Amber Darter
(*Percina antesella*)

5-Year Review:
Summary and Evaluation

March 2021

U.S. Fish and Wildlife Service
South Atlantic–Gulf and Mississippi Basin Regions
Georgia Ecological Services Field Office
Athens, Georgia

5-YEAR REVIEW
Amber Darter / Percina antesella

I. GENERAL INFORMATION

A. Methodology used to complete the review:

In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. We announced initiation of this review on March 25, 2020 and requested information in a published *Federal Register* notice with a 60-day comment period (85 FR 16951). We received two public comments during the 60-day open comment period. We used a variety of information resources, including long-term monitoring data provided by the Georgia Department of Natural Resources and University of Georgia. Specific sources included a Species Status Assessment (SSA) evaluating the biology and status of amber daters (Service 2019a), the final rule listing this species under the Endangered Species Act (ESA) (50 FR 31597); the Recovery Plan (Service 2019b); peer reviewed scientific publications; unpublished field observations by Federal, State, and other experienced biologists; unpublished studies and survey reports; and notes and communications from other qualified individuals. The completed draft review was sent to affected U.S. Fish and Wildlife Service field offices. Comments were evaluated and incorporated into this final document as appropriate. The SSA report represents our evaluation of the best available scientific information, including the resource needs and the current and future condition of the species (Service 2019a). Since the SSA underwent peer review and represents our most current knowledge of the species, this document which summarizes that information did not undergo additional peer review.

B. Reviewers

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Tennessee Ecological Services Field Office

C. Background

1. **Federal Register Notice citation announcing initiation of this review:**
   March 25, 2020. 85 FR 16951.
2. **Listing history**
   Original Listing
   Federal Register Notice: 50 FR 31597
   Federal Register Notice date: August 5, 1985
   Effective listing date: September 4, 1985
   Entity listed: Species

Classification: Endangered

3. **Associated rulemakings: None.**
4. **Review history:**
   Each year, the U.S. Fish and Wildlife Service (Service) reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a recovery data call that included status recommendations, such as "Stable", for this species. We continue to show this species' status recommendation in 5-year reviews. The last review conducted in 2014 showed this species as "Decreasing".
   a. **Recovery Outlines, Recovery Plan Amendments, Recovery Implementation Strategies:**
   b. **Previous 5-year Reviews:**
      - November 6, 1991 (56 FR 56882) – Multiple species were evaluated with no species-specific assessment of the five factors or threats as they pertained to recovery. No change was proposed for the status of the amber darter.
      - October 21, 2014 (74 FR 31972) – The Amber darter was evaluated along with the Cherokee and Etowah darters. It provided updated life history, genetic, and monitoring information and documented the observed decline in the Conasauga population. No change was proposed for the status of the amber darter.
   c. **Species Status Assessments:**
      - November 2019 – The SSA synthesized count data from long-term monitoring (1996-2019), genetic variation data, and shoal habitat occupancy data documenting the species' very low to low resiliency, low redundancy, and low to moderate representation. It concluded that the species is nearly undetectable in the Conasauga, and that recovery may require locating or establishing new viable populations, improving population connectivity, and reducing environmental stressors to improve juvenile recruitment.
5. **Species' Recovery Priority Number at start of review (48 FR 43098): 5**
   Degree of Threat: High
   Recovery Potential: Low
   Taxonomy: Species
6. **Recovery Plans**
   Name of plan: Recovery Plan for Conasauga Logperch (*Percina jenkinsi*) Thompson and Amber Darter (*Percina antesella*)
   Date issued: June 20, 1986
   Name of plan: The Mobile River Basin Aquatic Ecosystem Recovery Plan
   Date issued: November 17, 2000
   Name of plan: Revised Recovery Plan for the Amber Darter (*Percina antesella*)
   Date issued: January 9, 2020

