DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–ES–R4–2012–0031; 4500030113]

RIN 1018–AX73

Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for the Neosho Mucket, Threatened Status for the Rabbitsfoot, and Designation of Critical Habitat for Both Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Proposed rule.

SUMMARY: We, the U.S. Fish and Wildlife Service, propose to list the Neosho mucket (*Lampsilis rafinesqueana*), a freshwater mussel, as endangered and rabbitsfoot (*Quadrula cylindrica cylindrica*), a freshwater mussel, as threatened under the Endangered Species Act; and propose to designate critical habitat for both species. This rule fulfills our obligation under a settlement agreement. The effect of this regulation is to conserve the Neosho mucket and rabbitsfoot and their habitats under the Endangered Species Act.

DATES: We will accept comments received or postmarked on or before December 17, 2012. Comments submitted electronically using the Federal eRulemaking Portal (see **ADDRESSES** section, below) must be received by 11:59 p.m. Eastern Time on the closing date. We must receive requests for public hearings, in writing, at the address shown in the **ADDRESSES** section by November 30, 2012.

ADDRESSES: You may submit comments by one of the following methods:

(1) *Electronically:* Go to the Federal eRulemaking Portal: *http://www.regulations.gov.* In the Keyword box, enter Docket No. FWS–R4–ES–2012–0031, which is the docket number for this rulemaking. Then, in the Search panel on the left side of the screen, under the Document Type heading, click on the Proposed Rules link to locate this document. You may submit a comment by clicking on ''Send a Comment or Submission.''

(2) *By hard copy:* Submit by U.S. mail or hand-delivery to: Public Comments Processing, Attn: FWS–R4–ES–2012–0031; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, MS 2042–PDM; Arlington, VA 22203.

We request that you send comments only by the methods described above. We will post all comments on *http://www.regulations.gov.* This generally means that we will post any personal information you provide us (see the Public Comments section below for more information).

FOR FURTHER INFORMATION CONTACT: James F. Boggs, Field Supervisor, U.S. Fish and Wildlife Service, Arkansas Ecological Services Office, 110 South Amity Road, Suite 300, Conway, AR 72032, by telephone 501–513–4470 or by facsimile 501–513–4480. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION: This document consists of: (1) A proposed rule to list the Neosho mucket (*Lampsilis rafinesqueana*) as endangered and rabbitsfoot (*Quadrula cylindrica cylindrica)* as threatened; and (2) a proposed critical habitat designation for both species.

Executive Summary

Why we need to publish a rule. Under the Endangered Species Act (Act), a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. The Neosho mucket and rabbitsfoot are highly restricted in their ranges and the threats occur throughout their ranges; therefore, the species qualify for listing. We are proposing to list the Neosho mucket as an endangered species and rabbitsfoot as a threatened species. Their protection under the Act can only be done by issuing a rule.

- We estimate the Neosho mucket has been extirpated (no longer in existence) from approximately 62 percent of its historical range with only 9 of the 16 historical populations remaining (extant). This mussel is declining rangewide (eight of the nine extant populations) with only one remaining large viable population.
- We estimate the rabbitsfoot has been extirpated from approximately 64 percent of its historical range. While 51 of the 140 historical populations are extant (remain), only 11 populations (22 percent of extant populations or 8 percent of the historical populations) are viable; 23 populations (45 percent of extant populations) are at risk of extirpation; and 17 populations (33 percent of extant populations) show limited recruitment with little evidence of sustainability. Rabbitsfoot is extirpated from 2 States within its historical range.
- The majority (8 of the 11 or 73 percent) of the viable rabbitsfoot populations live in waters considered impaired under section 303(d) of the Clean Water Act or have numerous tributaries in their watersheds also listed as impaired. Thus, these mussels are subjected to water quality and quantity and sediment quality constraints. These constraints (impairment) are expected to be exacerbated by increased water demand, habitat degradation, and climate change. Therefore, the viability of the majority of rabbitsfoot populations is uncertain.
- The majority of extant rabbitsfoot populations are marginal to small (40 of 51 extant populations (78 percent)) and isolated (41 of 51 extant populations (80 percent)); because of the isolation, it is unlikely that recruitment between populations or establishment of new populations could occur naturally.
- We are proposing to list the Neosho mucket as an endangered species in Arkansas, Kansas, Missouri, and Oklahoma and the rabbitsfoot as a threatened species in Alabama, Arkansas, Georgia, Kansas, Kentucky, Illinois, Indiana, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and West Virginia.

The basis for our action. Under the Endangered Species Act, a species may be determined to be endangered or threatened based on any of five factors: (1) Destruction, modification, or curtailment of its habitat or range; (2) overuse; (3) disease or predation; (4) inadequate existing regulations; or (5) other natural or manmade factors.

We have determined that both species are threatened by destruction, modification, or curtailment of habitat or range, inadequate existing regulatory mechanisms, and other manmade factors:

This rule designates critical habitat for each species.

- We are proposing to designate critical habitat for the Neosho mucket in Arkansas, Kansas, Missouri, and Oklahoma and for the rabbitsfoot in Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, and Tennessee.
- In total, approximately 779 river kilometers (rkm) (484 river miles (rmi)) in the Cottonwood, Elk, Fall, Illinois, Neosho, Shoal, Spring, North Fork Spring, and Verdigris Rivers are being proposed for designation as critical habitat for the Neosho mucket in Arkansas, Kansas, Missouri, and Oklahoma.
- The proposed critical habitat for the Neosho mucket is located in:
  - Benton and Washington Counties, Arkansas;

○ Allen, Chase, Cherokee, Coffey, Elk, Greenwood, Labette, Montgomery, Neosho, Wilson, and Woodson Counties, Kansas;

○ Jasper, Lawrence, McDonald, and Newton Counties, Missouri; and

○ Adair, Cherokee, and Delaware Counties, Oklahoma.

• In total, approximately 2,662 rkm (1,654 rmi) in the Neosho, Spring (Arkansas River system), Verdigris, Black, Buffalo, Little, Ouachita, Saline, Middle Fork Little Red, Spring (White River system), South Fork Spring, Strawberry, White, St. Francis, Big Sunflower, Big Black, Paint Rock, Duck, Tennessee, Red, Ohio, Allegheny, Green, Tippecanoe, Walhonding, Middle Branch North Fork Vermilion, and North Fork Vermilion Rivers and Bear, French, Muddy, Little Darby and Fish Creeks in Alabama, Arkansas, Kansas, Kentucky, Illinois, Indiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, and Tennessee are being proposed for designation as critical habitat for the rabbitsfoot.

• The proposed critical habitat for the rabbitsfoot is located in:

○ Colbert, Jackson, Madison, and Marshall Counties, Alabama;

○ Arkansas, Ashley, Bradley, Clark, Cleveland, Dallas, Drew, Fulton, Grant, Hot Spring, Independence, Izard, Jackson, Lawrence, Little River, Marion, Monroe, Montgomery, Newton, Ouachita, Randolph, Saline, Searcy, Sevier, Sharp, Van Buren, White, and Woodruff Counties, Arkansas;

○ Allen and Cherokee Counties, Kansas;

○ Ballard, Green, Hart, Livingston, Logan, Marshall, and McCracken Counties, Kentucky;

○ Massac, Pulaski, and Vermilion Counties, Illinois; Carroll, Pulaski, Tippecanoe, and White Counties, Indiana; Hinds, Sunflower, Tishomingo, and Warren Counties, Mississippi;

○ Jasper, Madison, and Wayne Counties, Missouri;

○ Coshocton, Madison, Union, and Williams Counties, Ohio;

○ McCurtain and Rogers Counties, Oklahoma; Crawford, Erie, Mercer, and Venango Counties, Pennsylvania; and

○ Hardin, Hickman, Marshall, Maury, and Robertson Counties, Tennessee.

Peer review of our methods. During the public comment period, we will obtain review and opinions from knowledgeable individuals with scientific expertise on our technical assumptions, analysis, adherence to regulations, and whether or not we used the best available information in developing the proposed rule.

Information Requested

We intend that any final action resulting from this proposal will be based on the best scientific and commercial data available and be as accurate and as effective as possible. Therefore, we request comments or information from the public, other concerned governmental agencies, Native American tribes, the scientific community, industry, or any other interested party concerning this proposed rule. We particularly seek comments concerning:

(1) Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to these species and regulations that may be addressing those threats.

(2) Additional information concerning the historical and current status, range, distribution, and population size of these species, including the locations of any additional populations of these species.

(3) Any information on the biological or ecological requirements of the species and ongoing conservation measures for the species and their habitat.

(4) Any information regarding water quality data that may be helpful in determining the water quality parameters necessary for Neosho mucket and rabbitsfoot.

(5) The reasons why we should or should not designate habitat as ''critical habitat'' under section 4 of the Act (16 U.S.C. 1531 *et seq.*), including whether there are threats to the species from human activity, the degree of which can be expected to increase due to the designation, and whether that increase in threat outweighs the benefit of designation such that the designation of critical habitat is not prudent.

(6) Specific information on:

(a) The amount and distribution of Neosho mucket and rabbitsfoot habitat;

(b) What areas, that were occupied at the time of listing (or are currently occupied) and that contain features essential to the conservation of the species, should be included in the designation and why;

(c) What areas not occupied at the time of listing are essential for the conservation of the species and why.

(7) Land use designations and current or planned activities in the areas occupied by the species or proposed to be designated as critical habitat, and possible impacts of these activities on these species and proposed critical habitat.

(8) Information on the projected and reasonably likely impacts of climate change on the Neosho mucket and rabbitsfoot and proposed critical habitat.

(9) Any foreseeable economic, national security, or other relevant impacts that may result from designating any area that may be included in the final designation. We are particularly interested in any impacts on small entities, and the benefits of including or excluding areas from the proposed designation that are subject to these impacts.

(10) Whether our approach to designating critical habitat could be improved or modified in any way to provide for greater public participation and understanding, or to assist us in accommodating public concerns and comments.

(11) The likelihood of adverse social reactions to the designation of critical habitat and how the consequences of such reactions, if likely to occur, would relate to the conservation and regulatory benefits of the proposed critical habitat designation.

Please note that submissions merely stating support for or opposition to the action under consideration without providing supporting information, although noted, will not be considered in making a determination, as section 4(b)(1)(A) of the Act directs that determinations as to whether any species is a threatened or endangered species must be made ''solely on the basis of the best scientific and commercial data available.''

You may submit your comments and materials concerning this proposed rule by one of the methods listed in the **ADDRESSES** section. We request that you send comments only by the methods described in the **ADDRESSES** section.

If you submit information via *http://www.regulations.gov,* your entire submission—including any personal identifying information—will be posted on the Web site. If your submission is made via a hardcopy that includes personal identifying information, you may request at the top of your document that we withhold this information from public review. However, we cannot guarantee that we will be able to do so. We will post all hardcopy submissions on *http://www.regulations.gov.* Please include sufficient information with your comments to allow us to verify any scientific or commercial information you include.

Comments and materials we receive, as well as supporting documentation we used in preparing this proposed rule, will be available for public inspection on *http://www.regulations.gov,* or by appointment, during normal business hours, at the U.S. Fish and Wildlife Service, Arkansas Ecological Services Office, Conway, Arkansas (see **FOR FURTHER INFORMATION CONTACT**).

Previous Federal Actions

Neosho Mucket

The Neosho mucket was first identified as a candidate for protection under the Act in the May 22, 1984, **Federal Register** (49 FR 21664) notice. As a candidate, it was assigned a status Category 2 designation, which was given to those species with some evidence of vulnerability but for which additional biological information was needed to support a proposed rule to list as endangered or threatened. In our Notices of Review dated January 6, 1989 (54 FR 554), November 21, 1991 (56 FR 58804), and November 15, 1994 (59 FR 58982), we retained a status Category 2 designation for this species. We discontinued assigning categories to candidate species in our Notice of Review dated February 28, 1996 (61 FR 7596), and only species for which the Service had sufficient information on biological vulnerability and threats to support issuance of a proposed rule were regarded as candidate species. Thus, Neosho mucket was no longer considered a candidate species.

On October 30, 2001, we identified the Neosho mucket in the **Federal Register** (66 FR 54808) as a candidate species based on available information to support a proposed rule. Candidate species are assigned listing priority numbers (LPNs) based on immediacy and magnitude of threats, as well as taxonomic status. The lower the LPN, the higher priority that species is for us to determine appropriate action using our available resources. We assigned an LPN of 5 to Neosho mucket. In our Notices of Review dated June 13, 2002 (67 FR 40657), and May 4, 2004 (69 FR 24876), we maintained an LPN of 5.

We published a petition finding for the Neosho mucket on May 11, 2005 (70 FR 24870), in response to a petition received on May 11, 2004, stating in the finding that the Neosho mucket would retain an LPN of 5. In our Notices of Review dated September 12, 2006 (71 FR 53756), December 6, 2007 (72 FR 69034), and December 8, 2008 (73 FR 75176), we maintained an LPN of 5, reflecting the nonimminent threats of high magnitude. The LPN was elevated to 2 in our Notice of Review dated November 10, 2010 (75 FR 69222), to reflect the change from nonimminent to imminent threats of high magnitude.

Rabbitsfoot

The rabbitsfoot was first identified as a candidate for protection under the Act in the November 15, 1994, **Federal Register** (59 FR 58982). As a candidate, it was assigned a status Category 2 designation. The category 2 list was eliminated in 1996 (61 FR 7596). On November 9, 2009, we added the rabbitsfoot to our candidate list in the **Federal Register** (74 FR 57804) with an LPN of 9. An LPN of 9 indicates threats of a moderate magnitude; some of the threats are nonimminent, most are ongoing, and the threats are imminent overall. In our Notice of Review dated November 10, 2010 (75 FR 69222), it was again identified as a candidate species with an LPN of 9.

Status Assessment for Neosho Mucket and Rabbitsfoot

Background

It is our intent to discuss below only those topics directly relevant to the listing of the Neosho mucket as endangered and the rabbitsfoot as threatened in this section of the proposed rule.

Introduction

North American freshwater mussel fauna is the richest in the world and historically numbered around 300 species (Williams *et al.* 1993, p. 6). Freshwater mussels are in decline, however, and in the past century have become more imperiled than any other group of organisms (Williams *et al.* 2008, p. 55). Approximately 66 percent of North America's freshwater mussel species are considered vulnerable to extinction or possibly extinct (Williams *et al.* 1993, p. 6). Within North America, the southeastern United States is the hot spot for mussel diversity. Seventy-five percent of southeastern mussel species are in varying degrees of rarity or possibly extinct (Neves *et al.* 1997, pp. 47–51). The central reason for the decline of freshwater mussels is the modification and destruction of their habitat, especially from sedimentation, dams, and degraded water quality (Neves *et al.* 1997, p. 60). These two mussels, like many other southeastern mussel species, have undergone reductions in total range and population density.

General Biology

Freshwater mussels generally live embedded in the bottom of rivers, streams, and other bodies of water. They siphon water into their shells and across four gills that are specialized for respiration and food collection. Food items include algae, bacteria, detritus (disintegrated organic debris), and microscopic animals (Strayer *et al.* 2004, pp. 430–431). It also has been surmised that dissolved organic matter may be a significant source of nutrition (Strayer *et al.* 2004, p. 430). Adults are filter feeders and generally orient themselves on or near the substrate surface to take in food and oxygen from the water column. Juveniles typically burrow completely beneath the substrate surface and are pedal (foot) feeders (bringing food particles inside the shell for ingestion that adhere to the foot while it is extended outside the shell) until the structures for filter feeding are more fully developed (Yeager *et al.* 1994, pp. 200–221; Gatenby *et al.* 1996, p. 604).

Sexes in unionid (refers to taxonomic family Unionidae) mussels, such as the Neosho mucket and rabbitsfoot, are usually separate. Males release sperm into the water column, which are drawn in by females through their siphons during feeding and respiration. Fertilization takes place inside the shell, and success is apparently influenced by mussel density and water flow conditions (Downing *et al.* 1993, pp. 153–154). The eggs are retained in the gills of the female until they develop into mature larvae called glochidia. The glochidia of most freshwater mussel species, including the two species addressed in this rule, have a parasitic stage during which they must attach to the gills, fins, or skin of a fish to transform into a juvenile mussel. Depending on the mussel species, females release glochidia either separately, in masses known as conglutinates (gelatinous or jelly-like), or in one large mass known as a super-conglutinate. The duration of the parasitic stage varies by mussel species, water temperature, and perhaps host fish species. When the transformation is complete, the juvenile mussels drop from their fish host and sink to the stream bottom where, given suitable conditions, they grow and mature into adults. Host specificity is discussed in more detail below.

Growth rates for mussels are highly variable among individual mussel species, but overall, mussels tend to grow relatively rapidly for the first few years (Scruggs 1960, pp. 28–30; Negus 1966, pp. 517–518) then slow appreciably (Bruenderman and Neves 1993, p. 88; Hove and Neves 1994, pp. 34–36). This reduction in growth rate is correlated to sexual maturity, probably as a result of energy being diverted from growth to gamete production (Baird 2000, pp. 63–71). Heavy-shelled species, such as Neosho mucket and rabbitsfoot, grow slowly relative to thin-shelled species (Coon *et al.* 1977, pp. 19–21; Hove and Neves 1994, p. 38).

Strayer (1999a, pp. 468 and 472) demonstrated that mussels in streams occur chiefly in ''flow refuges'' (relatively stable areas that displayed little movement of substrate particles during flood events). Other researchers also concluded that mussel location and density are greatest in areas where shear stress (stream's ability to entrain and transport bed material created by the flow acting on the bed material) is low and sediments remain generally stable during flooding (Layzer and Madison 1995, p. 341; Strayer 1999a, pp. 468 and 472; Hastie *et al.* 2001, pp. 111–114). These ''flow refuges'' conceivably allow relatively immobile mussels, such as the Neosho mucket and rabbitsfoot, to remain in the same general location throughout their life span. However, these areas may be more important for the rabbitsfoot since it typically does not burrow like the Neosho mucket, making it more susceptible to displacement into unsuitable habitat. However, flow refuges are not created equally and other habitat variables are important, but poorly understood (Roberts 2008, pers. comm.).

Taxonomy, Life History, and Distribution

The Neosho mucket and rabbitsfoot are freshwater mussels in the family Unionidae. Both species are currently deemed valid by the Committee on Scientific and Vernacular Names of Mollusks of the Council of Systematic Malacologists and the American Malacological Union (Turgeon *et al.* 1998, pp. 35 and 37).

Neosho Mucket

Neosho mucket was originally described as *Lampsilis rafinesqueana* from Indian Creek, McDonald County, Missouri (Frierson 1927, pp. 69–70). There is no synonomy (scientific names previously describing the same species) of the Neosho mucket. Frierson (1927, pp. 69–70) described the Neosho mucket as a dimorphic (male and female shape differs) species; the male is elliptical, rounded before biangulate behind, with dorsal and basal margin equally arched, while the female is ovate with a widely expanded fan-shaped posterior. The shell is up to 9.5 centimeters (cm) (4 inches (in)), compressed, and relatively thin (Oesch 1984, pp. 219–221). The epidermis is olive-yellow to brown, becoming darker brown with age; green rays cover the surface, but are often discontinuous. Oesch (1984, pp. 219–221) describes the left valve as having two stout, divergent, striated, triangular pseudocardinal teeth. The two lateral teeth are short, stout, and slightly curved. The right valve has a single, tall, triangular to columnar, striated pseudocardinal tooth. The nacre (crystalline carbonate shell material of freshwater mussels) is bluish white to white.

Neosho mucket glochidia are an obligate parasite on smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), and spotted bass (*Micropterus punctulatus*) (Barnhart and Roberts 1997, p. 18; U.S. Fish and Wildlife Service 2005, p. 7). Neosho mucket is unusual among other *Lampsilis* species in the timing of reproduction. Neosho mucket spawns in late April and May, and female brooding occurs May through August. Most other *Lampsilis* spawn in the late summer or fall and brood glochidia throughout the winter months into the following spring or summer. Barnhart (2003, p. 9) reported an average fecundity to be approximately 1.3 million glochidia per female in the Spring River, Kansas. The female Neosho mucket inflates and extends a pair of mantle flaps (actually an extension of the inner lobe of the mantle edge) that, from a side angle, remarkably resembles a small fish. Each mantle flap in addition to its fish-like shape has pigmentation that resembles an eyespot as well as a fish's lateral line. Muscular contractions of the mantle flaps create an undulating or ''swimming'' motion that suffices to lure fish hosts (Obermeyer 2000, p. 9).

The Neosho mucket is associated with shallow riffles and runs comprising gravel substrate and moderate to swift currents. The species is most often found in areas with swift current, but in Shoal Creek and the Illinois River it prefers near-shore areas or areas out of the main current (Oesch 1984, p. 221; Obermeyer 2000, pp. 15–16). Neosho mucket historically occurred in at least 16 streams within the Illinois, Neosho, and Verdigris River basins covering four states (Arkansas, Kansas, Oklahoma, and Missouri). It is endemic to the Arkansas River system (Gordon 1980, pp. 318 and 347; Harris and Gordon 1987, pp. 53–54; Obermeyer 1996, pp. 3–4; Vaughn 1996, pp. 3–5; Mather 1990, pp. 7–13; Obermeyer *et al.* 1997a, pp. 44–47; Harris *et al.* 2009, p. 68). The Neosho mucket's known river and creek occurrences and current status are shown in Table 1.

For the purposes of this rule, a population is considered extant if live individuals or fresh dead specimens have been located since 1985. A population is considered viable if it is sizeable, comprised of different age classes, recruiting juveniles, and able to sustain itself over several decades without human intervention (Butler 2005, p. 23). Population trend estimates were generally made with a 20- to 30-year perspective when adequate historical information was available. Populations were deemed to have improving, stable, declining, or unknown status (Table 1).

TABLE 1—NEOSHO MUCKET RIVER AND CREEK OCCURRENCES AND CURRENT POPULATION STATUS

River basin	River/Creek	State(s)	Current status	Date of last observation
Neosho River	Neosho River	KS, OK	Declining	2000.
	Cottonwood River	KS	Unknown	2011.
	South Fork Cottonwood River	KS	Extirpated	Pre-1979.
	Spring River	KS, MO, OK	Stable	2010.
	North Fork Spring River	MO	Declining	1995.
	Center Creek	KS, MO	Extirpated	1995.
	Shoal Creek	KS, MO	Declining	2001.
	Elk River	MO, OK	Declining	1995.
	Indian Creek	MO	Extirpated	Pre-1980.
	Little Sugar Creek	MO	Extirpated	Pre-1980.
Illinois River	Illinois River	AR, OK	Declining	2008
Verdigris River	Verdigris River	KS, OK	Declining	2010
	Otter Creek	KS	Extirpated	Pre-1993.
	Fall River	KS	Declining	2004.
	Elk River	KS	Extirpated	Pre-1979.
	Caney River	KS, OK	Extirpated	Pre-1979.

Neosho River Basin

Neosho River: The Neosho River drains southeast through Kansas and Oklahoma. Historical data of Neosho mucket densities for the Neosho River are not available prior to the late 1970s (Obermeyer *et al.* 1997b, p. 112). Mussel harvest records from the early 1900s provide useful insight on the abundance of mussels in the river. From 1911 through 1912, the Neosho River provided 17 percent or approximately 85 million mussels used in the nation's pearl button industry. Many of the 30 tons of mussel shells processed weekly in 1918 at a shell blank factory in Iola, Kansas, came from the Neosho River near LeRoy, Kansas (Obermeyer *et al.* 1997b, p. 112).

Since the 1990s, extant populations have been found downstream of John Redmond Reservoir Dam to near Parsons, Kansas, in Allen, Coffey, Labette, and Neosho Counties, Kansas. In addition, fresh dead or relict (shell shows no sign of recent mortality, such as tissue inside shell or outer shell material (periostracum) is weathered) shells were collected at 11 sites extending to near the Kansas–Oklahoma state line in Cherokee County, Kansas (Obermeyer *et al.* 1997a, pp. 44–46; Obermeyer 2000, pp. 8–9). In 1994, Obermeyer *et al.* (1995, p. 24) collected 32 live Neosho mucket specimens (relative abundance = 0.6 percent) at 7 of 19 sites in Kansas. The Neosho mucket is becoming increasingly rare in the Oklahoma segment of the river (Tabor 2011, pers. comm.) with searches yielding no live or recently dead specimens. However, relict Neosho mucket shells confirm the historical presence of the species (Mather 1990, pp. 16–17; Vaughn 1996, p. 3; 1997, pp. 7–9).

Cottonwood River: The Cottonwood River drains easterly through eastern Kansas. There are few historical records of Neosho mucket from the Cottonwood River prior to the late 1970s. Obemeyer *et al.* (1997a, p. 111) collected 59 live mussels from 6 sites surveyed from 1993 through 1995, but only found weathered dead shells of Neosho mucket. Neosho mucket was considered extirpated from the Cottonwood River until Kansas Department of Wildlife and Parks (KDWP) reintroduced mature male and brooding female Neosho mucket individuals at two sites east of Cottonwood Falls, Chase County, Kansas, in 2011 (Tabor and Barnhart 2012, pers. comm.).

Spring River: The Spring River drains southwesterly through southwest Missouri, southeast Kansas, and eastern Oklahoma. There are few historical records of Neosho mucket from the Spring River prior to the late 1970s. Miscellaneous records from 1979 to 2010 report 10 localities yielding 119 live Neosho mucket specimens between Missouri Highway 97 near Stott City, Lawrence County, Missouri, and the Missouri and Kansas state line (McMurray 2011, pers. comm.). Cope (1985, pp. 19–20, 26–27, 33–34) collected 424 live Neosho mucket specimens out of 993 live mussels collected in 79 total one-square-meter quadrat samples from three Kansas sites upstream of Empire Lake.

Obermeyer (1996, p. 11) provides the most comprehensive status assessment of Neosho mucket in the Spring River. He collected 1,104 live Neosho mucket specimens from 13 of 20 sites extending from Missouri Highway 97 downstream to near the Turkey Creek confluence in Kansas. The KDWP surveyed a site approximately 0.5 to 0.8 rkm (0.3 to 0.5 rmi) downstream of the Kansas and Missouri state line in 2003 and collected 201 live Neosho mucket specimens (approximately 30 percent of live mussels collected). In 2006, KDWP collected 141 live Neosho mucket specimens (approximately 30 percent of live mussels collected) at a site just upstream of the Kansas and Missouri Highway YY (Miller 2011, pers. comm.). Eight to 10 percent of live Neosho mucket specimens collected at the 2006 site were quantitatively aged at less than 5 years (Tabor 2008, pers. comm.). A 2010 survey, 6 km (4 miles) east of Crestline, Kansas, found 400 live mussel specimens, of which approximately half were Neosho mucket (Tabor 2011, pers. comm.). The Spring River Neosho mucket population represents the only viable population rangewide.

North Fork Spring River: The North Fork Spring River is a tributary of the Spring River in Missouri. There are no historical records for Neosho mucket in the North Fork Spring River prior to 1980. Neosho mucket distribution is limited to a few sites downstream of the Dry Fork confluence southwest of Jasper, Jasper County, Missouri. Three sites yielded 136 live Neosho mucket specimens in the mid 1990s (Obermeyer *et al.* 1997a, p. 45; McMurray 2011, pers. comm.).

Shoal Creek: Shoal Creek is a southern tributary of the Spring River draining portions of southwest Missouri and southeast Kansas. There are few historical records for Neosho mucket in Shoal Creek prior to 1979. Surveys of Shoal Creek conducted from 1979 to 2001 from Missouri Highway W near Ritchey, Missouri, to Empire Lake, Cherokee County, Kansas, yielded 75 live Neosho mucket specimens from 11 sites (Obermeyer *et al.* 1995, p. 45; McMurray 2011, pers. comm.). No specimens were found in the Kansas portion of Shoal Creek.

Elk River: The Elk River, a tributary of the Spring River, drains southwestern Missouri and northeastern Oklahoma. The Oklahoma reach downstream of Buffalo Creek just west of the Missouri and Oklahoma state line is inundated by Grand Lake O' the Cherokees, resulting in the loss of Neosho mucket habitat. Live Neosho mucket individuals have been collected from two sites in Missouri, eight individuals in 1978 and two individuals in 1995, and the species is rare from Noel, Missouri, to the Kansas and Missouri state line (McMurray 2011, pers. comm.). Brooding Neosho mucket females and juveniles were reported in this reach at two sites in 1992 and 1998 (Barnhart 2008, pers. comm.).

Illinois River Basin

Illinois River: The Illinois River drains portions of northwest Arkansas and northeast Oklahoma. There are few historical records of Neosho mucket from the Illinois River prior to the late 1970s. In 1978, Gordon *et al.* (1979, pp. 35–36) surveyed 16 sites between Hogeye and Siloam Springs, Arkansas, but only report Neosho mucket as part of the mussel fauna. Eighteen live Neosho mucket specimens were reported from four Arkansas locations in the early 1990s, including the only specimen ever collected from the Muddy Fork Illinois River (Harris 1991, p. 7; Environmental and Gas Consulting, Inc. 1994, pp. field data sheets). Harris (1998) conducted a status survey of the Neosho mucket and found live specimens at 19 of 22 sites in the 48 rkm (30 rmi) reach, Washington and Benton Counties, Arkansas. Neosho mucket was the third most abundant species collected, but there was little evidence of recent recruitment (Harris 1998, p. 5).

In 2005, 92 live Neosho mucket specimens were collected from two Benton County, Arkansas, sites (Robinson Road Bridge and 800 m (2,624 feet) downstream of Chambers Spring Road, Benton County, Arkansas; Posey 2005, pers. comm.). The Arkansas Game and Fish Commission (AGFC) and the Service conducted a comprehensive status survey for Neosho mucket in the Arkansas portion of the Illinois River in 2008. Live specimens of Neosho mucket were collected at 9 of 15 survey sites. There was a 32 and 53 percent decline in number of extant (still in existence) mussel sites and sites inhabited by live Neosho mucket specimens, respectively, versus the Harris (1998) status survey. Sixty-seven percent of the sites with

Neosho mucket present were represented by three or fewer live specimens. Neosho mucket was the fourth most abundant species in this portion of the river, but 3 sites accounted for 85 percent of live Neosho mucket specimens (52 individuals) collected during this survey. Of the 15 survey sites, only 2 appear stable with the rest in decline, indicating imminent extirpation. No mussels were collected at the sites AGFC sampled in 2005 in 2008 further documenting the precipitous decline of mussels in the Arkansas portion of the Illinois River (Davidson 2011, pers. comm.).

Neosho mucket was locally common prior to the late 1990s in approximately 89 rkm (55 rmi) of the Illinois River from the Oklahoma and Arkansas state line downstream to Lake Tenkiller, Cherokee County, Oklahoma (Mather 1990, pp. 7–11). The population within the survey reach was estimated at more than 1,200 individuals in 1990. In 1995, Vaughn (1995, p. 3; 1997, p. 14) estimated the Neosho mucket population in the same reach surveyed by Mather in 1990 at between 500 and 1,000 individuals and locally common at 9 of 52 sites. Although some evidence of reproductive potential was observed during 1990 and 1995 (for example, gravid females displaying mantle lures), there was little evidence of recruitment into the population. Neosho mucket specimens were not found in or downstream of Lake Tenkiller.

Verdigris River Basin

Fall River: The Fall River is a southern tributary of the Verdigris River in southeast Kansas. There are few historical records from the Fall River prior to the mid 1990s (Obermeyer *et al.* 1995, p. 24). In 1994, Obermeyer *et al.* (1995 p. 24) found 34 live specimens (relative abundance = 1.7 percent) from 5 sites in the Fall River, with little evidence of recruitment into the population. In 2004, two sites were resurveyed and Neosho mucket composed 1.0 and 0.5 percent of qualitative and quantitative surveys, respectively (Tabor 2008, pers. comm.). All specimens were found downstream of Fall River Lake in Greenwood, Elk, and Wilson Counties (Obermeyer *et al.* 1995, p. 24).

Verdigris River: The Verdigris River flows through southeast Kansas and northeast Oklahoma until it reaches the Arkansas River in Oklahoma. There are few historical records from the Verdigris River in either State prior to the 1990s. Obermeyer *et al.* (1997a, p. 44; 1997b, p. 111) collected five Neosho mucket specimens from 4 of 14 sites from 1993 to 1995, representing 0.2 percent of the total sample from the Verdigris River between Altoona, Wilson County, Kansas, and Sycamore, Montgomery County, Kansas. The KDWP surveyed eight sites between the Fall and Verdigris River and Elk and Verdigris River confluences in 2003 and 2010. Six live Neosho mucket specimens were collected from two of these sites in 2003 (0.1 percent of the total mussel community) and seven live specimens from four sites in 2010 (0.2 percent of the total mussel community). Overall relative abundance of Neosho mucket in the Verdigris River in Kansas has ranged between 0.1 to 0.3 percent in the years from 1993 to 2010 (Miller 2011, pp. 1–2).

The majority of the Oklahoma reach has been inundated (Oologah Lake) and channelized as part of the McClellan-Kerr Arkansas River Navigation System. In 1996 and 1997, searches in the Verdigris in Oklahoma found no live Neosho mucket specimens at 32 sites. However, relict Neosho mucket shells confirmed the historical presence of the species (Vaughn 1996, p. 3; 1997, pp. 7–9). In 2008, researchers confirmed that the species is still extirpated from the Oklahoma reach (Boeckman 2008, pers. comm.).

Summary of Neosho Mucket Rangewide Population Status

The Neosho mucket is declining rangewide, with the exception of one population. Based on historical and current data, Neosho mucket has been extirpated from approximately 1,342 rkm (834 rmi) of its historical range (62 percent). Most of this extirpation has occurred within the Oklahoma and Kansas portions of its range. The extirpation of this species from numerous streams and stream reaches within its historical range signifies that substantial population losses have occurred. Extant populations are disjunct (not contiguous) in approximately 819 rkm (509 rmi). The Spring River in Missouri supports the only viable population based on the presence of a large number of individuals and evidence of recent recruitment. Given this compilation of current distribution, abundance, and status trend information, the Neosho mucket exhibits range reductions and population declines throughout its range.

Rabbitsfoot

The rabbitsfoot was originally described as *Unio cylindricus* (Say, 1817, no pagination but p. 13 of publication). The type locality is the Wabash River (Parmalee and Bogan 1998, p. 210), probably in the vicinity of New Harmony, Posey County, Indiana, and adjacent Illinois. Parmalee and Bogan (1998, p. 210) summarize the synonomy of the rabbitsfoot. The rabbitsfoot has been considered a member of the genera *Unio, Mya, Margarita, Margaron,* and *Orthonymus* at various times in history. It was first considered a member of the genus *Quadrula* by Lewis (1870, p. 218). The description of *U. cylindricus strigillatus* B.H. Wright, 1898 (=*Q. cylindrica strigillata,* the federally endangered rough rabbitsfoot; Turgeon *et al.* 1998, p. 37), rendered the rabbitsfoot, *Q. c. cylindrica,* a subspecies for *Q. cylindrica.* Davis and Fuller (1981, p. 241) and Sproules *et al.* (2006, p. 3) conducted taxonomic and genetic studies on the rough rabbitsfoot (*Q. c. strigillata*) and rabbitsfoot (*Q. c. cylindrica*). Although discussion continues over the correct taxonomic placement of the rabbitsfoot, the designation of the rabbitsfoot as a species would not affect its qualification for listing under the Act as it would qualify as a listable entity whether it was a subspecies or a species.

The rabbitsfoot is a medium to large mussel, elongate and rectangular, reaching 12 cm (6 inches) in length (Oesch 1984, pp. 91–93). Parmalee and Bogan (1998, pp. 210–212) describe the beaks as moderately elevated and raised only slightly above the hinge line. Beak sculpture consists of a few strong ridges or folds continuing onto the newer growth of the umbo (raised or domed part of the dorsal margin of the shell) as small tubercles (small, rounded projection on surface of the shell). Shell sculpture consists of a few large, rounded, low tubercles on the posterior slope, although some individuals will have numerous small, elongated pustules (small raised spots) particularly on the anterior. The periostracum (external shell surface) is generally smooth and yellowish, greenish, or olive in color becoming darker and yellowish-brown with age and usually covered with dark green or nearly black chevrons and triangles pointed ventrally (Say 1817, p. 13). These patterns are absent in some individuals.

Internally, the color of the nacre is white and iridescent, often with a grayish-green tinge in the umbo cavity. Specimens from the southern periphery of its range are occasionally purplish. Soft parts generally have an orange coloration (Oesch 1984, p. 91; Parmalee and Bogan 1998, pp. 211–212). However, Vidrine (1993, p. 55) noted that the rabbitsfoot in the Ouachita River system in Louisiana had black soft parts. Aspects of the soft anatomy are described by Ortmann (1912, pp. 256–257), Utterback (1915, pp. 148–149), Davis and Fuller (1981, pp. 228–233 and 241), and Oesch (1984, p. 91).

Suitable fish hosts for rabbitsfoot populations west of the Mississippi River include blacktail shiner (*Cyprinella venusta*) from the Black and Little River and cardinal shiner (*Luxilus cardinalis*), red shiner (*C. lutrensis*), spotfin shiner (*C. spiloptera*), and bluntface shiner (*C. camura*) from the Spring River, but host suitability information is lacking for the eastern range (Fobian 2007, p. ii). In addition, rosyface shiner (*Notropis rubellus*), striped shiner (*L. chrysocephalus*), and emerald shiner (*N. atherinoides*) served as hosts for rabbitsfoot, but not in all stream populations tested (Fobian 2007, p. 69).

Rabbitsfoot populations west of the Mississippi River reach sexual maturity between the ages of 4 to 6 years (Fobian 2007, p. 50). Rabbitsfoot exhibit seasonal movement towards shallower water during brooding periods, a strategy to increase host fish exposure but one that also leaves them more vulnerable to predation and fluctuating water levels, especially downstream of dams (Fobian 2007, pp. 48–49; Barnhart 2008, pers. comm.). It is a short–term brooder, with females brooding between May and late August (Fobian 2007, pp. 15–16). Similar to other species of *Quadrula,* the rabbitsfoot uses all four gills as a marsupium (pouch) for its glochidia (Fobian 2007, p. 26). Female rabbitsfoot release glochidia as conglutinates (matrices holding numerous glochidia together and embryos and undeveloped ova), which mimic flatworms or similar fish prey. Fecundity (capacity of abundant production) in river basins west of the Mississippi River ranged from 46,000 to 169,000 larvae per female (Fobian 2007, p. 19).

Rabbitsfoot is primarily an inhabitant of small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. Specimens also may occupy deep water runs, having been reported in 2.7 to 3.7 m (9 to 12 feet) of water. Bottom substrates generally include gravel and sand (Parmalee and Bogan 1998, pp. 211–212). This species seldom burrows but lies on its side (Watters 1988, p. 13; Fobian 2007, p. 24).

Rabbitsfoot historically occurred in 140 streams within the lower Great Lakes Subbasin and Mississippi River Basin (Table 2). The historical range included Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, Tennessee, and West Virginia. Rabbitsfoot populations are considered to be extant in 51 streams in 13 states (Butler 2005, pp. 18–20; Boeckman 2008, pers. comm.), representing a 64 percent decline (51 extant streams of 140 historical populations). In streams where it remains extant, populations are highly fragmented and restricted to short reaches. Based upon existing habitat use (need for flowing vs. impounded habitats) and fish host (small minnow species with limited individual ranges) data, it is unlikely that recruitment between populations or establishment of new populations could occur naturally.

Although quantitative historical abundance data are rare for rabbitsfoot, relative abundance information can be gathered from museum lots. Historical museum data indicated stable rabbitsfoot populations occurred in the Ohio, Walhonding, Big Sandy, Scioto, Olentangy, Nolin, Wabash, North Fork Vermilion, Obey, Tennessee, White, Black, Spring (White River system), Strawberry, Illinois, Glover and Cossatot Rivers (Butler 2005, p. 20). Call (1895, p. 15) considered the rabbitsfoot ''abundant in the St. Francis, Saline, and Ouachita Rivers in Arkansas.''

TABLE 2—RABBITSFOOT RIVER AND CREEK OCCURRENCES AND CURRENT POPULATION STATUS

River basin	River/Creek	States	Current status	Date of last observation
Lower Great Lakes	Maumee River	IN, OH	Extirpated	1927.
	St. Joseph River	IN, OH	Extirpated	1967.
	Fish Creek	IN, OH	Declining	2009.
	Feeder Canal	IN	Extirpated	1908.
	St. Mary's River	IN	Extirpated	Circa 1920.
	Auglaize River	OH	Extirpated	Mid 1900s.
Ohio River	Ohio River	IL, IN, KY, OH, PA, WV.	Stable	2005.
	Allegheny River	PA	Declining	2007.
	French Creek	PA	Stable	2008.
	Le Boeuf Creek	PA	Unknown	2006.
	Muddy Creek	PA	Declining	2003.
	Conneautee Creek	PA	Unknown	2006.
	Monongahela River	PA	Extirpated	Circa 1890.
	West Fork River	WV	Extirpated	Pre-1913.
	Beaver River	PA	Extirpated	1898.
	Shenango River	PA	Unknown	2009.
	Pymatuning Creek	PA	Extirpated	1909.
	Mahoning River	OH, PA	Extirpated	Unknown.
	Muskingum River	OH	Declining	2007.
	Tuscarawas River	OH	Extirpated	Circa 1990.
	Walhonding River	OH	Declining	2009.
	Killbuck Creek	OH	Extirpated	Pre-1990.
	Mohican River	OH	Extirpated	1977.
	Black Fork Mohican River	OH	Extirpated	Pre-1990.
	Little Kanawha River	WV	Extirpated	Circa 1900.
	Elk River	WV	Extirpated	Unknown.
	Big Sandy River	KY	Extirpated	Circa 1800.
	Levisa Fork	KY	Extirpated	1909.
	Scioto River	OH	Extirpated	1962.
	Olentangy River	OH	Extirpated	1962.
	Whetstone Creek	OH	Extirpated	Pre-1930.

TABLE 2—RABBITSFOOT RIVER AND CREEK OCCURRENCES AND CURRENT POPULATION STATUS—Continued

River basin	River/Creek	States	Current status	Date of last observation
	Big Walnut Creek	OH	Extirpated	1961.
	Alum Creek	OH	Extirpated	1961.
	Walnut Creek	OH	Extirpated	Pre-1990.
	Big Darby Creek	OH	Declining	2002.
	Little Darby Creek	OH	Declining	2000.
	Deer Creek	OH	Extirpated	Pre-1980.
	Ohio Brush Creek	OH	Extirpated	1970.
	Little Miami River	OH	Extirpated	Circa 1900.
	Licking River	KY	Extirpated	Circa 1990.
	South Fork Licking River	KY	Extirpated	Pre-1980.
	Kentucky River	KY	Extirpated	Circa 1920.
	South Fork Kentucky River	KY	Declining	1998.
	Salt River	KY	Extirpated	Pre-1980.
	Green River	KY	Improving	2009.
	Russell Creek	KY	Extirpated	1908.
	Nolin River	KY	Extirpated	1983.
	Barren River	KY	Declining	1993.
	Drakes Creek	KY	Extirpated	1926.
	West Fork Drakes Creek	KY	Extirpated	1927.
	Rough River	KY	Declining	1993.
	Wabash River	IL, IN	Declining	1988.
	Mississinewa River	IN	Extirpated	Pre-1990.
	Eel River	IN	Declining	2007.
	Tippecanoe River	IN	Stable	2005.
	Vermilion River	IL	Extirpated	Pre-1990.
	North Fork Vermilion River	IL	Declining	2006.
	Middle Branch North Fork Vermilion River	IL	Declining	2002.
	Middle Fork Vermilion River	IL	Extirpated	1918.
	Salt Fork Vermilion River	IL	Extirpated	Circa 1920.
	Sugar Creek	IN	Extirpated	1932.
	Embarras River	IL	Extirpated	Circa 1980.
	White River	IN	Extirpated	Circa 1960.
	East Fork White River	IN	Extirpated	1964.
	Driftwood River	IN	Extirpated	Circa 1940s.
	Big Blue River	IN	Extirpated	Early 1900s.
	Brandywine Creek	IN	Extirpated	Pre-1990.
	Sugar Creek	IN	Extirpated	Mid 1990s.
	Flatrock River	IN	Extirpated	Mid 1900s.
	West Fork White River	IN	Extirpated	Pre-1990.
	Black Creek	IN	Extirpated	Unknown.
Cumberland River	Cumberland River	KY, TN	Extirpated	1979.
	Rockcastle River	KY	Extirpated	1911.
	Big South Fork	KY	Extirpated	1911.
	Beaver Creek	KY	Extirpated	1949.
	Obey River	TN	Extirpated	1939.
	East Fork Obey River	TN	Extirpated	Unknown.
	Caney Fork	TN	Extirpated	1961.
	Stones River	TN	Extirpated	1964.
	East Fork Stones River	TN	Declining	2002.
	West Fork Stones River	TN	Extirpated	1966.
	Harpeth River	TN	Extirpated	Late 1800s.
	Red River	KY, TN	Declining	1992.
	Whippoorwill Creek	KY	Extirpated	Pre-1980.
Tennessee River	Tennessee River	AL, KY, MS, TN	Stable	2009.
	Holston River	TN	Extirpated	1915.
	French Broad River	TN	Extirpated	Unknown.
	Little Pigeon River	TN	Extirpated	Unknown.
	Little Tennessee River	TN	Extirpated	Unknown.
	Clinch River	TN	Extirpated	1935.
	Lookout Creek	GA	Extirpated	1973.
	Sequatchie River	TN	Extirpated	Pre-1925.
	Paint Rock River	AL	Improving	2007.
	Hurricane Creek	AL	Extirpated	1991.
	Estill Fork	AL	Extirpated	1970.
	Larkin Fork	AL	Extirpated	1966.
	Flint River	AL	Extirpated	1955.
	Elk River	TN	Declining	2006.
	Shoal Creek	AL, TN	Extirpated	Pre-1990.
	Bear Creek	AL, MS	Declining	2005.
	Duck River	TN	Improving	2009.
	Big Rock Creek	TN	Extirpated	Pre-1990.

TABLE 2—RABBITSFOOT RIVER AND CREEK OCCURRENCES AND CURRENT POPULATION STATUS—Continued

River basin	River/Creek	States	Current status	Date of last observation
	Buffalo River	TN	Extirpated	1969.
Lower Mississippi River	St. Francis River	AR, MO	Declining	2008.
	Big Creek	MO	Extirpated	1976.
	Yazoo River	MS	Extirpated	Unknown.
	Big Sunflower River	MS	Declining	2004.
	Big Black River	MS	Declining	1980.
White River	White River	AR, MO	Stable	2004.
	War Eagle Creek	AR	Unknown	2004.
	Buffalo River	AR	Declining	1995.
	North Fork White River	AR	Extirpated	1914.
	Black River	AR, MO	Declining	2005.
	Current River	AR	Declining	1983.
	Spring River	AR	Declining	2004.
	South Fork Spring River	AR	Declining	2002.
	Strawberry River	AR	Unknown	2006.
	Little Red River	AR	Extirpated	Circa 1970.
	Middle Fork Little Red River	AR	Stable	2009.
	Reeses Fork Cache River	AR	Extirpated	1980.
Arkansas River	Verdigris River	KS, OK	Unknown	2009.
	Fall River	KS	Extirpated	Circa 1900.
	Neosho River	KS, OK	Declining	1999.
	Cottonwood River	KS	Extirpated	Pre-1990.
	Spring River	KS, MO	Declining	2006.
	Center Creek	MO	Extirpated	Circa 1920.
	Shoal Creek	MO	Extirpated	Pre-1920.
	Illinois River	AR, OK	Declining	2008.
Red River	Blue River	OK	Extirpated	Circa 1900.
	Little River	AR, OK	Stable	2006.
	Glover River	OK	Declining	1996.
	Mountain Fork Little River	OK	Extirpated	1968.
	Cossatot River	AR	Declining	2007.
	Ouachita River	AR, LA	Stable	2007.
	Caddo River	AR	Extirpated	Pre-1986.
	Little Missouri River	AR	Declining	1996.
	Saline River	AR	Declining	2006.
	North Fork Saline River	AR	Extirpated	Pre-1986.
	Bayou Bartholomew	LA	Declining	2005.

Butler (2005, pp. 89–90) categorized the extant populations of rabbitsfoot into three groups based on population size, general distribution, evidence of recent recruitment, and assessment of current viability. Sizeable populations with evidence of recent recruitment were categorized as viable. Small populations were categorized based on limited levels of recent recruitment, generally highly restricted distribution, or doubtful or limited viability increasing its susceptibility to extirpation in the near future. Marginal populations were considered rare, with no evidence of recent recruitment, of doubtful viability, and possibly on the verge of extirpation in the immediate future.

Many of the small and marginal populations are demonstrably (clearly evident) declining (Table 2). Of 21 streams with marginal populations, 9 streams (43 percent) are represented by a single recent living or fresh dead specimen. Although we have sporadic collections from the last century, trends indicate declining populations in other streams as well (for example, Allegheny River, Walhonding River, Cossatot River, Buffalo River, and Bear Creek). The following is a summary of relative abundance and trends of extant rabbitsfoot populations by river basin.

Lower Great Lakes Subbasin

The Great Lakes Basin represents the most zoogeographically (geographic distribution of an animal) distinct population center for the rabbitsfoot. All known records for the rabbitsfoot in the Great Lakes Basin are from the Maumee River system, a tributary of western Lake Erie. Populations historically occurred in five streams in addition to a canal in this system, but Fish Creek is the only remaining stream population.

Fish Creek: Fish Creek is a tributary of the St. Joseph River, flowing through Indiana and eastward into Ohio. In 1988, rabbitsfoot comprised 1.2 percent relative abundance of all mussels in the stream (Watters 1988, p. 17). From 1996 to 2005, 17 live specimens were collected during 3 surveys (Watters 1996 *in* Butler 2005, p. 23; Watters 2000 *in* Butler 2005, p. 23; Brady *et al.* 2004 *in* Butler 2005, pp. 23–24; Tetzloff 2009, pers. comm.). In 2009, Ahlstedt (2009, p. 3) found one fresh dead rabbitsfoot specimen in Fish Creek. This population is categorized as marginal.

Ohio River Basin

Historically, rabbitsfoot populations were found in 66 streams within the Ohio River basin, the largest eastern tributary of the Mississippi River. Today, rabbitsfoot is extant in 20 streams, a 70 percent decline from historical stream occurrences. Several of the extant populations are represented by single living or fresh dead specimens in recent years (Muskingum, Wabash, Eel, South Fork Kentucky, Barren, and Rough Rivers and Big Darby Creek).

Ohio River: Historically, about 60 records for rabbitsfoot have been reported over 1,570 rkm (981 rmi) of the main stem (Butler 2005, p. 25). Linear river kilometers of mussel beds in the river declined greater than 20 percent from 1967 to 1982 (Williams and Schuster 1989, pp. 7–10). By 1982, a

1,069-rkm (664-rmi) mussel survey of the Ohio River (Ohio River Mile 317.0 to 981.0) yielded one rabbitsfoot specimen from near the mouth of the Green River, Kentucky (Williams and Schuster 1989, p. 23).

Currently, two extant rabbitsfoot populations exist in the Ohio River. One population is located near Spencer County, Indiana and Hancock County, Kentucky (Clarke 1995, p. 81). The largest Ohio River rabbitsfoot population is located downstream of Lock and Dam 52 and 53. Numerous live or fresh dead rabbitsfoot specimens have been reported over the past 25 years from this reach, mostly downstream of Lock and Dam 52 (approximately Ohio River km 1,511.2 or mile 939) near Paducah, Kentucky (Butler 2005, p. 26). In addition, the rabbitsfoot population downstream of Lock and Dam 52 and 53 includes multiple age or size classes (Butler 2005, p. 26). The Ohio River and lower Tennessee River (downstream of Kentucky Lake Dam) populations may be considered a single meta–population due to the absence of a significant barrier separating them and are considered to be a sizeable population (Butler 2005, p. 26).

Allegheny River: The Allegheny River begins in northwestern Pennsylvania, flows into New York, and then continues south into Pennsylvania before converging with the Monongahela River near Pittsburgh, Pennsylvania, to form the Ohio River. Historical records from Pennsylvania indicate rabbitsfoot was sporadically known from at least Armstrong County upstream to Warren County, Pennsylvania (Butler 2005, p. 28), but little sampling effort was performed over the past 100 years. Five live rabbitsfoot specimens were found from 1998 to 2001 at three of four intensely sampled sites at Kennerdell, Venango County, Pennsylvania (Villella 2008, pers. comm.). During surveys from 2001 to 2002 (25 sites) and 2007 (63 sites) encompassing 129 rkm (80 rmi), rabbitsfoot was found only at four sites, with very low densities. Three of four sites were downstream of the French Creek confluence (Villella 2008, pers. comm.). A 2006–2007 survey yielded no evidence of rabbitsfoot at five pools within the Allegheny River, approximately 60 rkm (37 rmi) (Smith and Meyer 2010, p. 558). The lower Allegheny River and French Creek likely represent a metapopulation because no barriers exist between the streams, but the Alleghany population is considered marginal (Butler 2005, p. 29).

French Creek: French Creek is a major tributary of the Allegheny River, with rabbitsfoot known from downstream of Union City Reservoir to approximately 11 rkm (7 rmi) above the Allegheny River confluence, a total of 121 rkm (75 rmi) (Butler 2005, p. 31). Museum records from 1985 to 1994 indicate that rabbitsfoot was known from 12 sites (Butler 2005, p. 30). Intensive quantitative sampling at 4 sites in Venango County from 1998 to 1999 yielded 205 live rabbitsfoot specimens (Butler 2005, p. 30). In 2003 and 2004, timed searches (qualitative) yielded 41 live rabbitsfoot specimens from 12 of 25 sites in Erie, Crawford, Mercer, and Venango Counties, Pennsylvania, while a quantitative survey at 7 of 10 sites yielded 57 live rabbitsfoot specimens (Smith and Crabtree (2010 p. 391–398). Rabbitsfoot abundance at the seven sites was estimated to be from 43 to 372 individuals (standard error = 30 to 123). Evidence of recent recruitment was found at three sites (Smith and Crabtree 2010, p. 400). The French Creek population appears to be healthy and stable, with evidence of recruitment.

LeBoeuf and Conneautee Creeks: LeBoeuf and Conneautee Creeks are tributaries of French Creek in Pennsylvania. Historical surveys for rabbitsfoot in these creeks are restricted to one relict found in 1991 from LeBoeuf Creek. In 2006, live rabbitsfoot specimens were confirmed near the confluence of each creek with French Creek. Recruitment has not been confirmed in either creek and the populations are considered marginal and likely a single meta–population with French Creek.

Muddy Creek: Muddy Creek is a tributary of French Creek in Crawford County, Pennsylvania. Dennis (1984 p. 34) first reported the rabbitsfoot from Muddy Creek in the 1970s from a site near its confluence with French Creek. Three live rabbitsfoot specimens were collected at 3 of 20 sites in 2003, a 3-rkm (2 rmi) reach located 6 rkm (4 rmi) upstream of its confluence with French Creek (Butler 2005 p. 32; Mohler *et al.* 2006, pp. 574 and 581). The rabbitsfoot population is categorized as small.

Walhonding River: The Walhonding River converges with the Tuscarawas River to create the Muskingum River near Coshocton, Coshocton County, Ohio. The rabbitsfoot was historically common at some sites in the Walhonding River (Butler 2005, p. 32). While subsequent surveys in the early 1990's collected live mussels, relative abundance of rabbitsfoot was 0.3 percent with limited evidence of recruitment (Hoggarth 1995–1996, pp. 157, 166–174). In 2009, five live rabbitsfoot were collected from four sites located 1,203 m (3,947 ft) to 2,014 m (6,608 ft) upstream of Six Mile Dam. No live or dead rabbitsfoot individuals were collected from Six Mile Dam downstream 2,267 m (7,438 ft) (EnviroScience 2010, Figure 5). The rabbitsfoot population is categorized as small and appears to be in decline (Butler 2005, p. 33).

Shenango River: The Shenango River is a tributary of the Beaver River in Mercer County, Pennsylvania. Nelson and Villelo (2010, p. 1) surveyed the Shenango River from Pymatuning Reservoir to Shenango River Lake in 2009 and they collected 34 live rabbitsfoot specimens (relative abundance = 1.1 percent) from this reach (Nelson and Villelo 2010, pp. 9–10). Prior to this survey, rabbitsfoot was believed to be extirpated from the Shenango River (Butler 2005, p. 96).

Muskingum River: The Muskingum River is a major tributary of the Ohio River. Rabbitsfoot was believed to be extirpated circa 1980 until two live specimens were found in 2007 near Dresden, Muskingum County, Ohio (Service 2010, p. 10). This population is categorized as marginal.

Big Darby Creek: Big Darby Creek is a tributary of the Scioto River in central Ohio. Watters (1994, p. 99) claimed the creek had the highest mussel diversity of any stream its size in North America. Many rabbitsfoot records exist for Big Darby Creek, dating back to the late 1950's (Butler 2005, p. 34). However, only weathered rabbitsfoot specimens were found during two intensive sampling years, 1986 and 1990 (Watters 1990, p. 31; 1994, p. 101). Since 1990, live and fresh dead rabbitsfoot records are limited to five live specimens from two localities (Tetzloff 2008, pers. comm.; Butler 2005, p. 35). Currently, the population is considered marginal.

Little Darby Creek: Little Darby Creek is the main tributary for Big Darby Creek. Rabbitsfoot were known from Little Darby Creek dating back to circa 1960, primarily in Madison County, Ohio (Butler 2005, p. 35–36). Watters (1994, p. 101) located seven live rabbitsfoot specimens at three sites during a 1990 survey. The population in Little Darby Creek, although categorized as small, appears to be persisting and stable in approximately 32 rkm in Union and Madison Counties, Ohio (20 rmi) (Watters 1994, p. 106; Tetzloff 2008, pers. comm.).

South Fork Kentucky River: The South Fork Kentucky River is a tributary of the Kentucky River in southeastern Kentucky that essentially converges to form the latter near Beattyville, Lee County, Kentucky. The rabbitsfoot was first discovered in the river in the late 1990s in Owsley County; a single relict rabbitsfoot specimen was collected in 1996 and a single live specimen was observed in 1998. The population is considered marginal and of questionable viability (Butler 2005, p. 37).

Green River: The Green River is a major Ohio River tributary, located in west–central Kentucky. Rabbitsfoot occurrences span almost 241 rkm (150 rmi) of the upper Green River (Butler 2005, p. 37). Historical rabbitsfoot records date back to circa 1900 (Butler 2005, p. 38). Periodic sampling from 1984 to 1996 produced live and fresh dead rabbitsfoot specimens from nine Green River sites between Green River Lake Dam and Munfordville, Kentucky (Cicerello 1999, p. 23). Cicerello (1999, Figure 1 and Table 1) sampled 40 sites from 1996 to 1998 over the 153-rkm (95-rmi) reach between Mammoth Cave National Park and Green River Lake Dam and reported the rabbitsfoot to be ''uncommon'' at 13 sites extending from Green River km 373.0 to 489.1 (mile 231.8 to 303.9; relative abundance of 0.1 percent) upstream of Munfordville, Kentucky. Sampling from 2000 to present has produced high numbers of fresh dead and numerous living specimens in Adair, Green, and Hart Counties (Butler 2005, pp. 38–39). The Green River population is one of a few rabbitsfoot populations that appear to be sizeable and improving, based on evidence of recruitment.

