South Carolina mayflies (Insecta: Ephemeroptera) of Conservation Concern

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Abstract: Nine mayfly species (Insecta: Ephemeroptera) that may be of conservation concern in South Carolina are discussed. Three such species associated with sand-bottomed streams are Acanthametropus pecatonica (Burks, 1953), Dolania americana Edmunds & Traver, 1959 and Homeoneuria dolani Edmunds, Berner & Traver, 1958. Three species of potential concern are associated with Hornleaf Riverweed (Podostemum ceratophyllum Michaux, 1803), and they include Barbaetis benfieldi Kennedy, 1985, Heterocloeon berneri (Muller-Liebenau, 1974) and Tsalia bernerii (Allen & Edmunds, 1958). Mayflies of slow or stagnant waters that may be of conservation concern in South Carolina include Arthroplea bipunctata (McDunnough, 1924), Macaffertium lenati (McCafferty, 1990) and Siphlonurus decorus Traver, 1932. Biological, ecological and geographic distribution studies of each species are reviewed. The South Carolina record of A. bipunctata is questionable. New data are provided for S. decorus.

Introduction

South Carolina is home to 185 documented species of mayflies (Insecta: Ephemeroptera), making it one of the North American states or provinces with greatest species richness; it is arguably second only to neighboring North Carolina, which has at least 207 species1,3. Nine of South Carolina’s mayfly species should be considered species of potential conservation concern within the state. In several cases, the species are threatened throughout their global range; in other cases, only their South Carolina populations may be in jeopardy. Even if the latter case is true, the South Carolina populations historically may have represented important genetic reserves due to their being either isolated, or to their being on the periphery of the overall geographic distribution of the species.

During the species evaluation period of this project, it became apparent that South Carolina’s rarest mayflies fell into three distinct larval habitat categories: sand-bottomed streams, streams with Hornleaf Riverweed (Podostemum ceratophyllum Michaux, 1803) and slow or standing waters. Each of these habitats faces significant threats.

Critical habitat 1: sand-bottomed streams

Streams with shifting sands tend to have benthic macroinvertebrate communities that are low in diversity, but highly specialized in their morphologies and behaviors. In general, these habitats are neglected by biologists, due in part to their low diversity4, but also due to difficulties associated with working in deep, swift water, with an unstable bottom5. However, macroinvertebrate denizens of these habitats have been generally under pressure for many years6,7, and the psammophilous mayflies, in particular, may be in serious jeopardy9, due to threats from habitat alteration and pollution. For the conservation requirements of these species to be addressed properly, significant time and effort will need to be expended, using specialized equipment and techniques. Until a comprehensive assessment can be done and new data collected on a broad scale, the following should be considered species of potential conservation concern.

Acanthametropus pecatonica (Burks, 1953)8

This species has been listed on the Wisconsin Endangered and Threatened Species List and has been considered endangered throughout its entire range of geographic distribution. Notably, it has been extirpated from parts of its range in Illinois and Wisconsin9. Aside from these two states, the species is known only from single historical locations in Georgia and South Carolina8,9. In South Carolina, it is known only from the Savannah River in Barnwell County. The only confirmed South Carolina record data9 for this species are based on specimens taken at Mile 157 in May 1952. Some differences may exist between the Southeast and Upper Midwest populations11, but these populations have been considered to be of a single species8.

If the populations eventually prove to represent different species, then the outlook for the southeastern variety will be even more dire. Acanthametropus pecatonica has been considered to be a vulnerable southeastern species12, and it has been listed officially as such13. In Wisconsin, the species is found in moderate- to large-sized, fairly rapid streams with rocky, but dominantly sandy, substrates in late spring through middle summer5,14,15. In particular, it has been found in rapidly shifting, fine silt and sand habitats, in current of about 0.5 – 1.0 m/s at a depth of about 0.5-1.5 m. The species appears tolerant of warm and at least somewhat eutrophic conditions, as long as the dissolved oxygen levels remain relatively high; some of its streams receive wastewater treatment effluents upstream of the species’ habitat. Difficulties associated with sampling the species’ habitat contributes to its scarce collection. No data are available about the population density of the species, but it might be relatively abundant in the extremely localized, proper habitat conditions, even though no large number of specimens ever has been collected at a single time8. Although no data are available about the diet and feeding behavior of this species, its mouthpart morphology suggests it is a predator, perhaps on chironomid midge larvae (Diptera: Chironominae), like other species in its family16. The highest protection possible has been recommended for historical locales of this species until more research can be done8.
Dolania americana Edmunds & Traver, 195917 (Behningiidae)

