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The Cherokee Frog, *Rana sylvatica cherokiana* nom. nov., of the Appalachian Mountain Region*

By EMIL WITSCHI

Dedicated to Doctor Fritz Baltzer, Professor of Zoology at the University of Bern, Visiting Professor at the State University of Iowa, 1948-1949, at the occasion of the Seventieth Anniversary of his Birth.

DESCRIPTION

Locality: Murphy, North Carolina, elevation 462 m (1540 ft.) (Appalachian Mountains), January 1953.

Live Size: Female, nose to anus 82 mm, toe to toe (4th) 270 mm. Male, nose to anus 67 mm, toe to toe (4th) 248 mm.

Shape: Typical body shape of brown frogs, with straight and rather pointed rostral head. Dorsolateral folds, from the dorsal circumference of the ear to the caudal fusion above the anus. Diameter of tympanic membrane 5.5 mm in the female, 5.0 mm in the male.

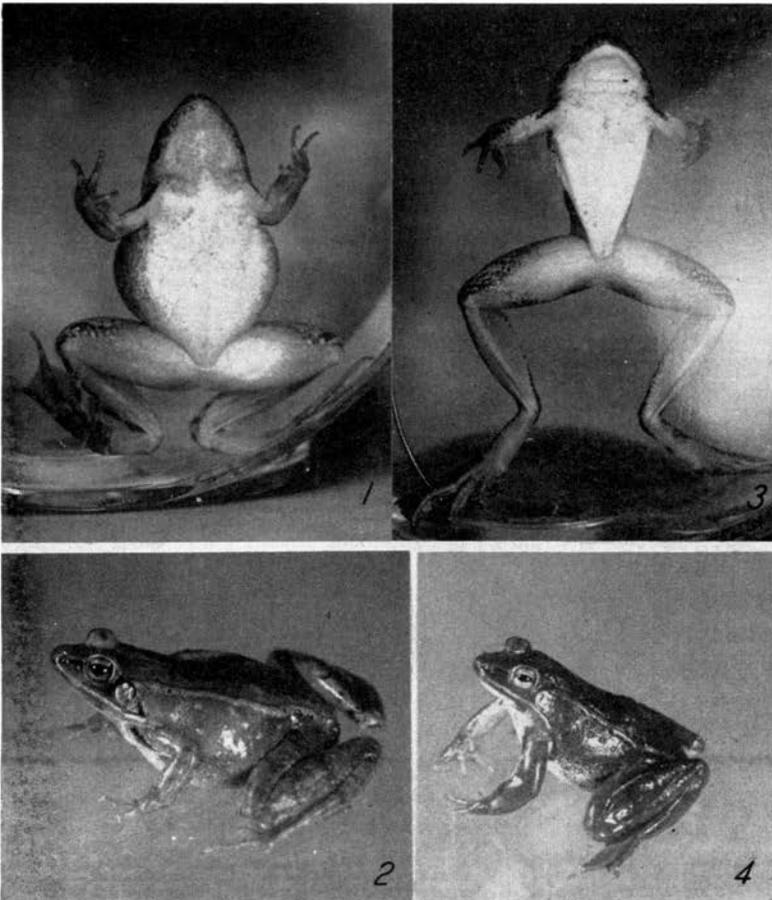
Color: As is typical for the breeding season, the male is in general much darker, above, than the female. The latter is of a bright orange red, due to contraction of the black chromatophores. In both, the dorsal field (between dorsolateral lines, eyes and nostrils) is nearly unicolored, with a few dark (1 mm) spots irregularly distributed. Along the dorsolateral lines are scattered some small black spots. The upper sides of arms, legs and feet are of the same color as the back, but with ten zebroid, dark cross bars on each leg, and five on each arm. The dark brown patch around the ear is pointed toward the shoulder and ventrally bordered by the prolongation of a light streak that starts at the nostril and runs the full length of the upper jaw. This streak is not as broad or as light as in *R. sylvatica sylvatica*. The flanks are finely mottled and turn lighter ventrally, becoming a sulfurous yellow in the region usually hidden beneath the folded up thighs. The same color extends also to the ventral surface of the thighs. The entire ventral body surface of the male is white; that of the female is sprinkled with brown spots, darkest on the throat, and finally disappearing on the lower abdomen (figs. 1-4). The

