

Proposal Entitled:

Threats Analysis and Conservation Actions for the Illinois Cave Amphipod: Vulnerability Assessment of Groundwater Quality, Land Use and Climate Change Impacts T-93-R-1

For Submission To:

Illinois Department of Natural Resources
ATTN: Paul Vehlow
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Submitted by:

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Make Award To: The Board of Trustees of the University of Illinois
c/o Office of Sponsored Programs and Research Administration
1901 S. First Street, Suite A
Champaign, IL 61820

Amount Requested: \$35,000

Project Period: October 1, 2014 – September 30, 2016

Steven J. Taylor, Principal Investigator
Illinois Natural History Survey

Brian Anderson, Director
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University of Illinois

Peter Schiffer
Vice Chancellor for Research
University of Illinois

Executive Summary

Title: Threats Analysis and Conservation Actions for the Illinois Cave Amphipod: Vulnerability Assessment of Groundwater Quality, Land Use and Climate Change Impacts

Applicant Information: Board of Trustees of the University of Illinois

Goals/Objectives:

Proposed Grant Period: October 1, 2014 – September 30, 2016

Amount Requested: \$35,000

State(s) and Partners Involved: IL Department of Natural Resources, IL Natural History Survey

Key Habitats Addressed: Caves within Monroe and St. Clair Counties

Summary Statement:

Estimated Cost:

	Federal Request	Non-Federal Match	Total Cost
Year One	\$17,500.00	\$9,432.08	\$26,923.08
Year Two	\$17,500.00	\$9,432.07	\$26,923.07
Total Funding	\$35,000.00	\$18,846.15	\$53,847.15

INHS will provide in-kind match of \$18,846.15 during the project period. Staff salary (\$3,347), benefits (\$1,437), F&A (\$2,804) and unrecovered F&A (\$11,258) will be provided during the project period.

Project Title: Threats Analysis and Conservation Actions for the Illinois Cave Amphipod: Vulnerability Assessment of Groundwater Quality, Land Use and Climate Change Impacts

(1) Need

The Illinois Cave Amphipod (ILCA, *Gammarus acherondytes*: Gammaridae) was listed as an Endangered Species by the U.S. Fish & Wildlife Service more than 15 years ago (USFWS 1998). A USFWS recovery plan for the species was completed in 12 years ago (USFWS 2002) that identified 28 prioritized action items (**Appendix I**) upon which recovery efforts could be focused. Most recently, a five-year review was completed for the species (USFWS 2011). The five-year review (USFWS 2011) concludes with the following recommendations:

"A working group of USFWS, NRCS, ILDNR, researchers, and non-government agencies should be assembled to:

- Develop a suite of best management practices designed to protect Illinois cave amphipod habitat, and the sinkholes and recharge areas that affect Illinois cave amphipod water quality in both agricultural and the increasingly urban landscape. Landowners should be contacted and provided information on the use of best management practices to protect the Illinois cave amphipod. The group could also devise a plan to reach existing and new landowners and help them to incorporate these practices.*
- Evaluate sites where conditions are suitable for the Illinois cave amphipod and determine where and how often future surveys should be conducted.*
- Identify sites that can be protected through land acquisition and conservation easements.*
- Research the potential impacts of global warming on the Illinois cave amphipod."*

The Illinois Wildlife Action Plan (IDNR 2005) give special attention to caves in general and to the Illinois Cave Amphipod in particular, under management guidelines for the Ozark Natural Division of Illinois (p. 182):

"Caves - Encourage sound management practices to maintain and reduce degradation of cave systems through landowner education and incentives, promotion of cave gates with enrollment into a long term protection program to minimize disturbance to these fragile ecosystems – while also protecting sensitive cave fauna and reducing vandalism to subterranean cave features. Create mapping efforts with local speleological societies for unmapped caves. Work with quarrying companies to enroll their property in long term protection plans and publicly promote their stewardship efforts. Protect recharge areas for caves that provide habitat for Illinois cave amphipod and other listed troglobitic [sic] species."