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) Policy

1. **Are these species under review listed as DPSs?** No.
2. **Is there relevant new information that would lead you to consider listing these species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes.
2. **Adequacy of recovery criteria:**
   d. **Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** Yes.
   e. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?** Yes.
3. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been achieved:**
   a. *Two stable, self-sustaining populations exist in both the Conasauga and Etowah Rivers, as evidenced by population trends over multiple spawning cycles.*
   Status: Not met. Based on long-term monitoring, the Conasauga population of the amber darter has declined significantly and has not been detected during surveys since 2017 (unpublished data, University of Georgia).
   b. *Eighty percent of shoals within the species' historic range in each river system are consistently occupied by the species.*
   Status: Not met.
   c. *Key water quality standards are met such that the species will remain viable, based on population viability analysis or other scientifically defensible evaluation methods, for the foreseeable future.*
   Status: Not met.
   d. *Amber darters are protected from habitat threats and/or managed such that the species will remain viable, based on population viability analysis or other scientifically defensible evaluation methods, for the foreseeable future.*
   Status: Not met.

C. Updated Information and Current Species Status

1. **Biology and Habitat**
   a. **Summary of new information of species biology and life history:**
   In 2019, the Service, along with several experts from the Georgia Department of Natural Resources, USGS, and University of Georgia, compiled the most current biological information for amber darters in the SSA (Service 2019a). Please refer to that document for details on the species biology and life history.
   b. **Abundance, population trends, demography:**
   Long-term monitoring data (1996-2020) suggest that both the Conasauga and Etowah populations of the amber darter are declining (Figure 2). Multivariate autoregressive state-space modeling, conducted by the University of Georgia and

U.S. Geological Survey (USGS), estimated that amber darters declined approximately 9-12% annually in the Conasauga and 9% annually in the Etowah River over the past two decades (Stowe et al. 2020). Occupancy of Conasauga shoals also declined between 1995-2014 (Freeman et al. 2017; Figures 1 and 2), and amber darter abundance in both systems have greatly reduced in the lower reaches of the historic range. As numbers declined, each population has become more vulnerable to environmental, demographic, and genetic stochastic processes. Analyses suggest that, at current rates of decline, amber darters would be effectively undetectable by traditional sampling methods by 2050. Stowe et al. (2020) project low catch-per-unit-efforts (i.e., one individual in 200 seine-sets at a given shoal) by 2032 in the Conasauga and between 2033 and 2042 in the Etowah. No observations or captures have been recorded in the last 3 years of monitoring (2018-2020) in the Conasauga despite fairly consistent sampling effort of 9 sites sampled in 2018, 14 sites in 2019, and 5 sites in 2020 (University of Georgia, unpublished data).

c. Genetics:

Despite the relatively large geographic distance between amber darter populations in the Etowah and Conasauga rivers, analysis of mitochondrial DNA and more rapidly-evolving nuclear microsatellite markers suggest that amber darter populations in the Etowah and Conasauga rivers have genetic differences but still represent a single species (summarized in the 2019 SSA; Freeman et al. 2012).

d. Taxonomic classification or changes in nomenclature:

None.

e. Distribution and trends in spatial distribution:

The amber darter has not been collected in the Conasauga basin since 2017 despite annual survey efforts (Fig. 1; University of Georgia, unpublished data). Survey efforts in the Conasauga basin has been fairly consistent year-to-year since 1996, sampling at least a set of occupied shoals. The lack of collections/observations is not believed to be related to reduced effort, but declining abundance and reduced ability to detect the species. In the last 5-year review, the species appeared to occupy a 19-mile reach of the basin. Monitoring in 2014-2016 detected the species at 6 shoals. This indicates that the species has likely undergone further decline in the system.

