Southeastern Fishes Council Proceedings

Number 51 (December 2009)

12-1-2009

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THE DESPERATE DOZEN: AN INTRODUCTION

Aquatic animals have experienced dramatic declines in recent decades (Abell et al., 2000). There are currently 582 species of animals on the Federal list of Endangered and Threatened species, of which 268 (46%) are found in freshwater habitats. Of the diverse assemblage of 675 fishes found in southeastern waters, more than a quarter are considered imperiled (Warren et al., 2000). While all of the Earth's ecosystems are threatened to some extent, freshwater habitats are recognized to be at severe risk because of their scarcity and the high demands placed on them by humans (Vitousek, 1997; Wood et al., 2000; Postel, 2002). The combined effects of agriculture, damming, dredging, construction, logging, overharvest, and pollution are destroying this critical resource for animals, plants, and even humanity itself (Master, 1990; Richter et al., 1997). This major conservation crisis calls for immediate action to conserve and protect the remaining populations and their habitats.

When resources are limited, one of the most important steps in conservation is prioritization (Master, 1991; Possingham et al., 2002). We sought to determine where immediate conservation actions were needed to prevent loss of native southeastern freshwater fish diversity. We decided to focus our efforts on the Desperate Dozen fishes, the 12 species that local and regional experts would identify as the most likely to become extinct in the Southeast. Our goal is to use this list to raise awareness of the plight of freshwater habitats in the Southeast, including rivers, creeks, wetlands, springs, and caves (Abell et al., 2000). By highlighting these 12 species, ranging from the spring pygmy sunfish (*Elassoma alabamae*) to the Alabama sturgeon (*Scaphirhynchus suttkusi*), we hope to encourage partnerships to address the needs of our freshwater animals and hopefully prevent them from slipping into extinction.

We created the initial list of the most imperiled southeastern fishes by using species listed as Endangered or Threatened by Warren et al. (2000), eliminating those species outside of the range of the Southeast as defined by the Southeastern Fishes Council (SFC) constitution. Species described since 2000 were added to the list, but undescribed species were not included in the ranking. Lists of imperilment created by the U.S. Fish and Wildlife Service (USFWS) or state wildlife agencies were not consulted in SFC's identification of the Desperate Dozen fishes at any stage of the process. The Southeastern Fishes Council Executive Committee (SFC ExCom) was asked to review and rank the initial list of 40 species. Criteria used for ranking, in order of importance, were distribution, number of populations, low abundance, and severity of threats. Species were not chosen to represent a broad geographic or taxonomic spectrum, nor based on the ease or potential success of their recovery.

Through this ranking system, the SFC ExCom developed a list of 14 potential Desperate Dozen species, with a brief synopsis on the status of each. This list was sent to four reviewers. Two responded with their ranking of the potential species and included three other species to consider. The SFC ExCom then ranked these 17 species, all listed as Endangered in the latest list of the conservation status of imperiled freshwater fishes of North America (Jelks et al., 2008). The 12 most highly ranked species from the SFC ExCom and external reviewers were selected as the Desperate Dozen. After the ranking based on level of imperilment, species were arranged in phylogenetic order so that all would receive equal attention. We contacted experts on each species to provide the following brief accounts on the Desperate Dozen, which include background, distribution, abundance, threats, and proposed conservation actions.

The Desperate Dozen:

Alabama sturgeon, *Scaphirhynchus suttkusi*
Slender chub, *Erimystax cahni*
Chucky madtom, *Noturus crypticus*
Alabama cavefish, *Speoplatyrhinus poulsoni*
Pygmy sculpin, *Cottus paulus*
Diamond darter, *Crystallaria cincotta*
Vermilion darter, *Etheostoma chermocki*
Relict darter, *Etheostoma chienense*
Bayou darter, *Etheostoma rubrum*
Pearl darter, *Percina aurora*
Conasauga logperch, *Percina jenkinsi*
Spring pygmy sunfish, *Elassoma alabamae*

The Desperate Dozen is represented by taxa that belong to seven families of fishes: a sturgeon (Acipenseridae), a minnow (Cyprinidae), a catfish (Ictaluridae), a cavefish (Amblyopsidae), a sculpin (Cottidae), six darters (Percidae), and a pygmy sunfish (Elassomatidae). Five species are restricted to Alabama, two in Mississippi, and one each in Kentucky, Tennessee, and West Virginia. Two species are found in two states: the slender chub (*E. cahni*) in Tennessee and Virginia and the Conasauga logperch (*P. jenkinsi*) in Tennessee and Georgia (Fig.1). Seven species have always been restricted to a small area, some to a single spring or cave, while four were historically wider ranging. Half of the Desperate Dozen occupy smaller bodies of water (e.g., springs, cave pools, creeks), while the other half live in medium and large rivers (Table 1). The main threat for all of these species is their relatively restricted ranges, where one acute pollution or habitat destruction event could cause extinction (Johnson, 1998; Purvis et al., 2000). Habitat alteration also impacts all species, from dams, channelization, and head-cutting in rivers and creeks to pumping of groundwater and the presence of impervious surfaces in recharge areas for caves and springs (Richter et al., 1996; Watters, 1999; Wenger et al., 2008). All of these habitat alterations potentially lead to population fragmentation (Dynesius and Nilsson, 1994; Richter et al., 1997). Water pollution, especially sedimentation, is also a pervasive problem for all Desperate Dozen species (Table 2). The recent severe drought in the southeastern U.S. coupled with burgeoning human population growth has placed additional stress on aquatic habitats (Manuel, 2008).

While each Desperate Dozen species has its own specific set of threats, many proposed conservation actions are similar. Those species occupying smaller habitats and ranges can greatly benefit from a watershed management plan that involves all public and private stakeholders in mitigating current conditions that contribute to habitat degradation and planning for wise future development (Leach et al., 2002; Bohn and Kershner, 2002). Watershed management plans require cooperation and coordination between municipal, state, federal, and non-government agencies, but can be relatively inexpensive, which is very important in times of economic shortfalls (Selin and Chevez, 1995; Heathcote, 1998). Other commonly recommended conservation actions for the Desperate Dozen include monitoring abundance, assessing water quality and quantity, surveying for additional populations, developing propagation programs, and examining the genetic diversity within and between populations (Table 3).

Only 8 of the Desperate Dozen are listed by the USFWS: 5 are Endangered and 3 are considered Threatened. Two are Candidate species for listing and 2 have no federal status (Table 4). Of the 8 listed species, only 4 have critical habitat determined and 6 have approved recovery plans. We encourage the use of all available recovery options under the Endangered Species Act to begin the process of habitat restoration and recovery for these species.