Barren River: The Barren River is the largest tributary of the Green River and flows in a northwesterly direction towards its confluence with the Green River in west–central Kentucky. Historical records of rabbitsfoot in the Barren River prior to the 1990s are limited to a couple collections in the 1920s and 1940s (Butler 2005, p. 40). Two surveys since the 1990s have yielded one live rabbitsfoot and relicts in small numbers (Gordon and Sherman 1995, Appendix A). If extant, the rabbitsfoot population in the Barren River is marginal and its viability is highly doubtful (Butler 2005, p. 41).

Rough River: The Rough River is a major Green River tributary flowing westward towards its confluence in western Kentucky. There are no historical rabbitsfoot records from the Rough River prior to the 1990s (Butler 2005, p. 41). A single fresh dead specimen collected in 1993 is the only known record of the rabbitsfoot in the Rough River (Gordon and Sherman 1995, Appendix A). This single specimen suggests a marginal and nonviable population (Butler 2005, p. 41).

Wabash River: The Wabash River is the largest northern tributary of the Ohio River. It originates in west–central Ohio, flows across Indiana, and then forms the boundary between southwestern Indiana and southeastern Illinois. The rabbitsfoot was once widespread throughout the Wabash River prior to the 1960s (Cummings and Mayer 1997, p. 137). Surveys conducted from the 1960s through 2004 yielded a single live rabbitsfoot specimen and a few relicts (Cummings *et al.* 1992, p. 3; Butler 2005, p. 42). Fisher (2006, p. 107) considered the rabbitsfoot ''functionally extirpated (in the Wabash River) and restricted to the tributaries.''

Eel River: The Eel River is a northern tributary of the Wabash River in north-central Indiana. Historical records from the Eel River prior to 1997 are sparse (Henschen 1987 *in* Butler 2005, p. 43), but rabbitsfoot was considered common by Daniels (1903, p. 651). Collections since 1997 are limited to nine live rabbitsfoot specimens found at sites in Miami and Cass Counties, Indiana (Butler 2005, p. 43). The rabbitsfoot is no longer considered common in the Eel River, restricted to less than 32 rkm (20 rmi) of the lower main stem, and is now categorized as marginal (Butler 2005, p. 43).

Tippecanoe River: The Tippecanoe River flows across north-central Indiana until reaching its confluence with the Wabash River. Daniels (1903, p. 651) considered the rabbitsfoot to be common in the Tippecanoe River. Surveys conducted between 1987 and 2001 yielded numerous live rabbitsfoot specimens at numerous sites (Cummings and Berlocher 1990, pp. 84–87; Ecological Specialists, Inc. 1993, pp. 47–50, 55–67, 84). Survey efforts over the past decade continue to produce similar results (EnviroScience, Inc. 2005, p. 35; Ecological Specialists, Inc. 2003, p. 9–15; Fisher 2008 and 2009, pers. comm.). The rabbitsfoot population is sizable, stable and viable in the Tippecanoe River, but at disjunct localities within the lower two–thirds of the river in Fulton, Pulaski, White, Carroll, and Tippecanoe Counties (Butler 2005, p. 45).

North Fork Vermilion River: The North Fork Vermilion River flows south out of western Indiana into eastern Illinois until reaching its confluence with the Wabash River. Through 45 years of collection history, four sites in an approximately 10-rkm (6-rmi) reach have produced rabbitsfoot records. Since 1980, researchers have documented 28 live and 6 fresh dead rabbitsfoot specimens (Illinois Natural History Survey (INHS) museum records; Cummings *et al.* 1998, p. 99). Cummings *et al.* (1998, p. 92) considered the North Fork to have ''perhaps the last reproducing population of the rabbitsfoot in the state [Illinois].'' The North Fork Vermilion River is considered a small metapopulation with the Middle Branch North Fork Vermilion River population (Butler 2005, p. 47).

Middle Branch North Fork Vermilion River: The Middle Branch North Fork Vermilion River is a tributary of the North Fork Vermilion River. Headwaters of the Middle Branch drain northwestern Warren County, Indiana, and northeastern Vermilion County, Illinois. The rabbitsfoot was discovered in the lowermost reach of the Middle Branch North Fork Vermilion River in 1998 (Butler 2005, p. 47). Since that time, a few live and fresh dead rabbitsfoot specimens are known from two sites sampled in 2000 and 2002. The population is very small and apparently contiguous with the rabbitsfoot population occurring in the North Fork Vermilion River (Butler 2005, p. 47).

Cumberland River Basin

The Cumberland River is a large southern tributary of the Ohio River. Historically, the rabbitsfoot was known from the main stem and 12 tributaries. Most records for the species were prior to 1950. Parmalee *et al.* (1980, pp. 93–95) found shells of the rabbitsfoot in shellers cull and stock piles in 1977, 1978, and 1979. Rabbitsfoot was considered rare at the time, comprising less than one percent of 1,000 specimens. No more recent records exist for the main stem. Recent collections suggest populations may still exist in only two tributaries of the Cumberland River, an 85 percent decline of stream populations. The East Fork Stones and Red Rivers are the only tributaries with extant populations, and their continued survival is tenuous.

East Fork Stones River: The East Fork Stones River is one of two major headwater tributaries, the other being the West Fork Stones River, which converge to form the Stones River. Researchers sampled numerous pre-impoundment sites from 1964 to 1967 on the East Fork Stones River, reporting rabbitsfoot from two sites but never more than three live specimens per site (Butler 2005, p. 49). Schmidt *et al.* (1989, pp. 56–59) sampled 23 East Fork Stones River sites during 1980 to 1981 and reported the rabbitsfoot to be ''rare'' at two lower sites. Sampling in 2002 at these two sites produced a single fresh dead specimen (Butler 2005, p. 48). The rabbitsfoot in the East Fork Stones River is considered very rare and declining;

thus it is categorized as marginal (Butler 2005, p. 49).

Red River: The Red River is a large tributary of the lower Cumberland River that drains southwestern Kentucky and northwestern Tennessee. Despite its size, no thorough survey of the stream has ever been attempted, although there are intermittent sampling dates to the 1960s. Records indicate that a small population of the rabbitsfoot existed from a few sites on the main stem in Logan County, Kentucky, and Robertson County, Tennessee. From 1988 to 1990, the rabbitsfoot has been found live and fresh dead at five sites in Kentucky (Butler 2005, p. 49). Subsequent sampling efforts in Kentucky have yielded no additional specimens. In 1990 and 1992, the Aquatic Resources Center (ARC) (1993, p. 1 and Appendix 1) qualitatively surveyed a reach of the Red River in Tennessee and collected a total of four live rabbitsfoot (relative abundance of 2.1 and 1.3 percent, respectively). The Red River rabbitsfoot population is categorized as marginal due to its small size, distribution and doubtful viability (Butler 2005, p. 50).

Tennessee River Basin

The Tennessee River is the largest tributary of the Ohio River. Historically the rabbitsfoot was known from the entire length of the Tennessee River and 17 of its tributaries. Today, it is known only from five streams in the Tennessee River basin, a 71 percent reduction in stream populations. Almost the entire length of the 1,046-rkm (650-rmi) Tennessee River main stem has been impounded beginning in 1925, destroying hundreds of km of riverine habitat for the rabbitsfoot. Extant rabbitsfoot populations persist in the two lowermost tail waters of the Tennessee River, Duck River, Paint Rock River, Elk River, and Bear Creek.

Tennessee River: The Tennessee River is formed from the confluence of the Holston and French Broad Rivers near Knoxville, Tennessee. Historically, the rabbitsfoot was found throughout the length of the Tennessee River (Ortmann 1925, p. 337). Today, extant populations only occur in the two lowermost tail waters, downstream of Pickwick Landing Dam and Kentucky Dam (Hubbs 2008, pers. comm.).

Over 20 live rabbitsfoot specimens were located along the marginal shelf of the Pickwick Lake tail waters in 1991 (Butler 2005, p. 51). From 1993 to 2000, live and fresh dead rabbitsfoot specimens were found at Tennessee River km 316.7 (mile 196.8, Diamond Island) and km 321.9 (mile 200). Fresh dead rabbitsfoot specimens aged at less than 10 years have been found in this same general reach of river as late as 2003 (Butler 2005, p. 124). This portion of the rabbitsfoot population exhibited recruitment in the 1990s (Hubbs 2010, pers. comm.).

Downstream of Kentucky Lake Dam, the rabbitsfoot has been found live and fresh dead at several sites in low numbers from 1985 to 2005 (Butler 2005, p. 52). In 1999, a 3.0-cm (1.2-inch) fresh dead rabbitsfoot juvenile was found at Tennessee River km 28.2 (mile 17.5) (Butler 2005, p. 52). In 2011, surveyors found greater than 80 live rabbitsfoot from Kentucky Lake Dam to the confluence with the Ohio River. Rabbitsfoot were found to occur most frequently in a narrow band of transitional substrate from clay and silt to sand and gravel along the toe of descending banks. Although not considered common, there were a few locations at which rabbitsfoot occurred in greater numbers (Koch 2012, pers. comm.). This population is likely contiguous with the population in the lower Ohio River, although the rabbitsfoot appears to be concentrated from Tennessee River km 16 to 32 (mile 10 to 20) (Butler 2005, p. 52). The Tennessee River rabbitsfoot population is considered sizable and viable (Butler 2005, pp. 89–90).

Paint Rock River: The Paint Rock River is a northern Alabama tributary of the Tennessee River. Historically, the three headwater tributaries, Estill and Larkin Forks and Hurricane Creek, of the Paint Rock River had metapopulations of rabbitsfoot. Live rabbitsfoot specimens were collected at three of five Paint Rock River sites in 1965 and 1967 (Isom and Yokley 1973, pp. 444–445). In 1980, only two live rabbitsfoot specimens were found in the middle reaches of the river during the first comprehensive survey (18 sites; Ahlstedt 1991a, p. 168). Ahlstedt (1995–96a, pp. 69–73) sampled 18 sites in 1991 and reported good numbers of rabbitsfoot. He collected 35 live rabbitsfoot specimens at 8 of 18 main stem sites. Seven tributary sites also were sampled, but no rabbitsfoot were found in tributaries.

During more recent sampling efforts in 1995 and 2002, three fresh dead and nine relict shells were found at a main stem site and a single live specimen upstream of the Larkin Fork confluence, respectively (McGregor and Shelton 1995, Appendix A; Godwin 2002, pp. 10–11, 22–23). In 2004, two live and some fresh dead rabbitsfoot specimens were found at a site on the lower main stem (Butler 2005, p. 54). An intensive survey (42 main stem and 5 Estill Fork sites) in 2008 found 218 live and fresh dead rabbitsfoot at 19 sites. Rabbitsfoot was the second most abundant species (Fobian *et al.* 2008, pp. 6–37). This population is categorized as sizeable and viable (Butler 2005, pp. 89–90).

Elk River: The Elk River is a tributary of the Tennessee River draining portions of south-central Tennessee to north-central Alabama. From 1965 to 1967, Isom *et al.* (1973, pp. 438–440) found the rabbitsfoot at three locations on the Elk River. Survey efforts on Elk River tributaries, Sugar and Richland Creek, did not yield any rabbitsfoot. In 1980, Ahlstedt (1983, pp. 44–45) found 10 live rabbitsfoot specimens at 6 of 108 sites in the Elk River, Lincoln County, Tennessee (Ahlstedt 1983, pp. 46–49). Two live rabbitsfoot specimens were found at approximately Elk River km 122 (mile 76) in 1999 (Service 1999, p. 6). Tennessee Valley Authority conducted a survey in 2006 and found three live individuals, one objectively aged at 6 or 7 years (Chance 2008, pers. comm.). This population is categorized as marginal (Butler 2005, pp. 89–90).

Bear Creek: Bear Creek is a southern tributary of the Tennessee River in northwestern Alabama and northeastern Mississippi. Historical records indicate rabbitsfoot occurred in 72 rkm (45 rmi; Ortmann 1925, p. 337; Butler 2005, pp. 56–57). In 1977, three live rabbitsfoot specimens were found at approximately Bear Creek km 90 (rmi 56) in Alabama (Butler 2005, p. 56). A 1991 record of a single fresh dead specimen is known from approximately Bear Creek km 40 (mile 25) in Colbert County, Alabama. McGregor and Garner (2004, p. 64) conducted the only comprehensive survey of the system from 1996 to 2001 and found rabbitsfoot live or fresh dead at two sites. It occurred on the main stem in the immediate vicinity of the Natchez Trace Parkway of the National Park Service (NPS) system in Colbert County, Alabama (Bear Creek km 39.4 and 40.9; mile 24.5 and 25.4). In Mississippi, one live and eight fresh dead specimens were found in a four-rkm (2.5-rmi) reach in 2002 and 2005 (Jones 2011, pers. comm.). Bear Creek is categorized as a small population (Butler 2005, pp. 89–90).

Duck River: The Duck River is a large tributary of the lower Tennessee River in central Tennessee. Ortmann (1924, pp. 24–33) documented the presence of rabbitsfoot in the early 1920s, considering it ''all over the interior region (and elsewhere).'' Surveys conducted between 1965 and 1979 found similar results (Isom and Yokley 1968, p. 36; Ahlstedt 1981, p. 62; Ahlstedt 1991, pp. 142–147).

Using stratified random sampling, Barr *et al.* (1993–94, p. 205) in 1981 estimated that 591 live rabbitsfoot occurred at Lillards Mill. Twenty rabbitsfoot were collected from Lillards Mill and translocated to a site in Bedford County in 1988 (Layzer and Gordon 1993, pp. 89–91). Resampling the Bedford County site in 2002, evidence of recruitment was noted by Ahlstedt *et al.* (2004, p. 101). Madison *et al.* (1999, Table 1) reported 34 live rabbitsfoot specimens from a Maury County site in 1998.

Ahlstedt *et al.* (2004, p. 101) conducted an extensive mussel survey in the system beginning in 2000. They reported 403 live and fresh dead rabbitsfoot specimens from 31 of 78 sites sampled (a few sites were sampled more than once). An average of 13 live or fresh dead rabbitsfoot specimens was found per site of occurrence. The rabbitsfoot population on the Duck River is primarily located between rkm 209 to 288 (miles 179 to 130), and scattered in the lower river (rkm 60 to 61; rmi 37 to 38; Hickman County) (Hubbs 1995, p. 46; Schilling and Williams 2002, p. 409; Butler 2005, p. 59). The extant rabbitsfoot population extends over at least 274 rkm (170 rmi; approximately Duck River km 60 to 333, mile 37 to 207) and ''* * * represents one of the best known populations rangewide'' (Ahlstedt *et al.* (2004, p. 101).

Lower Mississippi River Subbasin

The rabbitsfoot is known from five streams within the lower Mississippi River subbasin (excluding the White, Arkansas, and Red River systems). The five streams include St. Francis River, Big Creek, Yazoo River, Big Sunflower River, and Big Black River. Rabbitsfoot is extirpated from Big Creek and the Yazoo River (Butler 2005, p. 61).

St. Francis River: The St. Francis River is a tributary of the Mississippi River draining portions of southeastern Missouri and northeastern Arkansas. In the 1800s the rabbitsfoot was considered abundant in the St. Francis River (Call 1895, p. 15). Extant rabbitsfoot records are from the upper part of the river in Butler and Wayne Counties, Missouri (Butler 2005, p. 61). Hutson and Barnhart (2004, pp. 84, 109) in 2002 found 16 live rabbitsfoot specimens at 3 sites upstream of Lake Wappapello, Missouri; including 11 at rkm 277.0 (rmi 172.1), 3 at rkm 294.5 (rmi 183.0), and 2 at rkm 306.6 (rmi 190.5). At rkm 277.0 (rmi 172.1), 35 live rabbitsfoot specimens were found in the 1970s, but only 8 and 11 live specimens were found in 2001 and 2002, respectively. In 2005, seven live rabbitsfoot specimens were sampled at a site in the same reach (Butler 2005, p. 62). With the exception of Call's description, no rabbitsfoot have been found in the St. Francis River, Arkansas (Butler 2005, p. 61). The rabbitsfoot is rare in the St. Francis River, may be at risk from extirpation (Hutson and Barnhart 2004, p. 84), and is categorized as a small population (Butler 2005, pp. 89–90).

Big Sunflower River: A major tributary of the Yazoo River, the Big Sunflower River drains a large portion of the Mississippi Delta in west-central Mississippi. The rabbitsfoot was first reported in 1969 from the lower portion of the river (Florida Museum of Natural History, museum lot # 233299). Currently, rabbitsfoot occurs in a 32-rkm (20-rmi) reach upstream of the Quiver River confluence in Sunflower County. From 2000 to 2010, live and fresh dead rabbitsfoot specimens were collected at Blaine Road west of Blaine, Mississippi, downstream to near the Quiver River confluence (Jones 2011, pers. comm.). Butler (2005, pp. 89–90) categorized this population as small.

Big Black River: The Big Black River is a tributary to the lower Mississippi draining central and southwestern Mississippi. Hartfield and Rummel (1985, pp. 117–119) sampled the lower three-quarters of this 426-rkm (265-rmi) long river. The rabbitsfoot is restricted to a small portion of the lower river cutting through the Loess Hills physiographic division where mussels were generally found in gravel riffles and runs. At that time, 19 dead rabbitsfoot specimens were recorded at nine sites in Hinds and Warren Counties (Butler 2005, p. 64). The only other record is for a dead specimen located in 2000. Rabbitsfoot is still considered extant in this reach (Jones 2011, pers. comm.), and the population is categorized as small.

White River Basin

Historically, 13 rivers within the White River system harbored rabbitsfoot populations. Extant populations occur in 9 of 13 (69 percent) rivers in the basin. Further, no other major river basin has as many sizeable populations. At one time, the main stem of White River and 11 of its tributaries had a large metapopulation of rabbitsfoot (Butler 2005, p. 65). Three of the streams may still contain a metapopulation (Black, Spring, and Strawberry Rivers). Unfortunately, many of the tributaries appear to have declining populations (Buffalo, Black, Current, Spring, and South Fork Spring Rivers).

White River: The White River is a large western tributary of the Mississippi River. The rabbitsfoot population once extended throughout most of the 1,110-rkm (690-rmi) length of the White River and site records date back to circa 1910, but now it is restricted to the lower reaches downstream of Batesville, Independence County, Arkansas (Harris *et al.* 2009, p. 73). Historical abundance data are scarce. However, records indicate that the population was large (Butler 2005, p. 65).

From the 1980s to late 2000s, numerous live and fresh dead rabbitsfoot specimens have been found at numerous sites in two disjunct reaches of the White River (rkm 319 and 410; rmi 198 and 255 and rkm 92 to 146; rmi 57 to 91) (Bates and Dennis 1983, p. 42; AGFC Mussel Database 2011). In 1992, Christian (1995, pp. 146–197) estimated the total rabbitsfoot population from 13 sites on the lower White River at 928 individuals. The rabbitsfoot population is categorized as sizable, but remains extant in two disjunct reaches separated by approximately 161 rkm (100 rmi). The uppermost reach extends from the Batesville Dam at Batesville, Independence County, Arkansas, downstream to the Little Red River confluence north of Georgetown, White and Woodruff Counties, Arkansas. The lowermost reach extends from U.S. Highway 79 at Clarendon, Monroe County, Arkansas, downstream to Arkansas Highway 1 near St. Charles, Arkansas County, Arkansas (Butler 2005, p. 66; AGFC mussel database 2011).

War Eagle Creek: War Eagle Creek is a small, eastern White River tributary located in northwest Arkansas. Rabbitsfoot was not documented in War Eagle Creek until 1974. Since 1979, one live specimen was collected in 1981, and two fresh dead were found in 2004 (AGFC mussel database 2011). Little is known about the viability of this population. Therefore, it has been categorized as marginal (Butler 2005, pp. 89–90).

Buffalo River: The Buffalo River is a western White River tributary in north-central Arkansas. Rabbitsfoot was first documented in the Buffalo River in 1910 by Meek and Clark (1912, pp. 7–20). They reported rabbitsfoot as ''common'' at 11 of 26 sites; almost all specimens were located within the lower 40 rkm (25 rmi) within Searcy County, Arkansas. Two comprehensive surveys of the Buffalo River mussel fauna in 1995 and 2004 to 2005 found live rabbitsfoot specimens concentrated between Arkansas Highway 7 in Newton County to near the Cedar Creek confluence downstream of Rush, Arkansas (Harris 1996, p. 12; Matthews *et al.* 2009, pp. 116 and 122). NPS staff collected four live rabbitsfoot in 2008 from a site near the Cedar Creek confluence near Rush, Arkansas (Hodges 2011, pers. comm.). During a 2011 survey of this same site, changes in channel geomorphology caused by 2009 and 2011 flooding resulted in the entire site being covered with sand. Few live mussels were encountered, but one live rabbitsfoot was found and relocated to more suitable habitat downstream. While no live rabbitsfoot were encountered at the downstream relocation site, 2 fresh dead and 23 weathered rabbitsfoot shells were found at this site. Two live rabbitsfoot also were collected in 2011 at two sites located between Arkansas Highway 7 and U.S. Highway 65. The Buffalo River population is small and very susceptible to extirpation based on recent surveys (Davidson 2011, pers. comm.).

Black River: The Black River is the largest White River tributary draining southeastern Missouri and northeastern Arkansas. Based on data from the 1970s and 1980s, the rabbitsfoot was abundant at some Arkansas sites in the lower main stem between the confluences of the Current and Strawberry Rivers (approximately 121 rkm, 75 rmi; Ohio State University Museum of Biological Diversity (OSUM) museum lot #s 47673 and 47933; Miller and Hartfield 1986, pp. 8–9). In 1992, Rust (1993, Appendix 1.1) surveyed 48 sites in the Black River, finding rabbitsfoot live at 4 sites, and a combined population estimate of 1,503 individuals, between rkm 105 to 124 (rmi 65 to 77). A 2000 to 2003 survey at 51 sites in Missouri did not locate any rabbitsfoot (Hutson and Barnhart 2004, pp. 162–169). In 2005, AGFC collected 25 live rabbitsfoot specimens from a site located approximately two rkm (1 rmi) upstream of U.S. Highway 63 at Black Rock, Arkansas (AGFC Mussel Database 2011). The Black River population is considered one of the largest remaining range-wide (Butler 2005, pp. 89–90).

Current River: The Current River is a Black River tributary draining southeastern Missouri and northeastern Arkansas. The rabbitsfoot is known only from the Arkansas portion of the stream. Few records exist for the species in the Current River, including several live and dead specimens in 1983–1984 and 1994 (AGFC mussel database). The rabbitsfoot population in the Current River is categorized as marginal.

Spring River: The Spring River is a Black River tributary draining south-central Missouri and northeastern Arkansas. Based on pre-1986 records, the rabbitsfoot was once known from at least 14 sites in the 80-rkm (50-rmi) reach downstream of the South Fork Spring River confluence (Harris *et al.* 1997, pp. 80–82). Records from the 1980s also indicate that the rabbitsfoot was ''relatively common'' (Miller and Hartfield 1986, pp. 9–10; Harris and Gordon 1987, p. 54; ANSP 359907). A survey upstream of the South Fork Spring River confluence in 1985 did not find any rabbitsfoot (Miller and Hartsfield 1986, p. 9). In 1991, Rust (1993, Appendices 1.2 and 1.4) estimated rabbitsfoot relative abundance at 1.9 to 4.0 percent at 5 of 6 sites and total population size at 563 individuals at 3 of these sites. Sixty-eight live rabbitsfoot were collected in the river reach from near Ravenden to Imboden, Arkansas, during 2004 to 2005 (Harris *et al.* 2007, p. 16). The rabbitsfoot population appears to be recruiting, but the numbers of individuals are decreasing from the high numbers found in the mid-1980s (Butler 2005, p. 72). For this reason, the Spring River is categorized as a small rabbitsfoot population.

South Fork Spring River: The South Fork Spring River is a Spring River tributary draining portions of Howell County, Missouri, and Fulton and Sharp Counties, Arkansas. The rabbitsfoot was discovered in the South Fork Spring River in 2002 in central Fulton County, Arkansas (Butler 2005, p. 72). Judging from the number of fresh dead and relict shells found, it appears to have been the dominant species at this site, although no live mussels were located (Butler 2005, pp. 72–73). In 2006, a qualitative survey to assess mussel communities at 35 sites in the South Fork Spring River did not yield any rabbitsfoot (Martin *et al.* 2009, pp. 106–107). However, one live rabbitsfoot specimen was located on the river a week later, representing the only live specimen ever collected from the river (AGFC mussel database 2011). Based on limited information collected over the past decade on the rabbitsfoot status in the South Fork Spring River, this population is categorized as small.

Strawberry River: The Strawberry River is a Black River tributary draining portions of northeastern Arkansas. The most upstream record of live rabbitsfoot in the Strawberry River was collected 2.9 rkm (1.8 rmi) upstream of Hars Creek southeast of Franklin, Arkansas, in 1998 (AGFC Mussel Database 2011). From 1983 to 2006, 84 live rabbitsfoot specimens, including some juveniles, have been collected from 14 sites extending from the most upstream record downstream through Sharp and Lawrence counties (greater than 80 rkm or 50 rmi) (Rust 1993, p. 30; Harris *et al.* 2007, pp. 23–27; INHS 27526). The Strawberry River rabbitsfoot population is categorized as sizable.

Middle Fork Little Red River: The Middle Fork Little Red River is a headwater tributary of the Little Red River in north-central Arkansas. Rabbitsfoot was first discovered in the Middle Fork in 1991 with a single specimen from 26 sites (Harris 1992, p. 64). The Middle Fork Little Red River has been extensively surveyed during the past decade. Winterringer (2003, p. 46 and Appendix F) found 28 live rabbitsfoot specimens, including 2 juveniles, at 2 sites sampled in 2001 downstream of Little Tick Creek. The AGFC and Service collected seven live rabbitsfoot, including one juvenile, from two sites in this same reach in 2009 (Davidson 2011, pers. comm.). The rabbitsfoot population is categorized as small.

Arkansas River Basin

The rabbitsfoot distribution in the Arkansas River system is restricted to tributaries draining the western fringe of the Ozark Plateaus and adjacent Central Lowlands physiographic provinces located to the west. The rabbitsfoot range in the system includes east-central and southeastern Kansas, northeastern Oklahoma, extreme northwestern Arkansas, and extreme southwestern Missouri. Rabbitsfoot was once distributed throughout hundreds of km (miles) of streams in the basin, with populations in the Fall and Cottonwood Rivers and Center and Shoal Creeks now extirpated (50 percent reduction in stream populations). Scammon (1906, pp. 348–349) described rabbitsfoot as ''seeming to be nowhere abundant, it is not a rare species in [the Spring, Neosho, and Verdigris Rivers].'' Rabbitsfoot is now confined to reduced portions of the Verdigris, Neosho, Spring, and Illinois Rivers.

Neosho River: The Neosho River is a large northern tributary to the Arkansas River in eastern Kansas and northeastern Oklahoma. Historical evidence indicates rabbitsfoot was present in almost the entire 740-rkm (460-rmi) main stem of the Neosho River (Butler 2005, p. 75). Live rabbitsfoot specimens, including some juveniles, have been collected in a 12.8-rkm (8-rmi) reach from near Iola to Humboldt, Allen County, Kansas, from 1994 to 1999 (Obermeyer *et al.* 1995, pp. 31–32; Mulhern *et al.* 2002, p. 243; Butler 2005, p. 76). Relict shells were collected at 8 of 21 additional main stem sites from 1993 to 1995 (Obermeyer *et al.* 1995, p. 63). The rabbitsfoot is thought to be extirpated from the Oklahoma portion and remaining stretches in Kansas. The extant population in Kansas is categorized as small.

Spring River: The Spring River is a Neosho River tributary draining portions of southwest Missouri, southeast Kansas, and northeast

Oklahoma. Rabbitsfoot is extant in the Spring River from Missouri Highway 96 in Carthage, Jasper County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas. Six live rabbitsfoot specimens were collected from four Missouri sites in the early 1990's and 2006 (Obermeyer *et al.* 1995, p. 48; Missouri Natural Heritage Database 2011). In 2003, a Kansas site (known as the Pierce Site) located approximately 0.5 to 0.8 rkm (0.3 to 0.5 rmi) yielded 10 live rabbitsfoot, including 7 gravid females (Miller 2011). In 2006, KDWP collected eight live rabbitsfoot specimens from one 30 m^2 quadrat sample (1.9 percent of live mussels collected) at a site just upstream of Kansas and Missouri Highway YY. This rabbitsfoot population is categorized as small.

Illinois River: The Illinois River is an Arkansas River tributary draining portions of northwest Arkansas and northeast Oklahoma. Gordon *et al.* (1979, p. 35) surveyed 11 sites in Arkansas in the 1970s and found only a single shell. In 1994, Harris (1998, p. 4) found 34 live rabbitsfoot specimens at 7 of 22 sites in a 48-rkm (30-rmi) reach in Washington and Benton counties, Arkansas. In 1995, Vaughn (1997, pp. 28–30) surveyed 45 sites in Oklahoma and found live rabbitsfoot at 2 sites. A 2008 survey in Benton and Washington Counties found 10 live rabbitsfoot at 2 of 15 sites extending from just upstream of Muddy Fork to the Arkansas Highway 59 Bridge (Davidson 2011, pers. comm.). This population is categorized as marginal.

Verdigris River: The Verdigris River is an Arkansas River tributary draining portions of Kansas and Oklahoma. Rabbitsfoot is extant in a short reach from Oologah Lake dam north of Claremore, Oklahoma, downstream to Interstate 44 (Will Rogers Turnpike) west of Catoosa, Rogers County, Oklahoma. Numerous live rabbitsfoot specimens were collected at three sites clustered upstream and downstream of Oklahoma Highway 20 west of Claremore, Oklahoma, in 2006 and 2007 (Boeckman 2008, pers. comm.). Rabbitsfoot has been extirpated from reaches of the Verdigris River upstream of Oologah Lake in Kansas and Oklahoma. This population is categorized as marginal due to its restricted distribution.

Red River Basin

Streams within the Red River basin primarily drain the Ouachita Mountains in southeastern Oklahoma and southwestern Arkansas, but extant populations still occur in three stream reaches within the Gulf Coastal Plain ecoregion in southern Arkansas and northern Louisiana. The rabbitsfoot is extant in 7 of 11 historical streams (64 percent) within the Red River basin.

Little River: The Little River is a Red River tributary draining portions of southeastern Oklahoma and southwestern Arkansas. Isley (1924, p. 57) discovered one specimen in 1910. In 1983, six live individuals were located in Sevier County, Arkansas (AGFC mussel database 2011). Vaughn and Taylor (1999, p. 920) collected live rabbitsfoot specimens at six sites in the Little River located downstream of the Glover River confluence. Its ''abundance,'' defined as the number of mussels found per hour spent searching, ranged from 0.6 to 8.0 at these sites. In 2002, survey work occurred in the lowermost section, downstream of Millwood Reservoir, and no rabbitsfoot were located at any of the 14 sites surveyed (Farris *et al.* 2003, Appendix A). From 2006 to 2008, the AGFC and Service collected 89 live rabbitsfoot specimens from 13 Little River sites extending from near the Arkansas and Oklahoma state line to near U.S. Highway 71 north of Ashdown, Arkansas (AGFC Mussel Database, 2011). The rabbitsfoot population is sizeable and considered viable in this reach of the Little River (Davidson 2011, pers. comm.).

Glover River: The Glover River is a Little River tributary draining portions of southeastern Oklahoma. Museum records indicate a healthy population of rabbitsfoot once occupied a 48-rkm (30-rmi) reach of the river (Butler 2005, p. 82). An unspecified number of specimens were located in a 1993 to 1995 survey (Vaughn 2000, pp. 229). In 1996, researchers systematically surveyed 22 sites, and rabbitsfoot relative abundance was 0.7 and 3.0 percent at 2 sites (Vaughn 2003, p. 3). The Glover River appears to support a marginal population of rabbitsfoot that is greatly diminished from historical accounts (Vaughn 2003, p. 1).

Cossatot River: The Cossatot River is a Little River tributary draining portions of southwestern Arkansas. Few mussel collections have been made in the Cossatot River. Rabbitsfoot was first collected in 1970, with evidence of population recruitment (Butler 2005, p. 83). Twelve specimens were found in 1983 at a site in Sevier County, Arkansas (AGFC mussel database 2011). In 2004, four live specimens were found at one site (AGFC mussel database 2011). Viability of the population is doubtful, based on its small size and isolated location, and the population is categorized as marginal. However, no comprehensive survey data for the river exists (Butler 2005, p. 83).

Ouachita River: The Ouachita River is the largest tributary of the Red River, draining a large portion of southern Arkansas and eastern Louisiana. Wheeler (1918, pp. 122–123) observed rabbitsfoot in the Ouachita River and declared it ''in nearly every mussel bed of the river.'' Call (1895, p. 15) also considered the rabbitsfoot ''abundant.'' The rabbitsfoot is extant in a short reach (two sites) of the Ouachita River from Arkansas Highway 379 south of Oden, Montgomery County, Arkansas, downstream to Arkansas Highway 298 east of Pencil Bluff, Montgomery County, Arkansas (AGFC Mussel Database, 2011). Three reservoirs (Lakes Ouachita, Hamilton, and Catherine) separate the headwaters in the Ouachita Mountains from the Gulf Coastal Plain reaches in southern Arkansas and Louisiana.

Researchers collected 38 live specimens from 1992 to 2005 at 8 sites in Clark, Hot Spring, and Ouachita Counties, Arkansas (Posey 1997, Appendix 1.3; Butler 2005, p. 84, Harris 2006, Appendix 1e—1i; AGFC Mussel Database, 2011). Posey (1997, Appendix 1.3) estimated the rabbitsfoot population at 1,456 individuals in the Ouachita River from rkm 547 to 563 (rmi 340 to 350). Rabbitsfoot has not been observed in the Louisiana reach of the Ouachita River in over 100 years (Butler 2005, p. 84). The Ouachita River population is categorized as small due to its greatly diminished distribution and limited evidence of recent recruitment.

Little Missouri River: The Little Missouri River originates in the Ouachita Mountains and flows southeast to the Ouachita River in southwest Arkansas. The rabbitsfoot is known from a single collection in 1996 in the lower main stem in Clark County, Arkansas (Davidson 1997, pp. 46 and 130). The Little Missouri population likely is a metapopulation with the Ouachita River population and is categorized as marginal (Butler 2005, p. 85).

Saline River: The Saline River flows southward through south-central Arkansas before converging with the Ouachita River at Felsenthal National Wildlife Refuge (NWR) north of the Arkansas and Louisiana State line. Call (1895, p. 15) considered the rabbitsfoot ''abundant'' in the Saline River. Two fresh dead and one live specimen were documented in 1993 and 2006, respectively, in Grant County (AGFC Mussel database 2011). Davidson (1997) surveyed the Saline River from the northern boundary of Felsenthal NWR to its confluence with the Ouachita

River and was unable to locate any live rabbitsfoot. Davidson and Clem (2002, p. 17; 2004, p. 16) collected 26 live rabbitsfoot specimens from 13 of 230 sites from near Tull, Arkansas, to the northern boundary of Felsenthal NWR. Rabbitsfoot comprised 0.2 percent of the total mussel community. In 2005, Harris (2006, Appendix 1b–1d) quantitatively sampled three of the sites sampled by Davidson and Clem in 2004. He collected 24 live rabbitsfoot, representing 0.1 to 0.8 percent of the total mussel community per site. These sites were resampled in 2011 and four live rabbitsfoot were collected, representing zero to 0.1 percent of the total mussel community (Davidson 2012, pers. comm.). In 2011, the AGFC and Service collected 33 live rabbitsfoot, representing 0.1 to 0.3 percent of the total mussel community. Numerous dead rabbitsfoot were observed near the shoreline, apparently having succumbed to desiccation caused by severe drought conditions (Davidson 2012, pers. comm.). The rabbitsfoot population is categorized as small due to its ''patchy'' distribution, but there is evidence of recent recruitment (Davidson and Clem 2004, p. 16; Davidson 2011, pers. comm.).

Bayou Bartholomew: Bayou Bartholomew originates in southeast Arkansas and flows south into Louisiana before converging with the Ouachita River. The first record of rabbitsfoot in Bayou Bartholomew is from 1992 in Louisiana (Butler 2005, p. 87). One live specimen was found in Louisiana between 2000 and 2001 (Alley 2005, p. 75). From 2004 to 2005, two sites yielded five live and six dead specimens. A 2004 survey at 50 sites in the Arkansas portion of Bayou Bartholomew did not yield any live, dead, or relict rabbitsfoot specimens (Brooks *et al.* 2008, pp. 9–10). All records since 2000 are from three sites in Louisiana, two in the middle Louisiana reach and one near the Arkansas state line (Butler 2005, p. 87). This population is categorized as marginal.

Summary of Rabbitsfoot Rangewide Population Status

Based on historical and current data, the rabbitsfoot is declining rangewide. In ten of the 15 States comprising the rabbitsfoot's historical range, the species is considered by State law to be endangered (Illinois, Indiana, Kansas, Mississippi, Ohio, and Pennsylvania); threatened (Kentucky and Tennessee); of special concern (Arkansas); or it is assigned an uncategorized conservation status (Alabama). The American Malacological Union and American Fisheries Society also consider the rabbitsfoot to be threatened (*in* Butler 2005, p. 21). It is presently extant in 51 of the 140 streams of historical occurrence, a 64 percent decline. Further, in the streams where it is extant, populations with few exceptions are highly fragmented and restricted to short reaches. In addition, the species has been extirpated from West Virginia and Georgia. The extirpation of this species from numerous streams and stream reaches within its historical range signifies that substantial population losses have regularly occurred in each of the past several decades. Seventeen streams (33 percent of extant populations or 12 percent of historical populations) have small populations with limited levels of recruitment and are generally highly restricted in distribution, making their viability unlikely and making them extremely susceptible to extirpation in the near future. In addition, 15 of those 17 streams (88 percent) have populations that are declining. In many of these streams, rabbitsfoot is only known from one or two documented individuals in the past decade. Its viability in these streams is doubtful and additional extirpations may occur if this downward population trend is not eliminated. Eleven populations located in historical streams (22 percent of extant populations or 8 percent of historical populations; Ohio, Green, Tippecanoe, Tennessee, Paint Rock, Duck, White, Black, Strawberry, and Little Rivers and French Creek) are considered viable (Butler 2005, p. 88; Service 2010, p. 16). Given this compilation of current distribution, abundance, and status trend information, the rabbitsfoot exhibits range reductions and population declines throughout its range.

Summary of Factors Affecting the Species

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations at 50 CFR part 424 set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, we may list a species based on any of the following five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination. Each of these factors is discussed below.

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

The habitats of freshwater mussels are vulnerable to water quality degradation and habitat modification from a number of activities associated with modern civilization. The decline, extirpation, and extinction of mussel species are often attributed to habitat alteration and destruction (Neves *et al.* 1997, pp. 51–52). Bogan (1993, pp. 599–600 and 603–605) linked the decline and extinction of mussels to a wide variety of threats including siltation, industrial and municipal effluents, modification of stream channels, impoundments, pesticides, heavy metals, invasive species, and the loss of host fish. Chief among the causes of decline in distribution and abundance of the Neosho mucket and rabbitsfoot, and in no particular order of ranking, are impoundment, channelization, sedimentation, chemical contaminants, mining, and oil and natural gas development (Mather 1990, pp. 18–19; Obermeyer *et al.* 1997b, pp. 113–115; Neves *et al.* 1997, pp. 63–72; Davidson 2011, pers. comm.). Neosho mucket and rabbitsfoot are both found within medium to large river drainages exposed to a variety of landscape uses. These threats to mussels in general (and Neosho mucket and rabbitsfoot where specifically known) are individually discussed below.

Impoundments

Dams eliminate and alter river flow within impounded areas, trap silt leading to increased sediment deposition, alter water quality, change hydrology and channel geomorphology, decrease habitat heterogeneity, affect normal flood patterns, and block upstream and downstream movement of mussels and fish (Layzer *et al.* 1993, pp. 68–69; Neves *et al.* 1997, pp. 63–64; Watters 2000, pp. 261–264). Within impounded waters, decline of mussels has been attributed to direct loss of supporting habitat, sedimentation, decreased dissolved oxygen, temperature levels, and alteration in resident fish populations (Neves *et al.* 1997, pp. 63–64; Pringle *et al.* 2000, pp. 810–815; Watters 2000, pp. 261–264). Downstream of dams, mussel declines are associated with changes and fluctuation in flow regime, channel scouring and bank erosion, reduced dissolved oxygen levels and water temperatures, and changes in resident fish assemblages (Williams *et al.* 1992, p. 7; Layzer *et al.* 1993, p. 69; Neves *et *al.* 1997, pp. 63–64; Watters 2000, pp. 265–266; Pringle *et al.* 2000, pp. 810–815). Dams that are low to the water surface, or have water passing over them (small low head or mill dams) can have some of these same effects on mussels and their fish hosts, particularly reducing species richness and evenness and blocking fish host movements (Watters 2000, pp. 261–264; Dean *et al.* 2002, pp. 235–238). The decline of mussels within the Arkansas, Red, White, Tennessee, Cumberland, Mississippi, and Ohio River basins has been directly attributed to construction of numerous impoundments (Miller *et al.* 1984, p. 109; Williams and Schuster 1989, pp. 7–10; Layzer *et al.* 1993, pp. 68–69; Neves *et al.* 1997, pp. 63–64; Obermeyer *et al.* 1997b, pp. 113–115; Watters 2000, pp. 262–263; Sickel *et al.* 2007, pp. 71–78; Hanlon *et al.* 2009, pp. 11–12; Watters and Flaute 2010, pp. 3–7). Population losses due to impoundments have likely contributed more to the decline of the Neosho mucket and rabbitsfoot than any other factor. River habitat throughout the ranges of the Neosho mucket and rabbitsfoot has been impounded, leaving short, isolated patches of suitable habitat that sometimes lacks suitable fish hosts. Neither Neosho mucket nor rabbitsfoot occur in reservoirs lacking riverine characteristics. They are unable to successfully reproduce and recruit under these conditions (Obermeyer *et al.* 1997b, p. 114; Butler 2005, p. 96). On the other hand, rabbitsfoot may persist and even exhibit some level of recruitment in some large rivers with locks and dams where appropriate habitat quality and quantity remain (Ohio and Tennessee Rivers in riverine reaches between a few locks and dams) (Butler 2005, p. 96).

The majority of the main stem Ohio, Cumberland, Tennessee, and White Rivers and many of their largest tributaries are impounded, in many cases resulting in tail water (downstream of dam) conditions unsuitable for rabbitsfoot (Butler 2005, p. 96). There are 36 major dams within the Tennessee River basin (Holston, Little Tennessee, Clinch, Elk, Flint, and Sequatchie Rivers, and Bear Creek) that have resulted in the impoundment of 3,680 rkm (2,300 rmi) of the Tennessee River and its largest tributaries (Butler 2005, p. 95). Only three of these rivers support viable populations—Tennessee, Paint Rock, and Duck Rivers. Ninety percent of the Cumberland River downstream of Cumberland Falls (rkm 866, rmi 550) as well as numerous tributaries are either directly impounded or otherwise adversely affected by cold tail water releases from dams. Rabbitsfoot and its fish hosts are warm water species and the change in temperature to cold water below the dams further reduces suitable habitat for the species and may eliminate fish hosts that cannot adapt to colder water temperatures (see the Temperature section below for more information). Other tributary impoundments that adversely affected rabbitsfoot and its fish hosts within the Ohio River basin include, but are not limited to, the Walhonding, Barren, Rough, and Eel Rivers and two rivers with viable populations, Green and Tippecanoe Rivers. The majority (7 of 11 populations or 64 percent) of viable rabbitsfoot populations (Ohio, Green, Tippecanoe, Tennessee, Duck, White, and Little Rivers) occur downstream of main stem impoundments that make these populations more susceptible to altered habitat quality and quantity associated with the impoundment or dam operation, which may be exacerbated during stochastic events such as droughts and floods.

Navigational improvements on the Ohio River began in 1830, and now include 21 lock and dam structures stretching from Pittsburgh, Pennsylvania, to Olmsted, Illinois, near its confluence with the Mississippi River. Lock and dam structures convert riverine habitat to unsuitable static habitat for the mussel and prevent movement of their fish hosts. Numerous Ohio River tributaries also have been altered by lock and dam structures. For example, a 116-rkm (72-rmi) stretch of the Allegheny River in Pennsylvania has been altered with nine locks and dams from Armstrong County to Pittsburgh. A series of six locks and dams were constructed on the lower half of the Green River decades ago that extend upstream to the western boundary of Mammoth Cave National Park, Kentucky. The declines of rabbitsfoot populations are attributable to navigational locks and dams on the Ohio, Allegheny, Monongahela, Muskingum, Kentucky, Green, Barren, and White Rivers, and are widespread throughout the species range.

Impoundments have eliminated a large portion of the Neosho mucket population and habitat in the Arkansas River basin. For example, mussel habitat in the Neosho River in Kansas has been adversely affected by at least 15 city dams and 2 Federal dams, both with regulated flows. Almost the entire length of the river in Oklahoma is now impounded or adversely affected by tail water releases from three major dams (Matthews *et al.* 2005, p. 308). Several reservoirs and numerous small watershed lakes have eliminated suitable mussel habitat in several larger Neosho River tributaries in Kansas and Missouri (Spring, Elk and Cottonwood Rivers and Shoal Creek). The Verdigris River (Kansas and Oklahoma) has two large reservoirs with regulated flows, and the lower section has been channelized as part of the McClellan–Kerr Arkansas River Navigation System. All the major Verdigris River tributaries in Kansas and Oklahoma have been partially inundated by reservoirs with regulated flows and numerous flood control watershed lakes (Obermeyer *et al.* 1995, pp. 7–21). Construction of Lake Tenkiller eliminated Neosho mucket populations and habitat in the lower portion of the Illinois River, Oklahoma (Davidson 2011, pers. comm.).

Dam construction has a secondary effect of fragmenting the ranges of mussel species by leaving relict habitats and populations isolated upstream or between structures as well as creating extensive areas of deep uninhabitable, impounded waters. These isolated populations are unable to naturally recolonize suitable habitat downstream and become more prone to further extirpation from stochastic events, such as severe drought, chemical spills, or unauthorized discharges (Layzer *et al.* 1993, pp. 68–69; Cope *et al.* 1997, pp. 235–237; Neves *et al.* 1997, pp. 63–75; Watters 2000, pp. 264–265, 268; Miller and Payne 2001, pp. 14–15; Pringle *et al.* 2000, pp. 810–815; Watters and Flaute 2010, pp. 3–7). We conclude that habitat effects due to impoundment are a significant and ongoing threat to the Neosho mucket and rabbitsfoot.

Channelization

Dredging and channelization activities have profoundly altered riverine habitats nationwide. Hartfield (1993, pp. 131–139), Neves *et al.* (1997, pp. 71–72), and Watters (2000, pp. 268–269) reviewed the specific upstream and downstream effects of channelization on freshwater mussels. Channelization affects a stream physically (accelerates erosion, increases sediment bed load, reduces water depth, decreases habitat diversity, creates geomorphic (natural channel dimensions) instability, eliminates riparian canopy) and biologically (decreases fish and mussel diversity, changes species composition and abundance, decreases biomass, and reduces growth rates) (Hartfield 1993, pp. 131–139). Channel modification for navigation has been shown to increase flood heights (Belt 1975, p. 684), partly as a result of an increase in stream bed slope (Hubbard *et al.* 1993, p. 137). Flood events are exacerbated, conveying large quantities of sediment, potentially with adsorbed contaminants, into streams. Channel maintenance often results in increased turbidity and sedimentation that often smothers mussels (Stansbery 1970, p. 10).

Channel maintenance operations for commercial navigation have affected habitat for the rabbitsfoot in many large rivers rangewide. Periodic navigation maintenance activities (such as dredging and snag removal) may continue to adversely affect this species in the lower portions of the Ohio, Tennessee, and White Rivers, which represent 44 percent of the viable rabbitsfoot populations. In the Tennessee River, a plan to deepen the navigation channel has been proposed (Hubbs 2009, pers. comm.). Some rabbitsfoot streams were ''straightened'' to decrease distances traversed by barge traffic (for example, Verdigris River). Hundreds of miles of many midwestern (Eel, North Fork Vermilion, and Embarras Rivers) and southeastern (Paint Rock and St. Francis Rivers and Bear Creek) streams with rabbitsfoot populations were channelized decades ago to reduce the probability and frequency of flood events. Because mussels are relatively immobile they require a stable substrate to survive and reproduce and are particularly susceptible to channel instability (Neves *et al.* 1997, p. 23) and alteration. Channel and bank degradation have led to the loss of stable substrates in numerous rivers with commercial navigation throughout the range of rabbitsfoot. While dredging and channelization have had a greater effect on rabbitsfoot, the Neosho mucket has been affected by these activities in the Verdigris River. We conclude that habitat effects due to channelization are a significant and ongoing threat to the Neosho mucket and rabbitsfoot.

Sedimentation

Excessive sediments are believed to adversely affect riverine mussel populations requiring clean, stable streams (Ellis 1936, pp. 39–40; Brim Box and Mossa 1999, p. 99). Adverse effects resulting from sediments have been noted for many components of aquatic communities. Potential sediment sources within a watershed include virtually all activities that disturb the land surface. Most localities occupied by the Neosho mucket and rabbitsfoot, including viable populations, are currently being affected to varying degrees by sedimentation.

Sedimentation has been implicated in the decline of mussel populations nationwide, and remains a threat to Neosho mucket and rabbitsfoot (Ellis 1936, pp. 39–40; Vannote and Minshall 1982, pp. 4105–4106; Dennis 1984, p. 212; Brim Box and Mosa 1999, p. 99; Fraley and Ahlstedt 2000, pp. 193–194; Poole and Downing 2004, pp. 119–122). Specific biological effects include reduced feeding and respiratory efficiency from clogged gills, disrupted metabolic processes, reduced growth rates, limited burrowing activity, physical smothering, and disrupted host fish attraction mechanisms (Ellis 1936, pp. 39–40; Marking and Bills 1979, p. 210; Vannote and Minshall 1982, pp. 4105–4106; Waters 1995, pp. 173–175; Hartfield and Hartfield 1996, p. 373). In addition, mussels may be indirectly affected if high turbidity levels significantly reduce the amount of light available for photosynthesis, and thus, the production of certain food items (Kanehl and Lyons 1992, p. 7).

Studies tend to indicate that the primary effects of excess sediment levels on mussels are sublethal, with detrimental effects not immediately apparent (Brim Box and Mossa 1999, p. 101). The physical effects of sediment on mussel habitat appear to be multifold, and include changes in suspended and bed material load; bed sediment composition associated with increased sediment production and runoff in the watershed; channel changes in form, position, and degree of stability; changes in depth or the width and depth ratio that affects light penetration and flow regime; actively aggrading (filling) or degrading (scouring) channels; and changes in channel position. These effects to habitat may dislodge, transport downstream, or leave mussels stranded (Vannote and Minshall 1982, p. 4106; Kanehl and Lyons 1992, pp. 4–5; Brim Box and Mossa 1999, pp. 109–112). For example, many Kansas streams (such as Verdigris and Neosho Rivers) supporting mussels have become increasingly silted in over the past century, reducing habitat for the Neosho mucket and rabbitsfoot (Obermeyer *et al.* 1997a, pp. 113–114).

Increased sedimentation and siltation may explain in part why Neosho mucket and rabbitsfoot are experiencing recruitment failure in some streams. Interstitial spaces in the substrate provide crucial habitat (shelter and nutrient uptake) for juvenile mussel survival. When interstitial spaces are clogged, interstitial flow rates and spaces are reduced (Brim Box and Mossa 1999, p. 100), and this decreases habitat for juvenile mussels. Furthermore, sediment may act as a vector for delivering contaminants, such as nutrients and pesticides, to streams, and juvenile mussels may ingest contaminants adsorbed to silt particles during normal feeding activities. Neosho mucket and rabbitsfoot reproductive strategies depend on clear water (enables fish hosts to see mussel lures) during critical reproductive periods.

Agricultural activities are responsible for much of the sediment affecting rivers in the United States (Waters 1995, p. 170). Sedimentation associated with agricultural land use is cited as one of the primary threats to 7 of the 11 (64 percent) viable rabbitsfoot populations (French Creek, Tippecanoe, Paint Rock, Duck, White, Black, and Strawberry Rivers; Smith *et al.* 2009, Table 1; USACE 2011, pp. 21–22; Indiana Department of Environmental Management (IDEM) 2001, pp. 11–12; EPA 2001, p. 10; Brueggen 2010, pp. 1–2; MDC 2012, *http://mdc.mo.gov/landwater-care/stream-and-watershed-management/;* EPA Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). In addition, numerous stream segments in the Duck, White, Black, Little, and Strawberry River watersheds are listed as impaired waters under section 303(d) of the Clean Water Act (CWA) by EPA due to sedimentation associated with agriculture (USACE 2011, p. 21; EPA Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). An impaired water is a water body (i.e., stream reaches, lakes, water body segments) with chronic or recurring monitored violations of the applicable numeric or narrative water quality criteria. An impaired water cannot support one or more of its designated uses (e.g., swimming, the protection and propagation of aquatic life, drinking, industrial supply, etc.). Once a stream segment is listed as an impaired water, the State must complete a plan to address the issue causing the impairment; this plan is called a Total Maximum Daily Load (TMDL). A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards (WQS). Completion of the plan is generally all that is required to remove the stream segment from the 303(d) impaired water list and does not mean that water quality has changed. Once the TMDL is completed, the stream segment may be placed on the 305(b) list of impaired streams with a completed TMDL (*http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/intro.cfm*). For example, some stream segments within the White, Barren, Little River Mountain Fork, and Wabash Rivers, and French Creek have completed TMDL plans and have attained WQS for low dissolved oxygen, pathogens, nutrients, polychlorinated biphenyls (PCBs), and siltation. However, some of these same stream segments still have not attained WQS for lead (Little River Mountain Fork) and mercury (Wabash River).

Impaired streams in the Duck River watershed (approximately 483 rkm (300 rmi)) are losing 5 to 55 percent more soil per year than the natural streams (USACE 2011, pp. 21–22). Unrestricted livestock access occurs on many streams and potentially threatens associated mussel populations (Fraley and Ahlstedt 2000, pp. 193–194). Grazing may reduce water infiltration rates and increase runoff; trampling and vegetation removal increases the probability of erosion (Armour *et al.* 1991, pp. 8–10; Brim Box and Mossa 1999, p. 103).

As discussed above, specific impacts on mussels from sediments include reduced feeding and respiratory efficiency, disrupted metabolic processes, reduced growth rates, increased substrata instability, and the physical smothering of mussels. Increased turbidity levels due to siltation can be a limiting factor that impedes the ability of sight-feeding fishes to forage. Turbidity within the rivers and streams during the times that the mussels attempt to attract host fishes may have contributed and may continue to contribute to the decline of the Neosho mucket and rabbitsfoot by reducing their efficiency at attracting the fish hosts necessary for reproduction. In addition, sediment can eliminate or reduce the recruitment of juvenile mussels, interfere with feeding activity, and act as a vector in delivering contaminants to streams. Because the Neosho mucket and rabbitsfoot are filter-feeders and may bury themselves in the substrate, they are exposed to these contaminants contained within suspended particles and deposited in bottom substrates. We conclude that biological and habitat effects due to sedimentation are a significant and ongoing threat to the Neosho mucket and rabbitsfoot.

Chemical Contaminants

Chemical contaminants are ubiquitous in the environment and are considered a major threat in the decline of mussel species (Richter *et al.* 1997, p. 1081; Strayer *et al.* 2004, p. 436; Wang *et al.* 2007a, p. 2029; Cope *et al.* 2008, p. 451). Chemicals enter the environment through point and nonpoint discharges including spills, industrial and municipal effluents, and residential and agricultural runoff. These sources contribute organic compounds, heavy metals, nutrients, pesticides, and a wide variety of newly emerging contaminants such as pharmaceuticals to the aquatic environment. As a result, water and sediment quality can be degraded to the extent that results in adverse effects to mussel populations.

Cope *et al.* (2008, p. 451) evaluated the pathways of exposure to environmental pollutants for all four freshwater mollusk life stages (free glochidia, encysted glochidia, juveniles, adults) and found that each life stage has both common and unique characteristics that contribute to observed differences in exposure and sensitivity. Almost nothing is known of the potential mechanisms and consequences of waterborne toxicants on sperm viability. In the female mollusk, the marsupial region of the gill is thought to be physiologically isolated from respiratory functions, and this isolation may provide some level of protection from contaminant interference with a female's ability to achieve fertilization or brood glochidia (Cope *et al.* 2008, p. 454). A major exception to this assertion is with chemicals that act directly on the neuroendocrine pathways controlling reproduction (see discussion below). Nutritional and ionic exchange is possible between a brooding female and her glochidia, providing a route for chemicals (accumulated or waterborne) to disrupt biochemical and physiological pathways (such as maternal calcium transport for construction of the glochidial shell). Glochidia can be exposed to waterborne contaminants for up to 36 hours until encystment occurs; between 2 and 36 hours, and then from fish host tissue burdens (for example, atrazine), that last from weeks to months and could affect transformation success of glochidia into juveniles (Ingersoll *et al.* 2007, pp. 101–104).

Juvenile mussels typically remain burrowed beneath the sediment surface for 2 to 4 years. Residence beneath the sediment surface necessitates deposit (pedal) feeding and a reliance on interstitial water for dissolved oxygen (Watters 2007, p. 56). The relative importance of exposure of juvenile Neosho mucket and rabbitsfoot to contaminants in overlying surface water, interstitial water, whole sediment, or food has not been adequately assessed. Exposure to contaminants from each of these routes varies with certain periods and environmental conditions (Cope *et al.* 2008, pp. 453 and 457).

The primary routes of exposure to contaminants for adult Neosho mucket and rabbitsfoot are surface water, sediment, interstitial (pore) water, and diet; adults can be exposed when either partially or completely burrowed in the substrate (Cope *et al.* 2008, p. 453). Adult mussels have the ability to detect toxicants in the water and close their valves to avoid exposure (Van Hassel and Farris 2007, p. 6). Adult mussel toxicity and relative sensitivity (exposure and uptake of toxicants) may be reduced at high rather than at low toxicant concentrations because uptake is affected by the prolonged or periodic toxicant avoidance responses (when the avoidance behavior of keeping their valves closed can no longer be sustained for physiological reasons (respiration and ability to feed) (Cope *et al.* 2008, p. 454). Toxicity results based on low-level exposure of adults are similar to estimates for glochidia and juveniles for some toxicants (for example, copper). The duration of any toxicant avoidance response by an adult mussel is likely to vary due to several variables, such as species, age, shell thickness and gape, properties of the toxicant, and water temperature. There is a lack of information on toxicant response(s) for Neosho mucket and rabbitsfoot, but results of tests using glochidia and juveniles may be valuable for protecting adults (Cope *et al.* 2008, p. 454).

