Journal of Mammalogy, 86(5):873–880, 2005

A NEW SPECIES OF *NEUSTICOMYS* (ICHTHYOMYINI, SIGMODONTINAE) FROM CENTRAL BRAZILIAN AMAZONIA

A. R. Percequillo,* A. P. Carmignotto, and M. J. de J. Silva

Mastozoologia, Departamento de Sistemática e Ecologia, Universidade Federal da Paraíba, Caixa Postal 5133, 58051-970, João Pessoa, Paraíba, Brazil (ARP)
Mastozoologia, Museu de Zoologia, USP, C.P. 42594, 04299-970, São Paulo, São Paulo, Brazil (APC)
Laboratório de Genética, Instituto Butantan, Avenida Vital Brazil, 1500, 05503-900, São Paulo, São Paulo, Brazil (MJJS)

The known species of genus *Neusticomys* occur from the Colombian and Ecuadorian Andes southward to the Amazonian lowlands of Peru and eastward to Venezuela, Guyana, French Guiana, and Amapá, Brazil. In this study we describe a new species, *Neusticomys* sp. nov., from the Rio Juruena on the Central Brazilian shield, extending the distributional range of the genus and placing it in the center of South America. *Neusticomys* sp. nov. is defined and diagnosed by a unique combination of character states: ears and feet covered by dark brown hairs; size small; inferior zygomatic root anterior to 1st upper molar; orbicular apophysis absent; M3 present; m3 frequently present; posteroloph absent on M2 and M3; reduction of posterior lobe relative to the anterior lobe on M2; and 2n = 92, FN = 98.

Key words: Amazonia, Brazil, Ichthyomyini, Mato Grosso, *Neusticomys*, Sigmodontinae

The genus *Neusticomys* belongs to a unique neotropical muroid radiation, the Ichthyomyini, that exhibits numerous morphological adaptations to semiaquatic carnivory. Ichthyomyine rodents inhabit high-altitude and lowland forest habitats in or near streams throughout Central America and northern South America and consist of 16 species in 5 genera (Jenkins and Barnett 1997; Ochoa G. and Soriano 1991; Voss 1988). Currently, *Neusticomys* includes 5 species (Musser and Carleton 1993): *N. monticolus* Anthony, 1921; *N. venezuelae* (Anthony, 1929); *N. peruviensis* (Musser and Gardner, 1974), *N. oyapocki* (Dubost and Petter, 1978), and *N. mussoi* Ochoa G. and Soriano, 1991, and is the most speciose and least morphologically specialized ichthyomyine genus (Voss 1988). Its species are small-sized and generally brownish in coat color, with short blunt muzzles, small eyes and ears, large hind feet, and hairy tails (Voss 1988). Known species occur from the Colombian and Ecuadorian Andes southward to the Amazonian lowlands of Peru and eastward to Venezuela, Guyana, French Guiana, and Amapá, Brazil (Nunes 2002; Voss 1988; Voss et al. 2001).

These rodents are rarely collected, and except for *N. monticolus*, they are represented in museums by a mere handful of specimens (Nunes 2002; Voss et al. 2001:104, table 26). To date, known collecting localities of *Neusticomys* encircle the northern and western limits of Brazilian Amazonia, from which no specimens have yet been reported despite impressive faunal sampling efforts (e.g., Emmons 1984; George et al. 1988; Malcolm 1988; Patton et al. 2000; see also Voss and Emmons [1996] for unpublished inventories). In this study we report a new species of *Neusticomys* from the upper Rio Juruena on the Central Brazilian shield, extending the distributional range of the genus into the geographic center of South America.

Materials and Methods

Small mammals analyzed here were trapped in the vicinity of the Juruena, Mato Grosso, Brazil, in an area about 20 km west of the city. We used pitfall and conventional trapping during fieldwork. The pitfall arrays employed during fieldwork near Juruena consisted of 5 lines with forty 20-liter buckets aligned with drift fences, totaling 200 buckets; the total pitfall effort near Juruena was 2,000 pitfall-nights. Additionally, livetrap arrays consisted of 7 traplines with 30 traps each, including 26 Sherman traps (H. B. Sherman Traps, Inc., Tallahassee, Florida) and 4 Tomahawk traps (Tomahawk Live Trap Co., Tomahawk, Wisconsin); 182 Sherman and 28 Tomahawk live traps were used, for a total of 1,830 conventional trap-nights. Animal care and use procedures followed the guidelines established and approved by the American Society of Mammalogists (Animal Care and Use Committee 1998). Voucher specimens were deposited in Museu de Zoologia da Universidade de São Paulo (MZUSP) and chromosomal slides and tissues were deposited at the Laboratório de

