

CANDIDATE AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Cryptobranchus alleganiensis bishopi*

COMMON NAME: Ozark hellbender

LEAD REGION: 4

INFORMATION CURRENT AS OF: March 2003

STATUS/ACTION:

New candidate

Continuing candidate

Non-petitioned

Petitioned - Date petition received: \_\_\_\_

90-day positive - FR date: \_\_\_\_

12-month warranted but precluded - FR date: \_\_\_\_

Is the petition requesting a reclassification of a listed species?

Listing priority change

Former LP: \_\_\_\_

New LP: \_\_\_\_

Latest Date species first became a Candidate: October 30, 2001

Candidate removal: Former LP: \_\_\_\_

A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

F - Range is no longer a U.S. territory.

M - Taxon mistakenly included in past notice of review.

N - Taxon may not meet the Act's definition of "species."

X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Salamanders - Cryptobranchidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas, Missouri

CURRENT STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas, Missouri

LEAD REGION CONTACT: Rick Gooch, 404-679-7124

LEAD FIELD OFFICE CONTACT: Conway, Arkansas Field Office, Susan Rogers, 501-513-4481

BIOLOGICAL INFORMATION:

## Taxonomy

The Ozark hellbender (*Cryptobranchus alleganiensis bishopi*) was originally designated *C. bishopi* by Grobman (1943) from a specimen collected from the Current River in Carter County, Missouri. Due to the small amount of genetic variation possessed by the genus *Cryptobranchus* (Merkle *et al.* 1977, Shaffer and Breden 1989), Schmidt (1953) referred to the Ozark hellbender as a subspecies of the eastern hellbender, *C. alleganiensis*, and this was supported by Dundee and Dundee (1965). This designation persisted until Collins (1991) revived *C. bishopi*, due to the lack of intergradation between the eastern and Ozark hellbenders, which is unlikely to occur due to the allopatry of populations of these species (Dundee 1971). Although Ozark hellbenders have been shown to be distinct phenotypically (Grobman 1943, Dundee and Dundee 1965, Dundee 1971) and genetically (Routman 1993, Wagner *et al.* 1999) from eastern hellbenders, the U.S. Fish and Wildlife Service will continue the use of *C. a. bishopi*, which is the name currently recognized by the Center for North American Amphibians and Reptiles (Collins 1997). Although discussion continues over the taxonomic status of the Ozark hellbender, the designation of the Ozark hellbender as a species or subspecies does not affect its qualification for listing under the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 *et seq.*).

## Description

The Ozark hellbender is a large, strictly aquatic salamander endemic to streams of the Ozark plateau in southern Missouri and northern Arkansas. Its dorso-ventrally flattened body form helps it remain immobile in the fast flowing streams it inhabits (Wagner *et al.* 1999). Hellbenders have a large, keeled tail and tiny eyes. Adult Ozark hellbenders may attain total lengths of 29 - 57 cm (Dundee and Dundee 1965, Johnson 1987). Numerous fleshy folds along the sides of the body provide surface area for respiration (Nickerson and Mays 1973a) and obscure poorly developed costal grooves (Dundee 1971). Ozark hellbenders are distinguishable from eastern hellbenders by their smaller body size, dorsal blotches, increased skin mottling, heavily pigmented lower lips, smooth surfaced lateral line system, and reduced spiracular openings (Grobman 1943, Dundee 1971, Peterson *et al.* 1983, LaClaire 1993).

## Ecology and Habitat

Eastern and Ozark hellbenders are very similar in habitat selection, movement, and reproductive biology (Nickerson and Mays 1973a). Published works on the eastern hellbender may provide insights into Ozark hellbender ecology. Adult Ozark hellbenders are frequently found beneath large rocks in moderately deep (< 1m), rocky, fast-flowing streams in the Ozark plateau (Johnson 1987, Fobes and Wilkinson 1995, Wagner *et al.* 1999). In spring-fed streams, Ozark hellbenders typically concentrate just downstream of the area where there is no water temperature change throughout the year (Dundee and Dundee 1965). Adults are nocturnal, remaining beneath cover during the day and emerging to forage primarily on crayfish at night, although they are not entirely nocturnal (Nickerson and Mays 1973a, Noeske and Nickerson 1979, Collins 1997). Ozark hellbenders are territorial and will defend occupied cover from conspecifics (Nickerson and Mays 1973a). This species migrates little, with one tagging study revealing that 70 percent of marked individuals moved less than 30 meters from the site of

original capture (Nickerson and Mays 1973b). Home ranges average 28 square meters for females and 81 square meters for males (Peterson and Wilkinson 1996).

