Hell Creek Cave Crayfish
(*Cambarus zophonastes*)

5-Year Review:
Summary and Evaluation

USFWS Photo (D. Kampwerth)

U.S. Fish and Wildlife Service
Southeast Region
Arkansas Ecological Services Field Office
Conway, Arkansas

5-Year Review

Hell Creek Cave crayfish (*Cambarus zophonastes* Hobbs and Bedinger 1964)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

This review was completed by the U.S. Fish and Wildlife Service (Service) Arkansas Field Office in coordination with the Arkansas Natural Heritage Commission and the Arkansas Game and Fish Commission. In conducting this 5-year review, we relied on the best available information pertaining to historical and current distributions, life histories, genetics, habitats, and potential threats of this species. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period (72 FR 42425). Literature and documents were researched and reviewed as one component of this evaluation, although limited literature exists on this species. Recommendations resulting from this review are a result of the limited literature review, understanding ongoing conservation actions, input and suggestions from partners involved in conservation efforts. Comments and suggestions regarding the five year review were received from cave crayfish conservation partners listed in the peer review section of this document (see Appendix A). No part of the review was contracted to an outside party. Comments received on this review were evaluated and incorporated as appropriate.

Special thanks to private landowners, developers, and communities who, with their input, support, and cooperative spirit have made Hell Creek Cave crayfish conservation efforts successful. This animal was originally listed as cave crayfish (*Cambarus zophanastes*) in April 7, 1987. Since circa 2006, it has been commonly referred to as Hell Creek cave crayfish (Graening et al. 2006).

B. Reviewers

Lead Region: Southeast Region, Kelly Bibb, (404) 679-7132

Lead Field Office: Arkansas Ecological Services Field Office, David Kampwerth, (formerly with this office now with a new FWS office); and Chris Davidson (501) 513-4481

C. Background:

1. **Federal Register Notice citation announcing initiation of this review:** August 2, 2007. 72 FR 42425.

2. **Species status: Stable.** (2011 Recovery Data Call) Based on preliminary genetic analysis, an additional site has been identified 40 miles to the NW of previous sites. Conservation efforts at this new site were initiated in FY10, but have stalled due to available resources.

3. **Recovery achieved:** 1 (1 = 0-25% species' recovery objectives achieved)

4. Listing history

Original Listing
FR Notice: 52 FR 11170
Date Listed: April 7, 1987
Entity Listed: species
Classification: endangered

5. Associated rulemakings: None.

6. Review History:
Recovery Plan: 1988
Recovery Data Call: 2011- 1998

Five Year Review: November 6, 1991.
In this review (56 FR 56882), different species were simultaneously evaluated with no species-specific, in-depth assessment of the five factors as they pertained to the different species' recovery. In particular, no changes were proposed for the status of this crayfish in the review.

Smith, K. 1984. The status of *Cambarus zophonastes* (Hobbs and Bedinger), an endemic cave crayfish from Arkansas. Arkansas Natural Heritage Commission. Little Rock, Arkansas. 15 pp.

Graening, G.O., J.B. Koppelman, B.K. Wagner, M.E. Slay, and C.L. Brickey. 2006. Range extension and status update of the endangered Hell Creek Cave Crayfish, *Cambarus zophonastes* (Decapoda: Cambaridae). Southwestern Naturalist 51 (1): 94-99.

7. Species' Recovery Priority Number at start of review (48 FR 43098):
5. This number indicates a high degree of threat and a low recovery potential.

8. Recovery Plan
Name of Plan: *Cambarus zophonastes* Recovery Plan
Date Issued: September 26, 1988

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The Endangered Species Act (ESA or Act) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is a crayfish, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat? Yes.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

Reclassification of Cambarus zophonastes from endangered to threatened could be considered when the following criteria are met:

1) Protection of the existing Hell Creek Cave population by minimizing present and future threats within the cave and the recharge area by developing and implementing land use regulations and obtaining conservation agreements or acquiring fee title on all private lands in the extremely high hazard area;
2) Excluding recreational cavers and collectors from the cave; and
3) Location and protection (as above) of at least two other viable populations sufficiently removed from Hell Creek Cave and each other so that a single event is unlikely to impact any two populations. Viable populations are those with different age classes including males and females.

