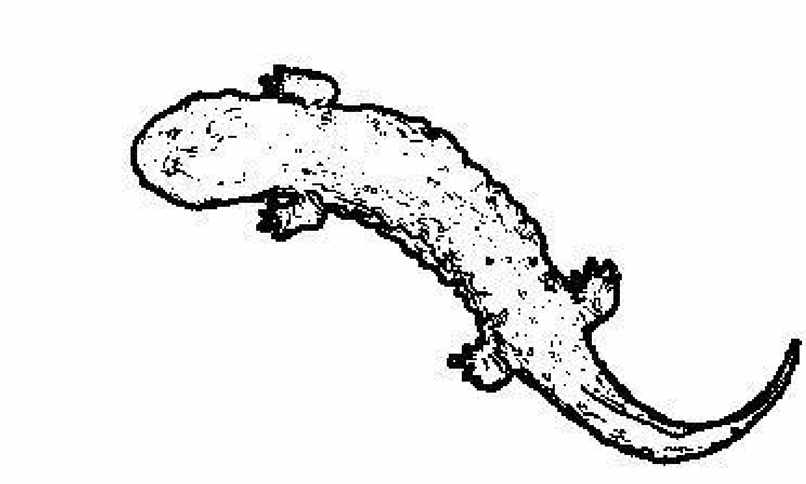
PETITION TO LIST THE OZARK HELLBENDER (*CRYPTOBRANCHUS ALLEGANIENSIS BISHOPI*) AS AN ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT



MISSOURI COALITION FOR THE ENVIRONMENT
WEBSTER GROVES NATURE STUDY SOCIETY
PETITIONERS
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NOTICE OF PETITION

Missouri Coalition for the Environment
6267 Delmar Blvd.
Suite 2-E
St. Louis, MO 63130
(314) 727-0600
Contact: Edward J. Heisel

Webster Groves Nature Study Society
1508 Oriole Lane
St. Louis, MO 63144
Contact: Yvonne Homeyer

Petitioners, Missouri Coalition for the Environment (MCE) and the Webster Groves Nature Study Society (WGNSS), formally request that the U.S. Fish & Wildlife Service (FWS) list the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*), throughout its range, as endangered pursuant to the Endangered Species Act (ESA). 16 U.S.C. §§ 1531 *et seq*. Petitioner also formally requests that FWS list the Ozark hellbender, on an emergency basis, to protect and sustain the species in the very immediate future pursuant to 16 U.S.C. § 1533(b)(7) and 50 C.F.R. § 424.20. In addition, MCE requests that FWS designate critical habitat concurrent with the aforementioned listing designation. This petition is filed under the Administrative Procedures Act (APA), 5 U.S.C. § 553(e), the ESA, 16 U.S.C. § 1533(b)(3), and FWS regulations at 50 C.F.R. § 424.14, which all grant interested parties the right to petition the Assistant Secretary of the Interior for issuance of a rule to list a species as endangered or threatened. This petition sets in motion a specific administrative process as defined by 16 U.S.C. § 1533(b)(3) and 50 C.F.R. § 424.14, that places mandatory response requirements on FWS, which has jurisdiction over this petition.

The Missouri Coalition for the Environment is a non-profit corporation that seeks to preserve and enhance the scenic, scientific, educational, historical, wilderness, wildlife, open space, outdoor recreation and public health values of the physical environment, and it coordinates, encourages, and assists efforts of others to maintain and enhance environmental quality. MCE has long worked for the protection of ecosystems in the Ozark region of Missouri, including the partial preservation of the Current, Jacks Fork and Eleven Point Rivers. MCE submits this petition on its own behalf and on behalf of its roughly 1,000 members.

The Webster Groves Nature Study Society is a not-for-profit organization created in 1920. WGNSS is dedicated to the study, appreciation, and conservation of nature, and it is the principal organization of amateur naturalists in the metropolitan St. Louis area. WGNSS endeavors to conserve natural areas that provide habitat for birds and other natural life.

Respectfully submitted,

____________________________ ________________________

EDWARD J. HEISEL DATE

EXECUTIVE SUMMARY

The Ozark hellbender is currently designated as a "candidate species" by the FWS, a clear recognition of its imperiled status. However, FWS has not taken the required action of placing the hellbender on the list of endangered species and designating critical habitat, which would ensure that the animal has the maximum protection afforded by Federal law. As a candidate species, the FWS has given the Ozark hellbender a listing priority ranking of "6" for "non-imminent threats of a high magnitude." However, to ensure the hellbender's continued survival, it is imperative to change this designation now by placing this species on the endangered species list and to also designate critical habitat as quickly as possible.

Scientists began studying the Ozark hellbender in 1938, and numerous studies have been conducted within the last three decades. As a result, it is one of the best-studied amphibians in North America. Recent studies indicate that populations of the Ozark hellbender have declined by over 70% and that the species may become extinct without additional protective measures, especially since repopulation and captive breeding efforts have proven to be unsuccessful. Records also show that much of the habitat for the species has been lost or fragmented due to habitat alteration from gravel mining, construction of impoundments, timber harvest and associated erosion, contamination from pesticides, and lead and zinc mining.

Currently, Missouri and Arkansas state regulations make it illegal to take or kill the Ozark hellbender, but there is insufficient regulatory protection of its habitat and inadequate disincentives for illegal collecting or killing. As a result, most known populations have experienced significant declines, and there is little documentation of reproduction. The FWS has even acknowledged that "the current combination of population fragmentation and habitat degradation may prohibit this species from recovering without the intervention and protection measures afforded under the Act" Therefore, MCE concludes that the current combination of population fragmentation, habitat degradation and illegal taking will prohibit this species from recovering without the intervention of protection and conservation measures afforded under the ESA.

The ESA provides for the listing of all species that warrant the protections afforded by the Act. The Ozark hellbender is one of two subspecies of *Cryptobranchus alleganiensis*, the other being the eastern hellbender, *C. a. alleganiensis.* The term "species" is defined broadly under the act to include "any subspecies of fish or wildlife or plants and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). Therefore, because the ESA protects both species and subspecies, the Ozark hellbender, a subspecies, qualifies for listing under the ESA.[1]

A species is added to the list when it is determined to be endangered or threatened because of any of the following factors: the present or threatened destruction, modification, or curtailment of the species' habitat; over utilization for commercial,

1 For ease of reference, this petition will simply refer to the Ozark hellbender as a "species."

recreational, scientific, or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting the species' survival. The Ozark hellbender meets all five criteria for listing.

In addition, the ESA also states that in determining which areas are critical habitat, the FWS shall consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection. Such requirements include, but are not limited to the following: space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. Therefore, because the Ozark hellbender's success is dependent upon the constancy of dissolved oxygen, temperature, and flow found in swift water areas, the Ozark hellbender's habitat, which encompasses all streams and springs within the historical range of the species as well as a protective buffer around those features, should be designated as critical habitat.

I. TAXONOMY

The Ozark hellbender is a member of the Cryptobranchidae family, one of two families that comprise the suborder Cryptobranchoidea. The hellbender is one of only three extant species of the family. The hellbender's genus and species name is *Cryptobranchus alleganiensis*. Cryptobranchus means "hidden gills," a reference to a paedomorphic feature. Like all members of the family, the hellbender is a true amphibian, a cold-blooded, smooth-skinned vertebrate that hatches as an aquatic larva with gills and then transforms into an adult having air-breathing lungs.

Two subspecies of hellbenders are currently recognized. Although Ozark hellbenders have been shown to be distinct phenotypically and genetically from the other subspecies, the Eastern hellbender, the FWS has continued the use of the subspecies designation *C. a. bishopi*, which is the name currently recognized by the Center for North American Amphibians and Reptiles (Rogers 2002).

The Ozark hellbender (*Cryptobranchus alleganiensis bishopi*) was originally designated as *C. bishopi* by Grobman (1943) from a specimen collected from the Current River in Carter County, Missouri. Schmidt (1953) referred to the Ozark hellbender as a subspecies of the Eastern hellbender, *C. alleganiensis*, and this was supported by Dundee and Dundee in 1965 (Rogers 2002).

