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Freshwater Turtles in the Blackwater River Drainage in Southeastern Virginia

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ABSTRACT

We conducted a trapping survey of the freshwater turtles in the Blackwater River (Chowan drainage) located in southeastern Virginia during 1987 and 1988. We captured 565 turtles representing seven species at 57 sites. These were (in order of decreasing abundance): *Sternotherus odoratus*, *Kinosternon baurii*, *Chrysemys picta*, *Trachemys scripta scripta*, *Pseudemys rubriventris*, *Clemmys guttata*, and *Chelydra serpentina*. *Sternotherus odoratus, K. baurii*, and *C. picta* were relatively abundant and widely distributed throughout the drainage. C*helydra serpentina*, *P. rubriventris*, and *T. scripta* were relatively uncommon but the varying catchability of turtles was due to different trap types and their use prevented us from obtaining a clear understanding of their distribution patterns in the Blackwater River drainage. *Clemmys guttata* was found only in small tributaries. The environmental differences between the upper and lower Blackwater River allow comparative studies of how contrasting abiotic environments affect the biology of turtles and other animals that inhabit this riverine system.

Key words: Blackwater River, community ecology, turtle ecology, Virginia.

INTRODUCTION

Knowledge of freshwater turtle ecology has been based largely on numerous studies in lotic habitats, such as lakes, ponds, and ephemeral wetlands (Bury, 1979; Gibbons, 1990). However, relatively few thorough studies on the structure of riverine turtle communities have been published. Of these, most have focused on assemblages in the Mississippi River drainage (Moll, 1980; Anderson et al., 2002; Moll & Moll, 2004; Dreslik et al., 2005). In the southeastern United States, the structure of riverine turtle assemblages has been evaluated by mark-recapture studies in Georgia (Sterrett et. al., 2010) and Florida (Johnston et al., 2011). Short-term studies focusing on other topics such as distribution and toxicology have provided information on turtle assemblages in several eastern rivers. For example, composition of the turtle fauna in the South Fork of the Shenandoah River in Virginia was revealed during sampling to study the effects of mercury contamination (Bergeron et al., 2007). Mitchell & Pague (1984) reported the results of a faunal survey of amphibians and reptiles in southwestern Virginia that included a list of known species in the Clinch River. Turtle assemblages in rivers typically consist of primarily omnivorous species such as those in the genera *Chelydra*, *Chrysemys*, and *Trachemys*, as well as herbivores in the genus *Pseudemys*, along with a few strict carnivores (e.g., *Apalone* [Softshell Turtles]) in some areas (Moll & Moll, 2004).

The river systems in Virginia vary in size and most drain more than one physiographic region. The Blackwater River is relatively unique because its entire drainage occurs only in the Coastal Plain (Woodward & Hoffman, 1991). This region supports a diverse turtle

fauna, which is mostly known from studies conducted in ponds and lakes (Mitchell, 1994). We report herein the results of the first turtle trapping study to encompass the entire Blackwater River drainage. Our study was somewhat limited in scope because of the limitations of trap styles available to us at the time. However, we offer it as a baseline for future, more comprehensive, studies of the freshwater turtle assemblage in this Coastal Plain river. Norman (1989) summarized the capture results for 33 stations sampled in 1987. In this paper, we summarize the results from the full two-year study and provide distribution maps.