Mussels are very intolerant of heavy metals (such as lead, zinc, cadmium, and copper) compared to commonly tested aquatic organisms. Metals occur in industrial and wastewater effluents and are often a result of atmospheric deposition from industrial processes and incinerators, but also are associated with mine water runoff (for example, Tri-State Mining Area in southwest Missouri) and have been attributed to mussel declines in streams such as Shoal, Center, and Turkey Creeks and Spring River in the Arkansas River basin (Angelo *et al.* 2007, pp. 485–489), which are streams with historical and extant Neosho mucket and rabbitsfoot populations. Heavy metals can cause mortality and affect biological processes, for instance, disrupting enzyme efficiency, altering filtration rates, reducing growth, and changing behavior of freshwater mussels (Keller and Zam 1991, p. 543; Naimo 1995, pp. 351–355; Jacobson *et al.* 1997, p. 2390; Valenti *et al.* 2005, p. 1244; Wang *et al.* 2007b, pp. 2039–2046; Wang *et al.* 2007c, pp. 2052–2055; Wang *et al.* 2010, p. 2053). Mussel recruitment may be reduced in habitats with low but chronic heavy metal and other toxicant inputs (Yeager *et al.* 1994, p. 217; Naimo 1995, pp. 347 and 351–352; Ahlstedt and Tuberville 1997, p. 75). Newly transformed juveniles (age at 5 days) are more sensitive to acute toxicity than glochidia or older juveniles (age at 2 to 6 months) (Wang *et al.* 2010, p. 2062).

Mercury is another heavy metal that has the potential to negatively affect mussel populations. Mercury has been detected throughout aquatic environments as a product of municipal and industrial waste and atmospheric deposition from coal-burning plants. One study on rainbow mussel (*Villosa iris*) concluded that glochidia were more sensitive to mercury than were juvenile mussels, with a median lethal concentration value of 14 *u*g/L for glochidia and 114 *u*g/L for juvenile mussels (Valenti *et al.* 2005, p. 1242). The chronic toxicity is a test which usually measures sublethal effects (e.g., reduced growth or reproduction) in addition to lethality. These tests are usually longer in duration or conducted during some sensitive period of an organism's life cycle. For this species, the chronic toxicity test showed that juveniles exposed to mercury greater than or equal to 8 *u*g/L exhibited reduced growth (Valenti *et al.* 2005, p. 1245). Mercury also affects oxygen consumption, byssal thread production, and filtration rates (Naimo 1995, Jacobsen *et al.* 1997, and Nelson and Calabrese 1988 *in* Valenti *et al.* 2005, p. 1245). Effects to mussels from mercury toxicity may be occurring in some streams due to illegal dumping, spills, and permit violations. For example, acute mercury toxicity was determined to be the cause of extirpation of diverse mussel fauna for a 112-rkm (70-rmi) reach of the North Fork Holston River (Brown *et al.* 2005, pp. 1455–1457). Of the 11 viable rabbitsfoot populations, 4 populations (French Creek, Duck River, Green River, and Ohio River) currently inhabit river reaches that are impaired by mercury and are listed as impaired waters under section 303(d) of the CWA.

One chemical that is particularly toxic to early life stages of mussels is ammonia. Sources of ammonia include agricultural wastes (animal feedlots and nitrogenous fertilizers), municipal wastewater treatment plants, and industrial waste (Augspurger *et al.* 2007, p. 2026) as well as precipitation and natural processes (decomposition of organic nitrogen) (Goudreau *et al.* 1993, p. 212; Hickey and Martin 1999, p. 44; Augspurger *et al.* 2003, p. 2569; Newton 2003, p. 1243). Therefore, ammonia is considered a limiting factor for survival and recovery of some mussel species due to its ubiquity in aquatic environments and high level of toxicity, and because the highest concentrations typically occur in mussel microhabitats (Augspurger *et al.* 2003, p. 2574). In addition, studies have shown that ammonia concentrations increase with increasing temperature, pH, and low flow conditions (Cherry *et al.* 2005, p. 378; Cooper *et al.* 2005, p. 381; Wang *et al.* 2007, p. 2045), which may be exacerbated by the effects of climate change, and may cause ammonia (un-ionized and ionized) to become more problematic for juvenile mussels (Wang *et al.* 2007, p. 2045). Sublethal effects include, but may not be limited to, reduced time the valves are held open for respiration and feeding; impaired secretion of the byssal thread (used for substrate attachment), reduced ciliary action impairing feeding, depleted lipid, glycogen, and other carbohydrate stores, and altered metabolism (Goodreau *et al.* 1993, pp. 216–227; Augspurger *et al.* 2003, pp. 2571–2574; Mummert *et al.* 2003, pp. 2548–2552).

Polychlorinated biphenyls (PCBs) are ubiquitous contaminants in the environment due to their widespread use from the 1920s to 1970s as insulating material in electric equipment, such as transformers and capacitors, as well as in heat transfer fluids and in lubricants. PCBs have also been used in a wide range of products, such as plasticizers, surface coatings, inks, adhesives, flame retardants, paints, and carbonless duplicating paper. PCBs were still being introduced into the environment at many sites (such as landfills and incinerators) until the 1990s. The inherent stability and toxicity of PCBs have resulted in them being a persistent environmental problem (Safe 1994 *in* Lehmann *et al.* 2007, p. 356). PCBs are lipophilic (affinity to combine with fats or lipids), adsorb easily to soil and sediment, and are present in the sediment and water column in aquatic environments, making them available to bioaccumulate and induce negative effects in living organisms (Livingstone 2001 *in* Lehmann *et al.* 2007, p. 356). Studies have demonstrated increased PCB concentrations in native freshwater mussels (Ruessler *et al.* 2011, pp. 1, 7), marine bivalves (Krishnakumar *et al.* 1994, p. 249), and nonnative, invasive mollusks (zebra mussels and Asian clams) (Gossiaux *et al.* 1996, p. 379; Lehmann *et al.* 2007, p. 363) in areas with high levels of PCBs. Oxidative stress (imbalance in the normal redox state of cells that causes toxic effects that damage all components of the cell, including proteins, lipids, and DNA) is a direct consequence of exposure to PCBs. Relevant changes, whether directly or indirectly due to oxidative stress, may occur at the organ and organism levels and will likely result in mussel population-wide effects, including reduced fecundity and chronic maladies due to PCB exposure (Lehmann *et al.* 2007, p. 363). Two of the 11 viable rabbitsfoot populations (18 percent) inhabit waters listed as impaired due to PCBs under section 303(d) of the CWA.

Agriculture, timber harvest, and lawn management practices utilize nutrients and pesticides. These are two broad categories of chemical contaminants that have the potential to adversely impact mussel species. Nutrients, such as nitrogen and phosphorus, primarily occur in runoff from livestock farms, feedlots, heavily fertilized row crops and pastures (Peterjohn and Correll 1984, p. 1471), post timber management activities, and urban and suburban runoff, including leaking septic tanks, and residential lawns.

Studies have shown that excessive nitrogen concentrations can be lethal to the adult freshwater pearl mussel (*Margaritifera margaritifera*) and reduce the lifespan and size of other mussel species (Bauer 1988, p. 244; Bauer 1992, p. 425). Nutrient enrichment can result in an increase in primary productivity, and the associated algae respiration depletes dissolved oxygen levels. This may be particularly detrimental to juvenile mussels that inhabit the interstitial spaces in the substrate where lower dissolved oxygen concentrations are more likely than on the sediment surface where adults tend to live (Sparks and Strayer 1998, pp. 132–133). For example, Galbraith *et al.* (2008, pp. 48–49) reported a massive die-off of greater than 160 rabbitsfoot specimens at a long-term monitoring site in the Little River, Oklahoma. While the exact cause for the die-off is unknown, the authors speculate that the 2005 Oklahoma drought coupled with high water temperature and extensive blooms of filamentous algae may have resulted in extreme physiological stress. Over-enriched conditions are exacerbated by low flow conditions, such as those experienced during a typical summer season and that may occur with greater frequency and severity as a result of climate change. Three of the 11 viable rabbitsfoot populations (French Creek, Duck River, and Tippecanoe River) are listed as impaired waters under section 303(d) of the CWA due to nutrient enrichment.

Elevated concentrations of pesticide frequently occur in streams due to residential or commercial pesticide runoff, overspray application to row crops, and lack of adequate riparian buffers. Agricultural pesticide applications often coincide with the reproductive and early life stages of mussels, and effects to mussels may be increased during a critical time period (Bringolf *et al.* 2007a, p. 2094). Recent studies tested the toxicity of glyphosate, its formulations, and a surfactant (MON 0818) used in several glyphosate formulations, to early life stages of the fatmucket (*Lampsilis siliquoidea*), a U.S. native freshwater mussel (Bringolf *et al.* 2007a, p. 2094). Studies conducted with juvenile mussels and glochidia determined that the surfactant (MON 0818) was the most toxic of the compounds tested and that *L. siliquoidea* glochidia were the most sensitive organism tested to date (Bringolf *et al.* 2007a, p. 2094). Roundup®, technical grade glyphosate isopropylamine salt, and isopropylamine were also acutely toxic to juveniles and glochidia (Bringolf *et al.* 2007a, p. 2097). The study of other pesticides, including atrazine, chlorpyrifos, and permethrin, on glochidia and juvenile life stages determined that chlorpyrifos was toxic to both *L. siliquoidea* glochidia and juveniles (Bringolf *et al.* 2007b, pp. 2101 and 2104). The above results indicate the potential toxicity of commonly applied pesticides and the threat to mussel species as a result of the widespread use of these pesticides.

There are instances where chemical spills have resulted in the loss of high numbers of mussels (Jones *et al.* 2001, p. 20; Brown *et al.* 2005, p. 1457; Schmerfeld 2006, pp. 12–13), and are considered a serious threat to mussel species. The Neosho mucket and rabbitsfoot are especially threatened by chemical spills because these spills can occur anywhere that highways with tanker trucks, industries, or mines overlap with their distribution.

Other examples of the influence of point and nonpoint-source pollutants on streams throughout the range of the Neosho mucket and rabbitsfoot include two documented mussel kills in Fish Creek (circa 1988) as a result of manure runoff from a hog farm and a diesel spill (Watters 1988, p. 18). Twelve point-source discharges occur on the Green River (Kentucky State Nature Preserves Commission and The Nature Conservancy 1998, pp. 15–19). The Illinois River, a tributary of the Arkansas River, is subject to nonpoint-source organic runoff from poultry farming and municipal wastewater.

Pharmaceutical chemicals used in commonly consumed drugs are increasingly found in surface waters. A recent nationwide study sampling 139 stream sites in 30 States detected the presence of numerous pharmaceuticals, hormones, and other organic wastewater contaminants downstream from urban development and livestock production areas (Kolpin *et al.* 2002, pp. 1208–1210). Another study in northwestern Arkansas found pharmaceuticals or other organic wastewater constituents at 16 of 17 sites in seven streams surveyed in 2004 (Galloway *et al.* 2005, pp. 4–22). Toxic levels of exposure to chemicals that act directly on the neuroendocrine pathways controlling reproduction can cause premature release of viable or nonviable glochidia. For example, the active ingredient in many human prescription antidepressant drugs belonging to the class of selective serotonin reuptake inhibitors may exert negative reproductive effects on mussels because of the drug's action on serotonin and other neuroendocrine pathways (Cope *et al.* 2008, p. 455). Pharmaceuticals or organic wastewater constituents are generally greater downstream of wastewater treatment facilities (Galloway *et al.* 2005, p. 28). Pharmaceuticals that alter mussel behavior and influence successful attachment of glochidia on fish hosts may have population-level implications for the Neosho mucket and rabbitsfoot.

The information presented in this section represents some of the threats from chemical contaminants that have been documented both in the laboratory and field and demonstrates that chemical contaminants pose a substantial threat to Neosho mucket and rabbitsfoot. A cursory examination of land use trends, non-point and point source discharges, and the list of impaired waters under section 303(d) of the CWA suggests that all 11 rabbitsfoot populations currently considered viable may be subjected to the subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. For example, 8 of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA. Reasons for impairment include mercury, nutrients, organic enrichment and dissolved oxygen depletion, pathogens, turbidity (sediment), and PCBs. Potential effects from contaminant exposure may result in death, reduced growth, altered metabolic processes, or reduced reproduction. We conclude that biological and habitat effects due to chemical contaminants are a significant and ongoing threat contributing to the decline of Neosho mucket and rabbitsfoot populations.

Mining

Gravel, coal, and metal mining are activities negatively affecting water quality in Neosho mucket and rabbitsfoot habitat. Instream and alluvial gravel mining has been implicated in the destruction of mussel populations (Hartfield 1993, pp. 136–138; Brim Box and Mossa 1999, pp. 103–104). Negative effects associated with gravel mining include stream channel modifications (altered habitat, disrupted flow patterns, sediment transport), water quality modifications (increased turbidity, reduced light penetration, increased temperature), macroinvertebrate population changes (elimination), and changes in fish populations, resulting from adverse effects to spawning and nursery habitat and food web disruptions (Kanehl and Lyons 1992, pp. 4–10). Gravel mining activities continue to be a localized threat in several streams with viable rabbitsfoot populations (Ohio, Tennessee, White, Strawberry, and Little Rivers). In the lower Tennessee River, instream mining occurs in 18 reaches totaling 77.1 rkm (47.9 rmi) between the Duck River confluence and Pickwick Landing Dam (Hubbs 2010, pers. comm.).

Coal mining activities, resulting in heavy metal-rich drainage, and associated sedimentation has adversely affected many drainages with rabbitsfoot populations, including portions of the upper Ohio River system in Kentucky, Pennsylvania, and West Virginia; the lower Ohio River system in eastern Illinois; the Rough River drainage in western Kentucky; and the upper Cumberland River system in Kentucky and Tennessee (Ortmann 1909 *in* Butler 2005, p. 102; Gordon 1991, pp. 4 and 5; Layzer and Anderson 1992 *in* Butler 2005, p. 102). Numerous mussel toxicants, such as polycyclic aromatic hydrocarbons and heavy metals (copper, manganese, and zinc) from coal mining contaminate sediments when released into streams (Ahlstedt and Tuberville 1997, p. 75). Low pH commonly associated with mine runoff can reduce glochidial attachment rates on host fish (Huebner and Pynnonen 1990, pp. 2350–2353). Thus, acid mine runoff may have local effects on mussel recruitment and may lead to mortality due to improper shell development or erosion.

Metal mining (lead, cadmium, and zinc) in the Tri-State Mining Area (15,000 km^2; 5,800 mi^2 in Kansas, Missouri, and Oklahoma) has adversely affected Center and Shoal Creeks and the Spring River. It has been implicated in the loss of Neosho mucket and rabbitsfoot from portions of these streams (Obermeyer *et al.* 1997b, p. 114). A study by Kansas Department of Health and Environment documented a strong negative correlation between the distribution and abundance of native mussels, including Neosho mucket, and sediment concentrations of lead, zinc and cadmium in the Spring River system (Angelo *et al.* 2007, pp. 477–493). Sediment and water quality samples exceeded EPA 2006 threshold effect concentrations for cadmium, lead, and zinc at numerous sampling locations within the Tri-State Mining Area (Gunter 2007, pers. comm.). These physical habitat threats combined with poor water quality and agricultural nonpoint-source pollution are serious threats to all existing mussel fauna in the basin.

In the St. Francis River basin, past metal mining and smelting (early eighteenth century through the 1940s) have resulted in continuing heavy metal (lead, iron, nickel, copper, cobalt, zinc, cadmium, chromium) contamination of surface waters in the area upstream of the extant rabbitsfoot population. Recent and historical metals mining and smelting produced large volumes of contaminated wastes. Most of these mining wastes are stored behind poorly constructed dams and impoundments (Roberts 2008, pers. comm.). Wappapello Reservoir and the confluence with Big Creek (with habitat degradation primarily from mining activities) may effectively limit the distribution of the rabbitsfoot in the St. Francis River. We conclude that biological and habitat effects due to mining activities are a significant and ongoing threat contributing to declining Neosho mucket and rabbitsfoot populations.

Oil and Natural Gas Development

Oil and natural gas resources are present in some of the watersheds that are known to support rabbitsfoot, including the Allegheny and Middle Fork Little Red Rivers and two watersheds with viable populations (White River and French Creek). Exploration and extraction of these energy resources can result in increased siltation, a changed hydrograph (graph showing changes in the discharge of a river over a period of time), and altered water quantity and quality even at considerable distances from the mine or well field because effects are carried downstream from the original source. Rabbitsfoot habitat in streams can be threatened by the cumulative effects of multiple mines and well fields (adapted from Service 2008, p. 11).

Recently, oil and gas exploration has been able to expand in areas of shale due to new technologies (i.e., hydraulic fracturing and horizontal drilling), making access possible to oil and gas reserves in areas that were previously inaccessible. Extraction of these resources, particularly natural gas, has increased dramatically in recent years in Arkansas, Oklahoma, Pennsylvania, and West Virginia. Although oil and natural gas extraction generally occurs away from the river, extensive road and pipeline networks are required to construct and maintain wells and transport the extracted resources. These road and pipeline networks frequently cross or occur near tributaries, contributing sediment to the receiving waterway. In addition, the construction and operation of wells may result in the discharge of chemical contaminants and subsurface minerals. Several of the viable rabbitsfoot populations occur in active shale basins (areas of shale gas formations) (*http://www.eia.gov/analysis/studies/worldshalegas/*). In 2006, more than 3,700 permits were issued for oil and gas wells by the Pennsylvania Department of Environmental Protection, which also issued 98 citations for permit violations at 54 wells (Hopey 2007; adapted from Service 2008, p. 13). A natural gas pipeline company pled guilty to three violations of the Act in 2011 for unauthorized take of a federally endangered mussel in Arkansas as a result of a large amount of sediment being transported from pipeline right-of-ways to tributary streams in the affected watershed (Department of Justice 2011, pers. comm.). Where oil and natural gas development occurs within the range of extant Neosho mucket and rabbitsfoot populations, we conclude that the resulting biological and habitat effects are a significant and ongoing threat contributing to the decline of both species.

Summary of Factor A

The decline of mussels in the eastern United States is primarily the result of long-lasting direct and secondary effects of habitat alterations such as impoundments, channelization, sedimentation, chemical contaminants, oil and gas development, and mining and it is reasonable to conclude that the changes in the river basins historically and currently occupied by the species are the cause of population level (river basin) effects. Historical population losses due to impoundments have probably contributed more to the decline and range reductions of the Neosho mucket and rabbitsfoot than any other single factor. Seven of the 11 (64 percent) viable rabbitsfoot populations (Ohio, Green, Tippecanoe, Tennessee, Duck, White, and Little Rivers) occur downstream of main stem impoundments that make these populations more susceptible to altered habitat quality and quantity associated with the impoundment and dam operation, which may be exacerbated during stochastic events such as droughts and floods. Sedimentation resulting from a variety of sources such as channelization, agricultural and silvicultural practices, and construction activities has degraded Neosho mucket and rabbitsfoot habitat and altered biological processes essential to their survival. For example, sedimentation associated with agricultural land use is cited as one of the primary threats to 7 of the 11 (64 percent) streams with viable rabbitsfoot populations. Land use conversion, particularly urbanization that increases impervious surfaces in watersheds (impervious surface increases flood intensity and duration), channelization, and instream gravel and sand mining alter natural hydrology and stream geomorphology characteristics that also degrade mussel habitat in streams that support the Neosho mucket and rabbitsfoot. Contaminants associated with industrial and municipal effluents, agricultural practices, and mining degrade water and sediment quality leading to environmental conditions that have lethal and sublethal effects to Neosho mucket and rabbitsfoot, particularly the highly sensitive early life stages. Eight of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA, which means that the rabbitsfoot may be subjected to the subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. Chronic contamination can affect the mussels in a variety of ways including sublethal effects (such as suppressed immune systems and effects to reproduction and fecundity from neuroendocrine disrupters) and lethal effects (such as sediment smothers and disruption of other metabolic processes).

In summary, we have determined that impoundments, channelization, sedimentation, chemical contaminants, mining, and oil and natural gas development are significant, ongoing threats to the Neosho mucket and rabbitsfoot that are expected to continue into the future. Although efforts have been made to restore habitat in some areas, these threats are still ongoing, as evidenced by population declines and range reduction. Thus, these changes in the species' historical or current range are not expected to be ameliorated in the future; therefore, we find it reasonably likely that the effects of these threats on both species will continue at current levels or potentially increase.

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The Neosho mucket was valuable in the pearl button industry (1800s to early 1940s), and historical episodes of overharvest in the Neosho River may have contributed to its decline (Obermeyer *et al.* 1997b, p. 115). The rabbitsfoot was never a valuable shell for the commercial pearl button industry (Meek and Clark 1912, p. 15; Murray and Leonard 1962, p. 65), nor the cultured pearl industry (Williams and Schuster 1989, p. 23), and hence these activities were probably not significant factors in its decline. However, it was noted occasionally in commercial harvests as evidenced from mussel cull piles (Isely 1924; Parmalee *et al.* 1980, p. 101). Currently, Neosho mucket and rabbitsfoot are not commercially valuable species but may be increasingly sought by collectors as they become rarer. Although scientific collecting is not thought to represent a significant threat, unregulated collecting could adversely affect localized Neosho mucket and rabbitsfoot populations.

Commercial mussel harvest is illegal in some States (for example, Indiana and Ohio), but regulated in others (for example, Arkansas, Alabama, Kentucky, and Tennessee). These species may be inadvertently harvested by inexperienced commercial harvesters unfamiliar with species identification. Although illegal harvest of protected mussel beds occurs (Watters and Dunn 1995, pp. 225 and 247–250), commercial harvest is not known to have a significant effect on the Neosho mucket and rabbitsfoot.

Summary of Factor B

Though it is possible that the intensity of inadvertent or illegal harvest may increase in the future, there is no evidence that this stressor is currently increasing in severity. On the basis of this analysis, we find that overutilization for commercial, recreational, scientific, or educational purposes is not a current threat to the Neosho mucket or rabbitsfoot in any portion of their range at this time nor is likely to become so in the future.

C. Disease or Predation

Little is known about diseases in freshwater mussels (Grizzle and Brunner 2007, p. 6). However, mussel die-offs have been documented in streams inhabited by rabbitsfoot (Neves 1986, pp. 8–11), and some researchers believe that disease may be a factor contributing to the die-offs (Buchanan 1986, p. 53; Neves 1986, p. 11). Mussel parasites include water mites, trematodes, oligochaetes, leeches, copepods, bacteria, and protozoa (Grizzle and Brunner 2007, p. 4). Generally, parasites are not suspected of being a major limiting factor in the species' survival (Oesch 1984, p. 6). However, mite and trematode burdens can affect reproductive output and physiological condition, respectively, in mussels (Gangloff *et al.* 2008, pp. 28–30). Stressors that reduce fitness may make mussels more susceptible to parasites (Butler 2007, p. 90). Furthermore, nonnative mussels may carry diseases and parasites that are potentially devastating to the native mussel fauna on an individual or population level basis (river basin), including Neosho mucket and rabbitsfoot (Strayer 1999b, p. 88). However, while individual mussels or beds of mussels historically or currently may have been affected by disease or parasites, we have no evidence that the severity of disease or parasite infestations impact either mussel on a population level (river basin).

The muskrat (*Ondatra zibethicus*) is cited as the most prevalent mussel predator (Kunz 1898, p. 328; Convey *et al.* 1989, p. 654–655; Hanson *et al.* 1989, pp. 15–16). Muskrat predation may limit the recovery potential of endangered or threatened mussels or contribute to local extirpations of previously stressed populations, according to Neves and Odom (1989, p. 940), who consider it, however, primarily a seasonal or localized threat. Galbraith *et al.* (2008, p. 49) hypothesized that predation may have exacerbated rabbitsfoot mortality in the Little River, Oklahoma, during the 2005 drought. Harris *et al.* (2007, p. 31) reported numerous dead rabbitsfoot from muskrat middens (mound or deposit containing shells) in the Spring River, Arkansas. Other mammals (for example, raccoon, mink, otter, hogs, and rats), turtles, and aquatic birds also occasionally feed on mussels (Kunz 1898, p. 328; Neck 1986, pp. 64–65). Recently, predation of Neosho mucket by reintroduced otters has been documented in a mussel bed also supporting rabbitsfoot in the Spring River, Kansas (Barnhart 2003, pp. 16–17), and likely occurs elsewhere. Muskrat predation has been documented for Neosho mucket and rabbitsfoot, but the overall threat is generally considered insignificant.

Some species of fish feed on mussels (for example, common carp (*Cyprinus carpio),* freshwater drum (*Aplodinotus grunniens*), and redear sunfish (*Lepomis microlophus*)) and potentially on young Neosho mucket and rabbitsfoot. Various invertebrates, such as flatworms, hydra, nonbiting midge larvae, dragonfly larvae, and crayfish, feed on juvenile mussels (Zimmerman *et al.* 2003, p. 28). Although predation by naturally occurring predators is a normal aspect of the population dynamics of a healthy mussel population, predation may amplify declines in small populations of this species. In addition, the potential now exists for black carp (*Mylopharyngodon piceus*), a mollusk-eating Asian fish recently introduced into the waters of the United States (Strayer 1999b, p. 89), to eventually disperse throughout the range of the Neosho mucket and rabbitsfoot. However, we have no evidence that the severity of predation has reached levels where populations (river basin) of either mussel have been historically or recently impacted or should be impacted in the future based on current information.

The life cycle of freshwater mussels is intimately related to that of the freshwater fish they use as hosts for their parasitic glochidia. For this reason, diseases that affect populations of freshwater fishes also pose a significant threat to mussels in general. Viral hemorrhagic septicemia (VHS) disease has been confirmed from much of the Great Lakes and St. Lawrence River system. If the VHS virus successfully migrates out of Clearfork Reservoir or the Great Lakes and into the Ohio and Mississippi River basins, it could spread rapidly and cause fish kills throughout the river basins. Few Neosho mucket and rabbitsfoot populations are currently recruiting at sustainable levels, and fish kills, particularly if VHS infects suitable fish hosts, could further reduce glochidia encounters with fish hosts and exacerbate mussel recruitment reductions. However, we have no evidence that fish kills affecting potential fish hosts of these two mussel species have had population affects historically or recently.

Summary of Factor C

Disease in mussels is poorly known and not currently considered a threat rising to a level such that it would have an effect on the Neosho mucket, nor the rabbitsfoot, as a whole. Studies indicate that, in some localized areas, disease and predation may have negative effects on mussel populations. Though it is possible that the intensity of disease or predation may increase in the future, there is no evidence that this stressor is currently increasing in severity. Based on our analysis of the best available scientific and commercial data available, we find that neither disease nor predation is a significant threat to the overall status of Neosho mucket and rabbitsfoot, nor is either likely to become so in the future.

D. The Inadequacy of Existing Regulatory Mechanisms

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

Nonpoint source (NPS) pollution comes from many diffuse sources, unlike pollution from industrial and sewage treatment plants. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it transports natural and human-made pollutants. While some pollutants may be ''deposited'', some may remain in suspension (dissolved) as they are transported through various waterbodies. States report that nonpoint source pollution is the leading remaining cause of water quality problems. The effects of nonpoint source pollutants on specific waters vary and may not always be fully assessed. However, these pollutants have harmful effects on fisheries and wildlife (*http://www.epa.gov/owow_keep/NPS/whatis.html.*)

Sources of NPS pollution within the watersheds occupied by both mussels include timber clearcutting, clearing of riparian vegetation, urbanization, road construction, and other practices that allow bare earth to enter streams (The Nature Conservancy 2004, p. 13). Numerous stream segments in the Duck, White, Black, Little, and Strawberry River watersheds are listed as impaired waters under section 303(d) of the CWA by EPA due to sedimentation associated with agriculture (USACE 2011, p. 21; EPA Water Quality Assessment Tool, *http://ofmpub.epa.gov/tmdl_waters10/attains_nation_cy.control?p_report_type=T*). For example, impaired streams in the Duck River watershed (483 rkm (300 rmi)) are losing 5 to 55 percent more soil per year than streams not labeled as impaired (USACE 2011, pp. 21–22). Currently, the CWA may not adequately protect Neosho mucket and rabbitsfoot habitat from NPS pollution. The Service has no information concerning the implementation of the CWA regarding NPS pollution specific to protection of both mussels. However, insufficient implementation could become a threat to both mussel species if they continue to decline in numbers or if new information becomes available.

Point-source discharges within the range of the Neosho mucket and rabbitsfoot have been reduced since the enactment of the CWA. Despite some reductions in point source discharges, adequate protection may not be provided by the CWA for filter-feeding organisms that can be affected by extremely low levels of contaminants (see *Chemical Contaminants* discussion under Factor A). The Neosho mucket and rabbitsfoot continue to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors. Eight of the 11 (73 percent) streams with viable rabbitsfoot populations are listed as impaired waters under section 303(d) of the CWA. Reasons for impairment include mercury, nutrients, organic enrichment, dissolved oxygen depletion, pathogens, turbidity (sediment), and PCBs. In addition, numerous tributaries within watersheds supporting viable Neosho mucket and rabbitsfoot populations also are listed as impaired waters under section 303(d) of the CWA, which means that both species may be subjected to greater, albeit subtle, pervasive effects of chronic, low-level contamination that is ubiquitous in these watersheds. However, there is no specific information known about the sensitivity of the Neosho mucket and rabbitsfoot to common point source pollutants like industrial and municipal pollutants and very little information on other freshwater mussels. Because there is very little information known about water quality parameters necessary to fully protect freshwater mussels, such as the Neosho mucket and rabbitsfoot, it is difficult to determine whether the CWA is adequately addressing the threats to these species. However, given that a goal of the CWA is to establish water quality standards that protect shellfish and given that documented declines of these mussel species still continue due to poor water quality and other factors, we take a conservative approach in favor of the species and conclude that the CWA has been insufficient to significantly reduce or remove the threats to the Neosho mucket and rabbitsfoot. We invite public comment on this matter, and solicit information especially regarding water quality data that may be helpful in determining the water quality parameters necessary for these species' survival (see Information Requested, item #4).

Summary of Factor D

In summary, the CWA has a stated goal to establish water quality standards that protect aquatic species, including the Neosho mucket and rabbitsfoot. However, the CWA has generally been insufficient at protecting mussels, and adequate water quality criteria that are protective of all life stages, particularly glochidia and juveniles, may not be established. Little information is known about specific sensitivities of mussels to various pollutants, but both species continue to decline due to the effects of habitat destruction, poor water quality, contaminants, and other factors. Based on our analysis of the best available scientific and commercial data, we conclude that the CWA is inadequate to reduce or remove threats to the Neosho mucket and rabbitsfoot throughout all of their range.

E. Other Natural or Manmade Factors Affecting Its Continued Existence

Population Fragmentation and Isolation

Population fragmentation and isolation prohibit the natural interchange of genetic material between populations. Most of the remaining Neosho mucket and rabbitsfoot populations are small and geographically isolated, and, thus, are susceptible to genetic drift, inbreeding depression, and stochastic changes to the environment, such as toxic chemical spills (Smith 1990, pp. 311–321; Watters and Dunn 1995, pp. 257–258; Avise and Hamrick 1996, pp. 463–466). For example, the Spring River (White River basin) and Muddy Creek (Ohio River basin) rabbitsfoot populations are the only small populations not isolated from a viable population. Three marginal populations (Alleghany River and LeBoeuf and Conneauttee Creeks), considered metapopulations with French Creek, also are not isolated from a viable rabbitsfoot population (French Creek). However, 41 of 51 extant rabbitsfoot populations (80 percent) are isolated from other extant populations, excluding those discussed above and the Strawberry, Tennessee, and Ohio Rivers, which are viable populations that are not isolated from another viable population (Black River) or each other (lower Tennessee and Ohio Rivers).

Inbreeding depression can result in early mortality, decreased fertility, smaller body size, loss of vigor, reduced fitness, and various chromosome abnormalities (Smith 1990, pp. 311–321). A species' vulnerability to extinction is increased when they are patchily distributed due to habitat loss and degradation (Noss and Cooperrider 1994, pp. 58–62; Thomas 1994, p. 373). Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population size (the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval) (Shaffer 1981, p. 131; Shaffer and Samson 1985, pp. 148–150; Gilpin and Soulé 1986, pp. 25–33). Furthermore, this level of isolation makes natural repopulation of any extirpated population unlikely without human intervention. Population isolation prohibits the natural interchange of genetic material between populations, and small population size reduces the reservoir of genetic diversity within populations, which can lead to inbreeding depression (Avise and Hambrick 1996, p. 461).

Neosho mucket and rabbitsfoot were once widespread throughout their respective ranges with few natural barriers to prevent migration (via fish host species) among suitable habitats. However, construction of dams extirpated many Neosho mucket and rabbitsfoot populations and isolated others. Recruitment reduction or failure is a potential problem for many small Neosho mucket and rabbitsfoot populations rangewide, a potential condition exacerbated by their reduced range, increasingly small populations, and increasingly isolated populations. If these trends continue, further significant declines in total population size and subsequent reduction in long-term survivability may be observed in the future.

The likelihood is high that some rabbitsfoot and Neosho mucket populations are below the effective population size (EPS—the number of individuals in a population who contribute offspring to the next generation), based on restricted distribution and populations only represented by a few individuals, and achieving the EPS is necessary for a population to adapt to environmental change and maintain long-term viability. Isolated populations eventually are extirpated when population size drops below the EPS or threshold level of sustainability (Soulé 1980, pp. 162–164). Evidence of recruitment in many populations of these two species is scant, making recruitment reduction or outright failure suspect. These populations may be experiencing the bottleneck effect of not attaining the EPS. Small, isolated, below the EPS-threshold populations of short-lived species (most fish hosts) theoretically die out within a decade or so, while below-threshold populations of long-lived species, such as the Neosho mucket and rabbitsfoot, might take decades to die out even given years of total recruitment failure. Without genetic interchange, small, isolated populations could be slowly expiring, a phenomenon termed the extinction debt (Tilman *et al.* 1994, pp. 65–66). Even given the absence of existing or new anthropogenic threats, disjunct populations may be lost as a result of current below-threshold effective population size. Additionally, evidence indicates that general habitat degradation continues to decrease habitat patch size, further contributing to the decline of Neosho mucket and rabbitsfoot populations.

We find that fragmentation and isolation of small remaining populations of the Neosho mucket and rabbitsfoot are current and ongoing threats to both species throughout all of their ranges and will continue into the future. Further, stochastic events may play a magnified role in population extirpation when small, isolated populations are involved.

Invasive Nonindigenous Species

Various invasive or nonnative species of aquatic organisms are firmly established in the range of the Neosho mucket and rabbitsfoot. The nonnative, invasive species that poses the most significant threat is the zebra mussel, *Dreissena polymorpha,* introduced from Europe. Its invasion poses a threat to mussel faunas in many regions, and species extinctions are expected as a result of its continued spread in the eastern United States (Ricciardi *et al.* 1998, p. 613). Strayer (1999b, pp. 75–80) reviewed in detail the mechanisms by which zebra mussels affect native mussels. Zebra mussels attach in large numbers to the shells of live native mussels and are implicated in the loss of entire native mussel beds. Fouling effects include impeding locomotion (both laterally and vertically), interfering with normal valve movements, deforming valve margins, and locally depleting food resources and increasing waste products. Heavy infestations of zebra mussels on native mussels may overly stress the animals by reducing their energy stores. They may also reduce food concentrations to levels too low to support reproduction, or even survival in extreme cases. Zebra mussels also may affect Neosho mucket and rabbitsfoot through filtering and removing their sperm and possibly glochidia from the water column, thus reducing reproductive potential. Habitat for native mussels also may be degraded by large deposits of zebra mussel pseudofeces (undigested waste material passed out of the incurrent siphon) (Vaughan 1997, p. 11).

Overlapping much of the current range of the Neosho mucket and rabbitsfoot, zebra mussels have been detected or are established in Neosho mucket (Neosho and Verdigris Rivers) and rabbitsfoot streams (Ohio, Allegheny, Green, Tennessee, White, and Verdigris Rivers, and French and Bear Creeks). Zebra mussel populations appear to be maintained primarily in streams with barge navigation (Stoeckel *et al.* 2003, p. 334). As zebra mussels may maintain high densities in big rivers, large tributaries, and below infested reservoirs, rabbitsfoot populations in these affected areas have the potential to be significantly affected. In addition, there is long-term potential for zebra mussel invasions into other systems that currently harbor Neosho mucket and rabbitsfoot populations. However, evidence is mounting in some northern streams where there is no barge navigation (French Creek and Tippecanoe River) and southern ones with barge traffic (Tennessee River) that the zebra mussel threat to native mussels may be minimal because native freshwater mussel populations are able to survive when zebra mussel abundance is low (Butler 2005, p. 116; Fisher 2009, pers. comm.).

The Asian clam (*Corbicula fluminea*) has spread throughout the range of Neosho mucket and rabbitsfoot since its introduction in the early twentieth century. It competes with native mussels, particularly juveniles, for resources such as food, nutrients, and space (Neves and Widlak 1987, p. 6; Leff *et al.* 1990, p. 414), and may ingest sperm, glochidia, and newly metamorphosed juveniles of native mussels (Strayer 1999b, p. 82; Yeager *et al.* 2000, p. 255). Periodic die-offs of Asian clams may produce enough ammonia and consume enough dissolved oxygen to kill native mussels (Strayer 1999b, p. 82). Yeager *et al.* (2000, pp. 257–258) determined that high densities of Asian clams negatively affect the survival and growth of newly metamorphosed juvenile mussels and thus reduced recruitment. Dense Asian clam populations actively disturb sediments that may reduce habitat for juveniles of native mussels (Strayer 1999b, p. 82).

Asian clam densities vary widely in the absence of native mussels or in patches with sparse mussel concentrations, but Asian clam density is never high in dense mussel beds, indicating that the clam is unable to successfully invade small-scale habitat patches with high unionid biomass (Vaughn and Spooner 2006, pp. 334–335). The invading clam therefore appears to preferentially invade sites where mussels are already in decline (Strayer 1999b, pp. 82–83; Vaughn and Spooner 2006, pp. 332–336) and does not appear to be a causative factor in the decline of mussels in dense beds. However, an Asian clam population that thrives in previously stressed, sparse mussel populations might exacerbate mussel decline through competition and by impeding mussel population expansion (Vaughn and Spooner 2006, pp. 335–336).

A molluscivore (mollusk eater), the introduced black carp (*Mylopharyngodon piceus*), is a potential threat to Neosho mucket and rabbitsfoot (Strayer 1999b, p. 89). It has been proposed for widespread use by aquaculturists to control snails, the intermediate host of a trematode (flatworm) parasite affecting catfish in ponds in the southeast and lower midwest. They are known to feed on various mollusks, including mussels and snails, in China. They are the largest of the Asiatic carp species, reaching more than 1.2 m (4 ft) in length (Nico and Williams 1996, p. 6). Foraging rates for a 4-year-old fish average 1.4–1.8 kg (3 or 4 pounds) a day, indicating that a single individual could consume 9,072 kg (10 tons) of native mollusks during its lifetime (MICRA 2005, p. 1). In 1994, 30 black carp escaped from an aquaculture facility in Missouri during a flood. The escape of nonsterile black carp is considered imminent by conservation biologists (Butler 2007, pp. 95–96). The black carp was officially added to the Federal list of injurious wildlife species on October 18, 2007 (72 FR 59019).

The round goby (*Neogobius melanostomus*) is another nonnative, invasive fish species released in the 1980s that is well established and likely to spread through the Mississippi River system (Strayer 1999b, pp. 87–88). This species is an aggressive competitor of similar-sized benthic fishes (sculpins and darters), as well as a voracious carnivore, despite its size (less than 25.4 cm (10 in.) in length), preying on a variety of foods, including small mussels and fishes that could serve as glochidial hosts (Strayer 1999b, p. 88; Janssen and Jude 2001, p. 325). Round gobies may, therefore, pose a threat to Neosho mucket and rabbitsfoot reproduction.

Nonnative, invasive species, such as those described above, are an ongoing threat to the Neosho mucket and rabbitsfoot. This threat is likely to increase as these and potentially other invasive species expand their occupancy within the ranges of the Neosho mucket and rabbitsfoot through displacement, recruitment interference, and direct predation of the mussels and their fish hosts.

Temperature

Natural temperature regimes can be altered by impoundments, tail water releases from dams, industrial and municipal effluents, and changes in riparian habitat. Exact critical thermal limits for survival and normal functioning of many freshwater mussel species are unknown. However, high temperatures can reduce dissolved oxygen concentrations in the water, which slows growth, reduces glycogen stores, impairs respiration, and may inhibit reproduction (Fuller 1974, pp. 240–241). Low temperatures can significantly delay or prevent metamorphosis (Watters and O'Dee 1999, pp. 454–455). Water temperature increases have been documented to shorten the period of glochidial encystment, reduce righting speed (various reflexes that tend to bring the body into normal position in space and resist forces acting to displace it out of normal position), increase oxygen consumption, and slow burrowing and movement responses (Fuller 1974, pp. 240–241; Bartsch *et al.* 2000, p. 237; Watters *et al.* 2001, p. 546; Schwalb and Pusch 2007, pp. 264–265). Several studies have documented the influence of temperature on the timing aspects of mussel reproduction (Gray *et al.* 2002, p. 156; Allen *et al.* 2007, p. 85; Steingraeber *et al.* 2007, pp. 303–309). Peak glochidial releases are associated with water temperature thresholds that can be thermal minimums or maximums, depending on the species (Watters and O'Dee 2000, p. 136).

Alterations in temperature regimes in streams, such as those described above, are an ongoing threat to the Neosho mucket and rabbitsfoot. This threat is likely to continue and increase in the future due to additional navigation or water supply projects and as land use conversion to urban uses increases within the entire ranges of the Neosho mucket and rabbitsfoot.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms ''climate'' and ''climate change'' are defined by the Intergovernmental Panel on Climate Change (IPCC). ''Climate'' refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007, p. 78). The term ''climate change'' thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007, p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Projected changes in climate and related effects can vary substantially across and within different regions of the world (e.g., IPCC 2007a, pp. 8–12). Thus, although global climate projections are informative and in some cases are the only or the best scientific information available, to the extent possible we use ''downscaled'' climate projections which provide higher resolution information that is more relevant to the spatial scales used to assess effects to a given species (see Glick *et al.* 2011, pp. 58–61 for a discussion of downscaling). With regard to our analysis for the Neosho mucket and the rabbitsfoot, downscaled projections of climate change are available, but projecting precise effects on these two species from downscaled models is difficult because of the large geographic areas inhabited by both species. However, projections for the change in annual air temperature by the year 2080 for the Neosho mucket ranges between an increase of 7 to 8 degrees F and, for the rabbitsfoot, an increase of 4.5 to 8 degrees F in annual air temperature (Maura *et al.* 2007, as displayed on *http://www.climatewizard.org/# 2012*).

Ficke *et al.* (2005, pp. 67–69; 2007, pp. 603–605) described the general potential effects of climate change on freshwater fish populations worldwide. Overall, the distribution of fish species is expected to change, including range shifts and local extirpations. Because freshwater mussels are entirely dependent upon a fish host for successful reproduction and dispersal, any changes in local fish populations would also affect freshwater mussel populations. Therefore, mussel populations will reflect local extirpations or decreases in abundance of fish species.

Summary of Factor E

In summary, a variety of natural and manmade factors threatens the continued existence of Neosho mucket and rabbitsfoot. Forty-one of the 51 (80 percent) extant rabbitsfoot populations are isolated from viable populations. A lack of recruitment and genetic isolation pose a threat to the continued existence of these species. Invasive, nonindigenous species, such as zebra mussel, black carp, and Asian clam, have potentially adversely affected populations of the Neosho mucket and rabbitsfoot and their fish hosts, and these effects are expected to persist into the future. Based on the best available information, we are unable to predict the timing and scope of any changes to these mussel species that may occur as a result of climate change effects.

Cumulative Effects of Threats

The life-history traits and habitat requirements of the Neosho mucket and rabbitsfoot, and other freshwater mussels in general, make them extremely susceptible to environmental change. Unlike other aquatic organisms (e.g., aquatic insects and fish), mussels have limited refugia from stream disturbances (e.g., droughts, sedimentation, chemical contaminants). Mechanisms leading to the decline of Neosho mucket and rabbitsfoot, as discussed above, range from local (e.g., riparian clearing, chemical contaminants, etc.), to regional influences (e.g., altered flow regimes, channelization, etc.), to global climate change. The synergistic (interaction of two or more components) effects of threats are often complex in aquatic environments, making it difficult to predict changes in mussel and fish host(s) distribution, abundance, and habitat availability that may result from these effects. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination) (Galbraith *et al.* 2010, p. 1176) on Neosho mucket and rabbitsfoot populations.

Summary of Threats

The decline of the Neosho mucket and rabbitsfoot (described by Butler 2005, entire; described by Service 2010, entire) is primarily the result of habitat loss and degradation (Neves 1991, p. 252). Chief among the causes of decline, but in no particular ranking order, are impoundments, sedimentation, channelization, chemical contaminants, oil and natural gas development, and mining (Neves 1991, p. 252; Neves 1993, pp. 4–6; Williams *et al.* 1993, pp. 7–9; Neves *et al.* 1997, pp. 60 and 63–75; Watters 2000, pp. 262–267). These stressors have had profound adverse effects on Neosho mucket and rabbitsfoot populations, their habitats, and fish hosts.

Regulations at the Federal level may not be providing the protection needed for the Neosho mucket and rabbitsfoot. For example, 8 of the 11 (73 percent) viable rabbitsfoot populations are located in waters listed as impaired under section 303(d) of the CWA. In addition, numerous tributaries within watersheds with viable Neosho mucket and rabbitsfoot populations also are listed as impaired waters under section 303(d) of the CWA. The CWA has a stated goal to establish water quality standards that protect aquatic species, including mussel species. However, the CWA has generally been insufficient at protecting mussels, and adequate water quality criteria that are protective of all mussel life stages, particularly glochidia and juveniles, may not be established. Little information is known about specific sensitivities of mussels to various pollutants, but both species continue to decline due to the effects of poor water quality, contaminants, and other factors.

The majority of extant Neosho mucket populations are small and isolated, with only one viable population remaining. The majority of extant rabbitsfoot populations are marginal and small (78 percent) and isolated (80 percent), with only two small (5 percent) and 4 viable populations (36 percent) not isolated from another viable population (Butler 2005, p. 22; Service 2010, pp. 3–8). The patchy distributional pattern of populations in short river reaches makes them more susceptible to extirpation from single catastrophic events, such as toxic chemical spills (Watters and Dunn 1995, p. 257). Furthermore, this level of isolation makes natural recolonization of extirpated populations virtually impossible without human intervention. Various nonnative species of aquatic organisms are firmly established in the range of the Neosho mucket and rabbitsfoot. The nonnative species that poses the most significant threat to the Neosho mucket and rabbitsfoot is the zebra mussel. Although there are ongoing attempts to alleviate some of these threats at some locations, there appear to be no populations without threats that are significantly impacting the species.

Proposed Determination

We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the Neosho mucket and the rabbitsfoot. Section 3(6) of the Act defines an endangered species as ''any species that is in danger of extinction throughout all or a significant portion of its range'' and defines a threatened species as ''any species that is likely to become endangered throughout all or a significant portion of its range within the foreseeable future.'' As described in detail above, these two species are currently at risk throughout all of their respective ranges due to the immediacy, severity, and scope of threats from habitat destruction and modification (Factor A), inadequacy of existing regulatory mechanisms (Factor D), and other natural or manmade factors affecting their continued existence (Factor E). Although there are ongoing actions to alleviate some threats, there appear to be no populations without current threats. These isolated species have a limited ability to recolonize historically occupied stream and river reaches and are vulnerable to natural or human-caused changes in their stream and river habitats.

Their range curtailment, small population size, and isolation make the Neosho mucket and rabbitsfoot more vulnerable to threats such as sedimentation, disturbance of riparian corridors, changes in channel morphology, point- and nonpoint-source contaminants, urbanization, invasive species, and to stochastic events (such as chemical spills).

Neosho mucket

The Neosho mucket has been extirpated (no longer in existence) from approximately 62 percent of its historical range with only 9 of the 16 historical populations remaining (extant). This mussel is declining rangewide (eight of the nine extant populations), with only one remaining large, viable population. Based on the best available scientific and commercial information, we have determined that the Neosho mucket is in danger of extinction throughout all of its range. Therefore, we are proposing to list it as an endangered species. In other words, we find that a threatened species status is not appropriate for the Neosho mucket due to its contracted range (nine extant river populations within three river basins) and only one remaining stable and viable population.

Rabbitsfoot

The rabbitsfoot has been extirpated from approximately 64 percent of its historical range. While this species is declining rangewide, it sustains recruitment and population viability consistently in 11 (8 percent of historical or 22 percent of extant distribution) large, extant river populations and, while reduced in numbers, it also sustains limited recruitment and distribution in another 17 river populations. Of the 17 river populations with limited recruitment and distribution, 15 of these populations (88 percent) are declining.

All remaining rabbitsfoot populations continue to be reduced in size or quality by habitat degradation as a result of impoundments and dams, navigation projects, commercial and residential development, agriculture, chemical contaminants, mining, and oil and natural gas development. Climate change could affect in-stream water temperatures, seasonal water flows, and mussel and fish host reproductive activities, including the availability of mussel fish host species. Invasive species occupying rabbitsfoot habitat cause displacement and recruitment interference. Eight of the 11 (73 percent) viable rabbitsfoot populations are in waters and have numerous tributaries in their watersheds that are listed as impaired waters under section 303(d) of the CWA. Regulatory mechanisms such as the CWA have been insufficient to significantly reduce or remove these types of threats to rabbitsfoot. The synergistic effects of threats such as these are often complex in aquatic environments and, while making it difficult to predict changes in mussel and fish host(s) distribution, abundance, and habitat availability, it is probable that these threats are acting simultaneously on the remaining rabbitsfoot populations with negative results and are expected to continue to do so. Thus, while rabbitsfoot sustains 11 viable populations, these populations continue to be at risk, and the rabbitsfoot's other extant populations are affected by isolation, fragmentation, limited recruitment and distribution, and population declines, which make the species particularly susceptible to extinction in the near future if threats continue or increase.

While we have determined that the rabbitsfoot is not currently in danger of extinction, because of the threats facing the species and impacts to its life history, we find that the species is likely to become in danger of extinction in the foreseeable future throughout all of its range. Therefore, we are proposing to list it as a threatened species. In other words, we find that endangered status is not appropriate for the rabbitsfoot because 8 percent of the historical populations or 22 percent of extant populations remaining in its historical streams can be considered viable, but are facing subtle, pervasive threats that are ubiquitous in each watershed.

Significant Portion of Its Range

Under the Act and our implementing regulations, a species may warrant listing if it is endangered or threatened throughout all or a significant portion of its range. The Act defines ''endangered species'' as any species which is ''in danger of extinction throughout all or a significant portion of its range,'' and ''threatened species'' as any species which is ''likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.'' The definition of ''species'' is also relevant to this discussion. The Act defines ''species'' as follows: ''The term 'species' includes any subspecies of fish or wildlife or plants, and any distinct population segment [DPS] of any species of vertebrate fish or wildlife which interbreeds when mature.'' The phrase ''significant portion of its range'' (SPR) is not defined by the statute, and we have never addressed in our regulations: (1) The consequences of a determination that a species is either endangered or likely to become so throughout a significant portion of its range, but not throughout all of its range; or (2) what qualifies a portion of a range as ''significant.''

Two recent district court decisions have addressed whether the SPR language allows the Service to list or protect less than all members of a defined ''species'': *Defenders of Wildlife* v. *Salazar,* 729 F. Supp. 2d 1207 (D. Mont. 2010), concerning the Service's delisting of the Northern Rocky Mountain gray wolf (74 FR 15123, April 2, 2009); and *WildEarth Guardians* v. *Salazar,* 2010 U.S. Dist. LEXIS 105253 (D. Ariz. September 30, 2010), concerning the Service's 2008 finding on a petition to list the Gunnison's prairie dog (73 FR 6660, February 5, 2008). The Service had asserted in both of these determinations that it had authority, in effect, to protect only some members of a ''species,'' as defined by the Act (i.e., species, subspecies, or DPS), under the Act. Both courts ruled that the determinations were arbitrary and capricious on the grounds that this approach violated the plain and unambiguous language of the Act. The courts concluded that reading the SPR language to allow protecting only a portion of a species' range is inconsistent with the Act's definition of ''species.'' The courts concluded that once a determination is made that a species (i.e., species, subspecies, or DPS) meets the definition of ''endangered species'' or ''threatened species,'' it must be placed on the list in its entirety and the Act's protections applied consistently to all members of that species (subject to modification of protections through special rules under sections 4(d) and 10(j) of the Act).

Consistent with that interpretation, and for the purposes of this finding, we interpret the phrase ''significant portion of its range'' in the Act's definitions of ''endangered species'' and ''threatened species'' to provide an independent basis for listing; thus there are two situations (or factual bases) under which a species would qualify for listing: A species may be endangered or threatened throughout all of its range; or a species may be endangered or threatened in only a significant portion of its range. If a species is in danger of extinction throughout a significant portion of its range, the species is an ''endangered species.'' The same analysis applies to ''threatened species.'' Based on this interpretation and supported by existing case law, the consequence of finding that a species is endangered or threatened in only a significant portion of its range is that the entire species shall be listed as endangered or threatened, respectively, and the Act's protections shall be applied across the species' entire range.

We conclude, for the purposes of this finding, that interpreting the significant portion of its range phrase as providing an independent basis for listing is the best interpretation of the Act because it is consistent with the purposes and the plain meaning of the key definitions of the Act; it does not conflict with established past agency practice (i.e., prior to the 2007 Solicitor's Opinion), as no consistent, long-term agency practice has been established; and it is consistent with the judicial opinions that have most closely examined this issue. Having concluded that the phrase ''significant portion of its range'' provides an independent basis for listing and protecting the entire species, we next turn to the meaning of ''significant'' to determine the threshold for when such an independent basis for listing exists.

Although there are potentially many ways to determine whether a portion of a species' range is ''significant,'' we conclude, for the purposes of this finding, that the significance of the portion of the range should be determined based on its biological contribution to the conservation of the species. For this reason, we describe the threshold for ''significant'' in terms of an increase in the risk of extinction for the species. We conclude that a biologically based definition of ''significant'' best conforms to the purposes of the Act, is consistent with judicial interpretations, and best ensures species' conservation. Thus, for the purposes of this finding, and as explained further below, a portion of the range of a species is ''significant'' if its contribution to the viability of the species is so important that without that portion, the species would be in danger of extinction.

We evaluate biological significance based on the principles of conservation biology using the concepts of redundancy, resiliency, and representation. *Resiliency* describes the characteristics of a species and its habitat that allow it to recover from periodic disturbance. *Redundancy* (having multiple populations distributed across the landscape) may be needed to provide a margin of safety for the species to withstand catastrophic events. *Representation* (the range of variation found in a species) ensures that the species' adaptive capabilities are conserved. Redundancy, resiliency, and representation are not independent of each other, and some characteristic of a species or area may contribute to all three. For example, distribution across a wide variety of habitat types is an indicator of representation, but it may also indicate a broad geographic distribution contributing to redundancy (decreasing the chance that any one event affects the entire species), and the likelihood that some habitat types are less susceptible to certain threats, contributing to resiliency (the ability of the species to recover from disturbance). None of these concepts is intended to be mutually exclusive, and a portion of a species' range may be determined to be ''significant'' due to its contributions under any one or more of these concepts.

For the purposes of this finding, we determine if a portion's biological contribution is so important that the portion qualifies as ''significant'' by asking whether *without that portion,* the representation, redundancy, or resiliency of the species would be so impaired that the species would have an increased vulnerability to threats to the point that the overall species would be in danger of extinction (i.e., would be ''endangered''). Conversely, we would not consider the portion of the range at issue to be ''significant'' if there is sufficient resiliency, redundancy, and representation elsewhere in the species' range that the species would not be in danger of extinction throughout its range if the population in that portion of the range in question became extirpated (extinct locally).

We recognize that this definition of ''significant'' (a portion of the range of a species is ''significant'' if its contribution to the viability of the species is so important that, without that portion, the species would be in danger of extinction) establishes a threshold that is relatively high. On the one hand, given that the consequences of finding a species to be endangered or threatened in a significant portion of its range would be listing the species throughout its entire range, it is important to use a threshold for ''significant'' that is robust. It would not be meaningful or appropriate to establish a very low threshold whereby a portion of the range can be considered ''significant'' even if only a negligible increase in extinction risk would result from its loss. Because nearly any portion of a species' range can be said to contribute some increment to a species' viability, use of such a low threshold would require us to impose restrictions and expend conservation resources disproportionately to conservation benefit: Listing would be rangewide, even if only a portion of the range of minor conservation importance to the species is imperiled. On the other hand, it would be inappropriate to establish a threshold for ''significant'' that is too high. This would be the case if the standard were, for example, that a portion of the range can be considered ''significant'' only if threats in that portion result in the entire species' being currently endangered or threatened. Such a high bar would not give the significant portion of its range phrase independent meaning, as the Ninth Circuit held in *Defenders of Wildlife* v. *Norton,* 258 F.3d 1136 (9th Cir. 2001).

The definition of ''significant'' used in this finding carefully balances these concerns. By setting a relatively high threshold, we minimize the degree to which restrictions will be imposed or resources expended that do not contribute substantially to species conservation. But we have not set the threshold so high that the phrase ''in a significant portion of its range'' loses independent meaning. Specifically, we have not set the threshold as high as it was under the interpretation presented by the Service in the *Defenders* litigation. Under that interpretation, the portion of the range would have to be so important that current imperilment there would mean that the species would be *currently* imperiled everywhere. Under the definition of ''significant'' used in this finding, the portion of the range need not rise to such an exceptionally high level of biological significance. (We recognize that if the species is imperiled in a portion that rises to that level of biological significance, then we should conclude that the species is in fact imperiled throughout all of its range, and that we would not need to rely on the significant portion of its range language for such a listing.) Rather, under this interpretation we ask whether the species would be endangered everywhere without that portion, *i.e.,* if that portion were completely extirpated. In other words, the portion of the range need not be so important that even the species being in danger of extinction in that portion would be sufficient to cause the species in the remainder of the range to be endangered; rather, the *complete extirpation* (in a hypothetical future) of the species in that portion would be required to cause the species in the remainder of the range to be endangered.

The range of a species can theoretically be divided into portions in an infinite number of ways. However, there is no purpose to analyzing portions of the range that have no reasonable potential to be significant or to analyzing portions of the range in which there is no reasonable potential for the species to be endangered or threatened. To identify only those portions that warrant further consideration, we determine whether there is substantial information indicating that: (1) The portions may be ''significant,'' *and* (2) the species may be in danger of extinction there or likely to become so within the foreseeable future. Depending on the biology of the species, its range, and the threats it faces, it might be more efficient for us to address the significance question first or the status question first. Thus, if we determine that a portion of the range is not ''significant,'' we do not need to determine whether the species is endangered or threatened there; if we determine that the species is not endangered or threatened in a portion of its range, we do not need to determine if that portion is ''significant.'' In practice, a key part of the determination that a species is in danger of extinction in a significant portion of its range is whether the threats are geographically concentrated in some way. If the threats to the species are essentially uniform throughout its range, no portion is likely to warrant further consideration. Moreover, if any concentration of threats to the species occurs only in portions of the species' range that clearly would not meet the biologically based definition of ''significant,'' such portions will not warrant further consideration.

