

would be along such a gradient that an "exploiting" species might evolve a cooperative relationship.

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CHARLES F. LECK, Department of Zoology, Rutgers University, New Brunswick, New Jersey 08903. Submitted 9 November 1970; accepted 20 November 1970.

Notes on the Biology of the Central American Squirrel, *Sciurus richmondi*

ABSTRACT: *Additional specimens of Sciurus richmondi are reported, along with comments on variation, distribution, reproduction and molt in this little known squirrel. As presently understood, S. richmondi occurs only in the Caribbean rain forests of Nicaragua. Significant secondary sexual variation in adults was found only in zygomatic breadth, in which females are the larger. Available evidence reveals that the breeding season extends at least from February to September, and suggests two seasonal molts annually.*

INTRODUCTION

Sciurus richmondi was named and described by Nelson (1898:146), based on a series of specimens collected by Charles W. Richmond in 1892 on the Río Escondido above Bluefields, Departamento Zelaya, Nicaragua. Subsequently, J. A. Allen (1908:660; 1910:104) recorded several specimens from the Caribbean drainage of central Nicaragua, but we are unaware of reports of additional material since Allen's second paper. In recent studies in Nicaragua, 53 specimens of *S. richmondi* have been collected, providing noteworthy data on the biology of this poorly known sciurid.

VARIATION

In the original description and in subsequent publications (Nelson, 1899:101; Hall and Kelson, 1959:395), *Sciurus richmondi* has been characterized as closely related to *S. granatensis*, recorded from northern Costa Rica southward into South America. Nelson (1898:147) supposed it "probable" that the two intergraded. *S. richmondi* differs principally from the North American subspecies of *S. granatensis*—*hoffmanni* of Costa Rica, *chiriquensis* of Costa Rica and Panama (these two represent but a single subspecies according to Harris, 1943:9-10) and *morulus* (*choco*, a synonym according to Handley, 1966:777) of Panama—in being smaller, both externally and cranially, slightly less richly colored overall, and in having conspicuously paler bands on the hairs of the tail (tawny ochraceous as opposed to fulvous or buffy orange).

We agree that *richmondi* resembles *granatensis* in general features and admit the possibility that the two may be found to be conspecific. Nevertheless, we are reluctant at this time to consider *richmondi* as a subspecies of *granatensis* because of the great size difference in the specimens available to us. The smallest adult *granatensis* that we have seen is a female (KU 60478) from El Dragón, 26 km S San José, Costa Rica, in which the greatest length of skull is 53.1 mm, whereas the largest *richmondi* is a male from El Recreo with a greatest length of skull of 51.5 mm (Table 1). The only indication of possible intergradation now available between the two taxa is revealed by a male (skin only) from Cataratas San Carlos, Costa Rica (AMNH 141922), which differs from other Costa Rican *granatensis* in that both dorsal and ventral sides of the tail are considerably less reddish-orange; the tail of this specimen thus closely resembles those of our Nicaraguan squirrels in color.

TABLE 1.—External and cranial measurements in millimeters of adult males and females of *Sciurus richmondi*. Double asterisk denotes the one measurement in which the two sexes differ significantly (.01 level, Student's *t*-test)

Measurements	Male			Female		
	N	Mean ± 1 SD	(Range)	N	Mean ± 1 SD	(Range)
Total length	19	364.4 ± 9.40	(347.0-385.0)	19	363.4 ± 17.85	(320.0-391.0)
Length of tail	19	166.6 ± 4.72	(159.0-184.0)	19	168.6 ± 10.43	(151.0-184.0)
Length of hind foot	23	49.5 ± 2.19	(45.0-53.5)	23	50.5 ± 1.88	(47.0-55.0)
Length of ear	19	21.1 ± 2.00	(18.0-25.0)	14	21.4 ± 1.45	(19.0-25.0)
Weight g	18	249.7 ± 17.70	(215.1-284.0)	7	239.3 ± 23.21	(208.3-266.5)
Greatest length of skull	22	50.0 ± 0.69	(48.8-51.5)	20	50.0 ± 0.79	(48.3-51.0)
Condylbasal length	21	44.9 ± 0.86	(42.9-46.5)	18	45.0 ± 0.89	(43.2-46.4)
Zygomatic breadth**	21	29.7 ± 0.53	(29.0-30.8)	21	30.4 ± 0.71	(28.7-31.5)
Interorbital constriction	23	16.1 ± 0.65	(15.0-17.5)	21	16.0 ± 0.55	(14.9-17.0)
Postorbital constriction	23	18.3 ± 0.53	(17.1-19.6)	21	18.1 ± 0.36	(17.6-19.0)
Mastoid breadth	18	22.5 ± 1.11	(20.1-23.7)	20	22.4 ± 1.08	(20.5-23.7)
Length of nasals	24	14.8 ± 0.87	(13.2-16.3)	22	14.4 ± 0.80	(13.0-15.8)
Length of palate	22	15.5 ± 0.54	(14.7-16.5)	22	15.4 ± 0.32	(14.8-15.9)
Crown length of maxillary toothrow	20	8.0 ± 0.20	(7.6-8.4)	21	8.2 ± 0.19	(7.9-8.6)

