CANDIDATE ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: Etheostoma moorei Raney and Suttkus, 1964

COMMON NAME: yellowcheek darter

LEAD REGION: 4

INFORMATION CURRENT AS OF: February 2003

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

ANIMAL/PLANT GROUP AND FAMILY: Fish - Percidae

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Arkansas

LEAD REGION CONTACT (Name, phone number): Rick Gooch, 404/679-7124

LEAD FIELD OFFICE CONTACT (Office, name, phone number): Conway, Arkansas Field Office, Susan Rogers, 501/513-4481

BIOLOGICAL INFORMATION (Describe habitat, historic vs. current range, historic vs. current population estimates (# populations, #individuals/population), etc.):

Description

The yellowcheek darter (Etheostoma moorei) is a small and compressed fish which attains a maximum length of about 64 mm (2.5 inches), has a moderately sharp snout, deep body, and deep caudal peduncle. The back and sides are grayish brown, often with darker brown saddles and lateral bars. Breeding males are brightly colored with a bright blue or brilliant turquoise breast and throat and light green belly, while breeding females possess orange and red-orange spots but are not brightly colored (McDaniel 1984, Robison and Buchanan 1988). First collected in 1959 from the Devils Fork tributary of the Little Red River, this species was eventually described by Raney and Suttkus in 1964, using 228 specimens from the Middle Fork, South Fork, and Devils Fork tributaries of the Little Red River. The yellowcheek darter is one of only two members of the subgenus Nothonotus known to occur west of the Mississippi River.

Habitat

The yellowcheek darter inhabits high gradient headwater tributaries with clear water, permanent flow, moderate to strong riffles, and gravel, rubble, and boulder substrates (Robison and Buchanan 1988). Yellowcheek darter prey items include aquatic dipteran larvae, stoneflies, mayflies, and caddisflies (McDaniel 1984).

Life History

Males and females reach sexual maturity at one year of age, and maximum life span is around four years (McDaniel 1984). Spawning occurs from late May through June in the swift to moderately swift portions of riffles, often around or under the largest substrate particles (McDaniel 1984), although ripe females have been found at the head of riffles in smaller gravel substrate (Wine et al. 2000). Spawning yellowcheek darters occupy large boulder substrate and turbulent water near the lower portion of riffles (Wine et al. 2000). During non-spawning months, there is a general movement to portions of the riffle with smaller substrate, such as gravel or cobble, and less turbulence (Robison and Harp 1981). A number of life history characteristics, including courtship patterns, specific spawning behaviors, egg deposition sites, number of eggs per nest, degree of male protection of the nest, and degree of territoriality, are unknown at this time; however, researchers have suggested that yellowcheek darters deposit eggs on the undersides of larger rubble in swift water (McDaniel 1984).

Genetics

A 1999 Arkansas State University (ASU) genetic study evaluated genetic and meristic variation among yellowcheek darter populations. The study revealed that although all known yellowcheek darter populations were genetically very similar, populations in the Turkey Fork reach of Devils Fork differed from South Fork and Middle Fork populations, possibly indicating that the Turkey Fork population may represent an evolutionarily significant unit (Mitchell 1999). It was also noted that individuals captured in Turkey Fork exhibited a markedly larger body size and a longer spawning period, suggesting some variation between populations. Therefore, it has been theorized that the Turkey Fork population may represent a subspecies of the original yellowcheek darter populations in Devils Fork (Mitchell 1999), and that individuals migrated to the South and Middle Fork at a later time (Dr. George Harp, ASU, personal communication.)

Current Distribution

The yellowcheek darter is endemic to four tributaries of the upper Little Red River: Devils Fork (including the Turkey Creek and Beech Fork segments), the Middle Fork of the Little Red River, the South Fork of the Little Red River, and Archey Creek, in Cleburne, Searcy, Stone, and Van Buren counties, Arkansas (Robison and Buchanan 1988). In 1962, the construction of a dam on the Little Red River to create Greers Ferry Lake impounded much of the range of this species, including the lower reaches of Devils Fork, which was the collection site of the holotype. The lake flooded optimal habitat for the species, and caused the genetic isolation of the populations in the four tributaries (McDaniel 1984).

