reased tidal flux associated with the levee breach may be useful in simulating a nario of rising sea level.

Fluorescence spectral characteristics of natural organic matter from utheastern U.S. rivers. *H. Townsend* (Wake Forest University) and J. J. berts.* Surface water samples were taken from four Georgia (St. Mary's, Satilla, amaha and Ogeechee) and three South Carolina rivers (Edisto, Black and Pee e) during May to July 1993. Filtered (<0.45 μm) water from each river was sequently ultrafiltered to obtain three organic matter (OM) size fractions: 00K OM (<0.45 μm but > 100,000 dalton nominal molecular weight - NMW), 0K OM (10,000 to 100,000 dal NMW), and <10K OM (<10,000 dal NMW). ch fraction, along with an aliquot of non-ultrafiltered water, was analyzed to ermine fluorescence excitation, emission spectra and dissolved organic carbon OC) concentration. Mass balance calculations of DOC in the fractionation pro- lure gave average recoveries of 89.1 ± 13.8%. Total DOC contents of the rs ranged from 2.9 to 27.3 mg C l^{-1} with size fractions >100K OM and >10K M together representing 48 to 68% of the total DOC. The predominance of ge molecular sized organic matter is similar to the distribution observed in these rs during previous studies conducted in summer 1991. The excitation spectra non-ultrafiltered water exhibited a single broad peak with a maximum at 0 ± 12 nm. Emission spectra of these samples were broad with major peaks 462 ± 2 nm and 482 ±3 nm. Emission and excitation spectra of the ultrafil- ed fractions had the same peak locations. It appears that natural riverine anic matter from sources in both Georgia and South Carolina have similar ak wavelength characteristics in fluorescence spectra, regardless of the relative lecular size or geographic origin of the DOC sampled. Intensity of chro- phore fluorescence (relative fluorescence intensity mg^{-1} C) of the intermediate fraction (> 10K OM) was significantly higher than either of the other fractions the non-ultrafiltered water, indicating that natural riverine OM of intermediate has greater chromophore conjugation than other size fractions of riverine anic compounds.

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NEW RECORDS OF *ZAPUS HUDSONIUS* AND *NAPAEOZAPUS INSIGNIS* (RODENTIA: ZAPODIDAE) FROM GEORGIA WITH COMMENTS ON THEIR CONSERVATION STATUS

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ABSTRACT

New records of Zapus hudsonius and Napaeozapus insignis are reported from Georgia, including the southernmost record of the latter from Lumpkin County. The conservation status of *Zapus* and *Napaeozapus* are reviewed in a regional context. *Zapus* is uncommon to rare throughout Georgia and adjacent regions of the Southeast. *Napaeozapus* is common in appropriate habitat in Georgia and adjacent regions of the Southeast.

INTRODUCTION

The family Zapodidae is represented in Georgia by two species, the meadow jumping mouse, *Zapus hudsonius* (Zimmerman, 1780) and the woodland jumping mouse, *Napaeozapus insignis* (Miller, 1891). Both species have been regarded as rare in Georgia (1,2,3). *Zapus* was known from 6 specimen records from 5 localities and *Napaeozapus* from 3 specimen records from 3 localities. Since Golley (1), Laerm (2), and Laerm et al. (3), additional information regarding the distribution and status of these mice in Georgia has become available. We report on new distributional records for these species and correct erroneous records. We also provide an assessment of their conservation status in Georgia based on data from surveys here and adjacent regions of the southeastern United States.