Few external or cranial measurements have been reported for *S. richmondi*. Analysis of secondary sexual variation of adult individuals from the vicinity of the type locality is given in Table 1. Zygomatic breadth was the only measurement in which a significant difference was detected between the sexes in our sample. Females were significantly larger than males at the .01 level in zygomatic breadth, whereas no other measurements were significantly different even at the .05 level (Student's *t*-test). In the other measurements, males averaged larger than females in seven, females averaged larger in five, and the mean was identical for greatest length of skull.

DISTRIBUTION

As currently understood, the geographic range of *Sciurus richmondi* is limited to the rain forests of the Caribbean lowlands of Nicaragua (Fig. 1). No specimens of this species are known from the Pacific drainage, where, at least at higher elevations, it is replaced by *S. deppei*, which closely resembles *richmondi* in external appearance and in behavior. Both species are small, dark ochraceous squirrels that regularly forage on the ground. In trees, both are most often observed on the main trunk or on the large lower branches; seldom are they seen in the high canopy. In the vicinity of El Recreo, where many of our specimens were obtained, much of the forest is second growth, although some large, old trees still persist, especially along watercourses. Many *richmondi*

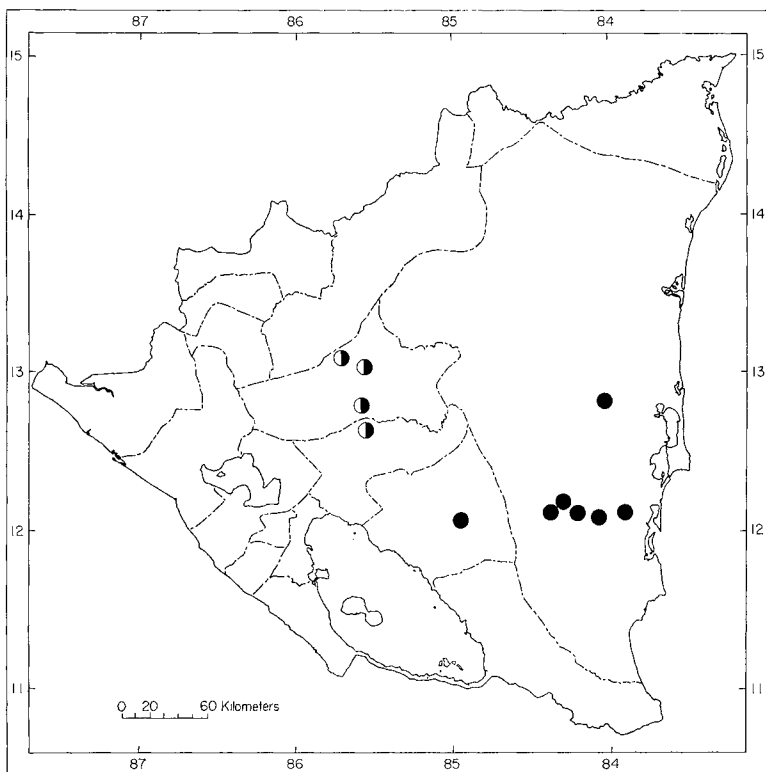


Fig. 1.—Map of Nicaragua showing known records of *Sciurus richmondi*. Solid symbols indicate localities from which specimens have been examined; half-solid symbols represent records from the literature

were taken there in an experimental plantation of cacao trees on the government agricultural station south of the Río Mico. In the vicinity of Villa Somoza, where two specimens were shot from trees along a stream, much of the original forest has been cleared and replaced by pastureland. The occurrence of *Sciurus richmondi* undoubtedly has been sharply restricted in areas where forest has been removed, and, in fact, the species now may be absent from many places in the western part of its former range as a result of agricultural activity.