At every stage of this process, it was clear that many other fishes also deserved to be on a list of species in a desperate need for conservation action. While our call to action is targeted at only 12 species, the principles behind their recovery must be applied throughout Southeastern drainages. Without immediate, coordinated action, the Southeast stands to lose far more than just the Desperate Dozen.

ACKNOWLEDGMENTS

We would like to thank the World Wildlife Fund and the particular help of Judy Takats for their support of this project. All fish illustrations were drawn by Joe Tomelleri. Special thanks to the Florida Museum of Natural History, Tennessee Aquarium, University of Alabama, and the Region 4 Field and Regional Offices of the U.S. Fish and Wildlife Service.

Scaphirhynchus suttkusi – Alabama Sturgeon

Background: One of the rarest vertebrates globally, the Alabama sturgeon is the smallest of eight North American sturgeon species (maximum 30.7 in [78 cm] fork length). Its description in 1991 (Williams and Clemmer, 1991) was followed by years of controversy regarding its taxonomic status even though numerous morphological and genetic studies support its validity as a species (Mayden and Kuhajda, 1996; Campton et al., 2000; Simons et al., 2001; Ray et al., 2007). The Alabama sturgeon was federally listed as Endangered in 2000 (USFWS, 2000a) and critical habitat was designated in 2009 (USFWS, 2009). This species is state protected in Alabama (ALDWFF, 2007) and considered a species of Highest Conservation Concern (Kuhajda, 2004a).

Distribution: Historical collection records and reports indicate the range of the Alabama sturgeon encompassed 1600 km of large rivers, including the Black Warrior, Tombigbee, Alabama, Cahaba, Coosa, Tallapoosa, Mobile,

and Tensaw rivers (Burke and Ramsey, 1995). Currently it occupies only 524 km of its historical range in the lower Cahaba River and Alabama River in south Alabama (USFWS, 2009).

Abundance: No population estimates available; very rare. An estimated 19,000 Alabama sturgeon were commercially harvested in 1898 (Mayden and Kuhajda, 1996), indicating an abundant historic population. However, very little information on abundance existed between 1898 and the early 1980s, although collection data and anecdotal reports indicated a general decline in abundance (USFWS, 2005a). Sampling efforts in the mid-1980s yielded only six Alabama sturgeon (Burke and Ramsey, 1985) with an additional five specimens collected from 1997 to 1999 (Rider and Hartfield, 2007). Over the last nine years only two specimens have been collected, one captured and released in the lower Cahaba River in 2000 and the other captured, sonic tagged, and released below Claiborne Lock and Dam in 2007.

Threats: Extremely small population size increases vulnerability to extinction. Historic unrestricted commercial harvesting likely triggered the initial decline of the Alabama sturgeon (USFWS, 2005a). Thereafter, years of habitat alteration proved detrimental, with large dams and navigation locks fragmenting free-flowing riverine habitats into a series of impoundments. These structures block migratory routes to spawning grounds and disrupt natural flow patterns leading to unsuitable conditions for feeding and larval development. Extensive dredging in the Mobile Basin has reduced or eliminated stable substrates, shoal areas, snags, channel sinuosity, and heterogeneous flows (USFWS, 2000b).

Proposed Conservation Actions:
1. Continue tracking of sonic tagged individual to identify new sampling sites and provide information on current habitat requirements.
2. Continue sampling for viable adults to establish propagation program.
3. Pursue fish passage at the 3 U.S. Army Corps of Engineers (USACE) hydro and navigation projects on the Alabama River.
4. Develop a baseline water quality model for the Alabama River.
5. Protect and maintain current habitat conditions.

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***Erimystax cahni* – Slender Chub**

Background: The slender chub (maximum 3.7 in [94 mm] total length [TL]) was described in 1956 (Hubbs and Crowe, 1956). At that time it had not been collected in 17 years, but it was rediscovered in the Powell River in 1964 (Davis and Reno, 1966). The slender chub was listed as federally Threatened with critical habitat designated in 1977 (USFWS, 1977). A recovery plan has been developed (USFWS, 1983) and relationships within the genus have been determined (Harris, 1986; Simons, 2004). It is currently listed by Tennessee and Virginia as Threatened (TDEC, 2004; VDGIF, 1987). Previous conservation actions include a status review (Burkhead and Jenkins, 1982) and several status surveys (see below).

Distribution: Historically known from the Clinch, Powell, and Holston rivers in the upper Tennessee River drainage, northeastern Tennessee, and southwestern Virginia. In the past quarter century the slender chub has been known from fewer than 100 river km in the Powell and Clinch rivers in Tennessee and Virginia (Harris, 1986; Etnier and Starnes, 1993; Jenkins and Burkhead, 1994).

Abundance: No population estimates available; very rare. Through 1987, a total of only ~420 individuals had been collected as a result of ~90–100 collecting efforts in the Clinch and Powell rivers (Hubbs and Crowe, 1956; Davis and Reno, 1966; Burkhead and Jenkins, 1982; Jenkins and Burkhead, 1991; R. Mayden, pers. comm.). Eight specimens were captured in a single collection in 1987 in the Clinch River (R. Mayden pers. comm.), but since then only a single specimen has been collected (1996, D. Etnier pers. comm.) in the Clinch River. Despite intensive efforts during favorable conditions in both the Clinch and Powell rivers, including over 740 person-hours effort since 2000, no additional specimens have been found.

Threats: Reduced range increases vulnerability to extinction. Severe chronic and acute water pollution from factories, sewage, and coal mines, excessive sedimentation from agricultural runoff, and gravel removal threaten slender chub populations and habitat. The highly porous karst geology and relatively narrow floodplains elevate nutrients and pollutants leeching into the Clinch and Powell rivers (Etnier and Starnes, 1993; Jenkins and Burkhead, 1994).

Proposed Conservation Actions:
1. Continue to conduct surveys in order to determine the status of this species.
2. Determine the causes of decline, using a surrogate species if necessary, and minimize or eliminate threats utilizing legal mechanisms to protect the species and its habitat (i.e., land acquisition and conservation easements; controlling or restricting mining, pollution, and poor agricultural practice).
3. If individuals are collected, determine the best methods

for protecting and increasing the population numbers (e.g., captive propagation and reintroduction of adults or juveniles or both).

4. Address potential genetic concerns, such as possible hybridization.
5. Gather life history information, including specific invertebrate food items and critical food population levels necessary for the slender chub, which are currently unknown.