In 1977, a study of 137 specimens, including 18 *bishopi* from the North Fork of the White River and 12 *bishopi* from Spring River, concluded that the subspecific status of *bishopi* was not warranted by biochemical comparisons, and genetic similarities between the Eastern and Ozark hellbenders suggested this group "is in fact represented by a single species" (Merkle et al 552). Nevertheless, it recommended the category of *bishopi* should be "retained in that most individuals can be identified as being from a certain geographic region" (Merkle et al 552). Eastern hellbenders were also found to have this low level of genetic variation by a later study, which speculated that "the population genetic consequences of reduced genetic variation [was] due to frequent extinction and recolonization by small founding groups" (Shaffer and Breden 1989, 1016, 1022).

The designation of *bishopi* as a subspecies persisted until Collins revived the species name *C. bishopi* due to the lack of intergradation between the Eastern and Ozark hellbenders (Rogers 2002). Evidence was also collected indicating that mitochondrial DNA differences between Ozark and Eastern hellbenders supported their status as distinct evolutionary units. Samples were collected from the Current River, Spring River, North Fork of the White River, and several others rivers for Eastern hellbenders, including the Big Piney, Gasconade, and Niangua Rivers. “High overall mtDNA diversity" was found for hellbenders (Routman 1993, 412), thus casting doubt on earlier conclusions that there was no biological evidence to support a species of *bishopi*. These results suggested, just as the earlier studies had, that hellbenders have undergone "a severe or prolonged reduction in population size." (Routman 1993, 415).

Although discussion continues over the taxonomic status of the Ozark hellbender, its designation as a distinct species or subspecies does not affect its qualification for listing under the Endangered Species Act. 16 U.S.C. § 1532(16).

II. SPECIES DESCRIPTION

A. IDENTIFYING CHARACTERISTICS

1. Size and Shape

As a salamander, the Ozark hellbender has an elongated body, four feet, and a long tail, but no scales. The hellbender is one of North America's largest salamanders, and grows on average from 30-74 cm (up to two and one-half feet) in total length (Petranka 1998). Hellbenders are also a long-lived species. They are thought to live over 30 years in the wild; one captive hellbender lived 29 years. The body and head of hellbenders are flattened to help it remain immobile in fast flowing streams, and they have a large keeled tail and small eyes. The hellbender's most notable feature is its very wrinkly folds of skin along each side of the body (Petranka 1998).

2. Coloration

Generally, hellbenders "are capable of rather dramatic color change from an olive-brown ground color to a rather bright orange" (Nickerson and Mays 1973, 19). However, coloring is one of the easiest ways to differentiate between Ozark and Eastern hellbenders. The Ozark hellbender typically has dorsal blotching versus spotting, increased chin mottling, a smooth surfaced lateral-line system in the pectoral region on non-larval forms, and reduced spiracular openings (Nickerson and Mays 1973). It has been speculated that the dorsal pigmentation of hellbenders is linked to a stream's bottom substrate and water clarity (Nickerson and Mays 1973, 20).

3. Internal Anatomy

Though they are amphibians, hellbenders can remain underwater indefinitely due to the unique way in which they breathe. One lab study surgically removed the lungs and sewed shut all external orifices; the hellbender survived. Follow-up studies have demonstrated that 90% of gas exchange happens through the skin of Ozark hellbenders. The skin folds along the sides of the body "are so richly supplied with capillaries that they form veritable lungs." Hellbenders do breathe through their nostrils, but this does not play an extensive role in respiration. Some scientists have speculated that their large size indicates that they "may be primarily hydrostatic in function" (Nickerson and Mays 1973, 28). In addition, hellbenders also have lateral-line sense organs that are sensitive to vibrations in the water and may be used in orientation, locating food, or determining a predator's approach (Nickerson and Mays 1973).

B. MOVEMENTS

The Ozark hellbender is basically nocturnal. It likes to remain concealed under rocks, logs, or other cover in the daytime. However, overcast days and rain can stimulate activity (Nickerson and Mays 1973). Hellbenders also tend to remain underwater, but have been observed sitting on rocks at night, and poking their nose up above the water.

In addition, Ozark hellbenders do not travel extensively, unlike some of the Eastern hellbender populations. They cannot swim against strong currents, but can use the current to "travel many meters quickly." "Hellbenders also appear to tire rapidly during rigorous swimming" (Nickerson and Mays 1973, 41). In one study done between 1969 and 1970, "only 3 of 74 recaptures were found further than 90 meters from the tagging site. 80% of the recaptures were less than 30 meters from the tagging site and 37% were found at the tagging station. A few were recaptured under the initial capture rock" (Nickerson and Mays 1973, 15).

In 1996, a detailed scientific effort was made to quantify the home range size of the Ozark hellbender. A home range is the area traversed by an individual in its normal activities of food gathering, mating and caring for young. Home range size is related to food density, metabolic needs, population density, and territoriality, and it is an important tool used to predict the effects of environmental disturbance on a species (Peterson and Wilkinson 1996). It was found that the females traveled significantly less than the males of the species. The average home range size for the females was 28 m^2 with a median size of 13 m^2, while the males averaged 81 m^2 with a median of 77 m^2 (Peterson and Wilkinson 1996, 126). Only a few specimens in the study traveled further, up to 346 m^2, which is similar to the reported home range size of a healthy Pennsylvania population of Eastern hellbenders.

Hellbenders will also defend their home range territory. Except in mating season, there is usually only one hellbender under any given rock. However, home range size is not directly related to home range location. Hellbenders have been observed to be "opportunistic in occupying a cover rock recently vacated by another hellbender" (Peterson and Wilkinson 1996, 127).

The small home range size for the Ozark hellbender also carries dire implications for its prospects for recovery. It has long been recognized that "populations of amphibians are likely to fluctuate considerably in size…The survival rate of eggs, hatchlings and larvae often vary over several orders of magnitude" (Alford 1999, 145). Most amphibians exist in a metapopulation, where a group of local populations inhabit more or less discrete patches of habitat with "substantial migration between local populations so that no local population is likely to remain extinct for any length of time" (Alford 1999, 153). Hellbenders, however, do not have this high level of migration due to environmental and species characteristics. First, while most of the streams they inhabit do indirectly connect, no hellbenders have ever been found in these connecting branches, which serve to genetically isolate populations and prevent repopulation in the event of a local extirpation. Second, the home range size of the hellbender is relatively small, as discussed above. This characteristic precludes extensive genetic exchange even where allowed for by the environment. Finally, the Ozark hellbender does not have a large regional population. Thus, the extinction of any local population could be disastrous for the species as a whole.

C. Feeding

The largest part of the Ozark hellbender's diet is crayfish, and it has been proposed that the hellbender may once have played an important role in regulating crayfish populations in some streams (Petranka 1998). The two main crayfish found when analyzing the contents of Ozark hellbender's stomachs were *Orconectes neglectus* and *O. propinquis* (Nickerson and Mays 1973). *Orconectes neglectus* has two recognized subspecies, *neglectus* and *chaenodactylus*. *O. n. chaenodactylus*, which only lives in the White River, one of the primary habitats of the Ozark hellbender, has been classified as a species of special concern by the Missouri Department of Conservation. Its National Heritage Status Rank is 2, indicating that its status in the United States is imperiled. This rank takes into account primary factors, such as total numbers of individuals remaining, threats, and long-term trends, as well as secondary elements such as geographic range and degree of habitat specificity the species requires. There is only one rank that indicates a species is doing worse. The Ozark hellbender holds this rank of 1 in both Missouri and Arkansas.

While the imperiled status of *O. n. chaenodactylus* could indicate a possible food shortage, hellbenders are not very particular about what they eat. One population was found to eat large quantities of snails. However, this was assumed to be a function of the incidental ingestion of snails because there was such a dense population of them rather then a function of selective feeding (Nickerson and Mays 1973). Hellbenders also tend to eat the numerous bait items offered by fisherman (Nickerson and Mays 1973). Hellbenders have even been observed eating their own skin, other hellbender eggs, and, even more rarely, other hellbenders.