* *Correspondent: arpercequillo@dse.ufpb.br*

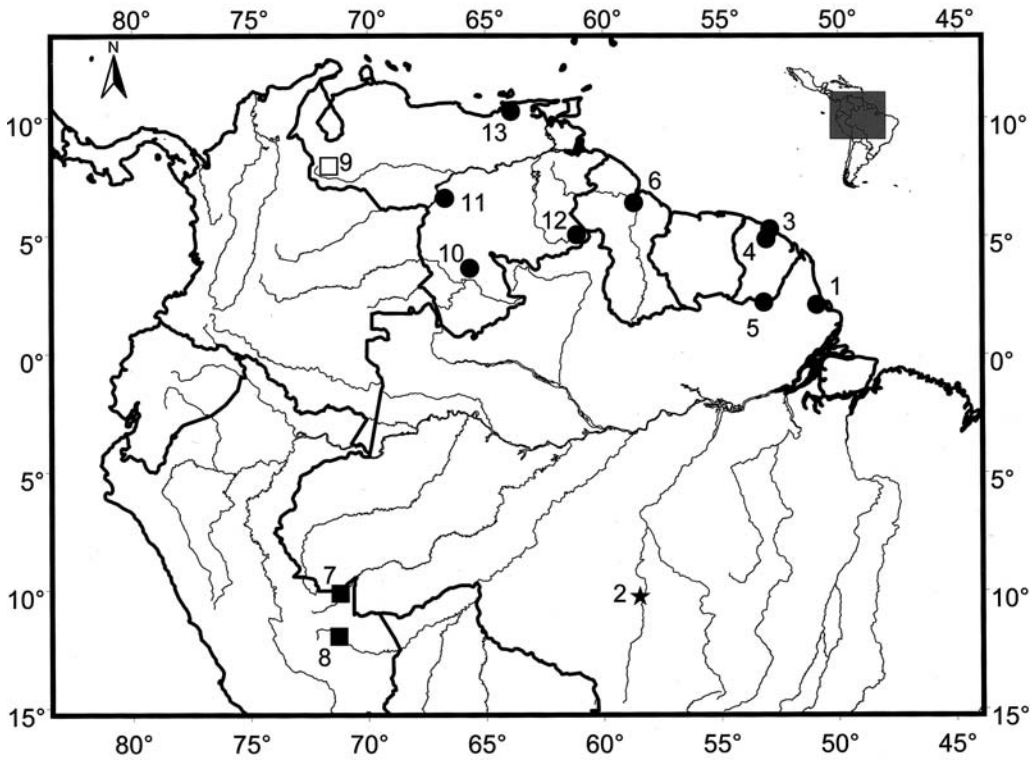

Fig. 1.—Known collecting localities of the 5 lowland species of genus *Neusticomys* in South America: *N. mussoi* (open square), *N. oyapocki*

Citogenética de Vertebrados, Instituto de Biociências, Universidade de São Paulo (LCV-IBUSP).

We followed the terminology and definitions employed by Reig (1977), Voss (1988, 1993), Steppan (1995), and Voss et al. (2001) for age classes, anatomical traits, and molar nomenclature herein described. Complete geographic information and geographical coordinates of all collecting localities mentioned in the text are provided in Appendix I.

We determined relative age classes of specimens based on the work of Voss (1988), which considers 6 tooth-wear and dental-eruption classes (1–6), 3 states of sphenooccipital suture closure (o = open, c = closed, and f = fused), and 3 different pelage patterns (i = immature, a = adult, and n = no distinction). Relative age classes provided in text are formed by the abbreviations of the 3 criteria, separated by slashes.

External and cranial measurements were assessed by following the works of Voss (1988) and Voss et al. (2001): length of head and body (HBL), length of tail (LT), length of hind foot (HF), length of ear (Ear), body mass (Wt), condyloincisive length (CIL), length of diastema (LD), length of maxillary molars (LM1–3), length of maxillary M1–2 (LM1–2), length of incisive foramina (LIF), breadth of the incisor tips (BIT), breadth of the incisive foramina (BIF), breadth of palatal bridge (BPB), length of nasals (LN), breadth of nasals (BN), least interorbital breadth (LIB), zygomatic breadth (ZB), breadth of braincase (BB), breadth of zygomatic plate (BZP), breadth of M1 (BM1), height of incisor (HI), depth of incisor (DI), breadth of occipital condyles (BOC).

Chromosomal preparations were obtained in vivo from bone marrow (Ford and Hamerton 1956) and spleen (Yonenaga 1972) in the field. Conventional (Giemsa) staining, CBG, and GTG bands were produced by using routine cytogenetic techniques (Seabright 1971; Sumner 1972). Slides were visualized and photographed by using a Zeiss Axiophot microscope (Carl Zeiss Göttingen, Göttingen, Germany) and HQ Imagelink film (Kodak Co., Rochester, New York). Karyotypes were organized according to chromosome morphology and size, and chromosomal homologies were identified based on banding patterns.

Results

Neusticomys ferreirai sp. nov.

Holotype.—MZUSP 32092, an adult female (age class 3/c/a of Voss [1988]) collected by A. P. Carmignotto (original field number APC 173), on 15 June 1997 in a pitfall trapline in an area of lowland rainforest (206 m elevation) near Juruena, in the Brazilian state of Mato Grosso (10°14′S, 58°29′W). Type locality located 20 km W of the left bank of the Rio Juruena, in the municipality of Juruena (Fig. 1). The holotype consists of a skin, skull, and partial postcranial skeleton, with liver and muscle tissue preserved in ethanol.

Paratype.—MZUSP 32093, a young adult male (age class 2/c/i of Voss [1988]) collected by A. P. Carmignotto (original field number APC 150) on 10 June 1997 at the same locality as the holotype, but in another pitfall trapline about 650 m away. The paratype consists of a skin, skull, partial postcranial skeleton, and stomach. A suspension of bone marrow cells in Carnoy's fixative (methanol : acetic acid), and liver and muscle tissue in ethanol also is preserved.

Distribution.—This species is known only from the type locality.

TABLE 1.—External and cranial measurements of the 5 lowland species of the genus *Neusticomys*: *N. ferreirai*, *N. mussoi*, *N. oyapocki*, *N. peruviensis*, and *N. venezuelae*. Sizes are from measurements on 2 specimens of *N. ferreirai* and measurements from the literature for other species (see table footnote). Numbers furnished represent the observed range interval with sample size in parentheses. Abbreviations for measurements as in text; m = male, f = female, u = undetermined.