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Noturus crypticus – Chucky Madtom

Background: The distinctiveness of the Chucky madtom, a small catfish (maximum size 2.9 in [74 mm] TL), was noted in 1969 (Taylor, 1969), but the species was not described until 2005 when additional comparative material became available (Burr et al., 2005). This species is listed as Endangered by the state of Tennessee (TDEC, 2004). Federal listing of *N. crypticus* as the undescribed Chucky madtom was first discussed in 1994 (USFWS, 1994a) and was given official Candidate status 12 years later (USFWS, 2002). Original listing priority for *N. crypticus* was level 2 and has not changed through subsequent reviews (USWFS, 2004; 2005b; 2006; 2007a). The USFWS has funded multiple surveys and worked with the Middle Nolichucky Watershed Association on an action plan for Little Chucky Creek. Seven Partners for Fish and Wildlife projects have been completed in the Little Chucky Creek watershed with support from the Greene County Soil Conservation District, the Natural Resources Conservation Service, the Tennessee Valley Authority, and the Tennessee Wildlife Resources Agency. These projects have installed riparian fencing, stabilized banks, and created alternate water sources for livestock.

Distribution: Historically known from only two streams in the French Broad River system of the upper Tennessee River drainage in northeastern Tennessee. It is considered extirpated from Dunn Creek (Little Pigeon River system, Sevier Co., TN) where a single specimen was collected in 1940, and is known recently (1991–2004) from two sites separated by 3 river km in Little Chucky Creek (Nolichucky River system, Greene Co., TN). The species may also have been found in the middle Tennessee River drainage in Alabama (Piney Creek and Flint and Paint Rock rivers), but positive identification of specimens is not possible due to extreme fading of pigments (Burr et al., 2005).

Abundance: No population estimates are available, but *N. crypticus* is very rare and both temporally and spatially patchy within its known range. The largest collection, nine specimens from the two Little Chucky Creek sites over two days, was made in 1994 and, despite intensive field surveys by several independent groups, only three specimens have been captured since (1 in 2000 and 2 in 2004, for a total of 14 known specimens) (Burr and Eisenhour, 1994; Shute et al., 1997; Lang et al., 2001; 2005; Weber and Layzer, 2007).

Threats: Extremely small range increases its vulnerability to extinction. Sedimentation from poor agricultural practices, including erosion due to removal of riparian vegetation and livestock access to the streambed have visibly degraded habitat in Little Chucky Creek (USFWS, 2005b). It is also possible that chemical contamination from agricultural runoff has an adverse effect, including chemical noise interfering with the chemosensitivity of catfishes (Etnier and Jenkins, 1980).

Proposed Conservation Actions:

1. Within the Little Chucky Creek watershed, it is imperative that the successful Partners for Fish and Wildlife projects are monitored, supported, and extended to new areas. The focus of these agreements has been and should continue to be improvement of stream conditions via a watershed management plan.
2. A captive breeding program must be developed so it can be activated quickly upon the capture of additional specimens.
3. There should be a continuous and intensive survey effort throughout the French Broad River system that utilizes a wide variety of sampling methods throughout the year.

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Speoplatyrhinus poulsoni – Alabama Cavefish

Background: The rarest and most cave-adapted of only five species of North American cavefishes, the Alabama cavefish (maximum size 2.8 in [70 mm] TL) is white, lacks eyes and pelvic fins, and has a snout with a bill-like appearance (Kuhajda, 2004b). It was described in 1974 (Cooper and Kuehne, 1974), listed as federally Threatened with critical habitat in 1977 (USFWS, 1977), and reclassified as Endangered in 1988 (USFWS, 1988). A revised recovery plan was approved in 1990 (USFWS, 1990). The Alabama cavefish is state protected in Alabama (ALDWFF, 2007) and considered a species of Highest Conservation Concern (Kuhajda, 2004b). Previous conservation actions include status surveys in the 1980s, 1990s, and most recently in 2008-09, and the establishment of the Key Cave National Wildlife Refuge in the high recharge area of the Key Cave aquifer (Kuhajda and Mayden, 2001; Kuhajda, 2004b).

Distribution: Restricted to Key Cave in Lauderdale County in northwestern Alabama within the Tennessee River drainage (Kuhajda and Mayden, 2001).

Abundance: Extremely rare with a total population estimated to be less than 100 individuals. The maximum number observed during a single visit to the cave was 10 individuals (Kuhajda and Mayden, 2001).

Threats: Extremely small native range, subterranean specialization, and complete reliance on Key Cave aquifer increases vulnerability to extinction. The Key Cave aquifer and recharge area are threatened by urban and industrial growth which can lead to lowering of water table, diminished winter flows (cues to synchronize spawning), and acute and chronic water pollution (Kuhajda, 2004c). Disruption of the gray bat (*Myotis grisescens*) colony could interrupt critical nutrients entering the deep cave ecosystem (Kuhajda, 2004b; 2004c).

Proposed Conservation Actions:

1. Protect Key Cave aquifer by more precisely delineating the recharge area and by using a management plan that addresses urban and industrial growth and agricultural practices within the unprotected recharge area to prevent lowering of water table, diminished winter flows (cues to synchronize spawning), and acute and chronic water pollution. This includes consistent networking and collaboration between federal and state agencies, non-government organizations, local governments and businesses, and private landowners to formulate unique strategies to protect groundwater.
2. Establish regular status surveys for Alabama cavefish and gray bats and monitor water quality and quantity in Key Cave to detect any issues in a timely manner.
3. Gather additional population and life history information for the Alabama cavefish.
4. Unsurveyed caves in the vicinity of Key Cave that have pools should be examined for additional populations of Alabama cavefish.

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Cottus paulus – Pygmy Sculpin

Background: The smallest sculpin in North America (rarely greater than 1.5 in [38 mm] standard length [SL]), the pygmy sculpin was originally described as *Cottus pygmaeus* in 1968 (Williams, 1968) and renamed as *C. paulus* in 2000 (Williams, 2000). It was listed as federally Threatened in 1989 (USFWS, 1989a), is state protected in Alabama (ALDWFF, 2007), and considered a species of Highest Conservation Concern (Stiles and Warren, 2004). Previous conservation actions include implementation of a minimum daily flow of the spring and water quality monitoring within the spring recharge area. Studies on pygmy sculpin have included population monitoring, habitat use (Johnston, 2001), reproductive biology (Johnston, 2000) and competitive interactions with variable crayfish (*Cambarus latimanus*; Johnston 2003) and banded sculpin (*Cottus carolinae*).

Distribution: Restricted to Coldwater Spring and spring run in east-central Alabama in the Coosa River drainage.