In the 1978-81 study by Robison and Harp (1981), yellowcheek darters occurred in greatest numbers in the Middle and South Forks of the Little Red River, with populations estimated at 36,000 and 13,500, respectively, while populations in both Devils Fork and Archey Fork were estimated at approximately 10,000 individuals (Robison and Harp 1981). During this study, the four major tributaries of the Little Red River supported an estimated 60,000 yellowcheek darters, and the species was considered the most abundant riffle fish present (Robison and Harp 1981). Extensive sampling of the first two tributaries of Little Red River below Greers Ferry Dam (both named Big Creek) failed to yield yellowcheek darters, and no darters were found in immediately adjacent watersheds (Robison and Harp1981).

While collecting specimens for the 1999 genetic study, ASU researchers discovered that yellowcheek darters were no longer the dominant riffle fish and were more difficult to find (Wine et al. 2000). Because optimal habitat had been destroyed by the creation of Greers Ferry Lake (McDaniel 1984), yellowcheek darters moved to upper stream reaches with lower summer flow, smaller substrate particle size, and reduced gradient (Wine et al. 2000). A thorough status survey conducted in 2000 found yellowcheek darters in only three of the four historic range tributaries in greatly reduced numbers(Wine et al. 2000). Populations in Middle Fork were estimated at approximately 6,000 individuals, 2,300 in South Fork, and 2,000 in Archey Fork. No yellowcheek darters were collected from the Devils Fork system. Where yellowcheek darters were captured, they were fifth in abundance compared to other riffle fishes, while historically they dominated the fish community. Fish community composition was similar between the 1978-81 and 2000 studies, but the proportion of yellowcheek darters declined substantially. Fish known to co-exist with yellowcheek darter include the rainbow darter (E. caeruleum) and greenside darter (E. blennioides), which can use pool habitats during periods of low flow, as evidenced by the collection of these two species from pools during electroshocking activities. Electroshocking has not revealed any yellowcheek darters in pools, suggesting that they are unable to tolerate pool conditions. An inability to use pools during low flows would make them much more vulnerable to seasonal fluctuations in flows that reduce riffle habitat. As a result, researchers have suggested that declines in yellowcheek darters are more likely a species rather than community phenomenon (Wine et al. 2000).

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

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

Robison and Harp (1981), McDaniel (1984), and Robison and Buchanan (1988) have attributed the decline in populations of yellowcheek darters in the four headwater tributaries of the Little Red River to habitat alteration and degradation. The suspected primary cause of the species' decline is the impoundment of the lower reaches of the four tributaries of the Little Red River that form Greers Ferry Lake, areas that in the past provided optimal habitat for this species. The creation of Greers Ferry Lake in 1962 converted optimal yellowcheek darter habitat (clear, cool, perennial flow with large substrate particle size, (Robison and Buchanan 1988)), to a deep water, lacustrine environment. This dramatic change in habitat flooded spawning sites, altered habitat radically, and changed chemical and physical characteristics in the streams which provide optimal habitat for this species. Impoundments profoundly alter channel characteristics, habitat availability, and flow regime with serious consequences for biota (Allan and Flecker 1993, Ward and Stanford 1995), change lotic to lentic waters, increase depths and sedimentation, decrease dissolved oxygen, drastically alter resident fish populations (Neves et al. 1997), disrupt fish migration, and destroy spawning habitat (Ligon et al. 1995).