Protection of recharge areas and reduction of degradation, and landowner education require that we first gain a strong understanding of the nature of threats and assess expert views on the relative importance of different types of threats - needs which the present proposal will address and enhance information included in the Plan for the Illinois Cave Amphipod. Findings of the study can then be used to update information in Appendix I (Species in Greatest Need of Conservation for Illinois as identified by eight criteria) and Appendix II (Status, Objectives, and Stresses to Illinois' Wildlife & Habitat Resources.) of the Wildlife Action Plan (IDNR 2005). In particular, this project will enhance and improve the quality of information in the Habitat Stresses, Community Stresses, Population Stresses and Direct Human Stresses columns in Appendix II for the Illinois Cave Amphipod.

(2) Purpose & Objectives

As a step towards achieving these actions to inform management, evaluate conditions, identify target lands, and assess potential impacts of global warming, the present proposed study will 1) conduct a threats analysis by September 30, 2016 which examines at least 10 stresses from Appendix II of the Illinois Wildlife Action Plan (see **Table 1**, below), and 2) identify at least 10 conservation actions for the ILCA, emphasizing vulnerability assessment of groundwater quality, land use and climate change impacts by September 28, 2016, and 3) write annual and final reports for this project.

(3) Expected Results and Benefits

After completion of the expert opinion poll for the threats analysis and vulnerability assessment, the data will be assembled and synthesized into a draft document, which will be shared with those who completed the poll, allowing a period of comment. After revisions as needed, the findings will be summarized in a presentation given in Waterloo, Illinois, potentially as part of a meeting of the Southwestern Illinois Wildlife Action Plan partnership, or, at minimum, in a separate meeting with invited members. With final input from this meeting, the document will be further revised, and then submitted to IDNR as the final product for this project.

Our findings will be placed in the context of the Illinois Wildlife Action Plan, and will enhance our understanding of Wildlife Action Plan Appendix II (IDNR 2005) stresses to the species and their relative perceived importance based upon expert opinion (see **Job 1**, above).

The final report will provide a clear view on expert opinion on threats and vulnerabilities for the ILCA, information which may be used to guide funding priorities for future management actions, land acquisitions, and climate change planning.