Typically, Ozark hellbender populations are dominated by older, large adults (Nickerson and Mays 1973a, Peterson *et al.* 1983, LaClaire 1993). Juveniles reach sexual maturity between 5 and 8 years, with males maturing at a smaller size and younger age than females. Ozark hellbenders may live 25 - 30 years in the wild (Peterson *et al.* 1983).

Breeding generally occurs between September and November, with Spring River, Arkansas, populations breeding in January (Peterson *et al.* 1983). Ozark hellbenders mate via external fertilization, and males will guard the fertilized eggs from predation by conspecifics (Nickerson and Mays 1973a). Clutch sizes vary from 138 to 450 eggs per nest (Dundee and Dundee 1965, Zug 1993), and eggs hatch after approximately 80 days (Zug 1993). Hatchlings and larvae are collected rarely during surveys, likely due to low capture efficiency and high mortality of young. Larvae and small individuals often live beneath small stones in gravel beds or shallow water habitats (Nickerson and Mays 1973a, LaClaire 1993).

### Distribution

Ozark hellbenders are endemic to the Black and White River drainages in Arkansas and Missouri (Johnson 1987) in portions of the Spring, White, Eleven Point, and Current Rivers and their tributaries (LaClaire 1993). This species is believed to be declining throughout its range, and no populations appear to be stable. Declines have been evident throughout the range of the eastern hellbender, as well, which holds state protective status in many eastern states. Because the two subspecies are very similar, closer scrutiny has revealed a similar, more recent decline in Ozark hellbenders. A description of what is known about Ozark hellbender populations follows.

### **White River System**

White River- There is only one Ozark hellbender record from the main stem of the White River, coming from Baxter County, Arkansas, in 1997 (Dr. S. Trauth, ASU, pers. com.). It is not known whether a viable population exists at this site or if the individual captured was a member of a relict population that was separated from the North Fork White River population by Norfork reservoir. Much of the hellbender habitat was destroyed by the series of dams constructed in the 1940's and 1950s on the upper White River, including Beaver, Table Rock, Bull Shoals, and Norfork dams. During a limited survey of the portion of the White River below Bull Shoals and Norfork dams in 2001, no hellbenders were found (Wheeler and Trauth 2002a).

North Fork White River- The North Fork White River historically contained a considerable Ozark hellbender population. In 1973, results of a mark-recapture study indicated approximately 1,150 hellbenders within a 2.67 km reach of river in Ozark County, Missouri, with a density of one individual per eight to ten m<sup>2</sup> (1/8-10 m<sup>2</sup>) (Nickerson and Mays 1973b). Ten years later, hellbender density in a 4.6 km section of the North Fork White River in the same county remained rather high, with densities between 1/6-7 m<sup>2</sup> and 1/13-16 m<sup>2</sup> (Peterson *et al.* 1983). Individuals caught in this study also represented a range of lengths (172 - 551 mm), indicating that reproduction was occurring in this population, and most individuals were sized at between 250 - 449 mm. Subsequently, in a 1992 qualitative study also in Ozark County,

Missouri, 122 hellbenders were caught during 49 man-hours of searching (Ziehmer and Johnson 1992). These individuals ranged from 254 - 457 mm, and no average size was included in this publication.

Up to the 1992 study, the North Fork White River population appeared to be fairly healthy. However, in a 1998 study of the same reach of river censused in 1983 (Peterson *et al.* 1983) and using the same collection methods, only 50 hellbenders were captured (Wheeler *et al.* 1999). These individuals ranged in length from 200 - 507 mm, with most being between 400 - 500 mm, and were on average significantly longer than those collected twenty years earlier (Wheeler 1999). This shift in length distribution was not a result of an increase in maximum length of individuals; instead, there were fewer individuals collected in the smaller size classes.