If other viable populations are discovered, the species could be considered for delisting when the following criteria are met:

1) The Hell Creek Cave population and at least nine others are known to exist; and
2) At least five viable populations and their habitat are protected from present and foreseeable human related and natural threats that may interfere with the survival of any of the populations.

The criteria for downlisting have not been achieved as only portions of the 4800 acre Hell Creek cave recharge zone are protected, and no formal conservation agreements have been signed with private landowners or communities. The Arkansas Natural Heritage Commission (ANHC) does own 160 acres of the delineated recharge zone including the two entrances to Hell Creek cave.

Installation of cave gates, fencing, and monitoring has secured the site, although trespass and vandalism still occur. The Nature Conservancy and ANHC have developed a site conservation plan for Hell Creek cave.

One additional population was located in 2002 and genetically verified in 2005 at Nesbitt Spring Cave. The recharge area at Nesbitt Spring cave has been delineated (Gillip et al. 2009). While the Nesbitt family remains dedicated to groundwater conservation, no further conservation measures have occurred at the cave or in the recharge area. In 2010, a third population was located and genetically verified at an upwelling adjacent to Town Branch in Yellville, Arkansas. A recharge delineation of the Yellville site was completed in late 2011 (T. Aley, pers. comm. 2012). No additional conservation measures have occurred at the upwelling site or within the recharge area.

It is extremely difficult to determine population viability due to this species being a groundwater dweller with variable biannual counts. At some localities, such as the Yellville site, there is no human access to the cave system. Occupied habitat consists of open and water filled underground conduits, with a high probability that the majority of their habitat is totally inaccessible to humans.

The Nature Conservancy is currently working with the Service and state partners to develop a programmatic cave safe harbor agreement and candidate conservation agreement with assurances. These agreements will promote conservation and recovery efforts on private lands in all the Hell Creek cave crayfish recharge areas as well as other cave systems across northern Arkansas that may harbor unknown populations of the species. Implementation is expected to occur in 2014, pending Service review and permitting in 2013.

Criteria for delisting have not been met, although numerous cave bioinventories have been conducted and only two other sites were documented to harbor *C. zophonastes*. The most recent specimen was collected in 2009 from Town Branch and verified as *C. zophonastes* using genetic analysis (Koppelman pers. comm.). That whole specimen was sent to Dr. Horton Hobbs at Wittenberg University for morphometric and meristic analysis to compliment the genetic analysis. This site is a groundwater upwelling with no human entrance. Individuals are rarely found and only after being flushed from the upwelling adjacent to Town Branch following large storm events or prolonged wet periods. Only one individual has been collected at this site since 2009. It was returned to the upwelling after being collected in Town Branch (C. Davidson, pers. comm.). Another cave location is also a likely candidate for *C. zophonastes*, but permission to access the site has been denied. Its proximity to verified sites and the fact that other cave crayfish species have been observed in the cave make this a potential *C. zophonastes* site.

C. Updated Information and Current Species Status

1. Biology and Habitat

C. zophonastes was first described from five specimens collected from Hell Creek Cave (Hobbs and Bedinger 1964). This cave crayfish is stygobitic, lacks pigment and eyes, and has an overall body length reaching 2.5 to 3.0 inches. *C. zophonastes'* biology and life history are not understood with no data available regarding life span, fecundity, egg and fry survival, or other aspects of the species' ecology. An ovigerous (egg bearing) female was discovered in Hell Creek Cave suggesting reproduction occurs in the late winter and spring months with higher water levels and nutrient inputs triggering reproduction (Smith 1984). Work on cave crayfish in Florida suggest life spans of 40 years or more (Hobbs pers. comm.), although no work has been conducted on *C. zophonastes* to determine its life span. *C. zophonastes* are found on muddy stream bottoms, cave stream walls, and other in-stream habitats. Specific habitat preferences have not been studied and are not readily apparent to trained observers. Individuals demonstrate no response to light or observation; however once attempts are made to capture the crayfish, they quickly recognize the threat and attempt to avoid capture.