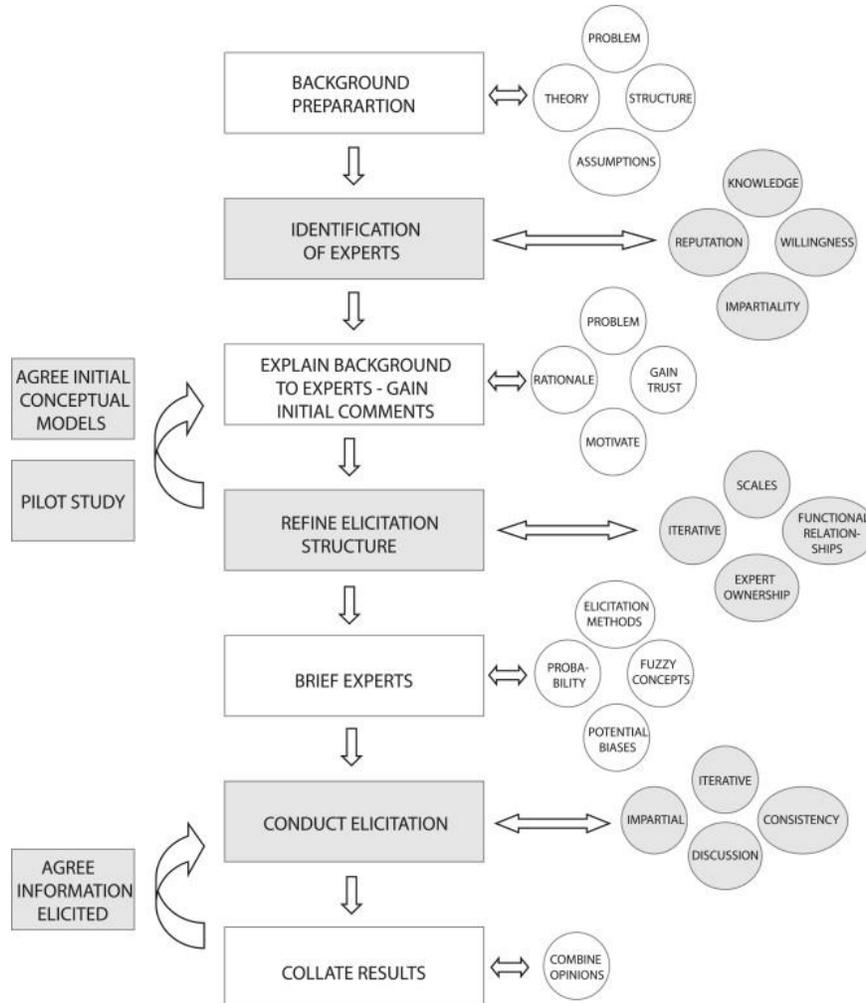


Figure 1. Steps involved in process of obtaining expert opinion. From Page et al. (2012).

Table 1. Stress categories from Appendix II of the Illinois Wildlife Action Plan (IDNR 2005).

Habitat	
Extent	the gross amount of habitat
Fragmentation	the effects of isolation (physical separation of habitat patches), juxtaposition (relative position of habitat types), patch size (size of individual habitat patches), and edge effects (phenomena of ecotones and patch edges, such as increased mortality)
Composition-Structure	the biological and physical attributes of habitat within a patch
Disturbance/ Hydrology	disturbance regimes are the frequency, timing and intensity of disturbances such as fire, and hydrology relates to patterns in water level and availability
Invasives/ Exotics	novel species that are changing a habitat (will overlap one or more habitat stress category)
Pollution - Sediment	abnormal inputs of chemical or physical materials or heat
Community	
Competitors	individuals of same or other species vying for shared resources
Predators	animals that kill and consume other (typically smaller) animals
Parasites-Disease	organisms (typically small) that consume part of, weaken and/or kill, animals
Prey-Food	organisms, their parts or products consumed for energy by an animal
Hosts	an organism necessary for supporting some life history stage of an animal (e.g., plants for larval insects, fishes for larval mussels)
Invasives/ Exotics	novel species that are changing a habitat (will overlap one or more habitat stress category)
Other Symbionts	other organisms necessary for a beneficial ecological relationship
Population	
Genetics	genetic constrains such as inbreeding, outbreeding depression
Dispersal	movement of individuals among habitat patches and/or subpopulations
Recruitment	entry of new individuals into a breeding population, the product of birth rate and juvenile survival
Mortality	death rate for a population
Direct Human	
Killing	direct killing/removal by humans
Disturbance	direct harassment by humans
Structures-Infrastructure	killing or harassment by structures (dams, towers, windows, etc.) or infrastructure (roads, utility lines, etc.)

(4) Approach

This study will be completed by staff of the Illinois Natural History Survey located in Champaign.

Job 1. Conduct a threats analysis

Threats analysis for ILCA will be evaluated by conducting an expert opinion survey (see: Donlan et al. 2010, Krueger et al. 2012). Leading experts with prior experience with ILCA, experts with experience with other karst groundwater Crustacea, and select local stakeholders (reached through the Southwestern Illinois Wildlife Action Plan Partnership) will be surveyed and to gauge threats to the species, through an iterative series of steps (**Figure 1**). This approach, expert elicitation, has been used to summarize expert opinion in field where there is a high degree of uncertainty, including areas such as conservation assessment (Aipanjiguly et al. 2003, Donlan et al. 2010, Halpern et al. 2007, Martin et al. 2005, Runge et al. 2011), climate change assessment (Cox et al. 2013, Doria et al. 2009) risk assessment (Aspinall 2010, Hänninen et al. 2014, Kerr 1996, Knol et al. 2009), and the social sciences (Cooke et al. 2008, O'Hagan et al. 2006). The threats analysis will examine at least 10 of the stresses given in Appendix II of the Illinois Wildlife Action Plan (see **Table 1**, below). The results of the treats analysis will be completed and included in the final report by September 30, 2016.

