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THE PRESENCE OF *WILFREDOMYS OENAX* (RODENTIA: CRICETIDAE: SIGMODONTINAE) IN SÃO PAULO STATE, SOUTHEASTERN BRAZIL: A LOCALLY EXTINCT SPECIES?

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ABSTRACT

The Rufous-nosed Mouse Wilfredomys oenax is a rare Sigmodontinae rodent known from scarce records from northern Uruguay and south and southeastern Brazil. This species is under-represented in scientific collections and is currently classified as threatened, being considered extinct at Curitiba, Paraná, the only confirmed locality of the species at southeastern Brazil. Although specimens from São Paulo were already reported, the presence of this species in this state seems to have passed unnoticed in recent literature. Through detailed morphological analyzes of specimens cited in literature, the present work confirms and discusses the presence of this species in São Paulo state from a specimen collected more than 70 years ago. Recently, by the use of modern sampling methods, other rare Sigmodontinae rodents, such as Abrawayomys ruschii, Phaenomys ferrugineous and Rhagomys rufescens, have been recorded to São Paulo state. However, no specimen of Wilfredomys oenax has been recently reported indicating that this species might be locally extinct. The record mentioned here adds another species to the state of São Paulo mammal diversity and reinforces the urgency of studying Wilfredomys oenax.

KEY-WORDS: Atlantic Forest; Scientific collection; Threatened species.

INTRODUCTION

Mammal species lists based on voucher-specimens and literature records are essential for offering groundwork to understand a species distribution and even to assess their conservation status. In Brazil, efforts were made to produce state check-lists using such data (e.g., Vivo, 1998; Cherem *et al.*, 2004; Cáceres *et al.*, 2008; Vivo *et al.*, 2011; Silva *et al.*, 2013), which often also deal with conservational status of each species at some Brazilian states (e.g., Machado, A.B.M. *et al.*, 1998; Bergallo *et al.*, 2000; Marques *et al.*, 2002; Mikich & Bérnils, 2004; Bressan *et al.*, 2009).

São Paulo is one of the most studied states in Brazil regarding to fauna. Mammal lists from this state have been elaborated since the late XIX century (Von Ihering, 1894; Vieira, 1944a, b, 1946, 1950, 1953; Vivo, 1998). The most updated of those lists was made by Vivo *et al.* (2011), which reported 231 species and described recent advances on mammal studies from which some facts draw attention to São Paulo state mammal fauna, such as the presence of recently described species (Leite *et al.*, 2008; Percequillo *et al.*, 2011; Costa *et al.*, 2011) and even a new genus (Percequillo *et al.*, 2011). New data on mammal species from São Paulo are obtained through new inventories

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(e.g., Gregorin *et al.*, 2004; Steiner-Souza *et al.*, 2008; Velasco, *et al.*, 2010) and by museum specimens (e.g., Silva *et al.*, 2003; Gregorin *et al.*, 2004; Pavan & Leite, 2011; Garbino, 2011), including records of rare and/or threatened species (e.g., Vaz, 2000; Percequillo *et al.*, 2004; Pardini & Umetsu, 2006; Vivo *et al.*, 2011).

Despite of the attention that has been given to its mammalian fauna, a conservation-relevant species went unnoticed in all São Paulo checklists mentioned herein: the Rufous-nosed Mouse *Wilfredomys oenax* (Thomas, 1928), a rare South American rodent that belongs to the Sigmodontinae radiation (Musser & Carleton, 2005). Although the presence of mesolophid on molars classifies *Wilfredomys* among pentalophodont rodents associated to forested habitats (see details in Voss & Carleton, 1993; Weksler, 2006; Machado *et al.*, 2013), this monotypic genus remains with an uncertain tribal affiliation (see D'Elía *et al.*, 2007). Yet, only a few specimens from northern Uruguay and south and southeastern Brazil are known for this species. Finally, it is classified by IUCN as globally endangered and locally extinct at Curitiba, Paraná (Vieira & Christoff, 2008), the only record near southeastern Brazil. In the present report, I confirm through detailed morphological analyzes of specimens cited in literature and discuss the presence of this species in São Paulo state.

MATERIAL AND METHODS

I have studied skins and skulls deposited in the mammal collections of Museu de Zoologia da Universidade de São Paulo, São Paulo (MZUSP) (Appendix I).