STUDY AREA

The Blackwater River is located in southeastern Virginia and flows south from its origin in Prince George County to the Nottoway River at the Virginia and North Carolina state line (Fig. 1), forming the Chowan River, a major tributary of the Albemarle-Pamlico Sound complex. In the vicinity of Isle of Wight County, the river changes direction (from southeasterly) and flows almost due south into North Carolina. The river is the boundary between Sussex and Surry counties, Southampton and Isle of Wight counties, and Southampton County and the City of Suffolk. The total length of the Blackwater River is 169 km and its watershed encompasses 1,917 km², most of which is agriculture, planted pine (mostly Loblolly Pine [*Pinus taeda*]), and secondary mixed hardwood forests (Fleming, 2012). The topography of the watershed is relatively flat to gently sloping terrain. Much of the riparian zone along the river is a heavily wooded floodplain wetland, especially in the upper reach. Dominant trees include Bald Cypress (*Taxodium distichum*), Tupelo Gum (*Nyssa sylvatica*), Water Hickory (*Carya aquatica*), Swamp Cottonwood (*Populus heterophylla*), Carolina Ash (*Fraxinus caroliniana*), Green Ash (*F. pennsylvanica*), Deciduous Holly (*Ilex decidua*), Green Hawthorn (*Crataegus viridis*), Red Maple (*Acer rubrum*), River Birch (*Betula nigra*), Overcup Oak (*Quercus lyrata*), Laurel Oak (*Q. laurifolia*), American Persimmon (*Diospyros virginiana*), and American Elm (*Ulmus americana*). Numerous debris dams, primarily from fallen trees, occur in the river from its origin in Prince George County to just above Franklin in Southampton County (MDN, pers. obs.). In this area, the forest canopy in the riparian zone usually covers and shades the entire river. Below Franklin, the river widens appreciably allowing exposure away from the forest canopy. In this lower section, the river has been channelized in three sections and occasionally cleared of snags for barge traffic to reach the city from Pamlico Sound. The Blackwater River is aptly named because the water is dark from tannic and other organic acids from decaying vegetation in the swamps.

Water quality in the Blackwater River is typical of Coastal Plain streams in Virginia. The water is somewhat acidic (pH generally 5.5-6.5) and relatively low in total hardness (generally 45-75 ppm). Total alkalinity is usually 40-70 ppm, specific conductance is 70-160 µSiemens, and dissolved oxygen is 2-4 ppm for most of the year with highs of 7-10 ppm during the winter months (Virginia Department of Game and Inland Fisheries, unpublished data).

MATERIALS AND METHODS

We selected 57 trap sites extending from the middle of Prince George County to below Franklin (Fig. 1). Twenty-eight of the stations were located on tributaries of the Blackwater River, 24 were on the mainstem, and five were located in millponds within the drainage. We conducted the survey during 6 June-1 November 1987 and 26 March-27 July 1988.

We captured most of the turtles in handmade traps (wire traps) made of one inch diameter poultry wire (76 x 30 x 30 cm) following the design created by Iverson (1979). Each end of the box trap had a funnel opening that measured about 3-4 cm high and 15-20 cm wide. The funnels were flexible to allow turtles to enter but they also restricted exit. We also used commercial trap nets (fyke nets) made of one inch (2.5 cm) mesh nylon netting commonly used in fish population sampling. Nets had two rectangular frames (approximately 90 x 150 cm) on the anterior end and 6-8 circular hoops of diminishing diameters (approximately 50-90 cm), one anterior funnel, and a lead about 10 m long and 0.76 m tall. These traps were set perpendicular to the shoreline with the distal end of the lead attached to vegetation. Turtles moving near the river's edge were directed into the trap by the lead.

We sampled most stations (49) exclusively with chicken wire funnel traps, six stations with trap nets, and one station with chicken wire traps and trap nets (Table 1). We captured turtles at one station only by hand. Sampling effort per station ranged from 5 to 152 trap days (mean = 46.2 d). Traps were not baited. Each was set in the water with the top above the surface to prevent drowning of captured turtles. Traps were generally checked twice per week when all turtles were removed and identified.

Kinosternon baurii (Striped Mud Turtle) was only recently determined to occur in southeastern Virginia (Lamb & Lovich, 1990), having been overlooked historically due to similarities with *K. subrubrum* (Eastern Mud Turtle). Although shell shape was first

described as being diagnostic (Lamb & Lovich, 1990), we identified them by the presence of a light bar between the eye and nostril on each side (Mitchell, 1994). Nomenclature and common names follow Crother (2012) for turtles and Weakley et al. (2012) for plants.