METHODS

We examined unpublished field notes and records housed at the University of Georgia Museum of Natural History, collection records of all North American

museums, published literature, and unpublished survey records for *Zapus* and *Napaeozapus* from Georgia. In addition, we report on results of ongoing (1993-present) small mammal surveys in the Blue Ridge (64 sites totalling, 134,120 combined pitfall and snap trap nights), Upper Piedmont (6 sites totalling 6,953 combined trap nights), Cumberland Plateau (10 sites totalling 25,740 combined trap nights), Ridge and Valley (11 sites totalling 5,770 combined trap nights) provinces of Georgia; the Blue Ridge Province of western North Carolina (26 sites totalling 35,136 combined trap nights) and western South Carolina (17 sites totalling 19,500 combined trap nights). Museum acronyms referred to in the text are as follows: MCZ (Museum of Comparative Zoology, Harvard University); UGAMNH (University of Georgia Museum of Natural History); USNM (National Museum of Natural History, Smithsonian Institution).

RESULTS AND DISCUSSION

Zapus hudsonius

Records of Occurrence in Georgia.

Museum records. *Barrow Co.*: 7 mi. E Jefferson, 1 (UGAMNH records, specimen not preserved); *Clarke Co.*: Athens, 1 (USNM); Athens, 2 mi. SE UGA campus, 2 (UGAMNH). *Dekalb Co.*: Pantherville School Road , 1 (UGAMNH); *Franklin Co.*: 2 mi. N Carnesville, 1 (UGAMNH record, specimen not preserved). *Fulton Co.*: No locality given, 1 (MCZ); Long Island Creek at Chattahoochee River, 4 (UGAMNH). *Hall Co.*: 15 mi. NW Gainesville, 1/4 mi. N. Hwy 52 at Hall-Lumpkin County line, 1 (UGAMNH). *Meriwether Co.*: No locality given, 1 (UGAMNH). *Oconee Co.*: Bogart, 1 (UGAMNH). *Oglethorpe Co.*: 2 mi. S Lexington, 1 (UGAMNH); *Union Co.*: Intersection of Hwy 180 and 180 spur leading to Brasstown Bald, 1 (UGAMNH record, specimen not preserved); and *Walker Co.*: 3 mi. W Lafayette, 1 (UGAMNH record, specimen not preserved).

Other records (Numbers in parentheses refer to references). *Clarke Co.*: Athens (4); Athens, 2 mi. SE UGA campus (5), *Dawson Co.*: No locality given, unverified record (1). *Hall Co.*: 15 mi. NW Gainesville, 1/4 mi. N. Hwy 52 at Hall-Lumpkin County line (5). *Oconee Co.*: Bogart (5).

The meadow jumping mouse was first reported from Georgia by Petrides (4), who collected a single individual near Athens, Clarke County in September, 1944. Petrides was apparently unfamiliar with a *Zapus* collected by L. M. Taylor in April, 1935, but never published upon, from Fulton County, Georgia and housed at the Museum of Comparative Zoology, Harvard University. Subsequently, Jenkins and Johnston (5) provided three additional published records: a specimen trapped 15 mi northwest of Gainesville, Hall County; a skin (specimen not preserved) recovered from a rattlesnake 2 mi. south of Whitehall, Clarke County; and a skull recovered in owl pellets at Bogart, Oconee County. Golley (1) plotted the Petrides (4) and Jenkins and Johnston (5) records on his range map for *Zapus*, but was apparently unaware of the MCZ Fulton County record. Golley also plotted two additional records: one from Meriwether County (no locality data available) and another from Dawson County. However, we can find no records of a Dawson County specimen in other publications or in museum collections. Laerm (2) erroneously reported a record of *Napaeozapus* from Franklin

County. The specimen is *Zapus hudsonius*. New records of occurrence in addition to these are listed previously.

Distribution and status in adjacent regions of the Southeast

The meadow jumping mouse ranges throughout much of Canada from the Arctic tree line south into the central and eastern United States (6,7). In the southeastern United States it occurs throughout most of Virginia including some of the barrier islands (8,9,10,11,12,13,14,15,16,17,18,19), but apparently is absent from the southeastern most counties (14,20,21) despite the range maps of Whitaker (6) and Hall (7). Contrary to Handley and Patton (11) and Webster et al. (14) there are *Zapus* records from southwestern Virginia (9). It is restricted to the Piedmont and Blue Ridge provinces of North Carolina (8,22,23,24,25,26,27) and South Carolina (28,29,30,31,32). Alabama records are restricted to Lee County at the lower limits of the Piedmont (33,34,35,36,37). A single record is reported from northern Mississippi (38,39). It apparently occurs state-wide in Tennessee (25,40,41,42,43,44,45,46,47,48). In Kentucky, contrary to Taylor and Horn (49), it is known only west of the Kentucky River (50,51,52).

