CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Cottus sp., sp. nov.*

COMMON NAME: Grotto sculpin

LEAD REGION: 3

INFORMATION CURRENT AS OF: January 2003

STATUS/ACTION:
___ New candidate
_X_ Continuing candidate
    _X_ Non-petitioned
    ___ Petitioned - Date petition received: _____
        __ 90-day positive - FR date: _____
        __ 12-month warranted but precluded - FR date: _____
        __ Is the petition requesting a reclassification of a listed species?
    ___ Listing priority change
        Former LP: ___
        New LP: ___
Latest Date species first became a Candidate: June 13, 2002
___ Candidate removal: Former LP: ___
    ___ A - Taxon more abundant or widespread than previously believed or not subject to a degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.
    ___ F - Range is no longer a U.S. territory.
    ___ M - Taxon mistakenly included in past notice of review.
    ___ N - Taxon may not meet the Act's definition of a "species."
    ___ X - Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Fish; Order Scorpaeniformes; Family Cottidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Missouri

CURRENT STATES/ COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Perry County, Missouri

LEAD REGION CONTACT: Laura Ragan, 612-713-5157

LEAD FIELD OFFICE CONTACT: Amy Salveter, 573-876-1911

BIOLOGICAL INFORMATION:

The following information is a summary of observations recorded in Burr et al. (2001), from Ginny Adams, Department of Zoology and Center for Systematic Biology, Southern Illinois University, Carbondale, IL, in litt., February 4, 2002, or Adams, personal communication, March 7, 2002.

The grotto sculpin (*Cottus sp., sp. nov.*) is a relatively small fish within the banded sculpin (*Cottus carolinae*) complex that exhibits distinct cave-adapted features. The banded sculpin complex includes both hypogean (below surface) and epigean (surface, primarily non-cave dwelling) forms. The sculpin is most likely the only hypogean form within the banded sculpin complex and can be distinguished from epigean fish within this complex by several cave-adapted features. These features include smaller, nearly non-functional eyes; reduced skin pigmentation; smaller optic nerves; larger anterior portion of the brain; and lower metabolic rates, among other features. Although the occurrence of *C. carolinae* in subterranean waters is well known [Poly and Boucher (1996) and Burr et al. (2001) documented the presence of banded sculpins in about 25 caves from several states with known karst environments], none of these sculpins show evidence of cave adaption to the extent exhibited by the grotto sculpin, and none are known to be permanent cave residents. Burr et al. (2001) have clearly demonstrated that the grotto sculpin is distinct from the epigean forms of banded sculpin. A formal description of this fish as a new species has not yet occurred, but is anticipated in the near future following the results of scheduled genetic analyses (Adams, Southern Illinois University, pers. comm. 2002).

Grotto sculpin inhabit cave systems, occupying pools and riffles with moderate stream flow and low to moderate stream depth. These fish can be found in the open water or hidden under rocks and occur over a variety of substrates including silt, gravel, cobble, rock rubble that originated from cave breakdown material or solid bedrock. Uniquely formed cave systems may be the only habitats that provide enough food (these caves provide an abundance of invertebrates) and sustained water flow for the species (Burr et al. 2001).

This species is restricted to two karst (limestone regions characterized by sink holes, abrupt ridges, caves and underground streams) areas, the Central Perryville Karst and Mystery-Rimstone Karst in Perry County, southeast Missouri. In determining the overall distribution of grotto sculpin, Burr et al. (2001) sampled over 27 cave streams within six karst regions in Perry County and documented the species in only five cave systems (Crevice, Moore, Mystery, Rimstone River, and Running Bull). To date, over 153 additional caves in Arkansas, Illinois, Indiana, Missouri, and Tennessee have been searched for grotto sculpin and epigean or hypogean forms of banded sculpin. Of these, *Cottus carolinae* was documented in 25 caves, but only fish in the 5 caves listed above exhibited the cave adaptations reported for grotto sculpin (Burr et al. 2001). The current overall range of grotto sculpin has been estimated to encompass approximately 260 square kilometers (100 square miles).