This is an eastern United States species that is known in South Carolina from only two streams: the Savannah River and Upper Three Runs Creek. It is primarily a species of the Southeast, but a disjunct population is known from Wisconsin19. This disjunct distribution pattern is similar to that seen for Acanthametropus pecatonica, above. This has been considered to be a vulnerable southeastern species20, and it has been listed officially as such. Further, more extensive discussion of this species is given elsewhere, and will not be repeated here.

Homoeoneuria dolani Edmunds, Berner & Traver, 195820 (Oligoneuriidae)

This species is a strictly southeastern United States species21. In South Carolina, this species is known only from the Savannah and South Saluda Rivers in Allendale, Barnwell and Greenville Counties. Elsewhere, it is known from Florida and Georgia, with most of the Georgia records being from the Savannah River, and thus shared with adjacent South Carolina. The larvae of this species are nearly transparent and thus easily overlooked. They are filter-feeders and live in shallow burrows in sand-beds of swiftly-flowing streams, usually in deeper water, where the substrate is free of vegetation. The species probably has one generation per year, with an extended flight period from late spring through middle autumn; adults swarm from mid morning until about noon on sunny days, about 1 m above the water’s surface.

Critical habitat 2: Hornleaf Riverweed

Hornleaf Riverweed (Podostemum ceratophyllum) plays an important role in providing habitat structure for many aquatic macroinvertebrates. The riverweed may itself be an indicator of environmental health, being sensitive to landscape-level environmental changes. Surely, the following mayflies are at least as sensitive. Protection of landscapes that drain into Podostemum streams may be warranted.

Barbaetus benfieldi Kennedy, 1985 (in Waltz et al., 1985)29 (Baetidae)

This is a species of clean, southeastern United States mountain streams, and it is the only species in its genus, representing an important component of regional and global phylogenetic diversity29.30. In South Carolina, it is known from three streams in Aiken (Cedar Cr.), Pickens (Cane Cr.) and York (Wildcat Cr.) Counties, with the most recent collections taken in 2000. Outside South Carolina, it has been reported only from North Carolina and Virginia, with it being considered endangered in Virginia. At least nine North Carolina populations have been found, all from far western, mountainous areas, with a concentration near the extreme northwestern tip of South Carolina. This species has been considered to be vulnerable, and it has been listed officially as significantly rare in North Carolina. Larvae are associated with Riverweed in stream ripples at a depth of about 0.5-2.5 m where the flow is about 0.5 m/s. Physical and chemical parameters vary widely, including temperature, but dissolved oxygen is always near the saturation point which is typical of rapidly flowing streams. This species has one generation per year, with adults emerging from late April through middle May. This species drifts at night, with 10 individuals per 100 cubic meters of water having been observed.

Heterocloeon bernerii (Muller-Liebenau, 1974)36 (Baetidae)

This species is known only from the extreme southern Appalachians. It is known in South Carolina from two streams (Flat Shoals R., Little R.) in Oconee County, with the most recent collections being from the former location in 2000. Elsewhere, it is only known from Cherokee and Lumpkin Counties in northern Georgia, not far from the extreme northwestern tip of South Carolina. The larva of the species occurs in rapidly flowing warm water at a depth of about 15-65 cm. It may be associated with crevices in rocks covered by Riverweed in streams with otherwise sandy and gravelly substrate. The species may not have sensitivity to slight siltation or even general turbidity. The ventral abdominal protuberances possibly serve as adhesive structures for life in swift current.