	N. ferreirai					
	MZUSP 32092, f	MZUSP 32093, m	*N. mussoi*[a] 1 m, 1 f	*N. oyapocki*[b,c] 3 m, 1 f	*N. peruviensis*[d] 1 m	*N. venezuelae*[a,b] 3 m, 2 f, 2 u
HBL	106	105	94–118 (2)	102–114 (4)	128	100–132 (7)
LT	85	79	—	66–87 (4)	108	105–120 (5)
HF	21/22.5	22/24	21 (2)	23–26 (4)	30	25–28 (7)
Ear	11.0	11.5	10 (2)	6–12 (4)	12	10–13 (7)
Wt	34	25	—	21–47 (3)	—	58–66 (2)
CIL	24.5	24.6	24.1–24.7 (2)	24–27.9 (4)	28.1	26.0–29.3 (6)
LD	6.7	6.9	6.2 (2)	6.7–7.8 (4)	7.5	6.7–7.6 (7)
LM1–3	3.5	3.2	3.3–3.4 (2)	—	3.8	4.0–4.3 (7)
LM1–2	3.0	2.8	—	2.9–3.0 (4)	3.2	3.3–3.6 (5)
LIF	5.0	4.6	4.6–4.8 (2)	4.1–5.2 (4)	5.6	4.8–5.7 (6)
BIT	1.8	1.8	1.6–1.9 (2)	1.9 (1)	2.2	1.5–2.0 (6)
BIF	1.9	2.0	1.8 (2)	2.3 (1)	2.0	1.8–2.2 (6)
BPB	2.6	2.6	2.5–2.6 (2)	2.5–3.0 (4)	3.3	2.5–3.1 (6)
LN	9.7	9.8	9.5 (1)	—	11.1	8.8–12.3 (6)
BN	3.1	3.3	3.3 (2)	3.3 (1)	3.7	3.2–3.6 (6)
LIB	4.9	4.8	4.5–4.6 (2)	4.8–5.4 (4)	5.2	5.0–5.4 (6)
ZB	13.0	12.6	12.2–12.3 (2)	12.3–15.1 (4)	14.4	12.8–14.5 (5)
BB	11.2	10.9	11.0 (2)	11.2 (1)	12.8	11.6–13.0 (6)
BZP	1.4	1.4	1.1 (2)	1.4–1.5 (4)	1.3	1.1–1.5 (7)
BM1	1.3	1.2	1.2 (2)	1.1 (4)	1.3	1.3–1.5 (7)
HI	4.3	4.4	4.1–4.3 (2)	5.2 (1)	4.9	4.0–5.1 (6)
DI	1.4	1.6	1.5 (2)	1.6 (1)	1.9	1.2–1.8 (6)
BOC	6.8	6.9	6.2–6.5 (2)	7.1 (1)	7.6	7.1–7.6 (5)

[a] Ochoa G. and Soriano (1991).
[b] Voss et al. (2001).
[c] Nunes (2002).
[d] Voss (1988).

Etymology.—The name is in honor of Alexandre Rodrigues Ferreira, the 1st Brazilian naturalist to explore the Amazon and Pantanal biomes along the states of Pará and Mato Grosso, in the 18th century (1783–1792). His expedition was one of the 1st to bring information on the inner country areas, contributing a rich collection of plants, animals, and minerals, together with drawings and reports on landscape and indigenous people (Cunha, 1991).

Diagnosis.—*Neusticomys ferreirai* is a member of the subfamily Sigmodontinae (sensu Reig 1980) readily distinguished from its congeners by the following combination of character states: ears and feet densely covered by dark brown hairs; smaller body size; small skull; inferior zygomatic root slightly anterior to M1; orbicular apophysis absent; M2 without posteroloph; posterior lobe of M2 much smaller than the anterior lobe; M3 present; m3 usually present.

Morphological description.—Head and body small (Table 1); tail short (about 75–80% of head-and-body length); hind feet narrow and short (with claws, about 21–22% of head-and-body length); ears rounded and small (about 10–11% of head-and-body length). Dorsal pelage short, compact, and soft; consisting of dense and dull underfur of wool hairs and glossy overfur of awns and guard hairs. Wool hairs abundant, short (4–5 mm), fine, and wavy; basal portion silvery gray and tip (about one-tenth of total length of hair) orange brown. Awns sparse and long (5–6 mm); basal three-fourths of hair straight and thin and gray in color; terminal one-fourth wider and nearly flat, dark brown with a medium to subterminal orange buffy band. Guard hairs sparse, slightly longer than awns (6–7 mm); basal one-fourth slender, straight, and gray; terminal three-fourths wider and almost flat, entirely brown or brown with a subterminal orange buffy band. Dorsal body color glossy brown grizzled with orange. Dorsal portion of head colored like body; cheeks predominantly orange; nose and mystacial region dark brown; rhinarium unpigmented; ventral portion of head, chin, and throat grayish brown; mouth surrounded by white hairs. Ventral pelage grayish orange buffy indisctinctly paler than dorsal pelage, harsher, and shorter, but with the same 3 hair types. Ventral wool hairs dense, thin, wavy, and short (3–4 mm), basal portion grayish with pale orange buffy tips. Ventral awns straight and longer (4–5 mm); basal one-half grayish and terminal one-half grayish brown fading to pale orange buffy tips. Ventral guard hairs sparse and longer (5–6 mm); basal one-fourth thin and gray; terminal three-fourths wider and colored like awn hairs. Eyes small. Pinnae small, rounded, conspicuous above fur of head; well covered with short, stiff, dark brown hairs; dorsal portion of pinnae covered with orange-tipped brown hairs; auditory opening concealed by long preauricular hairs. Mystacial vibrissae sparse and short, not surpassing ears when laid back alongside head; dorsalmost mystacial hairs

Fig. 2.—*Neusticomys ferreirai* sp. nov., dorsal, ventral, and lateral views of skull and mandible of holotype, MZUSP 32092 (condyloincisive length = 24.49 mm); Juruena, Mato Grosso, Brazil.