The total number of grotto sculpin that currently exist is unknown, but based on estimates obtained from Mystery (60 grotto sculpins) and Running Bull Cave (at least 150 grotto sculpins), the population probably does not exceed a few thousand fish (Burr et al. 2001).
THREATS:

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

Caves containing grotto sculpin are located down-gradient of the city of Perryville, Missouri;

dye trace studies of water movement suggest that urban runoff from Perryville and the surrounding area enters cave streams occupied by grotto sculpins (Burr et al. 2001). Vandike (1985) analyzed the deposition of various agricultural chemicals within the Perryville Karst area and reported detections of ammonia, nitrite/nitrate, chloride, and potassium from cultivation at levels high enough to be detrimental to aquatic life.

Of the five cave systems documented to have grotto sculpins, populations in one cave system (Running Bull Cave) were likely eliminated, presumably as the result of point source pollution. When the cave was searched in the spring of 2000, a mass mortality of grotto sculpin was noted, and subsequent visits to the cave have failed to document a single live grotto sculpin (Adams, pers. comm. 2002). Burr et al. (2001) conducted surveys in Running Bull Cave prior to the above-mentioned die-off and estimated the overall population within this system to be 150 sculpin. The loss of grotto sculpins from Running Bull Cave would result in a 20 percent decrease in the number of populations. Although the fish kill in Running Bull Cave affected a relatively small percentage of the overall population of grotto sculpin, as there are so few populations, the overall loss in genetic diversity represented by these populations may have been catastrophic.

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

Although some specimens of grotto sculpin have been taken for scientific investigations, such collecting activities do not appear to be at a level that poses a significant threat to this fish.

C. Disease or predation. Predatory fish occur in all of the caves occupied by grotto sculpin; these fish are potential predators on the eggs and young of sculpin (Burr et al. 2001). The predatory fish found in grotto sculpin caves include: common carp (*Cyprinus carpio*), fat-head minnow (*Pimephales promelas)*, yellow bullhead (*Ameiurus natalis*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), and channel catfish (*Ictalurus punctatus*) (Burr et al. 2001). These potential predators, normally excluded from cave environments, may escape surface farm ponds that unexpectedly drain through sinkholes into the underground cave systems and enter grotto sculpin habitat. Burr et al. (2001) indicates that these escaped fishes have increased potential predation pressure on grotto sculpin.

D. The inadequacy of existing regulatory mechanisms. We are unaware of any existing regulatory mechanisms that provide protection to the grotto sculpin. Because the grotto sculpin has not been formerly recognized as a distinct taxonomic entity, it is currently not being tracked as a species of conservation concern (Missouri Natural Heritage Program 2001) by the Missouri Department of Conservation and is not protected under the *Wildlife Code of Missouri* (Conservation Commission of Missouri 2001).

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

Karst regions are unique in that sinkholes, a significant component of the habitat, allow chemicals and pollutants to reach groundwater directly, without being filtered. Furthermore, Burr et al. (2001) state that more than half of the sinkholes in Perry County contain anthropogenic refuse, ranging from household cleansers and sewage to used pesticide and herbicide containers. As a result, potential water contamination from various sources of point and non-point pollution poses a significant threat to the grotto sculpin. Additionally, as the city

of Perryville expands closer to grotto sculpin caves, potential threats from these sources of pollution become greater.

The small population size and endemism (i.e., restricted to five cave systems in one county) of the grotto sculpin make it vulnerable to extinction due to genetic drift, inbreeding depression, and random or chance changes to the environment (Smith 1990). Inbreeding depression can result in death, decreased fertility, smaller body size, loss of vigor, reduced fitness, and various chromosome abnormalities (Smith 1990). Despite evolutionary adaptations for rarity, habitat loss and degradation increase a species' vulnerability to extinction (Noss and Cooperrider 1994). Numerous authors (e.g., Noss and Cooperrider 1994; Thomas 1994) have indicated that the probability of extinction increases with decreasing habitat availability. Although changes in the environment may cause populations to fluctuate naturally, small and low-density populations are more likely to fluctuate below a minimum viable population (i.e., the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval; Gilpin and Soule 1986; Shaffer 1981; Shaffer and Samson 1985). Current threats to the habitat of the grotto sculpin may exacerbate potential problems associated with its low population numbers and increase the likelihood of extinction.

