# Alabama Cave Shrimp
*(Palaemonias alabamae)*

# 5-Year Review:
# Summary and Evaluation

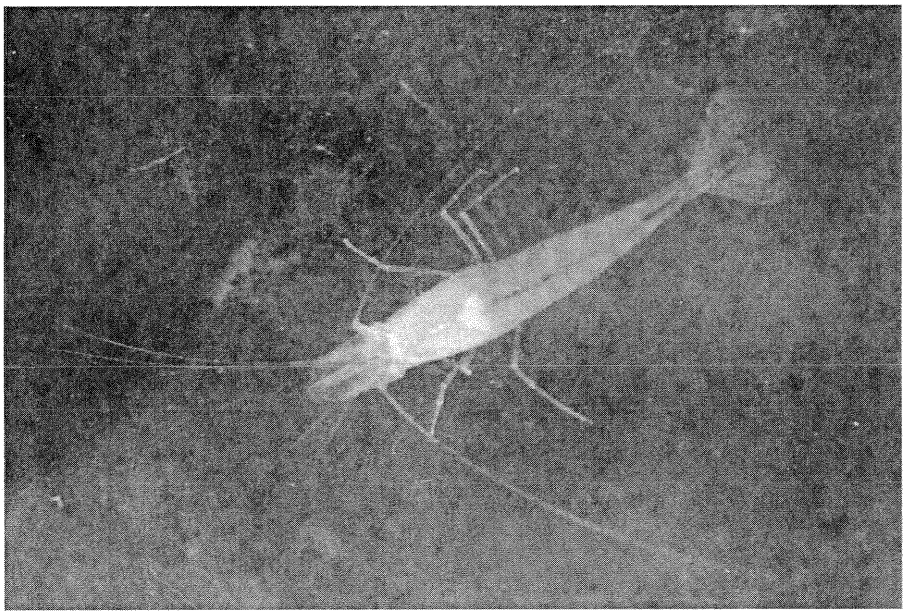

Photo: Dr. Bernard Kuhajda

**U.S. Fish and Wildlife Service**
**Alabama Ecological Services Field Office**
**Daphne, Alabama**

# 5-YEAR REVIEW
# Alabama cave shrimp/Palaemonias alabamae

## I. GENERAL INFORMATION

### A. Methodology used to complete the review

This 5-year review was conducted by the Daphne Field Office (Jeff Powell). The primary source of information used in this analysis was found in the 1988 final listing rule (53 FR 34696); the final recovery plan (FWS 1997); peer-reviewed reports; unpublished survey data and reports, and personal communication with recognized experts. Outreach consisted of a Federal Register notice (70 FR 34492) that requested any recent information related to the distribution and habitat quality of the Alabama cave shrimp. Data and additional information were received from Stuart McGregor, Dr. Bernard Kuhajda, Daniel Dunn, and Dr. Jennifer Buhay. All four of these experts also peer reviewed this document (Appendix A).

### B. Reviewers

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

**Lead Field Office – Daphne, AL: Jeff Powell, (251) 441-5858**

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### C. Background

1. **FR Notice citation announcing initiation of this review:** 70 FR 34492

2. **Species status:** Stable (2005 Recovery Data Call)

3. **Recovery achieved:** 1= 0 -25 % recovery objectives achieved (2005 Recovery Data Call)

4. **Listing history**
   Original Listing
   FR notice: 53 FR 34696
   Date listed: September 7, 1988
   Entity listed: Species
   Classification: Endangered

5. **Review History**
   Recovery Data Call: 2005 (stable), 2004 (stable), 2003 (stable), 1997 (Final Recovery Plan published)

6. **Species' Recovery Priority Number at start of review**: 5 (degree of threat is high, potential for recovery is low, and the taxonomy is the species level)

7. **Recovery Plan or Outline**
Name of plan: Alabama Cave Shrimp (Palaemonias alabamae) Recovery Plan
Date issued: September 4, 1997

## II. REVIEW ANALYSIS

**A. Application of the 1996 Distinct Population Segment (DPS) policy:** Not applicable. The Alabama cave shrimp is an invertebrate, and therefore, not covered by the DPS policy, and will not be addressed further in the other DPS questions in this review.

**B. Recovery Criteria**

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

2. **Adequacy of recovery criteria.**

   a. **Does 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 (and there is no new information to consider regarding existing or new threats)?** Yes

3. **Recovery Criteria**: The 1997 Final Recovery Plan only identifies downlisting (reclassification to threatened) criteria.