Job 2. Identify conservation actions

Identify at least 10 conservation actions for the ILCA, emphasizing vulnerability assessment of groundwater quality, land use and climate change impacts by September 30, 2016.

Findings will be analyzed using statistical approaches (e.g., Garthwaite et al. 2005, Page et al. 2012) and summarized in a final report. In addition to threats analysis, we will, in the same survey, poll expert opinion as part of a vulnerability assessment (see: Williams et al. 2008) for ILCA, assessing expert opinion on Exposure, Sensitivity and Adaptive Capacity¹ of the species. Niemiller et al. (2013) effectively used IUCN and NatureServe conservation assessments to evaluate populations of cave fish. To the extent feasible, we will compile data using a similar approach for the ILCA.

¹ For groundwater quality, land use, climate change: **Exposure** – the extent to which a system/focal taxon comes into contact with parameter conditions or their impacts. **Sensitivity** – the degree to which a system/focal taxon is directly or indirectly affected by changes in parameter conditions. **Adaptive Capacity** – the ability of a system/focal taxon to accommodate changes in parameter conditions.

Select field sites within the range of ILCA will be visited during this study to gain a better sense of the issues, interact with stakeholders, and obtain visual imagery to support better communication of the findings.

Job 3. Write reports

Provide annual and final reports that include progress towards (annual reports) and results of (final report) the threats analysis and identification and evaluation of conservation actions listed in Jobs 1 & 2 above. By August, 2015, provide preliminary findings available by that date to the project manager (Ann Holtrop) for possible inclusion in the current Wildlife Action Plan revision.

(5) Useful Life N/A

(6) Geographic Location:

The entire range of the Illinois Cave Amphipod is restricted to the Salem Plateau area of Monroe and St. Clair counties, Illinois (although the species has been extirpated from St. Clair County). Our study will focus on suitable habitat within the historical range of the species, that is, Monroe and St. Clair counties.

(7) Principal Investigator/Personnel

The following personnel from IDNR Office of Resource Conservation (ORC), One Natural Resources Way, Springfield, IL 62702 will manage this project:

Ann Marie Holtrop
IDNR – Office of Resource Conservation
Phone: 217-785-4325
Email: ann.holtrop@illinois.gov

The following personnel from INHS, University of Illinois at Urbana-Champaign, 1816 S. Oak St., Champaign, IL 61820 are involved in this project:

Steven J. Taylor
Principal Investigator, direct and assist in all stages of project
Phone: 217-714-2871
Email: sjtaylor@illinois.edu

Matthew Niemiller
Design of expert elicitation & threats survey, data analysis and write-up
Phone: 615-427-3049
Email: cavemander17@gmail.com

Scott Cinel

Assemble literature, assist in design and conduct surveys, assist in analysis and write-up.
 Phone: 708-502-5161
 Email: cinel1@illinois.edu