FOR RECYCLED PETITIONS:

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

LAND OWNERSHIP: The entire known range of grotto sculpin is under private ownership.

PRELISTING:

Although no conservation agreements are currently in place for the grotto sculpin, the Missouri Department of Conservation plans to develop either a State Conservation Agreement or Candidate Conservation Agreement for this fish involving all stakeholders and private land owners in Perry County within the range of the sculpin (Peggy Horner, Endangered Species Coordinator, Missouri Department of Conservation, Jefferson City, Missouri, pers. comm. 2002).

REFERENCES:

Burr, B.M., G.L. Adams, J.K. Krejca, R.J. Paul, and M.L. Warren, Jr. 2001. Troglomorphic sculpins of the *Cottus carolinae* species group in Perry County, Missouri: distribution, external morphology, and conservation status. *Environ. Bio. of Fishes* 62:279-296.

Conservation Commission of Missouri. 2001. Wildlife Code of Missouri- Rules of the Conservation Commission. Missouri Department of Conservation. Jefferson City, Missouri. 159pp.

Gilpin, M.E., and M.E. Soule. 1986. Minimum viable populations: The processes of species

extinctions. Pages 13-34 *in* Conservation Biology: The Science of Scarcity and Diversity, M.E. Soule, (ed.). Sinauer Associates, Sunderland, Mass.

Helfman, G.S., B.B. Collette, and D.E. Facey. 1997. The diversity of fishes. Blackwell Science, Inc. Malden. 528pp.

Missouri Natural Heritage Program. 2001. Missouri species of conservation concern checklist. Missouri Department of Conservation. Jefferson City, Missouri. xi + 28pp.

Noss, R.F., and A.Y. Cooperrider. 1994. Saving nature=s legacy. Protecting and restoring biodiversity. Island Press, Washington, D.C.

Poly, W.J. and C.E. Boucher. 1996. Nontroglobitic fishes in caves: their abnormalities, ecological classification, and importance. *Amer. Midl. Nat.* 136:187-198.

Shaffer, M. L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.

Shaffer, M.L., and F.B. Samson. 1985. Population size and extinction: a note on determining critical population size. American Naturalist 125:144-152.

Smith, R.L. 1990. Ecology and Field Biology. Fourth Edition. Harper Collins Publishers, New York, N.Y. 922 pp. + appendices.

Thomas, C.D. 1994. Extinction, colonization, and metapopulations: environmental tracking by rare species. Conservation Biology 8(2): 373-378.

Vandike, J.E. 1985. Movement of shallow groundwater in the Perryville Karst area, southeastern Missouri. Water Res. Rept. (40):1-56.

LISTING PRIORITY (* after number)

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

Rationale for Listing Priority Number:

The recent point source pollution event that may have eliminated one of the five known populations of grotto sculpin suggests that the threat from chemical contamination is immediate and of a high magnitude. Furthermore, as noted above, there is evidence (Vandike 1985) that this area is highly susceptible to additional sources of contamination that threaten the remaining four populations. The comment from Burr et al. (2001) that more than half of the sinkholes in Perry County contain anthropogenic refuse, ranging from household cleansers and sewage to used pesticide and herbicide containers, provides further evidence of the high magnitude and imminent threats to this species from chemical contamination. Further compounding the threats to the grotto sculpin are predation from predatory fish, developmental pressures from the nearby city of Perryville, and a recent loss of genetic diversity.

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

Approve: Marvin Moriarty 03/13/2003
Acting Regional Director, Fish and Wildlife Service Date

Concur: _____ _____
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Director's Remarks:

-

-

Date of annual review: 01-06-03
Conducted by: Amy Salveter

Comments:

-

-