We evaluated the current range of the Neosho mucket and rabbitsfoot to determine if there is any apparent geographic concentration of potential threats for either species. The Neosho mucket and rabbitsfoot are highly restricted in their ranges, and the threats occur throughout their ranges. We considered the potential threats due to impoundments, sedimentation, channelization, chemical contaminants, oil and gas development, mining, and climate change. We found no concentration of threats because of the species limited and curtailed ranges, and uniformity of the threats throughout its entire range. Having determined that the Neosho mucket is endangered throughout its entire range, it is not necessary to evaluate whether there are any significant portions of its range. Having determined that the rabbitsfoot is threatened throughout its entire range, we must next consider whether there are any significant portions of the range where the rabbitsfoot is in danger of extinction or is likely to become endangered in the foreseeable future.

We found no portion of the rabbitsfoot's range where potential threats are significantly concentrated or substantially greater than in other portions of their range. Therefore, we find that factors affecting the species are essentially uniform throughout its range, indicating no portion of the range of the species warrants further consideration of possible endangered or threatened status under the Act. Therefore, we find there is no significant portion of the rabbitsfoot range that may warrant a different status.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in public awareness and conservation by Federal, State, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and requires that recovery actions be carried out for all listed species. The protection required of Federal agencies and the prohibitions against take and harm are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act requires the Service to develop and implement recovery plans for the conservation of endangered and threatened species, unless such a plan will not promote the conservation of the species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and after preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan identifies site–specific management actions that set a trigger for review of the five factors that control whether a species remains endangered or may be downlisted or delisted, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (comprising species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, the recovery outline, draft recovery plan, and the final recovery plan will be available on our Web site (*http://www.fws.gov/endangered*), or from our Arkansas Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. Achieving recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

If these species are listed, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the States of Alabama, Arkansas, Indiana, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, and Tennessee would be eligible for Federal funds to implement management actions that promote the protection or recovery of the Neosho mucket and rabbitsfoot. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants.*

Although the Neosho mucket and rabbitsfoot are only proposed for listing under the Act at this time, please let us know if you are interested in participating in recovery efforts for these species. Additionally, we invite you to submit any new information on these species whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as endangered or threatened and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Federal agencies are required to confer with us informally on any action that is likely to jeopardize the continued existence of a proposed species. Section 7(a)(4) requires Federal agencies to confer with the Service on any action that is likely to jeopardize the continued existence of a species proposed for listing or result in destruction or adverse modification of proposed critical habitat. If a species is listed subsequently, section 7(a)(2) requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of the species or destroy or adversely modify its critical habitat. If a Federal action may adversely affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Federal agency actions within these species' habitat that may require conference or consultation or both as described in the preceding paragraph include, but are not limited to, the funding of, carrying out, or the issuance of permits for reservoir construction, navigation, natural gas extraction, stream alterations, discharges, wastewater facility development, water withdrawal projects, pesticide registration, mining, and road and bridge construction. This may include, but is not limited to, management and any other landscape-altering activities on Federal lands administered by the Department of Defense, and USDA Forest Service; issuance of Clean Water Act permits by the Army Corps of Engineers and Environmental Protection Agency; construction and maintenance of interstate power and natural gas transmission line right-of-ways by the Federal Energy Regulatory Commission; and construction and maintenance of roads or highways by the Federal Highway Administration.

The Act and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered wildlife. The prohibitions of section 9(a)(2) of the Act, codified at 50 CFR 17.21 for endangered wildlife, in part, make it illegal for any person subject to the jurisdiction of the United States to take (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt any of these), import, export, ship in interstate commerce in the course of commercial activity, or sell or offer for sale in interstate or foreign commerce any listed species. Under the Lacey Act (18 U.S.C. 42–43; 16 U.S.C. 3371–3378), it is also illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken illegally. Certain exceptions apply to agents of the Service and State conservation agencies.

We may issue permits to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits are codified at 50 CFR 17.22 for endangered species, and at 17.32 for threatened species. With regard to endangered wildlife, a permit must be issued for the following purposes: for scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities.

It is our policy, as published in the **Federal Register** on July 1, 1994 (59 FR 34272), to identify to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a proposed listing on proposed and ongoing activities within the range of species proposed for listing. The following activities could potentially result in a violation of section 9 of the Act; this list is not comprehensive:

(1) Collecting, handling, possessing, selling, delivering, carrying, or transporting of the species, including import or export across State lines and international boundaries that are unauthorized, except for properly documented antique specimens of these taxa at least 100 years old, as defined by section 10(h)(1) of the Act;

(2) Introduction of nonnative species that compete with or prey upon the Neosho mucket and rabbitsfoot, such as the introduction of a predator of mussels, the nonnative black carp to a water body (White River) in the State of Arkansas;

(3) The release of biological control agents that attack any life stage of Neosho mucket and rabbitsfoot that is unauthorized;

(4) Modification of the channel or water flow of any stream in which the Neosho mucket and rabbitsfoot are known to occur that are unauthorized or not covered under the Act for impacts to these species; and

(5) Discharge of chemicals or fill material into any waters supporting the Neosho mucket and rabbitsfoot that are unauthorized or not covered under the Act for impacts to these species.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the Service's Field Office in the State where the proposed activities will occur. Requests for copies of the regulations concerning listed animals and general inquiries regarding prohibitions and permits may be addressed to the U.S. Fish and Wildlife Service, Endangered Species Permits, 1875 Century Boulevard, Suite 200, Atlanta, GA 30345; telephone: 404–679–7140; facsimile: 404–679–7081.

If the Neosho mucket and rabbitsfoot are listed under the Act, the States of Kansas and Oklahoma's Endangered Species Act (Kansas Nongame and Endangered Species Conservation Act of 1975, Chapter 32. Wildlife, Parks and Recreation and Oklahoma Wildlife Conservation Code, Title 29, Game and Fish, Chapter 1, Article V. Game, Part 4, Protected Game, respectively) are automatically invoked, which would also prohibit take of these species and encourage conservation by State government agencies. Further, the State may enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species. Funds for these activities could be made available under section 6 of the Act (Cooperation with the States). Thus, the Federal protection afforded to these species by listing them as endangered and threatened species will be reinforced and supplemented by protection under State law.

Critical Habitat Designation for Neosho Mucket and Rabbitsfoot

Background

It is our intent to discuss below only those topics directly relevant to the designation of critical habitat for Neosho mucket and rabbitsfoot in this section of the proposed rule.

Critical habitat is defined in section 3 of the Act as:

(1) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features:

(a) Essential to the conservation of the species and

(b) Which may require special management considerations or protection; and

(2) Specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means to use and the use of all methods and procedures that are necessary to bring an endangered or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the requirement that Federal agencies ensure, in consultation with the Service, that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by non-Federal landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) of the Act would apply, but even in the event of a destruction or adverse modification finding, the obligation of the Federal action agency and the landowner is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.

Under the first prong of the Act's definition of critical habitat, areas within the geographic area occupied by the species at the time it was listed are included in a critical habitat designation if they contain physical or biological features (1) which are essential to the conservation of the species and (2) which may require special management considerations or protection. For these areas, critical habitat designations identify, to the extent known using the best scientific and commercial data available, those physical or biological features that are essential to the conservation of the species (such as space, food, cover, and protected habitat). In identifying those physical and biological features within an area, we focus on the principal biological or physical constituent elements (primary constituent elements such as roost sites, nesting grounds, seasonal wetlands, water quality, tide, soil type) that are essential to the conservation of the species. Primary constituent elements are the elements of physical or biological features that, when laid out in the appropriate quantity and spatial arrangement to provide for a species' life-history processes, are essential to the conservation of the species.

Under the second prong of the Act's definition of critical habitat, we can designate critical habitat in areas outside the geographic area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. For example, an area currently occupied by the species but that was not occupied at the time of listing may be essential to the conservation of the species and may be included in the critical habitat designation. We designate critical habitat in areas outside the geographic area occupied by a species only when a designation limited to its range would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific data available. Further, our Policy on Information Standards Under the Endangered Species Act (published in the **Federal Register** on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When we are determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, other unpublished materials, or experts' opinions or personal knowledge.

Habitat is dynamic, and species may move from one area to another over time. Climate change will be a particular challenge for biodiversity because the interaction of additional stressors associated with climate change and current stressors may push species beyond their ability to survive (Lovejoy 2005, pp. 325–326). The synergistic implications of climate change and habitat fragmentation are the most threatening facet of climate change for biodiversity (Hannah and Lovejoy 2005, p. 4). Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field *et al.* 1999, pp. 1–3; Hayhoe *et al.* 2004, p. 12422; Cayan *et al.* 2005, p. 6; Intergovernmental Panel on Climate Change (IPCC) 2007, p. 1181). Climate change may lead to increased frequency and duration of severe storms and droughts (Golladay *et al.* 2004, p. 504; McLaughlin *et al.* 2002, p. 6074; Cook *et al.* 2004, p. 1015). We recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species. For these reasons, a critical habitat designation does not signal that habitat outside the designated area is unimportant or may not be needed for recovery of the species. Areas that are important to the conservation of the species, both inside and outside the critical habitat designation, will continue to be subject to: (1) Conservation actions implemented under section 7(a)(1) of the Act, (2) regulatory protections afforded by the requirement in section 7(a)(2) of the Act for Federal agencies to ensure their actions are not likely to jeopardize the continued existence of any endangered or threatened species, and (3) section 9 of the Act's prohibitions on taking any individual of the species, including taking caused by actions that affect habitat. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. These protections and conservation tools will continue to contribute to recovery of these species. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans (HCPs), or other species conservation planning efforts if new information available at the time of these planning efforts calls for a different outcome.

Prudency Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary designate critical habitat at the time the species is determined to be endangered or threatened. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist: (1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or (2) such designation of critical habitat would not be beneficial to the species.

There is currently no impending threat of take attributed to collection or vandalism under Factor B for either of these species, and identification and mapping of critical habitat is not expected to initiate any such threat. In the absence of finding that the designation of critical habitat would increase threats to a species, if there are any benefits to a critical habitat designation, then a prudent finding is warranted. Here, the potential benefits of designation include: (1) Triggering consultation under section 7 of the Act in new areas for actions in which there may be a Federal nexus where it would not otherwise occur because, for example, it is or has become unoccupied or the occupancy is in question; (2) focusing conservation activities on the most essential features and areas; (3) providing educational benefits to State or county governments or private entities; and (4) preventing people from causing inadvertent harm to the species. Therefore, because we have determined that the designation of critical habitat will not likely increase the degree of threat to the species and may provide some measure of benefit, we find that designation of critical habitat is prudent for the Neosho mucket and rabbitsfoot.

Critical Habitat Determinability

Having determined that designation of critical habitat is prudent, under section 4(a)(3) of the Act, we must find whether critical habitat is determinable for the two species. Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable when one or both of the following situations exist:

(i) Information sufficient to perform required analyses of the impacts of the designation is lacking, or

(ii) The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

When critical habitat is not determinable, the Act allows the Service an additional year to publish a critical habitat designation (16 U.S.C. 1533(b)(6)(C)(ii)).

We reviewed the available information pertaining to the biological needs of the species and habitat characteristics where these species are located. This and other information represent the best scientific data available and led us to conclude that the designation of critical habitat is determinable for the Neosho mucket and rabbitsfoot.

Physical or Biological Features

In accordance with section 3(5)(A)(i) and 4(b)(1)(A) of the Act and regulations at 50 CFR 424.12, in determining which areas within the geographic area occupied by the species at the time of listing to designate as critical habitat, we consider the physical or biological features that are essential to the conservation of the species and which may require special management considerations or protection. These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;

(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) Cover or shelter;

(4) Sites for breeding, reproduction, or rearing (or development) of offspring; and

(5) Habitats that are protected from disturbance or are representative of the historical, geographic, and ecological distributions of a species.

We derive the specific physical or biological features required for Neosho mucket and rabbitsfoot from studies of these species' habitat, ecology, and life history as described below. Additional information can be found in the STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section of this proposed rule. We have determined that the following physical or biological features are essential for Neosho mucket and rabbitsfoot.

Space for Individual and Population Growth and for Normal Behavior

The Neosho mucket is historically associated with the Illinois, Neosho, and Verdigris Rivers and their larger tributaries (Arkansas River basin). Generally, the Neosho mucket is found embedded in stable substrates associated with shallow riffles (areas where shallow, generally less than 1 m (3.3 ft) in depth, turbulent water passes through and over stones or gravel of somewhat similar size) and runs (intermediate areas between pools and riffles with moderate current) with gravel and sand substrate and moderate to swift currents (Oesch 1984, p. 221; Harris 1998, p. 5; Obermeyer 2000, pp. 15–16). However, in Shoal Creek and the Illinois River, the Neosho mucket prefers near-shore areas or areas out of the main current (Harris 1998, p. 5). These habitats are formed and maintained by water quantity, channel slope, and normal sediment input to the system.

The rabbitsfoot is historically associated with small- to medium-sized streams and some larger rivers in the Lower Great Lakes and Lower Mississippi River sub-basins and Ohio, Cumberland, Tennessee, White, Arkansas, and Red River basins. The rabbitsfoot usually occurs in shallow areas along the bank and adjacent runs and riffles with gravel and sand substrates where the water velocity is reduced, but it also may occur in deep runs (Parmalee and Bogan 1998, pp. 211–212). Unlike the Neosho mucket (Barnhart 2003, p. 17), the rabbitsfoot seldom burrows in the substrate, but lies on its side (Watters 1988, p. 13; Fobian 2007, p. 24).

Neosho mucket and rabbitsfoot, similar to other mussels, are dependent on areas with flow refuges where shear stress (the stream's ability to entrain and transport bed material created by the flow acting on the bed material) is low and sediments remain stable during flood events (Layzer and Madison 1995, p. 341; Strayer 1999a, pp. 468 and 472; Hastie *et al.* 2001, pp. 111–114). Flow refuges conceivably allow relatively immobile mussels such as the Neosho mucket and rabbitsfoot to remain in the same general location throughout their entire lives. These patches of stable habitat may be highly important for the rabbitsfoot since it typically does not burrow, making it more susceptible to displacement into unsuitable habitat. However, flow refuges are not created equally and there are likely other habitat variables that are important, but poorly understood (Roberts 2008, pers. comm.).

Natural river and creek channel stability are achieved by allowing the river or creek to develop a stable dimension, pattern, and profile, such that, over time, channel features are maintained and the river or creek system neither aggrades nor degrades. Channel instability occurs when the scouring (flushing) process leads to degradation or excessive sediment deposition results in aggradation. Stable rivers and creeks consistently transport their sediment load, both in size and type, associated with local deposition and scour (Rosgen 1996, pp. 1–3).

Habitat conditions described above provide space, cover, shelter, and sites for breeding, reproduction, and growth of offspring for the Neosho mucket and rabbitsfoot. These habitats are formed and maintained by water quantity, channel features (dimension, pattern, and profile), and sediment input to the system through periodic flooding, which maintains connectivity and interaction with the flood plain, and are dynamic. Changes in one or more of these parameters can result in channel degradation or aggradation, with serious effects to mussels. Therefore, we identify adequate water quantity, stream channel stability, and floodplain connectivity to be physical and biological features for Neosho mucket and rabbitsfoot that are essential in accommodating feeding, breeding, growth, and other normal behaviors of these species and in promoting gene flow within each species' populations and movement of their fish hosts.

Food, Water, Air, Light, Minerals, or Other Nutritional or Physiological Requirements

The Neosho mucket and rabbitsfoot are riverine-adapted species that depend upon adequate water flow and are not found in ponds or lakes. Continuously flowing water is a habitat feature associated with all surviving populations of these species. Flowing water maintains the river and creek bottoms and flow refuge habitats in riffles and runs where these species are found, transports food items to the sedentary juvenile and adult life stages, removes wastes, and provides oxygen for respiration of the Neosho mucket and rabbitsfoot. A natural flow regime that includes periodic flooding and maintains connectivity and interaction with the floodplain is critical for the exchange of nutrients, movement of and spawning activities for potential fish hosts, and maintenance of flow refuges in riffle and run habitats.

Mussels, such as the Neosho mucket and rabbitsfoot, filter algae, detritus, microscopic animals, and bacteria from the water column (Fuller 1974, p. 221; Silverman *et al.* 1997, pp. 1862–1865; Nichols and Garling 2000, pp. 874–876; Strayer *et al.* 2004, pp. 430–431). Encysted glochidia are nourished by their fish hosts and feed for a period of one week to several months. Nutrient uptake by glochidia is not well understood, but probably occurs through the microvillae of the mantle (Watters 2007, p. 55). For the first several months, juvenile mussels partially employ pedal (foot) feeding, extracting bacteria, algae, and detritus from the sediment, although they also may filter interstitial (pore) water (Yeager *et al.* 1994, pp. 217–221). However, their gills are rudimentary and generally incapable of filtering particles (Watters 2007, p. 56). Adult mussels also can obtain their food by deposit feeding, siphoning in food from the sediment and its interstitial (pore) water and pedal feeding directly from the sediment (Yeager *et al.* 1994, pp. 217–221; Vaughn and Hakenkamp 2001, pp. 1432–1438). Food availability and quality for the Neosho mucket and rabbitsfoot in their habitats are affected by habitat stability, floodplain connectivity, flow, and water and sediment quality.

The ranges of many water quality parameters that define suitable habitat conditions for the Neosho mucket and rabbitsfoot have not been investigated or are poorly understood. The pathways of exposure to a variety of environmental pollutants for all four mussel life stages (free and encysted glochidia, juveniles, and adults) and differences in exposure and sensitivity were previously discussed (Factor A). Environmental contamination is a causal (contributing) factor in the decline of mussel populations. We estimate that most numeric standards for pollutants and water quality parameters (for example, dissolved oxygen, pH, heavy metals) that have been adopted by the States under the Clean Water Act represent levels that are essential to the conservation of these mussels. However, some regulatory mechanisms may not adequately protect mollusks in some reaches (see Factor D). The Service is currently in consultation with the EPA to evaluate the protectiveness of criteria approved in EPA's water quality standards for endangered and threatened species and their critical habitat as described in the Memorandum of Agreement that our agencies signed in 2001 (66 FR 11201, February 22, 2001). Other factors that can potentially alter water quality are droughts and periods of low flow, nonpoint-source runoff from adjacent land surfaces (excessive amounts of sediments, nutrients, and pesticides), point-source discharges from municipal and industrial wastewater treatment facilities (excessive amounts of ammonia, chlorine, and metals), and random spills or unregulated discharge events. This could be particularly harmful during drought conditions when flows are depressed and pollutants are more concentrated.

As relatively sedentary animals, mussels must tolerate the full range of environmental stressors that occur within the streams where they persist. Both the amount (flow) and the physical and chemical conditions (sediment and water quality) where these species currently exist vary widely according to season, precipitation events, and seasonal human activities within the various watersheds. Conditions across their historical ranges vary even more due to geology, geography, and differences in human population densities and land uses. In general, these species survive in areas where the severity, frequency, duration, and seasonality of water flow is adequate to maintain stable flow refuges in riffle and run habitats (sufficient flow to remove fine particles and sediments without causing degradation), and where sediment and water quality is adequate for year-round survival (moderate to high levels of dissolved oxygen; low to moderate exposure to environmental pollutants such as nutrients, dissolved metals, and pharmaceuticals; and relatively unpolluted water and sediments). Adequate water flow, water quality, and sediment quality (as defined above) are essential for normal behavior, growth, and viability during all life stages of the Neosho mucket and rabbitsfoot and their potential larva fish hosts. Therefore, based on the information above, we identify water flow, water quality, and sediment quality to be physical or biological features for both these species.

Sites for Breeding, Reproduction, or Rearing

Mussels require a fish host for transformation of larval mussels (glochidia) to juvenile mussels (Williams *et al.* 2008, p. 68); therefore, presence of the appropriate fish host(s) is essential to the conservation of the Neosho mucket and rabbitsfoot (see STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT). Neosho mucket and rabbitsfoot juveniles require stable habitats with adequate water quantity and quality as previously described for growth and survival. Excessive sediments or dense growth of filamentous algae can expose juvenile mussels to entrainment or predation and be detrimental to the survival of juvenile mussels (Hartfield and Hartfield 1996, pp. 372–374). Geomorphic instability can result in the loss of interstitial habitats and juvenile mussels due to scouring or deposition (Hartfield 1993, pp. 372–373). Water quality, sediment quality, stable habitat, health of fish hosts, and diet (of all life stages) all influence survival of each life stage and subsequent reproduction and recruitment (Cope *et al.* 2008, p. 452).

Connections between the rivers and adjacent flood plains occur periodically during wet years and provide habitat for spawning and foraging fish hosts that require flood plain habitats for successful reproduction and recruitment to adulthood. Barko *et al.* (2006, pp. 252–256) found that several fish host or potential host species benefited from exploiting the resources of flood plain habitats that were not typically available for use during normal hydrology years. Furthermore, Kwak (1988, pp. 243–247) and Slipke *et al.* (2005, p. 289) indicated that periodic inundation of floodplain habitats increased successful fish reproduction, which leads to increased availability of native host fishes for mussel reproduction. However, Rypel *et al.* (2009, p. 502) indicated that mussels tended to exhibit minimal growth during high flow years. Therefore, optimal flooding of these habitats would not be too frequent and should occur at similar frequencies to that of the natural hydrologic regime of the rivers and creeks inhabited by the Neosho mucket and rabbitsfoot. Based on the information above, we identify water quality, sediment quality, stable habitat, health of fish hosts, diet (of all life stages), and periodic flooding of floodplain habitat to be physical or biological features for these species.

Primary Constituent Elements (PCEs) for the Neosho Mucket and Rabbitsfoot

Under the Act and its implementing regulations, we are required to identify the physical or biological features (PBFs) essential to the conservation of Neosho mucket and the rabbitsfoot in areas occupied at the time of listing, focusing on the features' primary constituent elements. We consider primary constituent elements (PCEs) to be the elements of physical or biological features that, when laid out in the appropriate quantity and spatial arrangement to provide for a species' life-history processes, are essential to the conservation of the species.

In addition to the physical and biological features just described, we derive the PCEs from the biological needs of these species as described in the STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section of this proposed rule. Little is known of the specific habitat requirements for the Neosho mucket and rabbitsfoot other than that they require flowing water, stable river channels, adequate food, suitable substrate, and adequate water and sediment quality. Neosho mucket and rabbitsfoot mussel larvae also require fish hosts for development to juvenile mussels (see STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section). To identify the physical and biological needs of these species, we have relied on current conditions at locations where the species survive, the limited information available on these species and their close relatives, and factors associated with the decline and extirpation of these and other aquatic mollusks from extensive portions of the Lower Great Lakes and Lower Mississippi River subbasins and Ohio, Cumberland, Tennessee, White, Arkansas, and Red River Basins.

Based on the above needs and our current knowledge of the physical and biological features and habitat characteristics required to sustain the species' life-history processes, we determine that the PCEs specific to the Neosho mucket and rabbitsfoot are:

(1) Geomorphically stable river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as, stable riffles, sometimes with runs, and mid-channel island habitats that provide flow refuges consisting of gravel and sand substrates with low to moderate amounts of fine sediment and attached filamentous algae).

(2) A hydrologic flow regime (the severity, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.

(3) Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.

(4) The presence and abundance (currently unknown) of fish hosts necessary for recruitment of the Neosho mucket and rabbitsfoot. The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek will serve as an indication of appropriate presence and abundance of fish hosts until appropriate host fish can be identified.

(5) Either no competitive or predaceous invasive (nonnative) species, or such species in quantities low enough to have minimal effect on survival of freshwater mussels.

Special Management Considerations or Protection

When designating critical habitat, we assess whether the specific areas within the geographic area occupied by the species at the time of listing contain features which are essential to the conservation of the species and which may require special management considerations or protection.

Various activities in or adjacent to each critical habitat unit described in this proposed rule may affect one or more of the physical or biological features and may require special management considerations or protection. Some of these activities include, but are not limited to, those previously discussed in the ''Summary of Factors Affecting the Species.'' The PBFs in all the proposed critical habitat units may require special management due to threats posed by channelization and other navigation related projects, dams, impoundments, land use runoff, and point or nonpoint-source water pollution, or both (see Factors A and D). Other activities that may affect the features and their component PCEs in the proposed critical habitat units include those listed in the ''Effects of Critical Habitat Designation'' section below.

In summary, we find that the areas we are proposing as critical habitat that are occupied at the time of listing contain the features essential to the conservation of the Neosho mucket and rabbitsfoot, and that these features may require special management considerations or protections. Special management considerations or protections may be required to eliminate, or to reduce to negligible levels, the threats affecting each unit and to preserve and maintain the essential physical and biological features that the proposed critical habitat units provide to the Neosho mucket and rabbitsfoot. Additional discussions of threats facing individual sites are provided in the individual unit descriptions.

Criteria Used To Identify Proposed Critical Habitat

As required by section 4(b)(2) of the Act, we use the best scientific data available to designate critical habitat. We review available information pertaining to the habitat requirements of the Neosho mucket and rabbitsfoot. In accordance with the Act and its implementing regulation at 50 CFR 424.12(e), we consider whether designating additional areas—outside those currently occupied as well as those occupied at the time of listing—are necessary to ensure the conservation of the species. We are not currently proposing to designate any areas outside the geographic area occupied by the species because occupied areas are sufficient for the conservation of the species.

When determining proposed critical habitat boundaries, we made every effort to avoid including developed areas such as lands covered by buildings, pavement, and other structures because such lands usually lack physical or biological features for the species. Areas proposed as critical habitat for the Neosho mucket and rabbitsfoot include only stream channels within the ordinary high-water line, and do not contain any developed areas, structures, or areas inundated by lakes and reservoirs. The ordinary high-water line defines the stream channel and is the point on the stream bank where water is continuous and leaves some evidence, such as erosion or aquatic vegetation. The scale of the maps we prepared under the parameters for publication within the Code of Federal Regulations may not reflect the exclusion of structures or other developed areas. Any such areas inadvertently left inside critical habitat boundaries shown on the maps of this proposed rule have been excluded by text in the proposed rule and are not proposed for designation as critical habitat. Therefore, if the critical habitat is finalized as proposed, a Federal action involving these areas would not trigger section 7 consultation with respect to critical habitat and the requirement of no adverse modification unless the specific action would affect the physical or biological features in the adjacent critical habitat.

We are proposing for designation of critical habitat areas that we have determined are occupied at the time of listing, as defined in this proposed rule, and contain sufficient elements of physical or biological features to support life-history processes essential for the conservation of the Neosho mucket and the rabbitsfoot. The Neosho mucket and rabbitsfoot persist in scattered portions of 38 rivers and creeks. Distribution and status information pertaining to the Neosho mucket and rabbitsfoot was previously discussed in the STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section. River habitats are highly dependent upon upstream and downstream channel habitat conditions for their maintenance. Therefore, where one occurrence record was known from a river reach, we considered the entire reach between the uppermost and lowermost locations as occupied habitat, except lakes and reservoirs. We have defined occupied habitat for the Neosho mucket as those stream reaches known to be currently extant. For the rabbitsfoot, we have defined occupied habitat as those stream reaches that are sizeable and small populations as defined by Butler (2005), and the marginal populations of Fish Creek, Red River and Allegheny River that are the last extant populations in their respective basins (Great Lakes and Cumberland) and a metapopulation.

No unoccupied stream, as defined in this proposed rule, is proposed as critical habitat for Neosho mucket and rabbitsfoot. We find that unoccupied stream reaches are not essential for the conservation of either species for one or more of the following reasons:

(1) Unoccupied habitats are isolated from occupied habitats due to reservoir construction and dam operations (dam water releases have altered natural stream hydrology, geomorphology, water temperature, and native mollusk and fish communities);

(2) Unoccupied areas exhibit limited habitat availability, degraded habitat, or low potential value for management (Muskingum, Elk, Scioto, Little Miami, Licking, East Fork White, Cumberland, Holston, Clinch, Sequatchie, and Buffalo (Duck River system) Rivers);

(3) Collection records for these species indicate that these species have been extirpated from unoccupied areas for several decades or more; or

(4) There are no historical records of occurrence within the stream reach for Neosho mucket, rabbitsfoot, or both.

Our analysis concludes that inclusion of unoccupied habitats is not essential to conserve these species. While we recognize the importance to recovery of unoccupied habitat, in this case, unoccupied habitat also does not provide habitat for reintroduction, reduce the level of stochastic and human-induced threats, or decrease the risk of extinction:

(1) Unoccupied habitat does not currently contain sufficient physical and biological features or have the ability to be restored to support life-history functions of the Neosho mucket and rabbitsfoot (such characteristics as geomorphically stable channels, perennial water flows, adequate water quality, and appropriate benthic substrates);

(2) Unoccupied habitat does not support the once diverse mollusk communities, including the presence of closely related species requiring physical or biological features similar to the Neosho mucket and rabbitsfoot; or

(3) Unoccupied habitat is not adjacent to currently occupied areas where there is potential for natural dispersal and reoccupation by the Neosho mucket and rabbitsfoot. A total of 43 units are proposed for designation based on sufficient elements of physical or biological features being present to support Neosho mucket (8 units) and rabbitsfoot (35 units) life-history processes. Some units contained all of the identified elements of physical or biological features and supported multiple life-history processes. Some units contained only some elements of the physical or biological features necessary to support the Neosho mucket and rabbitsfoot particular use of that habitat.

Proposed Critical Habitat Designation

When designating critical habitat, we assess whether the areas within the geographical area occupied by the species at the time of listing contain features that are essential to the conservation of the species and whether those features may require special management considerations or protection. Three critical habitat units proposed for the Neosho mucket and rabbitsfoot are currently designated under the Act for the oyster mussel (*Epioblasma capsaeformis*) and Cumberlandian combshell (*Epioblasma brevidens*) encompassing the Duck River, Tennessee (74 rkm, 46 rmi) and Bear Creek, Alabama and Mississippi (40 rkm, 25 rmi) (50 CFR 17.95(f)) or proposed as critical habitat under the Act for the yellowcheek darter (*Etheostoma moorei*) in the Middle Fork Little Red River, Arkansas (23.2 rkm, 14.5 rmi; 76 FR 63360, October 12, 2011; Table 3). The existing critical habitat for the oyster mussel and Cumberlandian combshell completely overlaps Unit RF16 (Bear Creek), but the exact unit descriptions (length) differ due to mapping refinement since the earlier designation. In addition, five critical habitat units proposed for the Neosho mucket and rabbitsfoot are currently designated by the State of Kansas as critical habitat for both species in the Fall, Spring, Neosho, Cottonwood River, and Verdigris Rivers and Neosho mucket in Shoal Creek (K.S.A. 32–959; Table 3) and are afforded similar state-level protections as those provided under the Act. No other critical habitat units proposed for these species have been designated or proposed as critical habitat for other species under the Act.

TABLE 3—CRITICAL HABITAT AREAS PROPOSED FOR THE NEOSHO MUCKET AND RABBITSFOOT THAT ARE CURRENTLY DESIGNATED OR PROPOSED AS CRITICAL HABITAT FOR OTHER FEDERALLY AND STATE LISTED SPECIES

Unit (Unit #)	Species present in unit	Federal reference	State reference	Length of overlap (rkm/rmi)
Shoal Creek (NM3)	Neosho mucket, fluted shell, Ouachita kidneyshell, Western fanshell, redspot chub.		K.S.A. 32–959	9.7/6.0
Spring River (NM4 and RF1)	Neosho mucket, rabbitsfoot, elktoe, ellipse shell, Neosho madtom, fluted shell, Ouachita kidneyshell, Western fanshell, redspot chub.		K.S.A. 32–959	11.6/7.2
Fall River (NM6)	Neosho mucket, Western fanshell		K.S.A. 32–959	90.4/56.2
Verdigris River (NM6 and RF2).	Neosho mucket, rabbitsfoot, Ouachita kidneyshell, western fanshell, butterfly.		K.S.A. 32–959	80.6/50.1
Neosho River (NM7 and RF3).	Neosho mucket, rabbitsfoot, butterfly, Neosho madtom, Ouachita kidneyshell, western fanshell.		K.S.A. 32–959	245.9/152.8
Cottonwood River (NM8)	Neosho mucket, rabbitsfoot, butterfly, Ouachita kidneyshell, western fanshell.		K.S.A. 32–959	2.6/1.6
Middle Fork Little Red River (RF7).	Yellowcheek darter	76 FR 63360, October 12, 2011.		23.3/14.5
Bear Creek (RF16)	Oyster mussel, Cumberland combshell	50 CFR 17.95(f)		49.7/30.9
Duck River (RF19)	Oyster mussel, Cumberland Combshell	50 CFR 17.95(f)		74.0/46.0
Total				587.9/365.3

We are proposing eight units, totaling approximately 779 rkm (484 rmi), in four states (Arkansas, Kansas, Missouri, and Oklahoma) as critical habitat for the Neosho mucket (Table 4). We are proposing 35 units, totaling approximately 2,662 rkm (1,653.8 rmi), in 12 states (Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Missouri, Mississippi, Oklahoma, Ohio, Pennsylvania, and Tennessee) as critical habitat for the rabbitsfoot (Table 4). Four of the 43 units, Units NM4, NM7, RF1, and RF3 are occupied by both Neosho mucket and rabbitsfoot. Table 5 summarizes primary adjacent riparian landowners in each of the proposed Neosho mucket and rabbitsfoot critical habitat units by private, State, Tribal (jurisdictional not ownership), or Federal ownership. One Neosho mucket and two rabbitsfoot proposed critical habitat units, respectively, are located within Tribal jurisdictional areas, Unit NM1 (Illinois River, Oklahoma; 103.0 rkm (64.0 rmi)), Unit RF2 (Verdigris River; 45.5 rkm (28.3 rmi)), and Unit RF6 (Little River, Oklahoma; 41.4 rkm (25.7 rmi)).

Public lands adjacent to Neosho mucket and rabbitsfoot critical habitat units consist of approximately 505.3 rkm (314.0 rmi) of riparian lands in the following units.

- Unit NM1: Ozark National Forest, 20.3 rkm (12.7 rmi) Corps' Lake Tenkiller Project, 9.0 rkm (5.6 rmi), and Sparrowhawk Wildlife Management Area (WMA), 2.2 rkm (1.4 rmi);
- Units NM4 and RF1: Spring River Wildlife Area, 1.4 rkm (0.9 rmi);
- Unit RF2: Corps' Oologah Lake Project, 0.6 rkm (0.4 rmi) and Corps' McClellan-Kerr Arkansas River Navigation System Project, 3.4 rkm (2.1 rmi);
- Unit NM7: Neosho Wildlife Area 6.1 rkm (3.8 rmi);
- Unit RF4a: Ouachita National Forest, 21.8 rkm (13.6 rmi);
- Unit RF5: Jenkins' Ferry State Park, 22.2 rkm (13.9 rmi);
- Unit RF6: Little River NWR, 37.6 rkm (23.5 rmi), Ouachita National Forest 16.0 rkm (10.0 rmi), and Cossatot NWR, 11.5 rkm (7.2 rmi);
- Unit RF8a: Jacksonport State Park, 2.9 rkm (1.8 rmi) and Henry Gray-Hurricane Lake WMA, 7.8 rkm (4.9 rmi);
- Unit RF8b: White River NWR, 57.6 rkm (36.0 rmi);
- Unit RF9: Shirey Bay Rainey Brake WMA, 10.1 rkm (6.3 rmi);
- Unit RF10: Harold Alexander WMA, 1.1 rkm (0.7 rmi);
- Unit RF13: Buffalo National River, 113.6 rkm (70.6 rmi);
- Unit RF14: Sam A. Baker State Park 1.0 rkm (0.6 rmi) and Corps' Wappapello Lake Project 25.1 rkm (15.7 rmi);
- Unit RF16: Tishomingo State Park, 6.1 rkm (3.8 rmi), NPS Natchez Trace Parkway, 4.5 rkm (2.8 rmi), and TVA Pickwick Lake Project, 7.4 rkm (4.6 rmi);
- Unit RF18: Fern Cave NWR, 0.5 rkm (0.3 rmi);
- Unit RF19: Yanahli WMA, 38.9 rkm (24.3 rmi) and Santa Fe County Park, 1.4 rkm (0.9 rmi);
- Unit RF20a: Shiloh National Military Park, 2.6 rkm (1.6 rmi);
- Unit RF20b: Kentucky Dam Village State Resort Park, 0.6 rkm (0.4 rmi) and unnamed TVA land downstream of Kentucky Lake Dam, 2.4 rkm (1.5 rmi);
- Unit RF21: Massac Forest Nature Preserve, 2.2 rkm (1.4 rmi), West Kentucky WMA, 5.6 rkm (3.5 rmi), Ballard WMA, 2.6 rkm (1.6 rmi) and Chestnut Hills Nature Preserve, 2.4 rkm (1.5 rmi);
- Unit RF22: Mammoth Cave National Park, 17.0 rkm (10.6 rmi);
- Unit RF23: Pennsylvania State Game Land 277, 2.9 rkm (1.8 rmi) and Pennsylvania State Game Land 85, 0.6 rkm (0.4 rmi);
- Unit RF24: Clear Creek State Forest, 9.9 rkm (6.2 rmi);
- Unit RF25: Erie NWR, 16.2 rkm (10.1 rmi) in;
- Unit RF26: Prophetstown State Park, 2.1 rkm (1.3 rmi);
- Unit RF27: Muskingum Watershed Conservancy Land, 5.0 rkm (3.1 rmi);
- Unit RF28: Little Darby State Scenic Waterway–River Lands, 8.7 rkm (5.4 rmi);
- Unit RF30: Fish Creek Wildlife Area, 1.6 rkm (1.0 rmi); and
- Unit RF32: Corps' Shenango River Lake Project, 8.8 rkm (5.5 rmi).

TABLE 4—OCCUPANCY OF NEOSHO MUCKET AND RABBITSFOOT BY PROPOSED CRITICAL HABITAT UNITS

Species	Approximate river distances currently occupied by the species	
	River km	River miles
Neosho mucket	779.1	484.1
Rabbitsfoot	2,661.5	1,653.8
Total	3,440.6	2,137.9
Species, stream (unit), and State	**Currently occupied**	
Neosho mucket:		
Unit NM1, Illinois River AR, OK	146.1	90.8
Unit NM2, Elk River, MO, OK	20.3	12.6
Unit NM3, Shoal Creek, KS, MO	75.8	47.1
Unit NM4, Spring River, KS, MO	102.3	63.6
Unit NM5, North Fork Spring River, MO	16.4	10.2
Unit NM6, Fall and Verdigris Rivers, KS	171.1	106.3
Unit NM7, Neosho River, KS	244.5	151.9
Unit NM8, Cottonwood River, KS	2.6	1.6
Total	779.1	484.1
Rabbitsfoot:		
Unit RF1, Spring River, MO, KS	56.5	35.1
Unit RF2, Verdigris River, OK	45.5	28.3
Unit RF3, Neosho River, KS	26.6	16.5
Unit RF4a, Ouachita River, AR	21.9	13.6
Unit RF4b, Ouachita River, AR	157.9	98.1
Unit RF5, Saline River, AR	288.4	179.2
Unit RF6, Little River, OK, AR	139.7	86.8
Unit RF7, Middle Fork Little Red River, AR	23.3	14.5
Unit RF8a, White River, AR	188.3	117.0
Unit RF8b, White River, AR	68.9	42.8
Unit RF9, Black River, AR	92.2	57.3
Unit RF10, Spring River, AR	62.8	39.0
Unit RF11, South Fork Spring River, AR	16.4	10.2
Unit RF12, Strawberry River, AR	123.8	76.9
Unit RF13, Buffalo River, AR	113.6	70.6
Unit RF14, St. Francis River, MO	64.3	40.0
Unit RF15, Big Sunflower River, MS	51.5	32.0
Unit RF16, Bear Creek, AL, MS	49.7	30.9
Unit RF17, Big Black River, MS	43.3	26.9
Unit RF18, Paint Rock River, AL	81.0	50.3
Unit RF19, Duck River, TN	235.3	146.2
Unit RF20a, Tennessee River, TN	26.7	16.6
Unit RF20b, Tennessee River, KY	35.6	22.1
Unit RF21, Ohio River, KY, IL	45.9	28.5
Unit RF22, Green River, KY	175.6	109.1
Unit RF23, French Creek, PA	120.4	74.8
Unit RF24, Allegheny River, PA	57.3	35.6
Unit RF25, Muddy Creek, PA	20.1	12.5
Unit RF26, Tippecanoe River, IN	75.6	47.0
Unit RF27, Walhonding River, OH	17.5	10.9
Unit RF28, Little Darby Creek, OH	33.3	20.7
Unit RF29, North Fork Vermilion River and Middle Branch North Fork Vermilion River, IL	28.5	17.7
Unit RF30, Fish Creek, OH	7.7	4.8
Unit RF31, Red River, KY, TN	50.2	31.2
Unit RF32, Shenango River, PA	16.3	10.1
Total	2,661.5	1,653.8

States were granted ownership of lands beneath navigable waters up to the ordinary high-water line upon achieving statehood (*Pollard* v. *Hagan,* 44 U.S. (3 How.) 212 (1845)). Prior to statehood, the American colonies may have made grants to private parties that included lands below the ordinary high-water mark of some navigable waters that are included in this proposal. However, most, if not all, lands beneath the navigable waters included in this proposed rule are owned by the States. Riparian lands along the waters are either in private ownership, or owned by municipalities, States, or Federal entities (Table 5).

TABLE 5—PROPOSED CRITICAL HABITAT UNITS FOR NEOSHO MUCKET AND RABBITSFOOT AND OWNERSHIP OF RIPARIAN LANDS

Critical habitat units	Federal rkm; rmi	State & local government rkm; rmi	Private rkm; rmi	Tribal * (subset of private) rkm; rmi
Neosho Mucket				
Unit NM1: Illinois River	29.4; 18.3	2.3; 1.4	114.4; 71.1	103.0; 64.0
Unit NM2: Elk River	0	0	20.3; 12.6	0
Unit NM3: Shoal Creek	0	0	75.8; 47.1	0
Unit NM4: Spring River	0	1.4; 0.9	100.9; 62.7	0
Unit NM5: North Fork Spring River	0	0	16.4; 10.2	0
Unit NM6: Fall River	0	0	90.4; 56.2	0
Unit NM6: Verdigris River	0	0	80.6; 50.1	0
Unit NM7: Neosho River	0	6.1; 3.8	238.3; 148.1	0
Unit NM8: Cottonwood River	0	0	2.6; 1.6	0
Total	29.4; 18.3	9.8; 6.1	739.8; 459.7	103.0; 64.0
Rabbitsfoot				
Unit RF1: Spring River	0	1.4; 0.9	55.0; 34.2	0
Unit RF2: Verdigris River	4.0; 2.5	0	41.5; 25.8	41.5; 25.8
Unit RF3: Neosho River	0	0	26.6; 16.5	0
Unit RF4a: Ouachita River	3.9; 2.4	0	18.0; 11.2	0
Unit RF4b: Ouachita River	0	0	157.9; 98.1	0
Unit RF5: Saline River	0	22.3; 13.9	266.0; 165.3	0
Unit RF6: Little River	63.9; 39.7	0	75.8; 47.1	41.4; 25.7
Unit RF7: Middle Fork Little Red River	0	0	23.3; 14.5	0
Unit RF8a: White River	0	10.8; 6.7	177.5; 110.3	0
Unit RF8b: White River	57.9; 36.0	0	10.9; 6.8	0
Unit RF9: Black River	0	10.1; 6.3	82.1; 51.0	0
Unit RF10: Spring River	0	1.1; 0.7	61.6; 38.3	0
Unit RF11: South Fork Spring River	0	0	16.4; 10.2	0
Unit RF12: Strawberry River	0	0	123.8; 76.9	0
Unit RF13: Buffalo River	113.6; 70.6	0	0	0
Unit RF14: St. Francis River	25.2; 15.7	1.0; 0.6	38.1; 23.7	0
Unit RF15: Big Sunflower River	0	0	51.5; 32.0	0
Unit RF16: Bear Creek	11.9; 7.4	6.1; 3.8	31.7; 19.7	0
Unit RF17: Big Black River	0	0	43.3; 26.9	0
Unit RF18: Paint Rock River	0.5; 0.3	0	80.5; 50.0	0
Unit RF19: Duck River	0	40.5; 25.2	194.7; 121.0	0
Unit RF20a: Tennessee River	2.6; 1.6	0	24.1; 15.0	0
Unit RF20b: Tennessee River	2.4; 1.5	0.6; 0.4	32.5; 20.2	0
Unit RF21: Ohio River	0	12.9; 8.0	33.0; 20.5	0
Unit RF22: Green River	17.0; 10.6	0	158.5; 98.5	0
Unit RF23: French Creek	0	3.5; 2.2	116.8; 72.6	0
Unit RF24: Allegheny River	0	10.0; 6.2	47.3; 29.4	0
Unit RF25: Muddy Creek	16.3; 10.1	0	3.9; 2.4	0
Unit RF26: Tippecanoe River	0	2.1; 1.3	73.5; 45.7	0
Unit RF27: Walhonding River	0	5.0; 3.1	12.6; 7.8	0
Unit RF28: Little Darby Creek	0	8.7; 5.4	24.6; 15.3	0
Unit RF29: North Fork Vermilion River and Middle Branch North Fork Vermilion River	0	0	28.5; 17.7	0
Unit RF30: Fish Creek	0	1.6; 1.0	6.1; 3.8	0
Unit RF31: Red River	0	0	50.2; 31.2	0
Unit RF32: Shenango River	8.8; 5.5	0	7.4; 4.6	0
Total	328.1; 203.9	137.9; 85.7	2,195.7; 1,364.4	86.9; 54.0
Total for both species	357.6; 222.2	147.7; 91.8	2,935.6; 1,824.1	189.9; 118.0

Note: Distances may not sum due to rounding.
* Tribal Jurisdictional Area only, does not represent riparian land ownership by any tribe and is a subset of the private lands category.

We present brief descriptions of all units and reasons why they meet the definition of critical habitat for the Neosho mucket and rabbitsfoot. River-kilometer totals presented in the Unit descriptions below are the sums of Federal; State and local government; and private lands (Tribal lands are a subset of private lands). Proposed critical habitat units include the river channels within the ordinary high-water line. As defined in 33 CFR 329.11, the ordinary high-water mark on nontidal rivers is the line on the shore established by the fluctuations of water and indicated by physical characteristics, such as a clear, natural line impressed on the bank; shelving;

changes in the character of soil; destruction of terrestrial vegetation; the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding areas. For each stream reach proposed as a critical habitat unit, the upstream and downstream boundaries are described generally below.

Neosho Mucket

Neosho mucket status and distribution for each critical habitat unit was previously described in the STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section.

Unit NM1: Illinois River—Benton and Washington Counties, Arkansas; and Adair, Cherokee, and Delaware Counties, Oklahoma

Unit NM1 includes 146.1 rkm (90.8 rmi) of the Illinois River from the Muddy Fork Illinois River confluence with the Illinois River south of Savoy, Washington County, Arkansas, downstream to the Baron Creek confluence southeast of Tahlequah, Cherokee County, Oklahoma. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 2, 3, 4, and 5. The PBFs in this unit may require special management considerations or protection to address changes in stream channel stability associated with urban development and clearing of riparian areas due to land use conversion in the watershed; alteration of water chemistry or water and sediment quality; and changes in stream bed material composition and quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, confined animal operations, and timber harvesting (see Factor A). The majority of the adjacent riparian lands in this unit are in private ownership or private lands under tribal jurisdiction (Table 5).

Unit NM2: Elk River—McDonald County, Missouri; and Delaware County, Oklahoma

Unit NM2 includes a total of 20.3 rkm (12.6 rmi) of the Elk River from Missouri Highway 59 at Noel, McDonald County, Missouri, to the confluence of Buffalo Creek immediately downstream of the Oklahoma and Missouri State line, Delaware County, Oklahoma. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal; alteration of water chemistry or water quality; and changes in stream bed material composition and sediment quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, confined animal operations (turkey and chicken), timber harvesting, and mining (see Factor A). All the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM3: Shoal Creek—Cherokee County, Kansas; and Newton County, Missouri

Unit NM3 includes approximately 75.8 rkm (47.1 rmi) of Shoal Creek from Missouri Highway W near Ritchey, Newton County, Missouri, to Empire Lake where inundation begins in Cherokee County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes to the same activities as discussed in Unit NM2 above and releases of chemical contaminants from industrial and municipal effluents (see Factor A). All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM4: Spring River—Jasper and Lawrence Counties, Missouri; and Cherokee County, Kansas

Unit NM4 includes 102.3 rkm (63.6 rmi) of the Spring River from Missouri Highway 97 north of Stotts City, Lawrence County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes to the same activities as discussed in Unit NM2 above and releases of chemical contaminants from industrial and municipal effluents. Almost all (99 percent) of the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM5: North Fork Spring River—Jasper County, Missouri

Unit NM5 includes 16.4 rkm (10.2 rmi) of the North Fork Spring River from the confluence of Buck Branch southwest of Jasper, Missouri, downstream to its confluence with the Spring River near Purcell, Jasper County, Missouri. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes to the same activities as discussed in Unit NM2 above. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM6: Fall River—Elk, Greenwood, and Wilson Counties, Kansas; Verdigris River—Montgomery and Wilson Counties, Kansas

Unit NM6 includes a total of 171.1 rkm (106.3 rmi) including 90.4 rkm (56.2 rmi) of the Fall River from Fall River Lake dam northwest of Fall River, Greenwood County, Kansas, downstream to its confluence with the Verdigris River near Neodesha, Wilson County, Kansas. Unit NM6 also includes 80.6 rkm (50.1 rmi) of the Verdigris River from Kansas Highway 39 near Benedict, Wilson County, Kansas downstream to the Elk River confluence near Independence, Montgomery County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes to the same activities as discussed in Unit NM2 above. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM7: Neosho River—Allen, Cherokee, Coffey, Labette, Neosho, and Woodson Counties, Kansas

Unit NM7 includes 244.5 rkm (151.9 rmi) of the Neosho River from Kansas Highway 58 west of LeRoy, Coffey County, Kansas, downstream to the Kansas and Oklahoma State line, Cherokee County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes previously to the same activities as discussed in Unit NM2 above and releases of chemical contaminants from industrial and municipal effluents and tail water releases downstream of John Redmond Reservoir. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit NM8: Cottonwood River—Chase County, Kansas

Unit NM8 includes 2.6 rkm (1.6 rmi) of the Cottonwood River from the South Fork Cottonwood River confluence downstream to the Kansas Road 140 (also known as Heins Road), east of Cottonwood Falls, Chase County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protection to address changes in stream channel stability associated with clearing of riparian areas due to land use conversion in the watershed; alteration of water chemistry or water and sediment quality; and changes in stream bed material composition and quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, and release of contaminants from municipal effluents (see Factor A). All adjacent riparian lands in this unit are in private ownership (Table 5).

Rabbitsfoot

Rabbitsfoot status and distribution for each critical habitat unit was previously described in the STATUS ASSESSMENT FOR NEOSHO MUCKET AND RABBITSFOOT section.

The PBFs in units RF1 through RF32 may require special management considerations to address changes in the existing flow regime due to such activities as impoundment, water diversion, or water withdrawal; alteration of water chemistry or water quality; and changes in stream bed material composition and sediment quality from activities that would release sediments or nutrients into the water, such as urban development and associated construction projects, livestock grazing, confined animal operations (turkey and chicken), timber harvesting, and mining, and releases of chemical contaminants from industrial and municipal effluents (see Factor A). Where there are other activities in individual units requiring special management considerations, they are set forth in the individual unit descriptions.

Unit RF1: Spring River—Jasper County, Missouri; and Cherokee County, Kansas

Unit RF1 includes 56.5 rkm (35.1 rmi) of the Spring River from Missouri Highway 96 at Carthage, Jasper County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections described above. The majority of the adjacent riparian lands in this unit are in private ownership or private lands under tribal jurisdiction (Table 5).

Unit RF2: Verdigris River—Rogers County, Oklahoma

Unit RF2 includes 45.5 rkm (28.3 rmi) of the Verdigris River from Oologah Lake dam north of Claremore, Oklahoma, downstream to Interstate 44 (Will Rogers Turnpike) west of Catoosa, Rogers County, Oklahoma. This unit was occupied at the time of listing and contains all or some components of all four PBFs and in part, contains all five PCEs. It is possible that PCEs 1 and 2 are limiting factors for rabbitsfoot distribution and abundance from Oologah Lake dam downstream to the confluence of the Caney River; thus we are unable to determine at this time whether this reach contains PCEs 1 and 2. The PBFs in this unit may require special management considerations or protections as described above and changes in the existing flow regime due to such activities as impoundment, tail water releases from Oologah Lake dam, and channelization associated with the McClellan-Kerr Arkansas River Navigation System. The majority of the adjacent riparian lands in this unit are in private ownership or private lands under tribal jurisdiction (Table 5).

Unit RF3: Neosho River—Allen County, Kansas

Unit RF3 includes 26.6 rkm (16.5 rmi) of the Neosho River from the Deer Creek confluence northwest of Iola, Kansas, downstream to the confluence of Owl Creek southwest of Humboldt, Allen County, Kansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above except for releases of chemical contaminants from industrial and municipal effluents. Approximately 97 percent of the adjacent riparian lands in this unit are in private ownership and the remaining lands in State or local ownership (Table 5).

Unit RF4a: Ouachita River—Montgomery County, Arkansas

Unit RF4a includes 21.9 rkm (13.6 rmi) of the Ouachita River from Arkansas Highway 379 south of Oden, Montgomery County, Arkansas, downstream to Arkansas Highway 298 east of Pencil Bluff, Montgomery County, Arkansas. Units RF4a and RF4b are separated by three reservoirs (Lakes Ouachita, Hamilton, and Catherine). This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 82 percent of the adjacent riparian lands in this unit are in private ownership and the remaining 18 percent are in Federal ownership (Table 5).

Unit RF4b: Ouachita River—Clark, Hot Spring, and Ouachita Counties, Arkansas

Unit RF4b includes 157.9 rkm (98.1 rmi) of the Ouachita River from Interstate 30 at Malvern, Hot Spring County, Arkansas, downstream to U.S. Highway 79 at Camden, Ouachita County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. All the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF5: Saline River—Ashley, Bradley, Cleveland, Dallas, Drew, Grant, and Saline Counties, Arkansas

Unit RF5 includes 288.4 rkm (179.2 rmi) of the Saline River from Interstate 30 near Benton, Saline County, Arkansas, to the Snake Creek confluence north of the northern boundary of Felsenthal NWR northwest of Crossett, Ashley, and Bradley Counties, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 92 percent of the adjacent riparian lands in this unit are in private ownership and 8 percent are in State or local ownership (Table 5).

Unit RF6: Little River—McCurtain County, Oklahoma; and Little River and Sevier Counties, Arkansas

Unit RF6 includes 139.7 rkm (86.8 rmi) of the Little River from the Glover River confluence northwest of Idabel, McCurtain County, Oklahoma, downstream to U.S. Highway 71 north of Wilton, Little River and Sevier Counties, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Adjacent riparian lands in this unit are in private ownership (42 percent), Federal (35 percent), and private land under tribal jurisdiction (23 percent) (Table 5).

Unit RF7: Middle Fork Little River—Van Buren County, Arkansas

Unit RF7 includes 23.3 rkm (14.5 rmi) of the Middle Fork Little Red River from the confluence of Little Tick Creek north of Shirley, Arkansas, downstream to Greers Ferry Reservoir where inundation begins, Van Buren County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above and natural gas development and hillside rock harvesting. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF8a: White River—Independence, Jackson, White, and Woodruff Counties, Arkansas

Unit RF8a includes 188.3 rkm (117.0 rmi) of the White River from the Batesville Dam at Batesville, Independence County, Arkansas, downstream to the Little Red River confluence north of Georgetown, White, and Woodruff Counties, Arkansas. There are no records of rabbitsfoot from the 160 rkm (100 rmi) reach separating Unit RF8a from Unit RF8b (Butler 2005, p. 66). This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 2, 3, 4, and 5. The U.S. Army Corps of Engineers maintains a navigation channel, which involves routine dredging and snag removal, from Newport, Arkansas to its confluence with the Mississippi River. The PBFs in this unit may require special management considerations or protections described above except for releases of chemical contaminants from industrial and municipal effluents and including tail water releases from a series of reservoirs on the upper White River, row crop agriculture, increasing demand for instream sand from the White River upstream of Newport, Arkansas, to support natural gas development needs, natural gas development, and channelization. Adjacent riparian lands in this unit are in private ownership (94 percent) and State and local ownership (6 percent) (Table 5).

Unit RF8b: White River—Arkansas and Monroe Counties, Arkansas

Unit RF8b includes 68.9 rkm (42.8 rmi) of the White River from U.S. Highway 79 at Clarendon, Monroe County, Arkansas, downstream to Arkansas Highway 1 near St. Charles, Arkansas County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 2, 3, 4, and 5. The U.S. Army Corps of Engineers maintains a navigation channel, which involves routine dredging and snag removal, from Newport, Arkansas, to its confluence with the Mississippi River. The PBFs in this unit may require special management considerations or protections described above except for releases of chemical contaminants from industrial and municipal effluents and including tail water releases from a series of reservoirs on the upper White River, row crop agriculture, increasing demand for instream sand from the White River upstream of Newport, Arkansas, to support natural gas development needs, natural gas development, and channelization. Approximately 84 percent of the adjacent riparian lands in this unit are in Federal ownership and 16 percent are in private ownership (Table 5).

Unit RF9: Black River—Lawrence and Randolph Counties, Arkansas

Unit RF9 includes 92.2 rkm (57.3 rmi) of the Black River from U.S. Highway 67 at Pocahontas, Randolph County, Arkansas, downstream to the Strawberry River confluence southeast of Strawberry, Lawrence County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above and including row crop agriculture. Approximately 89 percent of the adjacent riparian lands in this unit are in private ownership and 11 percent are in State or local ownership (Table 5).

Unit RF10: Spring River—Lawrence, Randolph, and Sharp Counties, Arkansas

Unit RF10 includes 62.8 rkm (39.0 rmi) of the Spring River from U.S. Highway 412 and 62 at Hardy in Sharp County, Arkansas, downstream to its confluence with the Black River east of Black Rock, Lawrence, and Randolph Counties, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 99 percent of the adjacent riparian lands in this unit are in private ownership and almost 1 percent is in State or local ownership (Table 5).