Because it is endemic to only four headwater tributaries of the Little Red River, the yellowcheek darter is vulnerable to alterations in physical habitat characteristics and water quality degradation. As a result, yellowcheek darter numbers have declined by 83 percent in both the Middle Fork and South Fork, and 60 percent in Archey Fork in the past 20 years. No yellowcheek darters were found in the Devils Fork during the 2000 status survey, the species having apparently been extirpated in that reach. A comparison of inhabited stream reaches in the 1981 survey versus the 2000 survey reveals that the largest decline occurred in the South Fork, where reaches formerly inhabited by the yellowcheek darter declined by 70 percent. The second largest decline occurred in the Archey Fork, where there was a 60 percent reduction in inhabited stream reach. The Middle Fork showed the least decline in inhabited stream reach, at 22 percent.

Ozark headwater streams typically exhibit seasonal fluctuations in flows, with flow rates highest in spring, and lowest in late summer and fall. The upper reaches of these small tributaries are most affected by seasonally fluctuating water levels (Robison and Harp 1981). As a result, they often lack consistent and adequate flows, and by late summer or fall are reduced to a series of isolated pools (Mitchell Wine, pers. comm.). Because the yellowcheek darter requires permanent flows with moderate to strong current (Robison and Buchanan 1988), seasonal fluctuations in stream flows that reduce lentic flows to a series of isolated pool habitats, are a serious threat. Consequently, the 2000 status survey revealed yellowcheek darters in the lower reaches of only three of these four small headwater tributaries.

The Service believes that secondary causes of yellowcheek declines include habitat degradation from land use activities in the watershed, including agriculture and forestry. Traditional farming practices, feed-lot operations, and associated poor land use practices contribute many pollutants, and agriculture affects 72 percent of impaired river kilometers in the United States (Neves et al. 1997). Nutrients, bacteria, pesticides, and other organic compounds generally are found in higher concentrations in agricultural areas than forested areas. Nutrient concentrations in streams may result in increased algal growth in streams, and a related alteration in fish community composition (Petersen et al. 1999). Major agricultural activities within the Little Red River watershed include poultry, dairy, swine, and beef cattle operations.

The Arkansas Natural Resources Conservation Service has identified animal wastes, nutrients, excessive erosion, loss of plant diversity, and declining species as water quality concerns associated with agricultural land use activities in the upper Little Red River watershed (NRCS 1999). Large poultry and dairy operations increase nutrient inputs to streams when producers apply animal waste to pastures to stimulate vegetation growth for grazing and hay production. Continuous grazing methods in the watershed allow unrestricted animal access to grazing areas, and on steeper slopes this results in increased runoff and erosion (NRCS 1999). Since pastures often extend directly to the edge of the stream, and lack a riparian zone of vegetation, runoff from pastures carry sediments and nutrients directly into streams. Livestock spend a disproportionate amount of time in riparian areas during hot summer months and trampling and grazing can change and reduce vegetation, and eliminate riparian areas by channel widening, channel aggradation, or lowering of the water table (Armour et al. 1991).

Timber harvesting activities involving clear cutting entire, steep hillsides have been observed recently in the watershed (Dr. George Harp, ASU, pers. comm.). A lack of mandatory best management practices (BMP's) during timber harvests has resulted in water quality degradation and habitat alteration in stream reaches adjacent to harvesting operations. When timber harvests involve clear cutting to the water's edge, without leaving a riparian buffer, silt and sediment enter streams lying at the bottom of steep slopes. The lack of stream side vegetation also promotes bank erosion that alters stream courses and introduces large quantities of sediment into the channel (Allan 1995). Timber harvest operations that use roads on steep slopes to transport timber can carry silt and sediment from the road into the stream at the bottom of the slope. Logging impacts on sediment production are considerable, but often erosion of access and haul roads produces more sediment than the land harvested for timber (Brim Box and Mossa 1999).

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

Over collection is not thought to be a significant cause for decline, although it may contribute to an already declining population. The yellowcheek darter is a rare and unique species that has been collected by researchers and students throughout America. The bridge over the Middle Fork of the Little Red River near Clinton, Arkansas, is a popular locality to collect this species. Because the yellowcheek darter is not used as a sport fish or for bait, collection by the general public is not considered a threat.