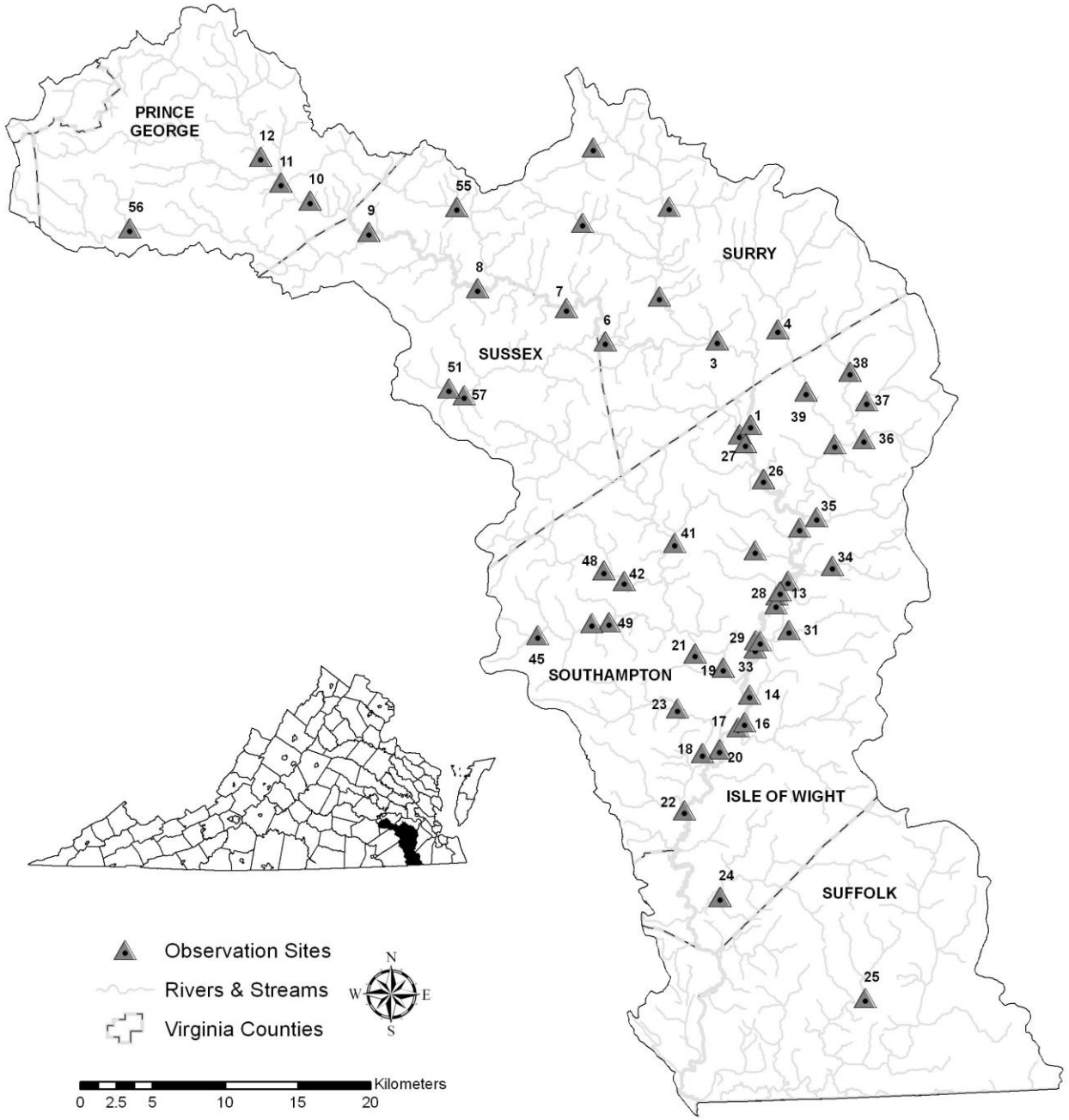

Fig. 1. Location of turtle sampling stations in the Blackwater River drainage, 1987-1988.