Hellbenders can also fast for long periods, from 5 weeks up to 5 months. Even after such a weight loss and being in cold water, hellbenders in one study were "vigorous when released" (Nickerson and Mays 1973, 18-19). Keeping hellbenders in captivity does not seem to negatively affect their appetite or ability to survive when released back into the wild (Nickerson and Mays 1973).

D. Reproduction and Growth

There has been some disagreement on the breeding season of the Ozark hellbender in the literature. Generally, hellbenders breed during late August to late September. However, both Eastern and Ozark hellbenders in the Ozarks have a more variable breeding season. It has been observed to start as early as May, and to go well past late September (Petranka 1998). For example, a survey went 1-3 times monthly from September 1979 through October 1980 in the Niangua River (Laclede County, MO) and again from October 1985 through September 1986 in the Spring River (Fulton County, Arkansas). Swelling was found around the cloaca in males starting in July for both locations, but the Ozark hellbender population in the Spring River continued in this breeding mode until February. Even the Eastern hellbender population in the Niangua River continued until December. Furthermore, the Ozark hellbenders seemed more active in January, with eggs being found, seminal fluid being expelled, and ovaries with their maximum mean percentage of body mass (Peterson and Wilkinson 1989). This late breeding is unique to the Spring River population, possibly as a result of a phenomenon that prevents the Spring River from freezing during the winter.

During the breeding season, hellbenders usually excavate a spot under a rock facing the downstream side of the depression. However, the Ozark hellbender does not always align it that way. It can use crevices and mud-gravel banks, too. "Characteristics of the stream bottom greatly affect the Ozark hellbender's population structure… Density in most sections appeared to relate directly to the number of suitable large rocks for shelter" (Nickerson and Mays 1973, 11). The importance of rocks and logs to reproductive sites was noted as early as 1927 by Alexander and in 1941 by Bishop. Such studies have become even more important in the attempts to propagate captive hellbenders.

It is traditionally the male who lies in wait for the female, and tries to guide or aggressively drive her into his burrow. Unlike most salamanders, hellbenders employ external fertilization. When the eggs begin to emerge from the female, the male releases semen over them. Experiments have shown that a male hellbender can even recognize a female that has released eggs through a sack, suggesting the use of chemical communication. The females lay eggs in strings, which get tangled with each other and settle at the bottom of the burrow. The females are then driven away, while the males stay to watch over nests for an unknown period of time. This is probably partially for protection, but it can also be a source of food as well (Petranka 1998)

The hatchlings of hellbenders have visible yolk sacs, "presumably … as a major source of energy for the first few months after hatching" (Petranka 1998, 143). It usually takes one and a half to two full years for a young hellbender to reach 10-13 cm in total length and to lose its external gills. Hellbenders do not sexually mature until 5-8 years of age. In the Eleven Point River, females were found to be mature after reaching 30 cm in total length. Hellbenders grow fast, up to 6-7 cm per year. But as a long-living species, by age 25-30 the maximum growth rate is down to one millimeter per year (Petranka 1998).

Recent population studies have found few, if any, gravid females. This indicates that the populations might no longer be reproducing. Studies have been commissioned to investigate the possible causes. One of the most recent avenues of research focuses on reproduction in hopes of understanding what is causing the lack of recruitment. Studies are underway to compare the health of sperm (sperm count, viability, fertilization success) and embryo development of Ozark hellbenders with sperm and eggs from declining and healthy populations of Eastern hellbenders (*C. a. alleganiensis*).

E. Interaction with Humans

The hellbender has been the victim of several myths, probably stemming from its overall appearance and size. Some have claimed that fish try to avoid the slimy hellbender because the slime is toxic. There is the "presence of an irritant, presumably a skin secretion. But it is likely to prevent excessive diffusion of water whilst allowing adequate diffusion of gases" (Nickerson and Mays 1973, 34-35). Some have vilified the hellbender as a destroyer of game fish and their eggs, though no evidence of this has ever been found (Nickerson and Mays 1973). Even the common name, Hellbender, may be a reference to "hell…where it's bent on returning," though the true origin of the name is not known exactly (Nickerson and Mays 1973, 57).

III. Abundance and Distribution

The Ozark hellbender has been the subject of numerous scientific studies; population data going back well over 30 years is available. In fact, a recently published study of hellbender populations noted that "the duration of our study is one of the longest that has been reported for amphibians" (Wheeler 2003, 152). The data from this study indicate that this species has suffered "drastic declines" throughout its range and that no populations appear to be stable (Huang 2003).

Historically, the Ozark hellbender could be found in several rivers and creeks within Missouri and Arkansas. These waterbodies are the White River, Black River, Big Creek, Lick Creek, Myatt Creek, South Fork River, Martin's Creek, Jane's Creek, Mine Creek, Piney Creek, Mill Creek, and North and South Sylamore Creek. However, this is no longer the case. Presently, there is only one Ozark hellbender record from the main stem of the White River, coming from Baxter County, Arkansas. It is not known whether a viable population exists at this site or if the individual captured is a member of a relic population that was separated from the North Fork of the White River population by Norfolk reservoir. Much of the hellbender habitat was destroyed by the series of dams constructed in the 1940s and 1950s on the upper White River, including Beaver, Table Rock, Bull Shoals, and Norfolk dams. The remaining habitat would be suitable for Ozark hellbenders, except for the extreme fluctuations in water levels that result whenever the generators are being run.

In addition, 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 (Trauth et al. 1992). Also, Big Creek, which empties into the White River, is within the expected range of a historical hellbender habitat. While there have been some reports from local fisherman, no survey has ever found hellbenders. What might once have been good habitat has now been polluted with too much silt to sustain the Ozark hellbender.

Further, Lick Creek, which is a major tributary to the North Fork of the White River, would also be excellent hellbender habitat, but it has suffered from reduced water flow recently. Almost certainly a part of the hellbender's historical range, Lick Creek no longer supports any hellbenders. Also, Myatt Creek, which is a tributary of the Spring River, might be expected to contain hellbenders, even given the small home range size of Ozark hellbenders. However, while hellbenders were most likely present in the past, Myatt Creek has now been completely changed. Water flow has been drastically reduced, and it is filled with gravel. Also, there are no longer any long riffles and deep pools to support Ozark hellbenders.

In addition, like Myatt Creek, the South Fork River is another tributary of the Spring River. However, no hellbenders have been found in what might seem to be prime habitat. This is likely the result of polluted water. Martin's Creek is another small tributary to the Spring River, just south of Hardy, Arkansas. This would also represent excellent hellbender sites, but hog farms and dog kennels have contributed to highly eutrophic conditions, prohibiting the development of a stable hellbender population. Further, Jane's Creek, another tributary of the Spring River, use to be deeper and faster flowing, but now it is filled with gravel and does not have enough exposed large rocks for the hellbenders. Therefore, no hellbenders have been found here. Finally, no hellbenders have been found in Piney Creek, Mill Creek, or North and South Sylamore Creeks because during times of low water, the flow is too low to support Ozark hellbenders.

Today, the Ozark hellbender is known to be in six waterbodies of Missouri and Arkansas. Most literature only identifies four of these, the Spring River, North Fork of the White River, Eleven-Point River, and the Current River. However, as a result of recent research into global amphibian declines, investigations into historic habitats of declining species increased dramatically. Such investigations for the Ozark hellbender uncovered extant populations of hellbenders in the Jacks Fork River and Bryant Creek.

A. Spring River

1. Population Trends

From May 1980 to September 1982, hellbenders were surveyed on the Spring River for a master's thesis. While a significant number of Ozark hellbenders were captured and subsequently released, most of the individuals found were adults. These results show a decline in the population of young hellbenders. This is demonstrated by the high average weight of the captured hellbenders in the chart below.