   1. **Identification and protection of reproductively viable populations of Alabama cave shrimp in five groundwater basins (or aquifers).**

Has not been met: At the time of listing, the Alabama cave shrimp (ACS) had been found in five caves in Madison County, Alabama: Shelta Cave (the type locality), Bobcat Cave, and the cave complex consisting of Hering, Glover, and Brazelton Caves (FWS 1988). Currently, viable populations of ACS have only been confirmed in two groundwater basins: in Bobcat Cave, in southwest Madison County (McGregor and O'Neil 2004) and in the Hering/Glover/Brazelton (HGB) cave system (Rheams et al. 1994), which is a series of hydrologically connected caves in southeast Madison County. The ACS has not been found in Shelta Cave since the 1970s (FWS 1997). Bobcat Cave is owned by the U.S. Army, Redstone Arsenal (RSA) and is therefore subject to

protection under Section 7 of the Endangered Species Act (ESA). The HGB caves are located on private lands, and are not currently protected.

In December 12, 1993, McGregor et al. (1994) reported three individual shrimp from a cave in western Jackson County about 24 km (15 miles) northeast of Hering Cave; however, this has not been confirmed (Limrock Blowing Cave). On November 17, 2005, an unidentified cave shrimp was reported from Muddy Cave, in southern Madison County (specimen was preserved) (Kuhajda 2005b). Preliminary observations indicate that it is likely an ACS (Kuhajda 2006, 2006a, 2005a). Although the cave had been surveyed several times before, no shrimp were ever reported (Kuhajda 2004). According to Kuhajda (2006), the specimen collected resembles the ACS both morphologically (B. Kuhajda, pers. comm., 2006) and is identical genetically, or nearly so, to specimens collected in Bobcat Cave and the HGB system (B. Kuhajda, per. comm., 2006a). This represents a third population (i.e., groundwater basin) of ACS and a slightly southern range extension for the species.

**2. Reproductive viability, defined as reproducing populations which are stable or increasing in size, should be demonstrated for all five populations for a 20-year period.**

Has not been met: Reproductively viable populations of ACS have been confirmed in two cave systems: in Bobcat Cave and in the HGB complex. The population in Bobcat Cave appears to be stable. According to McGregor and O'Neil (2004), ACS females with oocytes or attached ova have been observed annually since 1990. The status of the population in the HGB system is unknown; however, the most recent surveys were conducted in the early 90's, when it was presumed to be viable (Rheams et al. 1994; McGregor et al. 1994). The status of the population in Muddy Cave is unknown.

Which of the 5 listing factors are addressed by this criterion: The following listing factors (Factors A-C, modified from FWS 1997; Factors D-E, modified from FWS 1988) apply equally to both downlisting criteria.

*Factor A: The present or threatened destruction, modification or curtailment of its habitat or range.* Destruction of habitat includes physical alterations to a cave, such as dumping trash into a cave or sinkhole, or closing off cave entrances or sinkholes; alteration of drainage and hydrologic patterns; lowered groundwater levels; and groundwater degradation or contamination by toxins, nutrients, and/or sewage. Surface pollutants can easily and rapidly enter the subsurface aquifer, particularly during storm events. Urbanization of areas surrounding Shelta and Bobcat Caves, and development in the recharge area of the HGB system may cause contamination of the aquifers containing ACS. Groundwater contamination may result from sewage leakage, industrial contaminants, road and highway runoff, toxic spills, pesticides, and siltation. The Redstone Environmental Office has detected TCE (trichloroethylene) in several of the groundwater monitoring

wells coming onto the RSA installation northeast of Bobcat Cave (D. Dunn-RSA, pers. comm. 2006).

Urbanization has also increased water demand in Huntsville, Alabama. The City has experienced severe water shortages during the past few years due to increased demand and drought (Huntsville Times, 21 June 1989, in litt.). In response to this demand, the city drilled and brought on line the Drake well. Capable of pumping up to 7,570 liters (2,000 gallons) per minute, this well is located less than 1 km (0.5 miles) from Bobcat Cave. Increased water consumption has the potential to affect Bobcat and Shelta Cave aquifers by lowering groundwater levels and reducing the amount of available habitat for the ACS.