Table 1. Location (county), habitat, trap type, and trapping effort at the 57 stations included in the Blackwater River drainage study, 1987-1988.

Station	County	Habitat	Trap Type	No. Trap Days
1	Southampton	mainstem	wire trap	30
2	Isle of Wight	tributary	wire trap	30
3	Surry	mainstem	wire trap	40
4	Surry	tributary	wire trap	20
5	Surry	tributary	wire trap	16
6	Surry	mainstem	wire trap	93
7	Surry-Sussex	mainstem	wire trap	35
8	Surry-Sussex	mainstem	wire trap	28
9	Surry-Sussex	mainstem	wire trap	35
10	Prince George	mainstem	wire trap	32
11	Prince George	mainstem	wire trap	28
12	Prince George	mainstem	wire trap	28
13	Isle of Wight	mainstem	wire trap	28
14	Isle of Wight	mainstem	wire trap	21
15	Isle of Wight	mainstem	trap net	5
16	Isle of Wight	mainstem	trap net	5
17	Isle of Wight	mainstem	trap net	5
18	Southampton	mainstem	trap net	5
19	Southampton	tributary	wire trap	28
20	Isle of Wight	mainstem	wire trap	29
21	Southampton	tributary	wire trap	34
22	Southampton	mainstem	wire trap	17
23	Southampton	millpond	wire trap	12
24	Isle of Wight	millpond	wire trap	72
25	Suffolk	tributary	wire trap	8
26	Isle of Wight	mainstem	wire trap	59
			trap net	37
27	Isle of Wight	mainstem	wire trap	46
28	Isle of Wight	mainstem	wire trap	74
29	Isle of Wight	mainstem	wire trap	18
30	Isle of Wight	tributary	wire trap	45
31	Isle of Wight	tributary	wire trap	36
32	Isle of Wight	mainstem	trap net	32
33	Isle of Wight	mainstem	trap net	37
34	Isle of Wight	tributary	wire trap	42
35	Isle of Wight	tributary	wire trap	54
36	Isle of Wight	tributary	wire trap	92
37	Isle of Wight	tributary	wire trap	132
38	Isle of Wight	tributary	wire trap	137
39	Isle of Wight	tributary	wire trap	152
40	Southampton	tributary	wire trap	44
41	Southampton	tributary	wire trap	24
42	Southampton	tributary	wire trap	64
43	Southampton	tributary	wire trap	24
44	Southampton	tributary	wire trap	29
45	Southampton	tributary	wire trap	5
46	Southampton	tributary	wire trap	28
47	Southampton	tributary	wire trap	54
48	Southampton	millpond	wire trap	90
49	Southampton	tributary	wire trap	117
50	Isle of Wight	mainstem	hand	0
51	Sussex	tributary	wire trap	48
52	Surry	tributary	wire trap	38
53	Surry	tributary	wire trap	102
54	Surry	tributary	wire trap	48
55	Surry	tributary	wire trap	72
56	Prince George	millpond	wire trap	103
57	Sussex	millpond	wire trap	22

RESULTS

We captured a total of 565 turtles representing three families and seven species. In order of decreasing abundance, these included: *Sternotherus odoratus* (Eastern Musk Turtle), 354 individuals (62.7%); *K. baurii*, 96 individuals (17.0%); *Chrysemys picta picta* (Eastern Painted Turtle), 90 individuals (15.9%); *Trachemys scripta scripta* (Yellow-bellied Slider), 10 individuals (1.8%); *Pseudemys rubriventris* (Northern Red-bellied Cooter) and *Clemmys guttata* (Spotted Turtle), six individuals each (1.1%); and *Chelydra serpentina* (Snapping Turtle), three individuals (0.5%). We captured three species (*S. odoratus*, *K. baurii*, *C. picta*) throughout the Blackwater River drainage (Figs. 2-4), whereas the remaining four species were captured at four or fewer stations (Figs. 5-6). Relatively few *C. guttata*, *C. serpentina*, *P. rubriventris*, and *T. scripta* were captured in this study, although all were captured in both trap types. Capture success is summarized in Table 2.