Hell Creek Cave was the only known location for this species until recent determinations verified Nesbitt Spring in 2005 and preliminary genetic analysis suggests the species' presence at an additional site in 2009. This newest site is a groundwater upwelling in Town Branch, a normally dry stream bed, and it is extremely rare that additional cave crayfish are observed there. Interestingly, the location of the newest site is approximately 40 miles northwest of the other known sites, which are found near one another, suggesting a much wider subterranean distribution of the species.

Population genetics data are available, but not published (Koppelman, pers. comm.). Genetic data have been useful in confirming the identification of specimens from newly discovered populations of cave crayfish throughout the Ozarks, including *C. zophonastes* from Nesbitt Spring Cave in 2005 and Town Branch in 2009.

Hell Creek Cave is a limestone phreatic conduit developed in the Plattin Formation of Ordovician age. Waters within the Hell Creek Cave are contributed through surface losing stream reaches within the Hell Creek Cave delineated recharge zone (Aley and Aley 1985). Groundwater from

Hell Creek Cave resurges below the cave and continues as surface flow along Hell Creek until a confluence with the White River. The cave is several thousand meters long and ends in a terminal sump only accessible to cave divers. A 175 foot cave pit was expanded during a mining scam in the early 1900's, ending at the terminal sump. This shaft allows for introduction of organic matter and terrestrial organisms directly into the cave system. The sump was explored by members of the Mid-Ozark Sump Team in 2000 and members of the Ozark Cave Diving Alliance (OCDA) in 2007 extending the known cave passage by 1500 feet or more. In 1961, Bedinger and Stephens located 5 individuals; however, subsequent monitoring through 2009 indicates variation in observed numbers that have ranged from 2 to 15 individuals.

Nesbitt Spring Cave is also a limestone phreatic conduit developed in the Plattin Formation of Ordovician Age. Work currently under review by the U.S. Geological Survey (USGS) was conducted to determine the size of the surface recharge zone for Nesbitt Spring. Losing stream reaches and sinkholes within the predicted recharge zone are likely direct conduits for introduction of surface waters to the cave. In 1992, "dozens" of stygobitic crayfish were reported during a combined surface and cave dive survey, and in 2005 members of the OCDA sighted nine stygobitic crayfish and collected six with subsequent pereopod removal for genetic analysis. All specimens were returned to the cave alive, with the exception of one that was injured during capture and preserved as a voucher specimen. Genetic analysis conducted by Jeff Koppelman with the Missouri Department of Conservation determined these crayfish to be *C. zophonastes*. Cave divers are able to access several sumps with open air passage being found between. A third internal sump has not been explored to determine additional underwater passage.

Eight of the first nine *C. zophanastes* observed in Hell Creek cave were collected as the type series and as museum vouchers. The first *C. zophonastes* census (traversable and dive portions) in Hell Creek cave occurred in 1983 (Table 1). A 1990 and 2000 to 2001 census counted 13 and 14 crayfish, respectively. Since 2001, partial surveys of the traversable passage have been conducted in lieu of difficult complete census surveys (Table 1; Graening et al. 2006). When possible, partial census counts occur on a biannual basis and are similar to historical counts in the traversable passage (C. Davidson, pers. comm.).

Nesbitt Spring cave was first surveyed in 2002. Two *C. zophonastes* were counted from the non-submerged portion of the cave. With the assistance

of cave divers, the entire cave that is accessible to humans was surveyed in 2005 and 6 individuals were counted. Subsequent census counts in the non-submerged portion of the cave are similar to historical counts (C. Davidson, pers. comm.).

The upwelling adjacent to Town Branch in Yellville has flushed two known *C. zophonastes* into Town Branch, one of which was sacrificed for genetic analysis and a second individual that was returned to the upwelling site. The groundwater system at this site is not accessible to humans. As such, it is impossible to conduct census counts at this site.

Table 1. *Cambarus zophanastes* survey data for Hell Creek and Nesbitt Spring caves, 1961 – 2009.

