

Records of Anurans from Greensville County, Virginia

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Because of its location in southeastern Virginia, adjacent to the North Carolina state line and bisected by the Fall Zone into a western Piedmont half and eastern Coastal Plain half, Greensville County constitutes an important source area for biogeographic studies. Perhaps because of its location, 160 km inland from Virginia Beach and 96 km south of Richmond; the region has been generally overlooked by naturalists and collectors. One notable exception to this neglect was the renowned Harvard botanist Merritt Lyndon Fernald, who scoured parts of the county intensely during his search for rare plants during the 1930s and 1940s (e.g. Fernald, 1937). However, from a zoological standpoint, the potential for discoveries has remained almost entirely untapped.

Since 1952, the first author has been collecting various kinds of animals in Greensville County. For most of that time excursions were short and sporadic, but following establishment of the Virginia Museum of Natural History in 1989, a fairly regular inventory program has been conducted. A drift fence array was operated from May 1993 to July 1994, with frequent (two week or one month) pickups. After removal of the pitfalls, a Malaise trap was installed to capture flying insects at the same site. In addition to the pitfall servicing visits, numerous one or two-day forays have been made by museum staff during the past five years, entailing routine hand-collecting as well as operation of blacklight traps at a number of localities. Although the focus of this activity has been the collection of arthropods, opportunities to observe amphibians have been numerous. Because frogs are so often found by nocturnal road cruising and vocalizing

males are so audibly conspicuous, these amphibians have garnered the preponderance of this somewhat tangential attention.

During the months of May and June, 1990, the second author conducted inventories of terrestrial vertebrates in the vicinity of Skippers in the southwestern quadrant of the county, and obtained numerous sight and sound records for frogs in addition to specimens taken in pitfall operations. He had earlier (May 1984) accumulated records for reptiles and amphibians in the same general area.

On 29 - 30 May, 1960, W. Leslie Burger collected along several secondary roads west and northwest of Skippers. Presumably by road-cruising on the night of the 29th - on which date tropical storm "Brenda" passed through the region - Dr. Burger enjoyed a still unparalleled success with frog captures and obtained no fewer than 11 species. This material was deposited for some years in the VPI&SU reference collection, and later transferred to the American Museum of Natural History. Through the courtesy of R. G. Zweifel and M. W. Klemens, the second author was able to obtain the relevant collection data.

Although coverage of the entire county has been inadequate (the northern and western parts in particular receiving almost no attention), we believe that our collective information is of some importance in providing a fairly complete baseline catalog of the local frog fauna, one which is being impacted by ongoing development (agricultural, residential, silvicultural). Additional, more systematic, surveys seem appropriate and urgent, not only for anuran species but animals in general.

THE REGION

The major geographic features of Greensville County and the collection sites mentioned in the following account are represented on Figure 1. Because the southwestern (south of US 58 and west of I-95) and northern (north of US 58, west of I-95) thirds are so disturbed by agricultural and logging activities, most work by RLH has been confined to the southeastern third: adjacent to the still forested floodplains of the Meherrin River and its major tributary, Fontaine Swamp. Collections and observations by JCM were made chiefly in an area southwest of Skippers and also to the northwest thereof, along Fontaine Creek, thus mostly on the Fall Zone itself.

Land clearing goes on apace almost everywhere in the county, and both suburbanization and farming are spreading south from Emporia along county routes 730, 622, and 625. Virtually all of the county roads are now macadamized and carry a substantial load of high-speed traffic around the clock. Not only is the habitat becoming severely fragmented, but migration between the isolates is fraught with danger as well: any small animal on the pavement more than a minute or two faces certain death. It may occur in just a few more years that only the sections of the floodplains subject to annual inundation will remain forested. This is very unfortunate because the Coastal Plain biotopes here are the inlandmost in the state and biogeographically interesting on that account.