Species diversity at individual stations was limited. We found one species at 19 stations, two species at 19 stations, three species at 15 stations, one site with four species, and five species at one station. Species associations included *S. odoratus* and *K. baurii* or *S. odoratus* and *C. picta* at 23 stations each; *K. baurii* and *C. picta* at 19 stations; and *S. odoratus*, *C. picta*, and *K. baurii* at 17 stations. We captured turtles as early as March 26 and as late as November 1. Capture rate (#turtles/trap-day) varied considerably among stations and seasonally. We found no discernible seasonal peak in numbers captured per unit effort but the capture rate for all species declined appreciably after August.

We caught turtles at all but two stations (#46, Warwick Branch and #44, Horsepen Branch, a tributary of Warwick Branch). Stations with the most turtles collected (n = 48 each) were #6 (Blackwater River mainstem at Rt. 31) and #48 (Kello Millpond on Lightwood Swamp). Other stations with a high number of turtles captured were 36 individuals at #3 (Blackwater River mainstem at Rt. 617), 34 at #24 (Lee's Millpond), and 28 at #21 (Seacock Swamp at Rt. 623).

Overall mean capture rate for all species (using only the effort for the wire traps) combined was 0.219 per trap-day. The highest capture rate (1.08 turtles/trap-day) for any station was #23 (Wade Pond on Black Creek). In general, stations with higher catch rates were those on the river mainstem or in millponds. Of the 11 stations with a catch rate >0.5 turtles/trap-day, only two were on tributaries.

We trapped *Sternotherus odoratus* at more stations in this survey (40 of 57) than any other species. It is widely distributed throughout the drainage (Fig. 2). They were captured as early as April 3 and as late as October 18. Average number of *S. odoratus* captured per station was 8.9, although as many as 38 individuals were taken at a single location. Overall capture rate was 0.140 per trap-day. Of the 10 stations with the highest catch rates ($\geq$0.3 turtles/trap-day), eight were either on the mainstem or millponds. The two tributary stations with catch rates exceeding 0.3 per trap-day were both in Seacock Swamp, a major tributary.

We trapped *Kinosternon baurii* at 31 stations indicating that this species is widely distributed throughout the drainage (Fig. 3). The number of *K. baurii* per station ranged from one to nine and averaged 3.1. Overall capture rate was 0.036 per trap-day. These turtles were caught as early as April 3 and as late as October 4, although most were collected in June and July.

We trapped *Chrysemys picta* at 30 stations and numbers ranged from one to ten (mean = 1.6) per station. Overall capture rate was 0.035 per trap-day. It was also widely distributed throughout the drainage (Fig. 4). All captures were between April 5 and October 18, with most taken in June and July.

Table 2. Distribution of capture success by method for freshwater turtles at 57 sites in the Blackwater River drainage.

Species	#Sites	Wire trap	Trap net	Hand	Total
Sternotherus odoratus	40	344	10	0	354
Kinosternon baurii	31	89	5	2	96
Chrysemys picta	30	87	3	0	90
Trachemys scripta	2	10	0	0	10
Pseudemys rubriventris	4	1	5	0	6
Clemmys guttata	4	6	0	0	6
Chelydra serpentina	3	2	1	0	3
Number of trap days		2463	126		
Total	57	539	24	2	565

