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Sciurus spadiceus (Rodentia: Sciuridae)

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Abstract: *Sciurus spadiceus* Olfers, 1818, is a sciurid commonly known as the southern Amazon red squirrel. *S. spadiceus* is a large-bodied tree squirrel with a variable color pattern, but typically has a reddish brown dorsum, a dark midline, a white venter, and a brown and orange tail. *S. spadiceus* ranges from southern Colombia and Venezuela, south through Peru, western Brazil, Ecuador, and Bolivia in lowland rain forest. This species is listed as "Least Concern" by the International Union for Conservation of Nature and Natural Resources.

Key Words: Bolivia, Brazil, Colombia, Ecuador, lowland rain forest, Peru, South America, southern Amazon red squirrel, Venezuela

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Sciurus spadiceus Olfers, 1818
Southern Amazon Red Squirrel

Sc[iurus]. *spadiceus* Olfers, 1818:208. Type locality "Brasilia [Brazil]," restricted to "Cuyabá, Matto Grosso" by Hershkovitz (1959:346).

Sciurus spaciceus Olfers, 1818:208. Incorrect subsequent spelling of *S. spadiceus* Olfers, 1818.

Sciurus Langsdorffii Brandt, 1835:425, plate XI, figure 1. Type locality "Brasilia," restricted to "Cuyaba [= Cuiabá], Mato Grosso, Brazil" by Wagner (1848:275).

Sciurus pyrrhonotus Wagner, 1842:360. Type locality "Borba," Rio Madeira, Amazonas, Brazil.

Sciurus tricolor Tschudi, 1844:156, plate 11. Type locality "Maynas, lower Río Huallaga, Peru."

Sciurus Morio Wagner, 1848:275. Type locality "Marabitanos, überhaupt vom Rio negro, zusammengebracht [Marabitanos, from the Rio Negro]," Amazonas, Brazil.

Macroxus fumigatus Gray, 1867:428. Type locality "Upper Amazons, Brazil."

Macroxus brunneo-niger Gray, 1867:429. Type locality "Brazil (Castelnau)."

Sciurus castus Thomas, 1903:488. Type locality "Chimate, [La Paz,] Bolivia, 68° W., 15° S. on the Upper Rio Beni. Alt 700 m."

Sciurus duida J. A. Allen, 1914:594. Type locality "Rio Cunucunumá (altitude 700 feet), base of Mount Duida, [Amazonas,] Venezuela," dismissed as a composite specimen by Lawrence (1988).

Sciurus langsdorffii urucumus J. A. Allen, 1914:595. Type locality "Urucum (altitude 400 feet), Rio Paraguay (at mouth of Rio Tacuari), [Mato Grosso do Sul,] Brazil."

Sciurus langsdorffii steinbachi J. A. Allen, 1914:596. Type locality "Santa Cruz de la Sierra, [Santa Cruz,] Bolivia."

Sciurus (*Urosciurus*) *pyrrhonotus taparius* Thomas, 1926:635. Type locality "Urucurituba, Santarem," Pará, Brazil.

Sciurus pyrrhonotus juralis Thomas, 1926:636. Type locality "Jurua River [= Rio Jurua]," Acre or Amazonas, Brazil.

Urosciurus nigratus Pinto, 1931:309. Type locality "Rio Juruá, Amazonas, Brazil."

Hadrosciurus pyrrhonotus purusianus Moojen, 1942:31. Type locality "Lago Aiapuá, Baixo Purús, Estado do Amazonas," Brazil.

Hadrosciurus langsdorffii rondoniae Moojen, 1942:39. Type locality "Cabeceiras do Rio Aripuanã, Rondonia, Mato-Grosso," Brazil.

CONTEXT AND CONTENT. Order Rodentia, suborder Sciuromorpha, superfamily Sciuroidea, family Sciuridae, subfamily Sciurinae, and tribe Sciurini. *S. spadiceus* is closely related to and phenotypically similar to *S. igniventris*; both species are members of the subgenus *Urosciurus* (Patton 1984). Three subspecies of *S. spadiceus* are recognized (Hershkovitz 1959; Patton 1984; Thorington and Hoffmann 2005):

