**DEPARTMENT OF THE INTERIOR**

**Fish and Wildlife Service**

**50 CFR Part 17**

**[Docket No. FWS–R3–ES–2012–0065]; [MO 92210-0-0008 B2]**

**RIN 1018–AY16**

# Endangered and Threatened Wildlife and Plants; Determination of Endangered Species Status for the Grotto Sculpin (*Cottus specus*) Throughout Its Range

**AGENCY:** Fish and Wildlife Service, Interior.

**ACTION:** Final rule.

**SUMMARY:** We, the U.S. Fish and Wildlife Service, determine endangered species status under the Endangered Species Act of 1973, as amended, for the grotto sculpin, a species from Perry County, Missouri. The effect of this regulation will be to add this species to the lists of Endangered and Threatened Wildlife/Plants.

**DATES:** This rule becomes effective [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** This final rule and supplementary documents, such as comments received, are available on the Internet at *http://www.regulations.gov* at Docket No. FWS–R3–ES–2012–0065. Comments and materials received, as well as supporting documentation used in the preparation of this rule, will be available for public inspection, by appointment, during normal business hours at: U.S. Fish and Wildlife Service, Columbia Missouri Ecological Services Field Office, 101 Park De Ville Dr., Suite A, Columbia, MO 65203; telephone: 573–234–2132; facsimile: 573–234–2181.

**FOR FURTHER INFORMATION CONTACT:** Amy Salveter, Field Supervisor, Columbia Missouri Ecological Services Field Office (see **ADDRESSES** section). If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800–877–8339.

**SUPPLEMENTARY INFORMATION:**

**Executive Summary**

**Why we need to publish a rule.** Under the Endangered Species Act, a species may warrant protection through listing if it is endangered or threatened throughout all or a significant portion of its range. Listing a species as an endangered or threatened species can only be completed by issuing a rule. We are listing the grotto sculpin (*Cottus specus*) as endangered under the Endangered Species Act of 1973 (Act), as amended. Elsewhere

in today's **Federal Register**, we finalize designation of critical habitat for the grotto sculpin under the Act.

**The basis for our action.** Under the Endangered Species Act, we can determine that a species is an endangered or threatened species based on any of 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; or (E) Other natural or manmade factors affecting its continued existence. We have determined that there are current and ongoing threats to the grotto sculpin from habitat loss and degradation of aquatic resources due to improper waste disposal, contaminated groundwater, improper application and maintenance of vertical drains, and sedimentation. The species is found only in one county in Missouri and has a restricted distribution that is coincident with karst habitats.

**Peer review and public comment.** We sought comments from independent specialists to ensure that our decision is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal. We also considered all comments and information received during the comment period.

## Background

*Previous Federal Actions*

We first identified the grotto sculpin as a candidate species in a notice of review published in the **Federal Register** on June 13, 2002 (67 FR 40657). Candidate species are assigned listing priority numbers (LPNs) based on the 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. The grotto sculpin was assigned an LPN of 2 due to imminent threats of a high magnitude. On May 11, 2004, we received a petition dated May 4, 2004, from The Center for Biological Diversity to list 225 candidate species, including the grotto sculpin. From 2004 through 2011, notices of review published in the **Federal Register** (69 FR 24876, 70 FR 24870, 71 FR 53756, 72 FR 69034, 73 FR 75176, 74 FR 57804, 75 FR 69222, 76 FR 66370) continued to maintain an LPN of 2 for the species. On September 27, 2012, the Service published in the **Federal Register** (77 FR 59488) a proposed rule to list the grotto sculpin as endangered under the Act and proposed to designate critical habitat. We published a notice of availability in the **Federal Register** (78 FR 26581) on May 7, 2013, to make the public aware of the opportunity to review and provide comment on a draft economic analysis, the proposed rule, and the draft Perry County Community Conservation Plan. The comment period was reopened for 30 days (May 7 to June 6, 2013).

*Species Information*

Our proposed rule summarized much of the current literature regarding the grotto sculpin's distribution, habitat requirements, and life history and should be reviewed for detailed information (77 FR 59488; September 27, 2012). Below, we provide new information that we believe is relevant to understanding our analysis of the factors that are threats to the grotto sculpin.

Taxonomy and Species Description

The grotto sculpin belongs to the family Cottidae (Pflieger 1997, p. 253) and was found to be a unique species (*Cottus specus*) by Adams *et al.* (2013, pp. 488–493). No other *Cottus* species overlap the geographic range of the grotto sculpin. The grotto sculpin is morphologically and genetically distinguished from all other *Cottus* species. Unique characteristics include differences in eye size and cephalic pore size (Adams *et al*. 2013, p. 490). Morphology of brain structures in hypogean (underground) individuals also differs significantly from that of epigean (aboveground) banded sculpin, including reduced optic and olfactory lobes and enlarged inferior lobe of the hypothalamus, eminentia granularis, and crista cerebellaris (Adams 2005, pp. 17–18).

Adams *et al*. (2013, pp. 487–488) analyzed population genetics of *Cottus* sculpin in southeast Missouri through a study of sculpin from the Bois Brule drainage in Perry County, the Greasy Creek in Madison County, and the Current River in Ripley County. They identified unique evolutionary lineages for each of the three areas, based on distinct nuclear haplotypes—a single nuclear haplotype among sampled individuals throughout the Bois Brule drainage (Mystery Cave, Running Bull Cave, Rimstone River Cave,

Crevice Cave, Moore Cave, and Cinque Hommes Creek), a second from Greasy Creek, and a third from the Current River.

**Summary of Comments and Recommendations**

In the proposed rule published on September 27, 2012 (77 FR 59488), we requested that all interested parties submit written comments on the proposal by November 13, 2012. The comment period was reopened from May 7, 2013, to June 6, 2013 (78 FR 26581, May 7, 2013). We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other interested parties and invited them to comment on the proposal. We held a public meeting on October 30, 2012, and did not receive any requests for a public hearing. Newspaper notices inviting general public comment on the proposal and associated critical habitat documents were published in the St. Louis Post Dispatch, Cape Girardeau Southeast Missourian, and Perryville Republic Monitor.

During the comment periods for the proposed rule, we received 364 comment letters directly addressing the proposed listing of the grotto sculpin and proposed critical habitat. Of the 364 comments submitted, 8 explicitly stated support for the listing, whereas 50 explicitly stated opposition to the listing. The remaining 306 comments provided information on historical and contemporary practices in Perry County and posed a variety of questions including questions about the proposal process, information about the grotto sculpin, and implications of the listing to the citizens of Perry County. All

substantive information provided during the comment periods has either been incorporated directly into this final determination or addressed below.

*Peer Review*

In accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from four knowledgeable individuals with scientific expertise that included familiarity with the grotto sculpin, karst biota and habitats, biological needs of fishes, and threats. We received responses from two of the peer reviewers. We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of the grotto sculpin. The peer reviewers generally concurred with our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final rule. Peer reviewer comments are addressed in the following summary and incorporated into the final rule as appropriate.

*Peer Reviewer Comments*

*(1) Comment*: What is the rate of grotto sculpin movement? The proposed rule indicated movements of 0–50 m, but is that per day, hour, or lifetime?

*Our Response*: We reviewed our reference for this information and determined that Adams *et al.* (2008, pp. 6, 23) characterized movements by total distance moved from the beginning to the end of the 29-month study period. A total of 463 grotto sculpin were marked to allow for observations of movement during the study. During the 29-

month study period, 311 individuals (67 percent) moved less than 50 m (164 ft), 40 (9 percent) moved 51–100 m (167–328 ft), 49 (9 percent) moved 101–200 m (331–656 ft), and 63 (14 percent) moved greater than 201 m (659 ft).

*(2) Comment*: Reword the statement "We consider the geographic range of the grotto sculpin…" to reflect that the range definition is based on scientific data.

*Our Response*: We corrected this statement in the final rule to reflect that our range delineation is based on scientific studies.

*(3) Comment*: How many grotto sculpins have been taken for scientific investigations?

*Our Response*: Approximately 160 individuals have been taken for scientific research since 1991. This information is discussed under overutilization for commercial, recreational, scientific, or educational purposes in this rule.

*(4) Comment*: Clarify information about recognition of the grotto sculpin as a distinct species.

*Our Response*: Until the 2013 publication by Adams *et al.*, the grotto sculpin had not been formally described as a species and, therefore, was not recognized by the scientific community as a distinct species. Without an official species description, the State of Missouri could not offer protection under the Missouri State Endangered Species Law (MO ST 252.240). The new information provided by the 2013 Adams *et al*. paper was incorporated into this final rule.

*(5) Comment*: Clarify the apparent inconsistency in the statements about population size and distribution. Populations estimated in the thousands should not necessarily be characterized as "small." Instead of estimated population size, the rule should address the restricted distribution of the species.

*Our Response*: Because no data on the species are available prior to 1991, characterizing the population as "small" is not fully supported because it is unclear what the pre-settlement population numbers were. We based our determination of status on the fact that there was documented mortality, populations are known to be isolated, and populations have distributions that are restricted to few cave systems. The final rule has been corrected to characterize the population as restricted instead of small.

*(6) Comment*: One peer reviewer and several public comments addressed funding and potential methods for recovery of the species, including propagation and translocation.

*Our Response*: Recovery efforts for the grotto sculpin will be addressed in a Recovery Plan that will include potential funding sources, collaborations with partners, and specific recovery actions and benchmarks.

*(7) Comment*: Even if some factors contributing to the imperiled status of the grotto sculpin were overestimated, the interactive effects of all the factors detailed in the proposal likely have not only an additive but a multiplying effect, so that the overall negative impact may be underestimated.

*Our Response*: Although we lack definitive data to support this assertion, it is likely that effects of some factors may enhance the effects of other impacts. Because this

interaction could contribute to the decline of the grotto sculpin, we have referenced synergistic effects under Cumulative Impacts.

*Comments From States*

Section 4(i) of the Act states, "the Secretary shall submit to the State agency a written justification for his failure to adopt regulations consistent with the agency's comments or petition." Comments received from the State regarding the proposal to add the grotto sculpin to the list of threatened and endangered species are addressed below.

(8) *Comment*: The Missouri Department of Conservation (MDC) supports the Service's action to list the grotto sculpin due to its confined range and threats to its continued existence.

*Our Response*: The Service acknowledges the MDC's support of the listing action and will continue to coordinate with appropriate staff on future conservation efforts for the species.

*Federal Agency Comments*

We received no comments from Federal agencies on the proposal to list the grotto sculpin.