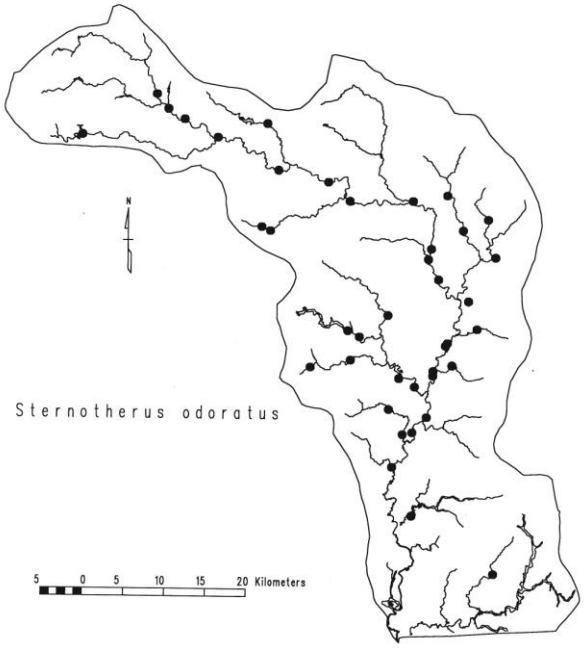

Fig. 2. Distribution of *Sternotherus odoratus* (Eastern Musk Turtle) captures in the Blackwater River, 1987-1988.

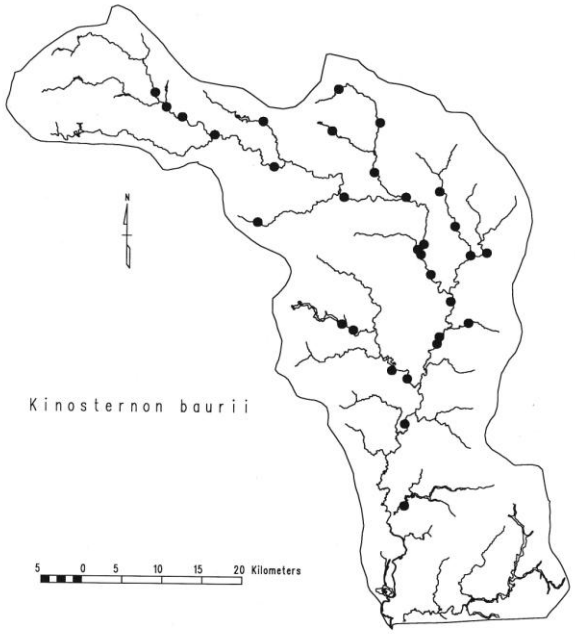

Fig. 3. Distribution of *Kinosternon baurii* (Striped Mud Turtle) captures in the Blackwater River, 1987-1988.

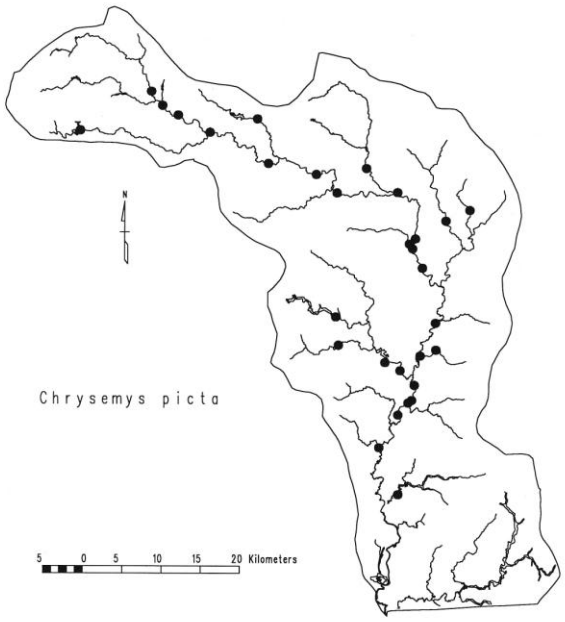

Fig. 4. Distribution of *Chrysemys picta* (Eastern Painted Turtle) captures in the Blackwater River, 1987-1988.

