMCL of 3 ppb. The herbicide Metolachlor was detected at 0.37 ppb in the May sample which is below the USEPAHAL of 100 ppb. Mercury and the herbicide Cyanazine were not detected in the water samples.

PAUTLER CAVE (MONROE COUNTY)

The entrance to this cave has been bulldozed shut (Webb *et al. 1993*). The status of *Gammarus acherondytes* in this cave could not be determined. No specimens of *G. acherondytes* have been collected here since 1965 (4 specimens, J. Holsinger collection).

Fauna: Aquatic organisms recorded from Pautler Cave (Hubricht 1941; Holsinger 1972; Hubricht & Mackin 1940; Peck & Lewis, 1978): Arthropoda: Crustacea: Amphipoda: Crangonyctidae: *Crangonyx forbesi.;* Gammaridae: *Gammarus acherondytes, G. troglophilus;* Isopoda: Asellidae: *Caecidotea brevicauda, C. packardi*; Diplopoda: Polydesmida: Nearctodesmidae: *Ergodesmus remingtoni;* Trichopolydesmidae: *Antriadesmus* sp.

STEMLER CAVE (ST. CLAIR COUNTY)

This cave is located in a wooded sinkhole surrounded by farmland and rural residential development (Webb *et al. 1993*). The main entrance is a sinkhole 12 m long by 3 m wide that drops vertically 4.6 m to a breakdown-covered floor by a large stream 1.5-3 m wide and up to 1 m deep. Ten meters upstream the passage sumps. Downstream the passage continues 1-3 m high by 1.5-6 m wide. This cave is 1800 m long (J. Sherrill, personal communication 1996). During one visit (June 25, 1993) shortly after a heavy rain, a strong odor of sewage could be detected 6 m from the entrance sink. There were accumulations of foam 1.2 m in diameter, and the water was murky. During a subsequent visit in 1995, no sewage odor was detected.

Fauna: The aquatic organisms recorded from this cave (Hubricht & Makin 1940; Peck & Lewis 1978; Webb *et al.* 1993) are Platyhelminthes: Turbellaria: *Sphalloplana hubrichti*; Mollusca: Gastropoda: *Fontigens antroecetes* (Hubricht); Arthropoda: Crustacea: Amphipoda: *Bactrurus brachycaudus, Crangonyx forbesi, Gammarus acherondytes, G. minus, G. troglophilus*; Isopoda: *Caecidotea brevicauda, C. packardi*.

In 1995, five sites in this cave were examined for amphipods (Table 5).

Current Status: This cave receives some human visitation and periodically receives sewage and sediment, particularly during floods. Threats include continued input of sediment, human and animal wastes, and agricultural chemicals.

This cave has a fair diversity of aquatic habitats. Collections were made at five sites in 1995, but no specimens of *Gammarus acherondytes* were among the 561 amphipods collected. Historically, this cave is one of the type localities for *G. acherondytes* and additional specimens were collected in 1965 (numerous specimens, J. Holsinger collection; syntype specimens in USNM). We have seen no *G. acherondytes* collected here since 1965, although sampling was conducted in

Table 5. The abundance and habitat of *Crangonyx forbesi* and *Gammarus troglophilus* collected from 5 sites in Stemler Cave, St. Clair County, Illinois on 25 August 1995.

Habitat Type	Width	Depth	Substrate	*Crangonyx forbesi*	*Gammarus troglophilus*
mainstream riffle	1.8 m	2.5-15 cm	breakdown, bedrock, gravel	65	307
mainstream riffle	1.5 m	2.5-10 cm	breakdown limestone	0	66
mainstream pool	3.7 m	15-45 cm	silt over bedrock	11	88
rivulet	2.5-20 cm	0.3 m	silt over bedrock	1	4
mainstream riffle	2.4-3.1 m	5-15 cm	gravel, breakdown, limestone	1	18
			TOTAL	78	483
			%	13.9	86.1

1993 and 1995.