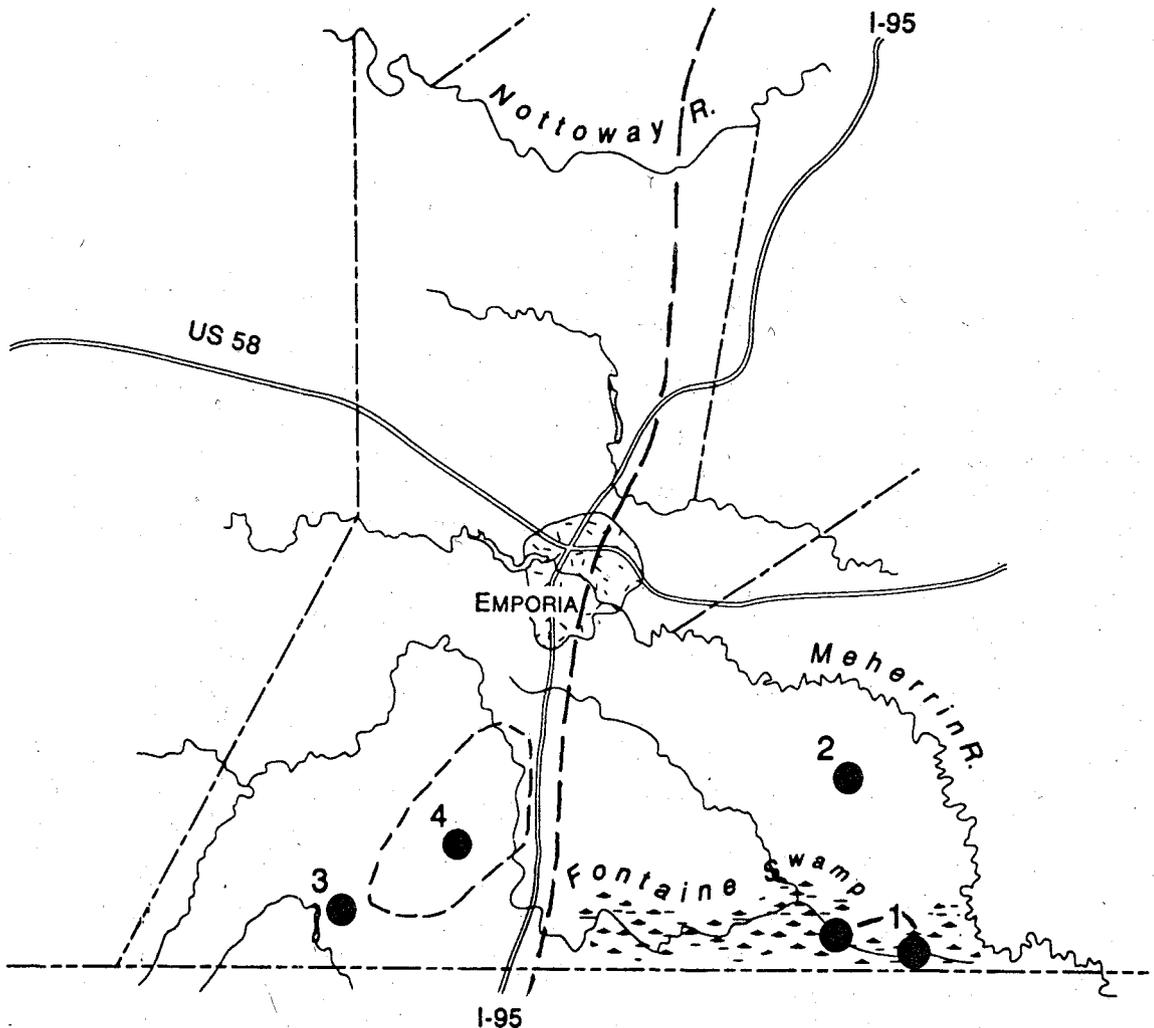


Figure 1. Greensville County, Virginia, showing main highways, settlements, and collecting areas mentioned in the text. The eastern edge of the "Fall Line (or Zone)" is indicated by the heavy dashed line.

PRIMARY COLLECTING SITES

The numbered paragraphs correspond to numbers on the map (Figure 1).

1. Fontaine (or Fountain) Swamp. The lowermost several km of Fontaine Creek, east of US 301, constitute a true year-round swamp, up to 3 km wide in places, which merges into that formed by the Meherrin River as it approaches the North Carolina state line. It is accessible from county routes 624 and 624 which cross the lower third. The southern boundary is marked by the pronounced scarp of a terrace that stands about 20-30 m above the swamp level; definition of the northern side is much less distinct. Most of the original cypress (*Taxodium distichum*) has been logged out, leaving black gum (*Nyssa sylvatica*) as the dominant emergent tree species. The higher regions are invested by pines (*Pinus echinata*, *P. taeda*), sweet gum (*Liquidambar styraciflua*), beech (*Fagus americana*), and red maple (*Acer rubrum*). Co. Rt. 624 runs adjacent to the swamp at nearly water level for about 3.5 km.