REPRODUCTION AND MOLT

Females with embryos were taken on 26 February 1968, 27 April 1963, and 21, 22, 23 and 25 June 1967. Of the six gravid females obtained, four carried three embryos each and the remaining two each contained two. Embryos of the female taken in February measured 22 mm in crown-rump length, those from the one obtained in April measured 16 mm, and embryos from the females collected in June measured 30, 24, 22 and 35 mm, respectively. A female obtained on 25 June 1967 at El Recreo was lactating, as was a female taken along the Río Kurinwás on 19 September 1967.

Ten adult males collected between 19 June and 25 June 1967 had testes that averaged 26.1 mm (23-33) in length. Two adult males taken in late February and one taken in early August also had enlarged testes that measured, respectively, 20, 22 and 23 mm. Three young adult males taken in late June had testes lengths of 7, 8 and 10 mm. Juvenile squirrels were collected in early and mid-April, mid-June and mid-July. Reproductive data indicate that *S. richmondi* has a relatively long breeding season that extends at least from the middle of February until the middle of September. No data are available for other times of the year.

Molt in adult *S. richmondi* evidently begins in the middorsal region and proceeds anteriorly and posteriorly as well as ventrally. In the material at hand, there are individuals that were molting from one adult pelage to another in late February and March (five of 11), mid- to late June and early July (eight of 23) and early October (two of three). No molt was evident on skins of nine adults taken in the period mid-July through September nor on seven specimens obtained in November and December. These data would seem to indicate that *richmondi* undergoes two seasonal molts annually.

RECORDS OF OCCURRENCE

In the list of specimens examined below, italicized localities are not plotted on Figure 1 because undue crowding of symbols would have occurred. Within departments, localities are listed from north to south.

Specimens examined (69).—Chontales: 1 km N, 2½ km W Villa Somoza, 330 m, 2 (KU). Zelaya: Río Kurinwás, 12° 52' N, 84° 03' W, 1 (USNM); La Esperanza, Río Siguia (4 km N, 7 km W Rama, ca. 20 m), 1 (KU); 2 miles ESE Rama, 1 (TCWC); El Recreo, ca. 25 m, 13 (6 KU, 7 USNM); *N side Río Mico, El Recreo, 25 m, 2 (KU)*; *S side Río Mico, El Recreo, 25 m, 32 (KU)*; *Old Rama Road, SW El Recreo, 1 (USNM)*; *Escondido River, 50 miles above Bluefields (I. P. Plantation, 3 km S, 13 km E Rama), 13 (USNM)*; *Escondido River, 25 miles above Bluefields (approximately 11 km N, 18 km W Bluefields, near mouth of Río Cama), 1 (USNM)*; *Escondido River, 45 miles above Bluefields, (approximately 6½ km S, 18 km E Rama), 1 (USNM)*; *Escondido River, 35 miles above Bluefields (approximately 9 km N, 25 km W Bluefields), 1 (USNM)*.

Additional records.—Boaco: "Chontales" [probably near Tierra Azul, 30 km NNE Boaco] (Allen, 1908:660). Matagalpa: Vijagua [probably near Guasaca, 35 km NE Matagalpa] (Allen, 1910:104); Río Tuma [probably near Sardinal on the Río Tuma] (Allen, 1910:104); Río Grande [probably on the Río Grande de Matagalpa near the mouth of the Río Upá] (Allen, 1908:660).

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Further Notes about Wisconsin Treehoppers and the Tension Zone (Homoptera, Membracidae)

ABSTRACT: Amended correlations between the distributions of Wisconsin treehoppers and the tension zone in Wisconsin are reported. Of 80 species, nine have distributions correlated with the tension zone.

INTRODUCTION

In a previous paper (Dennis, 1969) I described the relationships between Wisconsin treehopper distributions and the tension zone based on available records through 1967. In the three succeeding years, 1968, 1969 and 1970, records of collections by others and myself modify previous interpretations of these relationships.

DISCUSSION

The status in relation to the tension zone of each of these species has been changed.

Enchenopa binotata (Say), *Vanduzeea arquata* (Say), *Archasia galeata* (Fabricius), *Telamona westcotti* Goding, *Thelia bimaculata* (Fabricius) and *Acutalis tartarea* (Say) should be transferred from the "well-correlated" list to the "nearly-state-wide" distribution category.

Two species, *Cyrtolobus griseus* Van Duzee and *C. maculifrontis* (Emmons), should be transferred from the "nearly-state-wide" group to the "state-wide" list.

Glossonotus turriculatus (Emmons) had been thought to be too rare to categorize, but it can be removed from that list and be included in the "nearly-state-wide" section.

Two species recently discovered in Wisconsin should be added to those which are too rare to categorize. These are: *Cyrtolobus funkhouserii* Woodruff (Dennis and Kopp, 1969) and *C. maxinei* Dennis (Dennis, 1970).