Tsalia bernerii (Allen & Edmunds, 1958)36 (Ephemerellidae)

This is a strictly southern Appalachian species, and it is the only species in its genus, representing an important component of regional and global phylogenetic diversity. This species is known in South Carolina from only the Little River in Oconee County, with the most recent specimens taken in 1997. Elsewhere, it is known from scattered locations in Georgia, North Carolina, Tennessee and Virginia. This species has been considered to be vulnerable, and little is known about its specific ecological requirements. The species sometimes is locally abundant in larger streams with densities of more than 200 individuals/square meter. It is found in mats of Riverweed and Watermoss (Fontinalis Hedwig, 1801), on rootmats and on rocks in riffle areas. Where it is found, the general stream substrate is composed of exposed bedrock, coarse pebbles and some cobbles. Water temperatures tend to be cool (ca. 12-15°C). The species has been collected from streams below impoundments. Subimagos emerged in early afternoon through early evening.

Critical habitat 3: slow or standing waters

South Carolina’s diverse wetlands are of particular conservation interest, because they have continued to demonstrate a net loss in the state, even with construction of new wetlands and mitigation efforts in place. Each of the following mayfly species lives all or a significant part of its life in backwaters, overflows or slow edge-waters, especially during the later larval instars. Each species requires additional study in South Carolina, but until much more is known, each should be considered a species of concern in the state.

Arthroplea bipunctata (McDunnough, 1924)40 (Arthropleidae)

This Holarctic species is relatively widespread throughout Canada and the northeastern United States (including parts of the Upper Midwest), but it is primarily a far northern species. The species has been listed as occurring in both North Carolina and South Carolina, but the North Carolina reports have been disregarded recently, probably due to lack of substantiating data. Outside the Southeast, the nearest record is from northeast Ohio. The only South Carolina record is of a single larva from Boone Creek in Oconee County. This represents the only
potentially verifiable Southeast data for the species, but material has not been located for verification. Recently discovered North Carolina voucher material in the Purdue Entomological Research Collection proved to be a misidentification of Cinygula subaequilis (Banks, 1914) (Heptageniidae), a heptageniid species with protruding maxillary palps that very superficially resembles Arthroplea. A similar misidentification might be the case for the South Carolina record of Arthroplea. If the South Carolina report represents a bona fide record of the species, then it is the extreme southern limit of its distribution. The genus is relatively easy to identify. The larva occurs in stream overflow areas and backwaters with little or no flow, among coarse organic material, a habitat often neglected during field surveys of aquatic macroinvertebrates.

Maccaffertium lenati (McCafferty, 1990) (Heptageniidae)

This species is a strictly southeastern United States species. In South Carolina, this species is known only from the western front of the piedmont, from a tributary of Watermelon Creek in Anderson County and from “Lake Isaquenna” in Pickens County, with the latter representing its most recent data, having been collected in 1987. Elsewhere, it is known only from North Carolina, though from about 40 sites. The species appears to favor transition areas on the edges of the piedmont ecological region and thus may demonstrate a relatively narrow set of physiochemical habitat requirements. In the appropriate streams, later larval instars are found on large rocks in slow current, either near the head of a riffle or near the banks. Adults emerge in middle May.

Siphlonurus decorus Traver, 1932 (Siphlonuridae)

This southeastern United States Coastal Plains species has not been reported for over 35 years. In South Carolina, this species is known only from Orangeburg County, based on adult material collected in April; no other data have been available until now. Elsewhere, it is known only from two swamps in North Carolina. The larva remains unknown, so specific habitat requirements are not determinable at this time. However, given the biology of the genus and this particular species’ tentative association with Coastal Plain swamps, it is likely that the larva, especially the later instars, will be found in standing or very slow flowing waters. Obvious threats include wetland habitat destruction and alteration. Concerted efforts should be made to verify the continued existence of this species.

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References