2. VMNH pitfall site, 3 km east of Claresville, at the end of Co. Rt. 666. Beyond the end of state maintenance, the road continues as an access into privately owned land in the Meherrin River floodplain. There is a local mosaic of cultivated fields, pine woods, dense black gum swamp, and open areas occupied by water most of the year. The pitfall site is a small knoll high enough that it avoids inundation even during the highest spring floods. The eastern edge of this general area is the complexly meandering course of the river itself, entrenched about 3-6 m below the general level of the floodplain. In the last century the region had been substantially cleared and cultivated, with some dyking and channeling done to manage high water levels; more recently the surviving forest stands have been severely logged out except in the lowest and wettest places. The usual community of pine, sweetgum, and red maple is proceeding to recolonize the floodplain. The VMNH pitfall array consisted of four plastic buckets sunk flush with the surface, arranged in a "Y" shape with one bucket at the center and the other three spaced from five to seven meters distant; all were connected by drift fences of sheet aluminum flashing 0.5 m in height. The contents were removed at approximately monthly intervals from May 1994 to June 1995.

3. Garner's Millpond, located on the Piedmont in the extreme southwestern corner of the county, is approximately 12 km SSW of Skippers, at the end of Co. Rt. 641. About 0.7 km in length, it is formed by an impoundment of Beaverdam Creek.

4. Proposed site for Virginia Power generating plant, ca. five to ten km SW of Skippers, a subtriangular area delimited by Co. Rts. 633, 632, and 621. Pitfall traps were installed in

oak-pine and bottomland hardwood forest types, considered to represent the dominant woodland habitat types. Three pitfalls were placed in oak-pine stands at both the north and south ends of the study area, and six pitfalls were installed in a transect along the western boundary of Fontaine Creek and the eastern boundary of Cattail Creek, in bottomland forest. These traps operated during the period 9 May - 18 June, 1990. This study was conducted by the second author in connection with a contracted biological inventory, and he had previously (1984) obtained data from the same region by manual and visual procedures.

Aside from these primary sampling areas, we obtained numerous individual records during road cruising chiefly in the southern half of the county, as specified in the following species accounts.

Annotated species list

1. *Bufo americanus americanus* Holbrook.

In both call and cranial crest characters, the local population is clearly referable to this taxon rather than to *Bufo terrestris*. Tobey's maps for these two species (1985, p. 54) show Greensville County centered in a major hiatus for American road records, which can now be corrected. Three adult males (VMNH 6766-6768) were collected at three points southeast of Emporia: on Co. Rt. 730 about 6 km from the city limits, on Co. Rt. 666 about 1 km east of Claresville, and on Co. Rt. 624 as it passes through Fontaine Swamp, on the night of 12 April 1995, during the first rainfall in six weeks. Many others were seen by road cruising on the same night. Two (AMNH 122615-16) were taken by Burger "within 3 mi. of Barley", presumably on Co. Rt. 629, on 29 July 1960.

2. *Bufo fowleri* Hinckley.

Common and widespread, this is the species most often seen on the road after dark. Males advertise during May-June near Claresville. Calling and clasping at JCM site 4, on Co. Rt. 621 SE of Brink, 3 May 1984 (5 specimens). Tadpoles in logging road ruts, 9 May 1990. Metamorphs 14 June 1990. One immature specimen (VMNH 6583), 1.6 km E of Claresville, 6 Oct.-12 Nov. 1993.

3. *Bufo quercicus* Holbrook.

W. L. Burger obtained a single specimen (AMNH 122617) on Co. Rt. 627, 5 km NE of Barley, on 29 July 1960. We have had no personal experience with this species, which must be scarce at this, its inlandmost locality in Virginia.

4. *Scaphiopus holbrookii* (Harlan).