*Public Comments*

*(9) Comment*: Numerous commenters provided information on the culture, society, and economy of Perry County. Commenters also submitted information on current and historical land use practices, primarily pertaining to agriculture and farming

practices, but also including sinkhole management and stream management. Many more commenters posed questions regarding the biology, life history, and research of the grotto sculpin, as well as implications of the listing to agriculture, industry, and the local economy.

*Our Response*: We thank all of the commenters for their interest in the conservation of this species and thank those commenters who provided information for our consideration in making this listing determination. For commenters posing questions about the biology, life history, and research of the grotto sculpin previously summarized in our proposed rule, we refer you to detailed information provided in the proposed rule. Some comments contained information that provided clarity but did not substantially change information already contained in the proposed rule. This information has been incorporated into this final rule, where appropriate. Some commenters posed questions outside of the scope of this listing action that were not addressed in our final rule.

*(10) Comment*: The Service should work with the people of Perry County to address threats to the grotto sculpin by developing conservation strategies and best management practices and providing educational opportunities. Commenters suggested that implementation of additional practices should include incentives to landowners and contingency plans for unforeseen circumstances. One commenter asked how practices on private land would be enforced.

*Our Response*: The Service is working with landowners, citizens, businesses, and organizations in Perry County under a conservation plan that addresses threats to the grotto sculpin and provides benefits to water quality in the surrounding watershed. The Perry County Community Conservation Plan (Plan) is a voluntary, proactive, and self-

regulatory approach developed by the local community and supported by State and Federal agencies. The Plan includes an educational campaign, prioritization of threats, and best management practices to address the threats. Existing land conservation programs will be utilized where appropriate and can include financial incentives to program participants. Participation in U.S. Department of Agriculture (USDA) conservation programs and use of best management practices on private land is voluntary. However, if a landowner elects to participate in a specific USDA program, practice standards must be met in order to remain in compliance with program guidelines. Administrators of such programs are responsible for compliance monitoring and enforcement of practice standards on private land.

*(11) Comment*: Commenters inquired about funding that would be available to Perry County residents for water sampling, monitoring, land remediation, landowner incentives, implementation of best management practices, underground mapping, and stormwater management.

*Our Response*: Financial support for habitat restoration and enhancement can be acquired through participation in conservation programs sponsored by the USDA. Locally, those programs are administered by the Natural Resources Conservation Service (NRCS), Soil and Water Conservation District (SWCD), U.S. Fish and Wildlife Service Partners for Fish and Wildlife Program, and MDC Private Lands Division. The Service, MDC, and Soil and Water Conservation Districts provide landowners cost-share for projects that benefit Federal trust resources, state trust resources, and soil and water quality, which include but are not limited to sinkhole cleanouts, stream protection, and land restoration. Other competitive funding opportunities exist at state and national

levels. For example, entities can apply for Clean Water Act Section 319 funds if a watershed plan has been developed and implemented.

*(12) Comment*: Several commenters asked what has been done to date to protect and conserve the grotto sculpin and its habitat, including cooperative efforts with landowners, the length of time such efforts have been undertaken, and quantification of the effectiveness of those efforts.

*Our Response*: The Service has cooperated with the MDC since 2010 to implement conservation efforts and studies to aid in the conservation and protection of the grotto sculpin. The Service provided $35,000 to be used for sinkhole cleanouts, access agreements for known grotto sculpin caves, fencing projects, and surveys. The Service also contributed $5,000 to the University of Central Arkansas to finalize and publish in a peer-reviewed journal the genetic analysis of the grotto sculpin. Additionally, the MDC collaborated with the Perry County Soil and Water District and the University of Central Arkansas in 2008–2009 to conduct preliminary water quality sampling and analysis. Using Service funds, the MDC has completed four cave access agreements, one stream exclusion fencing and spring development project, three sinkhole cleanouts, one dye-tracing study, four presence-absence studies for the grotto sculpin, and one landowner workshop. Studies to measure the efficacy of those implemented measures have not been undertaken by the Service or the State, but will be included in the recovery plan for the grotto sculpin.

*(13) Comment*: Several commenters asked about monitoring and reporting requirements for water quality, grotto sculpin populations, and implemented practices. Specifically, how will the monitoring occur, who will conduct the monitoring and prepare

reports, to whom will reports be submitted, and how will the Service track improvements or deteriorations?

*Our Response*: Monitoring for the grotto sculpin will be conducted in coordination with the MDC, and water quality monitoring will be coordinated with the Missouri Department of Natural Resources. No specific monitoring protocols or regimes have been established. During the recovery planning process, we will design and implement a monitoring plan in coordination with the MDC, Missouri Department of Natural Resources, and participants in the Perry County Community Conservation Plan. Monitoring data will provide the Service information on whether the threats are being adequately addressed and minimized.

*(14) Comment*: Numerous commenters asked questions about how private land in Perry County will be affected, including any restrictions to land use or stream use, including watering of livestock, impacts to property value, loss of access to property or non-permitted access to private property by agency personnel, effects on planting and harvesting crops, and any potential impacts to farm subsidies.

*Our Response*: According to section 9(a)(1) of the Act, is it unlawful to ‘take’ a federally listed species. The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. An activity can be conducted on private land as long as that activity does not cause ‘take’ of the grotto sculpin. Most current land and stream uses are compatible with the continued persistence and recovery of the grotto sculpin. Many activities will have no effect on the grotto sculpin, whereas others can be made compatible with the use of best management practices. If it is determined that a practice is incompatible with the continued existence

of the grotto sculpin, meaning that even with implementation of best management practices the practice still causes threats to the species or its habitat, the Service will work closely with the Perry County Plan implementation committee and affected landowners to develop alternatives.

One of the threats to the grotto sculpin identified in the proposed rule was the decline in water quality because of sedimentation and the presence of chemicals, some of which are of agricultural origin. Farming practices that include best management practices, such as vegetative filter strips around groundwater inputs, and application of chemicals according to directions on the label likely will not require modification. The Perry County Plan identifies a need to review select current farming practices to ensure they are not impacting water quality and the grotto sculpin. Recommendations for modification of farming practices likely would be initiated through the Plan implementation committee.

Private landowners will not lose access to their property because a federally listed species is present on their property, farm subsidies will not be impacted, and, with the exception of law enforcement officials, no agency personnel or other private citizens are allowed to access private property without the owners' permission.

*(15) Comment*: Numerous commenters asked questions about impacts to private property value.

*Our Response*: Listing decisions are made independently of economic considerations. However, an economic analysis considering the effects of critical habitat, including impacts on private property values, was completed and made available on May 7, 2013 (78 FR 26586).

*(16) Comment*: A commenter asked how activities in Perry County with a Federal nexus (Federal permit requirements or use of Federal funds) will be affected.

*Our Response*: Section 7(a)(2) of the Act requires Federal agencies to consult with the Service to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species (referred to as the consultation process). Construction and development projects that involve Federal actions, permits, or funds require an environmental review that includes concurrence from the Service if Federal trust resources are present in the action area of the project. Addition of the grotto sculpin to the endangered species list is not anticipated to extend the review period for Federal projects beyond what already occurs. Conservation measures outlined in the Perry County Plan should avoid and minimize most potential impacts to the species. Projects will be reviewed on a case-by-case basis to determine if any additional measures are necessary to avoid take of the species.

Meyer (1995, p. 16) reviewed the record of 18,211 endangered species consultations by the Service and National Marine Fisheries Service from 1987 to 1991 and found that only 11 percent (2,050) were handled under formal consultation, meaning the other 89 percent proceeded on schedule and without interference. Of the 2,050 formal consultations, 181 (less than 10 percent) concluded that the proposed projects were likely to pose a threat to an endangered plant or animal. Most of these 181 projects proceeded with some modification in design and construction. Ultimately, 99 percent of the projects reviewed under the Act eventually proceeded unhindered or with moderate additional time and costs.

*(17) Comment*: Several commenters asked questions about various aspects of water quality. These comments generally centered on five subject areas and are addressed below.

*(17a) Comment:* Commenters asked for information on water quality and chemicals. They requested information about any recent water sampling since the Fox *et al.* (2010) study, human or livestock health issues related to chemicals present in the water samples taken in 2008, the possible origin of those chemicals, and the location of data collected from the water quality study.

*Our Response*: No large-scale water quality studies have been initiated since the Fox *et al.* (2010) study. Fox *et al.* (2010) noted that chemicals detected in water samples were from agricultural pest management activities. The authors of this study hold the data and results of the analysis. A copy of the Fox *et al.* (2010) manuscript was provided to the Perry County Plan committee and is available online and at the Columbia Missouri Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**).

*(17b) Comment*: Commenters asked for information pertaining to agricultural chemicals, specifically if there will be restrictions on agricultural chemicals and if contract sprayers will be more accountable to apply pesticide in a more precise way.

*Our Response*: Federal control of pesticides is provided under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). All pesticides used in the United States must be registered (licensed) by the Environmental Protection Agency (EPA). Registration assures that pesticides will be properly labeled and that, if used in accordance with specifications on the label, will not cause unreasonable harm to the

environment. By law, use of each registered pesticide must be consistent with use directions contained on the label or labeling.

*(17c) Comment*: Commenters provided and asked for information pertaining to water quality and sewer systems. One commenter provided information on the annexation of a subdivision into the city of Perryville and subsequent inclusion into the city sewer system. Two other towns in Perry County developed a joint public sewer system. The Perry County Health Department has developed automated notification systems that inform new homeowners and businesses of sewage laws. Commenters inquired about any changes to the septic requirements for landowners owning more than 3 acres and whether or not current systems would have to be replaced.

*Our Response*: We have included information provided about updates to sewer systems in this final rule. The Service is not aware of forthcoming changes to septic requirements for landowners who own more than 3 acres, and any changes that occur will be independent of this listing action. The Perry County Plan identifies the need to address potential problems with private septic systems. Recommendations for modification of private septic systems likely would be initiated through the Plan implementation committee.

*(17d) Comment*: Commenters provided information and asked questions regarding water quality and municipal sinkhole management. Commenters wanted to know how the listing action would affect the City's ability to maintain sinkholes and about any potential methods for mitigating stormwater draining into caves.

*Our Response*: The City of Perryville, Missouri is developing a sinkhole management policy as part of the Perry County Community Conservation Plan. This

policy will address sinkhole stabilization, stormwater management, and water quality issues.

*(18) Comment*: Commenters provided information and asked questions regarding vertical drains. Commenters wanted information about best management practices pertaining to vertical drains, cost-share used for installation and maintenance of vertical drains, and subsequent compliance with practice standards.