Abundance: Approximately 25,000 individuals in the spring pool and 2,500 in the spring run.

Threats: Extremely small native range and complete dependence on Coldwater Spring aquifer increases vulnerability to extinction. Although it is protected in the spring with an agreement between USFWS and the Anniston Water Works and Sewer Board (which removes less than half of the 32 million gallons per day outflow), groundwater contamination is a concern from the nearby Anniston Army Depot where hazardous compounds are stored (USFWS, 1991). Banded sculpin, which are excluded from the spring pool by a weir, are a potential predation threat to pygmy sculpin in the spring pool. Predation or competition with this species, together with limited habitat and changes in water quality, may limit the population size of pygmy sculpin in the spring run and its distribution in Coldwater Creek.

Proposed Conservation Actions:

1. Continue to develop and implement methods for removal of contaminants from Dry Creek and the recharge area of the aquifer. Environmental Protection Agency, USFWS, and the U.S. Army are working

towards decreasing the threat of groundwater contamination.

2. Continue working with Anniston Water Works and Sewer Board to maintain minimum spring flows. Continue water quality monitoring (Coldwater Spring) and groundwater monitoring by other agencies (wells throughout spring recharge area and Dry Creek).
3. Establish a monitoring program for pygmy sculpin in the spring pool and run. This program should account for variation in numbers with habitat type.
4. Implement regular monitoring of Coldwater and Dry creeks for pygmy and banded sculpins.

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Crystallaria cincotta – Diamond Darter

Background: One of only two species of darters in the genus *Crystallaria*, the diamond darter (maximum size 3 in [77 mm] SL) was described recently (Welsh and Wood, 2008) and not yet been reviewed for federal listing, but is considered critically imperiled in West Virginia (WVDNR, 2007). Previous conservation actions include genetic analyses (Wood and Raley, 2000; Morrison et al., 2006), a distribution and habitat assessment (Osier, 2005), and a threat assessment (Strager, 2008).

Distribution: Historically occurred within the Ohio River basin in the Cumberland, Elk, Green, and Muskingum River drainages in Kentucky, Ohio, Tennessee, and West Virginia (Welsh and Wood, 2008; Welsh et al., 2009). Extirpated from Kentucky (Burr and Warren, 1986), Ohio (Trautman, 1957), and Tennessee (Etnier and Starnes, 1993); extant within the lower 36 km of the Elk River in west-central West Virginia (Cincotta and Hoeft, 1987; Welsh and Wood, 2008).

Abundance: No population estimates available; very rare. Despite concerted sampling efforts, only 16 individuals collected from Elk River in 28 years; 12 individuals collected during the period of 1980 to 2005 (Welsh and Wood, 2008) and 4 collected in 2008 (S. Welsh, unpublished data).

Threats: Reduced range increases vulnerability to extinction. Large dams, river channel and flow modifications, water quality degradation from urban and rural sources, excessive sedimentation, and the effects of habitat fragmentation are likely principal causes for its widespread extirpation. Its rarity in the Elk River may be attributed to degradation of benthic habitats by sedimentation (Grandmaison et al., 2003; Strager, 2008).

Proposed Conservation Actions:

1. Conduct additional sampling and monitoring of the Elk River population to assess occupancy rates and further define its range.
2. Sample additional streams within the Ohio River drainage where populations were previously present.
3. Initiate a captive breeding program if and when appropriate broodstock can be obtained. Maintain a captive population and draft a plan for a reintroduction program. Include studies of reproductive biology and early life history as additional components of the captive breeding program.

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Etheostoma chermocki – Vermilion Darter

Background: This brightly colored darter (maximum size 2.4 in [60 mm] SL) was described in 1992 (Boschung et al., 1992) and was listed as federally Endangered in 2001 (USFWS, 2001). It is state protected in Alabama (ALDWFF, 2007) and considered a species of Highest Conservation Concern (Blanchard and Drennen, 2004). Previous conservation actions include status surveys (Blanco et al., 1995; 1996; Blanco and Mayden, 1997; Stiles and Blanchard, 2003; Khudamrongsawat, 2007), examination of population genetics (Khudamrongsawat, 2007), a life history study (Khudamrongsawat et al., 2005), and propagation techniques using the Warrior darter (*Etheostoma bellator*) as a surrogate (Rakes and Shute, 2005a). In addition, a federal recovery plan has been developed for this species (USFWS, 2007b).

Distribution: Restricted to only 12 km of Turkey Creek and two of its tributaries in the Locust Fork system of the Black Warrior River drainage in north-central Alabama (Blanchard and Drennen, 2004).

Abundance: Small population estimated from 1,667 to 2,919 individuals in the late 1990s (Blanco, 2001). Variably common at scattered locations within its range, however several populations have shown significant decline since 1990s (Stiles and Blanchard, 2003; USFWS, 2007b).

Threats: Extremely small native range and fragmented populations within that range plus benthic specialization increases vulnerability to extinction. The species occu-

pies an area of increasing and often poorly regulated urban and industrial development which has lead to heavy sedimentation, eutrophication, streambed modifications, as well as flashy runoff and fluctuating flows (Blanchard and Drennen, 2004; USFWS, 2007b).

Proposed Conservation Actions:

1. Continue to work with public and private stakeholders on sustaining and improving the watershed management plan designed to encourage best management practices in construction, forestry, and agriculture. Efforts should be made to help reduce sedimentation, nonpoint source pollution, and stormwater runoff and also improve water quality while protecting and enhancing riparian zones. Current stakeholders, including Jefferson County, the city of Pinson, the Society to Advance Resources at Turkey Creek, Freshwater Land Trust, and the State of Alabama, have made significant gains in protecting the area within the Turkey Creek watershed**.**
2. Establish regular status surveys of existing populations and continue monitoring stream habitats, water quality, and flows.
3. Obtain additional life history and habitat data.
4. Develop and implement a habitat restoration plan.

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Etheostoma chienense – Relict Darter

Background: The relict darter only reaches a maximum size of 3 in [76 mm] SL. It was described in 1992 (Page et al., 1992) and listed as federally Endangered in 1993 (USFWS, 1993). It is listed in Kentucky as Endangered and is considered a species in need of conservation action (KSNPC, 2005; KDFWR, 2005). A draft recovery plan was issued in 1994 (USFWS, 1994b), but a final plan has not been completed. A 5-year review was recently completed (USFWS, 2008). Previous conservation actions include information on distribution and abundance, threats, and reproductive biology. For example, the use of artificial spawning substrates, such as ceramic tiles, has been found to enhance reproduction (Piller and Burr, 1999). Other conservation actions included increased efforts to work cooperatively with landowners to restore habitat and reduce impacts through better land use practices (e.g., Partners for Fish and Wildlife projects).