(8) Program Income: N/A

(9) Budget

SALARIES & WAGES	<u>Request</u>	<u>Match</u>	<u>Total</u>
Professional ¹		\$3,347	\$3,347
GRA - academic yr ²	\$10,080		\$10,080
GRA - summer (no classes) ²	\$6,720		\$6,720
Non-student hourly ³	\$5,000		\$5,000
Total Salaries & Wages	\$21,800	\$3,347	\$25,147
FRINGE BENEFITS			
Professional @ 42.94% ¹		\$1,437	\$1,437
GRA - ac yr @ 6.36% ²	\$641		\$641
GRA - summer (no classes) 14.01% ²	\$941		\$941
Non-student hourly @ 7.79% ³	\$390		\$390
Total Fringe Benefits	\$1,972	\$1,437	\$3,409
 Total Salaries, Wages, & Fringe Benefits	 \$23,772	 \$4,784	 \$28,556
TRAVEL			
In state ⁴	\$4,000		\$4,000
Total Travel	\$4,000		\$4,000
MATERIALS & SUPPLIES - General⁵	\$1,395		\$1,395
Total Materials & Supplies	\$1,395		\$1,395
Total Direct Costs	\$29,167	\$4,784	\$33,951
Modified Total Direct Costs (MTDC)*	\$29,167	\$4,784	\$33,951
F&A (20% of MTDC)	\$5,833		\$5,833
F&A (58.6% MTDC)		\$2,804	\$2,804
Unrecovered F&A (20% vs. 58.6%)		\$11,258	\$11,258
Total Proposed Project Budget	\$35,000	\$18,846	\$53,847
	65.00%	35.00 ⁶	

Budget Justification footnotes on following page.

Budget Justification

¹**SALARIES, WAGES & FRINGE BENEFITS**- Professional:

Calculated as 3% of the PI's time for 24 months as a portion of matching funds

²**SALARIES, WAGES & FRINGE BENEFITS**-GRA:

A graduate research assistant is needed to prepare background information, plan and design the survey and assemble preliminary analyses of the results.

³**SALARIES, WAGES & FRINGE BENEFITS** -hourly:

An hourly assistant is needed to help prepare background information, help accumulate relevant literature, distribute survey, and collate results.

⁴**TRAVEL**-In state:

Travel funds are requested to visit field sites to develop information and obtain photographs of settings and animals, to meet with experts, and to present findings in the project area. Per trip mileage will be 500-600 miles/trip. Current mileage rate for use of an appropriate University vehicle is \$0.50/mile.

Overnight lodging will be necessary in the Columbia/Waterloo area of Monroe and St Clair counties, Illinois, and this will be at the state rate (varies by hotel).

Per diem will be necessary. Cave safety generally requires a field crew of at least 3 people to enter cave sites.

⁵**MATERIALS & SUPPLIES** - General:

Camera accessories (flashes, cords, batteries, lenses, etc.) [estimated at \$700]; caving supplies (lights, packs, knee pads, ropes, cable ladders, floatation, helmets, cave suits, etc.) [estimated at \$300]; miscellaneous office and laboratory supplies (paper, notebooks, vials, bags, pens, etc.) [estimated at \$285]; batteries and chargers for cameras and caving [estimated at \$100].