Year	Hell Creek Cave (Number of Individuals)	Nesbitt Spring Cave (Number of Individuals)	Size Distribution (small: medium: large)
1961	5	NS[1]	NR[2]
1972	2	NS	NR
1980	2[3]	NS	NR
1983	15[4]	NS	NR
1990	13[4]	NS	NR
1992	2[3]	"dozens"[4]	NR
2000a	6[3]	0[3]	NR
2000b	2[3]	NS	NR
2001	8[5]	0[3]	NR
2002	NS	2[3]	NR
2004	6[3]	NS	NR
2005	NS	9[4]	NR
2009	2[3]	NS	0:0:2

1 – Not sampled
2 – Not recorded
3 – Partial count, traversable portion of cave
4 – Traversable and dive portions of cave
5 – Only dive portion of cave

No data is available to assess whether sufficient levels of reproduction and recruitment are occurring to sustain population levels at historical levels. Future surveys will categorize individuals as small (less than one inch), medium (1 – 2 inches), and large (greater than 2 inches).

2. Five-Factor Analysis

a. Present or threatened destruction, modification or curtailment of its habitat or range:

As described under the Biology and Habitat section, it is difficult to ascertain what is occurring underground and the exact status of this species. Given an understanding of the functionality of the karst landscape in which this and the other sites occur, the best indicator of population viability is the landscape above and the threats posed by land management activities. Overall land use within the Hell Creek Cave recharge zone has changed little from early site characterization by Aley and Aley (1985), with the exception of a few additional houses and poultry operations. In 2006, a small development adjacent to the Hell Creek Cave recharge zone failed to apply sufficient erosion control measures, leading to creek sedimentation, and had not applied for appropriate permits from the Arkansas Department of Environmental Quality (ADEQ). Service, ANHC, and ADEQ coordination with the developers occurred immediately. Erosion and sedimentation concerns were rectified and subsequently an ADEQ permit was issued. Stormwater runoff from this and other developments, potential hazardous material spills along adjacent highways, and land application of animal litter pose ongoing threats to the species and its habitat. Aley and Aley (1985) analyzed threats within the Hell Creek Cave recharge zone and identified 12 potential contamination sources including animal litter, illegal dumping of waste, underground petroleum storage tanks, a cement company (siltation), maintenance of electrical transmission line right of ways (herbicides, ground disturbance), and unmanaged septic systems. Water quality sampling conducted in 2000 and 2001 determined all parameters met Arkansas Pollution Control and Ecology Standards and were comparable to regional levels reported by the National Water Quality Assessment Program (Graening et al. 2006).

The predicted recharge zone for Nesbitt Spring is mostly a rural setting and contains few identified threats. Subsequent to determination of this site as being occupied by *C. zophonastes*, a timber management action within the predicted recharge zone removed trees from sinkholes thereby possibly increasing sedimentation to the cave, although no evidence has been collected to verify any impact from the harvest. Septic tanks of uncertain condition, hazardous material spills from highways, and poultry operations all pose potential threats to *C. zophonastes* at Nesbitt Spring.

The Town Branch site in Yellville is in an urban area (small town of a couple thousand people). In 2011, there was an accidental release of gasoline from an underground storage tank. A dye trace study was being conducted at the time and surveyors believe that the majority of fuel remained above the most sensitive layer of the spring system that likely harbors *C. zophonastes*. The majority of the recharge area is upslope of the spill site and any groundwater affected by the spill that was occupied by *C. zophonastes* was expected to be minimal given the location of the spill (close to the upwelling) in relation to the recharge area (T. Aley, pers. comm.). Threats identified for rural areas in addition to contaminants in urban runoff pose risks to *C. zophonastes* at Town Branch site.