Location	Number	recaptured	no./100 m^2	avg. weight (g)
Spring River	360	92		
Site 1			4.3	971 ± 17
Site 2			0.9	769 ± 27

[Peterson et al 1988, 291-303]

Between July and November 1991, an updated study was completed using the same general methodology. This study focused on a 26-km stretch of the Spring River in Fulton County, Arkansas. In 36 dive hours, only 20 hellbenders were found (Trauth, Wilhide and Daniel 1992). The authors found that "[t]he results of the present study indicate that populations of the Ozark hellbender, *Cryptobranchus bishopi*, within the upper reaches of the Spring River in Fulton County, Arkansas, are at very low densities compared to their numbers less than a decade ago." In fact, the authors concluded that "[t]he Spring River populations of *C. bishopi* may soon be unable to continue to survive and thrive under the present onslaught which threatens their critical habitat. Therefore, we propose that the Ozark hellbender in Arkansas be immediately placed on the state/federal list of threatened or endangered species" (Trauth, Wilhide and Daniel 1992, 85). In 2002, a third study confirmed the decline of the Ozark hellbender in the Spring River. Looking at the same historic habitat locations on the Spring River as past studies, only seven hellbenders were found (Wheeler 2002).

2. Current Distribution

The Spring River has the most ecological disruptions of the four major Ozark hellbender habitats, which explains why the population has crashed. This popular recreational river now has a bottom littered with debris, a significantly altered watershed, and diverted water flows. In 2002, only 7 hellbenders were found, all south of Mammoth Spring in Arkansas. These hellbenders also clearly experienced little recruitment, as demonstrated by the larger overall sizes of individuals.

B. NORTH FORK OF THE WHITE RIVER

1. Population Trends

The North Fork of the White River is the best studied segment of Ozark hellbender habitat. One of the earliest population studies, from 1969, was conducted within a 2.67 km reach of the North Fork of the White River in Ozark County, Missouri. The Ozark hellbender population then appeared healthy: 341-573 hellbenders could be found per kilometer of streambed. The average weight was 365 grams. Hellbender biomass estimates were 124.5-210 kg/km of streambed (Nickerson and Mays 1973, 10).

Ten years later, in 1979, hellbender density in a different 4.6 km section of the North Fork in the same county remained healthy, with densities between one per 6 to 7 m^2 and one per 13 to 16 m^2 (Peterson et al. 1983). Individuals caught in this study also represented a range of lengths, from 172-551 mm, indicating that reproduction was occurring in this population. Most individuals were sized at between 250-449 mm.

Similarly, in a 1992 qualitative study in Ozark County, Missouri, 122 hellbenders were caught on the North Fork during 49 man-hours of searching (Ziehmer and Johnson 1992). These individuals ranged from 254-457 mm, though no average size was included. The researchers also found 12 Ozark hellbenders in 60 man-hours in Shannon County, Missouri. These individuals ranged in length from 330-380 mm.

Then, in June 1993 and August 1994, 15 more study sites were sampled in the North Fork in Missouri. By turning over rocks, 259 hellbenders were caught, with the densest population at Blair Access and Sunburst Riffle. Other sites had varying amounts of suitable habitat, but had relatively fewer hellbenders. This suggests that the hellbender's microhabitat is very specific. It also confirms the fact that hellbenders are territorial. Finding hellbenders did not appear to be particularly difficult during this study, though it did take 2 complete seasons, systemically turning over all rocks and using snorkels and masks (Fobes 1995).

However, compared to these older studies, a 1998-1999 study of the North Fork noticed a 70% decline in Ozark hellbender populations as is demonstrated in the table below. There was also a significant lack of individuals found in the size class less than 350 mm, with almost all individuals in the range of 450-500 mm. "Historical samples also contained a significantly greater proportion of small individuals than recent samples" (Wheeler et al 2003, 153). Some hellbenders were caught that had been marked in much earlier studies, and practically no young hellbenders were found. This indicates a serious lack of recruitment. Moreover, the authors noted that "[t]he limited range of the Ozark subspecies (*C. a. bishopi*) makes it of particularly critical concern" (Wheeler et al 2003, 155).

	1980s	1990s
North Fork River	54.9 ± 10.20 (17)	16.7 ± 19.21 (3)

hellbender captured per sampling day (sampling days)

[Wheeler et al 2003, 153]

The 1998 study also compared current hellbenders to the 1977 and 1978 historical data provided by Wilkinson and Peterson. Where Ozark hellbenders in the North Fork had previously shown a mean total length of approximately 330 mm and a mass of 325 grams for 351 samples, the 1998 survey found only 50, and those had a total length averaging 425 mm and an average mass of 550. This study demonstrates again that a greater proportion of the samples in 1998 were bigger and older, while a more even distribution existed in the early 1980s (Prosen et al, 1998).

2. Current Distribution

The North Fork of the White River has historically contained a considerable Ozark hellbender population. However, this population is now experiencing serious declines. In 2002, only 39 Ozark hellbenders were found near Dawt Mill. While this is a larger population than the other rivers in which hellbenders are currently found, it represents the only location on the river where hellbenders were found in this survey (Wheeler 2002).

C. ELEVEN-POINT RIVER

1. Population Trends

The Eleven Point River is probably the least impacted of the Ozark hellbender habitats, primarily due to limited access to the river (Wheeler 2002). Thus, the population appeared stable until around 1988. Prior to 1988, reports indicate that 29, 35, and roughly 40 hellbenders were captured per day. But then, the numbers dropped over 10 years to a mere 9 hellbenders/day, and these individuals were considerably larger than those caught previously.

From May 1980 to September 1982, hellbenders were caught as part of a master's thesis on the Eleven Point River, as they were for the Spring River. The results showed a decline in the population of young hellbenders, as is demonstrated in the table below by the low average weight. While a significant number were captured, and subsequently released, most of the individuals found were adults.

Location	Number	recaptured	no./100 m^2	avg. weight (g)
Eleven Point	211	55		
Site 1			4.3	214±11
Site 2			6.1	341±12

[Peterson et al 1988, 291-303]

The 1998-1999 study also showed a 70% decline in Ozark hellbender populations. This is demonstrated in the table below. There was also a significant lack of individuals found in the size class less than 350 mm, with almost all individuals in the range of 450-500 mm.

	1980s	1990s
Eleven Point River	33.5±3.28 (12)	9.0±3.87 (4)

hellbender captured per sampling day (sampling days)

[Wheeler et al 2002, 153]

Further, the 1998 study compared the current hellbenders to historical data provided by Wilkinson and Peterson from 1980, 1981 and 1982. Where Ozark hellbenders in the Eleven Point River had previously shown a mean total length of approximately 320 mm and a mass of 275 grams for 295 samples, the 1998 survey found only 31, and those had a total length averaging 405 mm and a mass of 480. This study demonstrates again that the greater proportion of the samples in 1998 were bigger and older, while a much more even distribution existed in the early 1980s (Prosen et al, 1998).

2. Current Distribution

As of 2002, there are only two sites that support multiple Ozark hellbenders (8 and 14 individuals found), but small numbers of hellbenders are scattered between Greer Spring, Missouri, and State Highway 90 bridge in Arkansas (Wheeler 2002). These population trends clearly show declines and a lack of recruitment similar to the other rivers.

D. CURRENT RIVER

1. Population Trends

The Current River is not as well studied as the other rivers, generally because of the difficulty in finding areas with more than a few hellbenders. Most studies merely repeat the assertion that "large populations exist" without further analysis.

2. Current Distribution

In 1999, only 14 hellbenders were collected in 3 days of float surveys, approximately 5 hellbenders/day. The individuals ranged from 375-515 mm, with most between 450-499 mm (Wheeler 1999). The average size of the individual has increased by nearly 100 mm, indicating an aging population with diminished recruitment. A similar trip in 2002 only resulted in 1 hellbender. The habitat appears to be good for hellbenders, but water conditions make it difficult to survey.

E. JACKS FORK RIVER

1. Population Trends

There have been no subsequent investigations of Jacks Fork since a 1992 survey, so no conclusions can be drawn about population trends in this stream.

2. Current Distribution

The 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 from over 66 man-hours, roughly 2 hellbenders/day. The individuals were large, ranging from 330-430 mm.