Distribution: Endemic to the Bayou du Chien drainage, a direct tributary of the Mississippi River, in extreme southwestern Kentucky. It is currently known from 16 sites in five streams in the upper half of Bayou du Chien drainage (Piller and Burr, 1998).

Abundance: Rare, population size estimated as 9,533–31,293 individuals occupying 47 linear km (29.3 mi.) of stream (Piller and Burr, 1998). Current population size and abundance estimates are unknown.

Threats: Extremely small native range and population fragmentation resulting from habitat deterioration increases vulnerability to extinction. Current regulatory mechanisms have been inadequate to prevent negative impacts to existing populations from channelization, riparian vegetation removal, siltation from poor land-use practices, drainage of riparian wetlands, and pollutants from municipal wastewater plants, resource extraction activities, and agricultural livestock operations. Low abundance levels observed make populations more vulnerable to extirpation from toxic chemical spills, habitat modification, siltation, and nonpoint-source pollution (Piller and Burr, 1998).

Proposed Conservation Actions:

1. Continue to protect, restore, and enhance habitat quality throughout the drainage through cooperative efforts by federal and state agencies and private stakeholders, especially in areas where reproduction has been documented (e.g., Jackson Creek).
2. Complete new survey of Bayou du Chien drainage to determine current status and distribution of the relict darter and associated fish species.
3. Evaluate genetic exchange between populations and genetic variation within populations to assess long-term viability of the species.
4. Determine habitat preferences and movements of larvae and juveniles.
5. Further explore the use of artificial spawning substrates (ceramic tiles, etc.) to enhance reproduction.

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Etheostoma rubrum – Bayou Darter

Background: The bayou darter is one of the smallest members of the subgenus *Nothonotus*, only reaching a maximum size of 2.2 in [57 mm] SL (Page, 1983; Ross, 2001). It was described in 1966 (Raney and Suttkus, 1966) and was listed as Threatened in 1975 (USFWS, 1975). It is designated by Mississippi as Endangered (MMNS, 2001). A revised recovery plan was approved in 1989 (USFWS, 1989b). Previous conservation actions include status surveys (Ross et al., 1992), population estimates (Ross et al., 2001), conservation genetics (Wood, 1996; Slack et al., *in press*) and studies focusing on basic life history (Knight and Ross, 1992; 1994; Ross and Wilkins, 1993; Slack et al., 2004).

Distribution: The bayou darter inhabits Bayou Pierre and lower sections of its major tributaries in southwestern Mississippi (Ross et al., 1992; 2001; Slack et al., 2004). The species tends to not occur in headwater reaches and is noticeably absent from Little Bayou Pierre despite the occurrence of suitable habitat (Ross et al., 1992).

Abundance: Greatest densities occur in the zone of active headcutting, primarily in the middle section of Bayou Pierre and the lower portion of Foster Creek, ranging from 3–10 individuals/m^2, but most sites with darters support <1 individual/m^2 (Ross et al., 2001).

Threats: Extremely small native range and population fragmentation resulting from headcutting increases vulnerability to extinction. Bayou Pierre is experiencing accelerated erosion in the form of headcutting as the system stabilizes from downstream channel modifications such as meander cutoffs, channelization, and in-stream and bankside gravel mining (Patrick et al., 1991a; b; Ross et al., 2001). The bayou darter has moved upstream following the zone of active erosion in response to development of upstream riffle habitat (Ross et al., 1992; Ross et al., 2001). From 1940 to 1994, the rate of knickpoint movement has varied from 48 to 750 m/year (Patrick et al., 1991b; Ross et al., 2001). Once the headcutting cycle reaches the headwaters, however, it is uncertain how much suitable habitat will remain. While headcutting results in the creation of upstream riffle habitat, it also promotes sedimentation of suitable downstream habitat. The bayou darter continues to persist downstream of the active headcut, but in low numbers.

Proposed Conservation Actions:

1. Reduction or cessation of activities that exacerbate headcut formation and knickpoint migration.
2. Continue promoting landowner cooperation by negotiating cooperative agreements with local stakeholders (board of supervisors, private landowners, timber companies, highway departments) to reduce erosion within the system by establishing conservation easements and streamside buffer zones and also implementing bank stabilization programs to restore previously damaged areas. Some examples of these efforts include establishing Partners for Fish and Wildlife agreements with landowners for small-scale bank stabilization projects, continued dialogue between USFWS and timber companies concerning the importance of watershed conservation, and providing recommendations to Mississippi Department of Transportation and National Park Service regarding bank stabilization projects in proximity to the Bayou Pierre watershed.
3. Restrict gravel mining in or near Bayou Pierre.

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Percina aurora – Pearl Darter

Background: The Pearl darter only reaches a maximum size of 2.4 in [60 mm] SL. It was described in 1994 (Suttkus et al., 1994) and listed as a Candidate for federal protection in 1999 (USFWS, 1999). It is designated by Mississippi as Endangered (MMNS, 2001). Previous conservation actions include status surveys (Bart and Piller, 1997; Bart et al., 2001; Ross et al., 2000; Slack et al., 2002; 2005), conservation genetics (Dugo et al., 2008), and studies focusing on captive propagation (Ross et al., 1998; Schofield et al., 1999; CFI, 2003; Schofield and Ross, 2003).

Distribution: The species is historically known only from the Pearl and Pascagoula River drainages in south-central and southeastern Mississippi and extreme eastern Louisiana. Pearl darters have not been taken in the Pearl River since 1973 and are considered extirpated from that system (Suttkus et al., 1994; Bart and Piller, 1997).

Abundance: The species is uncommon and rarely encountered in routine sampling. In targeted sampling it has been collected in abundances as high as 58 individuals per day in the Pearl River and 32 individuals per day in the Pascagoula River (Slack et al., 2005). No population estimates are available.

Threats: The species persists only in the Pascagoula River system and thus occupies less than 50% of its former range. The Pearl darter depends on mainstem portions of rivers, and its demise in the Pearl River was likely the result of completion of Ross Barnett Reservoir, which

caused geomorphic instability in the lower Pearl River, and low sill dams constructed to serve the West Pearl Navigation Waterway, which blocked migration to upstream spawning areas. This species is vulnerable to nonpoint-source pollution, urbanization, and changes in river geomorphology due to its localized distribution (Bart et al., 2001; Schofield and Ross, 2003). Increased urban and commercial development within the Pascagoula River watershed may result in increased runoff, sedimentation, and water withdrawal and discharge from the waterway.