In order to compare results between these qualitative and quantitative studies, Wheeler *et al.* (1999) converted historical hellbender collections (Peterson *et al.* 1983) to numbers of individuals caught per day. In addition, the other studies not included in that conversion (Peterson 1983, Peterson 1988, Ziehmer and Johnson 1992, Wheeler and Trauth 2002b) have been converted here. For comparison purposes, one search day is defined as 8 hours of searching by 3 people (i.e., 24 person-hours). Although this search day may be an underestimate of actual effort, a conservative estimate of effort will result in a conservative estimate of hellbender population declines. Therefore, in 1983, approximately 51 hellbenders were caught per sampling day (Peterson *et al.* 1983). In 1992, 60 hellbenders/day were caught (Ziehmer and Johnson 1992), and, in 1998, 16 hellbenders/day were caught (Wheeler 1999). Based on these comparisons, a decline in the North Fork White River is evident.

In 2001, a survey of the North Fork White River at Dawt Mill in Missouri yielded 46.8 hellbenders/day (Wheeler and Trauth 2002b). Historic information on the population at this site is lacking, so no comparisons may be made regarding trends. This site may be the last remaining healthy population in the North Fork, especially considering that a survey of the rest of the river during this time period resulted in 10.9 hellbenders/day (Wheeler and Trauth 2002b).

The North Fork White River had been considered the stronghold of the species, and the populations inhabiting this river were deemed stable (Ziehmer and Johnson 1992, LaClaire 1993). However, these populations now appear to be experiencing declines similar to those in other streams. The collection of young individuals has become rare, indicating little recruitment. In species such as the Ozark hellbender, which are long lived and mature at a relatively late age, detecting declines related to recruitment can take many years, as recruitment under healthy population conditions is typically low (Nickerson and Mays 1973a). A gradual, long-term decline appears to be occurring in the North Fork White River, although quantitative studies are needed to determine the likely effects of this decline on the population.

Bryant Creek- Bryant Creek is a tributary of the North Fork White River in Ozark County, Missouri, which flows into Norfork Reservoir. Ziehmer and Johnson (1992) expected to find Ozark hellbenders in this stream during an initial survey, but none were captured or observed after 22 man-hours. This apparent lack of the species conflicted with reports from Missouri Department of Conservation (MDC) personnel and fisherman who reported observations of fairly high numbers of hellbenders in Bryant Creek during winter months (Ziehmer and Johnson 1992). A subsequent survey of the creek resulted in the capture of 6 hellbenders (Wheeler *et al.*

1999), confirming the existence of a population in this tributary. However, a 2001 survey of sites where hellbenders were caught previously did not yield any hellbenders (Wheeler and Trauth 2002b). It is unknown whether the species still persists in this creek. This population is isolated from the other North Fork White River populations by Norfork reservoir, which could contribute to this population's apparent small size.

Additional North Fork White River tributaries- Lick Creek, Bennett's Creek, and Bennett's Bayou, tributaries to the North Fork White River above Norfork dam in Missouri, were surveyed in 2001 for Ozark hellbenders. Lick Creek contains several areas of suitable habitat, but no hellbenders were found in this stream (Wheeler and Trauth 2002b). Likewise, no hellbenders were found in Bennett's Creek or Bayou, although these streams do not appear to contain suitable habitat for the species (Wheeler and Trauth 2002b).

### Black River System

Black River- There are no documented records of Ozark hellbenders in the Black River, although it has not been extensively surveyed. Portions of the Black River in Missouri were surveyed in 1999 by researchers at Arkansas State University, but no Ozark hellbenders were observed (Wheeler *et al.* 1999). The Black River is presumed to be part of the historic range of the species, due to the presence of hellbenders in several of its tributaries, including the Spring, Current, and Eleven Point Rivers (Firschein 1951, Trauth *et al.* 1992).