F. Bryant Creek

1. Population Trends

Ziehmer and Johnson expected to find Ozark hellbenders in this stream during a survey of Bryant Creek. However, none were captured or observed after 22 man-hours. The absence of the species conflicted with reports from Missouri Department of Conservation personnel and fisherman who reported observations of fairly high numbers of hellbenders in Bryant Creek during winter months (Ziehmer and Johnson 1992).

2. Current Distribution

In 1999, a subsequent survey by Wheeler was conducted confirming the existence of an Ozark hellbender population in this tributary for the first time. Only 6 hellbenders were found, which could represent a remnant population from before the time that Norfolk Lake effectively prohibited interaction between hellbenders in the North Fork and in Bryant Creek (Wheeler 1999).

IV. The Ozark Hellbender Qualifies as an Endangered Species

FWS is required to determine, based solely on the best scientific and commercial data available, whether a species is endangered or threatened because of any of the following factors: the present or threatened destruction, modification, or curtailment of its habitat or range; over utilization for commercial, recreational, scientific or educational purposes; disease or predation; the inadequacy of existing regulatory mechanisms; or other natural or manmade factors affecting its continued existence. 16 U.S.C. §§ 1533(a)(1) and 1533(b). All five of these factors appear to have contributed to the decline of the Ozark hellbender.

A. The Present or Threatened Destruction, Modification, or Curtailment of its Habitat or Range

The precipitous decline of the Ozark hellbender in Missouri and Arkansas is most likely the result of habitat degradation and other environmental changes caused by human activities. Hellbenders are habitat specialists that "achieve an evolutionary stability within their habitat that magnifies the effects of rapid habitat alteration. The hellbender is confined to a narrow niche…[that] makes it acutely vulnerable to man's effects" (Williams et al 1981, 95). Therefore, even minor alterations to a stream habitat are likely detrimental to hellbender populations, and unfortunately, major alterations have been made throughout much of its habitat.

Most importantly, the hellbender is dependent on highly oxygenated, fast-flowing, cool water. Therefore, lakes and reservoirs are unsuitable habitats. The streams of the Ozark plateau have traditionally been home to numerous hellbenders, but over the last 20 years these numbers have dwindled. Three of the most cited causes for this decline are increased siltation, human recreation, and the impoundment of natural river systems (Trauth, Wilhide and Daniel 1992).

Trauth et al. (1992), after finding "very low" populations of Ozark hellbenders in the Spring River, made the following conclusions: "Putative reasons for this drastic decline are the removal of specimens for scientific or other purposes and habitat alteration related to extensive recreational activities (canoeing, fishing, swimming, etc.). Other contributing factors directly associated with human activity include the accidental killing of specimens by seining, swimming, and fishing practices. A spillage of diesel fuel directly into the river just below Access Site 4 following a train mishap (July, 1982) or a natural disaster (100 yr. flood of December, 1982) could have significantly reduced the numbers of salamanders as well. Increasing the silt burden of the river due to the latest clearing of riparian habitats for farming/agricultural purposes, industrial uses, and human occupation and development poses an additional major threat. Water pollution from various sources has also created eutrophic conditions along the river." Wheeler et al. (2003) concluded that: "For hellbenders, habitat degradation, including increased siltification and eutrophication, clearly has occurred in some areas and probably accounts for at least some of the observed decline. Over the past few decades, there has been substantial development associated with recreational use of rivers and agriculture in the region, suggesting the potential for influences of toxic chemical runoff."

Since as early as 1973, the potential for harm to the habitat of the hellbender was evident. "Siltation is currently minimal and usually restricted to pools and stream margins. However, clearing via bulldozing has increased greatly along this watershed during our studies, and it could soon be greatly affected" (Nickerson and Mays 1973, 7). These words have, unfortunately, proven prophetic. Clearing of riparian habitat for agricultural purposes, right up to the edge of the rivers, is a common practice in the Ozarks. Besides the increased silt burden, there is also increased contamination of waters from runoff waste and fertilizers. While nitrogen and phosphorous are essential plant nutrients found in streams, hellbenders are intolerant of elevated concentrations. Nutrient yield in areas associated with farming can be 3-10 times greater than nutrient yields observed in regional undeveloped streams.

More recently, a bridge project allowed one study to investigate amphibian responses to alterations in the physical habitat due to abnormal infusions of fine sediments. After sampling five affected and five unaffected streams, a clear decline in density of Pacific Giant Salamanders and its larvae in impacted streams was found. Like the hellbender, the Pacific Giant Salamander likes large rocky substrates, and the filling of the interstitial spaces in the affected streams resulted in finding fewer of those salamanders there (Welsh 1998). Researchers also noted that because the amphibians are a "sensitive species" whose numbers can change relatively quickly in response to a range of environmental perturbations, they make a good indicator species. Thus, the Ozark hellbender is not only suffering from stream pollution, but its very decline is proof that those Missouri streams are in decline as well (Welsh 1998).

Gravel mining is another cause of increased siltation in hellbender habitat. The effects of removing gravel and sand can stretch upstream and downstream for kilometers. The FWS has, on several occasions, noted that gravel mining can contribute to stream bed scour and erosion, increased turbidity, reduction of groundwater levels, and sedimentation, which often results in severe local impacts. 68 Fed. Reg. 33234, 33238; 67 Fed. Reg. 54262, 54263. Mining also disturbs hellbender den sites and reduces crayfish populations, which are the primary prey species of the Ozark hellbender. Because gravel mining is so common in northern Arkansas, and to a slightly lesser degree in southern Missouri, this was one of the acknowledged causes of habitat loss in the previous review of the hellbender. 66 Fed. Reg. 54811.

Timber harvesting is prominent in many areas within the range of the Ozark hellbender. Roads built for timber harvesting 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. In addition, erosion from roads contributes more sediment than the land harvested for timber. Peak stream flows often rise in watersheds with timber harvesting activities. This is due in part to compacted soils resulting from roads, landings, and vegetation removal. The cumulative effects of timber harvest on sedimentation rates last for many years, even after harvest practices have ceased in the area (Rogers 2002).

Recreational activities also affect the hellbender 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 of the White River. Overcrowding has contributed to litter problems, increased human waste, as well as serious aesthetic problems along heavily used sections of these rivers. A distinct correlation can be drawn between degradation of the environment and the increasing number of people who use it.

The historical habitat of the Ozark hellbender is now home to numerous dams and other impoundments. The hellbender has been especially affected by the changes in temperature, oxygen level, and flow velocities caused by these impoundments. Impoundments also serve to isolate different populations of hellbenders, another problem the hellbender has faced in the past. For example, Norfork dam was constructed on the North Fork of the White River in 1944 and has isolated Ozark hellbender populations in Bryant Creek and the White River from those in the North Fork of the 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 (Rogers 2002).

As a long living species, it was not readily apparent at first that a decline in hellbender populations was in progress. Thus, the initial event that would have triggered this lack of recruitment must have taken place 20-30 years ago, possibly around the time of the construction of the dams and the rise of recreational activities in the area. This also serves to further isolate populations from one another, which drastically increases the risk of "regional extinction by preventing migration among local populations" (Alford 1999, 137). Some of the data indicates we may be seeing this already for the hellbender, as only a few sites seem to have the most number of individuals.

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

Anecdotal reports indicate that Ozark hellbenders have been collected for commercial and scientific purposes. 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. Nonetheless, illegal collecting for the pet trade has been documented, with one report of over 100 hellbenders illegally collected nearly 18 years ago (Trauth et al. 1992). When considered cumulatively, collection and illegal or unintentional harvest is a threat to many of the declining hellbender populations. Because the species is long living 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 (Wheeler 2003).

A threat resulting from misinformation is the killing of hellbenders by angling and gigging. Gigging generally involves spotlighting and then spearing fish or frogs. Sometimes the hellbenders are speared accidentally, other times they may be killed because of the myths surrounding them, or even just curiosity. Anglers have been known to kill them as well, especially when they get caught on lines (Low, 2003).