One (USNM 135460) found on the road (Co. Rt. 627, ca 6.8 km SW of Emporia) after a thunderstorm, 3 May 1953 (RLH). Burger obtained three (AMNH 122387-89) further to the southwest and possibly on the same road ("within 3 mi. of Barley") on 29 July 1960. We have neither specimens nor sound records since then, despite plenty of midsummer road cruising during rainy weather.

5. *Pseudacris triseriata feriarum* (Baird).

This is an extremely unpredictable species in terms of its spring activities. On occasions, RLH heard the calls along every road in the southeast third of the county, virtually never being out of earshot, when a week earlier or later the roadside ditches and flooded fields were mute.

6. *Pseudacris crucifer* (Wied).

Ubiquitous, calling as late as mid-April, and again in late October and early November, often during the day.

7. *Hyla chrysocelis* Cope.

Ubiquitous, but not always vocalizing even when climatic conditions seemed optimal to a human observer. The call period seems to be from late April to mid-July. On two occasions small specimens (VMNH uncatalogued) were captured by Malaise trap (1.6 km east of Claresville).

8. *Hyla cinerea* (Schneider).

The green tree frog generally occurs in estuarine situations around the Chesapeake Bay and there are few truly "inland" records in Virginia (in contrast to the situation farther south). It had not been heard calling anywhere in the county prior to the summer of 1993, when many males were advertising in Fontaine Swamp. Capture was precluded by difficult access, but RLH obtained a single male (VMNH 6546) calling in a cypress/black gum swamp, near the intersection of Co. Rts. 730 and 624 on 14 June 1994. On 9 June 1995, males were calling here in large numbers, even from recently clear-cut areas. There is a large population at a pond about 0.5 km west of the intersection of Co. Rt. 624 and the North Carolina state line, but has not been recorded at the Rt. 625 crossing of Fontaine Swamp, only 2.5 km away, during many years of listening at that site.

Astonishingly, a visit to the drift fence site 1.6 km east of Claresville on 9 June 1995 disclosed *cinerea* calling in great

numbers from several separate sites, following a hot day (35° C) and an evening thunderstorm. The largest aggregation seemed to be in a permanent blackgum swamp, others from an open cattail (*Typha latifolia*) marsh half a mile away, with individuals and small groups generally distributed. Again, on 7 August 1996, hundreds of males were calling at this locality, although not a single one was in voice at Fontaine Swamp where advertising males had been numerous in previous years.

How could such a large and viable population have been missed in previous summers (e.g., 3 June 1993, 10 June 1994), when light-trapping was being done at the same place, nearly the same time, and under similar climatic conditions, with all of the other associated frog species actively vocalizing? The Claresville population is about 9 km NNW of that in Fontaine Swamp, and suggests that this species may occur throughout the lower Meherrin River floodplain east of Co. Rt. 730 - possibly even upstream as far as Emporia. The Greensville populations appear to be by far the most inland known for this species in Virginia.

The mating period seems to extend through May and June, but calling is not continuous through this time. More than once, RLH monitored known population sites on warm nights prior to, during, or after thundershowers, and was met with silence although a week earlier or later, choruses were active.

9. *Hyla femoralis* Bosc.

The pinewoods treefrog seems to be widespread in southern Greensville County but nowhere occurring in large colonies, and, to date, not found east of Co. Rt. 730 in the Meherrin floodplain. A fairly extensive population exists in the region ca 5-10 km southwest of Skippers, where heard calling and collected by JCM on 3 May 1984; others calling along Co. Rt. 632, where it passes through a pine plantation, 20 June 1989 (RLH).

Hyla femoralis attains its inlandmost limits at this latitude, and occurs well up on the Piedmont in southern Brunswick County. On 20 June 1989 RLH captured three vocalizing males (VMNH 6403-6405) at an area recently demolished by logging along Co. Rt. 602, 1.6 km W of Triplet. Later that night he heard a large chorus in a pond beside Co. Rt. 603, 2.5 km SE of the intersection named "Fitzhugh" on the DeLorme Atlas, p. 31 (but "Poplar Mount" on the VDOT Brunswick County map). This seems to be the inlandmost known Virginia locality for this species. No other populations were heard in the region despite a lot of road cruising during climatically optimal periods.

10. *Hyla squirella* Bosc.