entirely black or black with white or silvery tips, but ventral hairs entirely silvery; superciliary vibrissae absent; submental vibrissae short and stiff; interramal vibrissae present (consisting of 1 long hair); carpal vibrissae present (represented by 2 hairs proximal to each wrist). Dorsal surface of manus and pes covered with short dark brown hairs; ungual tufts inconspicuous, much shorter than claws, dark brown with whitish tips; plantar surfaces naked, unpigmented on manus but heavily pigmented (brownish) on pes; manus with 5 distinct plantar pads; pes with 4 small interdigital pads and 1 large tarsal pad (hypothenar; pad absent); hind feet with natatory fringe weakly developed on lateral metatarsal and tarsal margins; short webbing between pedal digits II, III, and IV; claws of pedal digits I and V extending to 1st interphalangeal joints of the adjacent digits, II and IV, respectively. Six mammae, in inguinal, abdominal, and thoracic pairs. Tail unicolored, densely covered with long dark brown hairs, forming an inconspicuous tuft at tip; hairs denser on the ventral surface of tail; hairs cover 6 or 7 scale rows on basal portion of tail; scales very small and irregular in shape and size.

Skull small (Fig. 2; Table 1). Rostrum short and moderately broad, tapering anteriorly; nasals and premaxillae long; nasals extending anteriorly to conceal nasal orifice from dorsal view; zygomatic notch absent; tip of capsular projection of nasolacrimal foramen visible in dorsal view (not visible in Fig. 2); lumen of nasolacrimal foramen long and narrow; gnathic process of premaxillae long, projecting forward well anterior to incisors; premaxillae not projected anteriorly, shorter than nasals; superior root of maxillary zygomatic process thin; zygomatic plate narrow with anterior margin nearly straight and posterior margin situated just a little anterior (0.4–0.6 mm) to M1; masseteric tubercle present; lumen of infraorbital foramen wide and almost elliptical in shape; incisive foramina long, almost reaching alveolus of M1, with nearly parallel lateral margins (lateral margins wider anteriorly in MZUSP 32093); capsule inflated, with small and distinct posterior projections. Interorbital region long and wide, converging posteriorly; supraorbital margins rounded, without beads or crests; supraorbital foramen on extreme dorsolateral portion of frontal, visible in dorsal view; molars not visible in dorsal view. Palate long, wide (sensu Hershkovitz 1962), and almost flat; posterolateral palatal pits small and simple; anterior border of mesopterygoid fossa posterior to M3, with well-developed medial projection; roof of mesopterygoid fossa completely ossified; lateral wall of alisphenoid with distinct alisphenoid strut separating the masticatory–buccinator and accessory oval foramina. Carotid arterial circulation primitive (pattern 1 of Voss [1988]). Zygomatic arches thin and delicate, parallel and incomplete; jugals small (present on specimen with undamaged zygomatic arches, MZUSP 32093). Braincase rounded, without temporal or sagittal crests; interparietal short (anteroposterior dimension) and wide (transverse dimension); parietal not present on lateral surface of braincase; lambdoidal crests weakly developed; occipital region rounded, without occipital crests; foramen magnum large; occipital condyles projecting posteriorly, visible in dorsal view. Subsquamosal fenestra absent. Auditory bullae globose and flask-shaped; eustachian tube short; stapedial process of ectotympanic absent; orbicular apophysis of malleus absent; tegmen tympani overlaps posterior suspensory process of squamosal.

Mandible short and deep (Fig. 2); coronoid process large, strongly falciform, and greatly surpassing the condyloid process in height; sigmoid notch short and deep; angular process short, rounded, extending posteriorly about as far as condyloid process; lunar notch moderately deep; capsular process of alveolus of lower incisor indistinct.

Dentition.—Upper incisors weakly opisthodont (almost orthodont), with yellow enamel bands; ungrooved. Upper molar rows parallel (Fig. 2). Principal labial and lingual molar cusps nearly opposite, with lingual cusps slightly posterior to labial ones (Fig. 3). Molars hypsodont. M1 longer and wider than M2 and M3; anterocone of M1 divided by anteromedian flexus into subequal anterolabial and anterolingual conules; anteroloph reduced (only a small salience on lingual surface of enamel); paraflexus deep and narrow; protoflexus shallow and

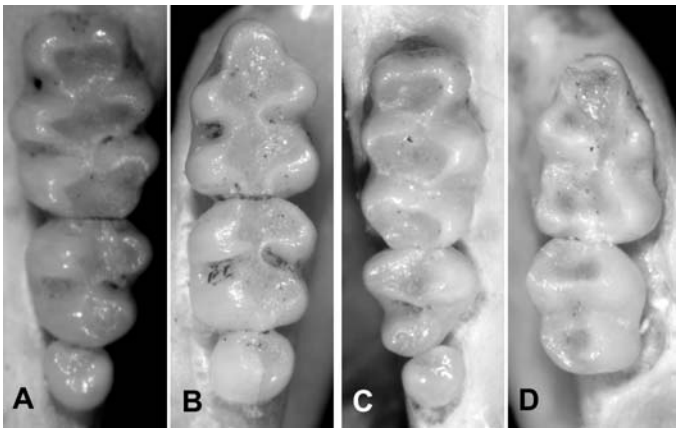

FIG. 3.—*Neusticomys ferreirai* sp. nov., occlusal view of A) upper and B) lower left molar toothrows of holotype, MZUSP 32092 (length of M1–3 = 3.5 mm, length of M1–2 = 3.0 mm, breadth of M1 = 1.3 mm) and C) upper and D) lower right molar toothrows of paratype, MZUSP 32093 (length of M1–3 = 3.2 mm, length of M1–2 = 2.8 mm, breadth of M1 = 1.2 mm); Juruena, Mato Grosso, Brazil.