*Our Response:* As outlined in the proposed rule, if landowners receive cost-share assistance from the NRCS, they must follow practice standards to remain in compliance with the conservation program. Those practice standards include vegetative buffers that act as filters for water before it enters the standpipe (NRCS 2006a, pp. 1–2; 2006b, pp. 1–3). If landowners are self-funding the installation of vertical drains, they are not required to follow practice standards and, therefore, might not install vegetative filter strips. Improving compliance under current program standards and broader application of best management practices to landowners who do not participate in cost-share programs were identified as action items in the Perry County Community Conservation Plan.

*(19) Comment*: Numerous commenters provided information on the use of current practices that have less environmental impacts than prior historical practices, including information on improvements to historical soil and water conservation actions and improved sewage systems.

*Our Response:* The Service has incorporated this information in this final rule, where appropriate.

*(20) Comment*: Commenters asked if there were existing management plans or guidance for managing sinkholes and karst and if there were any special regulations regarding sinkholes.

*Our Response:* The Service does not have any general guidance on managing sinkholes in karst areas. The MDC has developed best management practices for the Perry County Karst. As addressed in both the proposed listing rule and this final rule, State laws that apply to sinkholes, water quality, and waste management include the Missouri Clean Water Law of 1972 and the Missouri State Waste Management Law of 1972. Regulations under the Federal Clean Water Act of 1972 also would apply if a point-source for the pollution could be determined. County and municipal policies, such as the proposed Sinkhole Improvement Plan in Perryville, Missouri (Perry County 2013, pp. 14-16), also guide sinkhole management.

*(21) Comment*: Commenters asked about the validity of comparing a karst sinkhole system and underground water supplies and how the Service plans to determine contributing water sources in the future.

*Our Response:* In a karst system, the drainage system provided by sinkholes and underground streams are not always exclusive of each other and thus potential connections need to be considered. The study by Moss and Pobst (2010, pp. 146–160) delineated recharge areas for the known grotto sculpin cave systems. This information can be used to determine what surface waters contribute to the cave systems.

*(22) Comment*: Commenters asked about best management practices (BMPs), including how they will be determined, implications for building and road construction, and implementation in rural areas of the sinkhole plain.

*Our Response:* Best management practices have been developed for the federally threatened Ozark cavefish in Missouri. The BMPs being developed by the MDC and the Service in cooperation with the Perry County Plan will be similar, but tailored to the landscape and land use of Perry County as well as specific threats to the grotto sculpin and Perry County Karst. Best management practices for Perry County will include vegetated buffers around sinkholes and vertical drains—the ideal width is 50 ft (15 m), but the Service acknowledges that installation of a buffer of this width might not be feasible in all situations, such as urban areas with existing infrastructure. Standard methods of erosion control for building and road construction will continue to be recommended BMPs.

*(23) Comment*: Commenters asked questions about the genetics and species status of the grotto sculpin and whether or not there were other federally listed species in the genus *Cottus*.

*Our Response:* Adams *et al.* (2013, pp. 484–494) determined that the grotto sculpin (*Cottus specus*) was a unique species based on genetics and morphology. Other *Cottus* species that have been afforded special protections include three threatened *Cottus* species listed under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the federally threatened pygmy sculpin (*C. paulus*) in Calhoun County, Alabama.

*(24) Comment*: Commenters asked questions about potential threats to the grotto sculpin and its habitat by caving and cavers and whether caving and spelunking will be affected by the listing.

*Our Response:* The Service does not believe that caving and spelunking are incompatible with the continued existence of the grotto sculpin or that these activities are threats to the quality of its habitat, as long as cavers and spelunkers conduct these activities in a responsible manner. For example, minimize disturbance in known grotto sculpin caves during spawning periods and abide by a code of ethics for cavers, such as the Minimum Impact Caving Code that can be found at www.caves.org. Furthermore, the Service strongly encourages all cavers and spelunkers in Missouri to abide by the National White-Nose Syndrome Decontamination Protocol, which is readily available on the internet. Two federally listed species of bats are present in the caves of Perry County, and this protocol should be implemented to reduce the risk of transmission of the fungus to other bats and cave habitats. The Perry County Plan has included this recommendation for cavers and spelunkers in Perry County cave systems.

*(25) Comment*: Several commenters asked about the process for delisting a species that has been added to the List of Endangered and Threatened Wildlife.

*Our Response:* Recovery plans for listed species, developed by the Service in cooperation with stakeholders, identify delisting and downlisting goals. When a species achieves its delisting criteria, the Service considers removing it from the Federal List of Endangered and Threatened Wildlife and Plants. Likewise, when a species achieves its downlisting criteria, the Service considers changing its status from endangered to threatened.

To delist or downlist a species, we follow a process similar to when we consider a species for listing under the Act. We assess the population and its recovery

achievements, the existing threats, and seek advice from a variety of species experts. To assess the existing threats, the Service must determine that the species is no longer threatened or endangered based on 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; or (E) Other natural or manmade factors affecting its continued existence.

If the Service determines that the threats have been sufficiently reduced, then we may consider delisting or downlisting the species. When delisting or downlisting a species, we first propose the action in the **Federal Register**. At this time, we also seek comments from independent species experts, other Federal agencies, State biologists, and the public. After analyzing the comments received on the proposed rulemaking, we decide whether to complete the proposed action or maintain the species status as it is. Our final decision is announced in the **Federal Register**. The comments received and our response to them are addressed in the final rule.

*(26) Comment*: Commenters asked questions about the inadequacy of existing laws and regulations, including issues with lack of enforcement instead of lack of regulation.

*Our Response:* We agree that existing regulations suffer from lack of enforcement and lack of compliance, as opposed to the absence of laws and regulations. We have revised our discussion under Factor D, the inadequacy of existing regulatory mechanisms, in this final rule to reflect this.

*(27) Comment*: Several commenters asked about the population size and population trajectory of the grotto sculpin, including any information on carrying capacity of the species' habitat, possible presence of more individuals in inaccessible areas of caves, and other federally listed cavefish.

*Our Response:* Declining population trends are only one of many factors on which the Service bases decisions on listing determinations. In the case of the grotto sculpin, the Service did not base the proposed listing on a known decline in number of individuals, but rather a known set of current and ongoing threats, restricted population distribution, and known mortality events. The carrying capacity of Perry County karst habitats or similar habitats elsewhere is unknown, but caves are known to be energy-limited habitats and most cave-obligate species do not occur in large numbers. It is probable that grotto sculpin occur in inaccessible parts of currently known occupied cave systems, as well as other cave systems in the Perry County Karst where we currently have no documented occurrences.

One other federally listed cavefish species occurs in Missouri, the Ozark cavefish. This species similarly occurs in low densities in energy-limited cave habitats in southwest Missouri, Arkansas, and Oklahoma. The Ozark cavefish was designated as a federally threatened species in 1984 (49 FR 43965–43969, November 1, 1984).

*(28) Comment*: Many commenters asked how Federal listing of a species could affect the economy and development activity in Perry County.

*Our Response*: Listing decisions are made independently of economic considerations. However, an economic analysis considering the effects of critical habitat,

including effects on Perry County, was completed and made available in the **Federal Register** on May 7, 2013 (78 FR 26586).

*(29) Comment*: One commenter questioned the need to federally list the grotto sculpin because the species was already designated as a species of conservation concern by the MDC and the agency had developed best management practices to improve water quality and habitat for the species.

*Our Response*: Designating the grotto sculpin as a species of conservation concern by the MDC provides no requirement to implement any conservation measures through their agency regulations. While the Service lauds the development and implementation of best management practices for the grotto sculpin, we currently have insufficient evidence that the implementation of such measures have been adequate to reverse the degraded water quality and that poor water quality no longer presents a threat to this species.

*(30) Comment*: One commenter expressed opposition to any conservation measures that included the need to increase and maintain vegetative buffers around vertical drains.

*Our Response*: While the proper width of vegetative buffers around vertical drains is variable and can be considered further among various conservation partners, adequate vegetation around sinkhole openings is necessary to enhance water quality, especially in crop fields and pastures where silt, chemicals, and fertilizers can be directly deposited into underground karst through surface runoff.

**Summary of Changes From Proposed Rule**

We fully considered comments from the public and peer reviewers on the proposed rule to develop this final listing of the grotto sculpin. We also considered the conservation benefits of the Perry County Community Conservation Plan in our final decision. This final rule incorporates changes to our proposed listing based on comments received that are discussed above and on newly available scientific and commercial information. We made some technical corrections and updated the formal recognition of the grotto sculpin as a unique species.

**Summary of Factors Affecting the Species**

Section 4 of the Act and its implementing regulations (50 CFR 424) set forth the procedures for adding species to the Federal Lists of Endangered and Threatened Wildlife and Plants. A species may be determined to be an endangered or threatened species due to one or more of the five factors described in section 4(a)(1) of the Act: (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; or (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 grotto sculpin is a cave-adapted species that is endemic to karst habitats that provide consistent water flow, high organic input, and connection to surface streams, which allow for seasonal migrations to complete its life cycle. Nearly all of the land within the known range of the grotto sculpin is privately owned. Ball Mill Resurgence Natural Area (19.5 ac (7.9 ha)) and Keyhole Spring and Resurgence near Blue Spring Branch are owned by the L–A–D Foundation (a private foundation dedicated to sustainable forest management and protection of natural and cultural areas in Missouri (http://pioneerforest.org) that are managed by the MDC). The municipality of Perryville is in the Central Perryville Karst Area and is within the recharge area of Crevice Cave. Thirty-six percent (15.6 $km^2$ (6.02 $mi^2$)) of Perryville's total area of 43 $km^2$ (16.6 $mi^2$) lies within the karst area, whereas 24 percent (10.4 $km^2$ (4.02 $mi^2$)) lies within the southern portion of the recharge area of Crevice Cave (recharge area defined by Moss and Pobst 2010 pp. 151–152).

The karst in Perry County is characterized by thousands of sinkholes (Vandike 1985, p. 1) and over 700 caves (Fox *et al.* 2009, p. 5). Water quality in karst areas is highly vulnerable and can severely decline with rapid transmission of contaminants from the surface to the aquifer (Panno and Kelly 2004, p. 230). Moss and Pobst delineated recharge areas for known and potential grotto sculpin caves (2010, pp. 146–160) and evaluated the vulnerability of groundwater in the recharge areas to contamination (2010, pp. 161–190). Because the grotto sculpin is dependent not only on caves, but uses surface habitat in addition to caves, Moss and Pobst (2010, p. 161) evaluated hazards within and adjacent to recharge areas to best characterize impairment of cave and surface streams. They found all the recharge areas to be highly vulnerable to contamination and

contain hazards from historical sinkhole dumps, agricultural practices without universal application of best management practices, ineffective private septic systems, and roads with contaminated runoff (Burr *et al.* 2001, p. 294; Moss and Pobst 2010, p. 183). They noted additional hazards in the recharge area for Crevice Cave not found elsewhere, such as hazardous waste generators, wastewater outflows, stormwater outflows, and underground storage tanks for hazardous waste, that compound potential threats to groundwater and drinking water (Moss and Pobst 2010, p. 184). Impacts to groundwater are not proportional to the area impacted in such a highly vulnerable landscape—a localized pollution event can impact all aquatic habitats downstream.