Spring River- The Spring River, a tributary of the Black River, flows from Oregon County, Missouri, south into Arkansas. Ozark hellbender populations have been found in the Spring River near Mammoth Spring, Fulton County, Arkansas (LaClaire 1993). In the early 1980's, 370 individuals were captured during a mark-recapture study along 7 km of stream south of Mammoth Spring (Peterson *et al.* 1988). Hellbender density at each of the two surveyed sites was fairly high (approximately 1/23 m<sup>2</sup> and 1/111 m<sup>2</sup>). These individuals were considerably larger than hellbenders captured from other streams during the same time period, with 74 percent of Spring River Ozark hellbenders measuring over 450 mm total length (maximum 600 mm) (Peterson *et al.* 1988). This may indicate that Spring River populations are somewhat distinct genetically from other Ozark hellbender populations. This conclusion was upheld by a genetic study of the Spring, Current, and Eleven Point River populations (Wagner *et al.* 1999). In 1991, a longer reach (26 km) was surveyed for Ozark hellbenders, and only 20 were observed during 41 search hours over a 6 month period, at many of the same sites sampled by Peterson *et al.* (1983) (Trauth *et al.* 1992). The stream was surveyed for hellbenders again in 2001, and 28.5 hours of search time resulted in 14 hellbender captures (approximately 12 hellbenders/day using the search day conversion described above). No length information is available for either the 1991 or 2001 surveys, although the large sizes of the 1988 captures may be indicative of a population experiencing little recruitment. Although the recent surveys were less intensive than the previous studies, it is apparent that hellbenders have declined in this stream.

Eleven Point River- The Eleven Point River, a tributary of the Black River, has been surveyed several times since the 1970's. Historical data provided by Peterson were analyzed by Wheeler (1999). In 1978, 87 hellbenders were captured in Oregon County, Missouri, over 3 days, yielding 29 hellbenders/day. Later, in 9 collection days from 1980 - 1982 in the same area, 314 hellbenders were captured, yielding 35 hellbenders/day. Lengths over this period ranged from

119 - 451 mm. Six years later, Peterson *et al.* (1988) captured 211 hellbenders from the Eleven Point River and estimated hellbender density to be approximately 1/20 m<sup>2</sup>. Total lengths of these individuals ranged from 120 - 450 mm, with most between 250 - 350 mm. Although it was not presented, it can be estimated that roughly 40 hellbenders were caught per day during this study. Approximately 10 years later, Wheeler (1999) captured 36 hellbenders over 4 days from Peterson *et al.*'s (1988) sites, for an average of 9 hellbenders/day. These hellbenders were larger than those captured previously, with total lengths of 324 - 457 mm, and there were significantly fewer individuals in the smaller size classes. Subsequently, in 2001, Wheeler and Trauth (2002a) captured roughly 35 hellbenders/day. In summary, the population appears stable, with the exception of the 1999 survey. This population and the sizes of captured individuals must be monitored to determine trends in both the numbers and size classes of individuals. Currently, it appears the Eleven Point River is the stronghold of the species.

Current River- The Current River had not been surveyed extensively until the 1990's. Nickerson and Mays (1973a) reported a large population in this stream, but no numbers were presented. In 1992, Ziehmer and Johnson (1992) found 12 Ozark hellbenders in 60 man-hours in Shannon County, Missouri, or approximately 5 hellbenders/day, using the same search day conversion as presented above. These individuals ranged in length from 115 mm to over 380 mm (maximum length was not reported), with most between 330 mm and 380 mm. Seven years later, 14 hellbenders were collected over 3 collection days (approximately 5 hellbenders/day), also in Shannon County, Missouri, and the individuals ranged from 375 - 515 mm, with most between 450 - 499 mm (Wheeler 1999). An additional survey in 2001 in Ripley County, Missouri, resulted in one individual captured (Wheeler and Trauth 2002b). Using the search day conversion, this translates to 6 hellbenders/day. It appears that this population is quite small but persisting. However, the average size of individual has increased by nearly 100 mm, and this population shows a lack of recruitment.

The Current River in Arkansas does not appear to have adequate habitat for the Ozark hellbender, as the stream substrate changes from bedrock, cobble, and gravel in Missouri to gravel and silt in Arkansas (Wheeler and Trauth 2002a).

Jacks Fork- Jacks Fork, a tributary of the Current River, was surveyed for the first time in 1992 for Ozark hellbenders (Ziehmer and Johnson 1992). Four hellbenders were collected over 66 man-hours, roughly 2 hellbenders/day. The individuals were large, ranging from 330 - 430 mm. There have been no subsequent investigations of Jacks Fork, so no conclusions may be drawn about population trends in this stream.

Additional Spring River tributaries- Myatt Creek, Martin's Creek, Jane's Creek, and the South Fork Spring River were all surveyed for Ozark hellbenders in 2001 and none were found in 11 hours of search time, although ample habitat appeared available in the South Fork Spring River (Wheeler and Trauth 2002b).