Throughout its range, *Zapus* is associated with a variety of habitats in which there is ample herbaceous ground cover, such as moist weedy or grassy fields and dense herbaceous vegetation in woodlands (6,53,54,55). In the Southeast, they are also reported from upland grassy fields and brushy woodlots (5,15,19,27,35,44,51,52), mixed hardwoods (47,48), and mixed pine and hardwood communities (38). In Georgia, they are associated with wet meadows, open woods floodplains, and grassy areas near streams (1,2).

Zapus may be common to abundant in appropriate habitat in the more northern portions of its range (6,53). However, through most of the Southeast it is regarded as rare. It is monitored by the Alabama Department of Conservation and Natural Resources and the Mississippi Natural Heritage Program. It is considered a species of special concern by the Tennessee Department of Environment and Conservation, Ecological Services Division and the South Carolina Wildlife and Marine Resources Department.

Status in Georgia

We regard *Zapus* as rare in Georgia. It is known from only 15 records despite significant survey efforts. Over 5000 snap trap-nights during 1978 near the Barrow County locality yielded only a single record (2). Thousands of snap trap-nights by faculty and students at the University of Georgia over the past 40 years in Clarke County have yielded only two records subsequent to those of Petrides (4) and Jenkins and Johnson (5). Over 50,000 combined pitfall and snap trap nights recorded throughout the Blue Ridge Province during 1978-1980 yielded only two records, one each from Union County and Walker counties (2). No *Zapus* were captured during 1993-present small mammal surveys in the Ridge and Valley Cumberland Plateau, Blue Ridge or upper Piedmont provinces of Georgia. None were recovered in our surveys of the Blue Ridge of western North Carolina and South Carolina. However, in the Blue Ridge of southeastern Tennessee, Harvey et al. (47) reported 7 captures in 7,369 snap trap nights and 1 capture in

226,054 pitfall trap nights. In northeastern Tennessee, Harvey et al. (48) reported only 2 captures in 5,168 snap trap nights and none in 389,995 pitfall trap nights.

These surveys represent an intensive effort in the region and have provided significant information on numerous other species previously regarded as rare (47,48,56,57,58,59,60). Compared to other small mammals in the region, *Zapus hudsonius* is either rare or unusually difficult to trap. Reasons for its rarity are uncertain.

Napaeozapus insignis

Records of occurrence in Georgia.

Museum records. Fannin Co.: Jacks River, 10 mi. S Tennessee State Line, 1 (UGAMNH); Devils Den Branch, 1 (UGAMNH). *Lumpkin Co.*: Wahsega, 1 (UGAMNH); Dockery Lake Recreation Area, 1 (UGAMNH). *Rabun Co.*: Burnt Cabin Branch, 2 mi. N Tate City at North Carolina State Line, 1 (UGAMNH); Hwy 106 near North Carolina State Line, 1 (UGAMNH); Black Rock Mountain State Park, 2 (UGAMNH); Glassy Mountain, approximately 1.0 mi. W top of Mountain on FS 11, 1 (UGAMNH); Rabun Bald, 1 (UGAMNH). *Towns Co.*: Ga Hwy 180 Spur, 0.3 mi. S Brasstown Bald visitor center, 2 (UGAMNH); Beech Creek at Tallulah River, 2 (UGAMNH); 3 mi. W St. Augustine along Hwy 16, 1 (UGAMNH); Brasstown Bald, 1 (UGAMNH). *Union Co.*: 1.9 mi. WSW Suches, 1 (UGAMNH); 2.3 mi. WSW Suches, 2 (UGAMNH); 2.1 mi. SW Suches, 2 (UGAMNH); 2.0 mi. W Suches, 2(UGAMNH); Sosebee Cove, 1 (UGAMNH); 0.25 mi. N Lake Winfield Scott on Hwy 180, 5 (UGAMNH); 1.25 mi. N Lake Winfield Scott on Hwy 180, 5 (UGAMNH); Turkey Creek, 4 mi. E Ga 60 on FS 33, 2 (UGAMNH); Board Camp, 0.5 mi. W FS 39 and GA 180, 1 (UGAMNH); Bryant Gap, 2 (UGAMNH); Buckeye Gap, 1 (UGAMNH); 0.75 mi. W GA 180 and FS 107, 10 (UGAMNH); Cooper Creek Scenic Area, 3 (UGAMNH); 0.5 mi. W Fanny Gap, 2 (UGAMNH); Sosebee Cove Scenic Area, 5 (UGAMNH); .