wide; paracone with distinct marginal paralophule; metaflexus deep and penetrating on molar plane; protocone narrow and high; hypoflexus deep (bisects the molar in MZUSP 32093); mesoloph indistinct; metacone wide, totally fused to posteroloph; no trace of posteroflexus present. M2 short, with metacone–hypocone pair narrower than paracone–protocone pair; anteroloph small; paraflexus and protoflexus shallow; paracone with distinct marginal paralophule; metaflexus and hypoflexus deep and wide; metacone and hypocone coalesced, forming a small posterior cusp; posteroloph or posteroflexus absent. M3 peglike, extremely reduced in size. Lower molar rows parallel; lingual cusps slightly anterior to labial cusps; m1 longer than m2 and m3; shallow anteroconid narrower than metaconid–protoconid pair; anteroconid divided (MZUSP 32093) or not (MZUSP 32092) by anteromedian flexid; anterolophid not present; metaflexid and protoflexid restricted to enamel surface; entoflexid and hypoflexid deeply penetrating (almost bisect m1); entoconid with small marginal entolophulid; entoconid and hypoconid fused medially; posterolophid small, short, and medial. Lower m2 with entoconid–hypoconid pair narrower than metaconid–protoconid pair; small and indistinct anterolabial cingulum; protoflexid restricted to enamel surface; entoflexid and hypoflexid deeply penetrating (in specimen MZUSP 32093 the m2 is bisected by entoflexid and hypoflexid); small entolophulid present; posteroloph small and short (greatly reduced on MZUSP 32093). Lower m3 present or absent (on right mandibular ramus of MZUSP 32093); m3 peglike.

Postcranial skeletal.—The axial skeletal includes 7 cervical vertebrae, 13 thoracic vertebrae, 5 or 6 lumbar vertebrae, 4 sacral vertebrae, and 27 caudal vertebrae.

Comparisons.—Like most other lowland congeners (*N. venezuelae*, *N. peruviensis*, and *N. mussoi*), *N. ferreirai* does not exhibit any diagnostic autapomorphy. Instead, all of these species are diagnosed by unique combinations of character states that are operationally useful for species recognition (Table 2). The only exception to this rule is *N. oyapocki*, which uniquely lacks M3 and m3, an obviously derived character state.

The ears and feet of *N. ferreirai*, as in *N. oyapocki* and *N. venezuelae*, are covered with dark brown hairs (Voss et al. 2001), differing in this respect from *N. mussoi* and *N. peruviensis*, which exhibit present cream-colored ears and feet (Table 2). *N. ferreirai* shares with *N. mussoi* the presence of short mystacial vibrissae that do not extend posteriorly behind the ears when laid back alongside the head, whereas *N. oyapocki*, *N. venezuelae*, and *N. peruviensis* exhibit long mystacial vibrissae that extend behind the ears by almost 15 mm in the latter (Musser and Gardner 1974). *N. ferreirai* and *N. mussoi* differ from one another in the coloration of their mystacial vibrissae, which are dark brown in the former but ''entirely whitish'' in the latter (Ochoa G. and Soriano 1991:98).

Cranially, *N. ferreirai* resembles *N. mussoi* in almost all cranial and dental dimensions, but differs from the latter by

TABLE 2.—Geographic distribution and morphological comparisons among lowland species of *Neusticomys*. This table is based on Voss et al. (2001:104) and Pacheco and Vivar (1996).

	N. ferreirai	*N. mussoi*	*N. oyapocki*	*N. peruviensis*	*N. venezuelae*
Known distribution	Central Brazil	W Venezuela	French Guiana and N Brazil	E Peru	Guyana, E and S Venezuela
Fur of ears and feet	Dark brown	Cream	Dark brown	Cream	Dark brown
Length of vibrissae	Short	Short	Long	Long	Long
M2 morphology	Metacone–hypocone pair much narrower than paracone–protocone pair	Metacone–hypocone pair subequal to paracone–protocone pair	Metacone–hypocone pair much narrower than paracone–protocone pair	Metacone–hypocone pair subequal to paracone–protocone pair	Metacone–hypocone pair subequal to paracone–protocone pair
M3	Present	Present	Absent	Present	Present
m3	Present or absent	Present	Absent	Present	Present
Length of M1–3	3.2–3.5 mm	3.3–3.4 mm	—	3.8–4.0 mm	3.8–4.3 mm
Length of M1–2	2.8–3.0 mm	—	2.9–3.0 mm	3.2 mm	3.2–3.5 mm
Inferior zygomatic root	Slightly anterior to M1	Above or near M1	Well anterior to M1	Well anterior or above or near M1	Above or near M1
Masseteric tubercle	Present	Present	Variable	Present	Present
Orbicular apophysis	Absent	?	Absent	Small	Absent

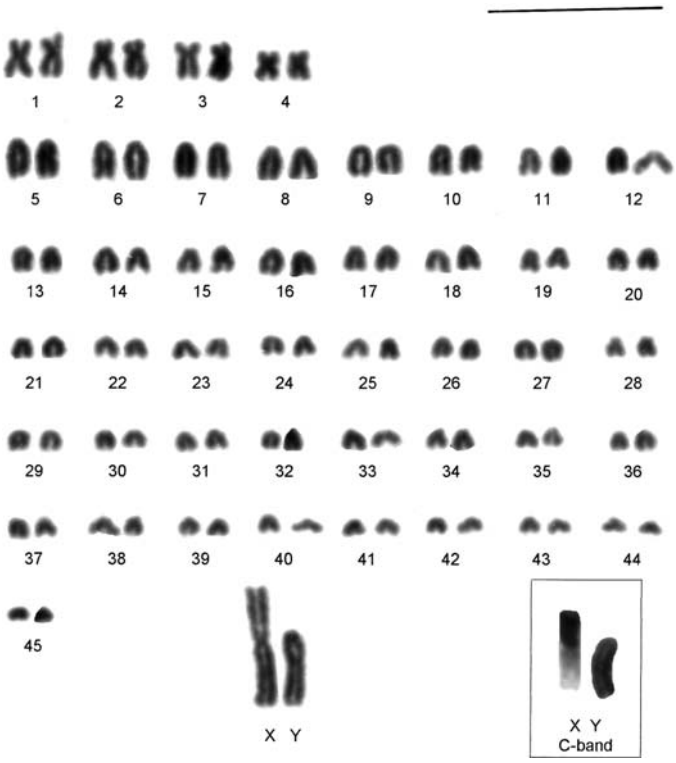

Fig. 4.—*Neusticomys ferreirai* sp. nov., karyotype with conventional staining of the paratype, MZUSP 32093 (2n = 92, FN = 98); Juruena, Mato Grosso, Brazil. Inset, C-banding pattern of X and Y. Scale bar = 10 μm.