Proposed Conservation Actions:

1. Investigate geomorphic changes in the Pearl and Pascagoula river systems and the relationship of these changes in the Pearl River to Ross Barnett Reservoir and flow regime changes in the West Pearl River. Explore conservation advantages of removing low sill dams associated with the defunct West Pearl Navigation Waterway.
2. Continue developing protocols for captive rearing including thermal tolerances and survivorship. The USFWS initiated a propagation program for this species in 2003 with Conservation Fisheries, Inc. (CFI), but the program has been met with limited success.
3. Develop a more integrated program demonstrating the importance of maintaining natural hydrologic regimes and adequate bankside vegetation in the Pearl and Pascagoula rivers. A partnership of the Pascagoula River Watershed Team, the USACE, the Pearl River Water Management District, and The Nature Conservancy could develop such a program.

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Percina jenkinsi – Conasauga Logperch

Background: A long, tiger-striped darter (maximum size 4.6 in [116 mm] SL), the Conasauga logperch was first captured in 1969 and described in 1985 (Thompson, 1985). It was listed as federally Endangered with critical habitat designated in 1985 (USFWS, 1985) and a recovery plan was completed in 1986 (USFWS, 1986). The Conasauga logperch is designated by Georgia and Tennessee as Endangered (TDEC, 2004; GADNR, 2006). Previous conservation efforts have largely focused on habitat restoration with cooperative landowners, including stream bank restoration and installing riparian buffers. Captive propagation was attempted by CFI in 2002, but initial efforts were unsuccessful (Rakes and Shute, 2005b). Ongoing efforts funded by USFWS, U.S. Forest Service, and U.S. Geological Survey include a study of conservation genetics (George et al., *in review*), surveys to estimate occupancy and detection (Freeman et al., 2006), and water quality monitoring in the Conasauga River (Freeman et al., 2006).

Distribution: Restricted to 55 river km of the mainstem Conasauga River (Coosa River system of the Mobile Basin) in northwestern Georgia and southeastern Tennessee (Thompson, 1985; George et al., *in review*).

Abundance: The best available estimate suggests a population size of 200 adults (George et al., *in review*). Over the past 20 years, numbers observed at historic localities have consistently declined and some localities are no longer being occupied by the species (Freeman et al., 2006).

Threats: Extremely small native range increases its vulnerability to extinction. Poor agricultural practices have led to sedimentation, nutrient enrichment, and pesticide runoff, resulting in a decline in the water quality (GADNR, 1998; Roghair et al., 2001). Conasauga logperch are particularly susceptible to siltation, which interferes with their feeding mode of flipping rocks during foraging (Jenkins and Burkhead, 1994). Recent flooding and drought events may have further jeopardized this species and increasing suburban development with competing demands for water pose future threats (Freeman et al., 1996).

Proposed Conservation Actions:

1. Riparian buffers should be installed to filter agricultural runoff and fencing erected to prevent livestock from entering the river.
2. Outreach programs on ways to minimize stressors to the Conasauga River should be increased for landowners, government officials, and local students.
3. Pilot captive propagation projects need to continue for ark populations or augmentation. Captive propagation must be done in conjunction with genetic analyses due to the small population size of the species.
4. Continue meetings with local government officials and other stakeholders to develop ordinances and guidelines to minimize the impact of future urbanization on the river.
5. The cause of the recent decline in aquatic vegetation, particularly river weed (*Podostemum*), must be determined and reversed.

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Elassoma alabamae – Spring Pygmy Sunfish

Background: The spring pygmy sunfish is one of the smallest fishes in the Southeast, with a maximum size of 1 inch (25 mm) SL. In 1938, the only known population (Cave Spring, Lauderdale Co., AL) was extirpated with the formation of Pickwick Reservoir. Another population discovered in 1941 at Pryor Spring (Limestone Co., AL) was extirpated by 1945 from aquatic herbicide treatment (Jandebeur, 1979). The species was thought extinct until its rediscovery in Beaverdam Creek (Limestone Co., AL) in 1973. It was proposed for federal listing in 1979, but the proposal was never finalized (J. Williams, pers. comm.). The spring pygmy sunfish was described in 1993 (Mayden, 1993). It is state protected in Alabama (ALDWFF, 2007) and considered a species of Highest Conservation Concern (Warren, 2004). A recent status review recommends this species be reconsidered for federal protection (Conway and Mayden, 2006).

Distribution: A single population occupies a five-mile stretch of Beaverdam Creek in north-central Alabama (Sandel, 2008). In the mid 1980s, populations were re-established in two spring pools at Pryor Branch (Mettee and Pullium, 1986), but suffers from groundwater withdrawal, herbicide application, and inbreeding, and may be re-extirpated.

Abundance: Rare and localized. May exceed 1 fish per cubic meter in optimal habitat of shallow vegetated areas of five spring pools, but low densities elsewhere in Beaverdam Creek (Sandel, 2008).

Threats: Extremely small native range and spring specialization increases vulnerability to extinction (Mayden, 1993). Chronic drought and increased irrigation has reduced spring flows and desiccated shoreline aquatic vegetation, eliminating critical habitat for this species. Of seven spring pools occupied by the spring pygmy sunfish, five are pumped for irrigation at rates of up to 16,000 gallons per minute (over four times the discharge rate during summer), and three were completely drained in 2007, resulting in the extirpation of two subpopulations and a 99% reduction in the third (Sandel, 2008). Rapid industrial and suburban growth threatens Beaverdam Creek with contamination, further groundwater withdraw, disruption of aquifer recharge via impervious surface runoff, and sedimentation (Warren, 2004). In light of these threats, it is imperative that USFWS list the spring pygmy sunfish as Endangered.

Proposed Conservation Actions:
In early 2008, a conservation summit was hosted by USFWS for the spring pygmy sunfish. The following conservation actions are derived, in part, from a list of priorities produced at that meeting.

1. Purchase property within the watershed and recharge area, especially within 150 feet of spring pools, wetlands, and spring runs (Warren, 2004).
2. Establish a water resource management plan for Beaverdam Creek, which regulates and schedules all municipal and agricultural withdrawals of surface and groundwater within the watershed and aquifer, and monitors groundwater levels and chemistry, with the ultimate goal of maintaining acceptable spring flow and minimum water levels in spring pools.
3. Determine the recharge area of the local aquifer.
4. Develop a regulation that limits the amount of impervious surface over the recharge zone, and identifies appropriate riparian buffers (91 m or 300 feet) surrounding Beaverdam Creek and all confluent spring pools.
5. Continue to develop captive husbandry protocol in collaboration with CFI, the Alabama Aquatic Biodiversity Center, or the Riverbanks Aquarium in Columbia, SC.