This is another treefrog that RLH missed for many years, until a large vocalizing population was located at Taylor's Millpond on 5 August 1993 (Hoffman, 1994). However, three decades earlier Dr. Burger had encountered a chorus "within 3 mi. of Barley" on 29 July 1960, and secured seven specimens (AMNH 123214-20). The species was heard calling along Fontaine Creek downstream from Co. Rt. 639 on 14 June, 1990 by the second author and C. A. Pague.

An additional locality was added on 19 August 1994, when a small chorus of about two dozen advertising males was heard beside Co. Rt. 730, at its intersection with Rt. 629 (ca. 6.5 km SE of Emporia). These frogs were calling sporadically in late afternoon following a day of heavy rain. Most recently (9 June 1995) several dozen were calling in a newly plowed flooded field (actually a vast mudpuddle) beside Co. Rt. 730 near Bryant's Corner, in company with *Bufo fowleri* and *Gastrophryne carolinensis*. A male was captured and examined but immediately escaped, and local conditions (there being no shoulder on which to get the car off the pavement) prevented stopping long enough to obtain a voucher.

Both of these localities have been driven past for many years, without an audible trace of *squirella* being detected; later in the year they dry up completely and seem a poor choice for a breeding site.

11. *Acris crepitans crepitans* Baird

Sporadic throughout the county, but not always distinguished by the first author from *Acris gryllus*. Burger captured one specimen (AMNH 122718), 30 July 1960, on Co. Rt. 629, 1.5 km SW of Skippers, and the second author both heard and captured specimens at the Virginia Power locality (our site 4) on the 1st and 3rd of May, 1984.

12. *Acris gryllus gryllus* LeConte.

The southern cricket frog is widespread in the south-eastern third of the county, calling from ditches, small ponds, and gum swamps. Vocalizing begins in mid-April and persists into August, during the day only as the summer wears on. A small voucher series was taken at Garner's Millpond on 21 September 1994 (VMNH 6717-27), all specimens with the hind foot webbing and femoral stripes exactly as stipulated for the species (e.g., by Conant & Collins, 1991). One (VMNH 6680) fell into a pitfall trap 1.6 km east of Claresville in the spring (25 March-25 May) of 1994. This site is about 100 m from the nearest water.

13. *Gastrophryne carolinensis* (Hollbrook).

Narrowmouth toads are obviously common in the county, as suggested by the number which found their way into our pitfall traps located about 1.6 km E of Claresville. VMNH has 33 specimens taken during the period 28 April-6 October 1993-1994 with the great majority taken from mid-May to mid-June. Burger found a single specimen (AMNH 122297) 1.5 mi. SW of Skippers on Co. Rt. 629 on 30 July 1960. JCM removed a male from a pitfall trap 2.0 mi. SW of Emporia and another 3.0 mi. SSW of Skippers on 18 June 1990.

It is a remarkable fact that in spite of numerous visits made by RLH to Greensville County over several decades - before, during, and after thunderstorms, this species was heard calling only once prior to 1990 and even then (25 May 1989) only one male was vocalizing. But for some arcane reasons the evening of 9 June 1995 was apparently optimal for the species, and calling was heard along virtually all backroads between Skippers and Claresville, again at the drift site 1.6 km E of Claresville, and also along Co. Rt. 730 south to Bryant's Corner. On 30 May 1990 JCM heard about 10 vocalizing males in pools in a clearcut area, 7.5 km SW of Skippers, and saw fresh egg masses of this species. Collectively these data suggest that late May and early June is the time of maximum reproductive effort (as also implied by the peak of pitfall catches). Elsewhere in eastern Virginia, calling may extend well into August.

14. *Rana catesbeiana* Shaw.

Calling east of Claresville and at Garner's Millpond 7 June 1990 and 9 May 1991 and a single, very large female on Co. Rt. 625 in Fontaine Swamp on a rainy night (17 July 1993). Two specimens preserved from Site 4, 1 May 1984, by JCM; one seen on Co. Rt. 632, 3 May 1984.

15. *Rana clamitans melanota* (Rafinesque)

Generally distributed but not abundant, calling throughout the summer. Several pitfall captures preserved (JCM) from the Virginia Power site, 1 May and 30 May 1984.

16. *Rana palustris* LeConte.

Calling in black gum swamp 2 km east of Claresville, also at Garner's Millpond, March-April, in small numbers. Not taken by Burger, and no material has been collected by either of us.