Other records (Numbers in parentheses refer to references): *Rabun Co.*: Hwy 106 near North Carolina State Line (61). *Lumpkin Co.*: Wahsega (1). *Fannin Co.*: Jacks River, 10 M S Tennessee State Line (1). *Towns Co.*: Beech Creek (62).

The woodland jumping mouse was first reported from Georgia by Autrey and Odum (61) who collected a specimen in Rabun County near the North Carolina state line. Golley (1) plotted the Autrey and Odum record on his range map for *Napaeozapus* as well as two additional records, one from Wahsega, Lumpkin County, and another from along the Jack's River, Fannin County. Subsequently, Wharton (62) noted the presence of the species at Beech Creek in Towns County. A record of *N. insignis* was erroneously reported by Laerm (2) from Franklin County. The specimen referred to was a *Z. hudsonius*. Since Golley (1), Laerm (2) and Laerm et al (3), numerous new county records not previously reported upon are noted above, including a record from Dockery Lake Recreation Area in Lumpkin County which represents the southern-most record for the species throughout its range.

Distribution and status in adjacent regions of the Southeast

The woodland jumping mouse ranges throughout much of southeastern Canada and the northeastern United States south throughout higher elevations of the Appalachian Mountains of Virginia (11,15,17,19,63), eastern Kentucky (50,51,64,65,66,67), eastern Tennessee (25,45,46,47,48), western North Carolina (23,24,27,68), extreme northwestern South Carolina (29,31) and northeastern Georgia (1,2,56,61,62).

Whitaker and Wrigley (69) and Wrigley (70) have shown that the distribution of *Napaeozapus* in the eastern United States coincides with vegetational communities containing spruce (*Picea* sp.)-fir (*Aebes* sp) and northern hardwood types consisting of various associations of beech (*Fagus* sp), maple (*Acer* sp), birch (*Betula* sp), basswood (*Tillia* sp), eastern hemlock (*tsuga canadensis)*, and white pine (*Pinus strobus)*. Throughout its range it is often associated with cool moist environments and many studies have reported it in association with streams, bogs, and swamps (26,70,71,72,73). Other studies report no particular association with habitats near water (55,74,75). Dense herbaceous ground cover (more abundant near water) including sedges and grasses, low woody vegetation, course woody debris and moss covered rocks may be important in its micro-habitat selection (55,70,75). In the South, Wrigley (70) notes the species generally does not occur in areas where the mean air temperature during the warmest months of the year exceeds 21 degrees C. Specimens from Georgia and adjacent regions of North Carolina, South Carolina and Tennessee were found near streams in mixed oak (*Quercus* sp)-hickory (*Carya* sp), mixed oak-white pine and hemlock-rhododendron (*Rhododendron* sp)-white pine stands in areas with substantial structural debris.