Based on data from the Missouri Department of Natural Resources (2010, unpaginated), the Service calculated that there are approximately 2 sinkholes per $km^2$ (6 per $mi^2$) in Perry County and 7 sinkholes per $km^2$ (17 per $mi^2$) in the Central Perryville and Mystery–Rimstone karst areas. Recharge areas around grotto sculpin caves contain up to four times the number of sinkholes compared to other parts of the county or other karst areas. Cave recharge areas in the Central Perryville Karst contain an average of 8 sinkholes per $km^2$ (22 per $mi^2$), whereas those in the Mystery-Rimstone Karst contain an average of 4 per $km^2$ (11 per $mi^2$) (Missouri Department of Natural Resources 2010, unpaginated). Water flow in Perry County karst systems occurs by way of surface features, such as sinkholes and losing streams, as well as connectivity to the underlying aquifer (Aley 1976, p. 11; Fox *et al.* 2009, p. 5). Without adequate protection, sinkholes can funnel storm-runoff directly into cave systems in a short period of time (Aley 1976, p. 11; White 2002, p. 88; Fox *et al.* 2010, p. 8838).

Illegal Waste Disposal and Chemical Leaching

At least half of the sinkholes in Perry County have been or are currently used as dump sites for anthropogenic waste (Burr *et al.* 2001, p. 294). Although it is illegal to dump waste in open sites in Missouri, the practice continues today—sinkholes continue to be used as dump sites for household wastes, tires, and occasionally dead livestock (http://dnr.mo.gov/env/swmp/dumping/enf_instruct.htm; Pobst 2012, pers. comm.). Moss and Pobst (2010, p. 169) observed that most historical farms in the sinkhole plain had at least one sinkhole that contained household and farm waste. Waste material found in sinkholes includes, but is not limited to, household chemicals, sewage, and pesticide and herbicide containers (Burr *et al*. 2001, p. 294). Fox *et al.* (2010, p. 8838) found that Perry County cave streams were contaminated by a mixture of organic pollutants that included both current-use and legacy-use pesticides and their degradation products. They found high concentrations of heptachlor epoxide and trans-chlordane, which are degradation products of the legacy-use pesticides heptachlor and chlordane (Fox *et al*. 2010, p. 8839). Heptachlor and chlordane were banned in 1988, but can persist in the environment through storage in sediments above or below ground or leaking containers in sinkholes (ATSDR 1994a, unpaginated; ATSDR 2007a, unpaginated). In water, heptachlor readily undergoes hydrolysis to a compound, which is then readily processed by microorganisms into heptachlor epoxide (ATSDR 2007b, p. 98).

Heptachlor and chlordane are highly persistent in soils, are almost insoluble in water, and will enter surface waters primarily though drift and surface runoff (ATSDR 1994a, unpaginated; ATSDR 2007a, unpaginated). Although not specifically tested on the grotto sculpin, both heptachlor and chlordane are highly toxic to most fish species

tested, including warm-water species such as bluegill (*Lepomis macrochirus*) and fathead minnow (*Pimephales promelas*) (Johnson and Finley 1980, pp. 19, 43–44). Heptachlor caused degenerative liver lesions, enlargement of the red blood cells, inhibited growth, and mortality in bluegill (Andrews *et al.* 1966, pp. 301–305). Heptachlor, heptachlor epoxide, and chlordane have been shown to bioaccumulate in aquatic organisms such as fish, mollusks, insects, plankton, and algae (ATSDR 1994b, p. 172; ATSDR 2007b, p. 89).

Chemical leaching in sinkholes likely is a major contributor of legacy-use pesticides, such as dieldrin, in aquatic habitats (Fox *et al.* 2010, p. 8840). Dieldrin, a domestic pesticide used in the past to control corn pests and banned by the USDA in 1970 (ATSDR 2002, unpaginated), was found at levels that exceeded ambient water quality criterion by 17 times in Mertz Cave and Thunderhole Resurgence (Mystery–Rimstone Karst Area) (Fox *et al.,* p. 8839). Dieldrin is a known endocrine disruptor that bioaccumulates in animal fats, especially those animals that eat other animals and, therefore, is a concern for the grotto sculpin because it is the top predator in its cave habitat (ATSDR 2002, unpaginated; Fox *et al*. 2010, p. 8839). The grotto sculpin feeds on several species of cave amphipods, including *Gammarus* sp. (Gerken 2007, pp. 16–17; Fox *et al.* 2010, p. 8839). Dieldrin has been detected in *G. troglophilus* through tissue bioassays (Taylor *et al.* 2000, p. 10). Tarzwell and Henderson (1957, pp. 253–255) found that dieldrin was toxic to fathead minnow, bluegill, and green sunfish (*Lepomis cyanellus*). Whereas the species exhibited differences in susceptibility, individuals of all species tested ultimately experienced loss of equilibrium followed by death (Tarzwell and Henderson 1957, p. 255).

Sinkholes have also been used as disposal sites for dead livestock (Fox *et al.* 2009, p. 6; Moss and Pobst 2010, p. 170). Animal carcasses dumped into sinkholes and cave entrances are potentially diseased and could carry pathogens that could be unintentionally introduced into the groundwater system. Decomposing animals in source water for cave streams also can lower the dissolved oxygen and negatively impact aquatic organisms.

Contaminated Water

In cave streams sampled by Fox *et al.* (2010, p. 8838), time-weighted average water concentrations of 20 chemicals were at levels above method detection limits; 16 of the 20 chemicals originated from agricultural pest management activities. Acetochlor, diethatyl-ethyl, atrazine, and desethylatrazine (DEA) were detected at all sites during both May and June sampling periods. Pyrene, metolachlor, DEET, and pentachloroanisole were detected at all sites during sampling periods (Fox *et al*. 2010, p. 8838). The list of potential impacts of these chemicals on fish is long, and includes reductions in olfactory sensitivity, immune function, and sex hormone concentrations; endocrine disruption; and increased predation and mortality due to adverse effects to behavior (Alvarez and Fuiman 2005, pp. 229, 239; Rohr and McCoy 2010, p. 30). The ubiquitous presence of current-use pesticides, such as atrazine, was not surprising based on the extensive agricultural land use in Perry County.

Atrazine has been the most frequently detected herbicide in ground and surface waters in Perry County (Fox *et al*. 2010, p. 8838) and in a similar karst and agricultural landscape in Boone County, Missouri (Lerch 2011, p. 107); levels of corn production

were similar in the two counties. Even at concentrations below EPA criteria for protection of aquatic life, atrazine has been shown to reduce egg production and cause gonadal abnormalities in fathead minnows (Tillitt *et al.* 2010, pp. 8–9). Sex steroid biosynthesis pathways and gonad development in male goldfish (*Carassius auratus*) were impacted by atrazine in concentrations as low as 1 nanogram per liter (ng/L) (Spano *et al.* 2004, pp. 367–377). Concentrations of atrazine in Perry County ranged from 20 to 130 ng/L (Fox *et al.* 2010, p. 8838). Li *et al.* (2009, pp. 90–92) showed that environmentally relevant concentrations of acetochlor can decrease circulating thyroid hormone levels, decrease expression of thyroid hormone-related genes, affect normal larval development, and affect normal brain development. Pyrene is known to cause anemia, neuronal cell death, and peripheral vascular defects in larval fish (Incardona et al. 2003, p. 191). Wan *et al.* (2006, pp. 57–58) considered metolachlor to be slightly to moderately toxic to freshwater amphibians, crustaceans, and salmonid fishes. Wolf and Moore (2010, pp. 457, 464–465) demonstrated that sublethal concentrations of metolachlor adversely affected the chemosensory behavior of crayfish and likely impacted their ability to locate prey. These researchers also noted that this herbicide also caused physiological impairment that likely impacted locomotory behavior and predator avoidance responses. Due to the importance of chemosensory organs to the grotto sculpin, the presence of metolachlor in occupied streams may impact this fish's ability to locate prey.

Additional potential adverse effects to grotto sculpin from contaminants include increased susceptibility to fish diseases (Arkoosh *et al*. 1998, p. 188); increased immunosuppression (Arkoosh *et al*. 1998, p. 188); disruption of the nervous system by inhibition of cholinesterase (Hill 1995, p. 244); and an increase in acute or chronic stress

resulting in reduced reproductive success, alterations in blood and tissue chemistry, diuresis, osmoregulatory dysfunction, and reduction in growth (Wedemeyer et al. 1990, pp. 452–453). As a result, water contamination from various sources of point and non-point source pollution poses a significant, ongoing threat to the grotto sculpin.

### Vertical Drains

Contaminant problems with sinkholes are further exacerbated by the presence and continued installation of vertical drains across the agricultural landscape in Ste. Genevieve and Perry Counties (Perry County Soil and Water Conservation District (PCSWCD) 2012, unpaginated). Vertical drains, also known as stabilized sinkholes or agricultural drainage wells (ADWs), are defined by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as "a well, pipe, pit, or bore in porous, underground strata into which drainage water can be discharged without contaminating groundwater resources" (NRCS 2006a, p. 1). This conservation practice is meant to reduce erosion by facilitating drainage of surface or subsurface water and often result in more land available to the farmer. As of 2012, the recharge areas for known and likely grotto sculpin habitat in the Central Perryville and Mystery–Rimstone karst areas contained an average of 2.5 vertical drains per $km^2$ (7 per $mi^2$), with the highest concentrations in the recharge areas for Keyhole Spring, Ball Mill Spring, and Mystery Cave (PCSWCD 2012, unpaginated). New vertical drains continue to be installed at a rate consistent with the installation rate that occurred in the 1990s, with approximately 40 new vertical drains installed at 15 properties in Perry County in 2011 (PCSWCD 2012, unpaginated).