17. *Rana sphenoccephala* Cope [in recent literature as *Rana utricularia* Harlan].

The species is generally distributed and common everywhere, calling as late as the end of May in 1989. Large numbers of recently metamorphosed specimens fell into the Claesville site pitfalls during the time interval 25 May-30 June 1994, apparently while dispersing from their transformation site.

Possible Additional Local Species

In addition to the anurans heard and occasionally captured, we note the conspicuous absences of *Rana virgatipes*, *Pseudacris ocularis*, and *Pseudacris brimleyi*. The latter species is plotted on Tobey's map (1985, p. 60) for adjoining Sussex Co. and probably occurs in the northeastern fringe of Greensville. Possibly, the two local species of pseudacrids are competitive, and one excludes the other. The experience of RLH with *brimleyi* in Caroline County some years ago was that a single colony near Dawn was a tiny island in a sea of *feriarum*, emphatically verified by prolonged road cruising throughout a 16 km radius of the *brimleyi* site. Early season visits to Greensville County when both *Pseudacris triseriata feriarum* and *P. crucifer* were vocalizing *en masse* have so far been negative for *brimleyi*, with its simultaneous calling period. Possibly *brimleyi* is localized in the scarcely collected northern half of the county. The same may be said for *P. ocularis*, recorded from several sites in adjacent Southampton County to the east, and from Brunswick County to the west. Almost certainly, location of the specific biotope required by *ocularis* will disclose its presence in Greensville County.

The apparent absence of *Rana virgatipes* is similarly inexplicable, considering its inland occurrences farther north in Virginia, and the abundance of apparently suitable local habitat. One noteworthy observation that has been dramatically impressed upon us by recent field experiences in Greensville County is that populations of various species may exist at particular sites *without* vocalizing during one or more breeding seasons. Another is that vigorous activity may be in progress at one site, but not at another - just a few miles away - which is known to have been a hotbed of clamor and tumult at other times. The accounts for *Hyla cinerea* and *Hyla squirella* provide examples of what to the human mind may seem flagrant behavioral inconsistency.

An Unusually Diverse Breeding Congress

It is not unusual for several species of anurans to utilize a particular breeding site simultaneously, yet in four decades of

listening to frogs in Virginia by RLH, only once did he ever hear as many as eight species (half of the known Greensville County frog fauna) advertising at once from the same place. This event occurred beside Co. Rt. 625 about 100 meters north of the VA-NC state line, on the southern periphery of Fontaine Swamp, 25 May 1989. The site had been devastated a year earlier by a clear-cut operation that resulted in a deeply-gouged and rutted wasteland of stumps, trunks, and slash, growing up with sweetgum, blackberries (*Rubus* spp.), and poison ivy (*Rhus toxicodendron*). The depressions had filled with water and attracted frogs. It was not possible to penetrate the morass, but a half-hour period of listening provided a good idea of what species were vocalizing. Approximate rank order, based on calling frequency, was as follows: *Acris gryllus* (dozens calling), *Hyla chrysoscelis* (dozens), *Bufo fowleri* (many), *Rana clamitans melanota* (many), *Rana catesbeiana* (several), *Rana sphenoccephala* (several), *Hyla femoralis* (only a few), and *Gastrophryne carolinensis* (only one). These records were made on a warm, clear, very humid night after a hot day. No rain had fallen for at least a week. Recent visits to the site have been rather negative; it is both drying up and growing up, and only a few of the commonest species listed above were heard.

FAUNISTIC SUMMARY

Our present total of 17 confirmed species of anurans is apparently the greatest now recorded for any Virginia county or comparable city, using the maps in F. J. Tobey's atlas (1985) as resource. The City of Virginia Beach is there credited with 16 species, the City of Chesapeake with 14, Surry County with 15, and Fairfax, Charlotte, and Alleghany counties with 12 each. In actuality Surry County may claim first place, since several very common species were not represented in Tobey's data, and when collected (if they have not already been taken) will raise the Surry total to 20 species or more, about the maximum to be expected for a Coastal Plain county.