having an inferior zygomatic root that is anterior to M1 (Table 2). The molar toothrow of *N. ferreirai* is very small, with M3 and m3 reduced and M2 and m2 with the metacone–hypocone cusp pair much narrower than the paracone–protocone pair, as is observed in all specimens of *N. oyapocki*. However, *N. ferreirai* can be differentiated from *N. oyapocki* by the apparently consistent presence of M3 and by the position of the inferior zygomatic root. The differences between *N. ferreirai* and *N. peruviensis* are more conspicuous: in the former species, the orbicular apophysis of the malleus is absent, the molars and general body and cranial size are smaller, and the posterior edge of the inferior zygomatic root is anterior, but closer, to M1. By contrast, *N. peruviensis* presents a larger body and cranial size, and the orbicular apophysis of the malleus and the posterior edge of the inferior zygomatic root well anterior to M1. Finally, in comparison to *N. venezuelae*, *N. ferreirai* exhibits much smaller molars that do not have posterolophs; small metacone–hypocone lobe on M2; and an inferior zygomatic root that is only slightly anterior to M1 (Table 2).

Morphometrically, *N. ferreirai* exhibits some overlap in body and cranial dimensions with other congeneric species, although several differences can be observed (Table 1). Compared to *N. venezuelae* and *N. peruviensis*, *N. ferreirai* is smaller overall, with a shorter tail, shorter hind feet, shorter and narrower skull, and smaller molars. *N. mussoi* and *N. ferreirai* are almost equal in size, although the former is slightly smaller than the latter in most external and cranial variables; *N. oyapocki* is morphometrically similar to both, but has a slightly larger and wider skull (Table 1).

Karyology.—The karyotype of MZUSP 32093 (Fig. 4) includes 92 chromosomes, of which the autosomes consisting of 4 biarmed metacentric or submetacentric pairs (pairs 1–3 are submetacentrics and pair 4 is a metacentric) and 41 pairs of acrocentrics resulting in a fundamental number (FN) of 98. Sex chromosomes are distinguished from autosomes by size, morphology, and CBG and GTG banding patterns. The X is the largest metacentric of the karyotype and the Y is the largest acrocentric (equivalent in size to about one-half the X chromosome). CBG bands revealed constitutive heterochromatin in the pericentromeric region of all autosomes in the short arm of the X and in the entire Y.

Natural history.—Juruena is situated at the border of the Central Brazilian highland, on the southern limit of the Amazon Basin. In this region, the predominant vegetation type is Amazonian upland rainforest (RadamBrasil 1980). The holotype was captured in a pitfall trapline located in the valley of a small, slow-moving, clear-water stream surrounded by primary forest, with a 25-m canopy bearing various epiphytes. The subcanopy was characterized by a great abundance and diversity of palms (*Astrocaryum*, *Euterpe*, *Mauritia*, and *Oenocarpus*, among others). The undergrowth consisted of numerous species of Cyperaceae, and a shallow litter layer covered the ground.

The paratype was captured about 650 m away in another pitfall trapline on smoothly sloping terrain. The capture site was covered by primary forest with a canopy about 30 m high and with large trees approximately 0.8 m in diameter. The subcanopy was open and consisted of regularly spaced dicotyledoneous trees and palms, with abundant lianas (woody vines) about 0.3 m in diameter. The undergrowth was characterized by the presence of a homogenous layer of 1-m-high ''caetês'' (*Heliconia*) and a dense leaf litter covering the sandy clay soil.

The local climate near Juruena can be classified as ''Am'' when following Köppen's (1948) system, being a warm and humid climate with a 3- to 4-month dry season. Mean annual temperature is about 24–25°C and the mean annual rainfall is about 2,300–2,400 mm (RadamBrasil 1980).

The 2 specimens were captured during the middle of the local dry season (June), and the female was pregnant with 5 large embryos. The stomach of the male specimen (MZUSP 32093) contained arthropod remains (Crustacea), suggesting that the diet of *N. ferreirai* corresponds to that of other ichthyomyine rodents with similar dental morphology (broad and heavy incisors and reduced molars).

Despite the intense capture effort and the high richness of the local small mammal community surveyed (45 specimens of 19 species were collected), only 2 individuals of *N. ferreirai* were obtained. *Nectomys rattus*, *Mesomys hispidus*, and *Monodelphis glirina* were captured in the same pitfall lines with *N. ferreirai*. Other species taken at the site were *Caluromys lanatus*, *Didelphis marsupialis*, *Marmosops noctivagus*, *Marmosops parvidens*, *Micoureus demerarae*, *Monodelphis emiliae*, *Monodelphis glirina*, *Neacomys spinosus*, *Oecomys trinitatis*, *Oryzomys macconnelli*, *Oryzomys mega-*

cephalus, *Oryzomys nitidus*, *Oxymycterus amazonicus*, *Proechimys* group *longicaudatus*, and *Proechimys* group *goeldii*.