The NRCS (2006a, p. 2) noted that "significant additions to subsurface water sources may raise local water tables or cause undesirable surface discharges down-gradient from the vertical drain." The impact of vertical drains on groundwater has been studied on a limited basis and studies have directly linked groundwater and drinking water contamination with vertical drains (EPA 1999, unpaginated). According to the conditions set by the NRCS, this practice can only be applied when it will not contaminate groundwater or affect instream habitat by reducing surface water flows (NRCS 2010, p. 1). The NRCS provides a cost-share of up to 75 percent for installation of vertical drains to stop erosion (NRCS 2010; 2011; 2012) and has conservation practice and construction standards that include secure placement of the standpipe, appropriate fill material around the drainage pipe, and a filter system around the drain (NRCS 2006a, pp. 1–2; 2006b, pp. 1–3). Although the USDA requires landowners to install a minimum of 7.6 m (25 ft) of grassed buffer around vertical drains to minimize erosion and the migration of nutrients and contaminants into the groundwater system, this guideline is not strictly followed (Moss and Pobst 2010, p. 170). Because vertical drains are potential targets for illegal dumping of liquid hazardous wastes (Fox *et al*. 2010, p. 8839) and there is an absence of adequate buffers around some vertical drains, the migration of sediment and contaminants is easily facilitated (Moss and Pobst 2010, p. 171).

Vertical drains allow contaminated water to flow directly into karst and groundwater systems without naturally occurring filtration (Pobst and Taylor 2007, p. 69) unless protective standards are implemented. Vertical drains act as conduits for all surface water, contaminants, and sediment directly from the surface through the bedrock into underground caves, streams, and karst voids (Pobst and Taylor 2007, p. 69). Such a

scenario is supported by Fox *et al*.'s (2010, pp. 8835–8840) contaminant study in the karst region of Perry County. The long list of harmful chemicals detected in the Fox *et al*. (2010, pp. 8835–8840) study is likely due to the migration of these contaminants directly from surface fields into the underground karst system through vertical drains and sinkholes.

Urbanization and Development

In addition to contamination from point sources of pollution and improper trash disposal, water quality of sculpin habitats is negatively impacted by urban growth of Perryville, located in the recharge area for Crevice Cave (Moss and Pobst 2010, p. 164). Crevice Cave had the lowest amount of cropland and grassland within its recharge and the most chemical detections. In contrast, Mystery Cave had the most cropland and grassland and fewest chemical detections (Fox *et al.* 2010, p. 8840). The only hazardous waste facility in the Central Perryville and Mystery-Rimstone karst areas is located in Perryville. The facility is permitted by the Missouri Department of Natural Resources as a large-volume hazardous waste generator. Additional hazards in Perryville include four other hazardous waste generators; nine underground storage tanks that could leak petroleum products; two National Pollutant Discharge Elimination System (NPDES) permits for wastewater outfalls; and seven NPDES permits for stormwater discharge, leaking sewer lines, or lines that remain plumbed into the caves below (Missouri Department of Natural Resources (MDNR) 2010, unpaginated).

Most of the runoff water in areas that recharge aquatic habitats for the grotto sculpin moves quickly into the groundwater system with ineffective natural filtration, and

the same is true for waste waters from septic systems (Aley 2012, pers. comm.). Contamination of groundwater by septic systems in karst areas has been documented on multiple occasions (Simon and Buikema 1997, pp. 387, 395; Panno *et al.* 2006, p. 60) because septic tank systems are poorly suited to karst landscapes (Aley 1976, p. 12). Panno and Kelly (2004, p. 229) listed septic systems as potential contributors of excess nitrogen to streams in the karst region of southern Illinois. Septic systems in the sinkhole plain can be direct conduits for introduction of septic effluent directly into the shallow karst aquifer (Panno *et al*. 2001, p. 114). In a karst area in southwest Missouri, poorly designed sewage treatment lagoons were allowing effluent from a small, rural school to seep into the only known location for the federally listed Tumbling Creek cavesnail (*Antrobia culveri*) (Aley 2003, unpaginated).

Most of the rural residents in the Central Perryville and Mystery-Rimstone karst areas use onsite septic systems (for example, in the Mystery Cave area) (Aley 1976, p. 12). The City of Perryville has a municipal sewer system and wastewater treatment plant. Perryville recently annexed a subdivision that previously was not tied into the wastewater treatment network and provided them with sufficient wastewater treatment. Septic system failures occur in karst areas of southeast Missouri, such as those in Perry County, but detections are problematic because most failures are not obvious from the surface, but instead occur underground into the groundwater system (Aley 2012, pers. comm.). One instance of a septic system failure was observed by Aley (1976, p. 12) near Mystery Cave. Sewage was discharged to a septic field within 100 ft (30.5 m) of the cave entrance and contaminated the waters of the Mystery Cave system. Water samples collected by the MDC within the range of the grotto sculpin indicated the presence of the

bacteria *Escherichia coli* at high levels, which might correspond to high inputs of phosphorus from septic systems (Pobst 2010, pers. comm.). Taylor *et al.* (2000, pp. 13–16) found that fecal contamination of karst groundwater is a serious problem in southeast Missouri. Among sampling locations in southeast Missouri, water samples were taken from streams and springs in Perry County that included sites within the range of the grotto sculpin (Mertz Cave, Running Bull Cave, Thunderhole Resurgence, and Cinque Hommes Creek) (Taylor *et al.* 2000, pp. 48–49). High fecal bacterial loads were found in the groundwater of grotto sculpin habitats and can be a combination of both human and animal wastes (Taylor *et al.* 2000, p. 14).

No animal feeding operations or concentrated animal feeding operations are present in the recharge areas of grotto sculpin habitat (MDNR 2010), but there are smaller livestock feeding areas that are in sinkholes or near sinkhole drainage points (Aley 1976, p. 12; Moss and Pobst 2010, p. 166). Large amounts of manure can be flushed through sinkholes and carry associated bacteria and pathogens into cave streams. Waste from mammalian sources, including humans and livestock, can increase nutrient loads and lower dissolved oxygen in the groundwater (Simon and Buikema 1997, p. 395; Panno *et al.* 2006, p. 60). Hypoxia resulting from eutrophication due to increases in nutrient load (especially phosphorus) can lead to mortality and sublethal effects by reducing the availability of oxygen needed by fish for locomotion, growth, and reproduction (Kramer 1987, p. 82; Gould 1989–1990, p. 467). Barton and Taylor (1996, p. 361) reported that low dissolved oxygen levels can cause changes in cardiac function, increased respiratory and metabolic activity, alterations in blood chemistry, mobilization

of anaerobic energy pathways, upset in acid-base balance, reduced growth, and decreased swimming capacity of fish.

Sedimentation

Concerns with sedimentation (actual deposition of sediment, not the transport) and wash load (portion of the sediment in transport that is generally finer than the sediment) (as defined by Biedenharn *et al.* 2006, pp. 2–6) relative to impacts to grotto sculpin habitat are primarily the transport of contaminants and the deposition of excessive amounts of sediment in cave streams. Soils in the Central Perryville and Mystery-Rimstone karst areas are dominated by highly erosive loess. Sediment transported into the karst groundwater can include agricultural chemicals that are bound to soil particles as evidenced by Fox *et al.'s* (2010, p. 8840) findings. Fox *et al.* (2010, p. 8840) determined that turbidity of streams in grotto sculpin caves in Perry County was positively correlated with total chemical and DEA concentrations. Additionally, Gerken and Adams (2007, p. 76) noted that siltation was a major problem in grotto sculpin sites and postulated that silt likely reduced habitat available to this fish.

Excessive siltation in aquatic systems can be problematic for fish because it can change the overall structure of the habitat (Berkman and Rabeni 1986, pp. 291–292). Silt can fill voids in rock substrate that are integral components of habitat for reproduction and predator avoidance. The grotto sculpin occurs in habitats with some level of sediment deposition (Gerken 2007, pp. 16–17, 23–25). However, siltation beyond what occurred historically could limit the amount of suitable habitat available (Gerken 2007, pp. 27–28; Gerken and Adams 2007, p. 76), and the threshold of siltation that renders

cave habitat unsuitable for grotto sculpin has not yet been determined. Many farmers in Perry County employ soil conservation methods, such as no-till planting and removal of highly erodible land from production, to reduce erosion in agricultural areas.

## Industrial Sand Mining

Industrial sand is also known as "silica," "silica sand," and "quartz sand," and includes sands with high silicon dioxide content. Silica sand production in the United States was 29.3 million metric tons (Mt), an increase of 5.3 Mt from 2009 to 2010 (U.S. Geological Survey (USGS) 2012, p. 66.6). The Midwest leads the Nation in industrial sand and gravel production, accounting for 49 percent of the annual total (USGS 2012, p. 66.1). One end-use of silica sand is as a propping agent for hydraulic fracturing. Higher production of silica sand in 2010 was primarily attributable to an increasing demand for hydraulic fracturing sand because of continuing exploration and production of natural gas throughout the United States. Conventional natural gas sources have become less abundant, leading drilling companies to turn to deep natural gas and shale gas. Of the 29.3 Mt of silica sand sold or used in the United States, 12.1 Mt (41 percent) was used for hydraulic fracturing in the petroleum industry (USGS 2012, p. 66.10). As of 2010, the price per ton for industrial silica sand was $45.24 in the United States (USGS 2012, p. 66.11). In addition to new facilities, existing hydraulic fracturing sand operations increased production capacity to meet the surging demand for sand.

Mining for silica sand in Missouri occurs in the St. Peter Sandstone in Jefferson, Perry, and St. Louis Counties (USGS 2011, p. 27.2). The St. Peter Sandstone formation is directly adjacent to (to the west) the Joachim Dolomite formation that forms the karst

habitat for the grotto sculpin in Perry County. The interface between these two formations generally comprises the western borders of the Central Perryville and Mystery–Rimstone karst areas. Four companies in Missouri produced 0.9 Mt of high-purity sand from the St. Peter Sandstone formation (USGS 2011, p. 27.2). The existing operation in Perry County lies 5.6 km (3.5 mi) northwest of Perryville and involves open pit mining on 101 ha (250 acres). This producer specializes in 40 to 70 and 70 to 140 size-grades that were used by the oil and gas well-servicing industry as a hydraulic fracture propping agent in shale formations (USGS 2010, p. 27.2).

Sand mining is typically accomplished using open pit or dredging methods with standard mining equipment and without the use of chemicals. Sand can be mined from outcrops or by removing overburden to reach subsurface deposits. Environmental impacts of sand mining are primarily limited to disturbance of the immediate area. The current operation in Perry County is partially within the Joachim Dolomite formation and at the western edge of the sinkhole plain with approximately four sinkholes occurring in the immediate vicinity. Erosion of soil and disturbed overburden could occur and increase the sediment loads in adjacent surface waters and cave streams via runoff. For example, a portion of the existing mining operation is within the Bois Brule watershed. Sediment-laden runoff could enter Blue Spring Branch, one of the surface streams occupied by the grotto sculpin.