C. Disease or predation. The Service is aware of no evidence which would demonstrate that disease or predation is a serious threat.

D. The inadequacy of existing regulatory mechanisms. The ADEQ has established water quality standards for surface waters in Arkansas, including specific standards for those streams designated as "extraordinary resource waters" based on "a combination of the chemical, physical, and biological characteristics of a waterbody and its watershed, which is characterized by scenic beauty, aesthetics, scientific values, broad scope recreation potential and intangible social values" (State of Arkansas 1998). As described in ADEQ's Regulation 2, Section 2.203, extraordinary resource waters "shall be protected by (1) water quality controls, (2) maintenance

of natural flow regime, (3) protection of in stream habitat, and (4) pursuit of land management protective of the watershed." This regulatory mechanism has precluded large scale commercial gravel mining in the watershed, therefore, gravel mining is not considered a cause of habitat degradation or a threat in the Little Red River watershed. However, the applicable water quality standards have not protected yellowcheek darter habitat from the damaging habitat alterations and water quality degradation from activities such as timber harvesting and agriculture.

The yellowcheek darter is ranked by the Arkansas Natural Heritage Commission (ANHC) as an S1G1 species: extremely rare in Arkansas, and critically imperiled globally. The ANHC's designation as an S1G1 species does not confer any official protection and has not prevented activities which could lead to the loss and degradation of habitat.

The Arkansas Forestry Commission is the state agency responsible for establishing best management practices for timber harvests in the state. BMP's for timber harvests in Arkansas consist only of recommendations and guidelines. Therefore, there is no requirement that timber harvesters include BMP's in timber operations. The BMP's are currently under revision, but the Service does not know what effect these revisions will have on aquatic habitats within the range of the species.

E. Other natural or manmade factors affecting its continued existence. The Little Red River watershed has experienced moderate drought conditions over the last two to three years (Southern Regional Climate Center 2000), which has affected flows in its tributaries. Stage height and flow rates were one foot lower during the sampling period for the 2000 status survey than during the 1979-80 study (Wine et al. 2000). Streamflow is strongly correlated with important physical and chemical parameters that can be considered "master variables" that limit the distribution and abundance of riverine species (Power et al. 1995, Resh et al. 1988) and regulates the ecological integrity of flowing water systems (Poff et al. 1997). No yellowcheek darters were found in the upper reaches of any study streams or in the Turkey/Beech Fork reach of Devils Fork, which is a result of drought conditions and indicates a contraction of yellowcheek darter range to stream reaches lower in the watershed where flows are maintained for a greater portion of the year (Wine et al. 2000).

Since the impoundment of Greers Ferry Lake, populations yellowcheek darters in the four tributaries of the Little Red River have been fragmented, such that genetic interchange no longer flows between subpopulations occurring in different tributaries, and each discrete subpopulation in each tributary reproduces only with other members in the same tributary. This fragmentation of the populations can reduce genetic diversity in the separated populations, promoting a loss of physiological or adaptive mechanisms that would improve the yellowcheek darter's chances for withstanding stochastic events. Genomic heterogeneity is lost when the natural interchange of genetic material between populations is prohibited. Population genetics has emphasized the profound negative effects the loss of genomic heterogeneity has on overall population viability of species with restricted and fragmented ranges (Chesser 1983, Gilpin and Soule 1986). Such isolation can eventually lead to inbreeding depression (Avise and Hambrick 1996), which can be a major detriment to a species' recovery (Frankham 1995). Inbreeding often result in decreased fitness of multiple life stages, and the loss of genetic heterozygosity results in significantly increased risk of extinction in localized natural populations (Saccheri et al. 1998).