Ongoing recovery efforts are focused on cooperation and coordination with private landowners, the community of Mountain View (near Hell Creek) and establishing an appropriate response to a hazardous material spill with the Arkansas Highway and Transportation Department (AHTD).

b. Overutilization for commercial, recreational, scientific, or educational purposes: While overutilization was a concern in the past including the collection of 8 individuals from 1961 to 1980 at Hell Creek cave and 2 from Nesbitt Spring cave (1 individual in 1992 and 1 individual in 2002), additional voucher specimens are not permitted for collection. Five pairs of walking legs were collected for genetic analysis at both Hell Creek and Nesbitt Spring Caves. These crayfish were returned alive to the cave. One specimen was collected and preserved for genetic analysis at the Town Branch site to confirm the species identity. Genetic material collection aids in establishment of a comparative baseline genetic library and allows the individual cave crayfish to be returned to its habitat. Genetic material collection will not be authorized from Hell Creek or Nesbitt Spring Caves in the near future as numerous samples have already been collected for comparative analysis of future discoveries with other cave crayfish populations. Genetic material only will be collected from the Town Branch upwelling if an individual is flushed from the spring system and there is no way to safely return it to the upwelling site.

Trampling of cave crayfish has been documented and is considered a continued threat to this species. While a cave gate and fence have been placed on Hell Creek Cave, no such human barrier has been installed at Nesbitt Spring Cave. Both caves have had unauthorized entries increasing the risk for trampling as well as collection of this species for various

purposes. However, collection or inadvertent trampling is currently thought to be a minimal threat.

c. Disease or predation:

While disease threats are unknown, cave species' endemicity suggests that the potential exists for transport of unknown parasites or diseases from cave to cave by researchers or recreational cavers. It is a standard protocol (prior to White-nose Syndrome and now in accordance with the National White-Nose Syndrome Decontamination Protocol) that all cave gear be clean and decontaminated before biannual surveys. No known predation of *C. zophonastes* occurs, although numerous surface crayfish and fish enter these systems as well as small mammals, so predation is likely, but is believed minimal and not a threat to the continued existence of the populations.

d. Inadequacy of existing regulatory mechanisms:

While surface streams have water quality standards that are monitored and enforced, groundwater generally does not have similar standards. Existing regulatory mechanisms regarding the protection of groundwater resources are limited. Progress is being made by the Arkansas Natural Resources Commission and the ADEQ for development of standards for groundwater quantity and quality. Through coordination of permit reviews and comment by the Service prior to issuance, ADEQ is supporting groundwater protection strategies. They conduct groundwater quality monitoring throughout the state, but cave crayfish sites are not on their scheduled sampling.

Arkansas Game and Fish Commission prohibits collection of cave crayfish without a scientific collection permit. ANHC owns the cave entrance and portions of the recharge areas at Hell Creek cave, but no state protection is afforded to the species habitat on private property.

Arkansas enacted legislation (Acts 1059, 1060 and 1061 of 2003), whereby land application of poultry litter must be conducted under an approved nutrient management plan. That plan is based on soil and vegetative communities present, and recommends distances from water ways where litter should be applied. As enforcement is limited and water quality in caves and wells show increases in nutrients and metals, it appears adherence to or success of these plans is limited.

Under the NPDES storm water program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) require

authorization to discharge pollutants under a NPDES permit. Medium and large MS4 operators are required to submit comprehensive permit applications and are issued individual permits. Regulated small MS4 operators have the option of choosing to be covered by an individual permit, a general permit, or a modification of an existing Phase I MS4's individual permit. All regulated Small MS4s permitted under the general permit are required to develop and implement a Storm Water Management Program (SWMP). The SWMP must include Best Management Practices (BMPs) along with Measurable Goals and interim milestones for each BMP.

The EPA has regulations and standards outlining water quality conditions for groundwater based on human health standards. Regulations and management guidance necessary to protect groundwater from non-point source pollution do not exist.

The objective of the Federal Water Pollution Control Act, commonly referred to as the CWA (33 U.S.C. 1251 *et seq.*), is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources and a stated goal that "…wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water be achieved by July 1, 1983." States are responsible for setting and implementing water quality standards that align with the requirements of the CWA. Overall, implementation of the CWA could benefit *C. zophonastes* through the point and nonpoint programs.