S. s. spadiceus Olfers, 1818:208. See above.

S. s. steinbachi J. A. Allen, 1914:596. See above; *langsdorffii* Brandt is a synonym.

S. s. tricolor Tschudi, 1844:156. See above.

DIAGNOSIS

Sciurus spadiceus is easily distinguished from most other sciurids that occur in its range (Eisenberg 1989; Eisenberg and Redford 1999; Emmons and Feer 1990). Members of the genus *Microsciurus* (dwarf squirrels) and *Sciurillus pusillus* (Neotropical pygmy squirrel) are much smaller (<30% of the body size of *S. spadiceus*) and differ in cranial morphology. Congeners that are sympatric with *S. spadiceus* include *S. aestuans* (Guianan squirrel) and *S. gilvigularis* (yellow-throated squirrel), which are much smaller (<50% the body size) with a brownish to agouti pelage. *S. spadiceus* differs from the smaller (<60% of the body size) *S. ignitus* (Bolivian squirrel) and *S. sanborni* (Sanborn's squirrel) in pelage coloration, with the latter species having sparsely haired ears, a gray to olive brown dorsum, a yellow to orange venter, and a banded tail. *S. spadiceus* is slightly smaller (about 90% of the body size) and lacks the grizzled yellowish dorsum of *S. flammifer* (fiery squirrel). *S. spadiceus* is similar to *S. pyrrhinus* (Junín red squirrel) in overall coloration, but differs in that *S. spadiceus* is larger (about 110% of body size) and has a tail longer than the body.

Sciurus spadiceus is very similar to the congeneric *S. igniventris* (the northern Amazon red squirrel). The 2 species differ in cranial morphology; *S. spadiceus* has a long-muzzled and narrow skull, whereas the skull of *S. igniventris* is broad with a shorter rostrum (Eisenberg 1989; Patton 1984; Thomas 1900). An analysis of measurements (mm) taken on animals from 3 sites in Peru resulted in a mean skull length of 69.75, mean rostral width of 12.07, and mean rostral length of 29.64 for *S. spadiceus* ($n = 71$) compared to 63.24, 15.29, and 25.83, respectively, for *S. igniventris* ($n = 66$—Patton 1984). *S. spadiceus* and *S. igniventris* are very similar in size and pelage coloration but differ in that *S. igniventris* lacks orange patches behind its ears as well as orange fur on the tops of its feet (Eisenberg and Redford 1999; Patton 1984).

Sciurus spadiceus spadiceus possesses a dorsum grizzled with pale yellowish and dusky fur, ochraceous buff underparts, and fur washed with reddish orange on cheeks and head. *S. s. steinbachi* is a larger form that is paler with upper parts grizzled with pale yellowish and dusky fur and ochraceous buff underparts, washed with yellowish on cheeks and head. *S. s. tricolor* has a dark brown to blackish dorsum washed with ochre and a venter of pale yellow.

GENERAL CHARACTERS

Sciurus spadiceus is a large-bodied tree squirrel with an elongated tail (Fig. 1). Mean (range) of external measurements (mm) of adult *S. spadiceus* were: total length, 524.5 (475.0–628.0); length of tail, 268.8 (240.0–340.0); length of hind foot, 65.3 (59.0–71.0); length of ear, 32.6 (30.0–34.0—Eisenberg 1989; Eisenberg and Redford 1999; Hayssen 2008; Patton 1984; Thomas 1903). Mean (range) body mass (g) was 615 (570–660—Eisenberg and Redford 1999; Hayssen 2008). The skull of *S. spadiceus* is relatively narrow and has a prominent rostrum (Fig. 2). Mean (range) cranial measurements (mm) were: length of skull, 68.00 (63.30–71.23); basilar length of Hensel, 54.00 (50.30–56.47); mastoid breadth, 26.48 (25.67–26.85); width of least interorbital constriction behind the postorbital process, 19.88 (19.09–20.44); least interorbital breadth anterior to postorbital process, 21.80 (20.90–22.54); zygomatic breadth, 39.08 (37.19–40.55); rostral length, 28.79 (26.21–30.51); length of nasal, 21.94 (20.42–23.41); rostral width, 11.76 (10.00–12.57); length of diastema, 20.98 (18.83–22.38); length of maxillary toothrow, 10.34 (9.79–10.74); palatal width at M1, 6.99 (6.70–7.18); mesopterygoid fossa width, 5.76 (5.59–6.07); basisoccipital width at junction with basisphenoid, 8.73 (7.23–9.12); bullar length, 10.52 (10.12–10.99); bullar height, 9.77 (9.46–10.18); cranial depth, 27.19 (25.00–28.01); ramus height from angular to coronoid process, 25.19 (23.59–26.15); length of ramus, 42.37 (37.93–46.02); ramus height at P4, 13.10 (12.03–13.82—Patton 1984). Sexual dimorphism is not apparent in *S. spadiceus* (Patton 1984).