Habitat degradation has occurred in Shelta Cave from unknown causes. Water samples taken in Shelta Cave in 1987 indicated that the aquifer had become contaminated by cadmium, heptachior epoxide, and dieldrin (J. French, *in litt.* 1987). Anomalous levels of cadmium, almost five times the drinking water standard, possibly originated from industrial or municipal sources. Both heptachlor epoxide and dieldrin can originate from the degradation of chemicals used for termite control. Both pesticides are extremely toxic to aquatic life and, along with cadmium, present a danger of bioaccumulation in the food web. Since aquatic troglobites, such as the ACS, tend to be long-lived and may store, rather than depurate, pollutants such as these, even low levels of pollutants can be of concern (Dickson et al. 1979, Bosnak and Morgan 1981, Hobbs 1992).

Comparison of aquatic surveys of Shelta Cave conducted during 1968-1975, 1985-1987, and 1988, reveal a decline in all aquatic organisms monitored (Hobbs and Bagley 1989). Whether this decline is due to water quality degradation, nutrient loss due to abandonment of the cave by bats, or a combination of these and/or unknown factors, remains to be determined. According to R. Blackwood (pers. comm. 2006), several leaks of chlorinated water have been observed by local cavers and a Huntsville Utility crew. Initial hypothesis are that the chlorinated water may be eliminating the bacteria and other food sources of the cave crayfish and cave fish.

Suburbanization is occurring near the HGB caves. Forests are being cleared for new homes around Keel Mountain, and septic tank systems are being installed in lieu of sewer system hookups. The ACS found in the HGB caves will be in danger of surface water and groundwater contamination from sewage leakage, lawn fertilizers, pesticides, and increased surface runoff from residential development in the near future (Campbell et al. 1995; S. McGregor, GSA, pers. comm. 1996; R. Blackwood, National Speleological Society-NSS, pers. comm. 1997). Additionally, large chicken farms are present in the Hering Cave recharge area and could impact water quality in all three caves in the cave complex by discarding excess grains and manure into sink holes. Abandoned underground gasoline storage tanks also threaten Glover and Brazelton caves (R. Blackwell, pers. comm. 2006).

*Factor B: Overutilization for commercial, recreational, scientific, or educational purposes.* Since the ACS population in each of these caves is so low that they are rarely seen, the removal of any ACS by collectors may affect the ability of the species to reproduce. Other cave species are known to have extremely low reproductive rates when compared to closely related surface species (Cooper 1975). If the same is true for the ACS, declining population numbers, compounded by low reproductive rates, will significantly affect the species' ability to recover. The HGB caves are located on private property and are easily accessible to cavers and trespassers. However, unauthorized collecting of cave shrimp from Shelta and Bobcat Caves is not likely to occur due to the protection afforded by the landowners. The entrances to Shelta Cave are owned by the National Speleological Society (NSS) protected by a large perimeter fence which controls public access (J. Buhay, per. comm. 2006). Bobcat Cave is located on Redstone Arsenal, a U.S. Army installation, and access is restricted.

*Factor C: Disease or predation.* Predation may impact ACS populations. Cooper and Cooper (1974) observed a southern cavefish, Typhlichthys subterraneus, regurgitating an ACS in Shelta Cave. Other potential predators in this cave include the Tennessee cave salamander, Gyrinophilus palleucus, and two troglobitic crayfishes. Potential predators observed in Bobcat, Brazelton, Glover, and Hering caves are the southern cavefish, troglobitic crayfish, unidentified salamanders, Tennessee cave salamander, bullfrogs, and raccoons (Rheams et al. 1992, McGregor et al. 1994). Predation by naturally occurring predators is a normal aspect of the population dynamics of a species. However, the effect of predation on a declining troglobitic species with an apparently low reproductive potential would be more significant than if the population were stable.

*Factor D. Inadequacy of existing regulatory mechanisms*: The ACS is only afforded protection under the ESA. The State of Alabama does not include the ACS on the State list of threatened or endangered species, or as a species of High Conservation Concern. Since there is no new information on the species' sensitivity to common pollutants, Federal water quality laws (e.g., Clean Water Act) such as those administered by the State, may or may not be protective of the ACS, especially since limitations and monitoring of groundwater are not common regulatory practices.

Shelta Cave is owned by the NSS and is currently gated to exclude unauthorized visitors. Bobcat Cave is owned by Redstone Arsenal and admittance is controlled. The entrances to the HGB caves are located on private lands and are currently unprotected.