Unit RF11: South Fork Spring River—Fulton County, Arkansas

Unit RF11 includes 16.4 rkm (10.2 rmi) of the South Fork Spring River from Fulton County Road 198 north of Heart, Arkansas, downstream to Arkansas Highway 289 at Saddle, Fulton County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. All of the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF12: Strawberry River—Izard, Lawrence, and Sharp Counties, Arkansas

Unit RF12 includes 123.8 rkm (76.9 rmi) of the Strawberry River from Arkansas Highway 56 south of Horseshoe Bend, Izard County, Arkansas, downstream to its confluence with the Black River southeast of Strawberry, Lawrence County, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. All of the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF13: Buffalo River—Newton and Searcy Counties, Arkansas

Unit RF13 includes 113.6 rkm (70.6 rmi) of the Buffalo River from the Cove Creek confluence southeast of Erbie, Newton County, Arkansas, downstream to U.S. Highway 65 west of Gilbert, Searcy County, Arkansas, and Arkansas Highway 14 southeast of Mull, Arkansas, downstream to the Leatherwood Creek confluence in the Lower Buffalo Wilderness Area, Arkansas. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. All of the adjacent riparian lands in this unit are in Federal ownership (Table 5).

Unit RF14: St. Francis River—Madison and Wayne Counties, Missouri

Unit RF14 includes 64.3 rkm (40.0 rmi) of the St. Francis River from the Twelvemile Creek confluence west of

Saco, Madison County, Missouri, downstream to Lake Wappepello where inundation begins, Wayne County, Missouri. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Adjacent riparian lands in this unit are in private (59 percent), Federal (39 percent), and less than 2 percent in State or local ownership (Table 5).

Unit RF15: Big Sunflower River—Sunflower County, Mississippi

Unit RF15 includes 51.5 rkm (32.0 rmi) of the Big Sunflower River from Mississippi Highway 442 west of Doddsville, Mississippi, downstream to the Quiver River confluence east of Indianola, Sunflower County, Mississippi. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above and row crop agriculture and channelization. All of the adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF16: Bear Creek—Tishomingo County, Mississippi; and Colbert County, Alabama

Unit RF16 includes 49.7 rkm (30.9 rmi) of Bear Creek from the Alabama and Mississippi State line east of Golden, Tishomingo County, Mississippi, downstream to Alabama County Road 4 southwest of Sutton Hill, Colbert County, Alabama (just upstream of Pickwick Lake). Unit RF16 in its entirety is currently designated as critical habitat for the oyster mussel (*Epioblasma capsaeformis*) and Cumberlandian combshell (*Epioblasma brevidens;* 50 CFR 17.95(f)). This unit was occupied at the time of listing and contains all or some components of all four PBFs, except in the Bear Creek Floodway, which has been channelized for flood control and only contains components of PBF 2 and contains all five PCEs, except in the Bear Creek Floodway, which has been channelized for flood control and only contains PCEs 3, 4, and 5. The PBFs in this unit may require special management considerations or protections to address changes described above. Adjacent riparian lands in this unit are in private (64 percent), Federal (24 percent), and 12 percent in State or local ownership (Table 5).

Unit RF17: Big Black River—Hinds and Warren Counties, Mississippi

Unit RF17 includes 43.3 rkm (26.9 rmi) of Big Black River from Porter Creek confluence west of Lynchburg, Hinds County, Mississippi, downstream to Mississippi Highway 27 west of Newman, Warren County, Mississippi. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above, as well as row crop agriculture and channelization. All riparian lands in this unit are in private ownership (Table 5).

Unit RF18: Paint Rock River—Jackson, Madison, and Marshall Counties, Alabama

Unit RF18 includes 81.0 rkm (50.3 rmi) of the Paint Rock River from the convergence of Estill Fork and Hurricane Creek north of Skyline, Jackson County, Alabama, downstream to U.S. Highway 431 south of New Hope, Madison and Marshall Counties, Alabama. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture and channelization. Approximately 99 percent of the adjacent riparian lands in this unit are in private ownership and one percent is in Federal ownership (Table 5).

Unit RF19: Duck River—Hickman, Marshall, and Maury Counties, Tennessee

Unit RF19 includes 235.3 rkm (146.2 rmi) of the Duck River from Lillard Mill (RKM 288; rmi 179) west of Tennessee Highway 272, Marshall County, Tennessee, downstream to Interstate 40 near Bucksnort, Hickman County, Tennessee. Seventy-four rkm (46 rmi) in Unit RF19 from rkm 214 (rmi 133) upstream to Lillards Mill at rkm 288 (rmi 179) is currently designated as critical habitat for the oyster mussel and Cumberlandian combshell (50 CFR 17.95(f)).

This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture and channelization. Approximately 83 percent of the adjacent riparian lands in this unit are in private ownership and 17 percent are in State or local ownership (Table 5).

Unit RF20a: Tennessee River—Hardin County, Tennessee

Unit RF20a includes 26.7 rkm (16.6 rmi) of Tennessee River from Pickwick Lake Dam downstream to U.S. Highway 64 near Adamsville, Hardin County, Tennessee. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 1, 3, 4, and 5. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture, channelization, and channel stability associated with tail water releases. Approximately 90 percent of the adjacent riparian lands in this unit are in private ownership and 10 percent are in State or local ownership (Table 5).

Unit RF20b: Tennessee River—Livingston, Marshall, and McCracken Counties, Kentucky

Unit RF20b includes 35.6 rkm (22.1 rmi) of Tennessee River from Kentucky Lake Dam downstream to its confluence with the Ohio River, McCracken and Livingston Counties, Kentucky. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 1, 3, 4, and 5. The PBFs in this unit may require special management considerations or protection to address changes described above. Approximately 93 percent of the adjacent riparian lands in this unit are in private ownership, 7 percent are in Federal ownership, and less than 1 percent is in State or local ownership (Table 5).

Unit RF21: Ohio River—Ballard, Livingston, and McCracken Counties, Kentucky; Massac and Pulaski Counties, Illinois

Unit RF21 includes 45.9 rkm (28.5 rmi) of the Ohio River from the Tennessee River confluence downstream to Lock and Dam 53 near Olmstead, Illinois. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 1, 3, 4, and 5. The PBFs in this unit may require special management considerations or protection to address changes described above, as well as row crop agriculture, channelization, and channel stability associated with tail water releases. Approximately 72 percent of the adjacent riparian lands in this unit are in private ownership and 28 percent are in State or local ownership (Table 5).

Unit RF22: Green River—Green, Hart, and Taylor Counties, Kentucky

Unit RF22 includes 175.6 rkm (109.1 rmi) of the Green River from Green River Lake Dam south of Campbellsville, Taylor County, Kentucky, downstream to Maple Springs Ranger Station Road in Mammoth Cave National Park, Kentucky. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains PCEs 1, 3, 4, and 5. Releases from Green River Lake dam have altered hydrologic flows and temperature regimes in the tail water reach (Butler 2005, p. 39). The PBFs in this unit may require special management considerations or protection to address changes described above and row crop agriculture, channelization, and channel stability associated with tail water releases. Approximately 90 percent of the adjacent riparian lands in this unit are in private ownership and 10 percent are in Federal ownership (Table 5).

Unit RF23: French Creek—Crawford, Erie, Mercer, and Venango Counties, Pennsylvania

Unit RF23 includes 120.4 rkm (74.8 rmi) of French Creek from Union City Reservoir Dam northeast of Union City, Erie County, Pennsylvania, downstream to its confluence with the Allegheny River near Franklin, Venango County, Pennsylvania. The Allegheny River rabbitsfoot population (Unit RF24) is likely a single metapopulation with the French Creek population (Butler 2005, p. 31). This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture and oil and gas development. Approximately 97 percent of the adjacent riparian lands in this unit are in private ownership and 3 percent are in Federal ownership (Table 5).

Unit RF24: Allegheny River—Venango County, Pennsylvania

Unit RF24 includes 57.3 rkm (35.6 rmi) of the Allegheny River from the French Creek confluence near Franklin, Venango County, Pennsylvania, downstream to Interstate 80 near Emlenton, Venango County, Pennsylvania. The lower Allegheny River and French Creek (Unit RF23) populations likely represent a single metapopulation because no barriers exist between the streams (Butler 2005, p. 29). This unit contains all or some components of all four PBFs and likely functions as a metapopulation to French Creek (Unit RF23). This unit was occupied at the time of listing and contains PCEs 1, 3, 4, and 5 for the rabbitsfoot. A series of nine lock and dams and Kinzua Dam constructed over the past century has resulted in altered hydrologic flow regimes in the Allegheny River (Butler 2005, p. 29). The PBFS in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture, oil and gas development, and channelization. Approximately 83 percent of the adjacent riparian lands in this unit are in private ownership and 17 percent are in State or local ownership (Table 5).

Unit RF25: Muddy Creek—Crawford County, Pennsylvania

Unit RF25 includes 20.1 rkm (12.5 rmi) of Muddy Creek from Pennsylvania Highway 77 near Little Cooley, Crawford County, Pennsylvania, downstream to its confluence with French Creek east of Cambridge Springs, Crawford County, Pennsylvania. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFS in this unit may require special management considerations or protections to address changes described above and oil and gas development. Approximately 81 percent of the adjacent riparian lands in this unit are in Federal ownership and 19 percent are in private ownership (Table 5).

Unit RF26: Tippecanoe River—Carroll, Pulaski, Tippecanoe, and White Counties, Indiana

Unit RF26 includes 75.6 rkm (47.0 rmi) of the Tippecanoe River from Indiana Highway 14 near Winamac, Pulaski County, Indiana, downstream to its confluence with the Wabash River northeast of Battle Ground, Tippecanoe County, Indiana, excluding Lakes Schafer and Freeman and the stream reach between the two lakes. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 97 percent of the adjacent riparian lands in this unit are in private ownership and 3 percent are in State or local ownership (Table 5).

Unit RF27: Walhonding River—Coshocton County, Ohio

Unit RF27 includes 17.5 rkm (10.9 rmi) of the Walhonding River from the convergence of the Kokosing and Mohican Rivers downstream to Ohio Highway 60 near Warsaw, Coshocton County, Ohio. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 83 percent of the adjacent riparian lands in this unit are in private ownership and 17 percent are in State or local ownership (Table 5).

Unit RF28: Little Darby Creek—Madison and Union Counties, Ohio

Unit RF28 includes 33.3 rkm (20.7 rmi) of Little Darby Creek from Ohio Highway 161 near Chuckery, Madison County, Ohio, downstream to U.S. Highway 40 near West Jefferson, Madison County, Ohio. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFS in this unti may require special management considerations or protections to address changes described above and row crop agriculture. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF29: North Fork Vermilion River and Middle Branch North Fork Vermilion River, respectively, Vermilion County, Illinois

Unit RF29 includes 28.5 rkm (17.7 rmi) of the North Fork Vermilion River from the confluence of Middle Branch North Fork Vermilion River downstream to Illinois Highway 1 and U.S. Highway 136 upstream of Lake Vermilion, Vermilion County, Illinois. Unit RF29 also includes 7.2 rkm (4.5 rmi) of the Middle Branch North Fork Vermilion River from the Jordan Creek confluence northwest of Alvin, Illinois, downstream to its confluence with North Fork Vermilion River west of Alvin, Vermilion County, Illinois. The rabbitsfoot in the North Fork Vermilion River is considered a metapopulation with the Middle Branch North Fork Vermilion River population (Butler 2005, p. 47). This unit was occupied at the time of listing and contains all or some components of all four PBFs, including connectivity between North Fork Vermilion River and Middle Branch North Fork Vermilion River. This unit contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above and channelization and row crop agriculture. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF30: Fish Creek—Williams County, Ohio

Unit RF30 includes 7.7 rkm (4.8 rmi) of Fish Creek from the Indiana and Ohio State line northwest of Edgerton, Ohio, downstream to its confluence with the St. Joseph's River north of Edgerton, Williams County, Ohio. This unit was occupied at the time of listing and contains all or some components of all four PBFs and sustains genetic diversity and historical distribution as the only remaining rabbitsfoot population in the Great Lakes subbasin. This unit contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture and confined animal operations (hogs). Approximately 90 percent of the adjacent riparian lands in this unit are in private ownership and 10 percent are in State or local ownership (Table 5).

Unit RF31: Red River—Logan County, Kentucky; and Robertson County, Tennessee

Unit RF31 includes 50.2 rkm (31.2 rmi) of the Red River from the South Fork Red River confluence west of Adairville, Kentucky, downstream to the Sulphur Fork confluence southwest of Adams, Tennessee. This unit was occupied at the time of listing and contains all or some components of all four PBFs and sustains genetic diversity and historical distribution as the largest of two remaining rabbitsfoot populations within the Cumberland River basin. This unit contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above as well as row crop agriculture and channelization. All adjacent riparian lands in this unit are in private ownership (Table 5).

Unit RF32: Shenango River—Mercer County, Pennsylvania

Unit RF32 includes 16.3 rkm (10.1 rmi) of the Shenango River from Kidds Mill Road near Greenville, Pennsylvania, downstream to the point of inundation by Shenango River Lake near Big Bend, Mercer County, Pennsylvania. This unit was occupied at the time of listing and contains all or some components of all four PBFs and contains all five PCEs. The PBFs in this unit may require special management considerations or protections to address changes described above. Approximately 54 percent of the adjacent riparian lands in this unit are in Federal ownership and 46 percent are in private ownership (Table 5).

Effects of Critical Habitat Designation

Section 7 Consultation

Section 7(a)(2) of the Act requires Federal agencies, including the Service, to ensure that any action they fund, authorize, or carry out is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. In addition, section 7(a)(4) of the Act requires Federal agencies to confer with the Service on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed under the Act or result in the destruction or adverse modification of proposed critical habitat.

Decisions by the United States Courts of Appeal for the Fifth and Ninth Circuits have invalidated our regulatory definition of ''destruction or adverse modification'' (50 CFR 402.02) (see *Gifford Pinchot Task Force* v. *U.S. Fish and Wildlife Service,* 378 F. 3d 1059 (9th Cir. 2004) and *Sierra Club* v. *U.S. Fish and Wildlife Service et al.,* 245 F.3d 434, 442 (5th Cir. 2001)), and we do not rely on this regulatory definition when analyzing whether an action is likely to destroy or adversely modify critical habitat. Under the provisions of the Act, we determine destruction or adverse modification on the basis of whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species.

If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency (action agency) must enter into consultation with us. Examples of actions that are subject to the section 7 consultation process are actions on State, tribal, local, or private lands that require a Federal permit (such as a permit from the U.S. Army Corps of Engineers under section 404 of the Clean Water Act or a permit from the Service under section 10 of the Act) or that involve some other Federal action (such as funding from the Federal Highway Administration, Federal Aviation Administration, or the Federal Emergency Management Agency). Federal actions not affecting listed species or critical habitat, and actions on State, tribal, local, or private lands that are not federally funded or authorized, do not require section 7 consultation.

As a result of section 7 consultation, we document compliance with the requirements of section 7(a)(2) through our issuance of:

(1) A concurrence letter for Federal actions that may affect, but are not likely to adversely affect, listed species or critical habitat; or

(2) A biological opinion for Federal actions that may affect, or are likely to adversely affect, listed species or critical habitat.

When we issue a biological opinion concluding that a project is likely to jeopardize the continued existence of a listed species and/or destroy or adversely modify critical habitat, we provide reasonable and prudent alternatives to the project, if any are identifiable, that would avoid the likelihood of jeopardy and/or destruction or adverse modification of critical habitat. We define ''reasonable and prudent alternatives'' (at 50 CFR 402.02) as alternative actions identified during consultation that:

(1) Can be implemented in a manner consistent with the intended purpose of the action,

(2) Can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction,

(3) Are economically and technologically feasible, and

(4) Would, in the Director's opinion, avoid the likelihood of jeopardizing the continued existence of the listed species and/or avoid the likelihood of destroying or adversely modifying critical habitat.

Reasonable and prudent alternatives can vary from slight project modifications to extensive redesign or relocation of the project. Costs associated with implementing a reasonable and prudent alternative are similarly variable.

Regulations at 50 CFR 402.16 require Federal agencies to reinitiate consultation on previously reviewed actions in instances where we have listed a new species or subsequently designated critical habitat that may be affected and the Federal agency has retained discretionary involvement or control over the action (or the agency's discretionary involvement or control is authorized by law). Consequently, Federal agencies sometimes may need to request reinitiation of consultation with us on actions for which formal consultation has been completed, if those actions with discretionary involvement or control may affect subsequently listed species or designated critical habitat.

Application of the ''Adverse Modification'' Standard

The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would continue to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical or biological features to an extent that appreciably reduces the conservation value of critical habitat for Neosho mucket and the rabbitsfoot. As discussed above, the role of critical habitat is to support life-history needs of the species and provide for the conservation of the species.

Section 4(b)(8) of the Act requires us to briefly evaluate and describe, in any proposed or final regulation that designates critical habitat, activities involving a Federal action that may destroy or adversely modify such habitat, or that may be affected by such designation.

Activities that may affect critical habitat, when carried out, funded, or authorized by a Federal agency, should result in consultation for the Neosho mucket and rabbitsfoot. These activities include, but are not limited to:

(1) Actions that would alter the geomorphology of their stream and river habitats. Such activities may include, but are not limited to, instream excavation or dredging, impoundment, channelization, sand and gravel mining, clearing riparian vegetation, and discharge of fill materials. These activities could cause aggradation or degradation of the channel bed elevation or significant bank erosion, result in entrainment or burial of these mollusks, and cause other direct or cumulative adverse effects to these species and their life cycles.

(2) Actions that would significantly alter the existing flow regime where these species occur. Such activities may include, but are not limited to, impoundment, channelization, urban development, water diversion, water withdrawal, and tail water releases downstream of dams. These activities could eliminate or reduce the habitat necessary for growth and reproduction of these mollusks and their life cycles including fish hosts.

(3) Actions that would significantly alter water chemistry or water quality (for example, temperature, pH, contaminants, conductivity, and excess nutrients). Such activities may include, but are not limited to, tail water releases downstream of dams, or the release of chemicals, biological pollutants, or heated effluents into surface water or connected groundwater at a point source or by dispersed release (nonpoint source). These activities could alter water conditions that are beyond the tolerances of these mussels or their fish hosts or both, and result in direct or cumulative adverse effects to the species and their life cycles.

(4) Actions that would significantly alter stream bed material composition and quality by increasing sediment deposition or filamentous algal growth. Such activities may include, but are not limited to, construction projects, gravel and sand mining, oil and gas development, livestock grazing, timber harvest, off-road vehicle use, and other watershed and floodplain disturbances that release sediments or contaminants into the water. These activities could eliminate or reduce habitats necessary for the survival, growth and reproduction of these mollusks or their fish hosts or both by causing excessive sedimentation and burial of Neosho mucket and rabbitsfoot or their habitats, sublethal effects from sediment exposure that are not readily apparent, acute and chronic exposure to chemical contaminants resulting in sublethal and lethal effects, and nutrification leading to excessive filamentous algal growth. Excessive filamentous algal growth can cause reduced nighttime dissolved oxygen levels through respiration and prevent mussel glochidia from settling into stream sediments.

Exemptions

Application of Section 4(a)(3) of the Act

The Sikes Act Improvement Act of 1997 (Sikes Act) (16 U.S.C. 670a) required each military installation that includes land and water suitable for the conservation and management of natural resources to complete an integrated natural resources management plan (INRMP) by November 17, 2001. An INRMP integrates implementation of the military mission of the installation with stewardship of the natural resources found on the base. Each INRMP includes:

(1) An assessment of the ecological needs on the installation, including the need to provide for the conservation of listed species;

(2) A statement of goals and priorities;

(3) A detailed description of management actions to be implemented to provide for these ecological needs; and

(4) A monitoring and adaptive management plan.

Among other things, each INRMP must, to the extent appropriate and applicable, provide for fish and wildlife management; fish and wildlife habitat enhancement or modification; wetland protection, enhancement, and restoration where necessary to support fish and wildlife; and enforcement of applicable natural resource laws.

The National Defense Authorization Act for Fiscal Year 2004 (Pub. L. 108–136) amended the Act to limit areas eligible for designation as critical habitat. Specifically, section 4(a)(3)(B)(i) of the Act (16 U.S.C. 1533(a)(3)(B)(i)) now provides: ''The Secretary shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under section 101 of the Sikes Act (16 U.S.C. 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation.'' There are no Department of Defense lands with a completed INRMP within the proposed critical habitat designation for the Neosho mucket and rabbitsfoot.

Exclusions

Application of Section 4(b)(2) of the Act

Section 4(b)(2) of the Act states that the Secretary must designate and make revisions to critical habitat on the basis of the best available scientific data after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. The Secretary may exclude an area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific data available, that the failure to designate such area as critical habitat will result in the extinction of the species. In making that determination, the statute on its face, as well as the legislative history, are clear that the Secretary has broad discretion regarding which factor(s) to use and how much weight to give to any factor.

Under section 4(b)(2) of the Act, we may exclude an area from designated critical habitat based on economic impacts, impacts on national security, or any other relevant impacts. In considering whether to exclude a particular area from the designation, we identify the benefits of including the area in the designation, identify the benefits of excluding the area from the designation, and evaluate whether the benefits of exclusion outweigh the benefits of inclusion. If the analysis indicates that the benefits of exclusion outweigh the benefits of inclusion, the Secretary may exercise his discretion to exclude the area only if such exclusion would not result in the extinction of the species.

Exclusions Based on Economic Impacts

Under section 4(b)(2) of the Act, we consider the economic impacts of specifying any particular area as critical habitat. In order to consider economic impacts, we are preparing an analysis of the economic impacts of the proposed critical habitat designation and related factors.

We will announce the availability of our draft economic analysis as soon as it is completed, at which time we will seek public comment. During the development of a final designation, we will consider economic impacts, public comments, and other new information related to economic impacts, and areas may be excluded from the final critical habitat designation under section 4(b)(2) of the Act and our implementing regulations at 50 CFR 424.19.

Exclusions Based on National Security Impacts

Under section 4(b)(2) of the Act, we consider whether there are lands owned or managed by the Department of Defense where a national security impact might exist. In preparing this proposal, we have determined that none of the lands within the proposed designation of critical habitat for the Neosho mucket and rabbitsfoot are owned or managed by the Department of Defense and, therefore, we anticipate no impact on national security. Consequently, the Secretary does not propose to exert his discretion to exclude any areas from the final designation based on impacts on national security.

Exclusions Based on Other Relevant Impacts

Under section 4(b)(2) of the Act, we consider any other relevant impacts, in addition to economic impacts and impacts on national security. We consider a number of factors, including whether the landowners have developed any HCPs or other management plans for the area, or whether there are conservation partnerships that would be encouraged by designation of, or exclusion of lands from, critical habitat. In addition, we look at any tribal issues, and consider the government-to-government relationship of the United States with tribal entities. We also consider any social impacts that might occur because of the designation.

In preparing this proposed rule, we have determined that there are currently no HCPs or other management plans for the Neosho mucket and rabbitsfoot. The proposed designation of critical habitat includes only tribal jurisdictional areas not lands managed by any Tribe. We anticipate no effect to tribal lands, partnerships, or HCPs from this proposed critical habitat designation. Accordingly, the Secretary does not propose to exert his discretion to exclude any areas from the final designation based on other relevant impacts.

Peer Review

In accordance with our joint policy published in the **Federal Register** on July 1, 1994 (59 FR 34270), we will seek the expert opinions of at least three appropriate and independent specialists for each species regarding this proposed rule. The purpose of peer review is to ensure that our critical habitat designation is based on scientifically sound data, assumptions, and analyses. We have invited these peer reviewers to comment during this public comment period on our specific assumptions and conclusions in this proposed designation of critical habitat.

We will consider all comments and information received during this comment period on this proposed rule during our preparation of a final determination. Accordingly, the final decision may differ from this proposal.

Public Hearings

Section 4(b)(5) of the Act provides for one or more public hearings on this proposal, if requested. Requests must be received within 45 days after the date of publication of this proposed rule in the **Federal Register**. Such requests must be sent to the address shown in **FOR FURTHER INFORMATION CONTACT**. We will schedule public hearings on this proposal, if any are requested, and announce the dates, times, and places of those hearings, as well as how to obtain reasonable accommodations, in the **Federal Register** and local newspapers at least 15 days before the hearing.

Required Determinations

Regulatory Planning and Review (Executive Orders 12866 and 13563)

Executive Order 12866 provides that the Office of Information and Regulatory Affairs (OIRA) will review all significant rules. The Office of Information and Regulatory Affairs has determined that this rule is not significant.

Executive Order 13563 reaffirms the principles of E.O. 12866 while calling for improvements in the nation's regulatory system to promote predictability, to reduce uncertainty, and to use the best, most innovative, and least burdensome tools for achieving regulatory ends. The executive order directs agencies to consider regulatory approaches that reduce burdens and maintain flexibility and freedom of choice for the public where these approaches are relevant, feasible, and consistent with regulatory objectives. E.O. 13563 emphasizes further that regulations must be based on the best available science and that the rulemaking process must allow for public participation and an open exchange of ideas. We have developed this rule in a manner consistent with these requirements.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (RFA; 5 U.S.C. 601 *et seq.*) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA; 5 U.S.C. 801 *et seq.*), whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effects of the rule on small entities (small businesses, small organizations, and small government jurisdictions). However, no regulatory flexibility analysis is required if the head of the agency certifies the rule will not have a significant economic impact on a substantial number of small entities. The SBREFA amended the RFA to require Federal agencies to provide a certification statement of the factual basis for certifying that the rule will not have a significant economic impact on a substantial number of small entities.

According to the Small Business Administration, small entities include small organizations such as independent nonprofit organizations; small governmental jurisdictions, including school boards and city and town governments that serve fewer than 50,000 residents; and small businesses (13 CFR 121.201). Small businesses include such businesses as manufacturing and mining concerns with fewer than 500 employees, wholesale trade entities with fewer than 100 employees, retail and service businesses with less than $5 million in annual sales, general and heavy construction businesses with less than $27.5 million in annual business, special trade contractors doing less than $11.5 million in annual business, and forestry and logging operations with fewer than 500 employees and annual business less than $7 million. To determine whether small entities may be affected, we will consider the types of activities that might trigger regulatory impacts under this designation as well as types of project modifications that may result. In general, the term ''significant economic impact'' is meant to apply to a typical small business firm's business operations.

Importantly, the incremental impacts of a rule must be *both* significant and substantial to prevent certification of the rule under the RFA and to require the preparation of an initial regulatory flexibility analysis. If a substantial number of small entities are affected by the proposed critical habitat designation, but the per-entity economic impact is not significant, the Service may certify. Likewise, if the per-entity economic impact is likely to be significant, but the number of affected entities is not substantial, the Service may also certify.

Under the RFA, as amended, and following recent court decisions, Federal agencies are only required to evaluate the potential incremental impacts of rulemaking on those entities directly regulated by the rulemaking itself, and not the potential impacts to indirectly affected entities. The regulatory mechanism through which critical habitat protections are realized is section 7 of the Act, which requires Federal agencies, in consultation with the Service, to ensure that any action authorized, funded, or carried by the Agency is not likely to adversely modify critical habitat. Therefore, only Federal action agencies are directly subject to the specific regulatory requirement (avoiding destruction and adverse modification) imposed by critical habitat designation. Under these circumstances, it is our position that only Federal action agencies will be directly regulated by this designation. Therefore, because Federal agencies are not small entities, the Service may certify that the proposed critical habitat rule will not have a significant economic impact on a substantial number of small entities.

We acknowledge, however, that in some cases, third-party proponents of the action subject to permitting or funding may participate in a section 7 consultation, and thus may be indirectly affected. We believe it is good policy to assess these impacts if we have sufficient data before us to complete the necessary analysis, whether or not this analysis is strictly required by the RFA. While this regulation does not directly regulate these entities, in our draft economic analysis we will conduct a brief evaluation of the potential number of third parties participating in consultations on an annual basis in order to ensure a more complete examination of the incremental effects of this proposed rule in the context of the RFA.

In conclusion, we believe that, based on our interpretation of directly regulated entities under the RFA and relevant case law, this designation of critical habitat will only directly regulate Federal agencies which are not by definition small business entities. And as such, certify that, if promulgated, this designation of critical habitat would not have a significant economic impact on a substantial number of small business entities. Therefore, an initial regulatory flexibility analysis is not required. However, though not necessarily required by the RFA, in our draft economic analysis for this proposal we will consider and evaluate the potential effects to third parties that may be involved with consultations with Federal action agencies related to this action.

Energy Supply, Distribution, or Use—Executive Order 13211

Executive Order 13211 (Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use) requires agencies to prepare Statements of Energy Effects when undertaking certain actions. Although two of the proposed units are downstream of hydropower reservoirs, current and proposed operating regimes have been deemed adequate for the species, and therefore their hydropower operations are not anticipated to be affected by the proposed designation of critical habitat.

Natural gas and oil exploration and development activities occur or could potentially occur in the rabbitsfoot proposed critical habitat (6 of 35 critical habitat units). However, compliance with State regulatory requirements or voluntary BMPs would be expected to minimize impacts of natural gas and oil exploration and development in the areas of proposed critical habitat for both species. The measures for natural gas and oil exploration and development are generally not considered a substantial cost compared with overall project costs and are already being implemented by oil and gas companies. Coal mining occurs or could potentially occur in 5 of 35 proposed critical habitat units for the rabbitsfoot. Incidental take for listed species associated with surface coal mining activities is currently covered under a programmatic, no jeopardy biological opinion between the Office of Surface Mining and the Service completed in 1996 (Service 1996, entire). The biological opinion covers existing, proposed, and future endangered and threatened species that may be affected by the implementation and administration of surface coal mining programs under the Surface Mining Control and Reclamation Act of 1977. Through its analysis, the Service concluded that the proposed action (surface coal mining and reclamation activities) was not likely to jeopardize the continued existence of any endangered, threatened, or proposed species or result in adverse modification of designated or proposed critical habitat.

All other proposed units are remote from energy supply, distribution, or use activities. We do not expect the designation of this proposed critical habitat to significantly affect energy supplies, distribution, or use. Therefore, this action is not a significant energy action, and no Statement of Energy Effects is required. However, we will further evaluate this issue as we conduct our economic analysis, and review and revise this assessment as warranted.

Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.)

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501 *et seq.*), we make the following findings:

(1) This rule will not produce a Federal mandate. In general, a Federal mandate is a provision in legislation, statute, or regulation that would impose an enforceable duty upon State, local, or tribal governments, or the private sector, and includes both ''Federal intergovernmental mandates'' and ''Federal private sector mandates.'' These terms are defined in 2 U.S.C. 658(5)–(7). ''Federal intergovernmental mandate'' includes a regulation that ''would impose an enforceable duty upon State, local, or tribal governments'' with two exceptions. It excludes ''a condition of Federal assistance.'' It also excludes ''a duty arising from participation in a voluntary Federal program,'' unless the regulation ''relates to a then-existing Federal program under which $500,000,000 or more is provided annually to State, local, and tribal governments under entitlement authority,'' if the provision would ''increase the stringency of conditions of assistance'' or ''place caps upon, or otherwise decrease, the Federal Government's responsibility to provide funding,'' and the State, local, or tribal governments ''lack authority'' to adjust accordingly. At the time of enactment, these entitlement programs were: Medicaid; Aid to Families with

Dependent Children work programs; Child Nutrition; Food Stamps; Social Services Block Grants; Vocational Rehabilitation State Grants; Foster Care, Adoption Assistance, and Independent Living; Family Support Welfare Services; and Child Support Enforcement. ''Federal private sector mandate'' includes a regulation that ''would impose an enforceable duty upon the private sector, except (i) a condition of Federal assistance or (ii) a duty arising from participation in a voluntary Federal program.''

The designation of critical habitat does not impose a legally binding duty on non-Federal Government entities or private parties. Under the Act, the only regulatory effect is that Federal agencies must ensure that their actions do not destroy or adversely modify critical habitat under section 7. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency. Furthermore, to the extent that non-Federal entities are indirectly impacted because they receive Federal assistance or participate in a voluntary Federal aid program, the Unfunded Mandates Reform Act would not apply and neither would critical habitat shift the costs of the large entitlement programs listed above onto State governments.

(2) We do not believe that this rule will significantly or uniquely affect small governments because the Neosho mucket and rabbitsfoot occur only in navigable waters in which the river bottom is generally owned by the State. However, the adjacent upland properties are owned by private, State, or Federal entities (see Table 5). As such, a Small Government Agency Plan is not required. We will, however, further evaluate this issue as we conduct our economic analysis and revise this assessment if appropriate.

Takings—Executive Order 12630

In accordance with Executive Order 12630 (Government Actions and Interference with Constitutionally Protected Private Property Rights), we have analyzed the potential takings implications of designating critical habitat for Neosho mucket and rabbitsfoot in a takings implications assessment. Critical habitat designation does not affect landowner actions that do not require Federal funding or permits, nor does it preclude development of habitat conservation programs or issuance of incidental take permits to permit actions that do require Federal funding or permits to go forward. The takings implications assessment concludes that this designation of critical habitat for Neosho mucket and rabbitsfoot does not pose significant takings implications for lands within or affected by the designation.

Federalism—Executive Order 13132

In accordance with Executive Order 13132 (Federalism), this proposed rule does not have significant Federalism effects. A Federalism assessment is not required. In keeping with Department of the Interior and Department of Commerce policy, we requested information from, and coordinated development of this proposed critical habitat designation with appropriate State resource agencies in Alabama, Arkansas, Illinois, Indiana, Kansas, Kentucky, Missouri, Mississippi, Oklahoma, Ohio, Pennsylvania, and Tennessee. The designation of critical habitat in areas currently occupied by the Neosho mucket and rabbitsfoot may impose nominal additional regulatory restrictions to those currently in place and, therefore, may have minor incremental impact on State and local governments and their activities. The designation may have some benefit to these governments because the areas that contain the physical or biological features essential to the conservation of the species are more clearly defined, and the elements of the features of the habitat necessary to the conservation of the species are specifically identified. This information does not alter where and what federally sponsored activities may occur. However, it may assist local governments in long-range planning (rather than having them wait for case-by-case section 7 consultations to occur).

Where State and local governments require approval or authorization from a Federal agency for actions that may affect critical habitat, consultation under section 7(a)(2) would be required. While non-Federal entities that receive Federal funding, assistance, or permits, or that otherwise require approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency.

Civil Justice Reform—Executive Order 12988

In accordance with Executive Order 12988 (Civil Justice Reform), the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and that it meets the requirements of sections 3(a) and 3(b)(2) of the Order. We have proposed designating critical habitat in accordance with the provisions of the Act. This proposed rule uses standard property descriptions and identifies the elements of physical or biological features essential to the conservation of the Neosho mucket and rabbitsfoot within the designated areas to assist the public in understanding the habitat needs of the species.

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 *et seq.*). This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*), need not be prepared in connection with listing a species as endangered or threatened under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

It is also our position that, outside the jurisdiction of the U.S. Court of Appeals for the Tenth Circuit, we do not need to prepare environmental analyses pursuant to NEPA in connection with designating critical habitat under the Endangered Species Act. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244). This position was upheld by the U.S. Court of Appeals for the Ninth Circuit (*Douglas County* v. *Babbitt,* 48 F.3d 1495 (9th Cir. 1995), cert. denied 516 U.S. 1042 (1996)). However, when the range of the species includes States within the Tenth Circuit, such as that of the Neosho mucket (Oklahoma) and rabbitsfoot (Oklahoma and Kansas), under the Tenth Circuit ruling in *Catron County Board of Commissioners* v. *U.S. Fish and Wildlife Service,* 75 F.3d 1429 (10th Cir. 1996), we will undertake a NEPA analysis for critical habitat designation. Accordingly, we will notify the public of the availability of the draft environmental assessment for this proposal when it is finished.

Clarity of the Rule

We are required by Executive Orders 12866 and 12988 and by the Presidential Memorandum of June 1, 1998, to write all rules in plain language. This means that each rule we publish must:

(1) Be logically organized;

(2) Use the active voice to address readers directly;

(3) Use clear language rather than jargon;

(4) Be divided into short sections and sentences; and

(5) Use lists and tables wherever possible.

If you feel that we have not met these requirements, send us comments by one of the methods listed in the **ADDRESSES** section. To better help us revise the rule, your comments should be as specific as possible. For example, you should tell us the numbers of the sections or paragraphs that are unclearly written, which sections or sentences are too long, the sections where you feel lists or tables would be useful, etc.

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination with Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes.

We have determined that there are tribal lands occupied at this time that contain the physical and biological features essential for the conservation of Neosho mucket and rabbitsfoot (1 of 8 Neosho mucket critical habitat units and 2 of 35 rabbitsfoot critical habitat units). However, these lands do not represent riparian land ownership by any Tribe, represent only tribal jurisdictional areas, are not manged by any Tribe, and are on otherwise privately owned lands. We contacted each Tribe in writing and considered their comments during preparation of this proposed rule. Their comments were limited to providing tribal land and jurisdictional area maps and biological data for the two mussels. At this time, we do not anticipate excluding any lands under tribal jurisdiction.

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* at Docket No. FWS–R4–ES–2012–0031 and upon request from the Arkansas Ecological Services Office (see **FOR FURTHER INFORMATION CONTACT**).

Authors

The primary authors of this package are staff of the Arkansas Ecological Services Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Proposed Regulation Promulgation

Accordingly, we propose to amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

2. In § 17.11(h) add entries for "Mucket, Neosho" and "Rabbitsfoot" in alphabetical order under "Clams" to the List of Endangered and Threatened Wildlife to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
*	*	*	*	*	*	*	
CLAMS							
*	*	*	*	*	*	*	
Mucket, Neosho	*Lampsilis rafinesqueana.*	U.S.A. (AR, KS, MO, OK).	NA	E	....	17.95(f)	NA
*	*	*	*	*	*	*	
Rabbitsfoot	*Quadrula cylindrica cylindrica.*	U.S.A. (AL, AR, GA, IL, IN, KS, KY, LA, MS, MO, OH, OK, PA, TN, WV).	NA	T	....	17.95(f)	NA
*	*	*	*	*	*	*	

3. In § 17.95, amend paragraph (f) by adding entries for "Neosho Mucket *(Lampsilis rafinesqueana)*" and "Rabbitsfoot *(Quadrula cylindrica cylindrica)*" after the entry for "Georgia Pigtoe *(Pleurobema hanleyianum)*" to read as follows:

§ 17.95 Critical habitat—fish and wildlife.

* * * * *

(f) *Clams and Snails.*

* * * * *

Neosho Mucket (Lampsilis rafinesqueana)

(1) Critical habitat units for the Neosho mucket are depicted on the maps below in:

(i) Arkansas: Benton and Washington Counties.

(ii) Kansas: Allen, Chase, Cherokee, Coffey, Elk, Greenwood, Labette, Montgomery, Neosho, Wilson, and Woodson Counties.

(iii) Missouri: Jasper, Lawrence, McDonald, and Newton Counties.

(iv) Oklahoma: Adair, Cherokee, and Delaware Counties.

(2) Within these areas, the primary constituent elements of the physical and biological features essential to the conservation of the Neosho mucket consist of five components:

(i) Geomorphically stable river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffles, sometimes with runs, and midchannel island habitats that provide flow refuges consisting of gravel and sand substrates with low to moderate amounts of fine sediment and attached filamentous algae).

(ii) A hydrologic flow regime (the severity, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.

(iii) Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.

(iv) The presence and abundance (currently unknown) of fish hosts necessary for recruitment of the Neosho mucket. The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek will serve as an indication of appropriate presence and abundance of fish hosts until appropriate host fish can be identified.

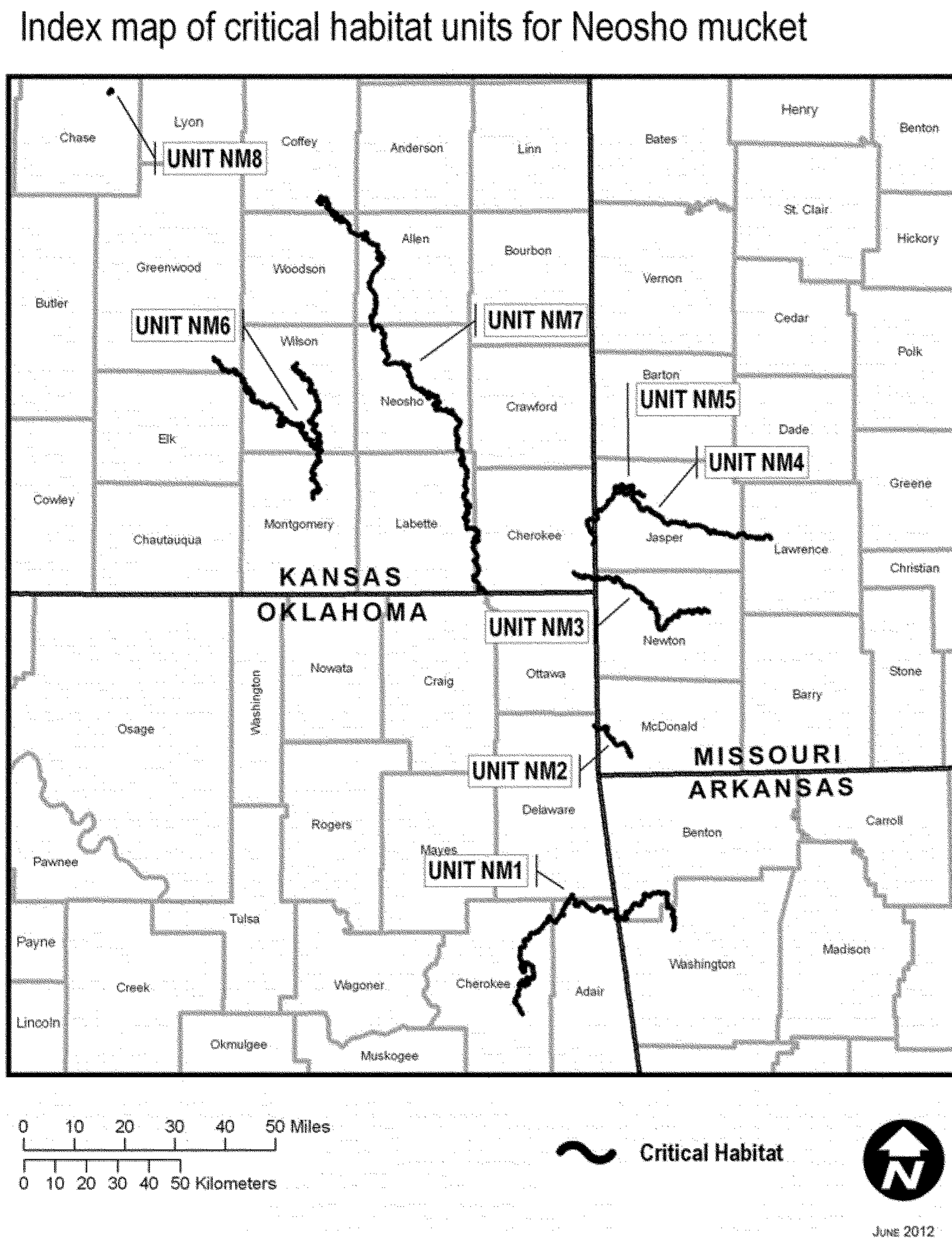
(v) Either no competitive or predaceous invasive (nonnative) species, or such species in quantities low enough to have minimal effect on survival of freshwater mussels.

(3) Critical habitat does not include manmade structures (such as buildings, bridges, aqueducts, airports, roads, and other paved areas) and the land on which they are located exists within the legal boundaries on the effective date of this rule.

(4) *Critical habitat map units.* Unit maps were developed using ESRI ArcGIS mapping software along with various spatial data layers. Critical habitat unit upstream and downstream limits were delineated at the nearest road crossing or stream confluence of each occupied reach. Data layers defining map units were created with USGS National Hydrography Dataset (NHD) Medium Flowline data. ArcGIS was also used to calculate river kilometers and miles from the NHD dataset, and it was used to determine longitude and latitude coordinates in decimal degrees. The projection used in mapping and calculating distances and locations within the units was North American Albers Equal Area Conic, NAD 83.

(5) **Note:** Index map of critical habitat units for the Neosho mucket follows:

BILLING CODE 4310–55–P

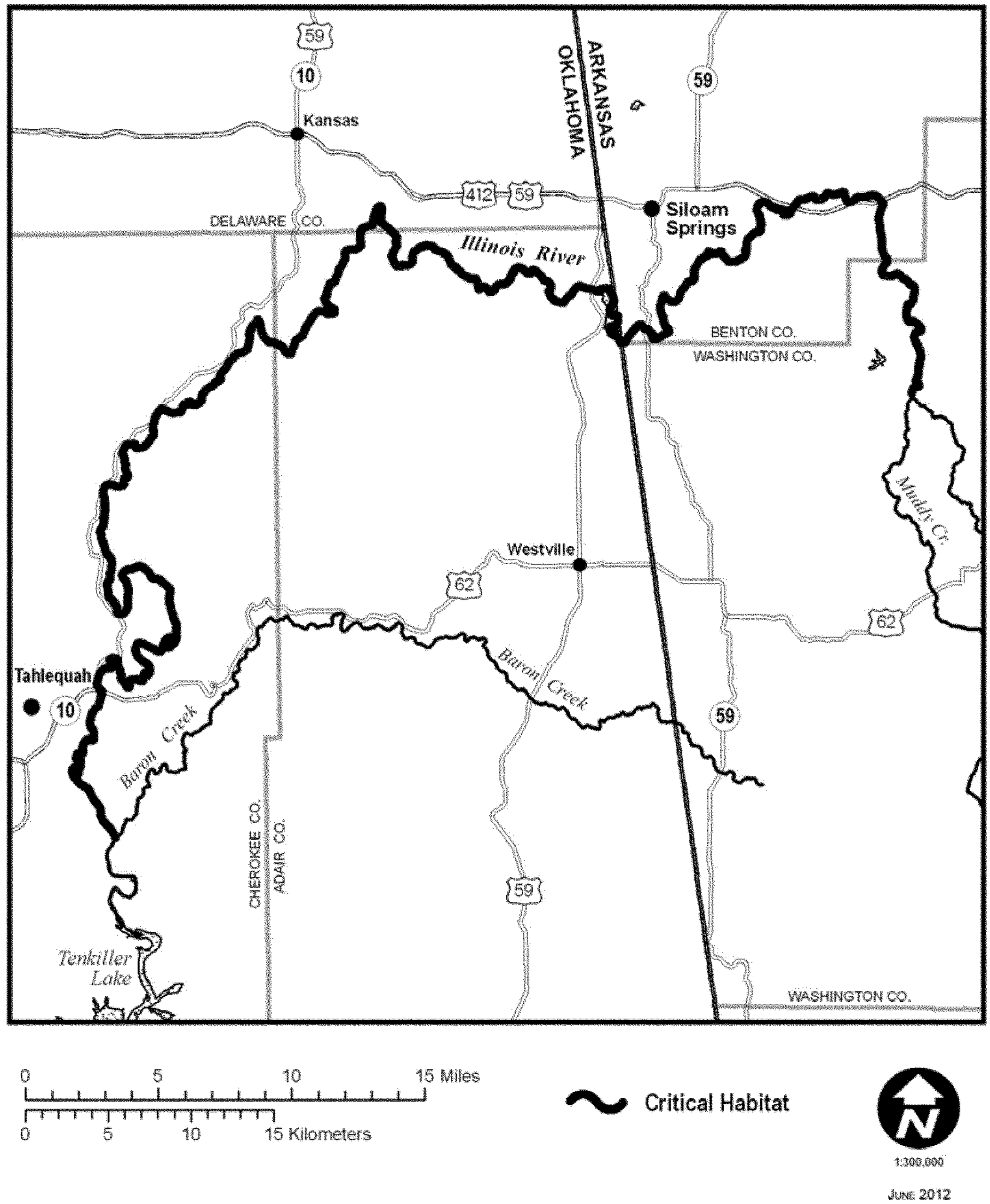


(6) Unit NM1: Illinois River—Benton and Washington Counties, Arkansas; and Adair, Cherokee, and Delaware Counties, Oklahoma.

(i) Unit NM1 includes 146.1 rkm (90.8 rmi) of the Illinois River from the Muddy Fork Illinois River confluence south of Savoy, Washington County, Arkansas, downstream to the Baron Creek confluence southeast of Tahlequah, Cherokee County, Oklahoma.

(ii) **Note:** Map of Unit NM1 (Illinois River) of critical habitat for Neosho mucket follows:

Map of Unit NM1 (Illinois River) of critical habitat for Neosho mucket

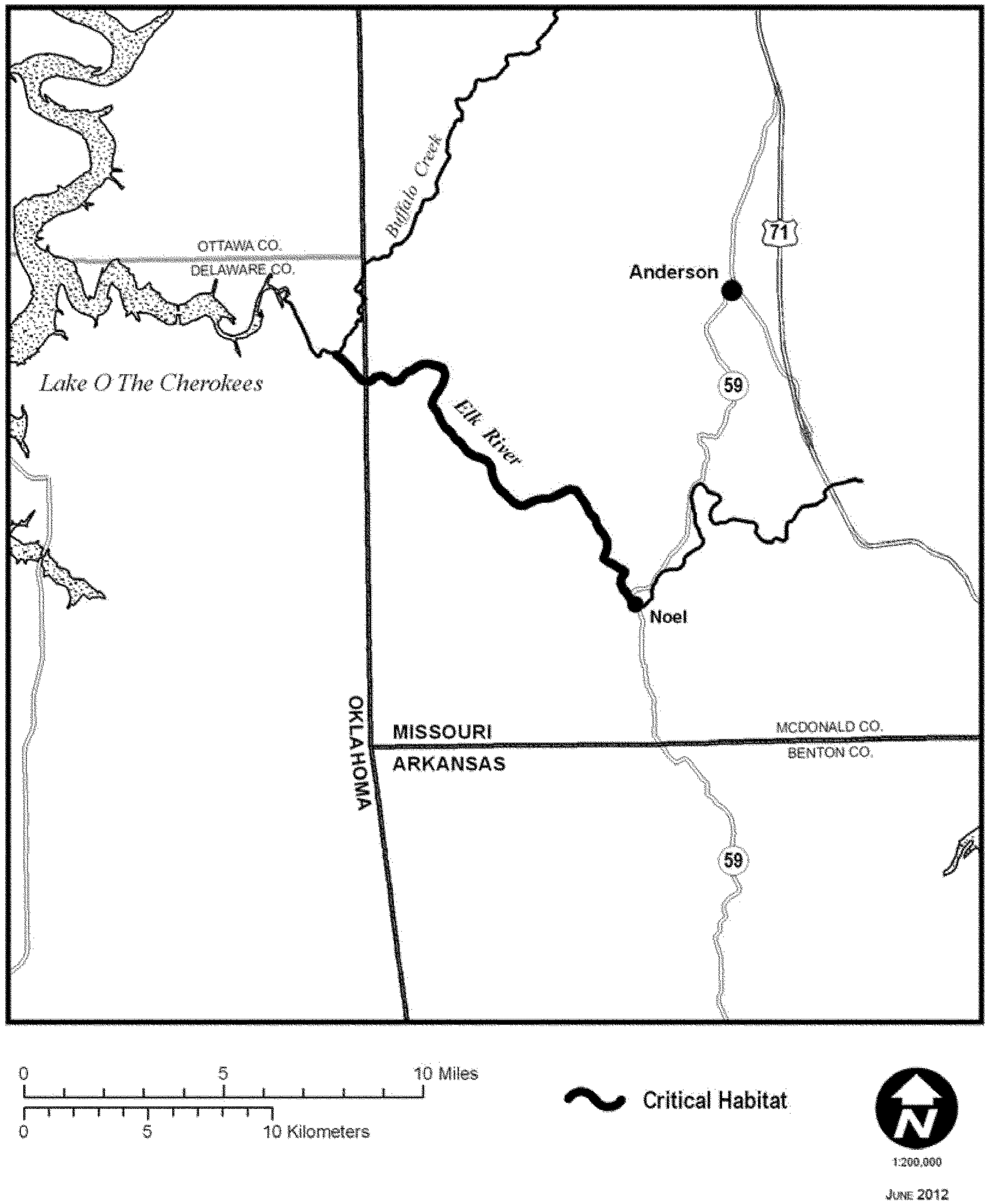


(7) Unit NM2: Elk River—McDonald County, Missouri; and Delaware County, Oklahoma.

(i) Unit NM2 includes 20.3 rkm (12.6 rmi) of the Elk River from Missouri Highway 59 at Noel, McDonald County, Missouri, downstream to the confluence of Buffalo Creek, Delaware County, Oklahoma.

(ii) **Note:** Map of Unit NM2 (Elk River) of critical habitat for Neosho mucket follows:

Map of Unit NM2 (Elk River) of critical habitat for Neosho mucket

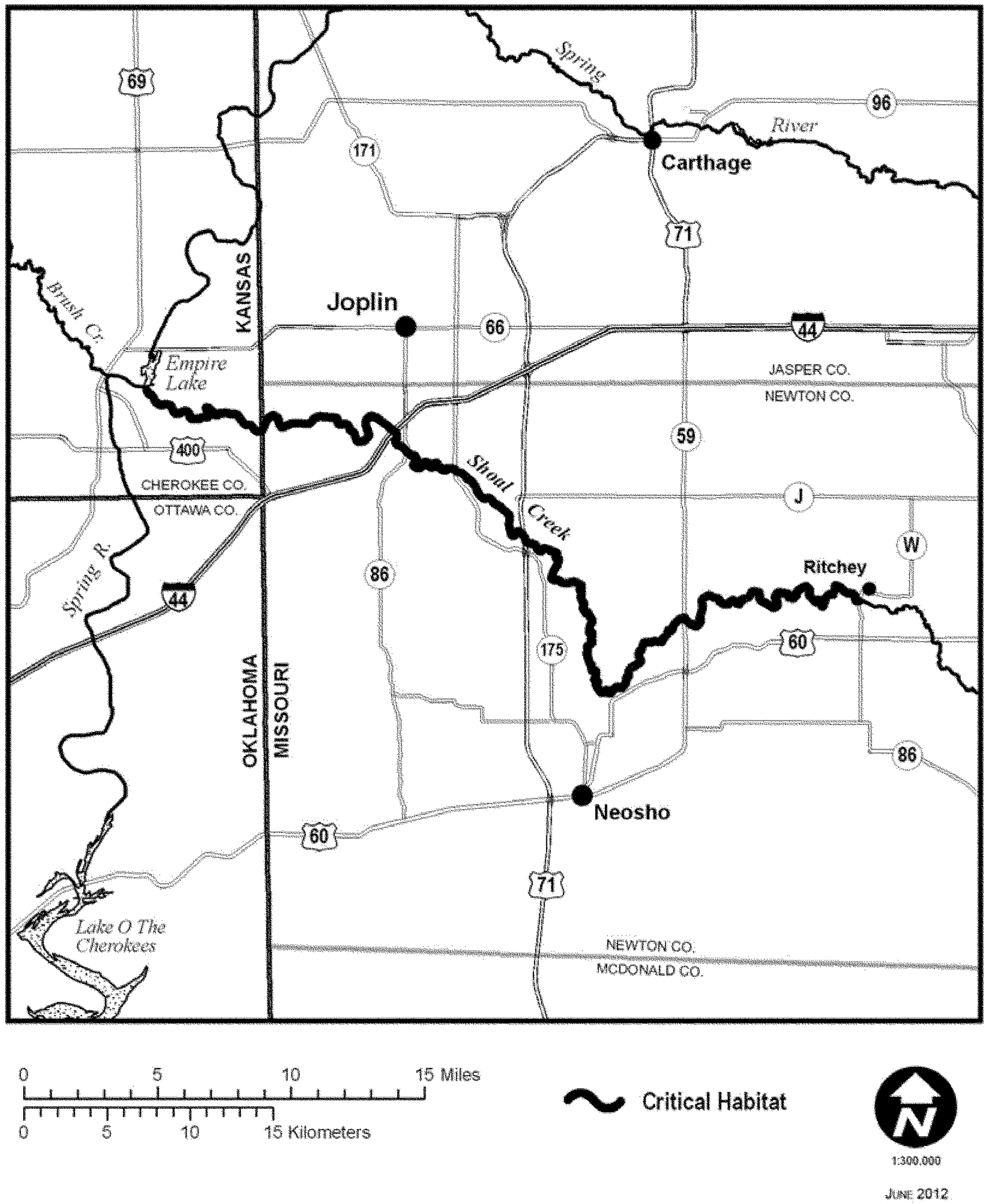


(8) Unit NM3: Shoal Creek—Cherokee County, Kansas; and Newton County, Missouri.

(i) Unit NM3 includes 75.8 rkm (47.1 rmi) of Shoal Creek from Missouri Highway W near Ritchey, Newton County, Missouri, downstream to the upstream point of inundation by Empire Lake, Cherokee County, Kansas.

(ii) **Note:** Map of Unit NM3 (Shoal Creek) of critical habitat for Neosho mucket follows:

Map of Unit NM3 (Shoal Creek) of critical habitat for Neosho mucket

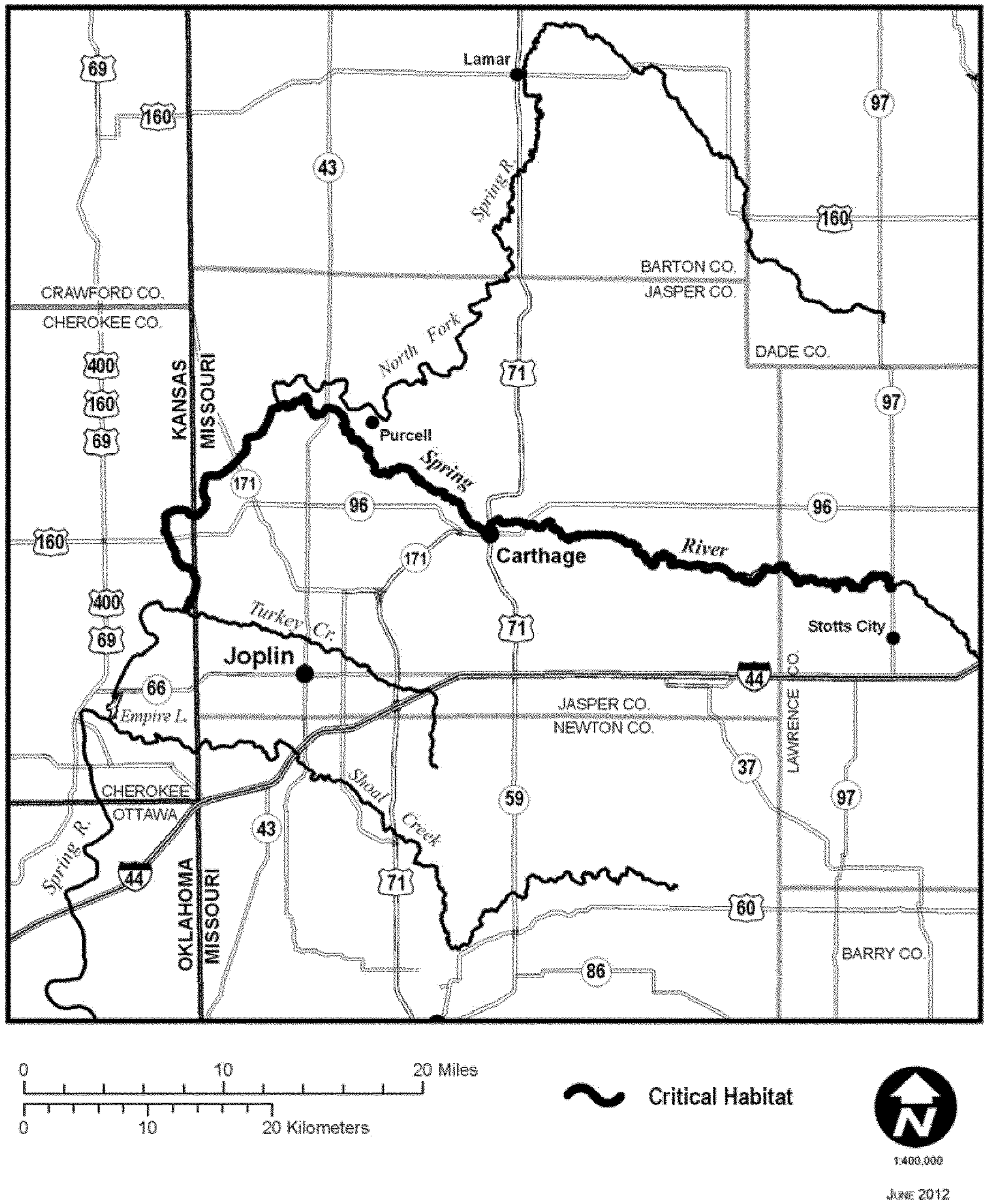


(9) Unit NM4: Spring River—Jasper and Lawrence Counties, Missouri; and Cherokee County, Kansas.