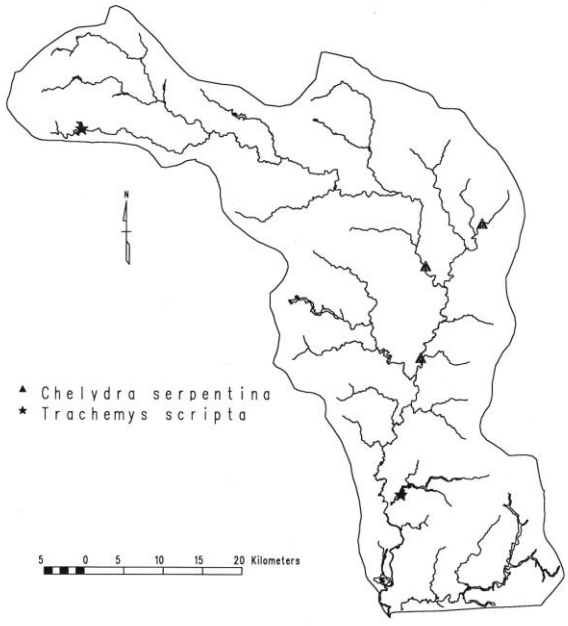

Fig. 5. Distribution of *Chelydra serpentina* (Snapping Turtle) and *Trachemys scripta* (Yellow-bellied Slider) captures in the Blackwater River, 1987-1988.

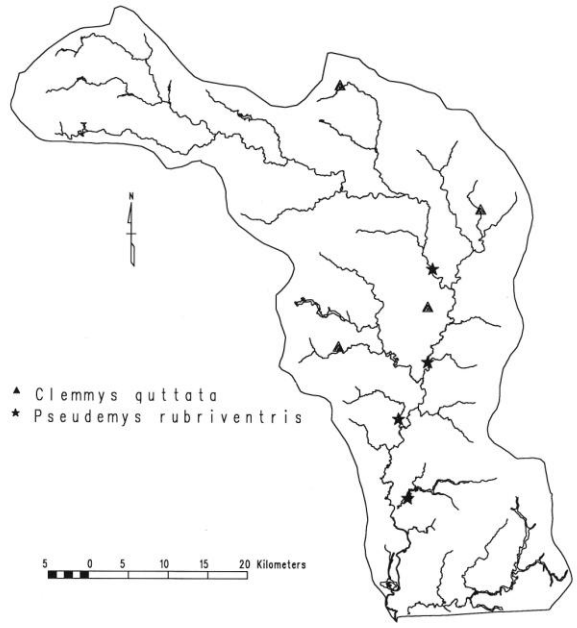

Fig. 6. Distribution of *Clemmys guttata* (Spotted Turtle) and *Pseudemys rubriventris* (Northern Red-bellied Cooter) captures in the Blackwater River, 1987-1988.

We cannot ascertain the distribution or relative abundance of the remaining four species in the Blackwater River, its tributaries, and associated millponds (Fig. 5) because they were captured in low numbers. We trapped *Trachemys scripta* at only two stations, both millponds. Overall capture rate was 0.004 per trap-day. Capture rates for the remaining three species were $\leq$ 0.002 per trap-day. We captured six *P. rubriventris* at four stations. One station was a millpond and the other three were on the mainstem. We also captured *C. guttata* at four stations, all of which were tributary streams. We trapped three *C. serpentina*, two in the mainstem and one in a tributary.

DISCUSSION

Trap design and type used to capture freshwater turtles in lotic and lentic habitats greatly influences the species and number of individuals captured (Ream & Ream, 1966; Plummer, 1979). Chicken wire traps, baited or unbaited, are especially effective for kinosternids (*Kinosternon* and *Sternotherus*) because the ramp provides a continuation of the bottom substrate contour. These turtles follow the ramp to the opening and once trapped are less likely to escape compared to other species (JCM, pers. obs.). These traps also capture large numbers of *C. picta* when bait, such as sardines, is used (Mitchell, 1988). *Clemmys guttata* can be trapped with chicken wire traps but they inhabit wetlands often too shallow to trap and rarely venture into deeper water (Mitchell, 1994). The number of *C. serpentina*, *P. rubriventris*, and *T. scripta* captured by chicken wire traps is usually less than that captured by conventional turtle hoop traps and fyke nets, especially when there is no bait (Vogt, 1980). The capture of so few individuals of these three species can be attributed to the size and type of trap used and lack of bait. In addition, *P. rubriventris*, and *T. scripta* are herbivorous as adults (Ernst & Lovich, 2009) and seldom caught with fish bait (JCM, pers. obs.). Thus, our understanding of the distribution of the freshwater turtles in the Blackwater River drainage is limited to three of the seven species captured. We are unable to describe the structure of the turtle community precisely because of the low captures of these four species.