In the Etowah River basin, most observations of the amber darters have been recorded at shoals within a 28-mile reach of the mainstem Etowah River, from just above its confluence with Amicalola Creek downstream to where the Etowah is impounded as Lake Allatoona. In 2019, researchers at the University of Georgia recorded the furthest upstream occurrence along the Etowah mainstem (~4.5 km upstream from the nearest occupied shoal). Fish sampling in the Etowah River has been fairly regular in the last few decades by the Service, UGA, and DNR. This new collection could represent a slight population range expansion upstream or an indication of individual(s) dispersing upstream from a downstream source rather than an over-looked portion of an existing population. Further details on the species' historical and current distribution are in the 2019 Species Status Assessment (Service 2019a).

f. Habitat or ecosystem conditions:

Agricultural, industrial, silvicultural, and urban development, as well as stochastic events have influenced the quantity and quality of suitable habitat for the amber darter in the Conasauga and Etowah watersheds (Table 1).

Studies have documented high levels of agriculturally derived nutrients (Sharpe and Nichols 2007; Baker 2012) and contaminants (Lasier et al. 2016) and bioavailable estrogen (Jacobs 2013) in the Conasauga's water, sediments, and aquatic biota. Long-term monitoring of benthic habitat demonstrates a shift from cobble and gravel substrates, free of silt or accumulated biofilm, and vegetated by riverweed (*Podostomum ceratophyllum*) that characterized the amber darter's Conasauga habitat in the 1980s to observations of benthic algal mats and declining *Podostemum* by the early 2000's (Freeman and Freeman 2019, Freeman, Argentina and Hagler 2005). Later studies quantified a decrease in *Podostemum* cover and biomass from upstream to downstream (Argentina, Freeman and Freeman 2010b, Argentina 2006, Baker, Hagler and Freeman 2013), and corresponding downstream increases in algal and diatom mats and declines in multiple taxa of benthic macroinvertebrates and fishes (Baker et al. 2013, Argentina et al. 2010b, Bumpers and Freeman 2017). These trends were observed both from upstream to downstream along the Conasauga mainstem and at particular shoals over time (Freeman and Freeman 2019). Further details on the species' habitat are in the 2019 Species Status Assessment (Service 2019a) (USFWS 2019).

g. Other:

Climate change is expected to bring more extreme weather events, such as flooding and drought. Hydrologic flows impact the availability and connectivity of shoal habitat, as well as spawning and recruitment behaviors of amber darters. For example, spring floods may be a factor limiting recruitment of amber darters (Hagler and Freeman 2014), who benefit from windows of low spring flow for spawning and recruitment success. High flows may damage eggs, wash larvae from nursery areas, prevent juveniles from migrating upstream to suitable shoal habitat, and increase turbidity and sedimentation that degrades habitat. Successive years of high spring flows may limit or eliminate juvenile recruitment at a given site with implications for the population.

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

a. Present or threatened destruction, modification or curtailment of its habitat or range:

In the 35 years since the amber darter was listed, some threats have been mitigated while key stressors associated with stream channel modifications and land use change persist and are expected to persist into the future. The 2019 SSA for the amber darter outlined current and emerging stressors, including fine sediment, excess nutrients, increased impervious surfaces, glyphosate-based herbicide, lack and/or removal of riparian buffers, declines in *Podostemum*, and reservoirs and dams (Table 1).

Surface waters in the Conasauga and Etowah River basins continue to receive pollution from point- and non-point source discharges associated with mining,

agriculture, industrial, and municipal development wastewaters and stormwater runoff. In the Conasauga basin, land use have contributed to changes in water quality associated with 1) a largescale shift to use to Roundup-ready seed and pesticide applications to agricultural fields, 2) widespread application of poultry litter to fertilize pastures and row crops and 3) hundreds of agricultural ditches bypass standard agricultural water quality BMPs, like riparian buffers or grass filter strips, and convey polluted runoff directly into the river and its tributaries.

In the more urbanized Etowah basin, sedimentation, fish passage barriers, impoundments, increased stormwater runoff (due to increased effective impervious area), and other human activities are sources of chronic stress on these fishes. Impoundments throughout the Conasauga and Etowah basins, and construction of a new reservoir, the 137-acre Russell Creek Reservoir, is currently underway in Dawson County will be completed by 2024. While it will not directly fragment amber darter habitat, land clearing and reservoir operations will affect water quality and hydrology of habitat on the Etowah mainstem (USFWS 2019).