The Tennessee Department of Environment and Conservation, Ecological Services Division and the South Carolina Wildlife and Marine Resources Department considers it to be a species of special concern.

Napaeozapus is widely distributed throughout higher elevations of the Appalachians (usually above 800 m), but it tends to be localized in occurrence. Most regional faunal reports indicate that it is uncommon in comparison to other elements of small mammals communities. However, in at least one study in Virginia it was reported to be the most abundant component of a small mammal fauna (15). In southeastern Tennessee, Harvey et al. (47) reported 15 captures in 7,369 trap nights and 1 capture in 226,054 pitfall trap nights. In northeastern Tennessee Harvey et al. (48) reported 8 captures in 5,168 snap trap nights and 53 captures in 389,995 pitfall trap nights. During our recent surveys we recovered 16 specimens in the Blue Ridge of western North Carolina and 24 in the Blue Ridge and Upper Piedmont Provinces of Georgia, where it was the most common rodent trapped in pitfalls (56). However, no *Napaeozapus* were recorded in our surveys in the Cumberland Plateau or Ridge and Valley of Georgia or in the Blue Ridge of South Carolina.

Status in Georgia

Although it is limited in distribution to the Appalachians regionally, and restricted to high elevation woodlands and forest-edge communities, *Napaeozapus* may be common to abundant in appropriate habitat throughout much of the

southern Appalachians including the eastern portion of the Blue Ridge of Georgia, where relatively mesic, high elevation montane communities occur. It is rare in more xeric habitats and at lower elevations in the region. This is probably why we recovered no specimens in the Blue Ridge and Piedmont of South Carolina and why the Georgia localities are restricted to the eastern portion of the Blue Ridge in Georgia. The western portion of the Blue Ridge, including the Cohutta Mountains, of Georgia are characterized by drier oak-hickory-pine communities with much of the area at or below 800 m elevation (76).

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WATER-SOLUBLE N-METHYL DERIVATIVES OF QUINOLYL PORPHYRINS 1. SYNTHESIS, SPECTROPHOTOMETRIC AND COMPUTATIONAL DETERMINATION OF pK_a VALUES.

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ABSTRACT

The synthesis of a water-soluble peripherally positively charged porphyrin, meso-tetrakis(N-methyl-4-quinolyl)porphyrin, (H_2-TMQP(4))#, is described. The pK_a's of the porphyrin have been determined spectrophotometrically, (pK_3 = 0.74 and pK_4 = 0.36), and the values of this porphyrin are compared to those of the tetrakis (N-methyl-4-pyridyl) porphyrin, (H_2-TMPyP(4))#, (pK_3 = 1.5 and pK_4 = 0.4). Corresponding pK_a values and UV-visible spectra of both porphyrins, which contain heterocyclic nitrogens, are comparable.

 # The charges and counter ions of these porphyrins have been omitted for clarity in abbreviations.

INTRODUCTION

Porphyrins belong to a special and unique class of cyclic conjugated tetrapyrrole pigments and they are essential constituents of a number of important biological systems. Their water-soluble derivatives have functioned favorably in a variety of novel medicinal applications. Consequently there is considerable interest in the synthesis of porphyrin compounds that exhibit ideal behavior in aqueous solution (1,2). Some novel chemical and medicinal procedures in which porphyrins are presently being used or tested are: a localization process in neoplastic tissue as a treatment for tumors (3,4); tumor phototherapy and photosensitization (5,6); magnetic imaging contrast agents (7); non-nucleotide anti-HIV activity (8), and nonlinear optical materials (9,10).

The behavior of porphyrin solutions has been a major obstacle for the investigation of chemical properties of these complexes. Either these compounds are insoluble in water, or even if they dissolve, they tend to aggregate (11-13). Thus far, only one water-soluble porphyrin, tetrakis(N-methylpyridyl)porphyrin, (H_2-TMPyP(4)), has not displayed aggregation in aqueous solution. This compound has certain deficiencies. The positive charges of the pyridyl rings, being