The three species for which we have adequate data (*C. picta*, *K. baurii*, *S. odoratus*) occur throughout the entire drainage in the river mainstem, its tributaries, and associated millponds. The numbers caught suggest that their populations were healthy in the 1980s in the Blackwater River.

Occurrences of all seven of the species we captured were expected because of the early distribution maps assembled from museum specimens and miscellaneous observations reported to the Virginia Herpetological Society by Tobey (1985). This document was the first to illustrate the distributions of all of Virginia's amphibians and reptiles. It and the turtle study by Mitchell (1988) provided confidence that our trapping methods, particularly the chicken wire traps, would capture most, if not all, of the species known to occur in the Blackwater River. Thus, perhaps with two exceptions, we are confident that the composition of the turtle fauna in this exclusively Coastal Plain river is now well known.

Coastal Plain Cooters (*Pseudemys concinna floridana*) occur in southeastern Virginia (Mitchell & Reay, 1999), but unlike its sister subspecies *P. c. concinna* (Eastern River Cooter) that occurs primarily in rivers in the Piedmont, this turtle has only been documented from ponds and lakes (Mitchell, 1994). *Pseudemys c. floridana* is well known to inhabit other rivers south of Virginia (Ernst & Lovich, 2009), suggesting that this species may eventually be documented in the Blackwater River.

We initially thought that many of the mud turtles captured were *K. subrubrum* (all were reported as such in Norman, 1989) and their locations were plotted on the map in Mitchell & Reay (1999). However, reexamination of these specimens, after clarification of

the occurrence of *K. baurii* in Virginia (Lamb & Lovich, 1990), indicated that they were in fact all *K. baurii*. We are confident our identification is correct due to the presence of light bars on the snouts of these specimens (a diagnostic character for the species). *Kinosternon subrubrum* almost certainly occurs in the Blackwater River drainage, especially in its preferred marsh and pond habitats, because it is widespread in the Coastal Plain (Mitchell, 1994; Mitchell & Reay, 1999). Future studies of the freshwater turtles in this area should seek to clarify the relative distributions of these two mud turtles.

Coastal Plain rivers in the southeastern United States support a diverse assemblage of freshwater turtles (Buhlmann & Gibbons, 1997). The Blackwater River is an example of an aquatic ecosystem that differs abiotically and biotically along its length (MDN, pers. obs.). The closed canopy over much of the upper reach of this river and the debris dams above Franklin undoubtedly create a different environment than that found below Franklin. Water temperature may influence seasonal activity patterns and open, sunny sites along the river needed for successful nesting may be scarce. These factors may in turn influence turtle life histories in the upper reach compared to contrasting temperatures and nesting success in the lower reach. The structure of other rivers in the Southeast also provides contrasting habitats for turtles. For example, the Santa Fe River in northern Florida is tannic and divided by a 5 km section where the river flows underground (Johnston et al., 2012). The upper Santa Fe River is narrower and has a more closed canopy than the lower portion of the river and the lower section is fed by a large number of springs that maintain stable water temperatures and water clarity (Johnston et al., 2011, 2012; Nico et al., 2012). Thus, environmental differences between the upper and lower Blackwater River provide abiotic environments that affect the biology of turtles and likely other animals such as macroinvertebrates (e.g., Smock et al., 1985, 1989) that inhabit blackwater stream systems.

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