Changes in land use within the Conasauga and Etowah watersheds have led to removal of riparian buffers and increased impervious surfaces within the watersheds with implications on stream ecosystems and biota. As the amount of impervious surface grows, precipitation runoff volume and rate increases, transporting more nutrients and contaminants into streams and rivers that support amber darters and other aquatic life. Furthermore, altered flow patterns in more "flashy" urban streams often destabilizes channel morphology, and impacts water quality, and restructures aquatic communities. Walsh et al. (2005) summarized the "urban stream syndrome" where urban streams consistently demonstrated impaired water quality, more flashy and erosive flows, a shift from sensitive to tolerant invertebrates and fishes. Amber darters are unlikely to occur in shoal habitat within a watershed with just 10% effective impervious area (Wenger et al. 2008, Wenger 2008). By 2016, the Conasauga basin had, on average, 3.01% impervious area and the upper Etowah basin had 3.71% impervious area (National Land Cover Dataset 2016). With increasing population growth in the region, percent impervious area is expected to continue into the future.

b. Overutilization for commercial, recreational, scientific, or educational purposes:

At the time of listing, there was concern that general public knowledge of the species distribution may lead to more collection. However, published maps only show the species distribution in general terms without coordinates of survey sites. Despite the issuance of multiple Endangered Species Act Section 10 permits that authorize presence-absence surveys, ecosystem studies, genetic studies, and other projects, we have seen no evidence that this is a significant threat. Although not known to be a large-scale threat, micro fishing (fishing that targets small minnows/shiners (family Cyprinidae) and darters (family Percidae)) has been increasing since 2012. There are several active groups, which have captured listed minnows (e.g., blue shiners (*Cyprinella caerulea*) and have targeted darters in both the Etowah and Conasauga River basins). Another potential pressure on shoals in the Conasauga is the continued interest in snorkeling at a few specific diverse and popular shoals in the basin. Each of these activities along with scientific collection

could be an added stressor that results in modifying fish behavior and inadvertent mortality from individuals walking through the habitat.

c. Disease or predation:

At the time of listing, there was concern that predation in reaches immediately below dams could threaten the species. We have seen no evidence that this is a significant threat.

d. Inadequacy of existing regulatory mechanisms:

The following regulatory frameworks protect the amber darter's habitat to varying degrees:

- The State of Georgia's Endangered Wildlife Act of 1973 (O.C.G.A. 27-3-130 *et seq.*) limits protection of listed species to individuals found on State public lands (excluding Georgia Department of Transportation lands). Individuals on private lands are unprotected by State law.
- Tennessee Nongame and Endangered or Threatened Wildlife Species Conservation Act of 1974 (Tenn. Code Ann. § 70-8-101) makes it unlawful for any person to take, attempt to take, possess, transport, export, process, sell or offer for sale or ship nongame wildlife.
- Clean Water Act (33 U.S.C. §1251 *et seq.*) Total maximum daily loads have been developed for the Conasauga basin that work to address issues of water pollution (e.g., fecal coliform).
- Georgia Erosion and Sedimentation Act (O.C.G.A. 12-7-1 *et seq.*) requires an erosion, sedimentation, and pollution control plan for land-disturbing activities on sites >1 acre. It requires minimal stream buffer protection (25-ft buffer between a permitted land-disturbing activity and a non-trout streams) and a buffer variance may be obtained. Water quality violations do happen and can result in impacts to amber darters and their habitat.
- Tennessee Water Quality Control Act of 1977 (Tenn. Code Ann. § 69-3-101) requires a 60-foot natural riparian buffer between a land-disturbing activity and a receiving stream designated as impaired or an Exceptional Tennessee waters. A 30-foot natural riparian buffer zone is required adjacent to all other streams.