As is evident from the foregoing list, the Greensville County anuran fauna basically reflects two distribution patterns, one being that of species widespread over much of eastern United States such as *Bufo americanus*, *Bufo fowleri*, *Acris crepitans*, *Pseudacris triseriata*, *P. crucifer*, *Scaphiopus holbrookii*, *Rana catesbeiana*, *R. clamitans*, and *R. palustris*. The second pattern is that of the classical "Lower Austral" life zone, and includes species which, if not actually restricted to the Coastal Plain, are at least most abundant there and may exist only sporadically on the Piedmont. Species in this category include **Bufo quercicus*, **Hyla cinerea*, *H. chrysoscelis*, *H. femoralis*, **H. squirella*, *Acris gryllus*, and *Gastrophryne carolinensis* (species marked by an asterisk reach their inlandmost Virginia localities on the Fall Line belt south and west of Emporia; and

H. femoralis extends only a few km further westward into Brunswick County). It is a little surprising that the "American Toad" represented here is the northern *B. americanus* rather than the southern *B. terrestris*.

CONSERVATION STATUS

Documentation of amphibian, particularly anuran, population declines are being published at an alarming rate (e.g., Drost & Fellers, 1996; Gamradt & Kats, 1996; Laurance et al., 1996). These reports and others demonstrate that amphibians worldwide are subject to a wide variety of perturbations (see reviews in Phillips, 1990, 1994; Livermore, 1992; Pechmann & Wilbur, 1994; Blaustein & Wake, 1995; Stebbins & Cohen, 1995). Declines in eastern North America have been less dramatic than those in the West. Habitat loss continues to be the most common cause of population declines in the East (Blaustein & Wake, 1995; Means et al., 1996; Mitchell, 1996), although acid precipitation is being documented as another important cause in some areas (Freda & Dunson, 1985; Wyman, 1988; Rowe et al., 1992).

The increasing rate of habitat loss, fragmentation, agricultural expansion, logging, and suburbanization in Greensville County sounds a conservation alarm. Except for those species that can tolerate wide environmental conditions (e.g., *Bufo fowleri*, *Hyla chrysocelis*), populations of most species will undoubtedly decline in this area. Declines in ephemeral and permanent wetlands, keystone resources for anurans, often accompany habitat alteration. It is of interest, however, that the most diverse chorus of frogs heard in Greensville County was in a recent clearcut with ephemeral pools in tire ruts. This abundance is deceptive because the conditions favorable to those species are highly ephemeral and may last only one to three years, as the site undergoes succession (as in fact has been observed in the case cited here). The source for these frogs must be within one or two km of the breeding site (see Dodd, 1996, for distances traveled by anurans). If the habitats of these source populations are themselves eliminated, as is happening in some urbanized areas of the county, then populations of several species will decline regionally and choruses of such magnitude will no longer occur. We note that except for incorporated urban areas, all of the land in the county is in private ownership, and therefore liable to modification at any moment. So far, the survival of wooded natural areas, even in secondary or tertiary growth stages, is solely by default.

We are particularly concerned about the increasing rates of mortality of anurans on Greensville County roads. There are no quantitative studies of such mortality on paved roads in Virginia, but observed rates are high in some areas,

especially where new roads are constructed through previously undisturbed habitat and those that were placed adjacent to freshwater wetlands. The cause of noted declines of anuran populations over a 50 year period in parts of western Virginia (Hoffman, 1992), and nearby Canada (Fahrig et al., 1995) was thought to be the geometric increase in the number of paved roads and logarithmic increase in volume of traffic on those roads. Mortality is probably highest during early parts of the mating season when adults migrate to breeding areas (late winter and early spring) and during dispersal of juveniles following metamorphosis (late spring and summer). The early spring mortality is especially severe in that a large percentage of the fatalities occur before the adults reach the breeding sites. Education of local citizens to avoid traveling on specific sensitive roads during rainy nights, or the involvement of interested naturalists to close the most vulnerable stretches of roads to vehicular traffic during peak activity times may be the only ways to curtail extreme mortality. Changing the attitude of local motorists who will drive off the pavement in order to run over a turtle or mammal would seem to be a formidable challenge!

Documentation of anurans in other parts of Greensville County would provide additional information on the location of the most sensitive habitats with adjacent roads. This type of information is critical to the development of county-wide conservation plans and to identification of target areas for conservation projects. Such county-wide inventories in all of the counties of Virginia are desirable in light of the rapid growth of the human population and the resulting impacts upon the natural landscape and resident wildlife.

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