As described above, sedimentation can change the structure of grotto sculpin habitat and negatively impact reproduction and predator avoidance. Presence of the current facility, only 0.5 km (0.3 mi) and 1.6 km (1 mi) from the Central Perryville Karst and Crevice Cave recharge area, respectively, shows that such operations can and do

occur in the Joachim Dolomite formation and immediately adjacent to grotto sculpin habitat. We currently are unaware of any plans for new facilities or expansions of current facilities. However, based on the presence of one existing operation, the occurrence of St. Peter Sandstone in Perry County, as well as recent growth of the hydraulic fracturing industry and associated increased demand for silica sand, it is likely that increased sand mining activity will occur in the future in areas where the grotto sculpin occurs. We consider sand mining to be a potentially significant threat to the species in the future.

Summary of Factor A

The threats to the grotto sculpin from habitat destruction and modification are occurring throughout the entire range of the species. All of the recharge areas for caves occupied by the grotto sculpin are highly vulnerable and contain hazards from historical sinkhole dumps, agricultural practices without universal application of best management practices, vertical drains, ineffective private septic systems, excessive sediment deposition in underground aquatic habitats, and degraded runoff from roads. Hazardous waste facilities, outfalls for waste and storm water, and underground storage tanks are found in the recharge area for Crevice Cave that are not found in other parts of the species' range. Water contamination from various sources of point and non-point source pollution poses a significant, ongoing threat to the grotto sculpin. Water flow in karst systems occurs by way of surface features, such as sinkholes and losing streams, as well as connectivity to the underlying aquifer. Sinkholes can funnel storm-runoff that carries contaminants directly into cave systems in a short period of time and severely degrades

water quality. The population-level impacts from these activities are expected to continue into the future.

Conservation Efforts To Reduce Habitat Destruction, Modification, or Curtailment of Its Range

When considering the listing of a species, section 4(b)(1)(A) of the Act requires us to consider efforts by any State, foreign nation, or political subdivision of a State or foreign nation to protect the species. Such efforts would include measures by Native American Tribes and organizations. Also, Federal, Tribal, State, and foreign recovery actions (16 U.S.C. 1533(f)) and Federal consultation requirements (16 U.S.C. 1536) constitute conservation measures. In addition to identifying these efforts, under the Act and our policy implementing this provision, known as Policy for Evaluation of Conservation Efforts (68 FR 15100; March 28, 2003), we must evaluate the certainty of an effort's effectiveness on the basis of whether the effort or plan establishes specific conservation objectives; identifies the necessary steps to reduce threats or factors for decline; includes quantifiable performance measures for the monitoring of compliance and effectiveness; incorporates the principles of adaptive management; is likely to be implemented; and is likely to improve the species' viability at the time of the listing determination. In general, in order to meet these standards for the grotto sculpin, conservation efforts must, at a minimum, provide outreach and education to stakeholders, report data on water quality and existing populations, describe activities taken to improve water quality, describe activities taken toward conservation of the species, demonstrate either through data collection or best available science how these measures will alleviate

threats, provide for a mechanism to integrate new information (adaptive management), and provide assurances of implementation (*e.g.*, funding and staffing mechanisms).

Below, we consider conservation measures that were discussed in documents submitted during the public comment period or known to us that could reduce threats under Factor A.

Perry County Community Conservation Plan

Perry County submitted a conservation plan focused on addressing threats to the grotto sculpin through a comprehensive, collaborative, and voluntary effort. The Perry County Community Conservation Plan (Plan) (PCCEEC 2013, entire) was written by representatives of local government, organizations, and businesses, as well as representatives of private landowners. To date, 47 private entities and businesses, 6 County and Municipal government entities, 5 State government entities, and 1 Federal agency are participating in the local conservation effort. Although the Plan has prioritized activities in known grotto sculpin habitat, the intention is that the activities outlined in the Plan will be implemented on a watershed scale to accomplish greater water quality protection and improvement. The mission statement of the Plan is to "Improve water quality throughout the Perry County Karst Watershed and Perry County through outreach and education." The goal of the Plan is to initiate and implement good land stewardship to promote good water quality and a sustainable biota through continuing community outreach, educational efforts, civic engagement, and interagency support. The Plan was developed in close coordination with the Service and MDC.

Environmental concerns addressed by the conservation efforts are to: (1) Minimize movement of surface chemicals to groundwater; (2) Review application of vertical drain practice and sinkhole stabilization or protection; (3) Improve vertical drain installation and maintenance; (4) Assure proper installation and function of septic tank or sewage lagoons; (5) Improve runoff control along roadways; (6) Improve management of wastewater outflows; (7) Improve management of stormwater outflows; (8) Ensure chemical spill plans are available; (9) Ensure proper installation and maintenance of storage tanks; (10) Improve animal waste management; (11) Minimize or avoid livestock waste in streams and sinkholes; (12) Dispose of animal carcasses properly; and (13) Minimize erosion and sediment transport to aquatic systems. The plan also includes a list of programs that are in place that will be continued, expanded, and improved.

The community of Perry County is committed to, and invested in, implementing the Perry County Plan. Time and labor to create and implement the Plan in the first 90 days amounted to approximately $250,000. This is an ongoing investment of time and finances. The City of Perryville has allocated $62,000 annually in their budget for sinkhole cleanout, maintenance, and repair. The committee is working to identify additional state and national partners and resources to support the Plan.

The Perry County Plan addresses threats to the grotto sculpin through education of County residents, specific on-the-ground actions, monitoring, and reporting, and set forth a long-term vision to improve and maintain high-quality water resources. As such, a permanent board, the Perry County Community Economic and Environmental Committee (Committee), was established to oversee implementation of the Plan and serve as the clearinghouse for records on activities and events related to water quality.

The first step in implementation is the initiation of a comprehensive educational campaign for all residents from elementary students to adults. The Committee developed educational objectives and is expanding educational opportunities that correspond directly to environmental concerns. The Committee prioritized on-the-ground actions to improve water quality, including sinkhole management, solid waste management, stormwater management, and implementation of temporary and permanent best management practices in rural and urban settings. Methods for monitoring grotto sculpin populations and water quality are being established in cooperation with the MDC and the Missouri Department of Natural Resources.

Since November 2012, some of the actions outlined in the Plan have been implemented. More than 350 tires have been removed from sinkholes in cooperation with the MDC and local volunteers. Participants have registered for educational programs including a teacher's workshop for K–12 teachers called Project Wet, and an Envirothon was held with support from the local Soil and Water Conservation District that focused on education about soils, aquatic habitats, and the grotto sculpin. Upcoming events include County-wide refuse disposal efforts, karst-specific training for pesticide applicators, and a water testing clinic.

We expect this partnership between local residents, City and County governments, and Federal and State agencies will improve water quality in the Perry County Karst and benefit the grotto sculpin in the future. Factors contributing to poor water quality were identified under Factor A as the greatest threat to the species and we anticipate that the voluntary actions taken by local residents will improve water quality and benefit the species. Furthermore, the actions in the Perry County Plan will have

conservation benefits beyond those that could be accomplished through the section 7 consultation process alone, because nearly all grotto sculpin habitat occurs on private land and few activities will have a Federal nexus. The Plan provides evidence of past environmental stewardship, education to stakeholders, prioritized future activities to improve water quality and conserve the grotto sculpin and its karst habitat, mechanisms to alleviate threats through on-the-ground activities, an adaptive management approach that will facilitate incorporation of new information, and commitment of financial and staff resources to implement the Plan.

Berome Moore Cave System Management Plan

The Missouri Caves and Karst Conservancy, Inc. (Conservancy) purchased 1 acre of land to form the Lloyd and Ethel Hoff Underground Nature Preserve, which includes the entrance to the Berome Moore Cave System. The Conservancy has agreed, via a Memorandum of Understanding, that the cave and property will be managed by Middle Mississippi Valley Grotto, Inc. (MMV), who have managed the cave since its discovery in 1961. The MMV will continue to manage Berome Moore Cave in order that it will be available for scientific study and recreation by responsible cavers, while at the same time protecting the cave and its ecosystem for future generations of cavers. MMV will also manage the surface property to enhance the overall natural setting while protecting the subsurface resources. The responsibility for managing the cave system falls with the MMV Berome Board. The Board consists of the Berome Moore Project Director, the MMV Chair, a Property Manager, and a Cave Manager.

The Missouri Department of Conservation

The MDC developed the Perry County Karst Project: Summary and Future Management Implications for the Grotto Sculpin. The plan includes goals to (1) educate and improve Perry County Karst stakeholders' awareness of groundwater movement and sources of inputs in the karst watershed; (2) improve soil stability near streams, sinkholes, and vertical drainpipes by implementing enhanced vegetative buffers; (3) improve water quality throughout the Perry County Karst watershed; and (4) maintain the abundance, diversity, and distribution of aquatic biota at or above current levels while improving the quality of the game fishery in the Perry County karst watershed. The MDC aims achieve these goals through a combination of outreach, workshops, and meetings to increase local awareness of available best management practices that can improve water quality, assistance with implementing best management practices, study water movement and recharge in the karst system, and conduct biological monitoring of the grotto sculpin and other cave biota.

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

Although approximately 160 specimens of the grotto sculpin have been taken for scientific investigations, we do not consider such collection activities to be at a level that poses a threat to the species. We do not have records of any individuals being taken for commercial or recreational purposes.

*C. Disease or Predation.*

Predation by invasive, epigean fish poses a threat to eggs, young-of-year, and juvenile grotto sculpin. Farm ponds are human-made features, as opposed to natural aquatic habitats, that often are stocked with both native and nonnative fishes for recreational purposes. Fish from farm ponds enter cave systems through sinkholes when ponds are unexpectedly drained (Burr *et al.* 2001, p. 284) or after high-precipitation events. Predatory fish were documented in all of the caves occupied by the grotto sculpin, and include common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas)*, yellow bullhead (*Ameiurus natalis*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), and channel catfish (*Ictalurus punctatus*) (Burr *et al.* 2001, p. 284).

The migration and persistence of invasive, epigean fish species into cave environments poses an ongoing and pervasive threat to the grotto sculpin because of unnatural levels of predation on eggs, young-of-year, and juveniles. Predation beyond what occurs naturally among adult and juvenile grotto sculpin may reduce population levels, potentially to an unsustainable level; however, no monitoring of invasive fish has been conducted to determine what level of effect their presence has on grotto sculpin populations.