**THREATS** (Describe threats in terms of the five factors in section 4 of the ESA providing specific, substantive information. **If this is a removal of a species from candidate status or a change in listing priority, explain reasons for change**):

A. The present or threatened destruction, modification, or curtailment of its habitat or range.

The decline of the Ozark hellbender in the White and Black River systems in Missouri and Arkansas is likely the result of habitat degradation, in the form of impoundments, ore and gravel mining, silt and nutrient runoff, and den site disturbance due to recreational uses of the rivers it inhabits (Williams *et al.* 1981, LaClaire 1993). Although the precise causes of hellbender declines are likely complex interrelationships among threats and the species' life history characteristics, habitat degradation is the most frequent cause of lotic faunal declines (Allan and Flecker 1993). Hellbenders are habitat specialists that depend on constant levels of dissolved oxygen, temperature, and flow (Williams *et al.* 1981). Therefore, even minor alterations to stream habitat are likely detrimental to hellbender populations.

Impoundments impact stream habitat in many ways. When a dam is built on a free-flowing stream, riffle and run habitats in the area impounded by the dam are converted to open water. As a result, water temperatures tend to increase and dissolved oxygen levels tend to decrease, due to the lotic conditions of the water (Allen 1995). Because hellbenders are habitat specialists, they cannot tolerate a wide range of habitat conditions. Hellbenders depend upon highly vascularized lateral skin folds for respiration; therefore, lakes and reservoirs are unsuitable habitats for Ozark hellbenders, as these areas have lower oxygen levels and higher water temperatures (Williams *et al.* 1981, LaClaire 1993) than their fast flowing, cool water, highly oxygenated stream habitat. In addition, impoundments on inhabited streams create unsuitable habitat for hellbenders and, therefore, are impediments to movement between populations. In the upper White River, construction of Beaver, Table Rock, Bull Shoals, and Norfork dams in the 1940's and 1950's has destroyed much of the historic hellbender habitat that occurred there and has effectively isolated hellbender populations.

Norfork dam was constructed on the North Fork White River in 1944 and has isolated Ozark hellbender populations in Bryant Creek and the White River from those in the North Fork White River. Additionally, populations downstream of Beaver, Table Rock, Bull Shoals, and Norfork dams were extirpated due to hypolimnetic releases from the reservoir. These releases are much cooler than normal stream temperatures, and the water in such releases is typically depleted of oxygen. In addition, the tailwater zones below dams experience extreme water level fluctuations and scouring for many miles downstream which impact hellbender populations by washing out the gravel and chert used by juveniles and creating unpredictable habitat conditions that fluctuate outside the Ozark hellbender's range of tolerance.

Gravel mining has occurred in many southeastern streams, including a number of streams within the historic range of the Ozark hellbender, which has contributed to Ozark hellbender habitat alteration and loss. Dredging results in stream instability both up and downstream of the dredged portion (Neves *et al.* 1997, Box and Mossa 1999). Head cutting, in which the increase in transport capacity of a dredged stream causes severe erosion and degradation upstream, results in extensive bank erosion, sloughing, and increased turbidity levels (Allan 1995). Reaches downstream of the dredged stream reach often experience aggradation as the sediment transport capacity of the stream is reduced (Box and Mossa 1999). These activities disturb hellbender den sites in dredged areas, and associated silt plumes can cover downstream den sites. In addition, these effects reduce crayfish populations, which are the primary prey species for Ozark hellbenders. Gravel dredging is widespread in the White and Black River systems in southern Missouri and northern Arkansas (LaClaire 1993). Modifications of stream channels associated

with gravel mining, as well as the removal of small stones and chert that are important microhabitat for larvae and subadults, contribute to the decline of Ozark hellbenders in these systems.

Portions of the Ozark plateau have a history of being major producers of lead and zinc, and some mining activity still occurs in the southeastern Ozarks, though at less than historic levels. Results of a recent USGS water quality study in the Ozark plateau revealed that concentrations of lead and zinc in bed sediment and fish tissue were substantially higher at sites with historical or active mining activity and that these concentrations were high enough to suggest adverse biological effects, such as reduced enzyme activity or death of aquatic organisms. Although mining for lead and zinc no longer occurs within the range of the Ozark hellbender, elevated concentrations are still present in the streams where mining occurred historically (Petersen *et al.* 1998).