C. Disease or predation

There have been recent reports that the stocking of trout in the Lake of the Ozarks region could have played a significant role in the decline of the Ozark hellbender. "Larval amphibians are extremely vulnerable to vertebrate and invertebrate predators" (Alford 1999, 136). Even antipredator mechanisms can be overwhelmed by predatory fish that were introduced to the habitat. In at least one study of the Northwestern Salamander (*Ambystoma gracile*), introduced trout were found to reduce abundance of the population, reduce or eliminate larvae, as well as alter larval behavior (Tyler et al, 1998, 95). Though no published reports specifically mention this threat, the increased abundance of game fish in the historical habitat of the Ozark hellbender could be more than a coincidence.

The occurrence of disease is virtually unknown in Ozark hellbender populations. However, research into the worldwide decline of amphibians has identified a three-step process that can affect an entire species. First, one or more environmental factors change sufficiently to cause sublethal stress. This stress then leads to suppression of the animal's immune system. Finally, immunosuppression leads to infectious agents, the death of individuals, and eventual extinction (Carey 1991, 355). In the case of the hellbender, several studies have noted an excess number of parasites in several Ozark hellbender populations (Nickerson and Mays 1973). Though most likely not the predominant cause of the drastic declines in Ozark hellbender populations across its range, such factors could certainly play a role in hastening the decline of the species without further protection from environmental stresses.

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 more pervasive threats.

On June 16, 2003, the Ozark hellbender officially became a Missouri endangered species. *Missouri Register*, vol. 28, no. 12, p.1088. As justification for listing the first amphibian, Dale Humburg of the Missouri Department of Conservation cited an average decline of 77% using "extensive data on population sizes, age structure, and body sizes" going back to the 1970s. The data showed a strong skew toward mature individuals, indicating a lack of reproduction and a list of threats that mirrors those provided above (Humburg, 2003).

Some areas of the Ozark hellbender habitat are protected under various measures. A 44-mile stretch of the Eleven Point River from Thomasville to State Highway 142 became part of the initial Wild and Scenic Riverways in 1968 because of its "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values." The Current River wends its way through Ozark National Scenic Riverways, a unit of the National Park System, as well as through the Mark Twain National Forest. Unfortunately, these designations, while important, have not proven to give the hellbender the amount of protection it needs and deserves. Recent accounts from the Ozark National Scenic Riverways indicate that certain recreational uses have polluted the river, leading to degradation of the watershed (Frazee, 2003). Moreover, the Mark Twain National Forest is open to numerous extractive industries such as timbering and mining, which can also degrade watersheds.

Existing authorities available to protect riverine ecosystems, such as the Clean Water Act, administered by the Environmental Protection Agency and the U.S. Army Corps of Engineers, have not been fully exercised to prevent in-stream activities and the resulting habitat degradation. This may have contributed to the general habitat degradation of riverine ecosystems and the 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 ESA would provide additional protection, as the threats to hellbenders and the other endangered species are not identical.

Further, there are currently no regulations governing BMPs of timber harvesting that would reduce impacts on water quality. BMPs have been established by the Arkansas Forestry Commission and the Missouri Department of Conservation, but they lack mandatory requirements for implementation and therefore often do not successfully reduce aquatic resource impacts associated with timber harvests. Many timber harvests involve clear-cutting to the stream bank, which promotes bank erosion and leads to sedimentation.

E. OTHER NATURAL OR MANMADE FACTORS AFFECTING ITS CONTINUED EXISTENCE

Certain characteristics of Ozark hellbenders cause the species to be vulnerable to extirpations and extinction. Ozark hellbenders have adapted to a relatively constant environment, and therefore, several structural, behavioral, and physiological specializations have resulted (Williams et al. 1981). Thus, the Ozark hellbender is extremely vulnerable to environmental perturbations. When populations are small, they are less likely to rebound following these perturbations. These specializations, in combination with the stable environment, seem to have resulted in very low levels of genetic diversity. This genetic uniformity is consistent with habitat specialization (Wagner et al. 1999). Without the level of interchange the hellbender has 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. The loss of genetic heterozygosity can also result in a significantly increased risk of extinction in localized natural populations (Rogers 2002). This is illustrated by Routman's 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, local extinctions cannot be repopulated.

Ozark hellbenders do not reproduce until approximately seven years of age. Thus, declines currently being observed may be the result of activities that occurred years earlier. 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 severe (Rogers 2002).

Long-lived animals, such as the hellbender, pose conservation challenges because of their slow growth rates, delayed maturity, and low fecundity. These factors lead to slow recoveries from environmental perturbations (Rogers 2002). Wheeler et al. (2003) succinctly summed up the status of the Ozark hellbender:

> For long-lived organisms, population stability requires relatively high rates of survival of juveniles (Congdon et al., 1993, 1994). Clearly this requirement has not been upheld for the hellbender populations in our study and low recruitment may explain the rapid decline in overall population numbers. Because long-lived species are slow to recover from perturbations, immediate conservation measures may be required to ensure recovery of this species.

The present distribution and status of Ozark hellbender populations in the White and Black River systems in Arkansas and Missouri are demonstrating the characteristics mentioned above. Genetic studies have repeatedly demonstrated 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 (Rogers 2002).

Abnormalities in the Ozark hellbender have been documented as well. Tumors, blindness and missing or deformed limbs have been found in surveys of the Spring River, Eleven Point River, and the North Fork of the White River. These abnormalities are "thought to occur during embryonic development, as a result of parasites, chemical contaminants, and resulting interactions between the two" (Wheeler, McCallum, and Trauth 2002). While some speculation that the limb abnormalities are a result of intraspecific aggression is justified, lack of eyes and limb bifurcation had to have occurred during development. Ozark hellbenders are now one of only three salamander species known to exhibit epidermal papillomas (Trauth, Harshbarger and Daniel 2002). While the cause is not clear, environmental factors certainly play a substantial role.

Other factors contributing to the decline of the Ozark hellbender may be directly associated with human activity, including the accidental killing of specimens by seining, swimming and fishing practices. Natural disasters like floods, fuel spills, and other sources of water pollution are possible problems, as well (Trauth, Wilhide and Daniel 1992). One study looked at endocrine disruptions caused by animal manure runoff, human wastes, fertilizers, herbicides, and pesticides (Huang 2002). Some of those pollutants possess a chemical similar to an important female hormone that has been shown to lead to reproductive failure (Huang 2002).

Other factors that could be affecting hellbenders but have not been documented in published research include: acidity and toxicants in the water, which can hurt larvae by several mechanisms, (Alford 1999, 139); ultraviolet radiation (UV-B); depletion of ozone, which would affect species such as the hellbender that breed in shallow clear water (Alford 1999, 135); and complex interactions among various environmental factors, instead of just one root cause (Alford 1999, 141).

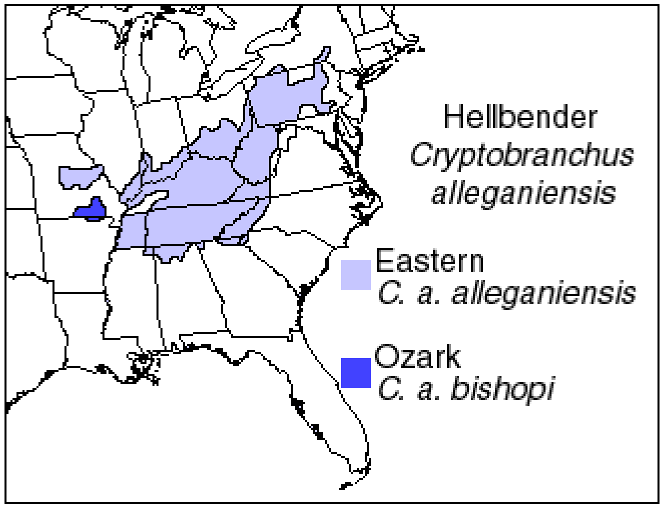
V. CRITICAL HABITAT SHOULD BE DESIGNATED FOR THE OZARK HELLBENDER

As stated in 50 C.F.R. § 424.12, critical habitat shall be specified to the maximum extent prudent and determinable at the time a species is proposed for listing. The designation of critical habitat for the Ozark hellbender is both prudent and determinable. A designation of critical habitat is prudent because the identification of critical habitat can be expected to decrease the threat to the hellbender, and it would also be beneficial to the species. It is determinable because there is information sufficient to perform the required analyses of the impacts of the designations, and the biological needs of the Ozark hellbender are sufficiently well known to permit identification of an area as critical habitat.