*D. The Inadequacy of Existing Regulatory Mechanisms.*

The primary threats to the grotto sculpin are degradation of aquatic resources from illegal waste disposal in sinkhole dumps, pesticide runoff, chemical leaching, urban development, and sedimentation. Existing Federal, State, and local laws have not been

able to prevent impacts to the grotto sculpin and its habitat largely because of noncompliance and inability to fully enforce existing laws.

Federal

The Federal Clean Water Act of 1972 (CWA; 33 U.S.C. 1251 et seq.) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Under the CWA, the EPA implements pollution control programs such as setting wastewater standards for industry and for all contaminants in surface waters. Under the CWA, it is unlawful to discharge any pollutant from a point source into navigable waters, unless a permit is obtained. EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges. Point sources are discrete conveyances such as pipes or manmade ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. Based on documented levels of contaminants present in the cave streams of Perry County (Fox et al. 2010, pp. 8835–8841), current compliance with and enforcement of the Clean Water Act of 1972 is insufficient to prevent water degradation in grotto sculpin habitat.

Federal control of pesticides is provided under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). All pesticides used in the United States must be registered (licensed) by the EPA. Registration assures that pesticides will be properly labeled and that, if used in accordance with specifications on the label, will not cause unreasonable harm to the environment. By law, use of each registered pesticide must be

consistent with use directions contained on the label or labeling. Some commonly used pesticides, such as atrazine, require that the chemical not be applied within 50 ft (15 m) of a groundwater input. Noncompliance with label instructions could result in the pesticide entering aboveground and underground streams and harming aquatic life. Based on documented levels of pesticides present in the cave streams of Perry County (Fox et al. 2010, pp. 8835–8841), current compliance with and enforcement of FIFRA is insufficient to prevent water degradation in grotto sculpin habitat.

State

Until its formal description as a distinct species in 2013, the grotto sculpin was not eligible for protection under the Missouri State Endangered Species Law (MO ST 252.240). The State of Missouri can consider adding the grotto sculpin to the State Endangered Species List now that the species designation has been formalized. While the grotto sculpin was a Candidate species, it was recognized by the MDC as a Missouri Species of Conservation Concern. All species in the State of Missouri are protected as biological diversity elements such that no harvest is permitted unless a method of legal harvest is described in the permissive Wildlife Code. No method of legal harvest is permitted for the grotto sculpin.

The Missouri Department of Natural Resources establishes water quality and solid waste standards that are protective of aquatic life. The Missouri Clean Water Law of 1972 (MO ST 644.006-644.141) addresses pollution of the waters of the State to prevent threats to public health and welfare; wildlife, fish, and other aquatic life; and domestic, agricultural, industrial, recreational, and other legitimate uses of water. It is unlawful for

any person: (1) To cause pollution of any waters of the State or to place or cause or permit to be placed any water contaminant in a location where it is reasonably certain to cause pollution of any waters of the State; (2) To discharge any water contaminants into any waters of the State that reduce the quality of such waters below the water quality standards established by the commission; or (3) To violate any regulations regarding pretreatment and toxic material control, or to discharge any water contaminants into any waters of the State that exceed effluent regulations or permit provisions as established by the commission or required by any Federal water pollution control act (MO ST 644.051). Based on documented levels of contaminants present in the cave streams of Perry County (Fox *et al*. 2010, pp. 8835–8841), current compliance with and enforcement of the Missouri Clean Water Law of 1972 is insufficient to prevent water degradation in grotto sculpin habitat.

According to the Missouri State Waste Management Law of 1972 (MO ST 260.210), it is illegal to dump waste materials into sinkholes. Regulations under the CWA would apply if a point-source for the pollution could be determined. Discrete pollution events that impact cave systems are problematic even if a point-source can be determined because it can be extremely difficult to assess damages to natural resources such as troglobitic biota that live underground. Cave systems are recharged by surface water and groundwater that typically travels several miles before resurfacing from cave openings and spring heads (Vandike 1985, p. 3). Based on the presence of numerous sinkhole dumps in Perry County, current compliance with and enforcement of Missouri State Waste Management Law of 1972 is insufficient to address threats to the grotto sculpin and its habitat.

Once a sinkhole has been modified or improved to function as a vertical drain (it accepts surface or subsurface drainage from agricultural activities), it qualifies as a Class V Injection Well (alternatively known as an "agricultural drainage well") (EPA 1999, p. 4). By definition, agricultural drainage wells receive fluids such as irrigation tailwaters or return flow, other field drainage (*e.g.*, resulting from precipitation, snowmelt, floodwaters), animal yard runoff, feedlot runoff, or dairy runoff (EPA 1999, p. 4). In addition to threats from permitted injectants, agricultural drainage wells are vulnerable to spills from manure lagoons and direct discharge from septic tanks, as well as release of agricultural substances, such as motor oil and pesticides (EPA 1999, p. 28). Nitrates, total dissolved solids (TDS; *e.g.*, solid salts, organometallic compounds, and other non-specific inorganic compounds that are dissolved in water), sediment, salts, and metals are the most common inorganic constituent in agricultural drainage well injectates (EPA, p. 12). The Safe Drinking Water Act of 1974 (42 U.S.C. 300f et seq.) and later amendments established the Federal Underground Injection Control (UIC) Program. The State of Missouri has obtained primacy from the EPA for the UIC program, and the Class V Injection Well program derives its authorities from Missouri Clean Water Law (MO ST 644) (MDNR 2006, p. 2). Even though Class V injection wells are covered under the Missouri Clean Water Law of 1972, compliance with and enforcement of the existing regulations do not prevent deposition of contaminants documented in occupied grotto sculpin habitats of Perry County.

Agricultural drainage wells in Iowa are present in an agricultural landscape characterized by karst features that include solution channels and sinkholes (EPA 1999, p. 6). Nitrates are derived from oxidized nitrogen compounds that are applied to cropland

to add nutrients and are highly mobile in ground water (EPA 1999, p. 12). Data from water sampling in Iowa indicate that nitrate is a primary constituent in ADW injectate and likely exceeds health standards (EPA 1999, p. 13). Water quality sampling of agricultural drainage well injectate conducted in Iowa, Texas, and Idaho showed that other constituents also have exceeded primary or secondary drinking water standards or health advisory levels, and include boron, sulfate, coliforms, pesticides (cyanazine, atrazine, alachlor, aldicarb, carbofuran, 1,2-dichloropropane, and dibromochloropropane), TDSs, and chloride (EPA 1999, pp. 14–20).

Local Ordinances

There are no water quality ordinances in effect in Perry County beyond minimum State standards in the Code of State Regulations (19 CSR 20-3.015) and, therefore, no limitations for onsite septic construction as long as septic systems are built on properties greater than 1.2 ha (3 ac) and the system is at least 3 m (10 ft) from the property line. A more protective ordinance has been adopted in Monroe County, Illinois, where the soils and topography are very similar to Perry County (Monroe County Zoning Code 40-5-3, chapter 40-4-29). The ordinance in Monroe County prohibits placement of any substances or objects in sinkholes, alteration of sinkholes, and development in sinkholes. The stated purpose of the ordinance is, "to reduce the frequency of structural damage to public and private improvements by sinkhole collapse or subsidence and to protect, preserve and enhance sensitive and valuable potable groundwater resource areas of karst topography, thus protecting the public health, safety and welfare and insuring orderly development within the County."

Greene County, Missouri, also is in a sinkhole plain and has adopted special regulations relative to construction of onsite septic systems. They require that systems are constructed above the sinkhole flooding area, which is defined as "the area below the elevation of the lowest point on the sinkhole rim or the areas inundated by runoff from a storm with an annual exceedance probability of 1 percent (100-year storm) and a duration of 24 hours (8 inches of rain in Green County)" (Green County 2003, pp. 3–9). Current compliance with and enforcement of minimum standards in the Code of State Regulations (19 CSR 20-3.015) for water quality standards in Missouri are not protective enough to prevent the deposition of silt and contaminants into occupied grotto sculpin habitats, as reported by Gerken and Adams (2007, p. 76) and Fox *et al*. (2010, pp. 8835–8841).

Summary of Factor D

Despite existing regulatory mechanisms that provide some protection for the grotto sculpin and its habitat, a wide array of factors (see Factors A, C, and E) remain threats to the grotto sculpin. Existing Federal and State water quality laws and State waste management law can be applied to protect water quality in surface and cave streams occupied by the grotto sculpin; however current compliance and enforcement of these laws have not been sufficient to prevent continued habitat degradation and mortality events. Although harvest of grotto sculpin is not permitted in the Missouri Wildlife Code, the species has not yet been protected under Missouri Endangered Species Law but is now eligible because it has been formally recognized as a distinct species. The existing regulatory mechanisms could provide protection of water quality in grotto sculpin habitat,

which is the most significant threat to the species, and address threats to the species throughout its range if enforcement and compliance were improved.

*E. Other Natural or Manmade Factors Affecting Its Continued Existence.*

Restricted Range and Isolated Populations

The grotto sculpin has a restricted range that is confined to five cave systems and two short stream reaches in two watersheds. Results of genetic analysis indicate isolation of grotto sculpin populations. Adams *et al.* (2013, p. 488) documented genetic isolation between northern sample locations (Moore Cave, Crevice Cave, Mertz Cave, Blue Spring Branch, and Cinque Hommes Creek) and southern sample locations (Mystery Cave, Running Bull Cave, Rimstone River Cave, and Thunderhole Resurgence). The grotto sculpin's isolated populations are each susceptible to local extirpation from a single catastrophic event, such as a toxic chemical spill or storm event that destroys its habitat. Local extirpation of one or more of the existing five populations would reduce the ability to recover from the cumulative effects of smaller chronic impacts to the population and habitat such as progressive degradation from water contamination.

Environmental stressors, such as habitat loss and degradation, exacerbate problems associated with the species' endemism and isolation, increasing the species' vulnerability to localized or rangewide extinction (Crnokrak and Roff 1999, p. 262; Hedrick and Kalinowski 1999, pp. 142–146). The isolation of populations of the grotto sculpin make it vulnerable to extinction and loss of genetic diversity caused by genetic drift, inbreeding depression, and stochastic events (Willis and Brown 1985, p. 316).

Small, isolated populations are more susceptible to genetic drift, possibly leading to fixation where all except one allele is lost, and population bottlenecks leading to inbreeding (Frankham *et al*. 2002, pp. 178–187). Inbreeding depression can result in death, decreased fertility, smaller body size, loss of vigor, reduced fitness, various chromosome abnormalities, and reduced resistance to disease (Hedrick and Kalinowski 1999, pp. 139–142).