*Factor E. Other natural or manmade factors affecting its continued existence*: The ACS's small population size and limited reproductive capabilities are natural factors that hinder its ability to recover from habitat or other population impacts.

Low water levels, resulting from drought or excessive water withdrawals, may also affect the ACS.

## C. Updated Information and Current Species Status

### 1. Biology and Habitat.

**a. Abundance/population trends**: Available information indicates that range-wide, the ACS may be declining. The population of ACS in Shelta Cave has not been observed since the early 1970's. The population in Bobcat Cave appears to be stable (McGregor and O'Neil 2004). Since 1990, Bobcat Cave has been surveyed monthly, when water levels allowed access (146 times), and ACS have been reported 77 times, for a total of 871 sightings. Sightings have been documented every month of the year except February, March, and April. The lack of reported sightings in these months is likely due to high water levels and inaccessibility to the cave's pools. ACS have been reported in all other months ranging from a low of 3 in May to a maximum of 403 in August. The most productive months, in terms of total number of sightings, are August (403), July (145), and October (134). The same is generally true for numbers of gravid ACS females sighted and include, August (60 gravid females), October (21 gravid females), and July (at least 8 gravid females) (McGregor and O'Neil 2004).

The ACS population in the HGB system has not been well documented. Between 1991 and 1994, there were approximately 19 individual sightings including at least two gravid females (Rheams et al. 1992; McGregor et al. 1994). R. Blackwood reported as many as 39 individual ACS sightings in his 1998 surveys (R. Blackwood, unpublished data). The population in Muddy Cave has not been determined.

**Demographic trends**: Demographic trends are relatively unknown. Cooper (1975) observed ACS gravid females in Bobcat Cave from July to January, where the number of eggs carried by each female ranged from 4 to 30. Cooper hypothesized that eggs matured in the fall and hatched in the winter. McGregor et al. (1994) believed that the ACS needs at least one growing season to reach sexual maturity; however, larval development for the species has not been fully determined. Cooper (1975) estimated that sex ratios for the ACS are approximately 1:1, and that sexual dimorphism does exist (females average 1.2 mm longer than males in total length, and the male rostrum averages 4.2 percent longer than the females'). Although life span has not been documented for the ACS, the closely related Kentucky cave shrimp (Palaemonias ganteri) is reported to live between 10 and 15 years (Leithauser 1988).

**b. Genetic variation**: Although several specimens have been maintained for genetic analysis, a detailed genetic analysis has not been conducted between currently extant ACS populations. However, attempts are being made to compare the

genetics between Palaemonias alabamae and its closest relative, the Kentucky cave shrimp (P. ganteri), found in Mammoth Cave in Kentucky. The Kentucky cave shrimp differs morphologically from the ACS by its larger size, longer rostrum (flattened frontal projection of head), more numerous ventral rostral spines, and more dorsal rostral spines (Smalley 1961). A third species, the Tuscumbia cave shrimp (undescribed), has been reported from a cave near Tuscumbia, Alabama, and differs both morphologically and genetically from both the Kentucky and Alabama cave shrimp (Kuhajda, pers. comm. 2006). Genetic analysis on the recently discovered ACS from Muddy Cave suggests that it is identical, or nearly so, to the ACS found in Bobcat and the HGB caves (Kuhajda, pers. comm. 2006a).

c. **Taxonomic classification or changes in nomenclature**: None

d. **Spatial distribution:** The ACS was first collected in Shelta Cave in 1958 (Cooper 1975), yet it has not been seen there since the early 1970's. The population in Bobcat Cave has been monitored monthly from 1990 to the present and remains viable. With the discovery of populations in Hering/Glover (1991) and in Brazelton Cave (1994) (Rheams et al. 1994), and Muddy Cave (2005) (Kuhajda, pers. comm. 2006a) the total range of the species extends approximately 20 km (12 miles) east-southeast across the Flint River and the Huntsville, Green, and Monte Sano Mountains and southward to near the Tennessee River (McGregor et al. 1994). In December 1993, McGregor et al. (1994) mentioned three individual shrimp from a cave in western Jackson County about 24 km (15 miles) northeast of Hering Cave (reported by a recreational caver). The observation was from Limrock Blowing Cave and was never confirmed.

e. **Habitat conditions**: Little is known about the habitat requirements of the ACS, other than it occurs in silt-bottomed pools in a cave environment (FWS 1997). Current knowledge is primarily based upon observations in Shelta and Bobcat caves. Only a few observations have been made in the HGB system and habitat conditions have not been documented. Habitat in the potentially new location, Muddy Cave, is described as being similar to that found in Bobcat and the HGB caves (S. McGregor, pers. comm. 2006).