⁶Required match is 35%

(10) Multipurpose Projects – N/A

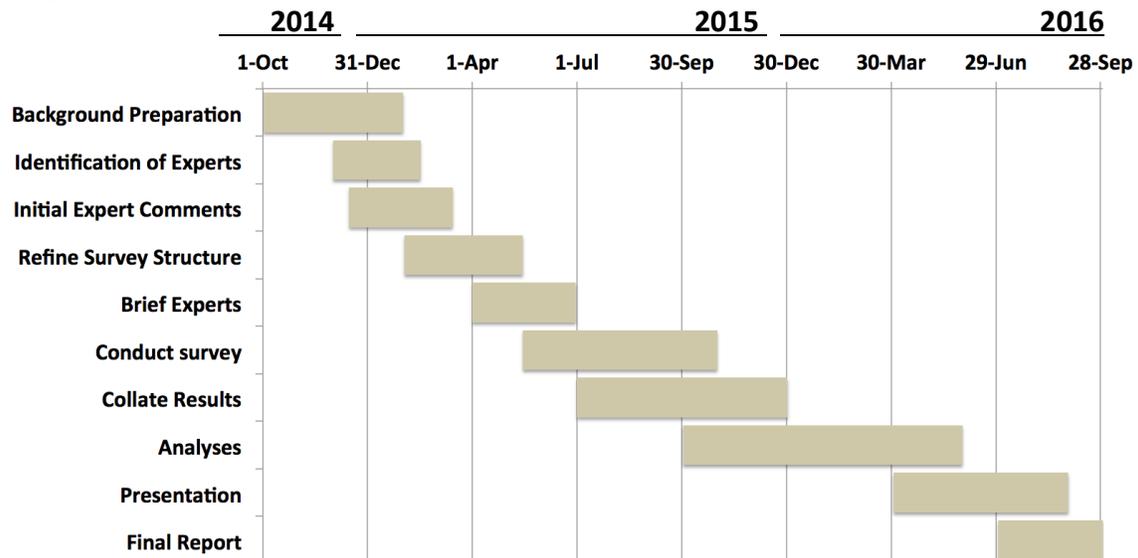
(11) Relationship To Other Grants This project builds on a 20+ years of research on karst systems in Monroe and St. Clair counties, Illinois. That research covers a variety of relevant areas, including but not limited to: geology, cave mapping, dye tracing, hydrology, groundwater chemistry and contaminants, ILCA molecular phylogeography, ecosystem structure and life histories. The lead PI on this grant is presently a PI on two other state-funded grants examining groundwater contaminants in the study area. In addition, he is actively involved in conservation, management, and monitoring activities on a 535 acre parcel recently purchased by Clifftop NFP and overlaying a significant portion of Fogelpole Cave (Monroe County), Illinois longest cave system and also known habitat for the ILCA. Findings from the proposed study will leverage these activities and grants, and help guide future work in conservation and management activities relating to this species and karst systems of Illinois in general. This work complements ongoing monitoring studies by Lewis and Associates (E-61-R-1; 11/1/2013 – 10/31/2014), whose work provides monitoring data for the species. Our project will utilize all available

monitoring information available to us, primarily various studies by Lewis and Associates, as a part of our analyses.

(12)Timeline

Activity	Start Date	End Date
Background Preparation	1-Oct-2014	31-Jan-2015
Identification of Experts	1-Dec-2014	15-Feb-2015
Initial Expert Comments	15-Dec-2014	15-Mar-2015
Refine Survey Structure	1-Feb-2015	15-May-2015
Brief Experts	1-Apr-2015	30-Jun-2015
Conduct survey	15-May-2015	31-Oct-2015
Collate Results	1-Jul-2015	31-Dec-2015
Analyses	1-Oct-2015	31-May-2016
Presentation	1-Apr-2016	31-Aug-2016
Final Report	1-Jul-2016	30-Sep-2016

Project Timeline:



(13) General

(i) Substantial in Character and Design

The project statement describes a need consistent with the State Wildlife Grants (SWG); states a purpose and sets objectives, both of which are based on the need; uses a planned approach, appropriate procedures and research; and is cost effective.

(ii) Compliance

The IDNR will use its CERP (Comprehensive Environmental Review Process) as a tool to aid the Department in meeting NEPA compliance for the project outlined under this grant proposal. It is the Department's policy to require CERP applications for all land disturbing activities unless those activities are covered by CERP exemptions.

All planned activities will also be in compliance with the Endangered Species Act. All determinations and documentation will be in accordance with the current established U.S. Fish and Wildlife Service protocols for section 7.

All planned activities will be in compliance with the National Historic Preservation Act and the Council on Historic Preservation Act. All determinations and documentation will be in accordance with the terms of the Programmatic Agreement, as amended, effective September 23, 2002. When applicable, those planned activities which involve a floodplain and/or jurisdiction wetlands will be done in accordance with Presidential Executive Orders 11988 and 11990.

When applicable, those planned activities which involve programs and/or site improvements will be done in accordance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act.