Even though some populations fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population (the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval) if they are influenced by stressors beyond those under which they have evolved (Shaffer 1981, p. 131; Shaffer and Samson 1985, pp. 148–150; Gilpin and Soule 1986, pp. 25–33). For example, grotto sculpin in Running Bull Cave exhibit the most distinct morphological adaptations to the cave environment and are the only individuals in the Cinque Hommes Creek drainage to have a rare genetic haplotype (Adams 2005, p. 49). One of the two known mass mortalities caused by a pollution event occurred in Running Bull Cave and temporarily eliminated grotto sculpin from the site. Grotto sculpin eventually recolonized the cave, but recolonization did not necessarily occur through local recruitment, but possibly through immigration by individuals from connected population segments within the same cave system. Unknown subterranean connections via inaccessible and currently unsurveyed portions of some grotto sculpin caves could provide a means of connecting populations between or among caves. For example, Running Bull Cave might serve as a primary site of population connectivity and

act as a connecting stream between Mystery and Rimstone River Caves (Day 2008, p. 52).

Even though haplotype diversity post-extirpation was comparable to that previously measured (Day 2008, p. 54), it is possible that previously undocumented haplotypes were lost and will not be recovered. Day (2008, p. 54) notes that extirpation events of longer duration or greater severity could negatively impact overall genetic diversity. Furthermore, this scenario is illustrative of the potential for extirpation of entire populations and the cascading effects on connected populations.

Climate Change

Our analyses under the 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 (for example, 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 (for example, 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. As is the case with all stressors that we assess, even if we conclude that a species is currently affected or is likely to be affected in a negative way by one or more climate-related impacts, it does not necessarily follow that the species meets the definition of an "endangered species" or a "threatened species" under the Act. If a species is listed as an endangered or threatened species, knowledge regarding the vulnerability of the species to, and known or anticipated impacts from, climate-associated changes in environmental conditions can be used to help devise appropriate strategies for its recovery.

The impact of climate change on the grotto sculpin is uncertain. The species is dependent on an adequate water supply and has specific habitat requirements (water depth and connectivity of caves and surface sites); we expect that climate change could significantly alter the quantity and quality of grotto sculpin habitat and thus impact the species in the future. This species relies on surface water for energy input into the cave system, recharge of groundwater, and availability of surface streams. Potential adverse effects from climate change include increased frequency and duration of droughts (Rind *et al.* 1990, p. 9983; Seager *et al.* 2007, pp. 1181–1184; Rahel and Olden 2008, p. 526) and changes in water temperature, which likely serves as a cue for reproduction in grotto sculpin (Adams 2005, pp. 10–11). Climate warming might also decrease groundwater levels (Schindler 2001, p. 22) or significantly reduce annual stream flows (Moore *et al.* 1997, p. 925; Hu *et al.* 2005, p. 9). In the Missouri Ozarks, it is projected that stream basin discharges may be significantly impacted by synergistic effects of changes in land cover and climate change (Hu *et al.* 2005, p. 9), and similar impacts are anticipated in the

karst regions of Perry County, Missouri. Grotto sculpin require deep pools in caves, which could decrease in availability under drought conditions. Overall, shallower water or reduced flows could further concentrate contaminants present and lower dissolved oxygen in cave habitats.

Summary of Factor E

The restricted nature and isolation of grotto sculpin populations makes it more vulnerable to decline or loss of populations from stochastic events. Such losses could have detrimental effects to the genetic diversity and long-term genetic viability of the species. The symptom of climate change most likely to have detrimental effects on the grotto sculpin is increased frequency and severity of drought, but the extent and intensity of impacts are known. Because the grotto sculpin is dependent on connectivity among underground aquatic habitats and connectivity between underground and aboveground aquatic habitats, sustained decreases in water levels could cut off migratory routes and make recolonization impossible should a population-limiting situation occur. Low pool levels also could concentrate any chemicals present in the water and magnify the impacts of those contaminants. However, it is the combination of Factor E with other threats to the species (primarily water quality degradation), not Factor E alone, that poses the greatest threat to the grotto sculpin. Therefore, we find that other natural or manmade factors alone do not pose a significant threat to the continued existence of the grotto sculpin now or into the future.

Cumulative Impacts

*Cumulative Effects From Factors A Through E*

Some of the threats discussed in this finding could work in concert with one another to cumulatively create situations that potentially impact the grotto sculpin beyond the scope of the combined threats that we have already analyzed. The restricted nature and isolation of grotto sculpin populations, loss of genetic diversity, and effects from climate change could exacerbate other factors negatively affecting the species. These factors are particularly detrimental when combined with other factors, such as habitat and water quality degradation and predation by invasive fish, and have a greater cumulative impact than would any of those factors acting independently. For example, compromised health from poor water quality might increase predation risk or extended periods of drought can reduce connectivity among subpopulations, impeding recolonization following a catastrophic event that extirpates a population.

Summary of Factors

The primary threat to the grotto sculpin is the present or threatened destruction, modification, or curtailment of its habitat or range. Water contamination from various sources of point and non-point source pollution poses a significant, ongoing threat to the grotto sculpin. Water flow in karst systems occurs by way of surface features, such as sinkholes and losing streams, as well as connectivity to the underlying aquifer. Sinkholes can funnel storm-runoff that carries contaminants directly into cave systems in a short period of time and severely degrades water quality. These factors are ongoing and thus pose current threats to the species.

**Determination**

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 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." We have carefully assessed the best scientific and commercial information available regarding the past, present, and future threats to the grotto sculpin. Numerous major threats, acting individually or synergistically, continue today (see **Summary of Factors Affecting the Species**). The most substantial threats to the species come from the present or threatened destruction, modification, or curtailment of its habitat (Factor A). Although no clear estimates of historical population numbers for the grotto sculpin exist in order to determine whether or not dramatic population declines have occurred in the past, two mass mortalities have been documented since the early 2000s. Both mortality events are thought to have been caused by point-source pollution of surface waters that recharge cave streams occupied by the grotto sculpin.

The known factors negatively affecting the grotto sculpin have continued to impact the species' habitat since it was elevated to candidate status in 2002 (67 FR 40657; June 13, 2002). All of the recharge areas for known grotto sculpin habitat are considered vulnerable. It is believed that the primary threats to the species are habitat destruction and modification from water quality degradation and siltation. In particular, documentation that a suite of chemicals and other contaminants is continuously entering the groundwater above levels that can be harmful to aquatic life is especially concerning. Potential sources and vehicles for introduction of pollution likely are industrialization,

contaminated agricultural runoff, sinkhole dumps, and vertical drains installed without appropriate best management practices.

A variety of current- and legacy-use pesticides from agricultural runoff and sinkhole leaching, evidence of human waste from ineffective septic systems, and animal waste from livestock operations have been detected in grotto sculpin streams. These not only negatively affect the grotto sculpin directly but also the aquatic ecosystems and aquifer underlying the Perry County sinkhole plain.

Siltation beyond historical levels affects the grotto sculpin in a variety of ways, such as eliminating suitable habitat for all life stages, reducing dissolved oxygen levels, increasing contaminants (that bind to sediments), and reducing prey populations. Predation on eggs, larvae, and juveniles by nonnative epigean fish can further reduce population numbers and will be a more prominent threat if siltation continues to degrade cave habitats to the point where refugia from predatory fish are no longer available to the grotto sculpin.

The grotto sculpin's endemism and isolated populations make it particularly susceptible to multiple, continuing threats and stochastic events that could cause substantial population declines, loss of genetic diversity, or multiple extirpations, leading ultimately to extinction of the species. Temporary extirpations of two of five known populations have occurred in the recent past. Recolonization after such mortality events is dependent on the presence and accessibility of source populations. Continued threats to the species not only impact individual populations, but also decrease the viability of source populations, and the likelihood that areas where the species has been extirpated will be recolonized. Furthermore, existing regulatory mechanisms provide little direct

protection of water quality in grotto sculpin habitat, which is the most significant threat to the species. In addition to the individual threats, primarily those discussed under Factor A, which is sufficient to warrant the species' listing, the cumulative effect of Factors A, C, and E is such that the influence of threats on the grotto sculpin are significant throughout its entire range.

Overall, impacts from increasing threats, operating singly or in combination, are likely to result in the extinction of the species. Because these threats are placing the species in danger of extinction now and not only at some point in the foreseeable future, we determined it is endangered and not threatened. Therefore, on the basis of the best available scientific and commercial information, we are listing the grotto sculpin as an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act.

**Available Conservation Measures**

Conservation measures provided to species listed as endangered or threatened species under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, 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 by Federal agencies and the prohibitions against certain activities 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. 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 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 (composed of 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 website (*http://www.fws.gov/endangered*), or from our Columbia Missouri 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, Tribal, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (*e.g.*, 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. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

Once this species is 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 State of Missouri will be eligible for Federal funds to implement management actions that promote the protection or recovery of the grotto sculpin. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants*.

Section 7(a) of the Act 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. Section 7(a)(4) of the Act 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) of the Act 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 affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Service.

Federal agency actions within the species habitat that may require conference or consultation or both as described in the preceding paragraph include management and any other landscape-altering activities on Federal lands administered by the Department of Defense, U.S. Fish and Wildlife Service, and U.S. Forest Service; issuance of section 404 Clean Water Act permits by the Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way 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 17.62 for endangered plants, and at 17.72 for threatened plants. 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.

**Required Determinations**

*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 Office of Management and Budget (OMB) under the Paperwork Reduction Act. 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*

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 an endangered or threatened species 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).

*Data Quality Act*

In developing this rule, we did not conduct or use a study, experiment, or survey requiring peer review under the Data Quality Act (Pub. L. 106-554).

**References Cited**

A complete list of all references cited in this rule is available on the Internet at *http://www.regulations.gov* or upon request from the Field Supervisor, Columbia Missouri Ecological Services Field Office (see **ADDRESSES** section).

**Author(s)**

The primary author of this document is staff from the Columbia Missouri Field Office (see **ADDRESSES**).

**List of Subjects in 50 CFR Part 17**

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

**Regulation Promulgation**

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

**PART 17—[AMENDED]**

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

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

2. Amend §17.11(h) by adding an entry for "Sculpin, grotto" to the List of Endangered and Threatened Wildlife in alphabetical order under Fishes 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 | | | | | | |
| * * * * * * * | | | | | | | |
| Fishes | | | | | | | |
| * * * * * * * | | | | | | | |
| Sculpin, grotto | *Cottus specus* | U.S.A. (MO) | Entire | E | 823 | 17.95(e) | NA |
| * * * * * * * | | | | | | | |

Dated: September 9, 2013.

Stephen Guertin,

Acting Director, U.S. Fish and Wildlife Service.

[Billing Code 4310-55-P]

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