Despite the claim by some that many Ozark streams outwardly appear to exist in pristine conditions, Harvey (1980) clearly demonstrated that various sources of pollution exist in the ground water in the Springfield-Salem Plateaus of southern Missouri. In comparing ground-water quality of sites within the Ozark Plateaus (including Arkansas and Missouri) with other National Water-Quality Assessment Program (NAWQA) sites, Petersen *et al.* (1998) documented that: 1) nitrate concentrations in parts of the Springfield Plateau aquifer were higher than in most other NAWQA drinking-water aquifers, and 2) volatile organic compounds were detected more frequently in drinking-water aquifers within the Ozark Plateaus than in most other drinking-water aquifers. These studies overlap well with the current distribution of Ozark hellbender in Arkansas and Missouri. Therefore, the Service believes that these water quality conditions may be contributing to the decline of Ozark hellbender in these systems.

Silt and sediment runoff from land use activities in the area have contributed to habitat degradation. Hellbenders are intolerant of siltation and turbidity (Nickerson and Mays 1973a) and can be impacted by these in several ways. First, sediment deposition in den sites will cover and suffocate eggs. Second sediment will fill in interstitial spaces in gravel/chert areas, reducing suitable habitat for larvae and subadults (FISRWG 1998). Third, suspended sediment loads can also cause water temperatures to increase, as there are more particles to absorb heat, thereby reducing dissolved oxygen levels (Allen 1995). Because the Ozark hellbender requires cool temperatures and high levels of dissolved oxygen, perturbations to environmental conditions can be detrimental to hellbender populations. Fourth, the Ozark hellbender's highly permeable skin causes them to be negatively affected by sedimentation. Various chemicals, such as pesticides, bind to silt particles and become suspended in the water column when flushed into a stream. The hellbender's permeable skin provides little barrier to these chemicals, which can be toxic (Blaustein and Wake 1990, Wheeler *et al.* 1999).

Timber harvesting is prominent in many areas within the range of the Ozark hellbender, and roads probably introduce the bulk of suspended sediment through erosion from road construction and the sediment-transporting ability of constructed roads. Roads can also cause marginally stable slopes to fail, and they capture surface runoff and channel it directly into streams (Allan 1995). In addition, erosion from roads contributes more sediment than the land harvested for timber (Box and Mossa 1999). Peak stream flows often rise in watersheds with timber harvesting activities, due in part to compacted soils resulting from roads, landings, and



vegetation removal (Allan 1995, Box and Mossa 1999). The cumulative effects of timber harvest on sedimentation rates last for many years, even after harvest practices have ceased in the area (Frissell 1997).

Nitrogen and phosphorus are essential plant nutrients that are found naturally in streams. However, elevated concentrations of these nutrients causes excessive growth of aquatic algae and plants in many streams and has detrimental effects upon water quality. Contamination of water in the Ozark plateau by nutrients has occurred from runoff of poultry and cattle wastes, human wastes, and fertilizers. National Water Quality Assessment (NAWQA) data collected in the Ozarks in 1993-1995 from wells and springs indicated that nitrate concentrations were strongly associated with the percentage of agricultural land near the wells or springs. In addition, fecal coliform levels have been elevated in these areas (Petersen *et al.* 1998). Livestock wading in streams, poor agricultural practices that lead to the degradation of riparian buffer zones, and faulty septic and sewage treatment systems have resulted in these elevated levels, which cause more algae to grow on streambed rocks. This growth affects aquatic species composition and causes benthic-feeding organisms to thrive (Petersen *et al.* 1998). Agriculture comprises approximately 30 percent of the land use within the range of the Ozark hellbender, which is intolerant of nutrient pollution (Nickerson and Mays 1973a).

Habitat disturbances may also be affecting hellbender success in several rivers. Canoeing and fishing are common in many of the rivers inhabited by the Ozark hellbender, including the Spring, Current, and North Fork White Rivers. Although no data are available that support this assertion, it has been speculated that the disturbance of den sites by contact with canoes may lead to the abandonment of those sites. In addition, some larger rocks have been removed in order to prevent canoe damage (Nickerson and Mays 1973a, Wheeler *et al.* 1999). The area under these large rocks is used as hellbender den sites, so, if these rocks are removed, the number of available den sites is diminished.