Further, in determining what areas are critical habitat, the FWS must consider those physical and biological features that are essential to the conservation of a given species and that may require special management considerations or protection. Such requirements include, but are not limited to, the following: space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal and; habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. 50 C.F.R. § 424.12.

The hellbender has been called a "habitat specialist" because "its success is dependent upon the constancy of dissolved oxygen, temperature, and flow found in swift water areas" (Williams et al. 1981, 94). Therefore, critical habitat should encompass all streams and springs within the historical range of the species, as well as a protective buffer around those features. As previously discussed, the Ozark hellbender is found only in lotic habitats in southeastern Missouri and northeastern Arkansas. Four rivers comprise the vast majority of the range of the Ozark hellbender: Spring River, North Fork White River, Eleven Point River, and Current River. However, a population of hellbenders also exists in the Jack’s Fork River and Bryant Creek (Wheeler 2002).

FIGURE 2



Such rivers have abundant small invertebrate food items and provide maximum protection from predation. Ozark hellbenders prefer to "inhabit large, rocky, fast-flowing streams" (Petranka 1998, 141). The size of the rocks and current velocity has also been the subject of scientific scrutiny. Hellbenders seem to prefer gravel beds on the bottom of the streams, composed of chert or piles of dolomite, limestone, and some sandstone rocks, as opposed to smooth water-swept beds of dolomite or limestone (Nickerson and Mays 1973). Using a modified Wentworth Particle Scale, where a range of rock diameters are coded with a particular integer 1 through 8, with larger diameters of rocks given the larger numbers, hellbenders greatly preferred numbers between 5 and 8, provided that the particles were not too deeply embedded in the bottom of the stream (Fobes 1995). In a 1993-1994 study of 259 Ozark hellbenders, the average cover rock diameter was 63.46 cm, with a range of 24-138 cm. However, most hellbenders preferred a medium sized rock that would not be too difficult or too easy to move in the stream. "Hellbenders used unembedded cover rocks associated with larger substrate particle sizes" (Fobes 1995, 21). While these types of environments inevitably produced numerous Ozark hellbenders, “smooth water-swept beds of dolomite, etc., were unproductive except where fragmentation had occurred" (Nickerson and Mays 1973, 12). Indeed, researchers seeking hellbenders in the wild frequently find them "beneath large rocks in shallow, rocky rapids" (Petranka 1998, 141). Crayfish, the main food source of hellbenders, use the rubble substrate to hide in, and were always found within one meter of capture locations (Fobes 1995).

Unlike Eastern hellbenders, Ozark hellbenders are not often found in shallow areas near stream banks or backwater habitats. They seem to avoid particularly shallow or deep pools. The preferred water depth in one study averaged 89.66 cm, with a range of 28-149 cm. Water velocity did not seem to matter very much to the hellbenders, except that a velocity of zero was unacceptable, due to their unique method of breathing through the skin. The bottom current velocity averaged 0.20 meters/second, and ranged from 0-0.56 meters/second (Fobes 1995). The availability of 5 "microhabitat" characteristics, cover rock diameter, water depth, velocity, substrate type, and embeddedness are critically important to the hellbender, and can be used to predict with reasonable accuracy the presence or absence of hellbenders at a particular site. The more available microhabitat was, the more hellbenders were found (Fobes 1995, 34).

The temperature range that hellbenders can withstand is quite large. In captivity, they have survived in 1 degree C water for days, with vigorous thrashing and biting as a side effect. Though it was clearly uncomfortable for the hellbender, rivers in Missouri and Arkansas can freeze over and possibly reach this low temperature in the winter months. Generally, hellbenders prefer 18-22 degree C stream water. Hellbenders generally prefer a lower temperature than most salamanders, which further restricts their habitat to cooler aquatic environments (Williams et al 1981).

A. Spring River

The Spring River begins in Missouri, where three major streams, the South Fork of the Spring River, Myatt Creek, and the Warm Fork of the Spring River, flow in a southeastern direction and cross the Missouri/Arkansas border to join the Spring River in Arkansas at Mammoth Spring, Arkansas. From there, it flows for about 114 km before joining the Black River just north of the town of Black Rock, Arkansas.

Little water quality or hydrologic data exists for the Spring River watershed. However, in its Missouri reaches, existing data indicate that high fecal coliform levels, nutrient loading, and the potential disturbance of sediment and gravel budgets are the most severe threats to surface water quality. Ground water in the area has also experienced water quality problems relating to turbidity and high bacteria counts. Poor land use practices, gravel dredging, large numbers of cattle, and runoff and sewage effluent associated with developed and urbanized areas all contribute to water quality problems of both surface water and ground water. For the most part, there have not been significant channel alterations within the watershed, though some have undoubtedly occurred in areas of the upper portion of Howell Creek as well as some of its tributaries in and around West Plains due to urban expansion and development.

Within the town of Mammoth Spring, Arkansas, Mammoth Spring has been inundated by a dam, but it still discharges 152 million liters/hour of cold 58 degree water. The lake has been stocked with a variety of fish, including catfish, sunfish, bass, and tiger muskies since the beginning of the 20th century. Some of the structures that characterize this stretch of the river include Dam 3, an old hydropower plant, the Arkansas Game and Fish Commission's Spring River State Fish Hatchery, and the FWS Mammoth Spring National Fish Hatchery. The shoreline is generally characterized by beds of emergent vegetation, dense stands of Brazilian elodea (a rooted aquatic macrophyte), steep dirt banks, riprap banks, backwater sloughs, silty flats, and lawns. Upland hardwood forest is the predominant vegetative type of the area, consisting of various oak-hickory stands interspersed with glades invaded by eastern red cedar. Below Dam 3 the river returns to a relatively natural state, but still accommodates various floats and wade fishermen, and it features more long, slow pools.

The biotic community of the Spring River watershed is diverse. Since 1963, forty six species of fish have been collected within the watershed. In addition, 5 species of mussels and 8 species of crayfish have been collected. In Missouri, a total of 39 "species of conservation concern" are known to occur within the watershed.[1]

B. North Fork of the White River

The North Fork of the White River originates in the vicinity of Mountain Grove in southeastern Wright County, Missouri. The river flows in a general southerly direction across Douglas and Ozark counties for 67 miles through the Mark Twain National Forest before emptying into Norfolk Reservoir near Tecumseh, Missouri. The U.S. Army Corps of Engineers completed a dam on the North Fork in 1944, forming Norfolk Lake.

Water quality within the North Fork watershed is relatively good; however, high fecal coliform bacteria levels, nutrient loading, and sediment/gravel deposition are occasional threats to water quality. Gravel dredging, indiscriminate land clearing, and the presence of livestock in riparian zones for extended periods of time are some causes of these water quality problems. In addition, the potential contamination of ground water by septic systems, as well as municipal discharges to losing streams, is also of concern. There is one municipal waste water discharge, and eight additional permitted discharges within the watershed.