Discussion

The specimens reported here extend the known range of the genus *Neusticomys* more than 1,380 km eastward from the nearest known collecting locality of *N. peruviensis* and about 1,350 km southward from the nearest record of *N. oyapocki* (Fig. 1). Thus, the range of the genus now almost completely encircles central Amazonia, but because *Neusticomys* are so difficult to collect this pattern cannot be interpreted with any certainty.

Voss (1988) and Voss et al. (2001) stated that the species of *Neusticomys* inhabit areas near small, clear, rocky or sandy-bottomed forest streams found in highland and lowland landscapes. However, although our specimens agree in habitat type with that described by that author, other researchers have reported different habitats for particular species. Pacheco and Vivar (1996:582) collected 1 specimen of *N. peruviensis* in "upper floodplain forest : secondary floodplain subject to periodic inundation of rapidly moving water." Examination of recent data points to the presence of *N. oyapocki* in a savanna landscape at least 1 km from the nearest forested watercourse (Nunes 2002). The embryo number reported here is interesting because reproductive data for ichthyomyine rodents are rare, and the previously known number of embryos is of 1 and 2 for other species (Voss 1988:434, table 44). Thus, the known variation in embryo number and the inclusion of terrestrial and aquatic food items (Ochoa G. and Soriano 1991; Pacheco and Vivar 1996) suggest that the species of this genus may prove to be less specialized and more opportunistic than other ichthyomines, perhaps being able to colonize diverse habitat types.

Chromosomal data have not previously been reported for any species of *Neusticomys*. However, the karyotype of *N. ferreirai* herein presented is quite similar to those with 2n = 92 and FN = 98 reported for *Ichthyomys pittieri* (Schmid et al. 1988), *Chibchanomys trichotis* (previously identified as *Anotomys leander* by Gardner [1971]; see Voss [1988]), *N. monticolus*, and *Ichthyomys hydrobates* (R. S. Voss, in litt.). Thus, apparently the diploid chromosome number seems to be very conservative, currently presenting no diagnostic value on specific or generic level among ichthyomyine rodents.

The presence of *N. ferreirai* in the Central Brazilian highlands favors the above-mentioned hypothesis of Voss (1988) and Voss et al. (2001). However, the apparent lack of ichthyomyine rodents in central portions of the Amazon Basin could be interpreted as a sampling artifact, considering that most of the region is still relatively poorly known (see Voss and Emmons 1996). Moreover, pitfall traps have been employed as a capture method in mammalian inventories in the Amazon Basin only recently (this study; Hice and Schmidly 2002; Voss et al. 2001). Because most recently captured specimens (this report; Nunes 2002) were obtained through the use of such traps, much sampling effort should be done in the Amazon Basin before we can have a clear picture of the actual geographical distribution of *Neusticomys* species in South America.

Resumo

As espécies conhecidas do gênero *Neusticomys* ocorrem a partir dos Andes colombianos e equatorianos alcançando ao sul as planícies amazônicas do Peru e à leste a Venezuela, Guiana, Guiana Francesa e o estado do Amapá, no Brasil. Neste estudo nós descrevemos uma nova espécie, *Neusticomys ferreirai* sp. nov., proveniente do rio Juruena, MT. Este novo registro situa-se no escudo central brasileiro, o que estende os limites de distribuição do gênero, e estabelece sua presença no centro da América do Sul. *Neusticomys ferreirai* sp. nov. é definida por uma combinação exclusiva de estados de caracteres orelhas e pés recobertos por pêlos marrom escuro; pequeno tamanho; raiz zigomática inferior situada anteriormente ao M1; apófise orbicular ausente; M3 e m3 frequentemente presentes; posterolofo ausente; lobo posterior do M2 muito reduzido em relação ao lobo anterior; e 2n = 92, NF = 98.

Acknowledgments

We are grateful to M. T. Rodrigues for providing support and assistance during the fieldwork and data about the pitfall trap design and habitat descriptions. We are grateful to M. de Vivo, R. S. Voss, and 1 anonymous referee for valuable comments on the manuscript. This work was supported by CNPq fellowship grant 309978/2003-3 (to ARP); Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) grants 98/12273-0 (ARP), 99/08156-0 (MJJS), and 00/06642-4 (APC); FAPESP/BIOTA grants 98/05075-7 and 99/11653-6; and by American Museum of Natural History, The Field Museum, Museum of Comparative Zoology, and National Museum of Natural History grants (to ARP).

Literature Cited

Animal Care and Use Committee. 1998. Guidelines for the capture, handling, and care of mammals as approved by the American Society of Mammalogists. Journal of Mammalogy 79:1416–1431.

Cunha, O. R. 1991. O naturalista Alexandre Rodrigues Ferreira: uma análise comparativa de sua Viagem Filosófica (1783–1793) pela Amazônia e Mato Grosso com a de outros naturalistas posteriores. Museu Paraense Emílio Goeldi, Belém, Pará, Brazil.

Emmons, L. H. 1984. Geographic variation in densities and diversities of non-flying mammals in Amazonia. Biotropica 16:210–222.

Ford, C. E., and J. L. Hamerton. 1956. A colchicine hypotonic-citrate squash sequence for mammalian chromosome. Stain Technology 31:247–251.

Gardner, A. L. 1971. Karyotype of two rodents from Peru, with a description of the highest diploid number recorded for mammal. Experientia 26:1088–1089.

George, T. K., S. A. Marques, M. de Vivo, L. C. Branch, N. Gomes, and R. Rodrigues. 1988. Levantamento de mamíferos do PARNA Tapájos. Brasil Florestal 63:33–41.

Hershkovitz, P. 1962. Evolution of neotropical cricetine rodents (Muridae) with special reference to the phyllotine group. Fieldiana: Zoology 46:1–524.

Hice, C. L., and D. J. Schmidly. 2002. The effectiveness of pitfall traps for sampling small mammals in the Amazon Basin. Mastozoologia Neotropical 9:87–89.