#### B. Overutilization for commercial, recreational, scientific, or educational purposes.

Anecdotal reports indicate that Ozark hellbenders have been collected for commercial and scientific purposes (Trauth *et al.* 1992). Commercial collections are currently illegal in both Missouri and Arkansas, but in Arkansas, hellbenders may be collected with a permit from the Arkansas Game and Fish Commission. Missouri imposed a moratorium on hellbender collecting from 1991 to 1996 and has since only allowed limited numbers of collecting permits (P. Horner, Missouri Department of Conservation, pers. com.). Nonetheless, illegal collecting for the pet trade has been documented, with one report of over 100 hellbenders illegally collected nearly 18 years ago (P. Horner, Missouri Department of Conservation, pers. com.), and likely remains a threat. In addition, there are unpublished reports of hellbenders killed accidentally killed by frog giggers, who may gig a hellbender inadvertently.

When considered cumulatively, collection and illegal or unintentional harvest is a threat to many of the declining hellbender populations. Because the species is long lived and does not reproduce until approximately age 7, the removal of even a few individuals from a population that is experiencing declines can impact the recruitment potential of that population. Presently, collecting levels appear reduced (LaClaire 1993), but collecting could become more of a threat if populations continue to decline.

### C. Disease or predation.

The occurrence of disease is virtually unknown in Ozark hellbender populations and has been studied little. Although young hellbenders are occasionally preyed upon by large fish, turtles, and water snakes, this is rare due to their noxious skin secretions and likely does not occur after hellbenders reach 380 mm (Nickerson and Mays 1973a, Peterson *et al.* 1983). It is unlikely an otherwise healthy population would be threatened by natural levels of predation. No evidence has been presented that would indicate that disease or predation are serious threats.

### D. The inadequacy of existing regulatory mechanisms.

The states of Arkansas and Missouri prohibit the taking of Ozark hellbenders for any purpose without a state scientific collecting permit. However, enforcement of this permit requirement is difficult. Additionally, state regulations do not protect hellbenders from other threats. Existing authorities available to protect riverine ecosystems, such as the Clean Water Act (CWA), administered by the Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers, may not have been fully exercised in an effort to prevent in-stream activities and the resulting habitat degradation. This may have contributed to the general habitat degradation apparent in riverine ecosystems and decline of both eastern and Ozark hellbender populations throughout their ranges. Although the Ozark hellbender coexists with other federally listed species throughout parts of its range, listing under the Endangered Species Act would provide additional protection, as the threats to hellbenders and the other endangered species are not identical.

Currently, there are no regulations governing best management practices (BMPs) of timber harvesting, which would reduce impacts on water quality. Existing BMPs are established by the Arkansas Forestry Commission and Missouri Department of Conservation and lack mandatory requirements for implementing methods to reduce aquatic resource impacts associated with timber harvests. Many timber harvests involve clear-cutting to the streambank, which promotes bank erosion.

### E. Other natural or manmade factors affecting its continued existence.

Certain population characteristics of Ozark hellbenders cause the species to be fairly vulnerable to extirpations and extinction. The Ozark hellbender, having specialized habitat requirements, is extremely vulnerable to environmental perturbations. When populations are small, they are less likely to rebound following these perturbations. In addition, Ozark hellbenders exhibit very low genetic diversity (Merkle *et al.* 1977, Wagner *et al.* 1999). This genetic uniformity is consistent with habitat specialization (Nevo 1978, Wagner *et al.* 1999). Ozark hellbenders have adapted to a relatively constant environment, and, therefore, several structural, behavioral, and physiological specializations have resulted (Williams *et al.* 1981). These specializations, in combination with the stable environment, seems to have resulted in very low levels of genetic diversity (Wagner *et al.* 1999). Fragmentation of populations by impoundments, habitat degradation, and other impediments to dispersal may exacerbate this situation. Without the level of interchange the hellbender experienced historically, many small, isolated populations do not receive the influx of new genetic material that once occurred. As the populations decrease in

size, genetic diversity is lost and inbreeding can occur, which may result in decreased fitness, and the loss of genetic heterozygosity can result in a significantly increased risk of extinction in localized natural populations (Saccheri *et al.* 1998). This is illustrated by Routman's (1983) study, in which hellbender populations from different rivers showed very little within-population variability, and relatively high between-population variability. Due to this population fragmentation, localized extinctions cannot be repopulated.