(i) Unit NM4 includes 102.3 rkm (63.6 rmi) of the Spring River from Missouri Highway 97 north of Stotts City, Lawrence County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas.

(ii) **Note:** Map of Unit NM4 (Spring River) of critical habitat for Neosho mucket follows:

Map of Unit NM4 (Spring River) of critical habitat for Neosho mucket

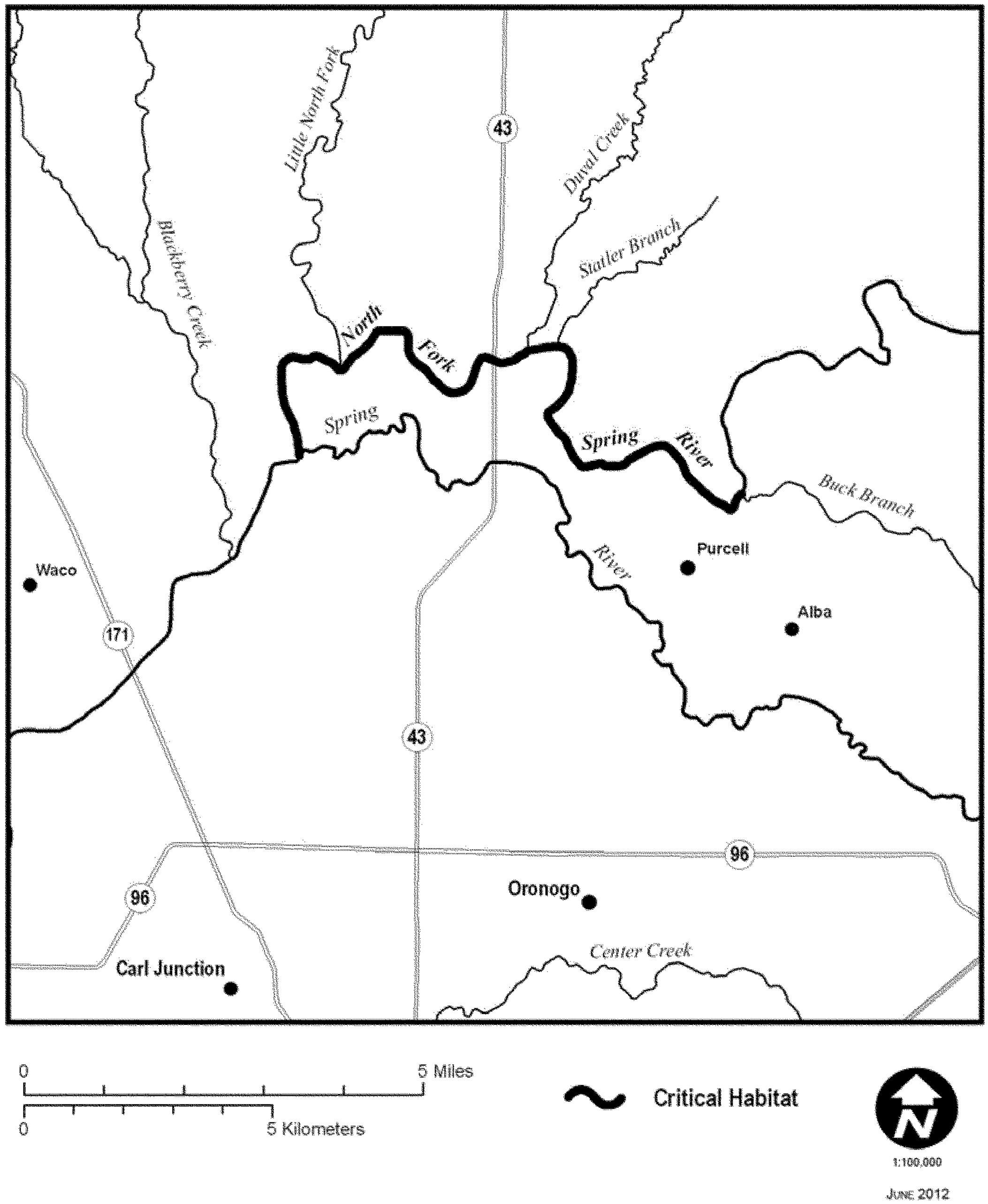


(10) Unit NM5: North Fork Spring River—Jasper County, Missouri.

(i) Unit NM5 includes 16.4 rkm (10.2 rmi) of the North Fork Spring River from the confluence of Buck Branch southwest of Jasper, Missouri, downstream to its confluence with the Spring River near Purcell, Jasper County, Missouri.

(ii) **Note:** Map of Unit NM5 (North Fork Spring River) of critical habitat for Neosho mucket follows:

Map of Unit NM5 (North Fork Spring River) of critical habitat for Neosho mucket

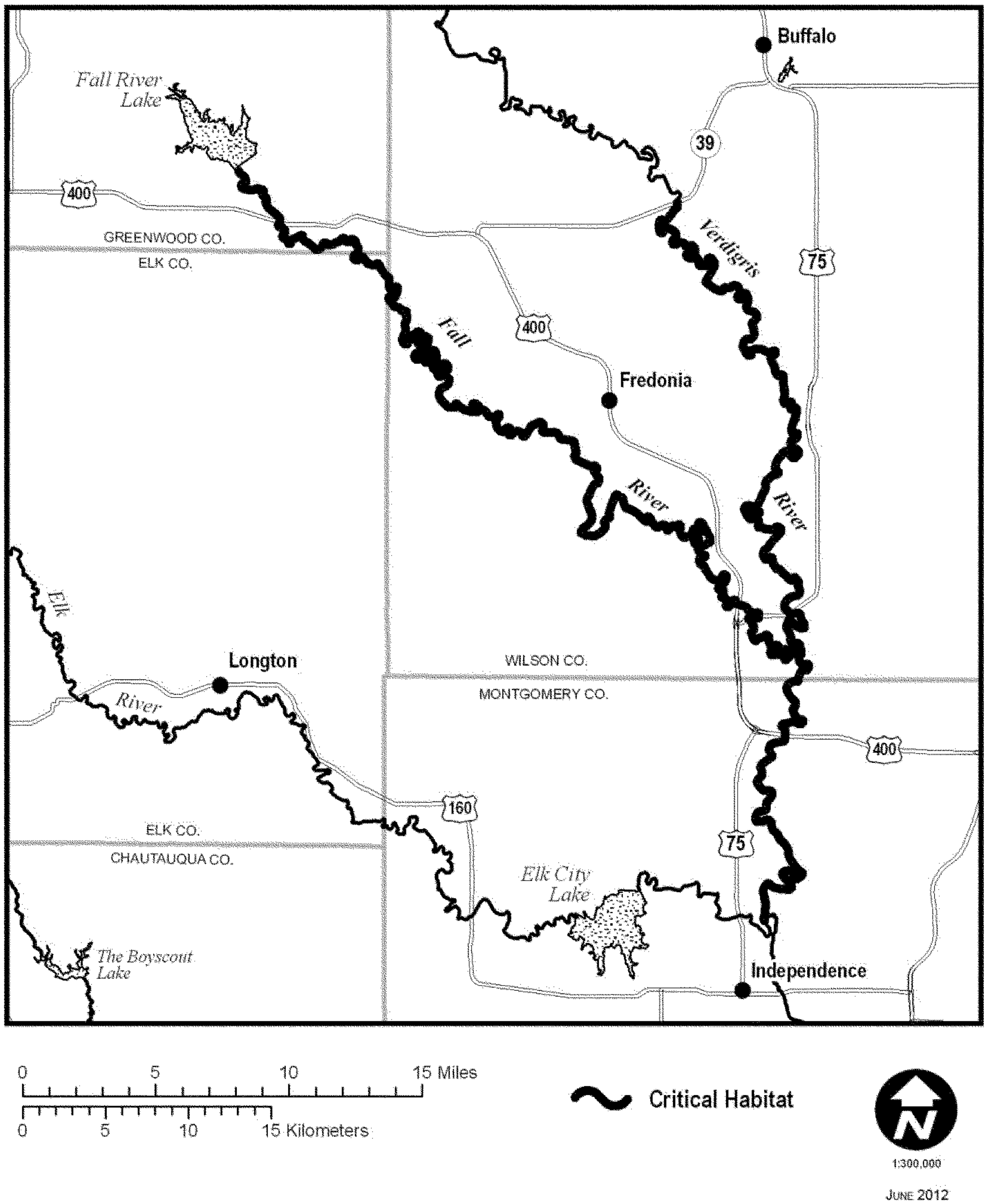


(11) Unit NM6: Fall River—Elk, Greenwood, and Wilson Counties, Kansas; Verdigris River—Montgomery and Wilson Counties, Kansas.

(i) Unit NM6 includes a total of 171.1 rkm (106.3 rmi) including 90.4 rkm (56.2 rmi) of the Fall River from Fall River Lake dam northwest of Fall River, Greenwood County, Kansas, downstream to its confluence with the Verdigris River near Neodesha, Wilson County, Kansas. Unit NM6 also includes 80.6 rkm (50.1 rmi) of the Verdigris River from Kansas Highway 39 near Benedict, Wilson County, Kansas, downstream to the Elk River confluence near Independence, Montgomery County, Kansas.

(ii) **Note:** Map of Unit NM6 (Fall and Verdigris Rivers) of critical habitat for Neosho mucket follows:

Map of Unit NM6 (Fall & Verdigris Rivers) of critical habitat for Neosho mucket

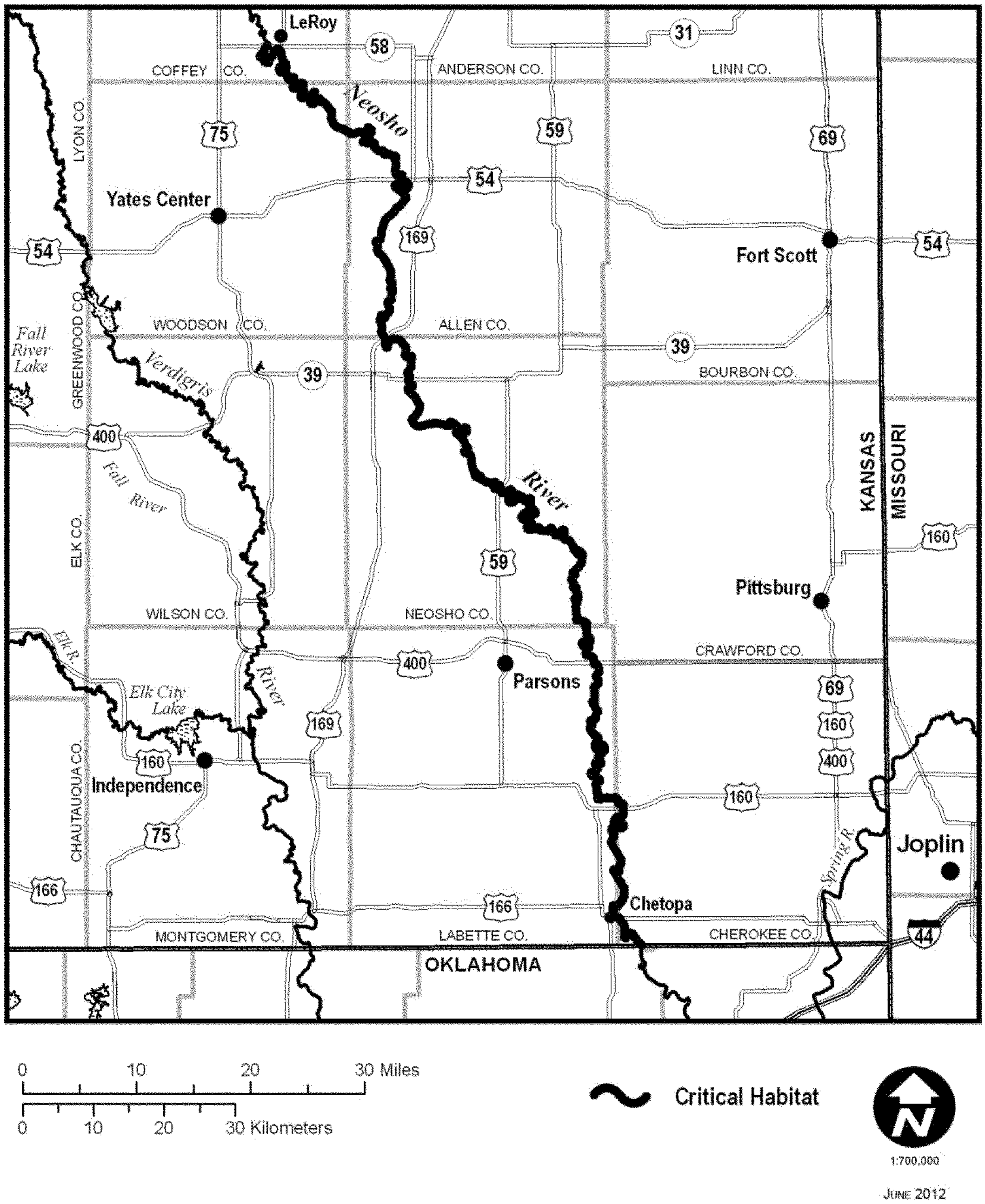


(12) Unit NM7: Neosho River—Allen, Cherokee, Coffey, Labette, Neosho, and Woodson Counties, Kansas.

(i) Unit NM7 includes 244.5 rkm (151.9 rmi) of the Neosho River from Kansas Highway 58 west of LeRoy, Coffey County, Kansas, downstream to the Kansas and Oklahoma State line, Cherokee County, Kansas.

(ii) **Note:** Map of Unit NM7 (Neosho River) of critical habitat for Neosho mucket follows:

Map of Unit NM7 (Neosho River) of critical habitat for Neosho mucket

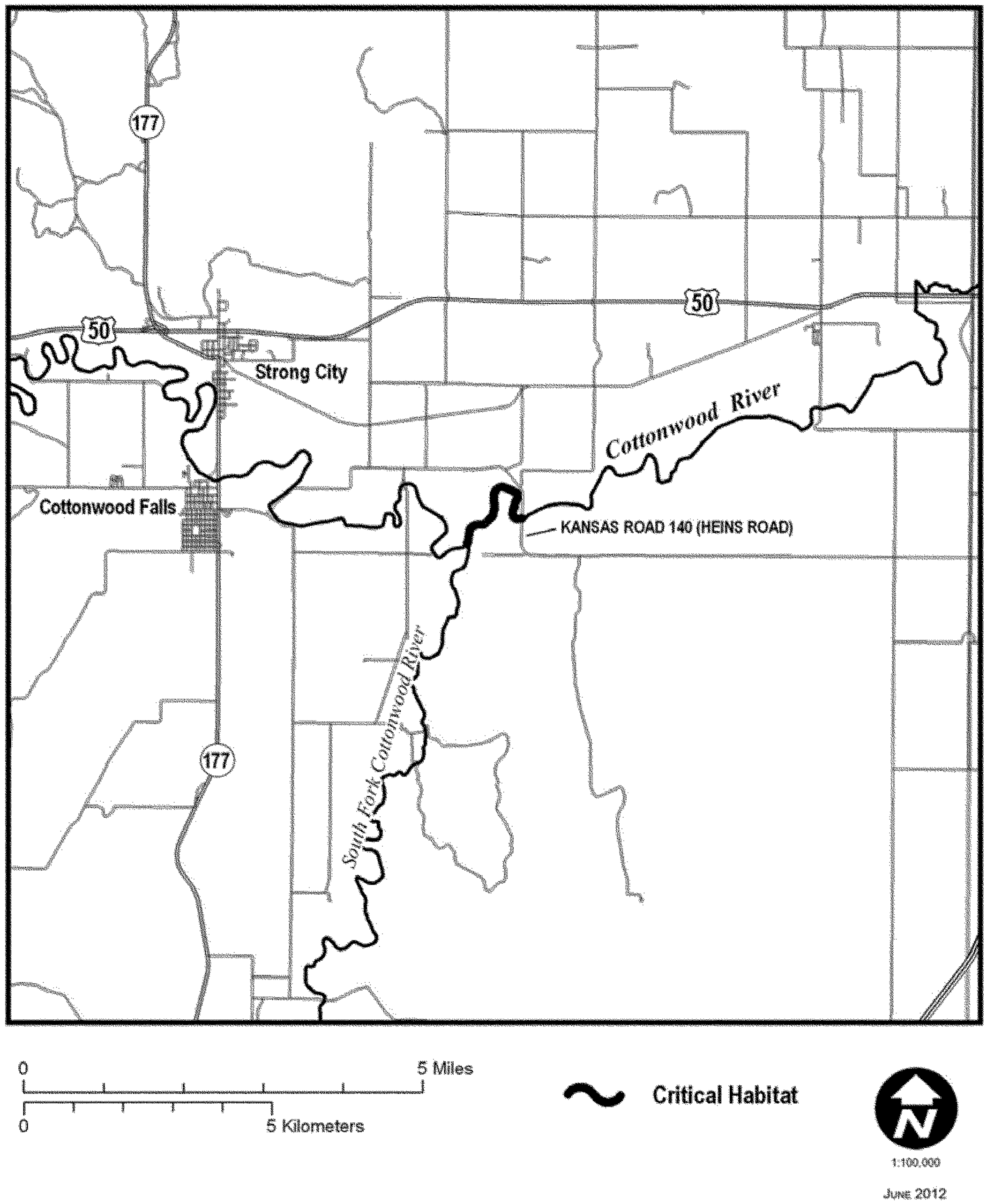


(13) Unit NM8: Cottonwood River—Chase County, Kansas.

(i) Unit NM8 includes 2.6 rkm (1.6 rmi) of the Cottonwood River from the South Fork Cottonwood River confluence downstream to the Kansas Road 140 (also known as Heins Road), east of Cottonwood Falls, Chase County, Kansas.

(ii) **Note:** Map of Unit NM8 (Cottonwood River) of critical habitat for Neosho mucket follows:

Map of Unit NM8 (Cottonwood River) of critical habitat for Neosho mucket



Rabbitsfoot *(Quadrula cylindrica cylindrica)*

(1) Critical habitat units are depicted for the rabbitsfoot in:

(i) Alabama: Colbert, Jackson, Madison, and Marshall Counties.

(ii) Arkansas: Arkansas, Ashley, Bradley, Clark, Cleveland, Dallas, Drew, Fulton, Grant, Hot Spring, Independence, Izard, Jackson, Lawrence, Little River, Marion, Monroe, Montgomery, Newton, Ouachita, Randolph, Saline, Searcy, Sevier, Sharp, Van Buren, White, and Woodruff Counties.

(iii) Kansas: Allen and Cherokee Counties.

(iv) Kentucky: Ballard, Green, Hart, Livingston, Logan, Marshall, and McCracken Counties.

(v) Illinois: Massac, Pulaski, and Vermilion Counties.

(vi) Indiana: Carroll, Pulaski, Tippecanoe, and White Counties.

(vii) Mississippi: Hinds, Sunflower, Toshimingo, and Warren Counties.

(viii) Missouri: Jasper, Madison, and Wayne Counties.

(ix) Ohio: Coshocton, Madison, Union, and Williams Counties.

(x) Oklahoma: McCurtain and Rogers Counties.

(xi) Pennsylvania: Crawford, Erie, Mercer, and Venango Counties.

(xii) Tennessee: Hardin, Hickman, Marshall, Maury, and Robertson Counties.

(2) Within these areas, the primary constituent elements of the physical and biological features essential to the conservation of the rabbitsfoot consist of five components:

(i) Geomorphically stable river channels and banks (channels that maintain lateral dimensions, longitudinal profiles, and sinuosity patterns over time without an aggrading or degrading bed elevation) with habitats that support a diversity of freshwater mussel and native fish (such as stable riffles, sometimes with runs, and midchannel island habitats that provide flow refuges consisting of gravel and sand substrates with low to moderate amounts of fine sediment and attached filamentous algae).

(ii) A hydrologic flow regime (the severity, frequency, duration, and seasonality of discharge over time) necessary to maintain benthic habitats where the species are found and to maintain connectivity of rivers with the floodplain, allowing the exchange of nutrients and sediment for maintenance of the mussel's and fish host's habitat, food availability, spawning habitat for native fishes, and the ability for newly transformed juveniles to settle and become established in their habitats.

(iii) Water and sediment quality (including, but not limited to, conductivity, hardness, turbidity, temperature, pH, ammonia, heavy metals, and chemical constituents) necessary to sustain natural physiological processes for normal behavior, growth, and viability of all life stages.

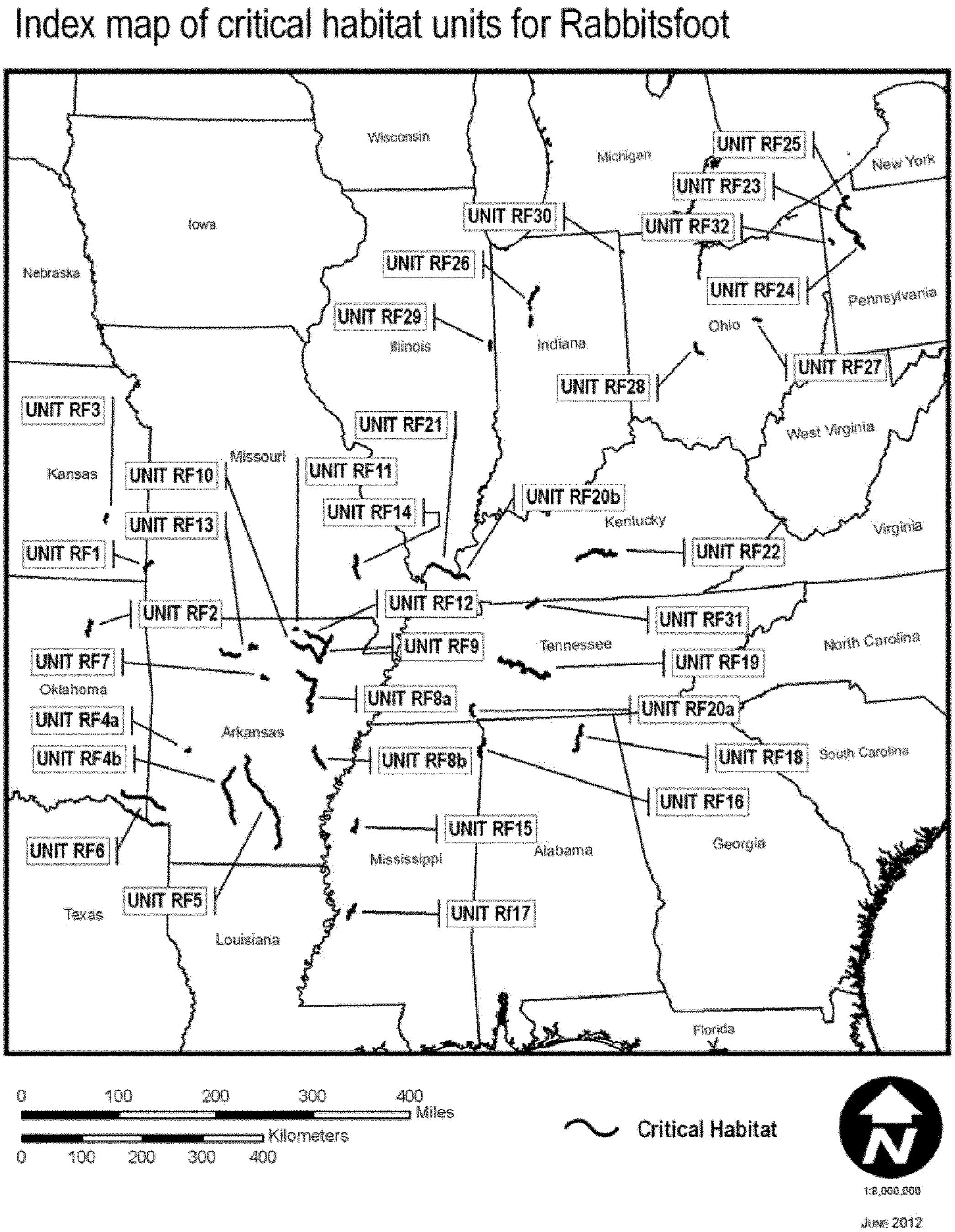
(iv) The presence and abundance (currently unknown) of fish hosts necessary for recruitment of the rabbitsfoot. The occurrence of natural fish assemblages, reflected by fish species richness, relative abundance, and community composition, for each inhabited river or creek will serve as an indication of appropriate presence and abundance of fish hosts until appropriate host fish can be identified.

(v) Either no competitive or predaceous invasive (nonnative) species, or such species in quantities low enough to have minimal effect on survival of freshwater mussels.

(3) Critical habitat does not include manmade structures (such as buildings, bridges, aqueducts, airports, roads, and other paved areas) and the land on which they are located exists within the legal boundaries on the effective date of this rule.

(4) *Critical habitat map units.* Unit maps were developed using ESRI ArcGIS mapping software along with various spatial data layers. Critical habitat unit upstream and downstream limits were delineated at the nearest road crossing or stream confluence of each occupied reach. Data layers defining map units were created with USGS National Hydrography Dataset (NHD) Medium Flowline data. ArcGIS was also used to calculate river kilometers and miles from the NHD dataset, and it was used to determine longitude and latitude coordinates in decimal degrees. The projection used in mapping and calculating distances and locations within the units was North American Albers Equal Area Conic, NAD 83.

(5) **Note:** Index map of critical habitat units for the rabbitsfoot follows:

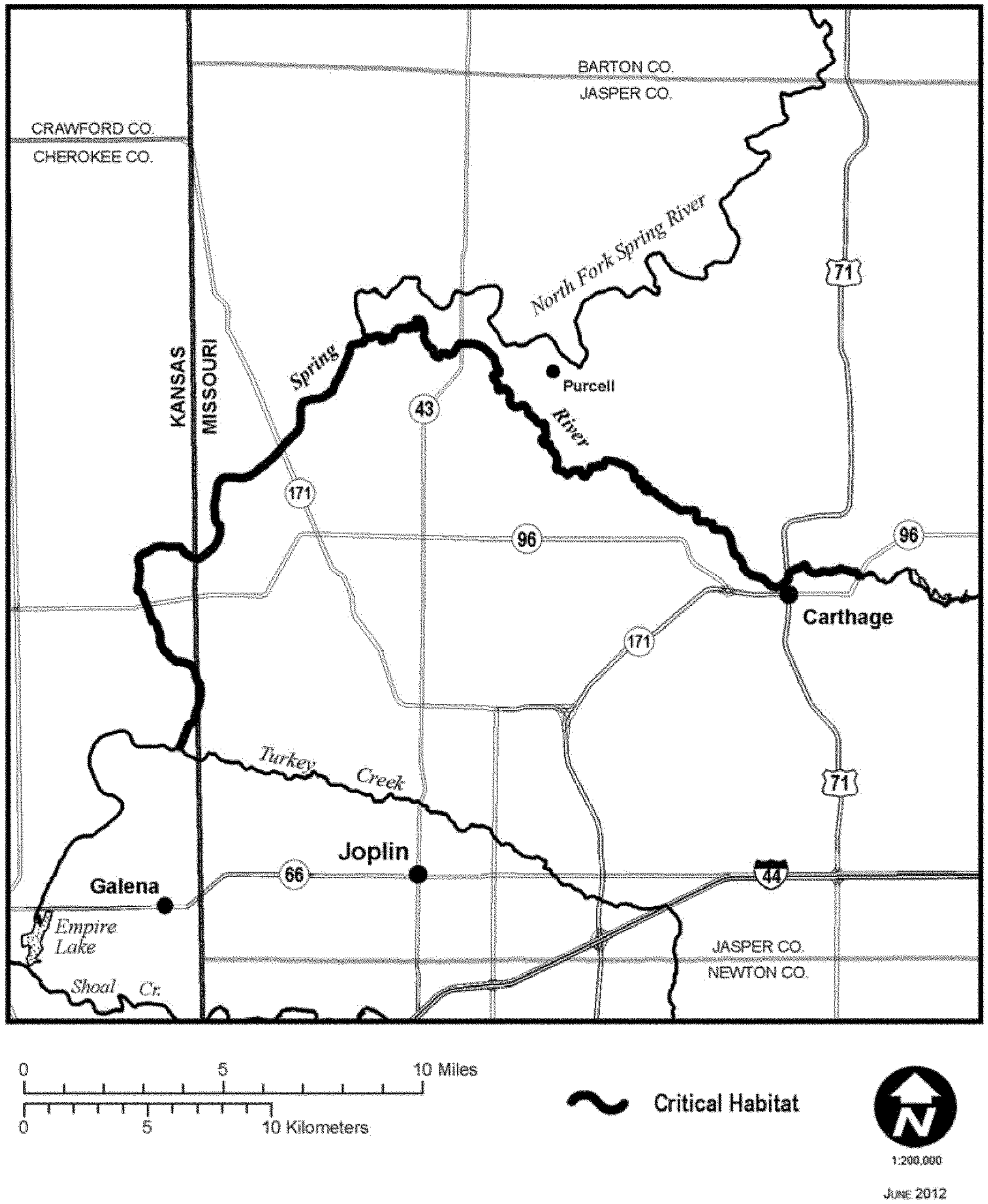


(6) Unit RF1: Spring River—Jasper County, Missouri; and Cherokee County, Kansas.

(i) Unit RF1 includes 56.5 rkm (35.1 rmi) of the Spring River from Missouri Highway 96 at Carthage, Jasper County, Missouri, downstream to the confluence of Turkey Creek north of Empire, Cherokee County, Kansas.

(ii) **Note:** Map of Unit RF1 (Spring River) of critical habitat for rabbitsfoot follows:

Map of Unit RF1 (Spring River) of critical habitat for Rabbitsfoot

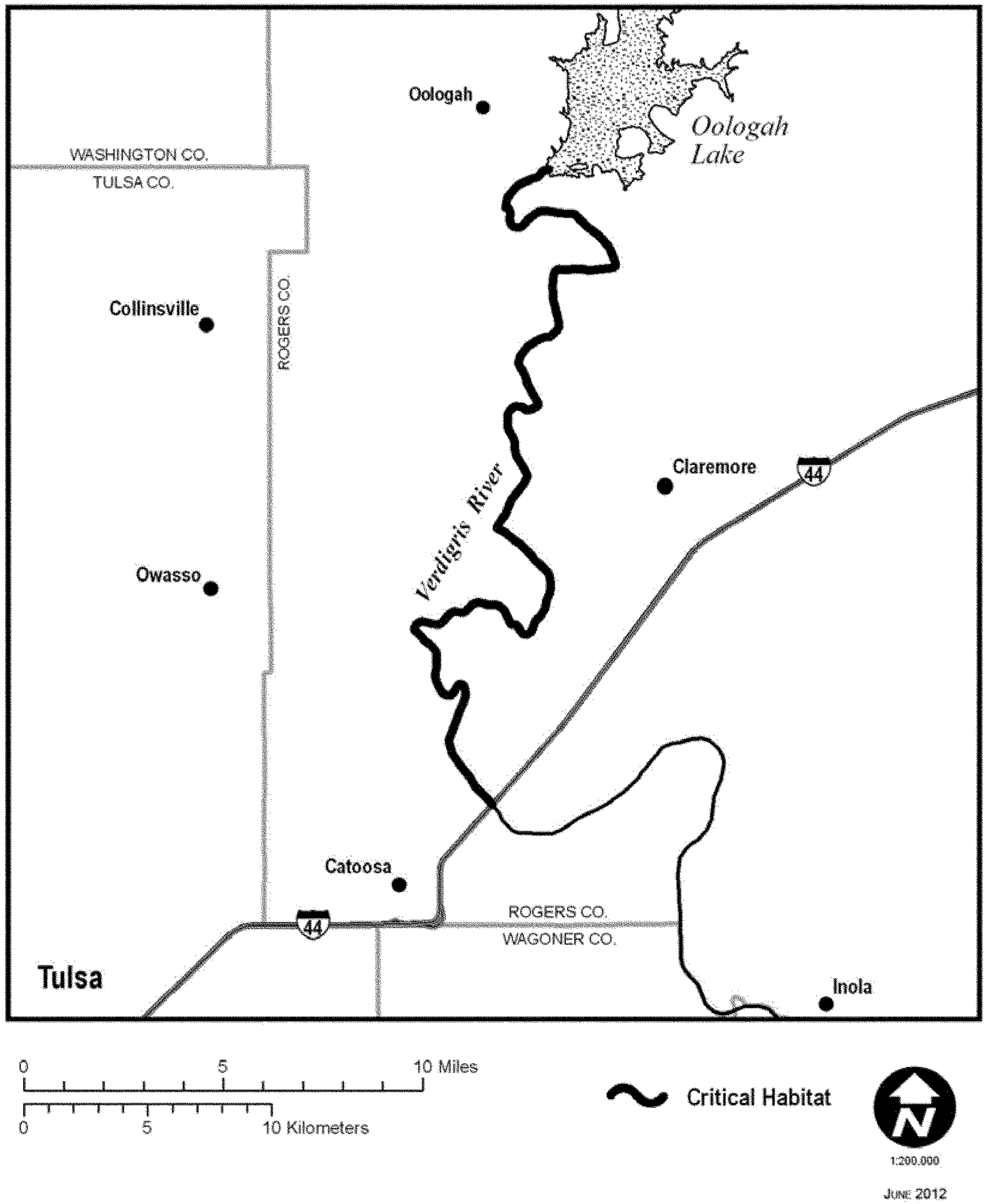


(7) Unit RF2: Verdigris River—Rogers County, Oklahoma.

(i) Unit RF2 includes 45.5 rkm (28.3 rmi) of the Verdigris River from Oologah Lake dam north of Claremore, Oklahoma, downstream to Interstate 44 (Will Rogers Turnpike) west of Catoosa, Rogers County, Oklahoma.

(ii) **Note:** Map of Unit RF2 (Verdigris River) of critical habitat for rabbitsfoot follows:

Map of Unit RF2 (Verdigris River) of critical habitat for Rabbitsfoot

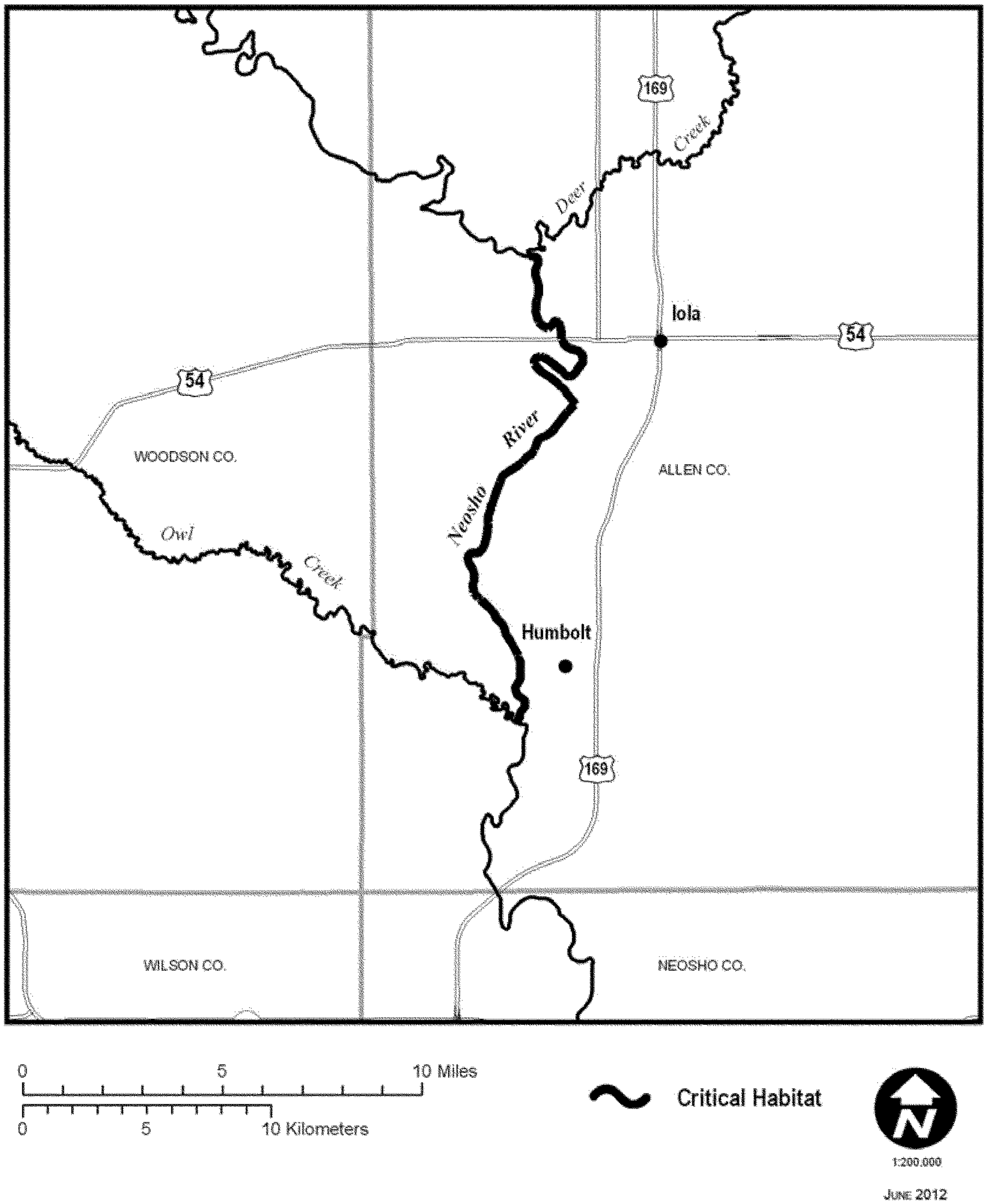


(8) Unit RF3: Neosho River—Allen County, Kansas.

(i) Unit RF3 includes 26.6 rkm (16.5 rmi) of the Neosho River from the Deer Creek confluence northwest of Iola, Kansas, downstream to the confluence of Owl Creek southwest of Humboldt, Allen County, Kansas.

(ii) **Note:** Map of Unit RF3 (Neosho River) of critical habitat for rabbitsfoot follows:

Map of Unit RF3 (Neosho River) of critical habitat for Rabbitsfoot

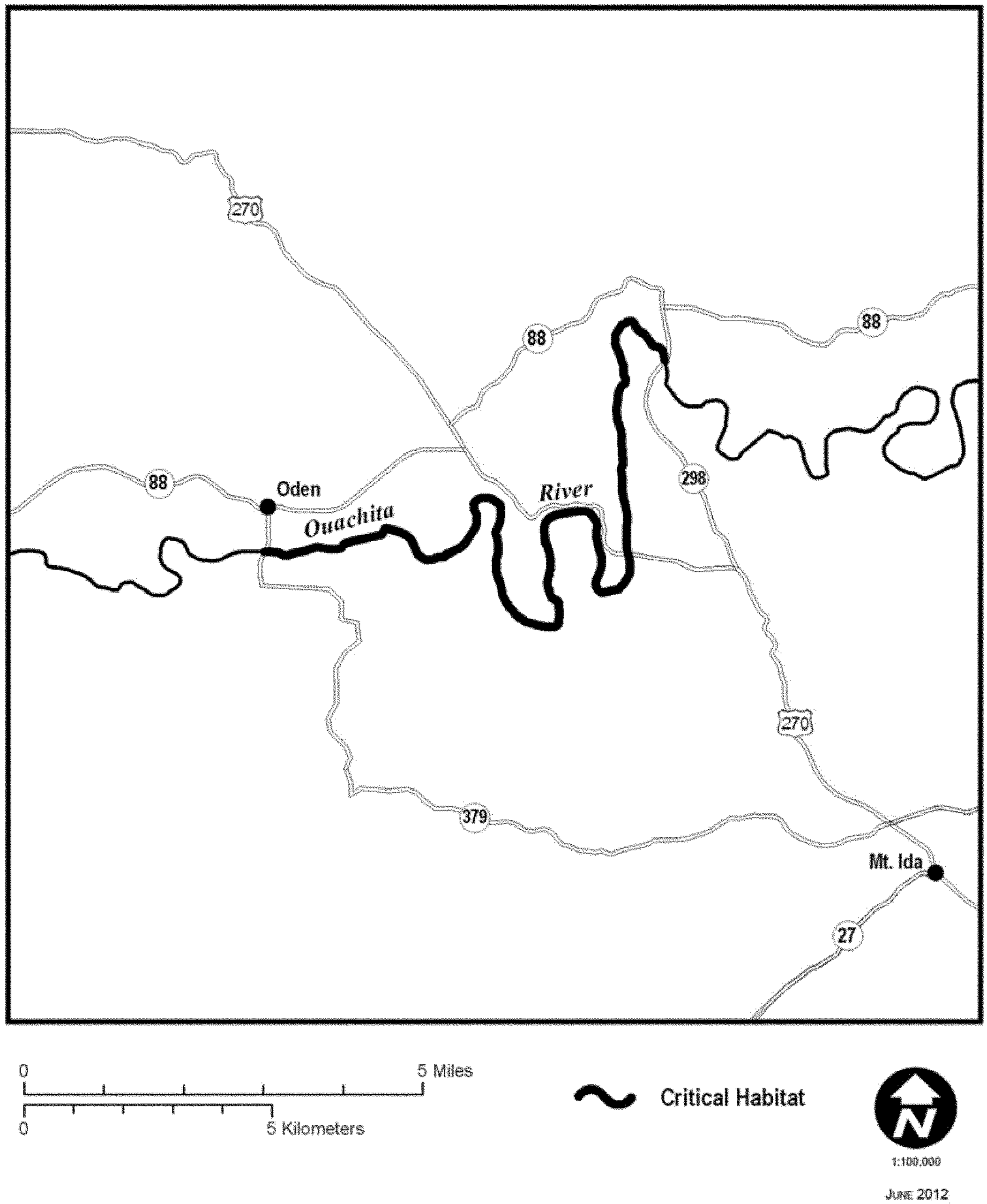


(9) Unit RF4a: Ouachita River—Montgomery County, Arkansas.

(i) Unit RF4a includes 21.9 rkm (13.6 rmi) of the Ouachita River from Arkansas Highway 379 south of Oden, Montgomery County, Arkansas, downstream to Arkansas Highway 298 east of Pencil Bluff, Montgomery County, Arkansas.

(ii) **Note:** Map of Unit RF4a (Ouachita River) of critical habitat for rabbitsfoot follows:

Map of Unit RF4a (Ouachita River) of critical habitat for Rabbitsfoot

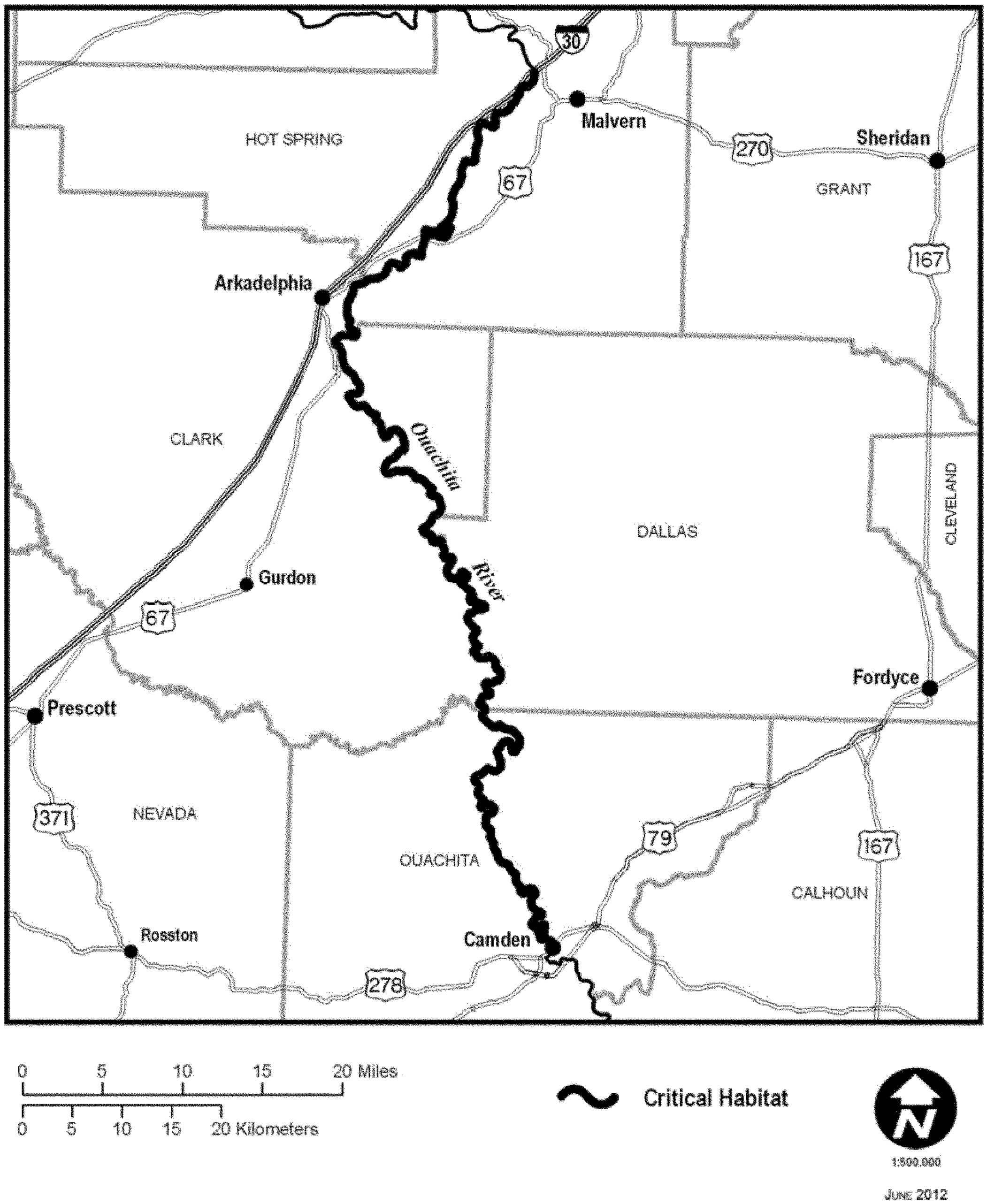


(10) Unit RF4b: Ouachita River—Clark, Hot Spring, and Ouachita Counties, Arkansas.

(i) Unit RF4b includes 157.9 rkm (98.1 rmi) of the Ouachita River from Interstate 30 at Malvern, Hot Spring County, Arkansas, downstream to U.S. Highway 79 at Camden, Ouachita County, Arkansas.

(ii) **Note:** Map of Unit RF4b (Ouachita River) of critical habitat for rabbitsfoot follows:

Map of Unit RF4b (Ouachita River) of critical habitat for Rabbitsfoot

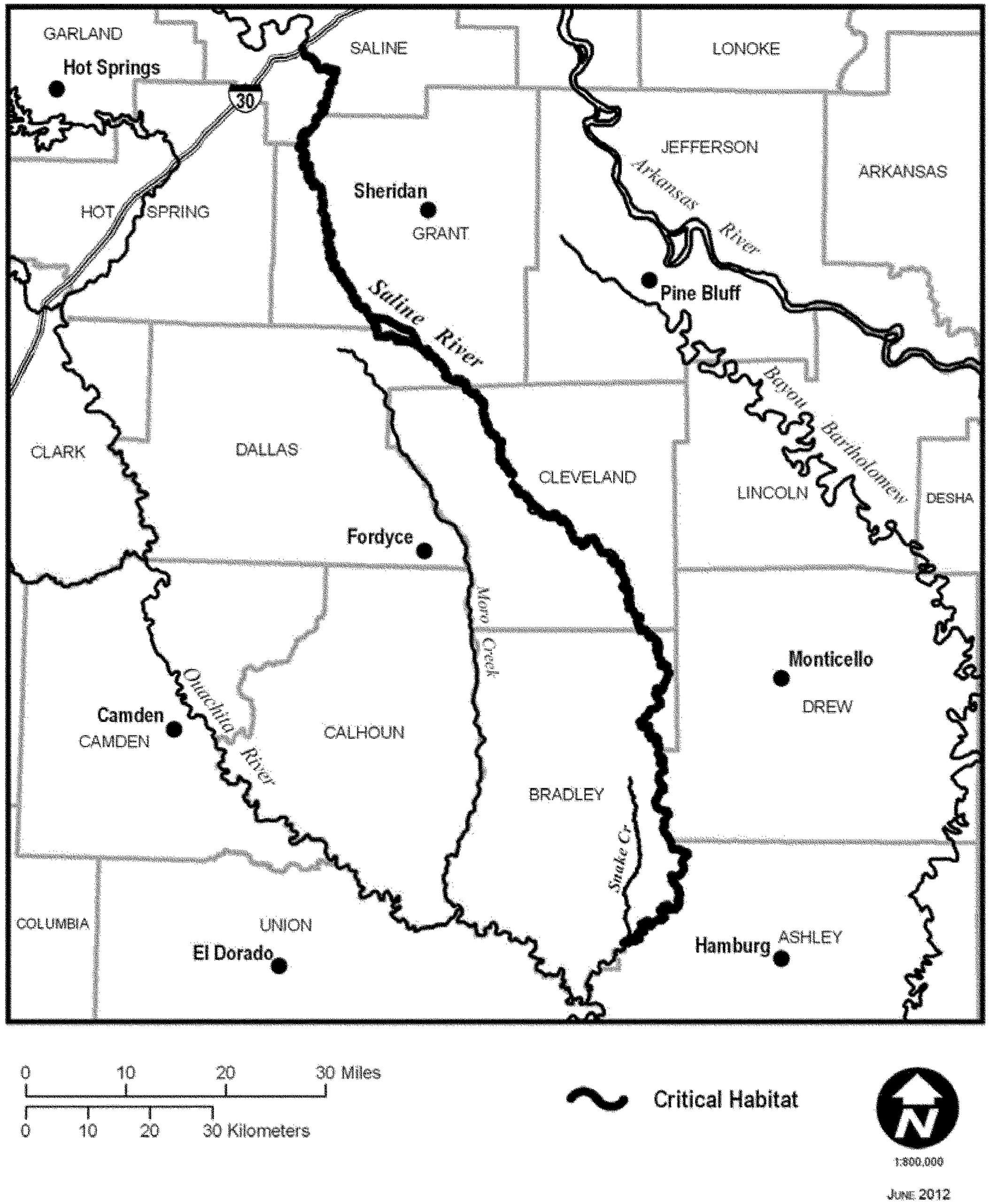


(11) Unit RF5: Saline River—Ashley, Bradley, Cleveland, Dallas, Drew, Grant, and Saline Counties, Arkansas.

(i) Unit RF5 includes 288.4 rkm (179.2 rmi) of the Saline River from Interstate 30 near Benton, Saline County, Arkansas, downstream to Snake Creek confluence north of Felsenthal National Wildlife Refuge's northern border located northwest of Crossett, Ashley and Bradley Counties, Arkansas.

(ii) **Note:** Map of Unit RF5 (Saline River) of critical habitat for rabbitsfoot follows:

Map of Unit RF5 (Saline River) of critical habitat for Rabbitsfoot

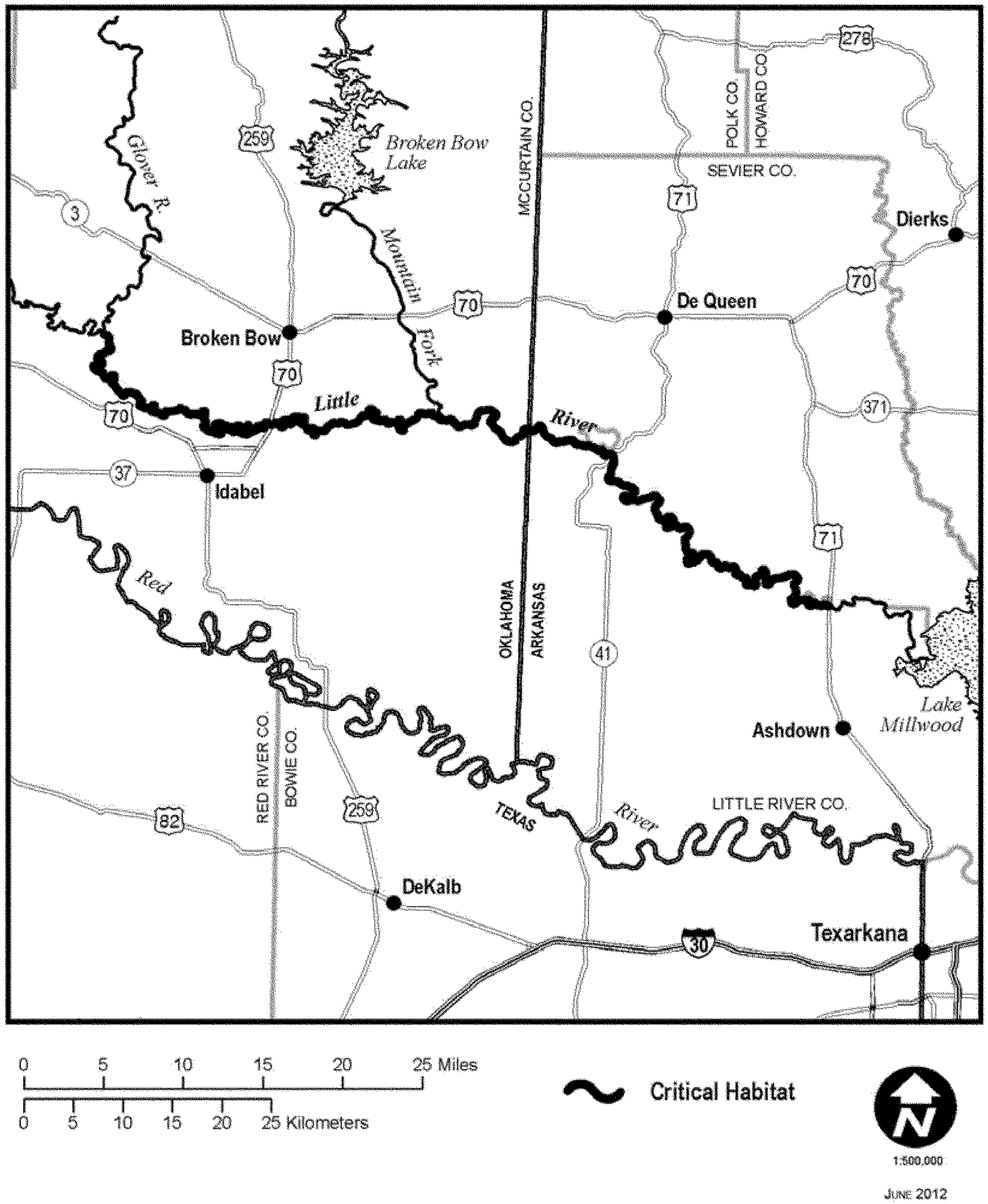


(12) Unit RF6: Little River—McCurtain County, Oklahoma; and Little River and Sevier Counties, Arkansas.

(i) Unit RF6 includes 139.7 rkm (86.8 rmi) of the Little River from the Glover River confluence northwest of Idabel, McCurtain County, Oklahoma, downstream to U.S. Highway 71 north of Wilton, Little River and Sevier Counties, Arkansas.

(ii) **Note:** Map of Unit RF6 (Little River) of critical habitat for rabbitsfoot follows:

Map of Unit RF6 (Little River) of critical habitat for Rabbitsfoot

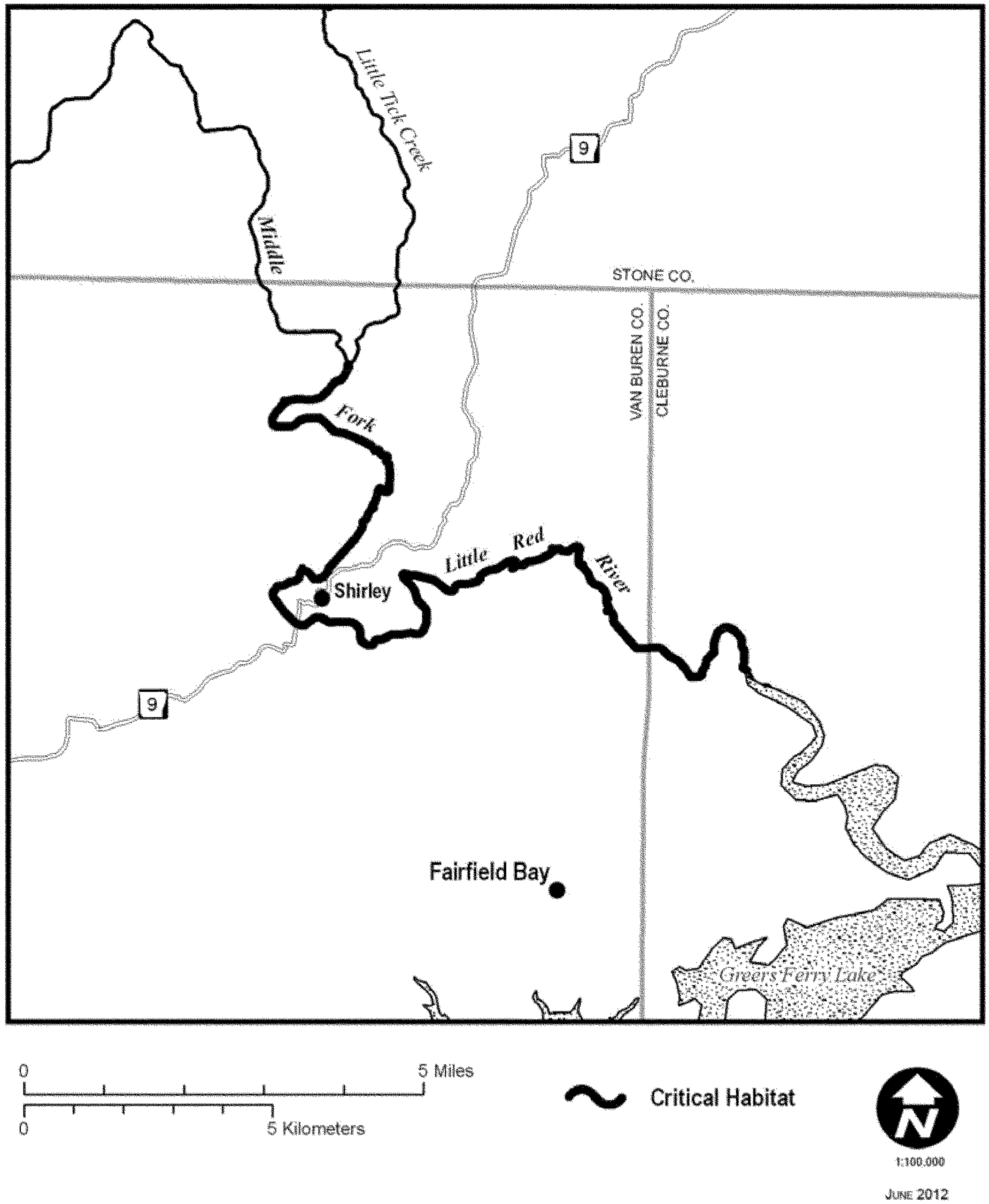


(13) Unit RF7: Middle Fork Little River—Van Buren County, Arkansas.