Agriculture and forestry are fully or partially exempt from regulation under Georgia's Erosion and Sedimentation Control Act and the Tennessee Water Quality Control Act. The States address threats associated with agriculture and silviculture primarily through voluntary State BMPs. Compliance for forestry BMPs for stream protection have been evaluated in Georgia and Tennessee, where we see over 80-96% compliance for the projects that were assessed (Georgia Forestry Commission 2017, 2019, 2015; Tennessee Forestry Commission 2019). Agricultural BMPs are encouraged through cost-share and assistance programs with the Natural Resources Conservation Service, Georgia Soil and Water Conservation Commission, and the USDA Farm Service Agency. The degree of compliance with BMPs for agricultural activities have not been systematically measured in either state.

e. Other natural or human-related factors affecting its continued existence:

Amber darters generally occupy shoal habitat along the mainstem of the Conasauga River, and the mainstem and certain large tributaries of the Etowah River above Lake Allatoona. Amber darters are exhibiting marked declines in abundance and occupancy (Fig. 2; Stowe et al. 2020); their limited geographic distribution along mostly linear reaches of river makes the species vulnerable to localized extirpations in the event of toxic chemical spills, catastrophic natural events (e.g., flood or severe drought), genetic drift, and other stochastic events.

Climate change presents a more global stressor already affecting populations of the amber darter and other rare and threatened fishes. Persistent threats on freshwater systems from climate change include increasing water temperatures, altered discharge (e.g., high spring flows), and interactions among these and other factors. However, the effects of climate change on aquatic species in the Conasauga and Etowah River basins have not been studied. Climate models project that weather variability will increase in the southeastern U.S., resulting in more frequent and extreme dry and wet years over the next century (Ingram et al. 2013, Mulholland et al. 1997). Increasing water temperatures, decreasing dissolved oxygen levels, altered streamflow patterns, increased demand for water storage and agricultural irrigation, and increasing toxicity of pollutants will impact aquatic systems (Ficke, Myrick and Hansen 2007, Rahel and Olden 2008). Reduced spring and summer rainfall, coupled with increased evapotranspiration and water demand, could lead to severe dry-downs and local extirpation (Ingram et al. 2013). Climate change is resulting in large-scale shifts in the range and abundance of species (Lenoir and Svenning 2015, Pacifici et al. 2017). Models suggest that shifts in species' ranges will continue, with freshwater organisms generally moving northward to higher latitudes (cooler waters) and to greater depths (Urban 2015). Dispersal ability and habitat suitability will determine whether fishes not constrained by movement barriers could move upstream to cooler waters. However, the amber darter was not known to occur further upstream of the TN Hwy 74 crossing in the Conasauga, or above Dawson Forest Wildlife Management Area in the Etowah, or in tributaries except close to the confluence with the mainstem river. While threatened and endangered species management has focused on maintaining or restoring historical conditions, this approach may no longer be effective as the climate changes. In the Conasauga and Etowah basins, strategically restoring and conserving areas that support species or suitable habitat, including potential habitat in areas upstream with cooler temperatures, ensuring habitat connectivity, and active approaches such as controlled propagation and reintroduction will be key components in helping the amber darter adapt to changing environmental conditions.

D. Synthesis

The 2019 Species Status Assessment for the amber darter describes current and emerging stressors to the Conasauga and Etowah populations, including excess nutrients and sedimentation caused by a lack or removal of riparian buffers and increased impervious surfaces, fish passage barriers, and declines in benthic macrophytes and habitat quality. The amber darter has become increasingly rare in the Conasauga River basin with no captures since 2017, which makes its continued viability in the system tenuous. While regulatory mechanisms that are protective of some amber darter habitat (primarily water quality) have

improved, agriculture and forestry are fully or partially exempt from these regulations, and BMP implementation is limited. The species' limited geographic range, small population size, and increases in threats related to changes in water quality, quantity, and timing make it vulnerable to catastrophic events that could eliminate large portions of one or both populations. Therefore, at this time, the amber darter continues to meet the definition of an endangered species under the Act.