DISCUSSION

Gammarus acherondytes was originally described from Illinois Caverns and Stemler Cave in Illinois (Hubricht & Mackin 1940). Subsequently (Holsinger 1972; Peck & Lewis 1978) it was collected from Fogelpole, Krueger-Dry Run, and Pautler caves, and later it was reported from Madonnaville Cave (Webb 1993). The entrance to Pautler Cave was bulldozed shut by the landowner (Webb 1993). *Gammarus acherondytes* has been proposed for inclusion on the federal list of endangered and threatened species (U.S. Department of the Interior, Fish & Wildlife Service 1997). In 1992, 1993, and 1995, attempts were made to collect *G. acherondytes* from 80 caves in Illinois and to examine material collected from 84 Illinois caves by Oliver and Graham (1988). *Gammarus acherondytes* specimens collected in the present study include: Fogelpole Cave, 10 (1993) and 19 (1995) specimens; Illinois Caverns, 20 (1992), 1 (1993), and 56 (1995) specimens; Krueger-Dry Run Cave, 2 (1995) specimens; Stemler Cave, 0 (1992, 1993, 1995) specimens; and Madonnaville Cave, 0 (1995) specimens. Although a wide diversity of aquatic habitats were sampled, all specimens of *G. acherondytes* collected were from gravel riffles in the mainstream (87% [94 specimens]) or side passage streams (13% [14 specimens]).

Gammarus acherondytes was generally found in association with *G. troglophilus* and *Crangonyx forbesi*. *Gammarus troglophilus* was the most abundant amphipod in subterranean streams of the Salem Plateau Section of Illinois, generally followed by *C. forbesi*. Exceptions include Illinois Caverns, where *G. acherondytes* was the second most abundant amphipod collected, and Madonnaville Cave where *G. minus* was the most abundant species of amphipod. *Gammarus minus* has been shown to be a predator of other amphipods (MacNeil *et al.* 1997; Jenio 1972, 1979; Culver & Fong 1991), and Fong and Culver (1994) suggest that predation by *G. minus* may account for the absence of the isopod *Caecidotea holsingeri* (Steeves) (a know prey species for *G. minus*) and the amphipod *Stygobromus spinosus* Holsinger from parts of a West Virginia cave system.

Gammarus acherondytes appears to be well established in Fogelpole and Illinois Caverns. It is particularly interesting that in Illinois Caverns, *G. acherondytes* was collected only in the mainstream, an area that receives considerable disturbance from the many visitors that annually walk through this cave stream. In Krueger-Dry Run Cave, *G. acherondytes* was not collected in 1993, but a small population was present in 1995. No specimens of *G. acherondytes* have been collected in Stemler Cave since 1965, even though *G. troglophilus* and *C. forbesi* are abundant. A single specimen of *G. acherondytes* was collected in Madonnaville Cave in 1986, but no specimens were collected in 1995, even though other amphipods were abundant.

Surface runoff of sediments and pesticides are the principal threats to the general well-being of *Gammarus acherondytes* populations in the cave streams of Monroe and St. Clair counties. During periods of heavy rains, cave streams in these counties become very turbid and loaded with silt. In addition, nitrate nitrogen can generally be detected every month of the year from the groundwater in this karst region, and is often at levels above USEPAMCLs (Panno *et al.* 1996; Webb *et al*. 1993, 1996). Similarly, the herbicides Alachlor, Atrazine, Cyanazine, and Metolachlor were detected during various months, occasionally above USEPAMCLs or USEPAHALs (Panno *et al.* 1996; Webb *et al*. 1993, 1996). Mercury is not often detected in groundwater samples from this region, but evidence of its accumulation to concentrations of 658 ppb was found in bioassays of amphipods collected from Fogelpole Cave.

Another threat to the amphipods of Monroe and St. Clair counties is the rapid increase in residential development. There is concern that this situation may lead to increase in raw sewage input into cave streams, which typically results in degradation of natural cave communities and the replacement of troglobitic species by more opportunistic troglophiles. Panno *et al.* (1996), in a study of groundwater contamination in the karst terrain of Monroe County, found that in nine springs and one cave stream (Illinois Caverns) all water samples collected contained coliform, fecal coliform, total (aerobic) bacteria, and other types of bacteria. The species present suggested that the bacteria were from both human and livestock sources. All of their water samples from the nine springs and the one cave stream exceeded the drinking water standard of less than one colony of coliform and fecal coliform bacteria/100 mL of water. They document a rapid increase in col-

iform bacteria from 1987-1995 in Monroe County well water samples, and attribute this increase to the increase in residential development in the county. Panno *et al.* (1997) suggest that a significant portion of the bacterial contamination of this karst aquifer may come from private septic systems. The detection of sewage at Stemler Cave, the abundant population of *Gammarus minor* at Madonnaville Cave, and the absence of *G. acherondytes* from both sites in the 1990s suggest that this type of habitat degradation may already be taking place. The apparently healthy populations of *G. acherondytes* at Illinois Caverns, the most frequently visited of the caves in this study, suggests that human visitation is not adversely affecting populations of this species.

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