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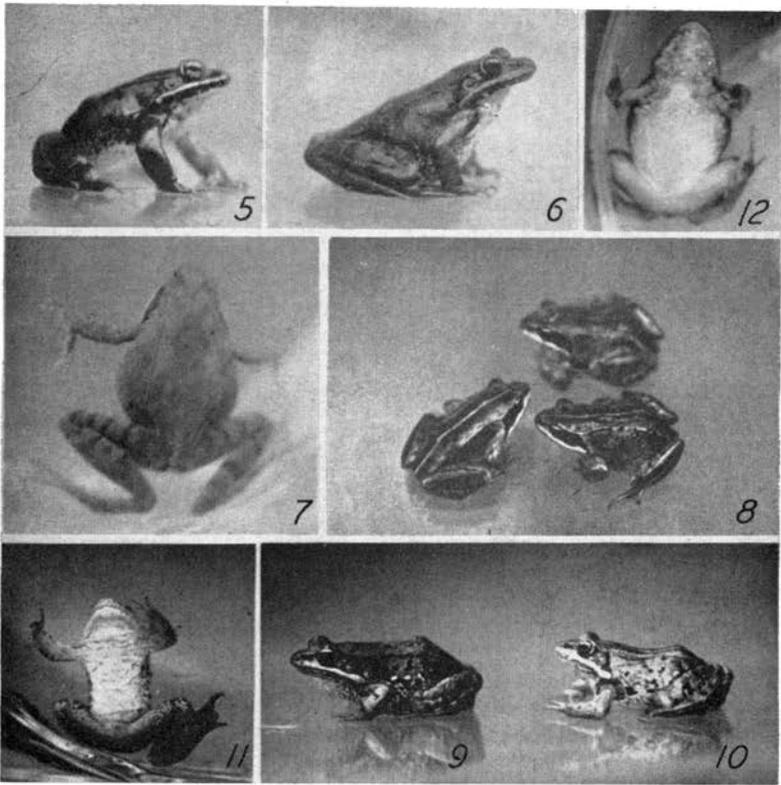
diameter of the eggs is 2.5 mm; the length of the sperms (acrosome, plus head, plus middle piece) is 0.025 mm.

RANGE

For several years now our laboratory has received shipments of large brown frogs that were collected in the general region of Murphy, Cherokee County of North Carolina (altitude 462 m or 1540 ft.). While they were sold to us as wood frogs (*Rana sylvatica*), it was very evident that they are unlike the frog from the northeastern states that is known under this name. They are much larger—so much so that they have already attracted the at-



Figs. 1-4. Type specimens of *Rana sylvatica cherokeeana* nom. nov., from Murphy, N. C., toward the end of the breeding season. The female (Figs. 1 and 2) has the eggs in the uteri. The thumb pads of the male (Figs. 3 and 4) had been shed and have



Figs. 5-7. *Rana sylvatica sylvatica* Le Conte, from Hanover, New Hampshire; 5 male, 6 and 7 female; $\frac{1}{2}$ nat. size.

Fig. 8. *Rana sylvatica cantabrigensis* Baird, three males from Edmonton, Alberta; $\frac{1}{2}$ nat. size.

Figs. 9-12. *Rana sylvatica cantabrigensis* Baird, from Churchill, Hudson Bay; $\frac{1}{2}$ nat. size.

tention of the epicureans and are sold yearly by thousands to their markets. They are also much more colorful; especially during the breeding season, when the females are of an intense dark copper or orange red. At first sight they remind an observer of the European *R. temporaria*. But the similarity is a superficial one, suggested merely by the combination of size and color. The European species has an extremely wide range of local and individual variations in color, size and shape of the head. The frogs from Murphy, however, are comparatively uniform. It seems also that they are restricted to a relatively small area, having been found so far only in the eastern Appalachians of North Carolina from Murphy to Linville and Grandfather Mountain. Whether they change gradually into the northern *sylvatica* is not yet known.

SIZE

The sizes of our type specimens, female and male, are included in the description. We have during the last three years examined some 400 of these frogs and compared them with samples of typical *sylvatica*. The measures of random adult groups (16 females and 17 males) vary between the following limits:

	Females		Males	
	Nose/anus mm	Toe/toe mm	Nose/anus mm	Toe/toe mm
Largest:	81	300	65	246
Smallest:	67	250	57	218

The largest sizes, being not unusual, are certainly most characteristic for the species, since the smaller individuals may not have attained full size.