Habitat is extremely difficult to quantify due to the dynamic nature of cave systems. Basic chemical and physical conditions in the caves are highly influenced by land use in the recharge area and can be impacted by surface runoff from developments (e.g., residential) and manipulation of landscapes (e.g., clearing of forestland) in the recharge area.

## 2. Five Factor Analysis (threats, conservation measures and regulatory mechanisms).

**Factor A. Present or threatened destruction, modification or curtailment of its habitat or range:** Groundwater contamination is likely the greatest threat to ACS populations. Groundwater quality has been monitored annually in Bobcat Cave since 1996. Recent monitoring data (McGregor and O'Neil 2004) show a continual increase in maximum lead concentrations in Bobcat Cave. Lead was detected in 7 of 11 samples in Bobcat Cave in 2003-04 ranging from <0.9 to 20.0 µg/L with a median of 1.5 µg/L. It has not been determined if this rise has impacted ACS populations in Bobcat Cave. Groundwater monitoring data from Redstone Environmental Office document TCE moving onto Redstone Arsenal from the north. Although concentrations are small, they have been detected in wells near Bobcat Cave (D. Dunn, pers. comm., 2006).

Other potential threats facing the Bobcat Cave ACS population include: development of lands outside RSA, but lying within the recharge area; pumping of large municipal wells and lowering of water levels, and accidental disruption of aquatic habitat by investigators (Campbell 1997). The greatest threats to the ACS at the HGB caves are potential pollutants originating from residential development and delivered to the caves during periods of runoff.

Over the past 13 years, considerable progress has been made in monitoring ACS populations in Bobcat Cave, as well as understanding the relationships between surface runoff and groundwater quality and precipitation amounts and cave water levels (Rheams et al. 1992; McGregor and O'Neil 1996, 2000, 2001, 2002, 2003, 2004; McGregor et al. 1996, 1999; McGregor et al. 1997, 1999; Campbell et al. 1997). The recharge area around Bobcat Cave has been delineated and dye tracer studies have documented a direct hydrologic connection among the HGB caves (Campbell 1998). Also, the immediate surface drainage into Bobcat Cave has recently been protected by removing cattle and other agricultural practices, and returning the landscape to an unmanaged state (McGregor and O'Neil 2004). These multi-agency supported studies have significantly contributed to our awareness about ACS life history and population trends. Results have recently been summarized in two publications (Burnett et al. 2003; McGregor et al. 2003), and at the 4$^{th}$ White House Conference on Cooperative Conservation, August 2005.

**Factor B. Overutilization for commercial, recreational, scientific, or educational purposes:** The population size of the ACS apparently remains at low levels and is subject to impacts from scientific or other collecting.

**Factor C. Disease or predation:** ACS population numbers apparently remain low and continue to be subject to natural predation from other cave-dwelling species.

**Factor D. Inadequacy of existing regulatory mechanisms:** Since there is no new information on the species' sensitivity to common pollutants, Federal water quality laws (e.g., Clean Water Act) such as those administered by the State, may or may not be protective of the ACS, especially since limitations and monitoring of groundwater are not common regulatory practices.

Conservation measures include: property owners at Shelta (NSS) and Bobcat (RSA) Caves have gated entrances and limited access, and the Environmental Protection Agency (EPA) has restricted the use of the heptachlor epoxide and banned the use of dieldrin, both of which are presumably lethal to the ACS. EPA County bulletins prescribe buffers for certain current-use pesticides, which may also be helpful.

**Factor E. Other natural or manmade factors affecting its continued existence:** Natural droughts as well as water withdrawn for human use, especially during times of drought, can impact cave water levels. Changes in land use in the recharge area can accelerate pollutants delivery to caves during surface runoff. Other factors include; human-induced random events such as toxic spills in the recharge area; construction of new facilities/buildings in the recharge area; and potential road construction projects in the recharge area. Also, a proposed bypass around Huntsville is projected to pass near the entrance to Muddy Cave and may affect surface runoff into the cave (Huntsville Times, 4 December 2005). The City of Huntsville and Madison County are currently actively working on a plan to widen Zierdt Road from two to four lanes, from I-565 south to Martin Road, to handle increased traffic expected from new housing development to the west of Redstone. Zierdt Road runs along the western boundary of Redstone Arsenal and passes within 1,200 feet of Bobcat Cave (D. Dunn, pers. comm. 2006).