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TABLE 1. Distribution data and abundance for the Desperate Dozen.

Species	State (current)	State (historical)	Habitat	Narrow endemic	Once widely distributed	Abundance
Alabama sturgeon	AL	MS	Big river		Yes	2 individuals seen in last 9 yrs
Slender chub	TN, VA		River		Yes	1 individual seen in last 21 yrs
Chucky madtom	TN	AL?	Small creek		?	3 individuals seen in last 14 yrs
Alabama cavefish	AL		Cave	Yes		Fewer than 100 individuals
Pygmy sculpin	AL		Spring	Yes		27,500 individuals
Diamond darter	WV	KY, OH, TN	Big river		Yes	16 individuals seen in 28 yrs
Vermilion darter	AL		Small creek	Yes		1,667 to 2,919 individuals
Relict darter	KY		Small creek	Yes		9,533 to 31,293 individuals
Bayou darter	MS		River	Yes		Most sites < 1 individual per m^2
Pearl darter	MS	LA	Big River		Yes	No estimates
Conasauga logperch	TN, GA		River	Yes		200 individuals
Spring pygmy sunfish	AL		Spring	Yes		No estimates

TABLE 2. Threats to the Desperate Dozen.

Species	Threat 1	Threat 2	Threat 3
Alabama sturgeon	Habitat alteration - dams & dredging	Historical overharvest	
Slender chub	Reduced range	Water pollution - industrial & agricultural	
Chucky madtom	Small range	Water pollution - agricultural	
Alabama cavefish	Small range & specialization	Aquifer reduction & pollution	
Pygmy sculpin	Small range & specialization	Water pollution	Competition
Diamond darter	Reduced range	Habitat alteration - dams	Water pollution - sedimentation
Vermilion darter	Small range & fragmentation	Water pollution & flows - urban	
Relict darter	Small range & fragmentation	Habitat alteration - channelization	Water pollution
Bayou darter	Small range & fragmentation	Habitat alteration - head cutting	
Pearl darter	Habitat alteration - dams	Water pollution - urban & industry	
Conasauga logperch	Water pollution – agriculture and siltation	Small range	
Spring pygmy sunfish	Small range & specialization	Aquifer reduction	Water pollution

TABLE 3. Proposed conservation actions (PCA) for the Desperate Dozen.

Species	1st PCA	2nd PCA	3rd PCA	4th PCA	5th PCA
Alabama sturgeon	Tracking	Broodstock capture/propagation	Fish passage	Water quality	Protect habitat
Slender chub	Survey abundance	Cause of decline	Propagation	Genetics	Life history data
Chucky madtom	Watershed plan	Propagation	Survey		
Alabama cavefish	Watershed plan	Survey abundance/ monitor water quality	Life history data	Survey	
Pygmy sculpin	Decontaminate watershed	Monitor water quality	Survey abundance	Survey competitors	
Diamond darter	Survey abundance	Search additional populations	Propagation		
Vermilion darter	Watershed plan	Survey abundance/ monitor water quality	Life history data	Habitat restoration	
Relict darter	Watershed plan	Survey abundance	Genetics	Life history data	Spawning techniques
Bayou darter	Habitat restoration	Watershed plan	Restrict gravel mining		
Pearl darter	Habitat restoration	Propagation	Watershed plan		
Conasauga logperch	Habitat restoration	Outreach programs	Propagation/genetics	Restrict impacts	Address aquatic vegetation decline
Spring pygmy sunfish	Purchase property	Watershed plan	Determine recharge area	Limit impervious surfaces	Propagation

TABLE 4. Year of species description, current status of federal protection (Candidate, Threatened, or Endangered), status of critical habitat, recovery plan, and 5-year reviews, and imperiled status in conservation publications for the Desperate Dozen.

Species	Year Described	C	T	E	Critical Habitat	Recovery Plan	5-year Review	Warren et al., 2000	Jelks et al., 2008
Alabama sturgeon	1991			2000	2009	NO	NO	E	E
Slender chub	1956		1977		1977	1983	2008	E	E
Chucky madtom	2005	2002						T	E
Alabama cavefish	1974		1977	1988	1977	1990	NO	E	E
Pygmy sculpin	1968		1989		NO	1991	2008	E	E
Diamond darter	2008							T	E
Vermilion darter	1992			2001	NO	2007	2008	E	E
Relict darter	1992			1993	NO	1994 draft	2007	E	E
Bayou darter	1966		1975		NO	1990	2006	E	E
Pearl darter	1994	1999						E	E
Conasauga logperch	1985			1985	1985	1986	2005	E	E
Spring pygmy sunfish	1993							E	E