Nonpoint source (NPS) pollution comes from many diffuse sources, unlike pollution from industrial and sewage treatment plants. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it transports natural and human-made pollutants to lakes, rivers, wetlands, coastal waters and ground waters. States report that nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, these pollutants have harmful effects on fisheries and wildlife (http://www.epa.gov/owow_keep/NPS/whatis.html).

Sources of NPS pollution within the recharge areas occupied by *C. zophonastes* include timber harvest, clearing of riparian vegetation,

urbanization, road construction, and other practices that allow bare earth to enter streams, sinkholes, and other conduits that transport surface waters to groundwater systems (The Nature Conservancy 2004, p. 13). Currently, the CWA may not adequately protect Hell Creek cave crayfish habitat from nonpoint-source pollution. No streams within the Hell Creek recharge area are listed as impaired waters under section 303(d) of the CWA. The Service has no information concerning the implementation of the CWA regarding nonpoint source pollution specific to protection of *C. zophonastes*.

Point-source discharges within the range of *C. zophonastes* are primarily restricted to Yellville. Despite some reductions in point source discharges, adequate protection may not be provided by the CWA for crayfish that may be affected by extremely low levels of contaminants. However, there is no specific information known about the sensitivity of *C. zophonastes* to common industrial and municipal point source pollutants (for example, dissolved metals and nutrients). Because there is very little information known about water quality parameters necessary to fully protect cave crayfish, it is difficult to determine whether the CWA is adequately addressing the threats to this species. However, it is a goal of the CWA to establish water quality standards that protect aquatic life.

Water quality threats to *C. zophanastes* are typically derived from non-point source contaminants. These contaminants degrade water and sediment quality leading to environmental conditions that may result in sub-lethal or lethal effects. Currently, the CWA may not adequately protect *C. zophanastes* habitat from non-point source pollution. The Service has no information concerning the implementation of the CWA regarding NPS pollution specific to protection of cave crayfish or *C. zophanastes*. However, insufficient implementation could become a threat to *C. zophanastes* since populations are generally small and restricted to three known localities. There is no specific information known about the sensitivity of *C. zophanastes* to common point source pollutants like industrial and municipal pollutants and very little information on other crayfish. Because there is very little information known about water quality parameters necessary to fully protect crayfish, such as *C. zophanastes*, it is difficult to determine whether the CWA is adequately addressing the threats to this species. However, given that a goal of the CWA is to establish water quality standards that protect aquatic life, we take a conservative approach in favor of the species and conclude that the CWA regulations are insufficient to provide adequate protection and significantly reduce or remove threats.

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e. Other natural or manmade factors affecting its continued existence:

No other natural or man-made factors have been identified as apparent threats in the conservation and continued existence of *C. zophonastes*.

D. Synthesis

C. zophonastes occurs with a broader distribution than originally described and although census counts may fluctuate widely between surveys; counts over the past decade are comparable to historical counts (pre-2003) (reference Table 1, Section C.1). Direct enumeration of populations does not assure stability due to the extreme difficulty of conducting surveys. No data on population reproduction exists to evaluate the threat of low or no reproduction, as identified in the recovery plan. As such, land management and water quality studies within the delineated and predicted recharge zones serve as predictors of population viability. Threats within the predicted or delineated recharge zones include point and nonpoint source contaminants from illegal refuse dumping, salvage yards, malfunctioning septic systems and discharge of urban storm water and treated municipal sewage. While surface and ground water quality sampling conducted to date in the recharge areas has not detected excessive nutrient, bacteriological, metals, or other contaminants, land management within the recharge areas continue to threaten populations. Additional work should be focused on private landowner, city, county, and AHTD coordination, thereby ensuring their knowledge of site sensitivity and building cooperative management strategies for conservation of groundwater resources. Continued biannual census counts and water quality monitoring will be essential for assessing population trends and re-evaluating the species status. *C. zophanastes* and its habitat continue to be threatened by trampling or disturbance from amateur cavers and land use activities in the recharge areas. Population isolation increases the threat of stochastic events that impair water quality impacting one of the remaining populations. For these reasons, we believe *C. zophanastes* still meets the definition of an endangered species and do not recommend a change in status at this time.