FOR RECYCLED PETITIONS:

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

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

The yellowcheek darter is known historically from four headwaters tributaries of the upper Little Red River in Cleburne, Searcy, Stone, and Van Buren counties, Arkansas. Approximately 93 percent of the upper Little Red River watershed is in private ownership, with the remaining 7 percent publically-owned (U.S. Army Corps of Engineers (4 percent), the U.S. Forest Service (2 percent), and the Arkansas Game and Fish Commission (1 percent)).

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

No conservation agreements or conservation activities have been developed by Service personnel in the Little Red River watershed above Greers Ferry Lake. The Natural Resources Conservation Service administers the Environmental Quality Incentives Program, a conservation program of the 1996 Farm Bill that is intended to address natural resources concerns. A few projects designed to prevent water quality degradation from agricultural practices have been implemented in the watershed under this program, but broad scale conservation measures that would address the above identified threats have not been implemented. Otherwise, the Service is unaware of any conservation activities that have been undertaken for the benefit of the species.

In September 2002, several adult yellowcheek darters were collected to begin determining propagation protocols for the species. Once protocols are developed, a propagation program will be established to ensure the species' persistence while threats to its habitat are abated.

REFERENCES (Identify primary sources of information (e.g., status reports, petitions, journal publications, unpublished data from species experts) using formal citation format):

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Armour, C. L., D. A. Duff, and W. Elmore. 1991. Fisheries 16:1. American Fisheries Society Draft Position Statement: The effects of livestock grazing on riparian and stream ecosystems.

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Chesser, R. K. 1983. Isolation by distance: relationship of the management of genetic resources. Pages 66-77 In: C. M. Schonewald-Cox, S. M. Chambers, B. MacBryde, and W. L. Thomas, eds. Genetics and conservation: a reference for managing wild animal and plant populations. Benjamin/Cummings Publishing Co., Inc., Menlo Park, California.

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Power, M. D., A. Sun, M. Parker, W. Dietrich, and J. Wootton. 1995. Hydraulic food chain models: an approach to the study of food web dynamics in large rivers. BioScience 45:159-167.

Resh, V. W., A. Brown, A. Covich, M. Gurtz, H. Li, G. W. Minshall, S. Reice, A. Sheldon, J. Wallace, and R. Wissmar. 1988. The role of disturbance in stream ecology. Journal of the North American Benthological Society 7:433-455.

Robison, H. W., and T. M. Buchanan. 1988. Fishes of Arkansas. The University of Arkansas Press, Fayetteville.

Robison, H. W., and G. L. Harp. 1981. A Study of Four Endemic Arkansas Threatened Fishes. Federal Aid Project E-1-3, -4, -5.

Saccheri, I., M. Kuussaari, M. Kankare, P. Vikman, W. Fortelius, and I. Hanski. 1998. Inbreeding and extinction in a butterfly metapopulation. Nature 392:491-494.

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Natural Resources Conservation Service. 1999. USDA-NRCS Conservation Programs. Environmental Quality Incentives Program On-line Data System. Project Name: Upper Little Red/Greers Ferry Lake Watershed. United States Department of Agriculture.

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Wine, M., S. Blumenshine, and G. Harp. 2000. Status Survey of the Yellowcheek Darter (Etheostoma moorei) in the Little Red River Basin. Department of Biological Sciences, Arkansas State University, State University.

LISTING PRIORITY (place * 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:

Magnitude: The drought has had a dramatic impact on yellowcheek darters in all four tributaries it inhabits. Available habitat has been severely reduced in recent years, and the species does not appear to have the ability to recolonize new available habitats rapidly.

Imminence: Yellowcheek darter populations have drastically declined in a very short period of time, and the drought has continued over a number of years. The threat of one or more populations disappearing is imminent.

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

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

Concur: _____ _____
Director, Fish and Wildlife Service — Date

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

Director's Remarks:

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Date of annual review: February 2003

Conducted by: Susan Rogers - Conway, Arkansas FO

Comments:

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