The biotic community of the North Fork watershed is diverse. 76 species of fish, 21 species of mussels, 15 species of snails, 5 species of crayfish, and 106 taxa of benthic invertebrates have been collected within the watershed. Several species of sport fish occur within the watershed including grass pickerel, chain pickerel, rainbow trout, brown trout, smallmouth bass, largemouth bass, channel catfish, warmouth, walleye, spotted bass, flathead catfish, black crappie, white crappie, striped bass, and white bass. In addition, a total of 65 "species of conservation concern" are known to occur within the watershed. Three species have federal endangered and state endangered species status. These include the gray bat, Indiana Bat, and running buffalo clover. An additional five species have state endangered species status. These are the mountain lion, black-tailed jackrabbit, Bachman's Sparrow, Swainson's Warbler, and the Ozark hellbender.[2]

C. Eleven Point River

The Eleven Point River originates near the town of Willow Springs, located in northeastern Howell County, Missouri. The river flows southeasterly across northern

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[1] Excerpted from Spring River Watershed Inventory and Assessment, *available at* http://www.mdc.state.mo.us/fish/watershed/springr/contents/240cotxt.htm

[2] Excerpted from North Fork of the White River Watershed Inventory and Assessment, *available at* http://www.conservation.state.mo.us/fish/watershed/northfrk/contents/260cotxt.htm

Howell and Oregon Counties and then south, crossing the Arkansas state line about 2.5 miles west of the southeastern corner of Oregon County. From there it flows generally south through Randolph County, Arkansas, joining the Spring River approximately 3.7 miles above the Spring River/Black River confluence near Black Rock, Arkansas.

Water quality within the Eleven Point watershed is relatively good; however, high fecal coliform levels, nutrient loading, and sediment and gravel deposition are occasional threats to water quality. Poor land use practices, gravel dredging, and increasing cattle populations are the primary causes of the water quality problems. Lead prospecting has occurred throughout the watershed. Lead prospecting and lead mining are both potential threats to water quality in the watershed. There are three municipal waste water discharges within the watershed, and four additional permitted discharges. There have been no significant channel alterations anywhere within the Missouri portion of the Eleven Point watershed, though small channelization projects have probably occurred on private and municipal property and also during road and bridge construction.

The biotic community of the Eleven Point watershed is diverse. Sixty-six species of fish, 10 species of mussels, and 6 species of crayfish have been collected within the watershed. A total of 76 "species of conservation concern" are known to occur within the watershed. This includes four species of fish, one species of amphibian, three species of mussel, and two species of crayfish .[3]

D. CURRENT RIVER

The Current River originates near the town of Montauk, in the southwestern corner of Dent County, Missouri. It is fed by Welch Spring, as well as Big Creek, Gladden Creek, and Ashley Creek. As it flows south and east out of Montauk State Park, the Ozark National Scenic Riverways ("ONSR") unit of the National Park System begins and follows the course of the river. The river flows southeast across Shannon County, past Akers, the Sunklands Conservation Area, Round Rock and about 2 miles north of the city of Eminence. The ONSR ends slightly to the southeast of Van Buren, but the Current River then flows less then 5 miles before entering the Mark Twain National Forest. It exits the National Forest near Doniphan and crosses the Missouri-Arkansas border in Ripley County by the border town of Current View, Missouri. In Arkansas, it continues south for 6 miles, forming the border between Randolph and Clay counties, until it turns southeast towards Pocahontas, where it merges with the Black River.

The Ozark National Scenic Riverways was created "for the purpose of conserving and interpreting unique scenic and other natural values" of the Current and Jacks Fork Rivers. 16 U.S.C. § 460m. The Current River has been developed to accommodate large numbers of tourists, many of whom float the river in canoes, john boats, and tubes. Though the water remains reasonably clean in the ONSR and the Mark Twain National

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[3] Excerpted from Eleven Point River Watershed Inventory and Assessment, *available at* http://www.conservation.state.mo.us/fish/watershed/elevenpt/contents/090cotxt.htm

Forest, other factors often negatively impact the river, such as large numbers of recreationists in summer months and discharges from the town of Eminence.

E. JACKS FORK

The Jacks Fork River, formed by the confluence of two streams, the North Prong and the South Prong of the Jacks Fork, drains directly into the Current River. The North Prong has its beginnings approximately 9 miles south of Raymondville, Missouri, while the headwaters of the South Prong are located approximately 5 miles east of Cabool, Missouri. Both streams join to form the Jacks Fork River northwest of Mountain View, Missouri. From this point, the Jacks Fork flows in an easterly direction for 49.1 miles before joining the Current River northeast of Eminence, Missouri.

Water quality concerns within the Jacks Fork Watershed include gravel dredging, indiscriminate land clearing, high levels of recreational river use, municipal waste water discharges, and the presence of livestock in riparian zones for extended periods. In addition, the potential contamination of ground water by poorly constructed and/or maintained septic systems as well as municipal discharges to losing streams is also of concern. Five miles of the Jacks Fork River from T29N, R3W, section 9 to T29N, R4W, and section 26 are currently included in the 303(d) list of impaired waters for fecal coliform, resulting from organic wastes. Within the Jacks Fork Watershed there are currently two dams. One is a reinforced earth structure located on a tributary of the South Prong of the Jacks Fork River. The height of this dam is 27 feet. The other dam is a reinforced earth structure with a height of 41 feet located on a tributary of Shawnee Creek.

The biotic community of the Jacks Fork Watershed is diverse. There are 67 species of fish, 19 species of mussels, and 5 species of crayfish that have been collected within the watershed. A total of 51 "species of conservation concern" are also known to occur within the watershed. One species, the gray bat, has both federal and state endangered species status. In addition, the Bachman's Sparrow is a state endangered species as well as a former federal candidate for listing.[4]

F. BRYANT CREEK

Bryant Creek, the largest tributary to the North Fork of the White River, originates near Cedar Gap in southwestern Wright County. Bryant Creek flows southeasterly across Douglas and Ozark counties for 71 miles before emptying into the North Fork River at Norfolk Lake. The Bryant is similar to most Ozark streams, and features narrow, swift-flowing ripples fed by several large springs, interspersed with

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[4] Excerpted from Jack's Fork River Watershed Inventory and Assessment, *available at* http://www.conservation.state.mo.us/fish/watershed/jcksfork/contents/160cotxt.htm

deeper and slower pools (North Fork of the White River Watershed Inventory and Assessment 2001).

The water quality of Bryant Creek has been degraded by the presence of dairy and beef cattle operations. Animal wastes, coming off-site from concentrated animal feeding areas, dairy milking parlors, loafing areas, improper rates and timing of manure applications to overgrazed fields, and direct deposition of animal wastes into creeks have negative impacts on fish and other wildlife dependent on the streams for habitats. This pollution has also affected recreational users, who have access to 43 miles of the Creek at Ripple Creek Conservation Area, Vera Cruz, Sycamore, Warren Bridge, and Florence C. Cook access points.[5] Recent bridge improvement projects for Missouri Route 14 could also have negatively impacted water quality.

Bryant Creek harbors at least 15 Ozark endemic species of fish and crayfish, including the Ozark shiner, Ozark madtom, bluestripe darter, golden crayfish, and the Ozark crayfish. Other species found in the North Fork of the White River inhabit the lower stretches of Bryant Creek, as well.

VI. CONCLUSION

Section 4(a) of the Endangered Species Act, 16 U.S.C. 1531 et seq., directs the Secretary of the Interior to determine whether a species is threatened or endangered based on any current and potential threats to its existence as specified in sections 4(a)(1)(A) through (E). The Ozark hellbender is clearly imperiled and warrants endangered status under the ESA. The Ozark hellbender has declined and continues to decline in distribution and abundance throughout a significant portion of its range and is on a rapid slide toward extinction. It is documented that the species has disappeared from numerous historic locations throughout southern Missouri and northern Arkansas. The remaining populations are not secure. Existing state and federal regulatory mechanisms are inadequate. Today, as the information presented in this petition makes clear, the Ozark hellbender is in even greater peril than when the first candidate notice was written, and it deserves prompt action under the ESA to protect it and its threatened habitat.

The conservation trust mandate of the U.S. Fish and Wildlife Service is very clear, and the Endangered Species Act's design for the preservation of biodiversity is also very clear. Now, only faithful compliance by the Fish and Wildlife Service with these fundamental principles will make the difference between survival and extinction for Ozark hellbender. Therefore, emergency listing as endangered and designation of critical habitat is imperative if the Ozark hellbender is to survive.

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[5] Bryant Creek Tributaries Water quality Demonstration Project, *available at* http://www.dnr.state.mo.us/wpscd/wpcp/nps/G98-NPS-07.htm

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