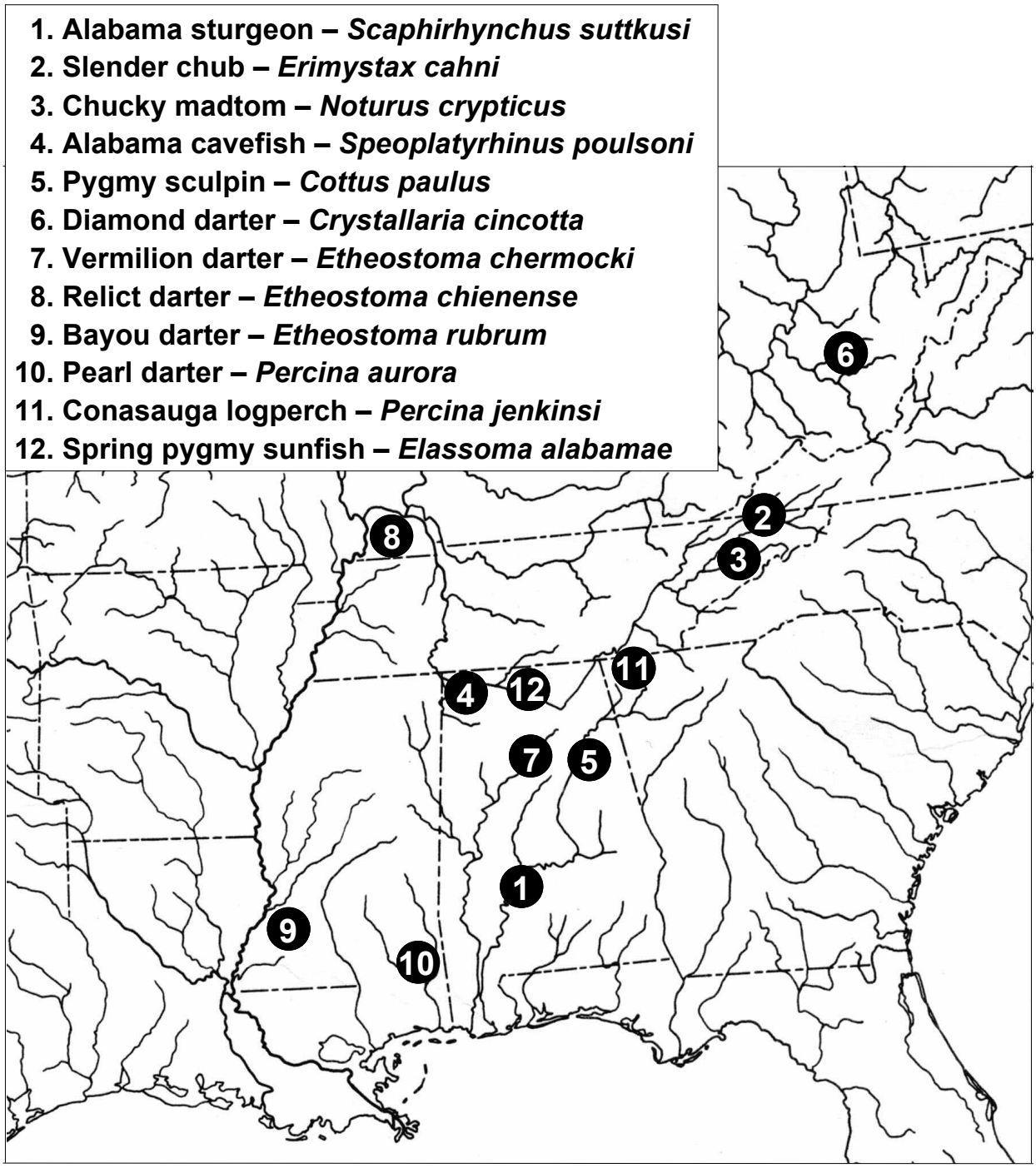
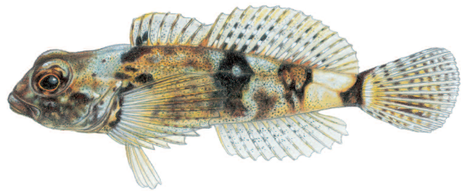


FIGURE 1. Distribution of the Desperate Dozen in the southeastern U.S.

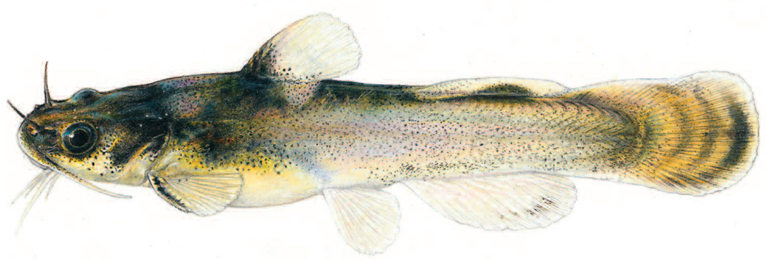
Alabama sturgeon, *Scaphirhynchus suttkusi*



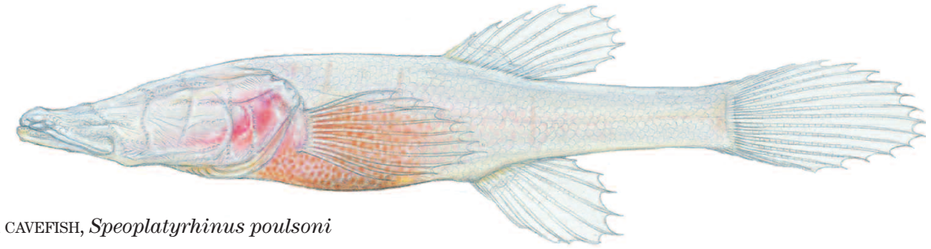
Pygmy sculpin, *Cottus paulus*

Vermilion darter, *Etheostoma chermocki*

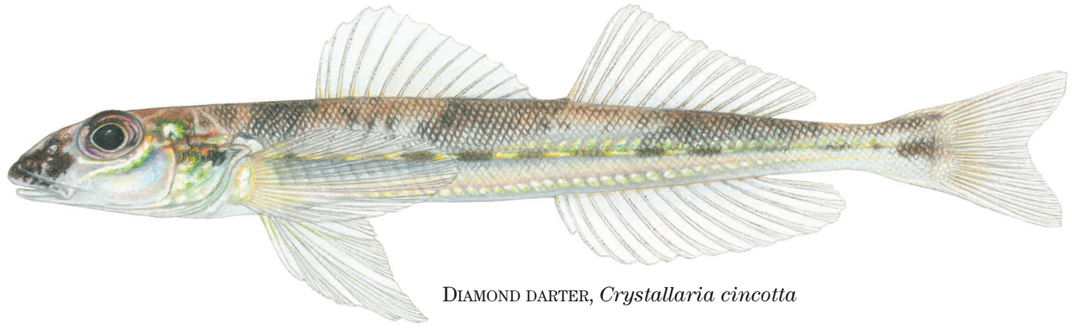
Spring pygmy sunfish, *Elassoma alabamae*



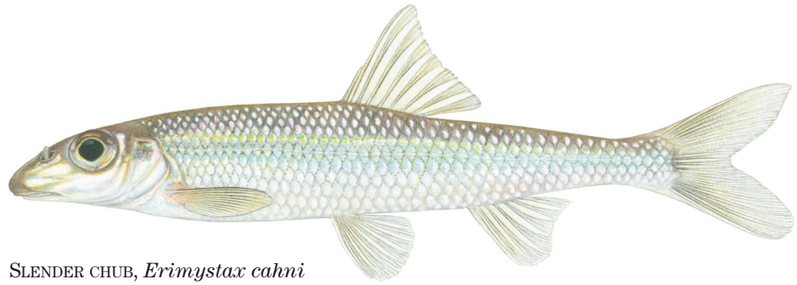
Chucky madtom, *Noturus crypticus*



Alabama cavefish, *Speoplatyrhinus poulsoni*



Diamond darter, *Crystallaria cincotta*



Slender chub, *Erimystax cahni*

Relict darter, *Etheostoma chienense*

Bayou darter, *Etheostoma rubrum*

Conasauga logperch, *Percina jenkinsi*

Pearl darter, *Percina aurora*