Fig. 1.—An adult *Sciurus spadiceus* from western Brazilian Amazon in the Mamiraua Reserve between the Solimones River and the Japura River. Photograph by William Quatman used with permission.

DISTRIBUTION

Sciurus spadiceus is found from southern Colombia and Venezuela, south through the lowland forests of Peru, Ecuador, western Brazil, and Bolivia, often extending into the foothills of the Andes (Fig. 3; Eisenberg 1989; Eisenberg and Redford 1999). *S. s. spadiceus* was collected in the western Brazilian state of Matto Grosso and appears to be found primarily in Brazil; *S. s. steinbachi* was collected and is found primarily in Bolivia; *S. s. tricolor* was originally collected and appears to be found primarily in Peru. Accurate geographical

Fig. 2.—Dorsal, ventral, and lateral views of skull and lateral view of mandible of an adult male *Sciurus spadiceus* (Field Museum of Natural History specimen 21545) from Porto Velho, Brazil. Occipitonasal length is 1.5 cm. Photograph by Bruce Patterson used with permission.

boundaries that separate each of these subspecies remain unclear. No fossils of *S. spadiceus* are known.

FORM AND FUNCTION

Sciurus spadiceus has a variable pelage but typically has a reddish brown dorsum with orange patches behind its ears, a dark midline, and a white venter. The feet often have black fur on the dorsal surface, and the tail is dark brown at its base with orange fur on the distal two-thirds. Melanistic specimens have been collected for this species, and thus black morphs do occur (Cabrera 1961; Eisenberg 1989; Eisenberg and Redford 1999; Thomas 1900, 1903). In addition to the prominent coloration, tails are noticeably elongated and exceed the body length. Mammae count is 8 in females (Thomas 1900). The relatively long snout (compared to the similar *S. igniventris*) does not convey mechanical advantage when forces generated are considered (Velhagen and Roth 1999). The dental formula for *S. spadiceus* is i 1/1, c 0/0, p 1/1, m 3/3, total 20.

ONTOGENY AND REPRODUCTION

The reproductive behavior and timing of *Sciurus spadiceus* is unknown. Young squirrels have been seen in Peru in early June, suggesting that breeding occurs at least in the autumn months of the Southern Hemisphere and possibly around August in Bolivia, producing a litter of 2–4 (Anderson 1997).

ECOLOGY

Sciurus spadiceus lives in the foothill forests of the Andes and persists in some disturbed forests (Mena and Medellín 2010); however, *S. spadiceus* is most common in lowland rain forests of the Amazon Basin (Eisenberg 1989; Eisenberg and Redford 1999; Solari et al. 2006), which are subject to wet and dry seasons that include seasonal flooding (Butt et al. 2008; Haugaasen and Peres 2007). Given these conditions, *S. spadiceus* remains in the upper canopy of the forest when the ground and understory are inundated with water and does not abandon flooded areas (Haugaasen and Peres 2005, 2007). However, *S. spadiceus* is most often seen on the ground, in low undergrowth, or in palm trees (Emmons and Feer 1990). Lowland Amazon forests are incredibly diverse in tree species (Gentry 1992; Terborgh and Andresen 1998), and *S. spadiceus* specializes in the thick, hard-shelled nuts common to many of the tree species of this ecosystem (Emmons 1984). In the western Amazon region, *S. spadiceus* specializes on large nuts with thick, hard endocarps; fruit from 4 large-seeded genera (*Astrocaryum*, *Attalea*, *Scheelea*, and *Dipteryx*) provide the vast majority of this species' diet (Cintra and Horna 1997; Emmons 1984; Peres 1994; Peres and Baider 1997). *S. spadiceus* also consumes clay and soil on rare occasions (Brightsmith and Munoz-Najar 2004). The difference in rostral length between *S. spadiceus* and the phenotypically similar and often syntopic *S. igniventris* suggests an ecological difference between the 2 species, but this remains unconfirmed (Hershkovitz 1959; Patton 1984).