When applicable, those planned activities which involve the use of pesticides, herbicides or other comparable chemicals will be done in accordance with current state and federal regulations to assure the safe and legal application of those chemicals. All chemicals will be applied in accordance with the manufacturers label instructions. All persons applying chemicals will be licensed by the Illinois Department of Agriculture as a chemical operator along with a licensed applicator, in accordance with Illinois state law.

(iii) Literature Cited

Aipanjiguly, S., S. K. Jacobson, and R. Flamm. 2003. Conserving manatees: knowledge, attitudes, and intentions of boaters in Tampa Bay, Florida. *Conservation Biology* 17:1098–1105.

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Appendix I. Summary of action items toward recovery of the Illinois Cave Amphipod, listed in the species' recover plan (USFWS 2002).

Action Priority	Action	Action Description
1	1.1.1	Encourage voluntary best management practices and land use protection plans through land owner contacts using incentives from existing USDA tools such as EQUIP, CRP, Rural Development, and others, and promoting new programs specific to the Sinkhole Plains
1	1.1.2	Encourage development of a board (Local Ecosystem Marketing Board) that works toward a strong coordinated marketing program highlighting the special needs of this area and its ecosystem, along with the Best Management Practices and preservation of agricultural lands.
1	1.2.1.1	Bring new and existing sewage treatment facilities (public and private) standards protective of Karst groundwater.
3	1.2.1.2	Provide cost share to demonstrate alternative, better systems.
2	1.2.1.3	Encourage development of a regional sewer district with a centralized sewage treatment system.
3	1.2.2.1	Encourage adequate storm water control ordinances that deal with the unique features of a karst terrain are implemented and enforced.
2	1.2.2.2	Discourage inappropriate industry from locating in karst topography
2	1.2.3.1	Encourage enforcement of regulations pertaining to dumping of waste in sinkholes and other karst features. Implement a program to clean-up existing sinkholes.
2	1.2.4.1	Encourage use of above-ground storage facilities in the Sinkhole Plain.
2	1.2.4.2	Coordinate with response agencies to ensure that spills of toxic substances from traffic accidents or other sources do not enter the groundwater system.
1	1.2.5	Encourage development of residential land use plans and regulations which would prevent perturbations to lands and its groundwater system. Provide cost share to demonstrate alternative, better systems
2	1.3.1	Discourage publicizing names of specific caves, entrances, or entrance locations.
3	1.3.2	Monitor visitation trends in selected caves containing <i>G. acherondytes</i> .
2	1.3.3	Reduce the potential impacts of visitation in Illinois Caverns.
1	1.3.4	Utilize measures to assist with controlling access to caves.
3	1.3.5	All caves should be mapped by qualified cavers with suitable experience in mapping techniques.
3	1.3.6	Researchers and cavers should be encouraged to locate new cave entrances.
1	1.3.7	Delineate all sinkholes and surface recharge areas in the Columbia, Waterloo, and Renault Sub-regions of the Illinois Salem Plateau
3	2.1.1	Assess the feasibility and suitability of restoring extirpated <i>G. acherondytes</i> populations to historical habitats.
3	2.2.1	Reintroduce <i>G. acherondytes</i> into historical habitats if feasible.
1	3.1.1	Conduct studies aimed at increasing understanding of the biology and ecology of <i>G. acherondytes</i> , including life history, behavior, and population level genetics.
2	3.1.2	Assess potential adverse effects of contaminants and other water quality factors on Illinois cave amphipod
1	3.2.1	Conduct surveys to define the species' range.
1	3.2.2	Delineate all groundwater basins within the range of <i>G. acherondytes</i> .
1	3.3.1	Quantitatively monitor population status of <i>G. acherondytes</i> .
2	3.3.2	Monitor and evaluate trends in land use practices.
2	3.3.3	Monitor water quality both above ground and in shallow karst aquifers within the known range of <i>G. acherondytes</i> .
1	4.10	Hire a permanent full time karst resource coordinator, located in the Sinkhole Plain, to implement the education program and other outreach activities.