III. RESULTS

A. Recommended Classification: No change is needed.

B. New Recovery Priority Number: 5

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Assessment and monitoring of current and potential suitable habitat in the Conasauga, Etowah, and Coosawattee River basins
- Investigating species' demographics and threat sensitivity
- Protecting and restoring key parcels via land acquisition, conservation agreements, and conservation easements
- Restoring shoal habitat in the Conasauga and Etowah basins to promote adequate substrate, flows, and water quality, moderate spring flows, and increase shoal habitat connectivity
- Developing controlled captive propagation and reintroduction plans for the species
- Monitoring and reducing sources of sedimentation, nutrients, toxins, and contaminants impacting amber darter habitat in the Conasauga and Etowah basins (e.g., nutrient management plans and trading programs, sediment trapping projects, livestock exclusion, subsurface fertilizer application, streamside buffers, streamside fencing, continuous no-till, cover crops)
- Develop and implement local/county/state policy to regulate stormwater management, nutrient management, and earth-moving activities, establishing stormwater utility fees, and other actions to address urban, agricultural, and industrial stressors in the Conasauga and Etowah basins
- Develop and implement state and local government policy and regulations to improve protection of the fish and its habitat and enhance enforcement of such policies and regulation

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TABLES AND FIGURES.

Table 1. Current and emerging stressors to amber darters in the Conasauga and Etowah basins that may lead to habitat loss or impairment, physiological stress, or change in food base. Physiological stress and change in food base can lead to reduced survival and fecundity, and increased predation and disease risk. Habitat loss or impairment can result in the loss of protective cover and reduced spawning habitat.

Stressor	Effect on Amber darters	References
Fine sediment (legacy, agricultural, development)	Habitat loss and impairment, physiological stress, change in food base	(Walters, Leigh and Bearden 2003, Jackson et al. 2005, Jones et al. 1999)
Excess nutrients (fertilizer, human/animal waste)	Habitat loss and impairment, physiological stress, change in food base	(Sharpley et al. 2013, Hebert, Fugere and Gonzalez 2019)
Increased impervious surface	Habitat impairment, physiological stress due to more runoff containing sediment and toxins	(Wenger et al. 2010, O'Driscoll et al. 2010, Wenger et al. 2008)
Glyphosate-based herbicides	Physiological stress	(Lasier et al. 2016, Benbrook 2016, Golovanova and Aminov 2019, Hebert et al. 2019, Villamar-Ayala et al. 2019)
Lack/loss of riparian buffers	Habitat impairment, physiological stress due to more runoff containing sediment and toxins	(Jones et al. 1999, Roy et al. 2006)
Declines in *Podostemum*	Habitat loss and impairment	(Argentina, Freeman and Freeman 2010a, Davis, Beaumont and Wood 2018, Hutchens Jr, Bruce Wallace and Romaniszyn 2004, Wood and Freeman 2017)
Reservoirs and dams	Habitat loss and fragmentation	(Freeman, Pringle and Jackson 2007)
Climate change	Physiological stress due to increasing temp, change in food base, more extreme variability in hydrologic flow	(Hagler and Freeman 2014, Ficke et al. 2007, Ingram et al. 2013, Mulholland et al. 1997, Pacifici et al. 2017, Urban 2015)

Figure 1. Current (2000-2019) occupancy ranges of amber darters in the Conasauga and Etowah basins. Known amber darter streams/rivers include all historic and currently occupied rivers and tributaries. Historic and currently occupied HUC10 watersheds within these streams/rivers are shown in yellow.