It has been stated that sciurids represent 50% of the biomass in the Neotropics (Peres 1999). Population densities and biomass for *S. spadiceus* in different parts of its range are 2.4–12.2 individuals/10 km or 3.8–6.6 individuals/km^2 and 3.0–9.8 kg/km^2, respectively (Aquino 2005; Emmons 1984; Endo et al. 2010; Gómez et al. 2003; Peres 1999). Endoparasites include the coccidian *Eimeria damnosa*, which may

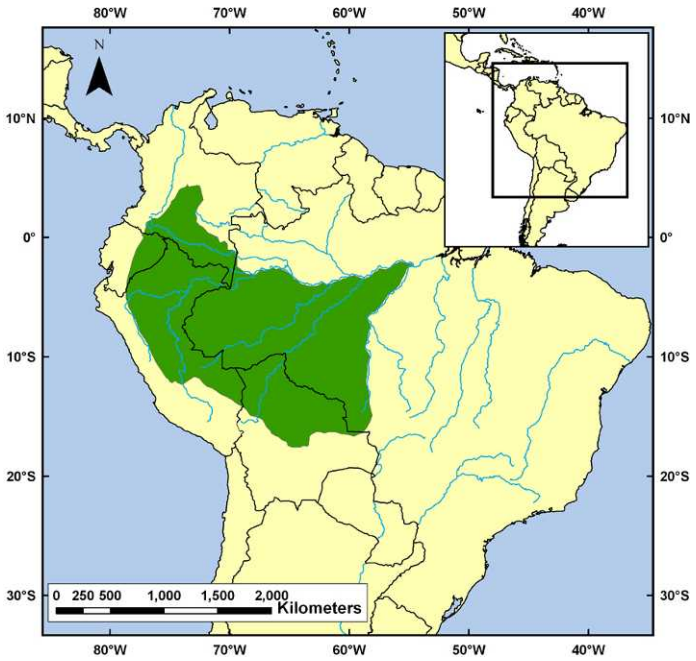

Fig. 3.—Geographic distribution of *Sciurus spadiceus*.

cause death, and unidentified species of *Giardia* and *Trypanosoma* (Lainson et al. 2004, 2005). Ocelots (*Leopardus pardalis*) and jaguars (*Panthera onca*) are known predators of *S. spadiceus* (Emmons 1987).

BEHAVIOR

Sciurus spadiceus is diurnal, nonterritorial, and remains active year-round. The loud gnawing to access the endosperm within the thickened coverings of various rain-forest fruits and nuts is an excellent indicator of the presence of *S. spadiceus*. Several individuals have been observed feeding in the same tree, leaving conspicuous feeding sign at the tree's base. Nuts are often cached in the ground and several individuals can easily remove hundreds of nuts from a palm. *S. spadiceus* does not travel in the forest canopy and instead descends to the ground and runs away in the undergrowth when alarmed. *S. spadiceus* rarely calls but when threatened produces an alarm call that sounds much like a sneeze followed by a series of chatters and chucks (Eason 2010; Emmons and Feer 1990). Home ranges are estimated to be 25–50 ha (Haugaasen and Peres 2005).

GENETICS

The diploid number (2n) for *Sciurus spadiceus* is 40 with a fundamental number (FN) of 76, with all autosome pairs being biarmed (Lima and Langguth 2002). In a genetic analysis of New World tree squirrels it was determined, based on a locus by locus protein analysis, that the genus *Sciurus* (North and South American species) is more closely related to the Neotropical genus of dwarf squirrels (*Microsciurus*) than to the Neotropical genus of pygmy squirrels (*Sciurillus*—Hafner et al. 1994).

CONSERVATION

Sciurus spadiceus is listed as "Least Concern" on the *International Union for Conservation of Nature and Natural Resources Red List of Threatened Species* (Amori et al. 2008). The species has a large geographic range and does not appear to be declining at a significant rate (Amori et al. 2008). Habitat destruction is a significant threat to the survival of *S. spadiceus* as well as all other mammals in the Amazon Basin (Amori et al. 2008). Individuals of *S. spadiceus* are able to persist in disturbed forest but the long-term impacts are unknown (Mena and Medellín 2010). Coupled with deforestation is hunting for bush meat, which has been observed for this species in Ecuador and Peru (Emmons 1984). Dogs are trained to hunt *S. spadiceus* (Jernigan 2009) and although it is not a preferred item for hunters, numbers and biomass of *S. spadiceus* decrease demonstrably in areas where this large-bodied squirrel is hunted for food (Bodmer 1995; Emmons 1984; Endo et al. 2010; Mena-Valenzuela 1998). Camera traps and feeding sign can be used to document the presence of *S. spadiceus* (Tobler et al. 2008). The conservation of *S. spadiceus* would be greatly improved by greater knowledge of this squirrel's basic ecology, microhabitat affinities, and other aspects of its natural and life history.

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