III. RESULTS

A. Recommended Classification:

__X__ No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

During the next review period, the following priority actions should be undertaken: 1) continue efforts to prevent human disturbance to cave systems containing *C. zophonastes* through the use of outreach, signage, surveillance, and gating, 2) finalize, apply for permits, and begin implementation of the cave safe harbor agreement and candidate conservation agreement with assurances, 3) continue to establish partnerships with private landowners, local businesses, city and county officials to share the importance of the cave ecosystem and solicit their support in conservation initiatives (such as, the cave safe harbor agreement), 4) develop a hazardous materials spill action plan for implementation by local responders and AHTD, 5) continue searching for additional sites, 6) establish a water quality monitoring program at currently known sites, 7) conduct recharge delineations at identified locations, 8) continue efforts to purchase conservation easements or acquire lands within recharge zones, and 9) continue biannual monitoring efforts which include the use of cave divers.

V. REFERENCES

Aley, Thomas and Catherine Aley. 1985. Water Quality Protection Studies Hell Creek Cave, Arkansas. Report to Arkansas Natural Heritage Commission and The Nature Conservancy. 44pp.

Hobbs, H.H., Jr., and M.S. Bedinger. 1964. A new troglobitic crayfish of the genus *Cambarus* (Decapoda, Astracidae) from Arkansas with a note on the range of *Cambarus cryptodytes* Hobbs. Proceedings of the Biological Society of Washington 77: 9-16.

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Gillip, J.A., Galloway, J.M., and Hart, R.M., 2009, Assessment of local recharge area characteristics of four caves in northern Arkansas and northeastern Oklahoma, 2004-07: U.S. Geological Survey Scientific Investigations Report 2009-5118, 25 p.

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Koppelman, J. 2005 and 2009. Personal Communication. Regarding the results of cave crayfish genetic samples collected in Arkansas. Resource Scientist. Missouri Department of Conservation. Columbia, Missouri.

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Stewart, J. 1987. Endangered and threatened wildlife and plants: Determination of endangered status for *Cambarus zophonastes*. U.S. Fish and Wildlife Service. Federal Register 52(66): 11170-11172.

U.S. Fish and Wildlife Service. 1988. Recovery plan for the cave crayfish (*Cambarus zophonastes*). Atlanta, Georgia. 18pp.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Hell Creek Cave crayfish (*Cambarus zophonastes)*

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: David Kampwerth, Arkansas Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Acting _____ Date 6/25/2012

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

Lead Regional Director, Fish and Wildlife Service

for

Approve _____ Date 8/15/12

Appendix A. Summary of peer review for the 5-year review of Hell Creek Cave crayfish (*Cambarus zophonastes)*

A. Peer Review Method: Peer review was requested from three knowledgeable individuals. Responses were received from these peer reviewers.

A draft copy of this 5-year review was sent to the following knowledgeable individuals for their review and comment. The following biologists comprise the Arkansas Aquatics Threatened and Endangered Species Team and are recognized for their expertise and involvement in conservation actions for this species.

Douglas Fletcher, Chief of Stewardship
Arkansas Natural Heritage Commission

Mike Slay, Karst Ecologist
The Nature Conservancy, Arkansas

Brian Wagner, Nongame Aquatics Biologist
Arkansas Game and Fish Commission

B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments/Report: Peer reviewer responses were supportive of the information and conclusions presented in this review. Reviewers also provided general editorial comments.

D. Response to Peer Review: The Service was in agreement with all comments and concerns received from peer reviewers. Comments were incorporated into the 5-year review where appropriate.

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, Arkansas Ecological Services Field Office

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with U.S. Fish and Wildlife Service (Service) policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data apparently not used by the Service.

3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.

4. Provide written comments on:
   - Validity of any models, data, or analyses used or relied on in the review.
   - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
   - Oversights, omissions, and inconsistencies.
   - Reasonableness of judgments made from the scientific evidence.
   - Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.
   - Strengths and limitation of the overall product.

5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents and portions may be incorporated verbatim into the Service's final decision document with appropriate credit given to the author of the review.