In comparison, the northern wood frogs are much smaller. In our collections of adults we recorded the following largest sizes (in mm as above).

Females	Males	Locality
60—226	49—191	New Haven, Connecticut
59—215	55—191	Hanover, New Hampshire
46—145		Oshkosh, Wisconsin
49—146	43—133	Edmonton, Canada

The accompanying photographs (figs. 1-12) all taken at the same scale express clearly these differences in size between various local types.

COLOR

In the northern wood frogs the red component is distinctly reduced; females in the breeding season are rather of an ochreous tan than red. The dark pigment is increased especially in the back where it produces an interesting bordered broad dark band (fig. 7). Sometimes the dorsal midline is left clear, a pattern especially frequently observed in the Canadian wood frogs (collections from Edmonton and Churchill). In fact this frequent but not at all universal dorsal midline (figs. 8 and 10) is the best known characteristic of the subspecies *cantabrigensis*.

GERM CELLS

Our interest in the Carolina wood frogs originated from the need of early egg supplies for laboratory work. The breeding season opens shortly after the first of the year and usually lasts until the first week in February. The eggs are very distinctly larger than those of northern representatives. In numerous measurements all were found to have diameters above 2 mm. Eggs of

2.5 mm are not at all exceptional; the average of recent measurements from six different females is 2.49 mm. On the other hand the following average values were obtained in northern collections:

New Haven, Connecticut	1.8 mm
Hanover, New Hampshire	1.71 mm
Edmonton, Alberta	1.7 mm

The sperms show a corresponding size difference. They were photographed with the phase contrast method while still alive, and then measured. Tails proved too complicated and the following list gives only the length from the tip of the acrosome to the end of the middle piece.

Murphy, North Carolina	24.7 μ
Hanover, New Hampshire	21.7 μ
Edmonton, Alberta	21.7 μ

Preliminary chromosome studies show that we are not dealing with a tetraploid or otherwise polyploid form.

A NEW SUBSPECIES

There can be no doubt but that the frogs from North Carolina differ more widely from the New England and New York type than the northern subspecies *cantabrigensis*. It seems therefore justified to consider them as a particular subspecies, and it is proposed to name them after the other red skinned native of this region who already lent his name to the county in which our type specimens were caught.

BREEDING RECORDS

Beginning in 1926, the writer has at different times undertaken to cross fertilize various species of frogs and especially those belonging to the brown group. The detailed results will be published separately. The hope to clear up some questions of evolutionary kinship by this means has so far not materialized. While the egg of *R. temporaria* is not fertilized by the sperm of any other species, its own sperm impregnates and activates the eggs of a great number of European and American species. In contrast, the eggs of *cherokeeana* are easily fertilizable by sperms of not closely related species, as the following list shows:

<u>Eggs</u>	<u>Sperms</u>	<u>Result</u>
<i>R. s. cherokeeana</i>	<i>R. boylii</i>	mid gastrulae
<i>R. s. cherokeeana</i>	<i>R. temporaria</i>	early gastrulae
<i>R. s. cherokeeana</i>	<i>R. pipiens</i>	cleavage
<i>R. s. cherokeeana</i>	<i>R. arvalis</i>	cleavage

It is a costly process to bring frogs of many lands and provinces together, and to raise hybrids and controls in sufficient numbers to

ascertain the degree to which cross breedings are possible. But also, good and bad luck play many tricks with well calculated plans. Thus *sylvatica* males have never been available for combination with mature *cherokiana* females. However, the reciprocal arrangement was realized. Eggs of *sylvatica* of Hanover, N. H. fertilized with sperms of *cherokiana* produced fully viable hybrids. The little frogs that issued from this cross, now one year old, grow unusually well and are of great vigor. These studies must still be extended but at the present, they seem to indicate that *cherokiana* does not deviate sufficiently from *sylvatica* to warrant the status of a separate species.

SUMMARY

A new subspecies of *Rana sylvatica* from the Appalachian Mountains of North Carolina is described under the name of *Rana sylvatica cherokiana*.

Bibliography

An exhaustive list and discussion of the faunistic and taxonomic literature on the species *sylvatica*, together with original descriptions will be found in the excellent *Handbook of Frogs and Toads of the United States and Canada* by Albert Hazen Wright and Anna Allen Wright, 3d. Ed., Comstock Publishing Company, Inc., Ithaca, New York, 1949.

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