## D. Synthesis -

The Alabama cave shrimp is a rare, troglobitic cave shrimp that survives in only two of its three known locations. The population in its type locality, Shelta Cave, has not been seen since the early 1970s. Population levels in Bobcat Cave and the HGB (R. Blackwood, pers. comm. 2006) Cave system appear to be low but stable. The status of the newly identified population in Muddy Cave is unknown. The sighting in western Jackson County (Limrock Blowing Cave), by McGregor et al. (1994), should be further evaluated. Results from survey data throughout the range indicate that population levels remain low where the species exists.

Specific life history and habitat needs have not been well documented. Water quality and suitable cave habitat continue to be chronically plagued by polluted surface runoff. Recent water quality data from Bobcat Cave indicates that polluted deep groundwater may also pose a potential impact and should be further evaluated.

Many of the studies conducted over the past 13 years have advanced our understanding of surface/groundwater interactions, as well as how precipitation relates to the timing and magnitude of waters being delivered to caves. However, the cave environment is extremely dynamic and more research is needed to better understand the quality of water in caves and how and when it is delivered. This is a critical concept, not only for the cave shrimp, but for all karst dependent species.

The Alabama cave shrimp, despite numerous surveys over the past fifteen years, remains extremely rare throughout its range and is in danger of extinction. According to recovery

criteria (FWS 1997), a total of five viable populations in five distinct groundwater systems needs to be identified, protected, and documented as viable prior to downlisting the species. At the time of this review, there are only two confirmed populations in two separate groundwater basins.

## III. RESULTS

**A. Recommended Classification**: No change is needed

## IV. RECOMMENDATIONS FOR FUTURE ACTIONS

(a) Continue monitoring Alabama cave shrimp populations in Bobcat Cave to develop long-term trends.
(b) Continue monitoring ground-water quality and water levels in Bobcat Cave. Special attention should be placed on the levels and trends of potential toxins, such as lead and cadmium, persistent current-generation pesticides, and other parameters associated with urban runoff (see McGregor and O'Neil 2004 for more details).
(c) Determine the origin (age, source, and recharge area) of deep ground water in the Bobcat Cave aquifer.
(d) Work with private landowners to confirm shrimp populations and develop water quality monitoring plans for the HGB system, Muddy Cave, and in the unnamed cave in western Jackson County, Alabama.
(e) Work with EPA to determine the source of, and remediate, TCE and other contaminants plumes that will affect Bobcat Cave population.
(f) Implement all other recovery actions (listed below).

Recovery Actions (FWS 1997):

1. Protect Alabama cave shrimp populations and their groundwater habitat.
2. Develop technical information and educational material essential for cave and recharge area stewardship.
3. Monitor Alabama cave shrimp populations.
4. Conduct life history and other needed research.
5. Continue searching for additional populations.
6. Modify or replace the gated entrance to Shelta Cave.
7. Assess suitability of re-introduction of Alabama cave shrimp into Shelta Cave.

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Geological Survey of Alabama, Tuscaloosa, AL.

Mr. T.W. Hazle (as signatory authority).
Department of the Army, Redstone Arsenal, AL.

Dr. Bernard Kuhajda
University of Alabama, Tuscaloosa, AL

Mr. Randall Blackwood
National Speleological Society, Huntsville, AL.

**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of *the Alabama cave shrimp***

Current Classification ____Endangered_____
Recommendation resulting from the 5-Year Review

**____ Downlist to Threatened**
**____ Uplist to Endangered**
**____ Delist**
**_X_ No change is needed**

Appropriate Listing/Reclassification Priority Number, if applicable _NA_

Review Conducted By __Jeff Powell, Daphne, AL Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Elaine Suffer-Conner Date 5/5/06

*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**

Approve Franklin Quarterman Acting ARD-ES Date 8/29/06

*The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.*

**Cooperating Regional Director, Fish and Wildlife Service**

_____Concur _____ Do Not Concur

Signature_____Date_____

**APPENDIX A: Summary of peer review for the 5-year review of the Alabama cave shrimp (Palaemonias alabamae)**

**A. Peer Review Method:** see below

**B. Peer Review Charge:** see below

Request sent (email – dated 03/30/2006) to potential reviewers requesting comments on the 5-year review (see below for copy of actual request). Request was sent to, Mr. Randall Blackwood (NSS), Mr. Stuart McGregor (GSA), Dr. Horton Hobbs III (Whittenberg University), Dr. Bernard Kuhajda (University of Alabama), Mr. Daniel Dunn (RSA), and Ms. Gabrielle Ehinger (RSA).