Ozark hellbenders do not reproduce until approximately 7 years of age. Declines being observed presently may be the result of activities that occurred years earlier. Because juvenile hellbenders are rarely observed, it takes many years to detect population trends. The lack of recruitment in most Ozark hellbender populations is a significant sign that little reproduction has occurred in these populations for several years. Delayed reproduction, when paired with a long life span, can disguise declines until they become fairly severe.

The present distribution and status of Ozark hellbender populations in the White and Black River systems in Arkansas and Missouri may be demonstrating the characteristics mentioned above. Genetic studies have demonstrated repeatedly very low genetic diversity in hellbender populations, which may be a factor in the decline of the species. The current combination of population fragmentation and habitat degradation may prohibit this species from recovering without the intervention of conservation measures designed to facilitate hellbender recovery.

**FOR RECYCLED PETITIONS:**

- a. Is listing still warranted? \_\_\_\_
- b. To date, has publication of a proposal to list been precluded by other higher priority listing actions? \_\_\_\_
- c. Is a proposal to list the species as threatened or endangered in preparation? \_\_\_\_
- d. If the answer to c. above is no, provide an explanation of why the action is still precluded.

**LAND OWNERSHIP** (Estimate proportion Federal/state/local government/private, identify non-private owners):

Approximately 80 percent of the land within the range of the Ozark hellbender is in private ownership, with the remaining 20 percent federally owned and managed by the U.S. Forest Service (Mark Twain National Forest).

**PRELISTING** (Describe status of conservation agreements or other conservation activities):

No conservation agreements have been developed for the Ozark hellbender. However, the states of Arkansas and Missouri have identified the need for conservation of this species. Missouri has provided extra protection for the Ozark hellbender in the Wildlife Code of Missouri, outlawing collection of hellbenders, and the species is currently proposed to be a state listed endangered species. Outreach has been considerable in both states, which have erected signs throughout the range of the Ozark hellbender alerting recreationists to their presence. Additionally, numerous stream surveys have been conducted by both states. Presently, work is underway at Mammoth Springs National Fish Hatchery to examine potential refugia, propagation, marking, and tracking techniques. The Service has funded a study at Southwest Missouri State University to examine

the reproductive status of the species. In addition, the Service is supporting work at the University of Missouri at Rolla to examine potential endocrine disruptors as a cause of hellbender decline. Collaboration is beginning with the Missouri Department of Conservation and the St. Louis Zoo to develop a propagation protocol for the species.

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LISTING PRIORITY (place \* after number)

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|--------|
| THREAT |
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| Magnitude       | Immediacy    | Taxonomy              | Priority |
|-----------------|--------------|-----------------------|----------|
| High            | Imminent     | Monotypic genus       | 1        |
|                 |              | Species               | 2        |
|                 |              | Subspecies/population | 3        |
|                 | Non-imminent | Monotypic genus       | 4        |
|                 |              | Species               | 5*       |
|                 |              | Subspecies/population | 6        |
| Moderate to Low | Imminent     | Monotypic genus       | 7        |
|                 |              | Species               | 8        |
|                 |              | Subspecies/population | 9        |
|                 | Non-imminent | Monotypic genus       | 10       |
|                 |              | Species               | 11       |
|                 |              | Subspecies/population | 12       |

**Rationale for listing priority number:**

*Magnitude:* The hellbender is threatened by habitat destruction, siltation, poor water quality, impoundments, and direct mortality through indiscriminate killing. Specific life history characteristics, such as the amount of time it takes for the young to reach reproductive maturity and their low reproductive rate, compound these threats, which causes the threats to the Ozark hellbender to be high in magnitude.

*Imminence:* The threats listed have been ongoing for many years and have not seemed to dramatically increase in recent years. In the absence of drastic population declines, it appears the threats are chronic rather than imminent.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes to the candidate list, including listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all additions of species to the candidate list, annual retentions of candidates, removal of candidates, and listing priority changes.

Approve: Linda Kelsey March 14,  
2003  
Acting Regional Director, Fish and Wildlife Service Date

Concur: \_\_\_\_\_  
Director, Fish and Wildlife Service Date \_\_\_\_\_

Do not concur: \_\_\_\_\_  
Director, Fish and Wildlife Service Date \_\_\_\_\_

Director's Remarks:

-  
-

Date of annual review: December 2002

Conducted by: Susan Rogers - Conway, Arkansas FO

Comments:

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