(i) Unit RF7 includes 23.3 rkm (14.5 rmi) of the Middle Fork Little Red River from the confluence of Little Tick Creek north of Shirley, Arkansas, downstream to the upstream point of inundation by Greers Ferry Reservoir, Van Buren County, Arkansas.

(ii) **Note:** Map of Unit RF7 (Middle Fork Little Red River) of critical habitat for rabbitsfoot follows:

Map of Unit RF7 (Middle Fork Little Red River) of critical habitat for Rabbitsfoot

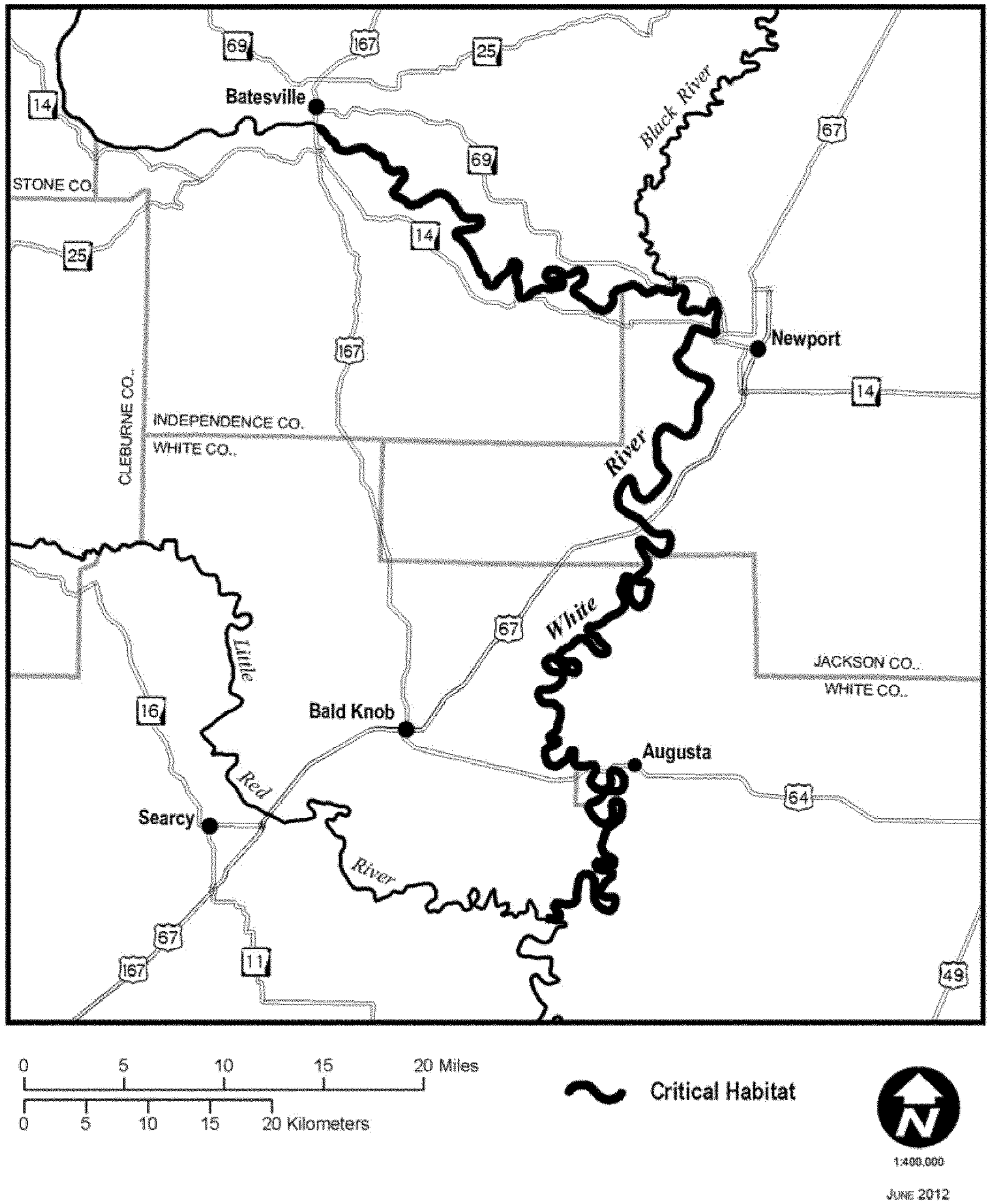


(14) Unit RF8a: White River—Independence, Jackson, White, and Woodruff Counties, Arkansas.

(i) Unit RF8a includes 188.3 rkm (117.0 rmi) of the White River from the Batesville Dam at Batesville, Independence County, Arkansas, downstream to the Little Red River confluence north of Georgetown, White, and Woodruff Counties, Arkansas.

(ii) **Note:** Map of Unit RF8a (White River) of critical habitat for the rabbitsfoot follows:

Map of Unit RF8a (White River) of critical habitat for Rabbitsfoot

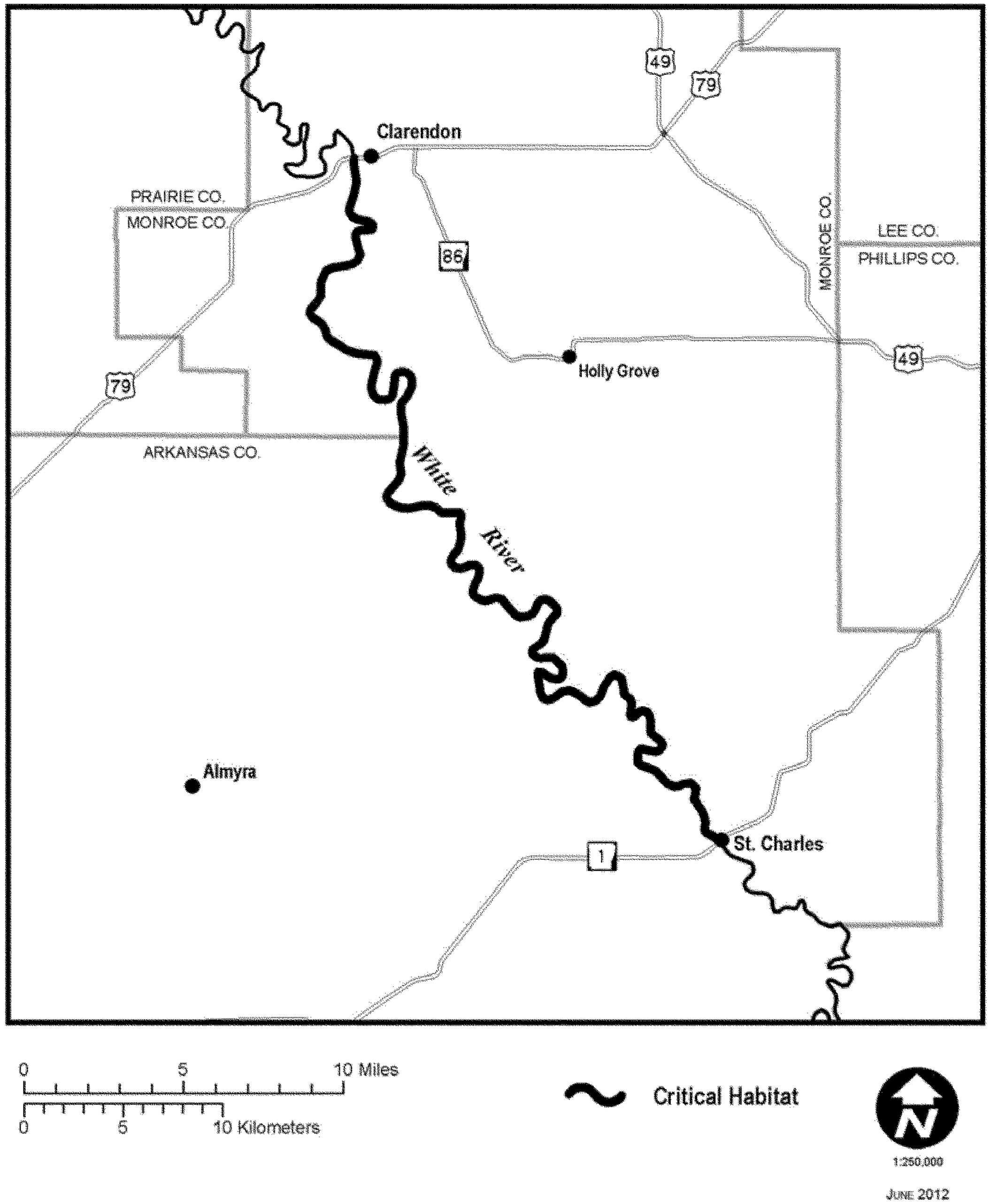


(15) Unit RF8b: White River—Arkansas and Monroe Counties, Arkansas.

(i) Unit RF8b includes 68.9 rkm (42.8 rmi) of the White River from U.S. Highway 79 at Clarendon, Monroe County, Arkansas, downstream to Arkansas Highway 1 near St. Charles, Arkansas County, Arkansas.

(ii) **Note:** Map of Unit RF8b (White River) of critical habitat for rabbitsfoot follows:

Map of Unit RF8b (White River) of critical habitat for Rabbitsfoot

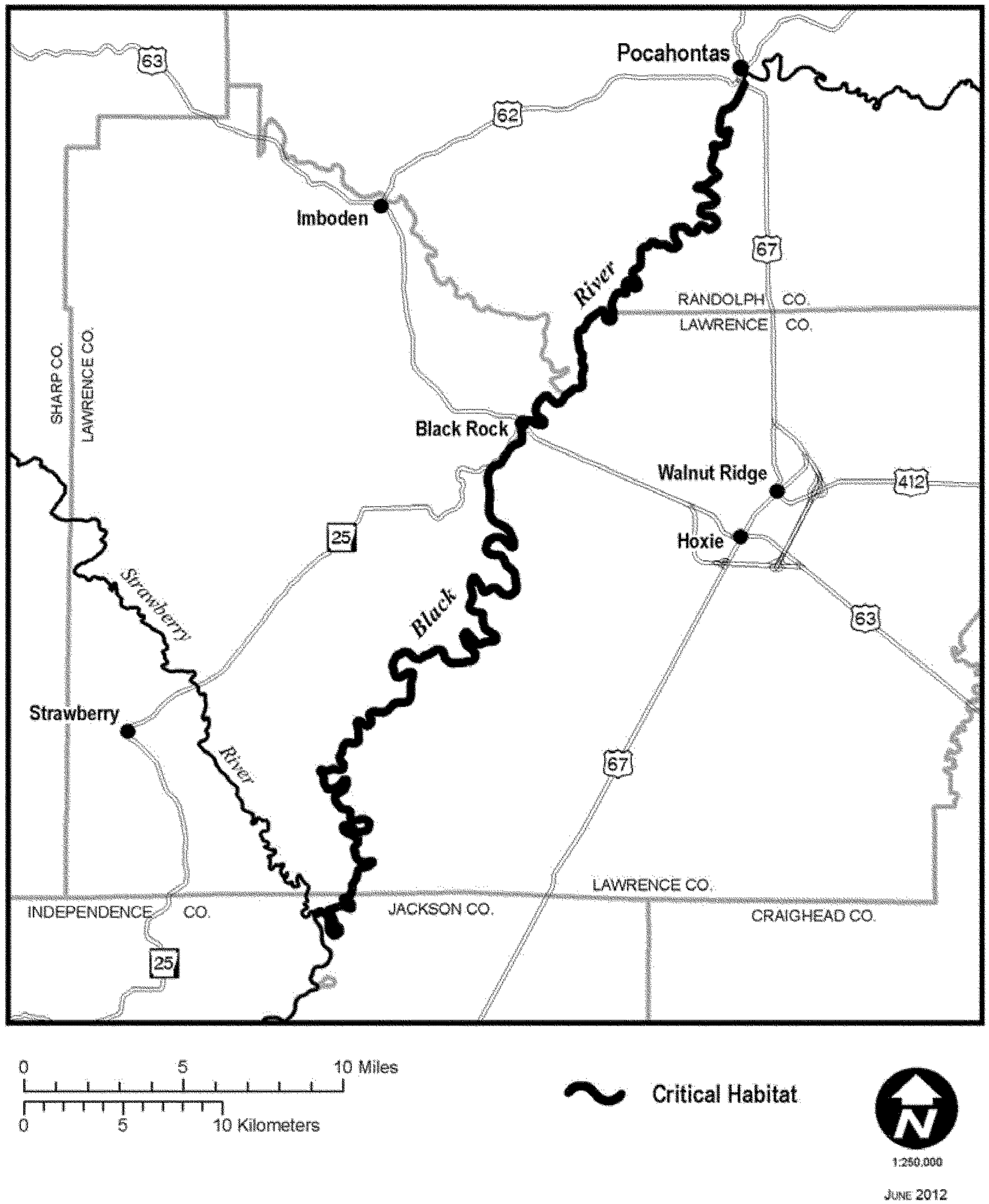


(16) Unit RF9: Black River—Lawrence and Randolph Counties, Arkansas.

(i) Unit RF9 includes 92.2 rkm (57.3 rmi) of the Black River from U.S. Highway 67 at Pocahontas, Randolph County, Arkansas, downstream to the Strawberry River confluence southeast of Strawberry, Lawrence County, Arkansas.

(ii) **Note:** Map of Unit RF9 (Black River) of critical habitat for rabbitsfoot follows:

Map of Unit RF9 (Black River) of critical habitat for Rabbitsfoot

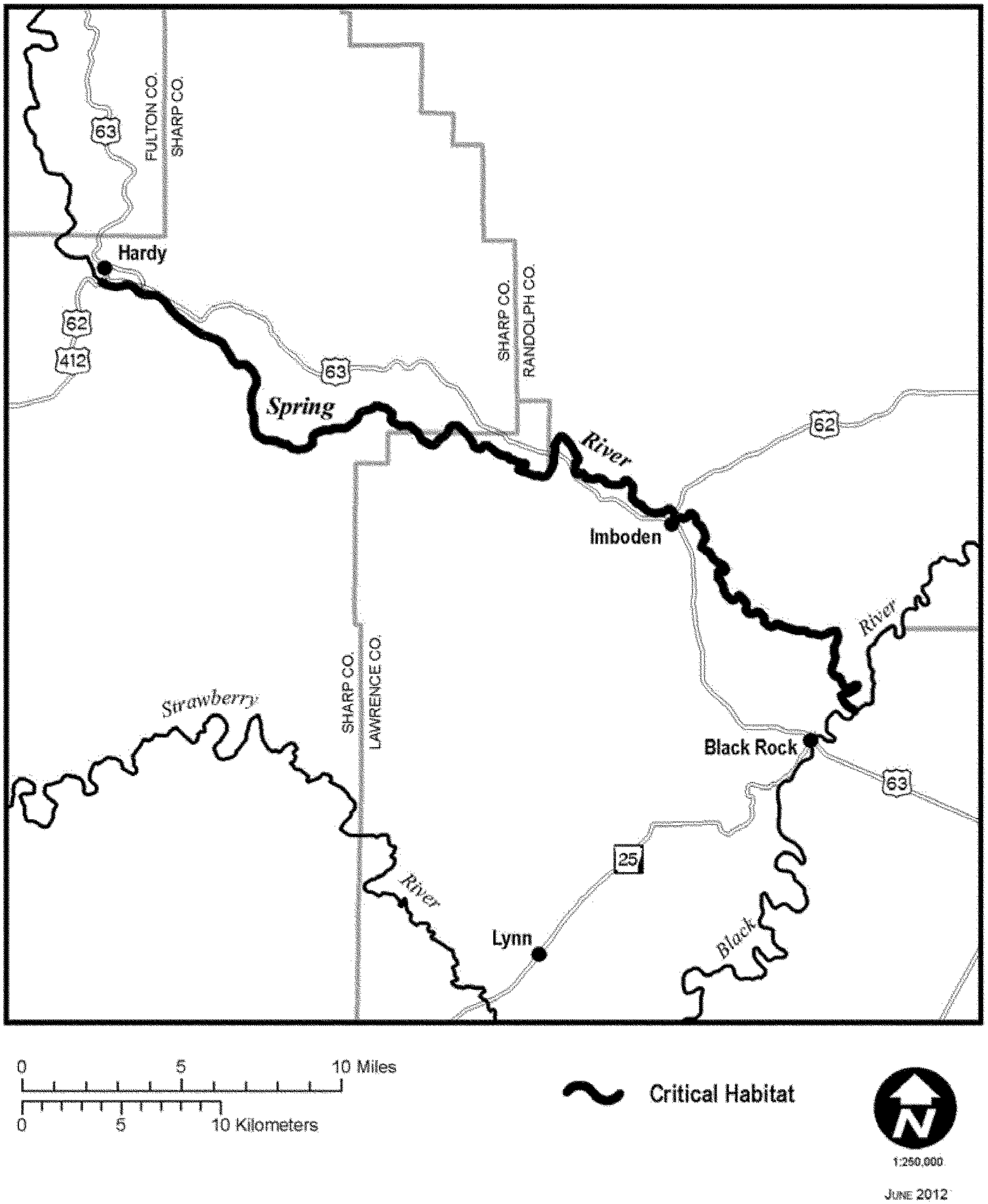


(17) Unit RF10: Spring River—Lawrence, Randolph, and Sharp Counties, Arkansas.

(i) Unit RF10 includes 62.8 rkm (39.0 rmi) of the Spring River from U.S. Highway 412 and 62 at Hardy in Sharp County, Arkansas, downstream to its confluence with the Black River east of Black Rock, Lawrence, and Randolph Counties, Arkansas.

(ii) **Note:** Map of Unit RF10 (Spring River) of critical habitat for rabbitsfoot follows:

Map of Unit RF10 (Spring River) of critical habitat for Rabbitsfoot

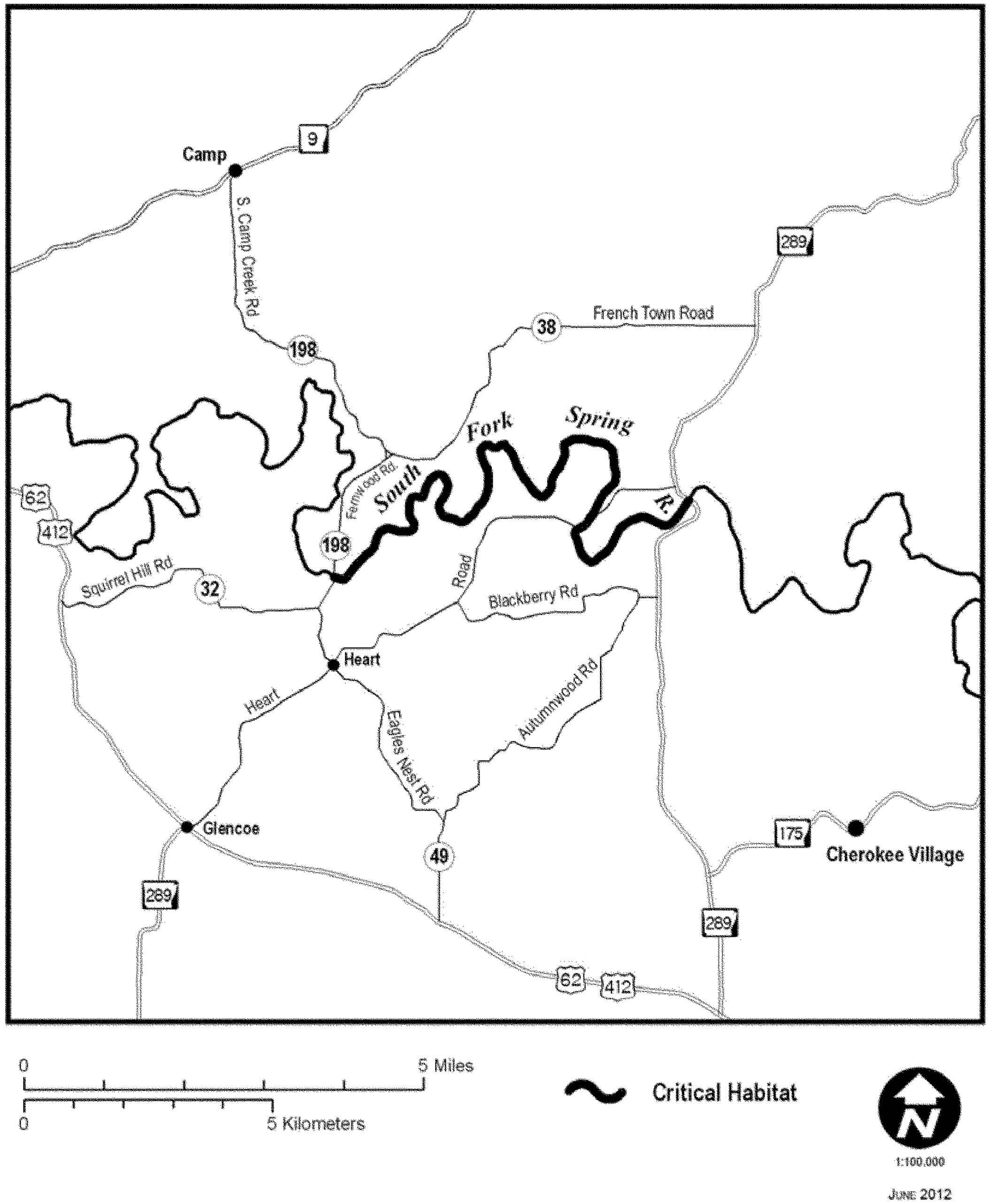


(18) Unit RF11: South Fork Spring River—Fulton County, Arkansas.

(i) Unit RF11 includes 16.4 rkm (10.2 rmi) of the South Fork Spring River from Fulton County Road 198 north of Heart, Arkansas, downstream to Arkansas Highway 289 at Saddle, Fulton County, Arkansas.

(ii) **Note:** Map of Unit RF11 (South Fork Spring River) of critical habitat for rabbitsfoot follows:

Map of Unit RF11 (South Fork Spring River) of critical habitat for Rabbitsfoot

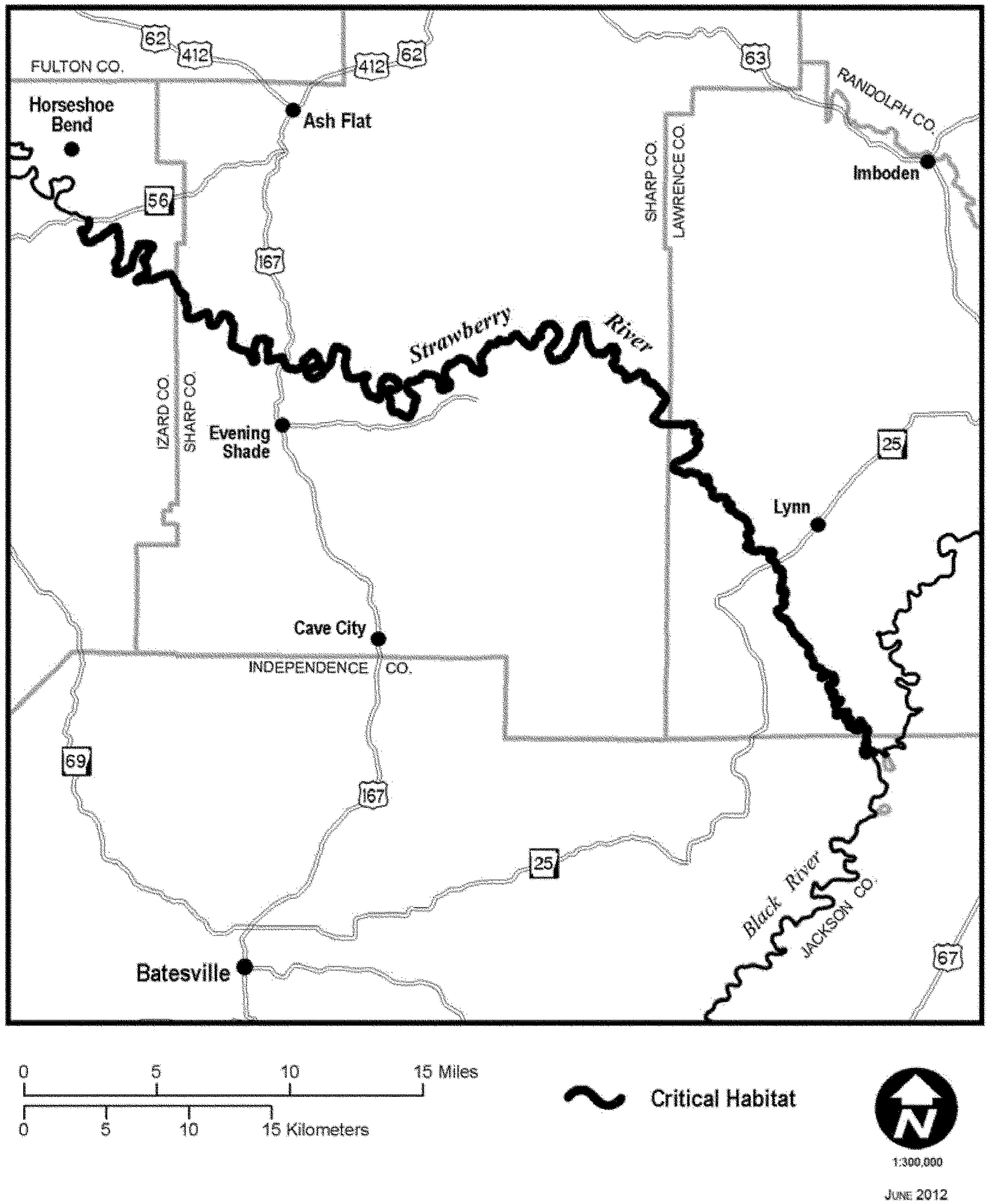


(19) Unit RF12: Strawberry River—Izard, Lawrence, and Sharp Counties, Arkansas.

(i) Unit RF12 includes 123.8 rkm (76.9 rmi) of the Strawberry River from Arkansas Highway 56 south of Horseshoe Bend, Izard County, Arkansas, downstream to its confluence with the Black River southeast of Strawberry, Lawrence County, Arkansas.

(ii) **Note:** Map of Unit RF12 (Strawberry River) of critical habitat for rabbitsfoot follows:

Map of Unit RF12 (Strawberry River) of critical habitat for Rabbitsfoot

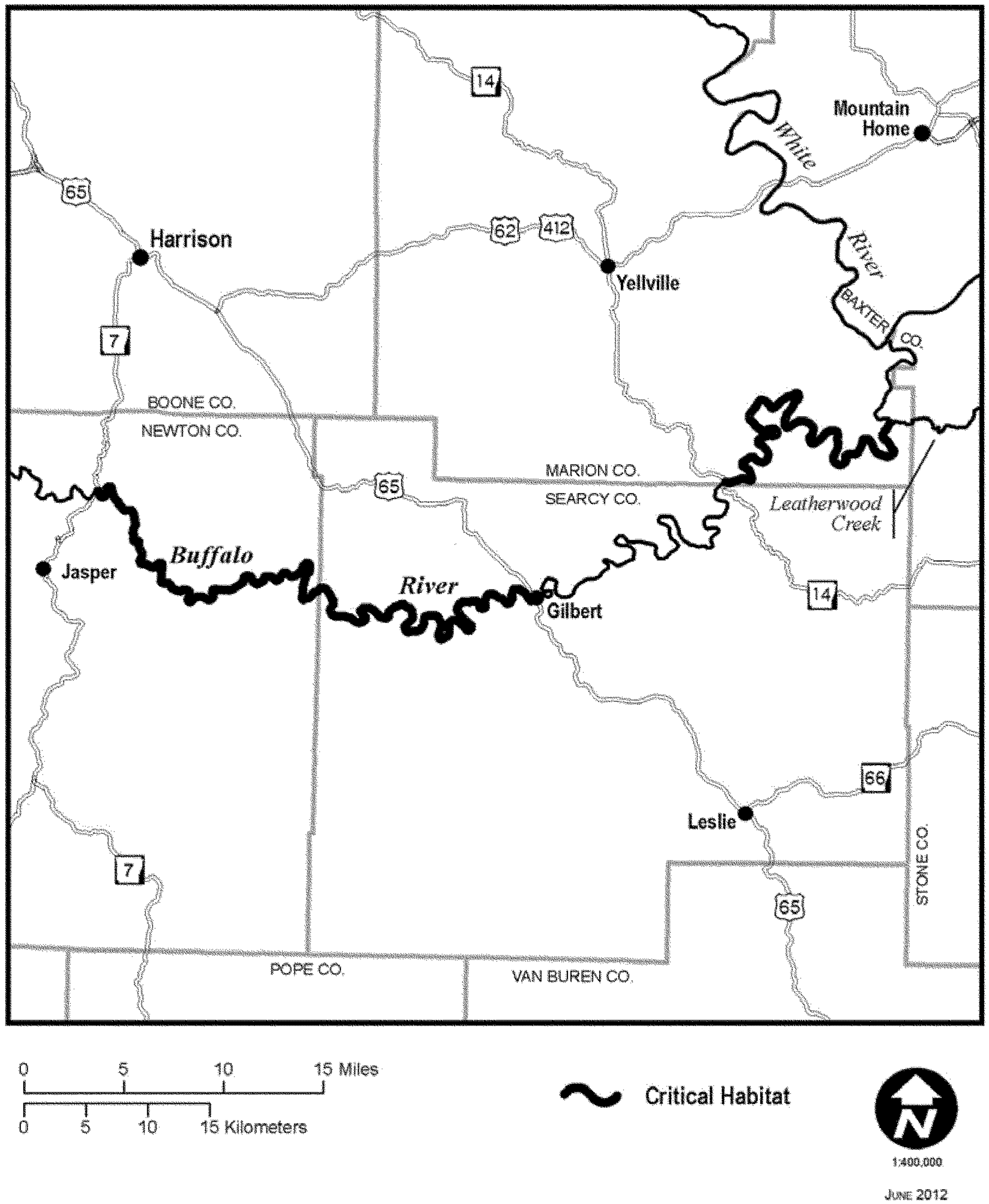


(20) Unit RF13: Buffalo River—Newton and Searcy Counties, Arkansas.

(i) Unit RF13 includes 113.6 rkm (70.6 rmi) of the Buffalo River from the Cove Creek confluence southeast of Erbie, Newton County, Arkansas, downstream to U.S. Highway 65 west of Gilbert, Searcy County, Arkansas (western segment), and Arkansas Highway 14 downstream to the confluence of Leatherwood Creek in the Lower Buffalo Wilderness Area (eastern segment).

(ii) **Note:** Map of Unit RF13 (Buffalo River) of critical habitat for rabbitsfoot follows:

Map of Unit RF13 (Buffalo River) of critical habitat for Rabbitsfoot

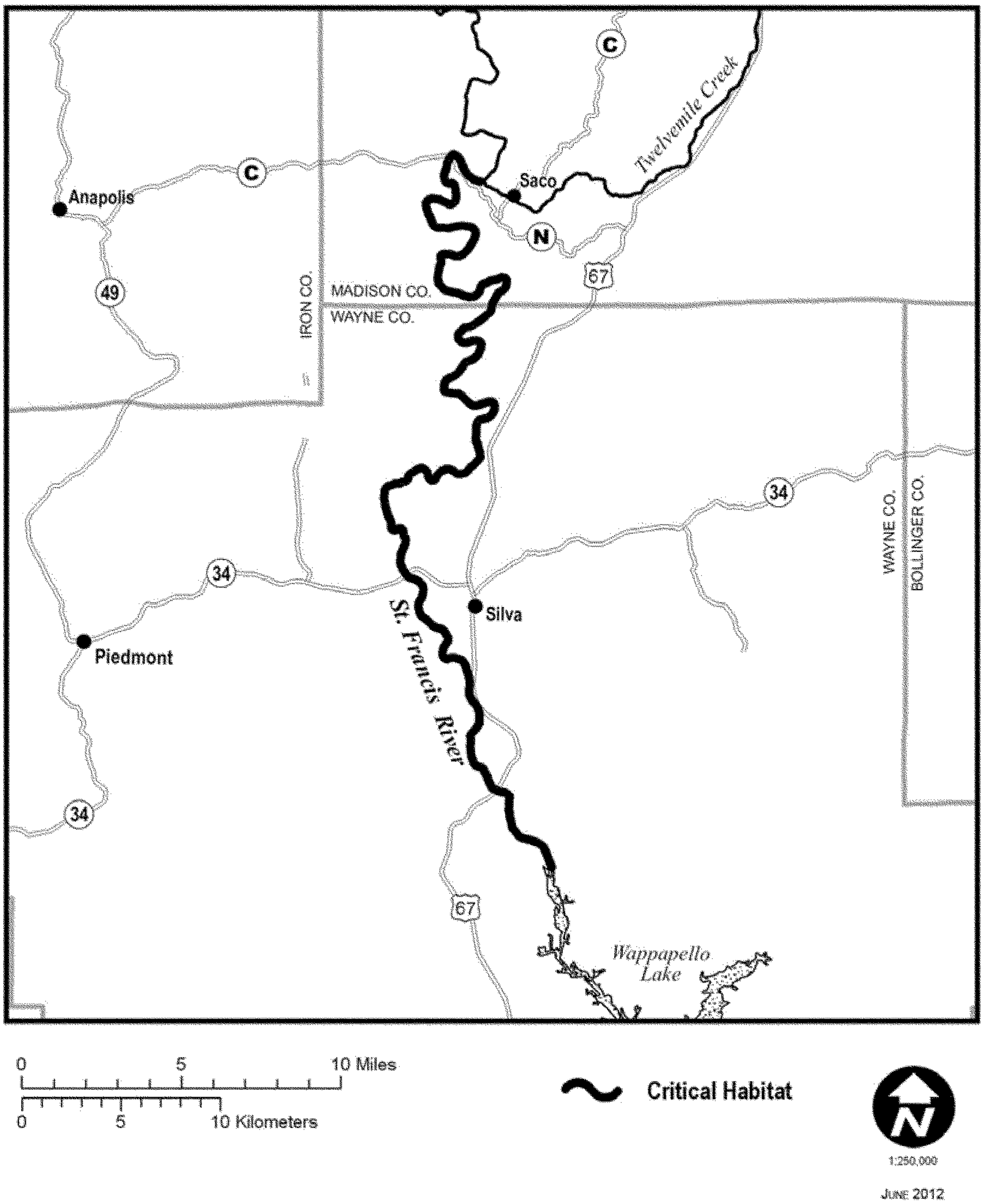


(21) Unit RF14: St. Francis River—Madison and Wayne Counties, Missouri.

(i) Unit RF14 includes 64.3 rkm (40.0 rmi) of the St. Francis River from the Twelvemile Creek confluence west of Saco, Madison County, Missouri, downstream to the upstream point of inundation by Lake Wappepello, Wayne County, Missouri.

(ii) **Note:** Map of Unit RF14 (St. Francis River) of critical habitat for rabbitsfoot follows:

Map of Unit RF14 (St. Francis River) of critical habitat for Rabbitsfoot

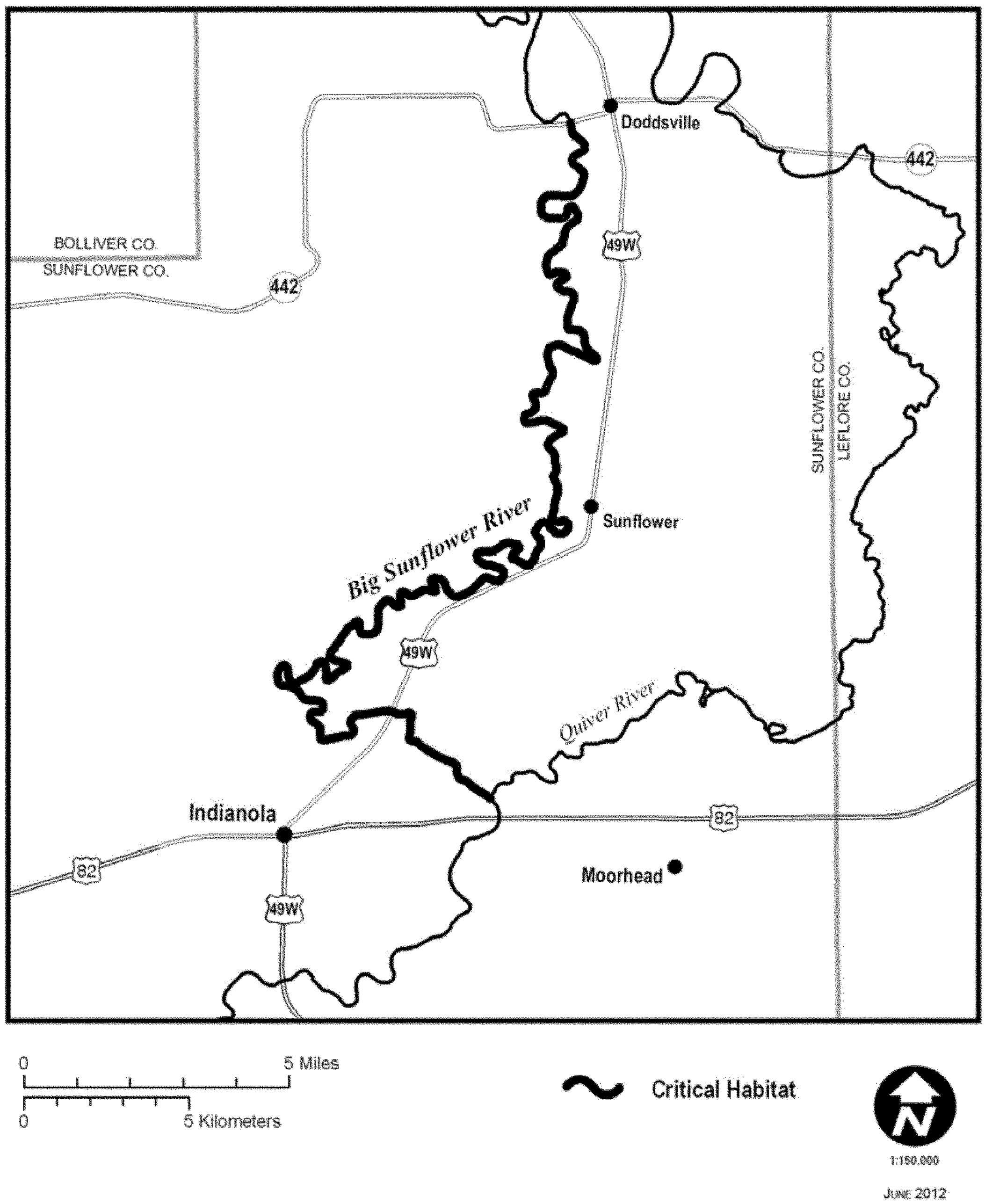


(22) Unit RF15: Big Sunflower River—Sunflower County, Mississippi.

(i) Unit RF15 includes 51.5 rkm (32.0 rmi) of the Big Sunflower River from Mississippi Highway 442 west of Doddsville, Mississippi, downstream to the Quiver River confluence east of Indianola, Sunflower County, Mississippi.

(ii) **Note:** Map of Unit RF15 (Big Sunflower River) of critical habitat for rabbitsfoot follows:

Map of Unit RF15 (Big Sunflower River) of critical habitat for Rabbitsfoot

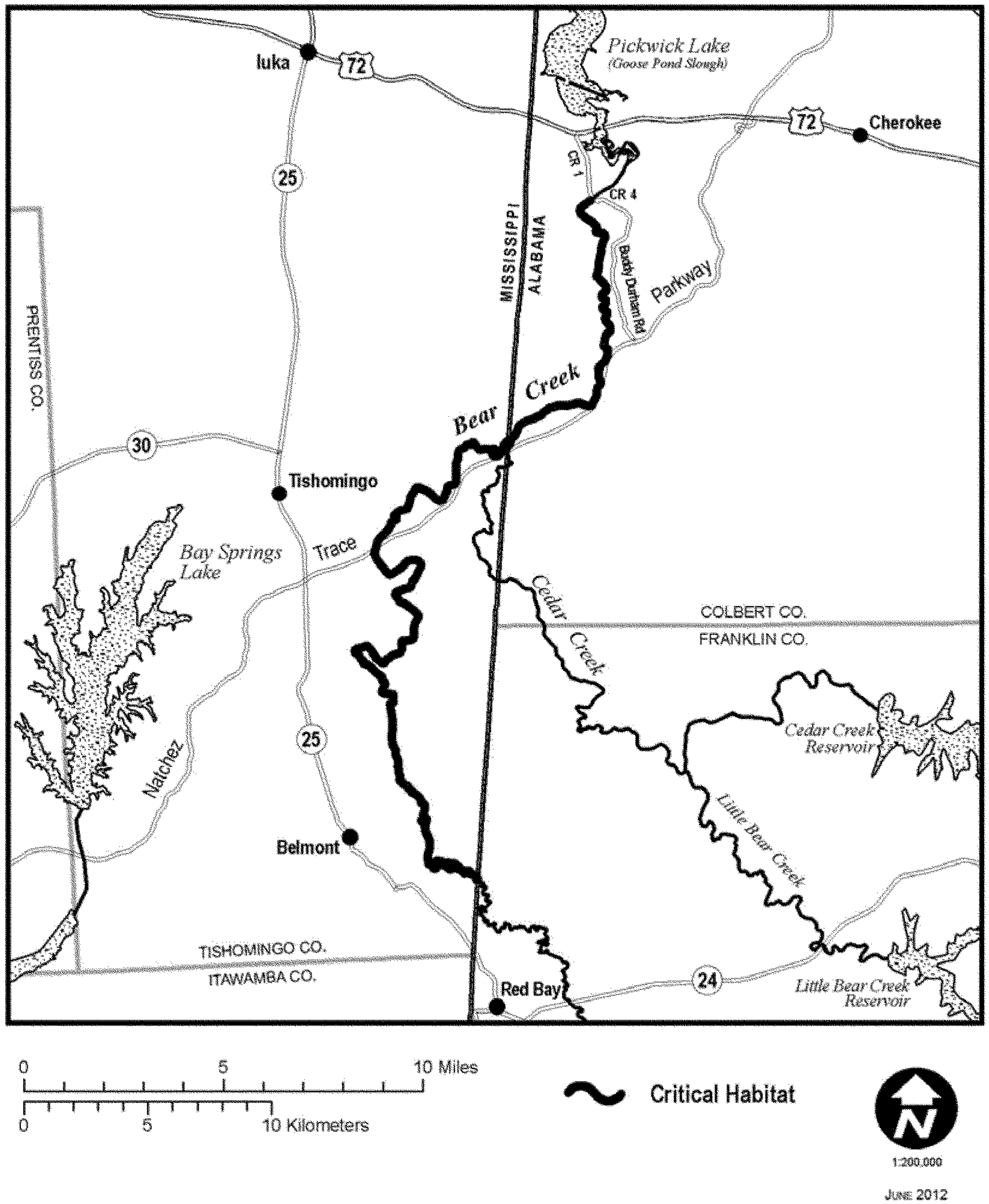


(23) Unit RF16: Bear Creek—Tishomingo County, Mississippi; and Colbert County, Alabama.

(i) Unit RF16 includes 49.7 rkm (30.9 rmi) of Bear Creek from the Alabama and Mississippi State line east of Golden, Tishomingo County, Mississippi, downstream to Alabama County Road 4 southwest of Sutton Hill, Colbert County, Alabama (just upstream of Pickwick Lake).

(ii) **Note:** Map of Unit RF16 (Bear Creek) of critical habitat for rabbitsfoot follows:

Map of Unit RF16 (Bear Creek) of critical habitat for Rabbitsfoot

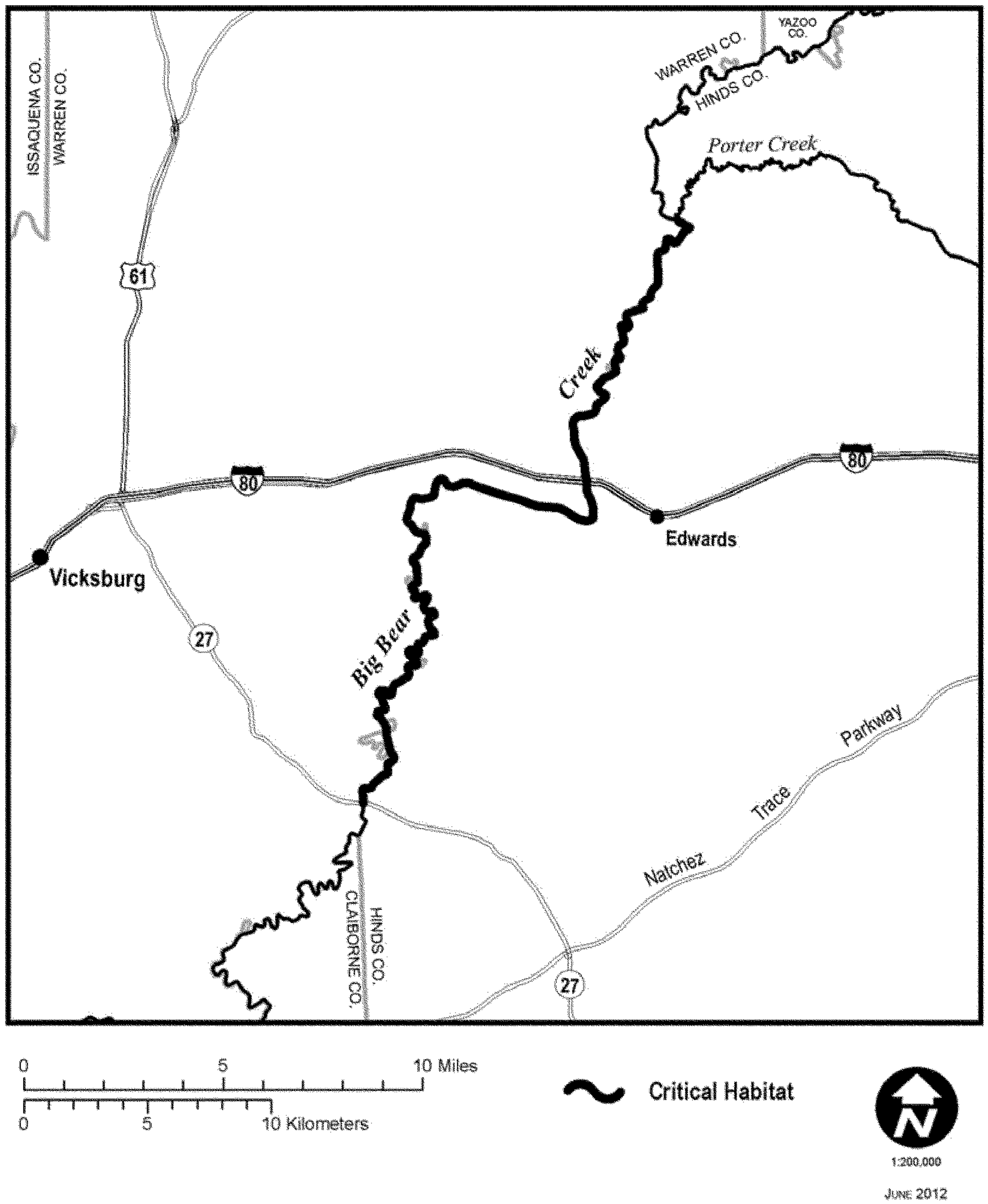


(24) Unit RF17: Big Black River—Hinds and Warren Counties, Mississippi.

(i) Unit RF17 includes 43.3 rkm (26.9 rmi) of the Big Black River from Porter Creek confluence west of Lynchburg, Hinds County, Mississippi, downstream to Mississippi Highway 27 west of Newman, Warren County, Mississippi.

(ii) **Note:** Map of Unit RF17 (Big Black River) of critical habitat for rabbitsfoot follows:

Map of Unit RF17 (Big Black River) of critical habitat for Rabbitsfoot

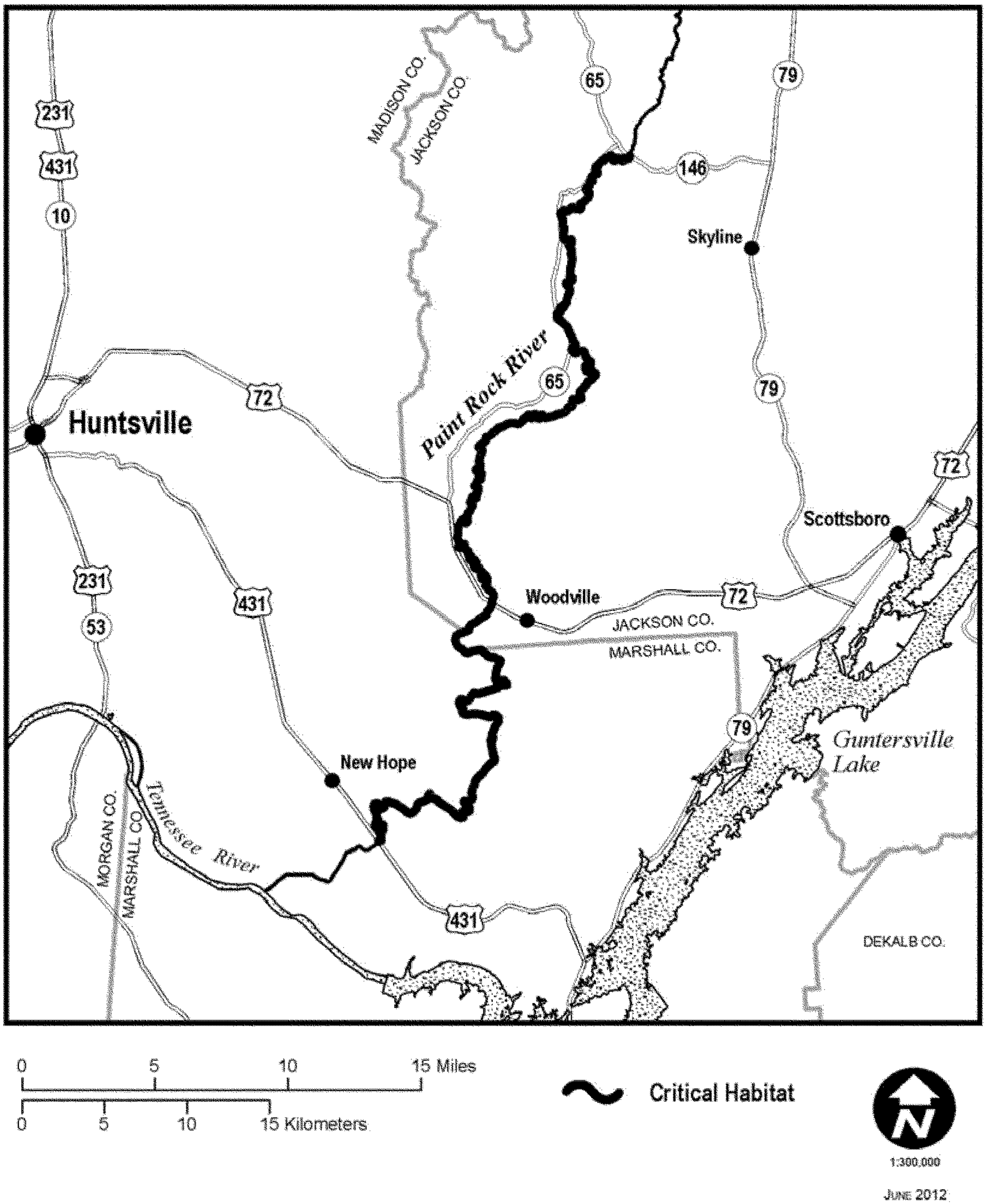


(25) Unit RF18: Paint Rock River—Jackson, Madison, and Marshall Counties, Alabama.

(i) Unit RF18 includes 81.0 rkm (50.3 rmi) of the Paint Rock River from the convergence of Estill Fork and Hurricane Creek north of Skyline, Jackson County, Alabama, downstream to U.S. Highway 431 south of New Hope, Madison and Marshall Counties, Alabama.

(ii) **Note:** Map of Unit RF18 (Paint Rock River) of critical habitat for rabbitsfoot follows:

Map of Unit RF18 (Paint Rock River) of critical habitat for Rabbitsfoot

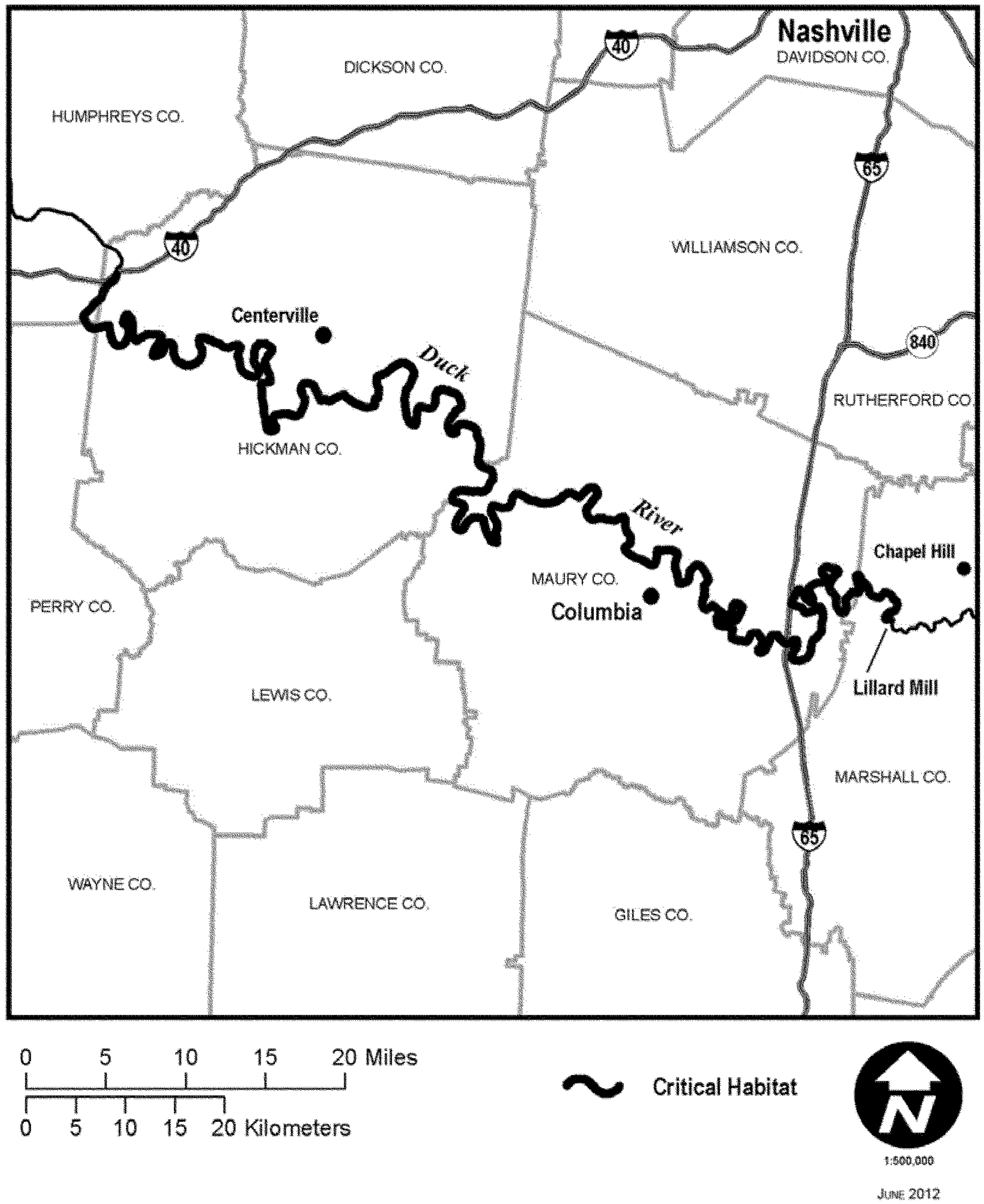


(26) Unit RF19: Duck River—Hickman, Marshall, and Maury Counties, Tennessee.

(i) Unit RF19 includes 235.3 rkm (146.2 rmi) of the Duck River from Lillard Mill (RKM 288.1; RMI 179) west of Tennessee Highway 272, Marshall County, Tennessee, downstream to Interstate 40 near Bucksnort, Hickman County, Tennessee.