*Hi Folks,*

*As you may know, on June 14, 2005, the U.S. Fish and Wildlife Service published a notice in the Federal Register announcing a 5-year review of the following 25 federally listed species: ringed map turtle, flatwoods salamander, pygmy sculpin, Alabama moccasinshell, orange-nacre mucket, fine-lined pocketbook, lacy elimia, painted rocksnail, round rocksnail, watercress darter, southern acornshell, ovate clubshell, southern clubshell, upland combshell, triangular kidneyshell, Coosa moccasinshell, dark pigtoe, southern pigtoe, cylindrical lioplax, flat pebblesnail, plicate rocksnail, tulotoma snail, Alabama cave shrimp, Alabama leather flower, and Morefield's leather flower. The purpose of 5-year review is to ensure that the classification of species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12) is accurate. It is my responsibility to prepare the review for the Alabama cave shrimp and coordinate peer reviews. I should have a draft copy of the review available in the next couple weeks and was hoping that you all could take a look at it and provide comments or suggestions. The format is standardized according to our regs and the sections you would be reviewing consist of approximately 4-5 pages. The review would have to be completed by May 7th. If you feel like you can serve as a peer-reviewer, please let me know.*

*If you have any questions, please feel free to let me know. Thanks*

*jeff*

*U.S. Fish and Wildlife Service*
*1208-B Main Street*
*Daphne, AL. 36526*
*phone: (251) 441-5858*

**C. Summary of Peer Review Comments/Report**

Mr. Stuart McGregor, Geological Survey of Alabama, Tuscaloosa, AL: Majority of comments were editorial corrections/suggestions (refer to DFO file for reviewed document).

Mr. Randall Blackwood, National Speleological Society, Huntsville, AL: Mr. Blackwood's had several updated remarks on the current land use in the recharge area around the HGB complex; suggesting chicken farms may be impacted water quality. He also provided some an excel file with data he and his students have collected since ~1998. Apparently, Mr. Blackwell has a considerable amount of survey information to present. He plans on published the data in summer

of 2006. Also, noted that chlorinated water has been detected on multiple occasions in Shelta Cave.

Mr. Daniel Dunn, U.S. Army, Redstone Arsenal, Huntsville, AL: Mr. Dunn pointed out that TCE had been detected entering the RSA northern boundary from an offsite source. Suggested working with EPA to develop a monitoring plan. Mr. Dunn also noted that Madison County was planning a road-widening project on Zierdt Road, which runs approximately 1200 feet from the entrance to Bobcat Cave (refer to DFO file for reviewed document).

Dr. Jenifer Buhay, Brigham Young University, Provo, UT.: Dr. Buhay questioned the potential occurrence in Limrock Blowing Cave in Jackson County, Alabama. Although only recently discovered, Dr. Buhay suggests that Muddy Cave is perfect habitat for the ACS. Pointed out that since her initial visit to Hering Cave in 2002, conditions had drastically degraded. Water clarity was reduced and large amounts of sediment deposited on bottom of the pools. She went on to report that either Hering or Brazelton Cave, she could not remember which, was "disgusting" and full of organic matter, silt, and foul smells. She highly recommended that the Service focus on protecting and continuing surveys in Hering Cave. She also sent a copy of her recent paper which discusses the subterranean phylogeography of freshwater crayfishes.

**D. Response to Peer Review**

Mr. Stuart McGregor, Geological Survey of Alabama, Tuscaloosa, AL: Agreed with all comments and incorporated.

Mr. Randall Blackwood, National Speleological Society, Huntsville, AL: Agreed with all comments and incorporated.

Mr. Daniel Dunn, U.S. Army, Redstone Arsenal, Huntsville, AL: Agreed with all comments and incorporated.

Dr. Jennifer Buhay, Brigham Young University, Provo, UT.: Incorporated changes as appropriate.