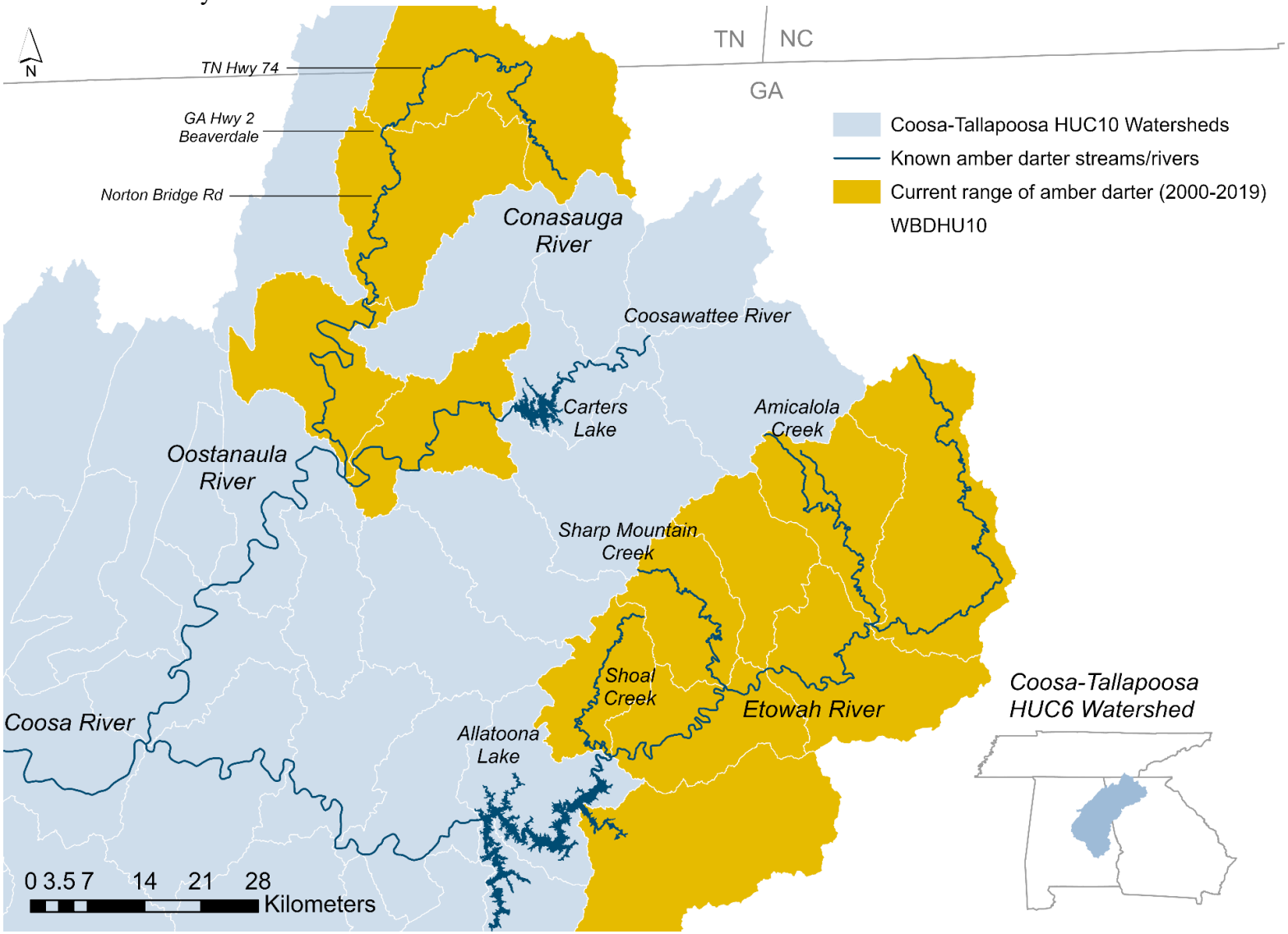
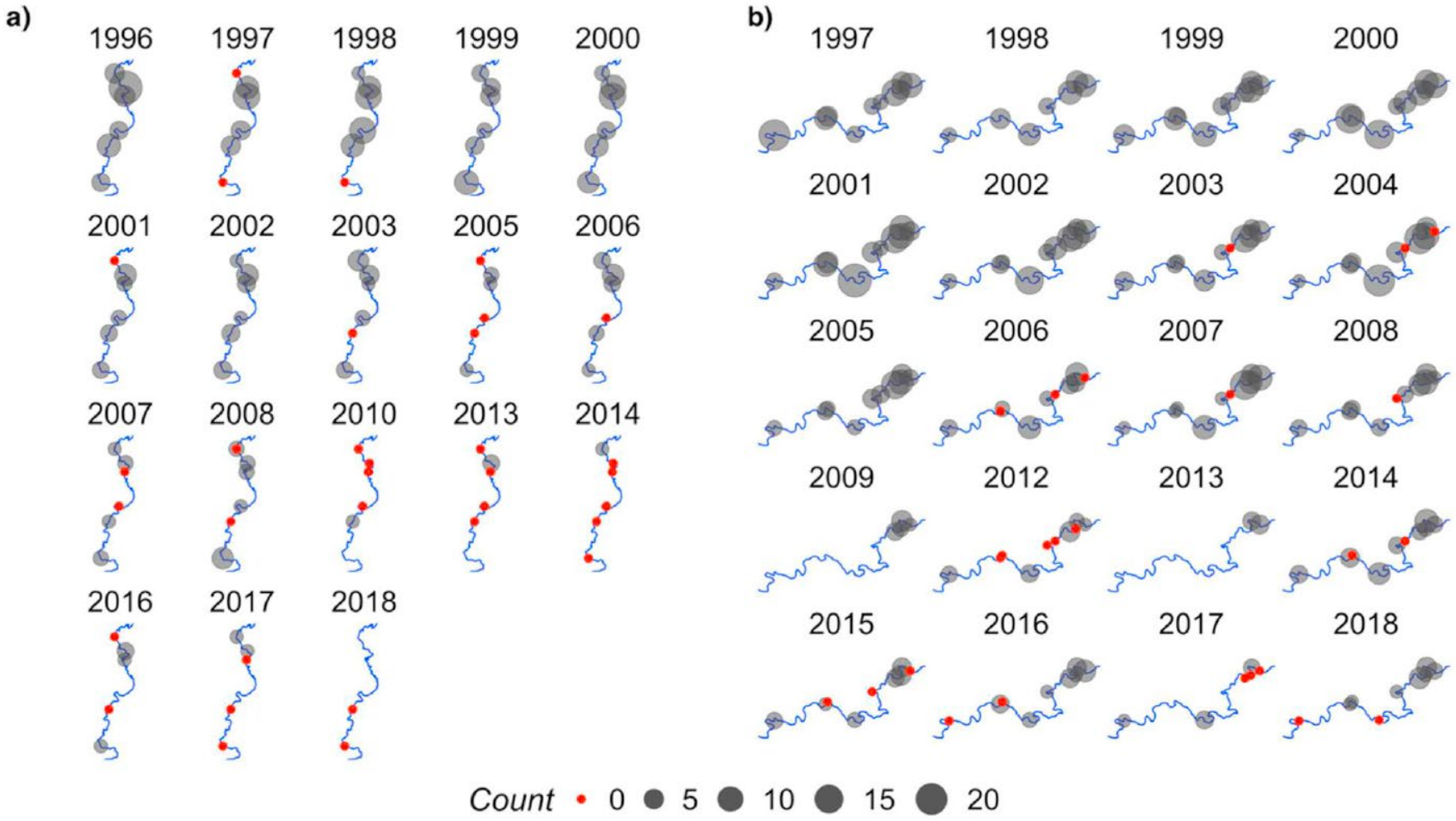


Figure 2. Counts of amber darters at 16 long-term sampling locations in the Conasauga (a) and Etowah (b) river sampling reaches from 1996 to 2018 (not all sites were sampled in all years; each sampled site is shown by a red or gray circle). Sites are not depicted in years when they were not sampled. Absent years indicate that no sampling was conducted during that time period. Red dots indicate shoals that have had known amber darter occurrences in the past but were sampled and amber darters were absent for that collection year (Source: Stowe et al. 2020)



U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Amber Darter (*Percina antesella*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

_____ Downlist to Threatened
_____ Uplist to Endangered
_____ Delist
__X__ No change needed

Review Conducted By: Martha Zapata, Georgia Ecological Services Field Office.

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve 

_____ Date __23 March 2021__
Donald W. Imm, Georgia Ecological Services