(ii) **Note:** Map of Unit RF19 (Duck River) of critical habitat for rabbitsfoot follows:

Map for Unit RF19 (Duck River) of critical habitat for Rabbitsfoot

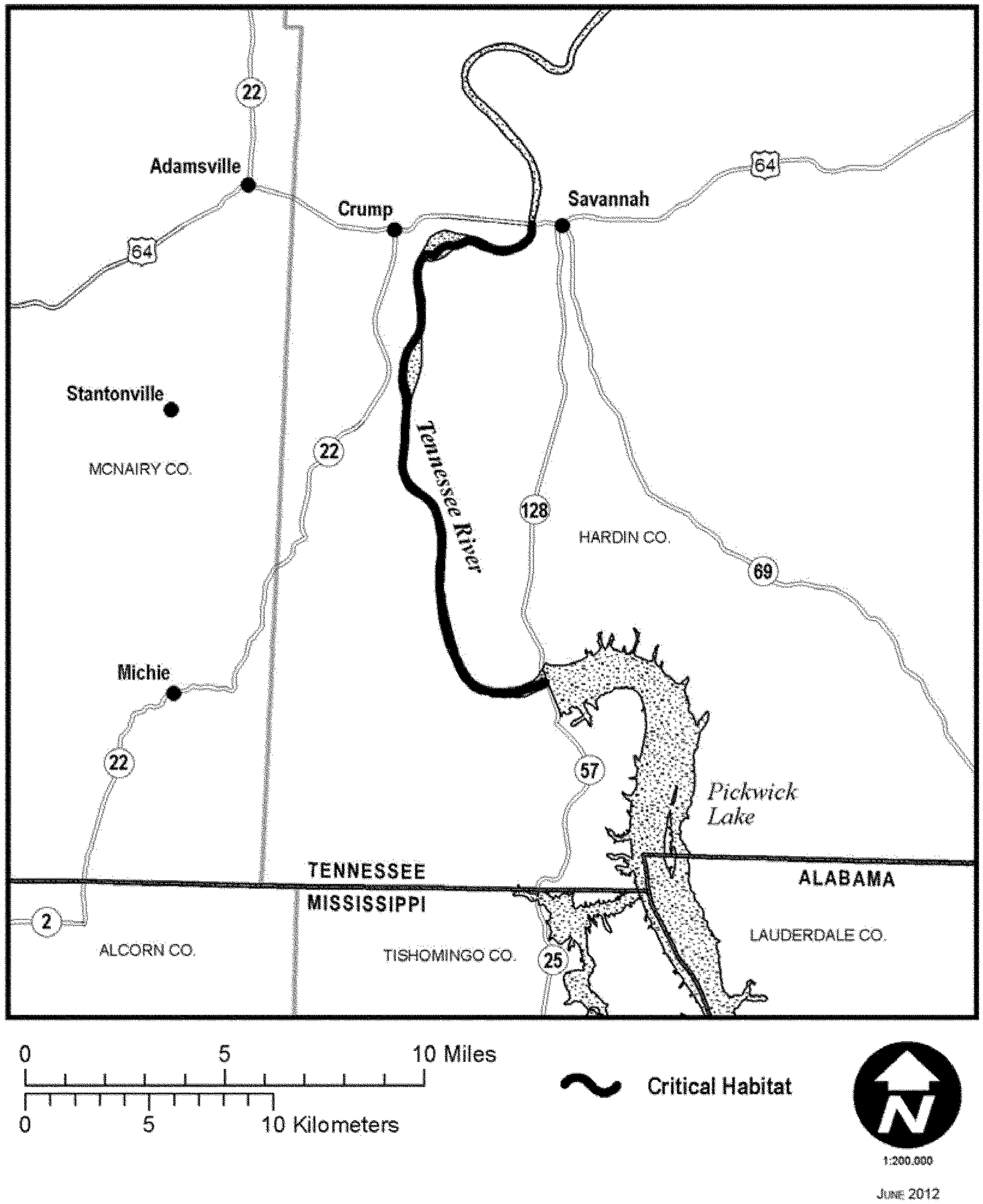


(27) Unit RF20a: Tennessee River—Hardin County, Tennessee.

(i) Unit RF20a includes 26.7 rkm (16.6 rmi) of the Tennessee River from Pickwick Lake Dam downstream to U.S. Highway 64 near Adamsville, Hardin County, Tennessee.

(ii) **Note:** Map of Unit RF20a (Tennessee River) of critical habitat for rabbitsfoot follows:

Map for Unit RF20a (Tennessee River) of critical habitat for Rabbitsfoot

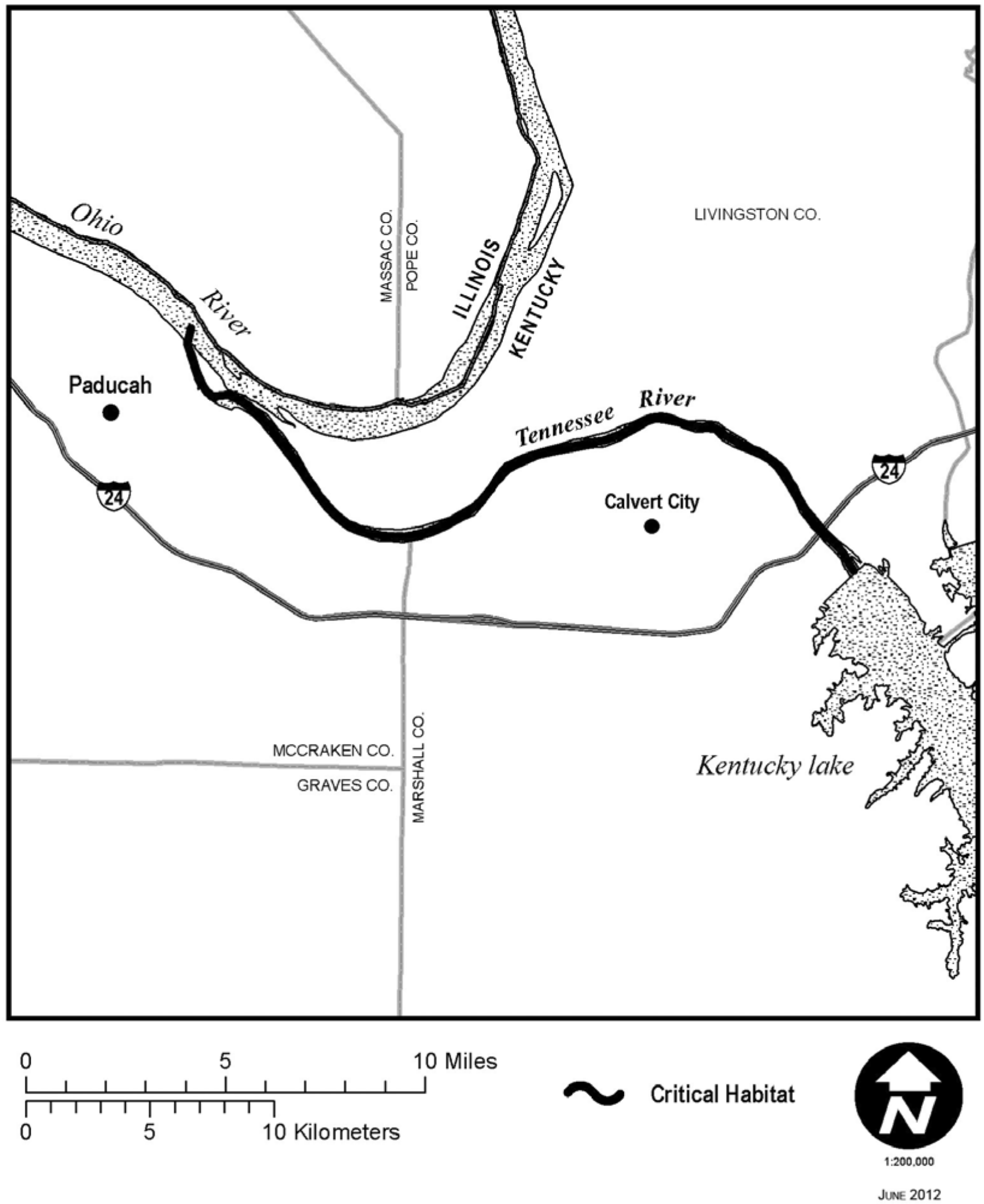


(28) Unit RF20b: Tennessee River—Livingston, Marshall, and McCracken Counties, Kentucky.

(i) Unit RF20b includes 35.6 rkm (22.1 rmi) of the Tennessee River from Kentucky Lake Dam, Marshall and Livingston Counties, Kentucky, downstream to its confluence with the Ohio River, Livingston and McCracken Counties, Kentucky.

(ii) **Note:** Map of Unit RF20b (Tennessee River) of critical habitat for rabbitsfoot follows:

Map for Unit RF20b (Tennessee River) of critical habitat for Rabbitsfoot

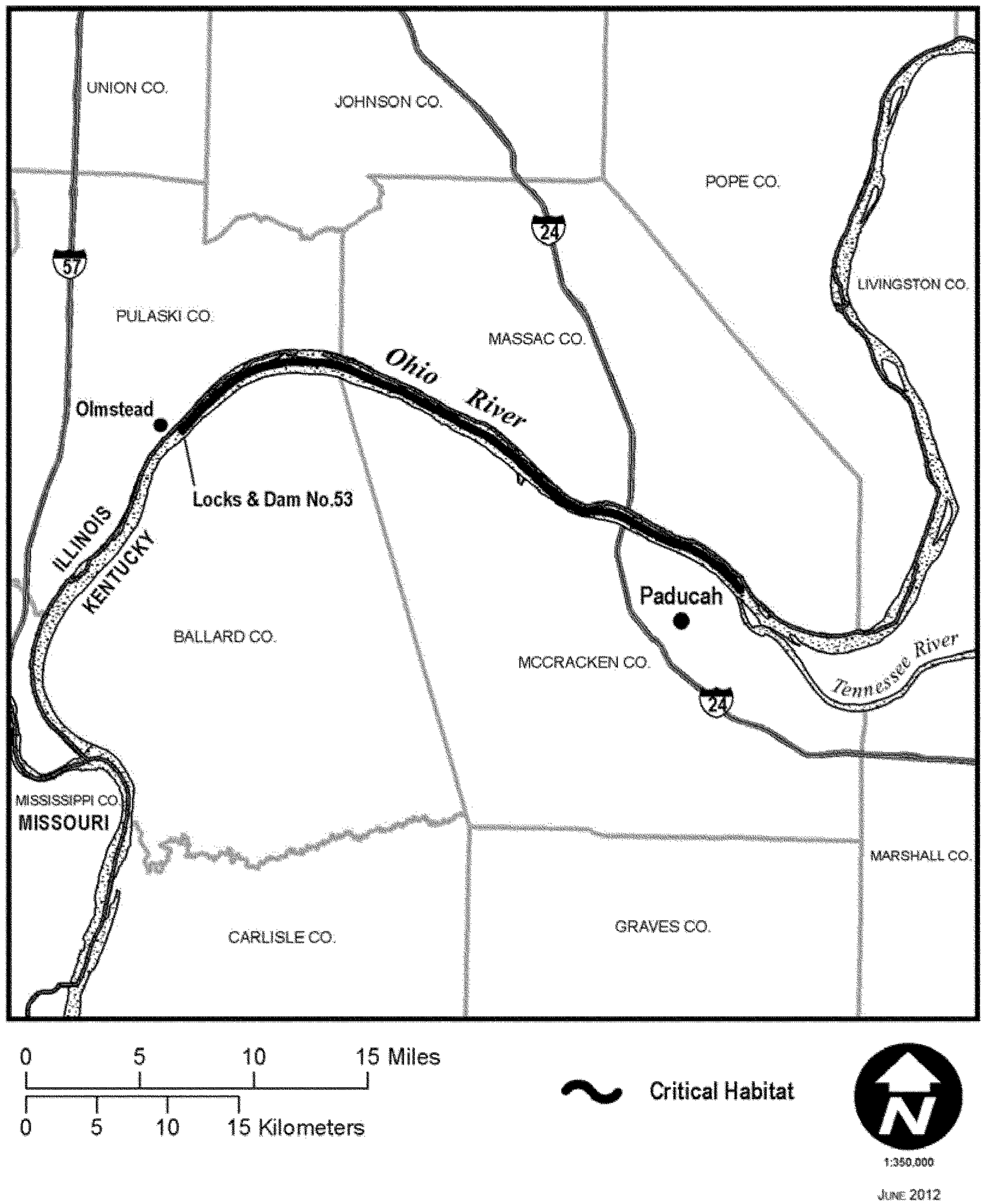


(29) Unit RF21: Ohio River—Ballard, Livingston, and McCracken Counties, Kentucky; Massac and Pulaski Counties, Illinois.

(i) Unit RF21 includes 45.9 rkm (28.5 rmi) of the Ohio River from the Tennessee River confluence, Livingston and McCracken Counties, Kentucky, downstream to Lock and Dam 53 near Olmstead, Pulaski County, Illinois.

(ii) **Note:** Map of Unit RF21 (Ohio River) of critical habitat for rabbitsfoot follows:

Map for Unit RF21 (Ohio River) of critical habitat for Rabbitsfoot

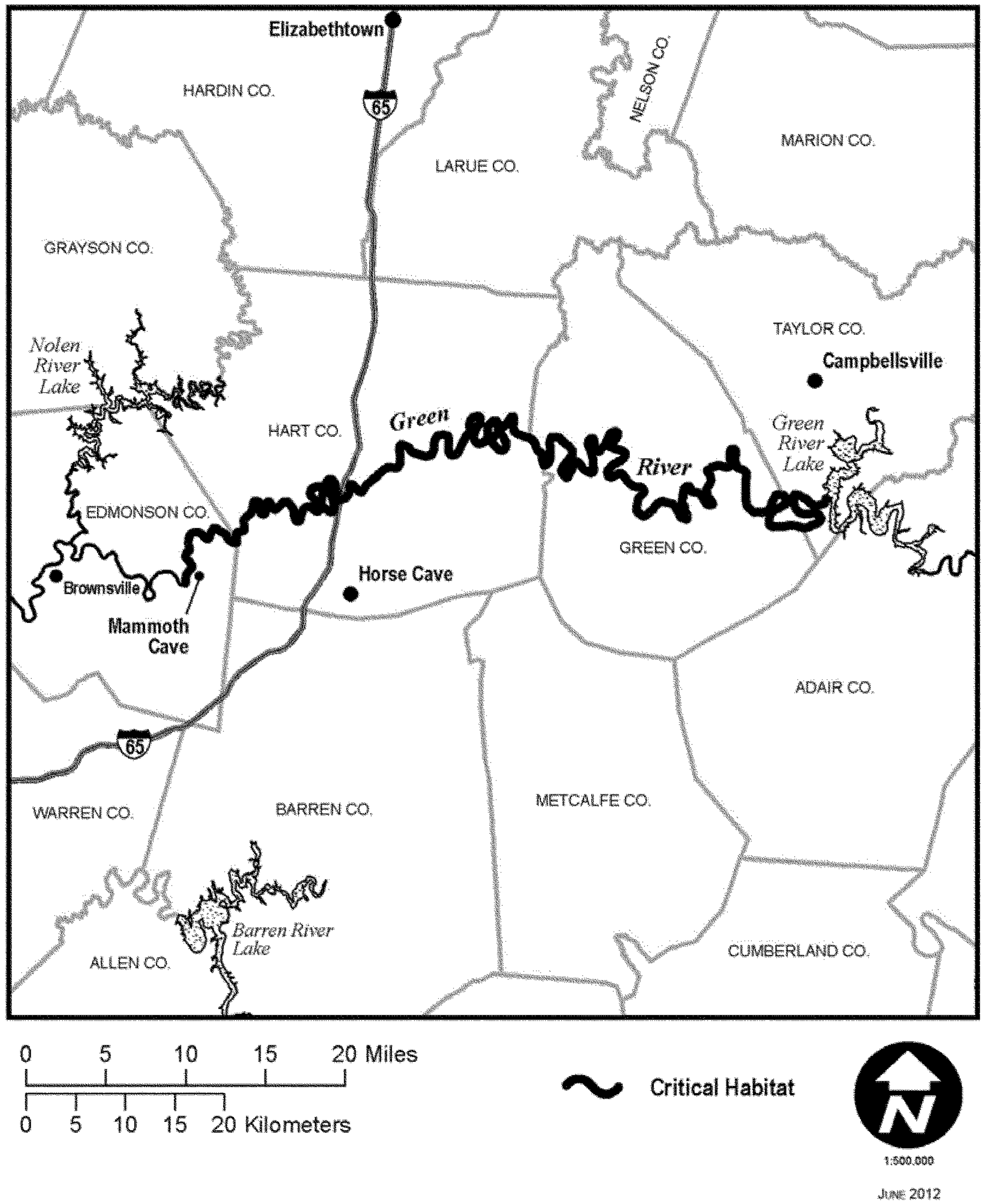


(30) Unit RF22: Green River—Green, Hart, and Taylor Counties, Kentucky.

(i) Unit RF22 includes 175.6 rkm (109.1 rmi) of the Green River from Green River Lake Dam south of Campbellsville, Taylor County, Kentucky, downstream to Maple Springs Ranger Station Road in Mammoth Cave National Park, Kentucky.

(ii) **Note:** Map of Unit RF22 (Green River) of critical habitat for rabbitsfoot follows:

Map for Unit RF22 (Green River) of critical habitat for Rabbitsfoot

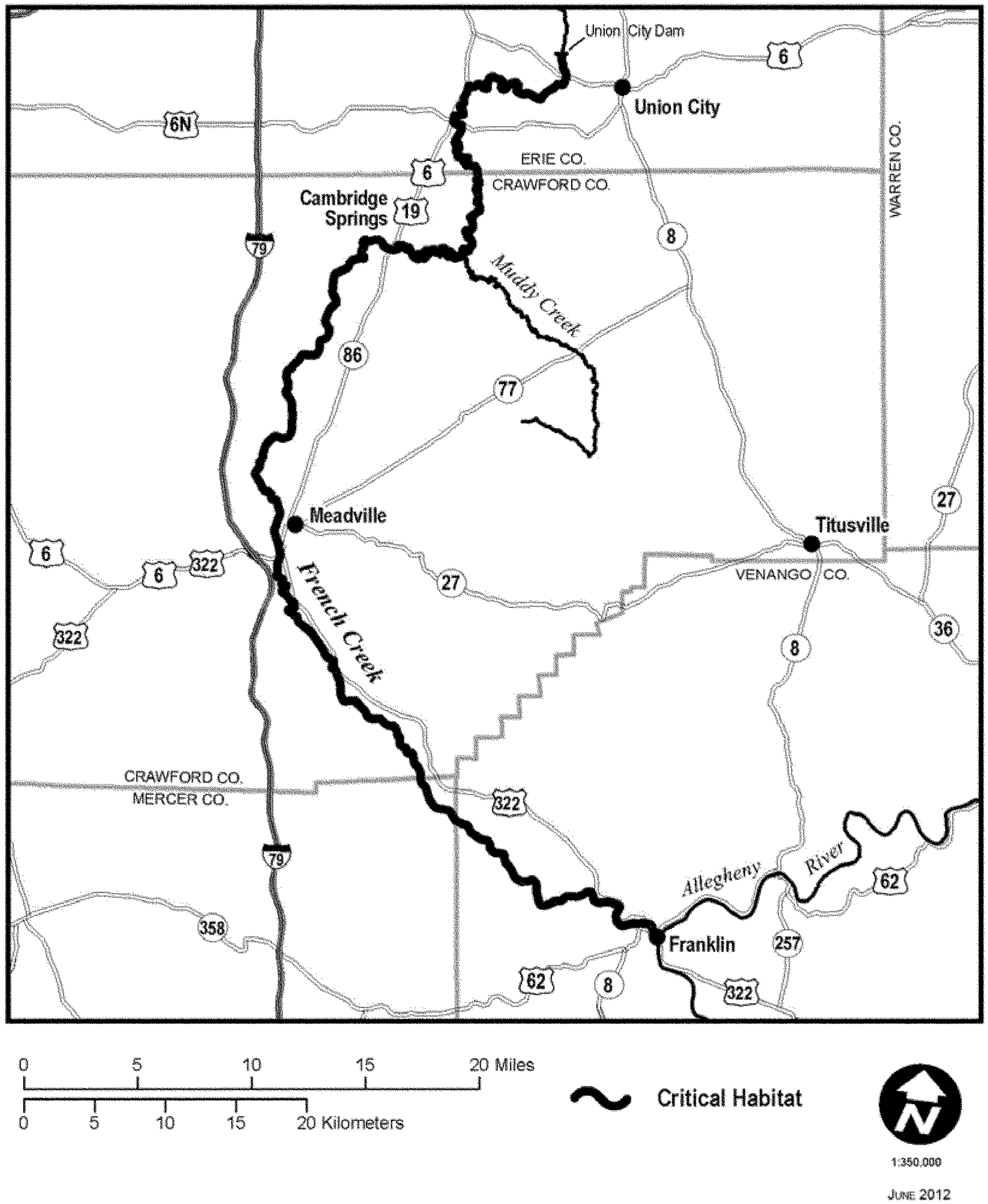


(31) Unit RF23: French Creek—Crawford, Erie, Mercer, and Venango Counties, Pennsylvania.

(i) Unit RF23 includes 120.4 rkm (74.8 rmi) of French Creek from Union City Reservoir Dam northeast of Union City, Erie County, Pennsylvania, downstream to its confluence with the Allegheny River near Franklin, Venango County, Pennsylvania.

(ii) **Note:** Map of Unit RF23 (French Creek) of critical habitat for rabbitsfoot follows:

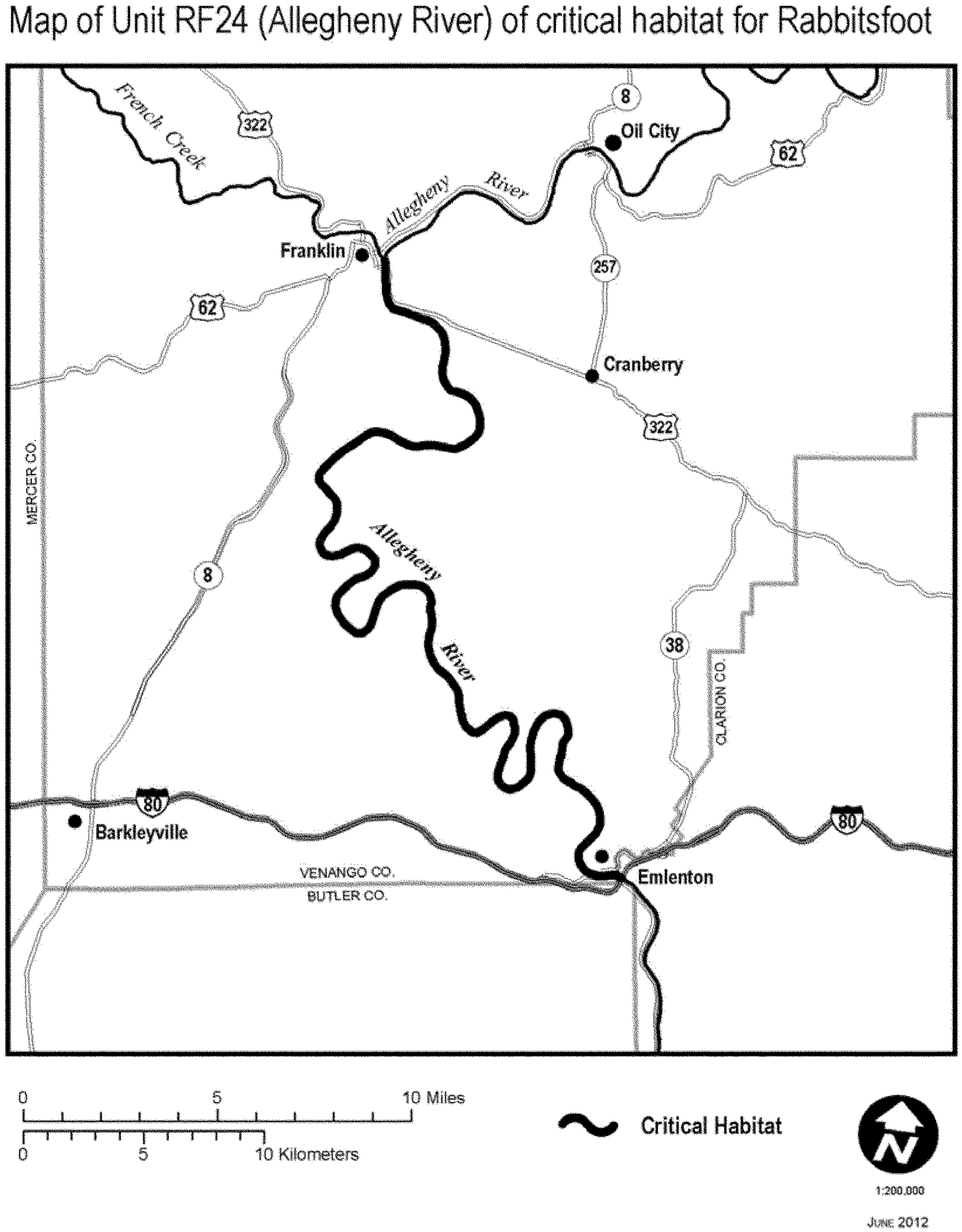
Map for Unit RF23 (French Creek) of critical habitat for Rabbitsfoot



(32) Unit RF24: Allegheny River—Venango County, Pennsylvania.

(i) Unit RF24 includes 57.3 rkm (35.6 rmi) of the Allegheny River from the French Creek confluence near Franklin, Venango County, Pennsylvania, downstream to Interstate 80 near Emlenton, Venango County, Pennsylvania.

(ii) **Note:** Map of Unit RF24 (Allegheny River) of critical habitat for rabbitsfoot follows:

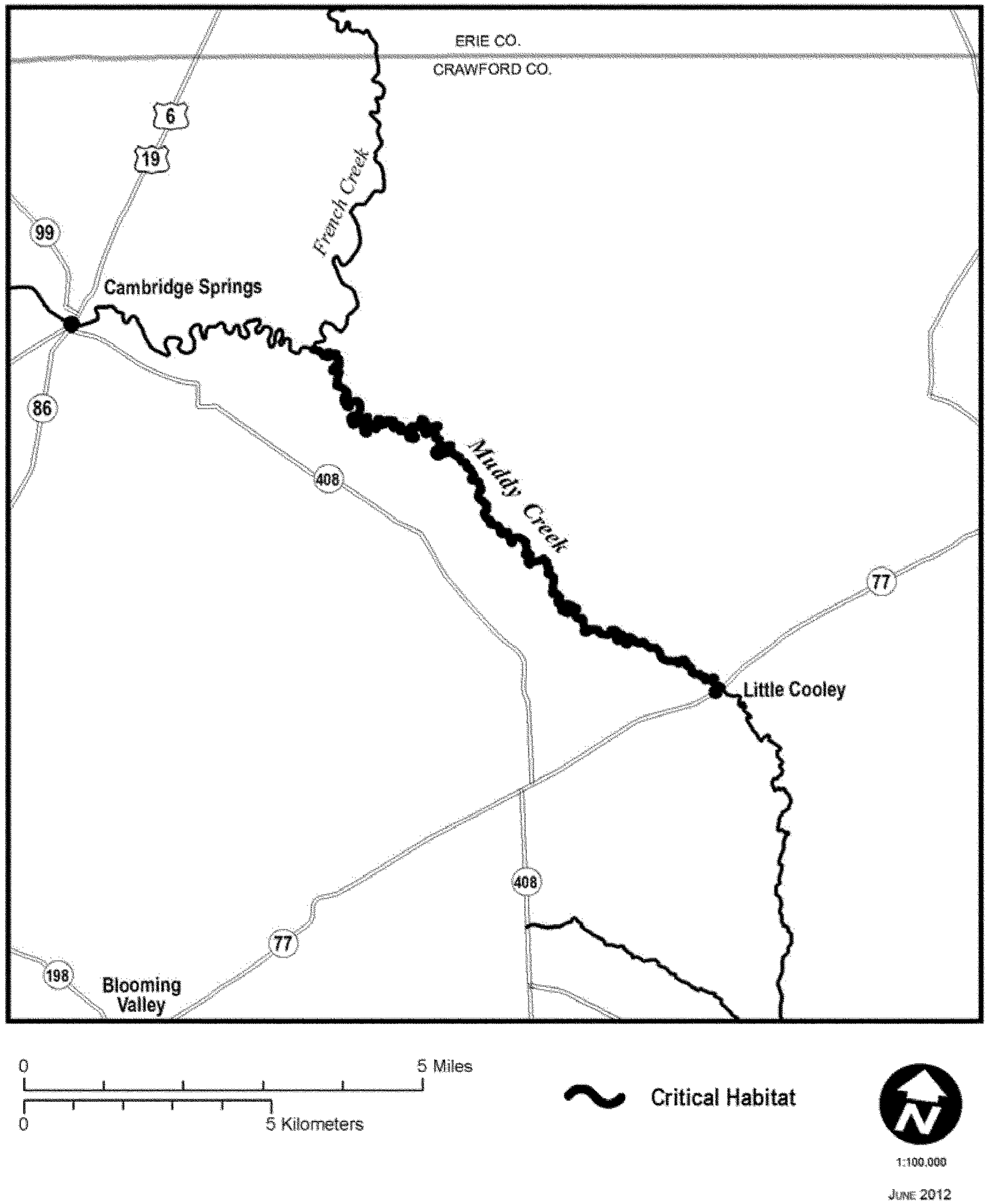


(33) Unit RF25: Muddy Creek—Crawford County, Pennsylvania.

(i) Unit RF25 includes 20.1 rkm (12.5 rmi) of Muddy Creek from Pennsylvania Highway 77 near Little Cooley, Crawford County, Pennsylvania, downstream to its confluence with French Creek east of Cambridge Springs, Crawford County, Pennsylvania.

(ii) **Note:** Map of Unit RF25 (Muddy Creek) of critical habitat for rabbitsfoot follows:

Map of Unit RF25 (Muddy Creek) of critical habitat for Rabbitsfoot

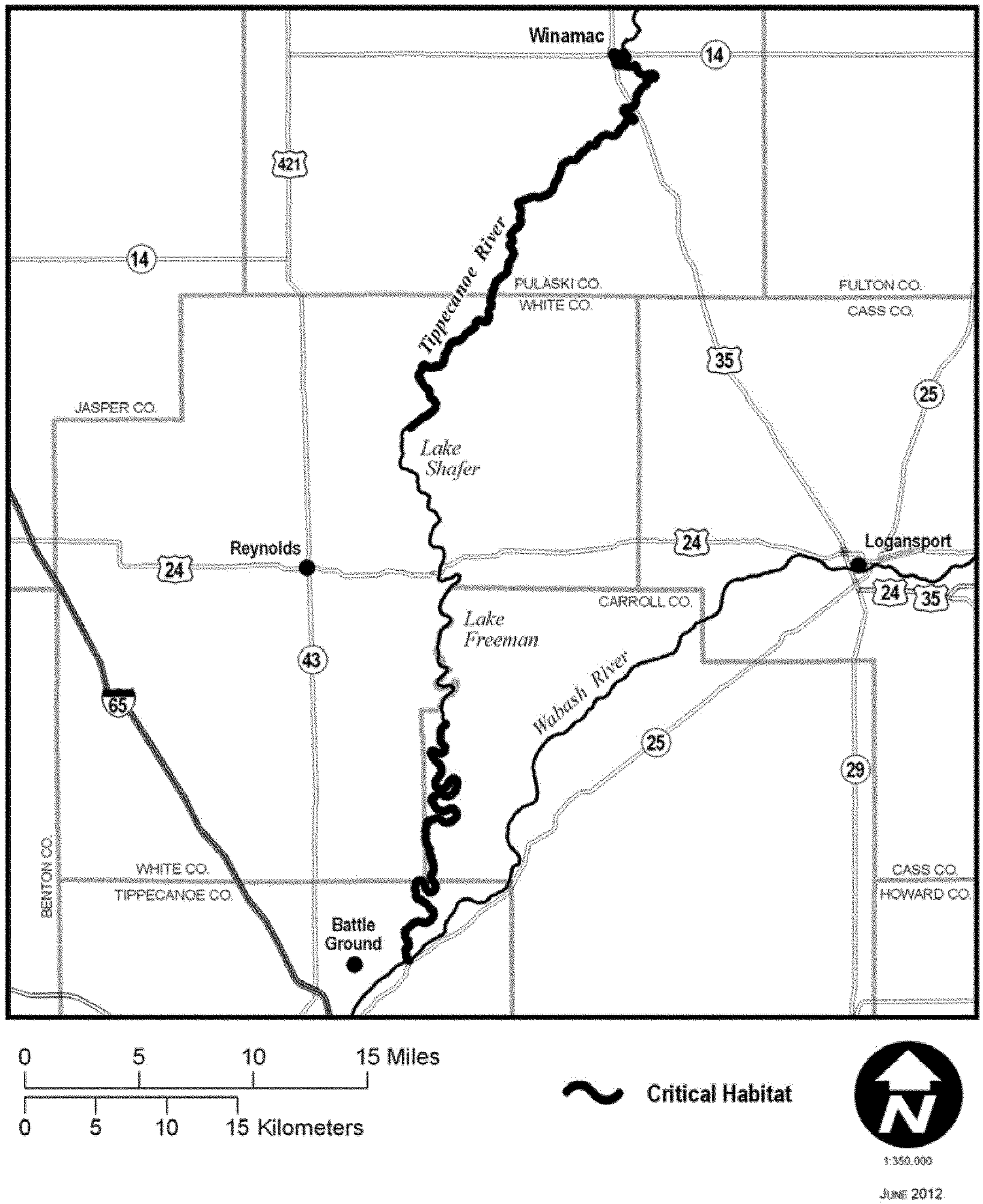


(34) Unit RF26: Tippecanoe River—Carroll, Pulaski, Tippecanoe, and White Counties, Indiana.

(i) Unit RF26 includes 75.6 rkm (47.0 rmi) of the Tippecanoe River from Indiana Highway 14 near Winamac, Pulaski County, Indiana, downstream to its confluence with the Wabash River northeast of Battle Ground, Tippecanoe County, Indiana, excluding Lakes Schafer and Freeman and the stream reach between the two lakes.

(ii) **Note:** Map of Unit RF26 (Tippecanoe River) of critical habitat for rabbitsfoot follows:

Map of Unit RF26 (Tippecanoe River) of critical habitat for Rabbitsfoot

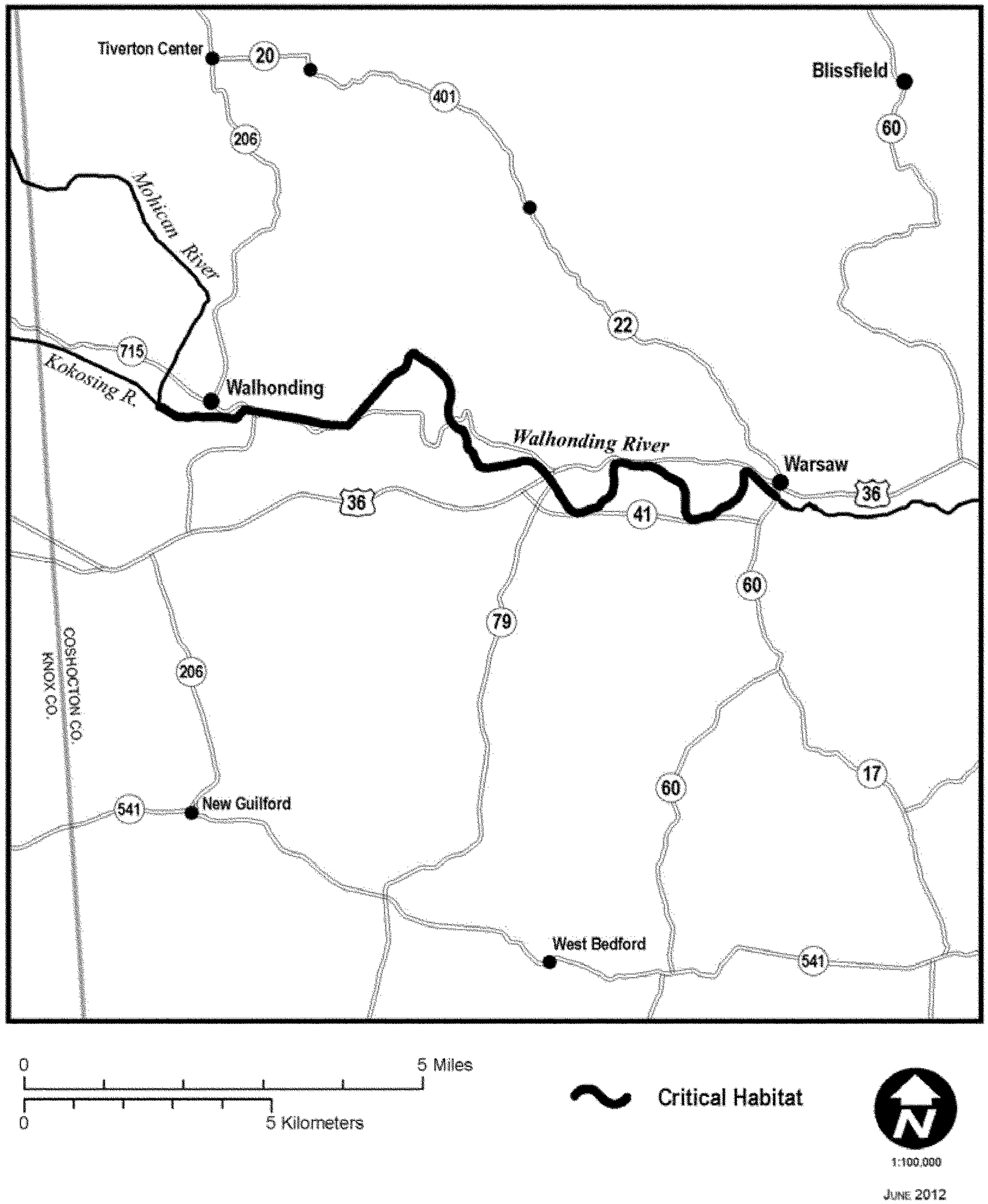


(35) Unit RF27: Walhonding River—Coshocton County, Ohio.

(i) Unit RF27 includes 17.5 rkm (10.9 rmi) of the Walhonding River from the convergence of the Kokosing and Mohican Rivers downstream to Ohio Highway 60 near Warsaw, Coshocton County, Ohio.

(ii) **Note:** Map of Unit RF27 (Walhonding River) of critical habitat for rabbitsfoot follows:

Map of Unit RF27 (Walhonding River) of critical habitat for Rabbitsfoot

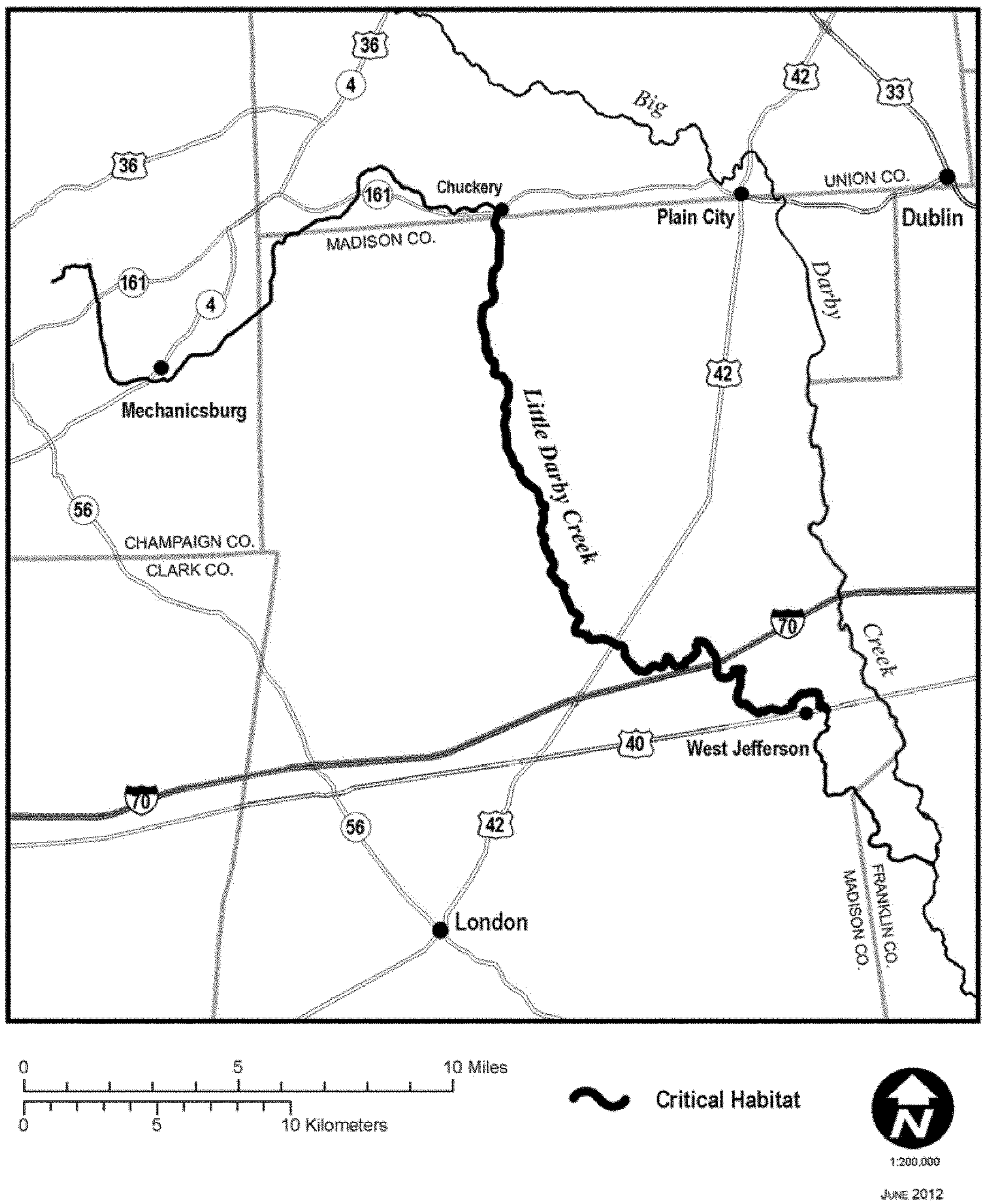


(36) Unit RF28: Little Darby Creek—Madison and Union Counties, Ohio.

(i) Unit RF28 includes 33.3 rkm (20.7 rmi) of Little Darby Creek from Ohio Highway 161 near Chuckery, Madison County, Ohio, downstream to U.S. Highway 40 near West Jefferson, Madison County, Ohio.

(ii) **Note:** Map of Unit RF28 (Little Darby Creek) of critical habitat for rabbitsfoot follows:

Map of Unit RF28 (Little Darby Creek) of critical habitat for Rabbitsfoot

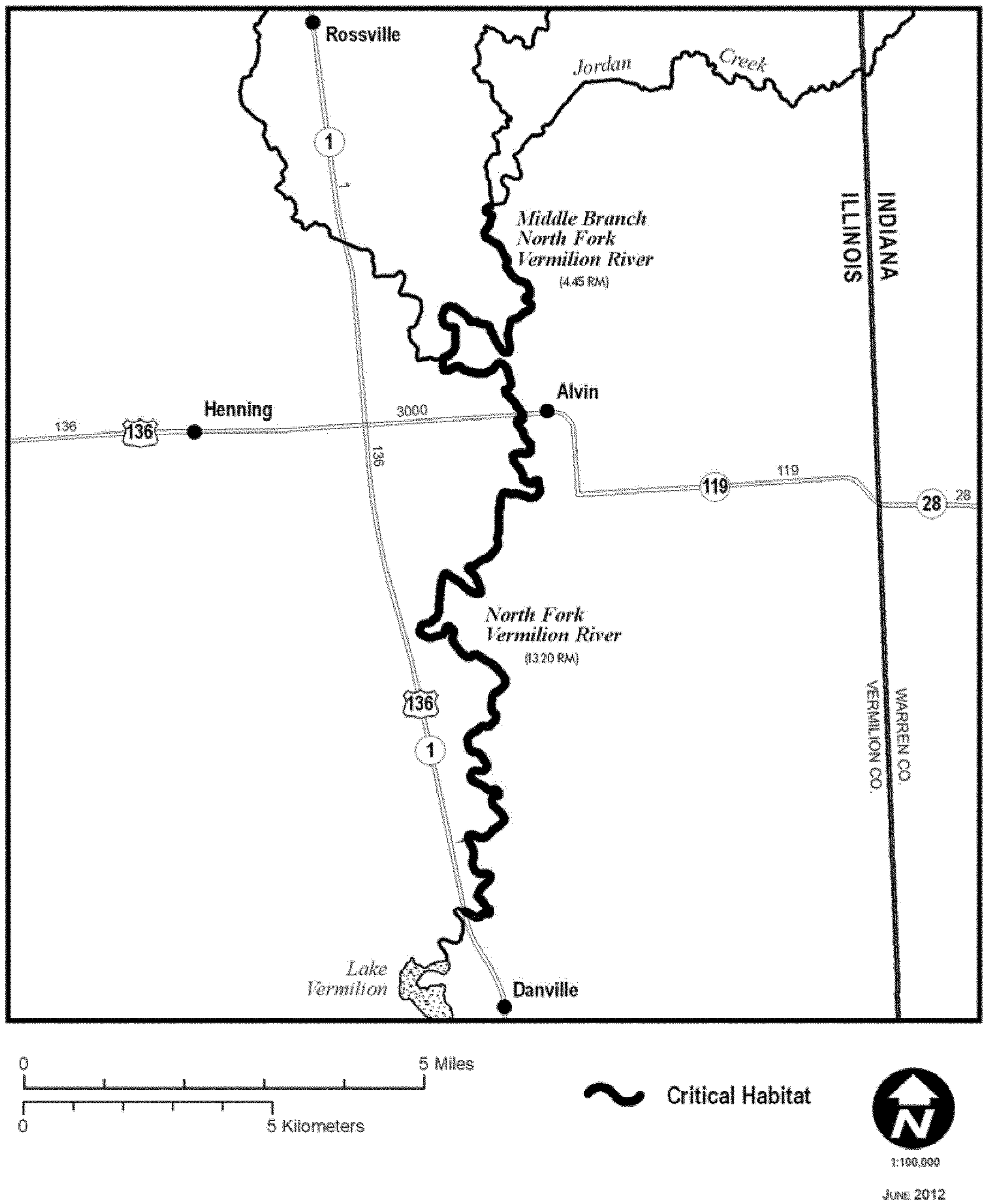


(37) Unit RF29: North Fork Vermilion River and Middle Branch North Fork Vermilion River, respectively, Vermilion County, Illinois.

(i) Unit RF29 includes 28.5 rkm (17.7 rmi) of the North Fork Vermilion River from the confluence of Middle Branch North Fork Vermilion River downstream to Illinois Highway 1 and U.S. Highway 136 upstream of Lake Vermilion, Vermilion County, Illinois. Unit RF29 also includes 7.2 rkm (4.5 rmi) of the Middle Branch North Fork Vermilion River from the Jordan Creek confluence northwest of Alvin, Illinois, downstream to its confluence with North Fork Vermilion River west of Alvin, Vermilion County, Illinois.

(ii) **Note:** Map of Unit RF29 (North Fork Vermilion River and Middle Branch North Fork Vermilion River) of critical habitat for rabbitsfoot follows:

Map for Unit RF29 (North Fork Vermilion River and Middle Branch Vermilion River) of critical habitat for Rabbitsfoot

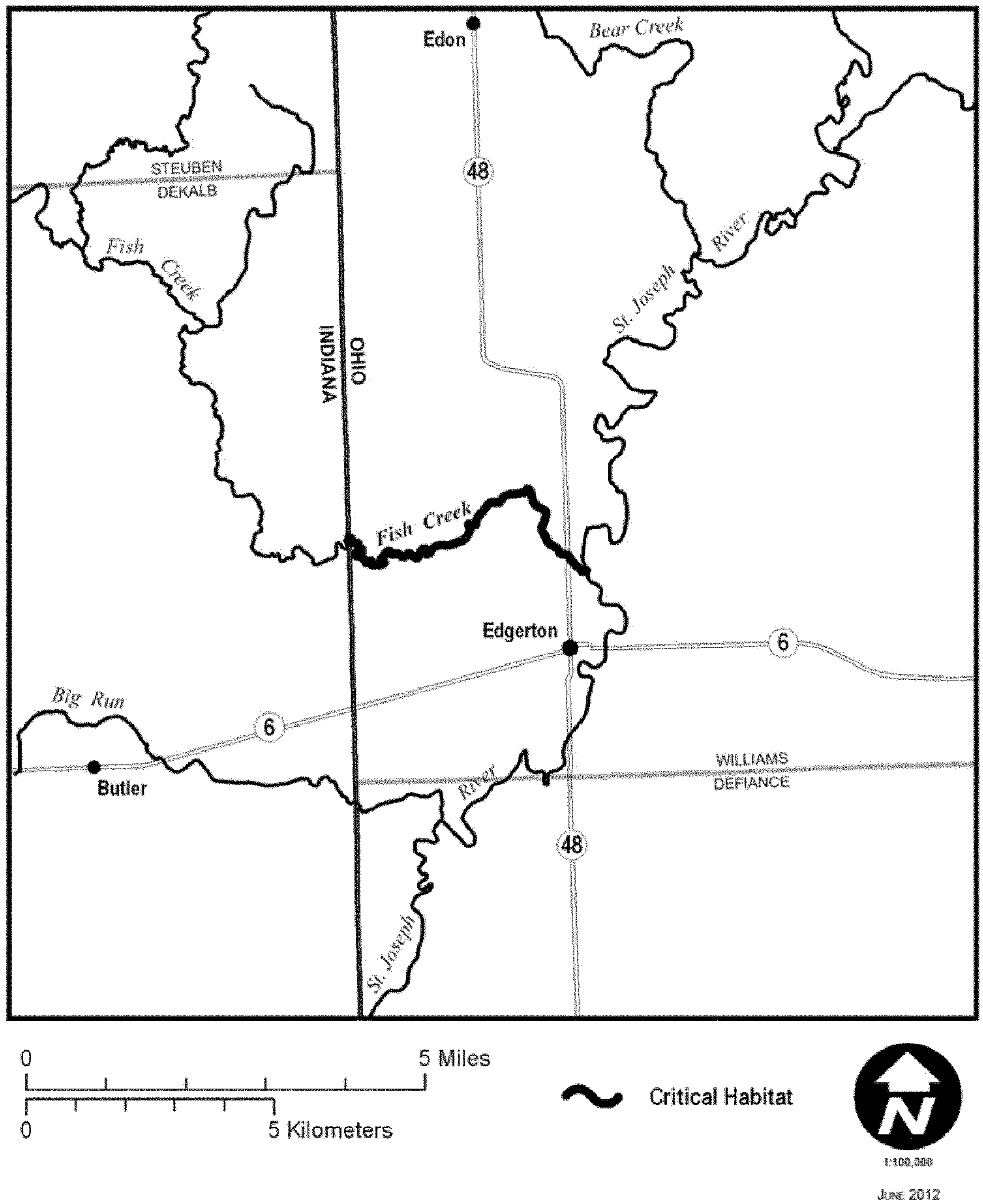


(38) Unit RF30: Fish Creek—Williams County, Ohio.

(i) Unit RF30 includes 7.7 rkm (4.8 rmi) of Fish Creek from the western (upstream) portion of Fish Creek Wildlife Area near the Indiana and Ohio State line northwest of Edgerton, Ohio, downstream to its confluence with the St. Joseph's River north of Edgerton, Williams County, Ohio.

(ii) **Note:** Map of Unit RF30 (Fish Creek) of critical habitat for rabbitsfoot follows:

Map of Unit RF30 (Fish Creek) of critical habitat for Rabbitsfoot

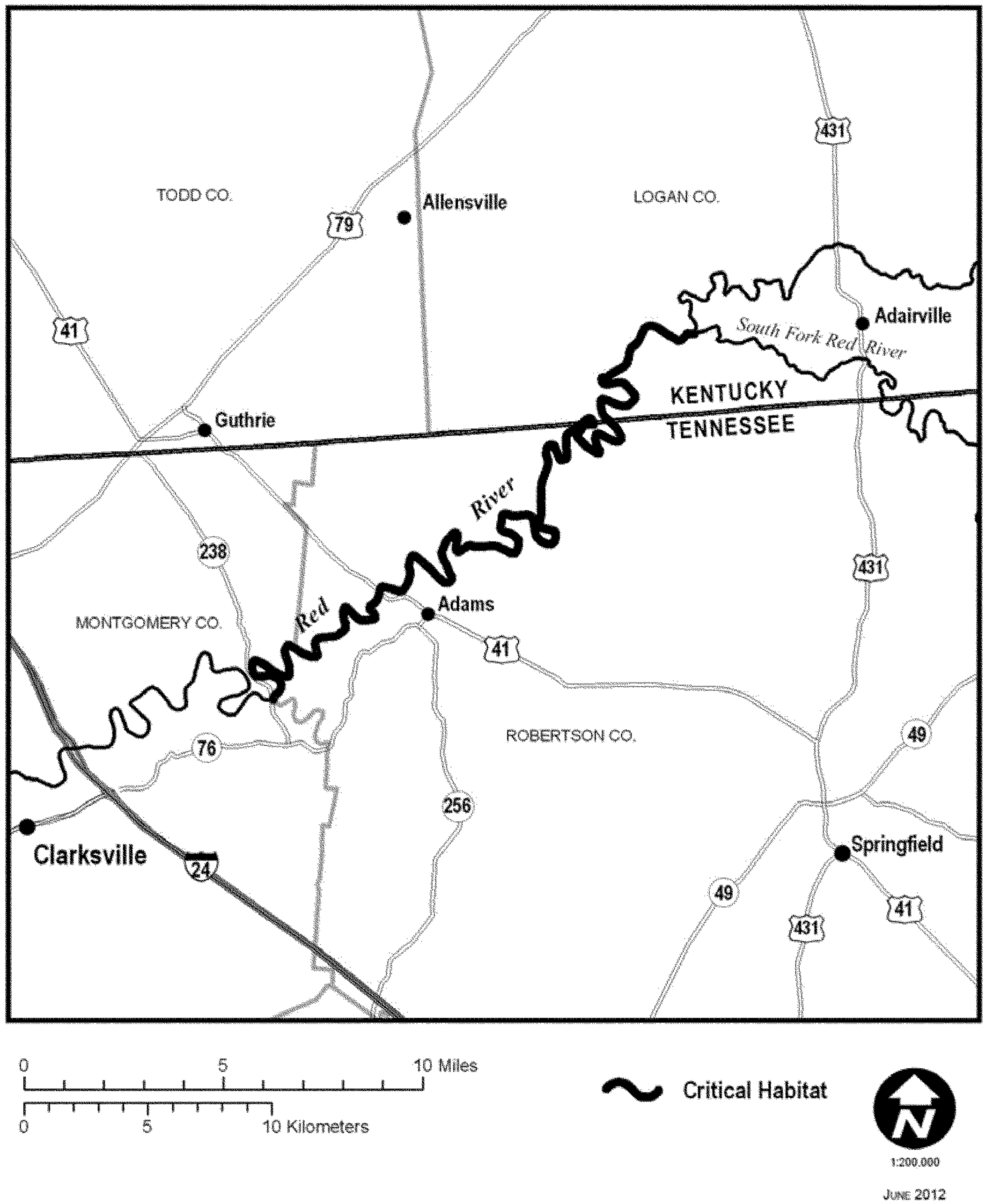


(39) Unit RF31: Red River—Logan County, Kentucky; and Robertson County, Tennessee.

(i) Unit RF31 includes 50.2 rkm (31.2 rmi) of the Red River from the South Fork Red River confluence west of Adairville, Logan County, Kentucky, downstream to the Sulphur Fork confluence southwest of Adams, Robertson County, Tennessee.

(ii) **Note:** Map of Unit RF31 (Red River) of critical habitat for rabbitsfoot follows:

Map of Unit RF31 (Red River) of critical habitat for Rabbitsfoot

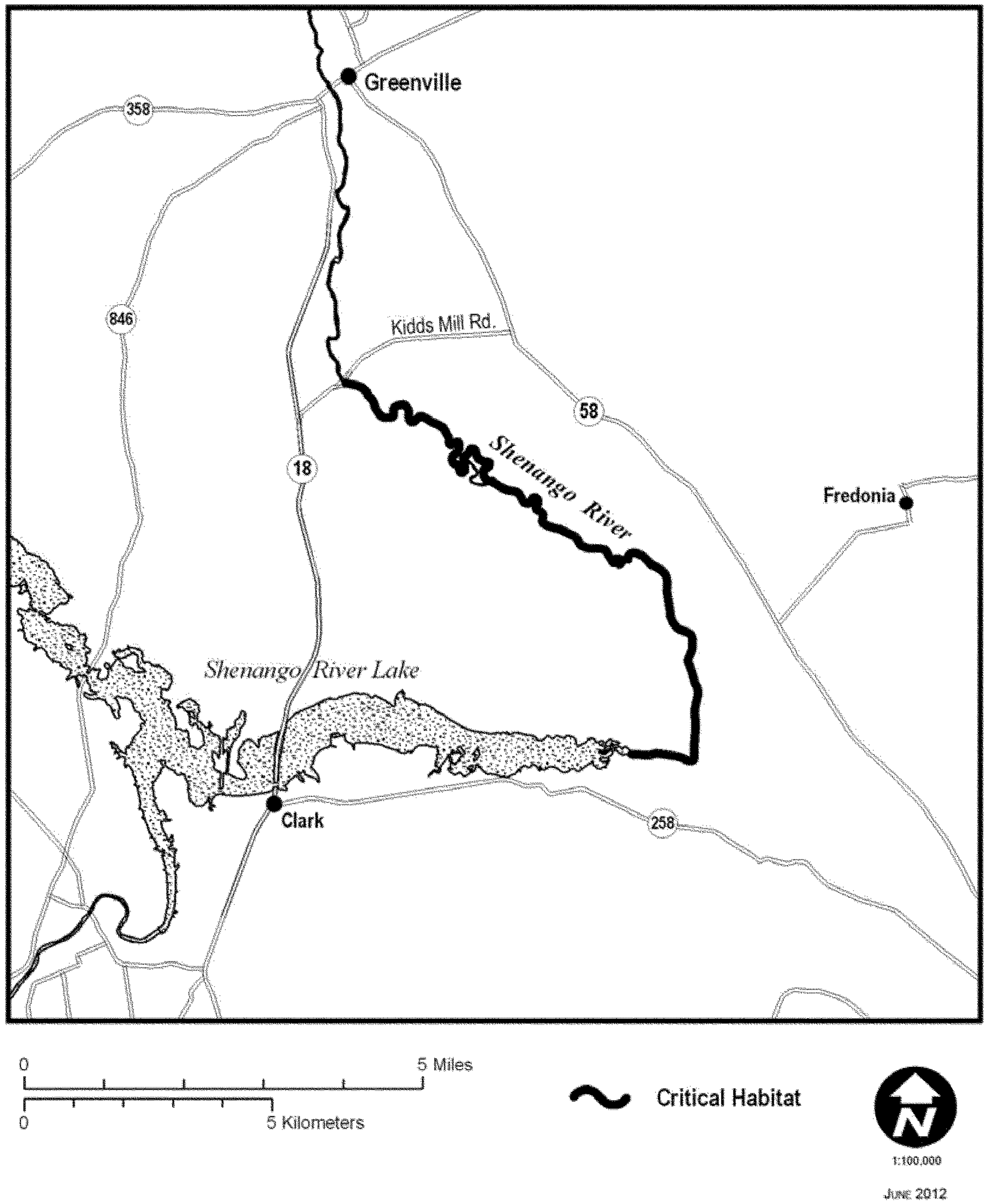


(40) Unit RF32: Shenango River—Mercer County, Pennsylvania.

(i) Unit RF32 includes 16.3 rkm (10.1 rmi) of the Shenango River from Kidds Mill Road near Greenville, Pennsylvania, downstream to the upstream point of inundation by Shenango River Lake near Big Bend, Mercer County, Pennsylvania.

(ii) **Note:** Map of Unit RF32 (Shenango River) of critical habitat for rabbitsfoot follows:

Map of Unit RF32 (Shenango River) of critical habitat for Rabbitsfoot



* * * * *

Dated: August 22, 2012.

Rachel Jacobson,

Principal Deputy Assistant Secretary for Fish and Wildlife and Parks.

[FR Doc. 2012–24151 Filed 10–12–12; 8:45 am]

BILLING CODE 4310–55–c