Jenkins, P. D., and A. A. Barnett. 1997. A new species of water mouse of the genus *Chibchanomys* (Rodentia: Muridae: Simodontinae) from Ecuador. Bulletin of the Natural History Museum, London (Zoology) 63:123–128.

KÖPPEN, W. 1948. Climatologia, con un estudio de los climas de la tierra. Versión de Pedro R. Hendrichs. Fondo de Cultura Económica, México Distrito Federal, Mexico.

MALCOLM, J. R. 1988. Small mammal abundances in isolated and non-isolated primary forest reserves near Manaus, Brazil. Acta Amazonica 18:67–83.

MUSSER, G. G., AND M. D. CARLETON. 1993. Family Muridae. Pp. 501–756 in Mammal species of the world: a taxonomic and geographic reference (D. E. Wilson and D. M. Reeder, eds). Smithsonian Institution Press, Washington, D.C.

MUSSER, G. G., AND A. L. GARDNER. 1974. A new species of the ichthyomyine *Daptomys* from Perú. American Museum Novitates 2537:1–23.

NUNES, A. 2002. First record of *Neusticomys oyapocki* (Muridae: Sigmodontinae) from the Brazilian Amazon. Mammalia 66:445–447.

OCHOA G., J., AND P. SORIANO. 1991. A new species of water rat, genus *Neusticomys* Anthony, from the Andes of Venezuela. Journal of Mammalogy 72:97–103.

PACHECO, V., AND E. VIVAR. 1996. Annotated checklist of the non-flying mammals at Pakitza, Manu Reserve Zone, Manu National Park, Perú. Pp. 577–591 in Manu, the biodiversity of southeastern Peru (Manu, la biodiversidad del sureste del Perú) (D. E. Wilson and A. Sandoval, eds). Smithsonian Institution and Editorial Horizonte, Washington, D.C.

PATTON, J. L., M. N. F. DA SILVA, AND J. R. MALCOLM. 2000. Mammals of the Rio Juruá and the evolutionary and ecological diversification of Amazonia. Bulletin of the American Museum of Natural History 244:1–306.

RADAMBRASIL. 1980. Levantamento de recursos naturais. Vol. 20. Folha SC 21. Juruena. Ministério das Minas e Energia, Departamento Nacional da Produção Mineral, Projeto RadamBrasil, Rio de Janeiro, Brazil.

REIG, O. A. 1977. A proposed unified nomenclature for the enamelled components of the molar teeth of the Cricetidae (Rodentia). Journal of Zoology (London) 181:227–241.

SCHMID, M., A. FERNANDEZ-BADILLO, W. FEICHTINGER, C. STEINLEIN, AND J. I. ROMAN. 1988. On the highest chromosome number in mammals. Cytogenetics and Cell Genetics 49:305–308.

SEABRIGHT, M. 1971. A rapid banding technique for human chromosomes. Lancet 2:971–972.

STEPPAN, S. J. 1995. Revision of the tribe Phyllotini (Rodentia: Sigmodontinae), with a phylogenetic hypothesis for the Sigmodontinae. Fieldiana: Zoology (New Series) 80:1–112.

SUMNER, A. T. 1972. A simple technique for demonstrating centromeric heterochromatin. Experimental Cell Research 75:304–306.

VOSS, R. S. 1988. Systematics and ecology of ichthyomyine rodents (Muroidea): patterns of morphological evolution in a small adaptive radiation. Bulletin of the American Museum of Natural History 188:259–493.

VOSS, R. S. 1993. A revision of the Brazilian muroid rodent genus *Delomys* with remarks on ''thomasomyine'' characters. American Museum Novitates 3073:1–44.

VOSS, R. S., AND L. H. EMMONS. 1996. Mammalian diversity in neotropical lowland rainforests: a preliminary assessment. Bulletin of the American Museum of Natural History 230:1–115.

VOSS, R. S., D. P. LUNDE, AND N. B. SIMMONS. 2001. The mammals of Paracou, French Guiana: a neotropical lowland rainforest fauna part 2. Nonvolant species. Bulletin of the American Museum of Natural History 263:1–236.

YONENAGA, Y. 1972. Polimorfismos cromossômicos em roedores brasileiros. Ph.D. dissertation, Universidade de São Paulo, São Paulo, Brazil.

Submitted 2 August 2004. Accepted 3 February 2005.

Associate Editor was Enrique P. Lessa.

APPENDIX I

Collecting localities of genus *Neusticomys* presented in the gazetteer below, as well the specific identifications, were obtained from Voss et al. (2001), except as noted. Numbers before the collecting localities correspond to those shown in Fig. 1.

BRAZIL: 1. Fazenda Itapõa, Amapá (02°07′N, 50°93′W—Nunes 2002). 2. Juruena, Mato Grosso (10°23′S, 58°48′W—present report). FRENCH GUIANA: 3. Paracou (05°27′N, 52°92′W). 4. Saint Eugene (04°85′N, 53°08′W). 5. Trois Sauts (02°17′N, 53°18′W). GUYANA: 6. Kartabo, Cuyuni-Mazaruni (06°38′N, 58°70′W). PERU: 7. Balta, Ucayali (10°13′S, 71°22′W). 8. Pakitza, Madre de Dios (11°95′S, 71°28′W—Pacheco and Vivar 1996). VENEZUELA: 9. 14 km SE Pregonero, Tachira (07°95′N, 71°65′W). 10. Cerro Duida, Amazonas (03°62′N, 65°68′W). 11. Los Pijiguaos, Bolivar (06°58′N, 66°73′W). 12. San Ignacio Yuruani, Bolivar (05°03′N, 61°13′W). 13. Rio Neveri, Sucre (10°25′N, 63°92′W).