The following external measurements were obtained from original specimen tags: Total length (TL); length of tail (LT); ear length (E) and hind foot length (HF). Cranial measurements were obtained with digital calipers, with data recorded to the nearest 0.01 mm. I employed the following measurements (see Voss *et al.*, 2001; Percequillo *et al.*, 2011): occipito-nasal length (ONL); condylo-incisive length (CIL); length of diastema (LD); length of rostrum (LR); length of nasals (LN); breadth of rostrum (BR); length of incisive foramina (LIF); breadth of incisive foramina (BIF); length of palatal bridge (LPB); breadth of bony palate across the first upper molars (BPPB); crown length of maxillary tooththrow (CLM1-3), from molar 1 (M1) to molar 3 (M3); breadth of first upper molar (BM1); breadth of anterocone of first upper molar (BM1ant); greatest

zygomatic breadth (ZB); interorbital breadth (IB); length of orbital fossa (LOF); breadth of zygomatic plate (BZP); braincase breadth (BRB); length of interparietal (LIP); and breadth of interparietal (BIP); zygomatic length (ZL).

Specimen age classes were based on maxillary tooth eruption and abrasion and fusion of the skull sutures. Specimen is only classified as adult if covered by full adult pelage – not the juvenile coat or the transitional molt from juvenile to adult fur – and have completely erupted third molars (see Musser *et al.*, 1998). Dental molar toothwear were classified based on five stages of dental attrition from Voss (1991).

RESULTS

Among 12,000 specimens (a rough estimation) of rodents deposited at the MZUSP, I found a single specimen of *W. oenax* from São Paulo: MZUSP 6281, an age class 3 adult individual of unknown sex, comprising skull (Fig. 1) and skin (Fig. 2). It was collected by José Leonardo Lima at Ubatuba (23°26'S, 45°04'W) on November 19, 1943.

To the present date the scarcity of specimens of *W. oenax* prevented an updated and comprehensive description of its complete morphology and clarification of its phylogenetic position based on morphological characters (see Pacheco, 2003). Although morphology studies on *Wilfredomys* are scarce when compared to other genera from southeastern Brazilian Atlantic Forest, descriptions of Ávila-Pires (1960), Pine (1980) and González (2000) provide data on general pelage characters: long, lax and soft dorsal fur; brownish (somewhat grayish) dorsal pelage with orangish nose, ears and rump; yellowish (somewhat buffy) gray-based venter, except for the self colored yellow throat region (Fig. 2); light orangish manus and feet; long dorsoventrally bicolored tail; medium sized rodent (Table 1), much larger than *Juliomys*, the most externally similar Atlantic Forest species (Pavan & Leite, 2011: Table I and II).

Additionally, craniodental characters described by Percequillo *et al.* (2004) unambiguously distinguish *Wilfredomys* from other pentalophodont Atlantic Forest Sigmodontinae genera: Skull with medium length rostrum and shallow and narrow zygomatic notch (Fig. 3A and B); narrow and hourglass-shaped interorbital region, with squared margins and a shallow depression along the frontals (Fig. 3A); very long (reaching M1) and wide incisive foramina (broader medially), with convex margins (Fig. 3D); short and slightly narrow palate, with numerous, medium and



FIGURE 1: Dorsal, ventral, and lateral views of the cranium and lateral and dorsal views of the mandible of *Wilfredomys oenax* (MZUSP 6281) from Ubatuba, São Paulo. Scale 10 mm.

deep pits; narrow mesopterygoid fossa that reaches M3 level (Fig. 3C), perforated by long and wide sphenopalatine vacuities (partially occluded in this specimen due an inadequately cleaned palatal region); wide and strongly concave parapterygoid fossa, which is wider than the mesopterygoid fossa (Fig. 3C); alisphenoid strut absent (Fig. 3I); pattern 1 of carotid circulation; middle lacerate foramen absent; suspen-

sory process of squamosal present; orbicular apophysis of maleus rounded; dentary with ventral surface slightly concave; angular process surpassing condyloid process level; coronoid process small, triangular, lower than condyloid process; sigmoid notch shallow and angular notch deeply excavated (Fig. 3F); molars incipiently lophodont with cusps in opposite pairs; anterocone slightly narrower than paracone-protoco-

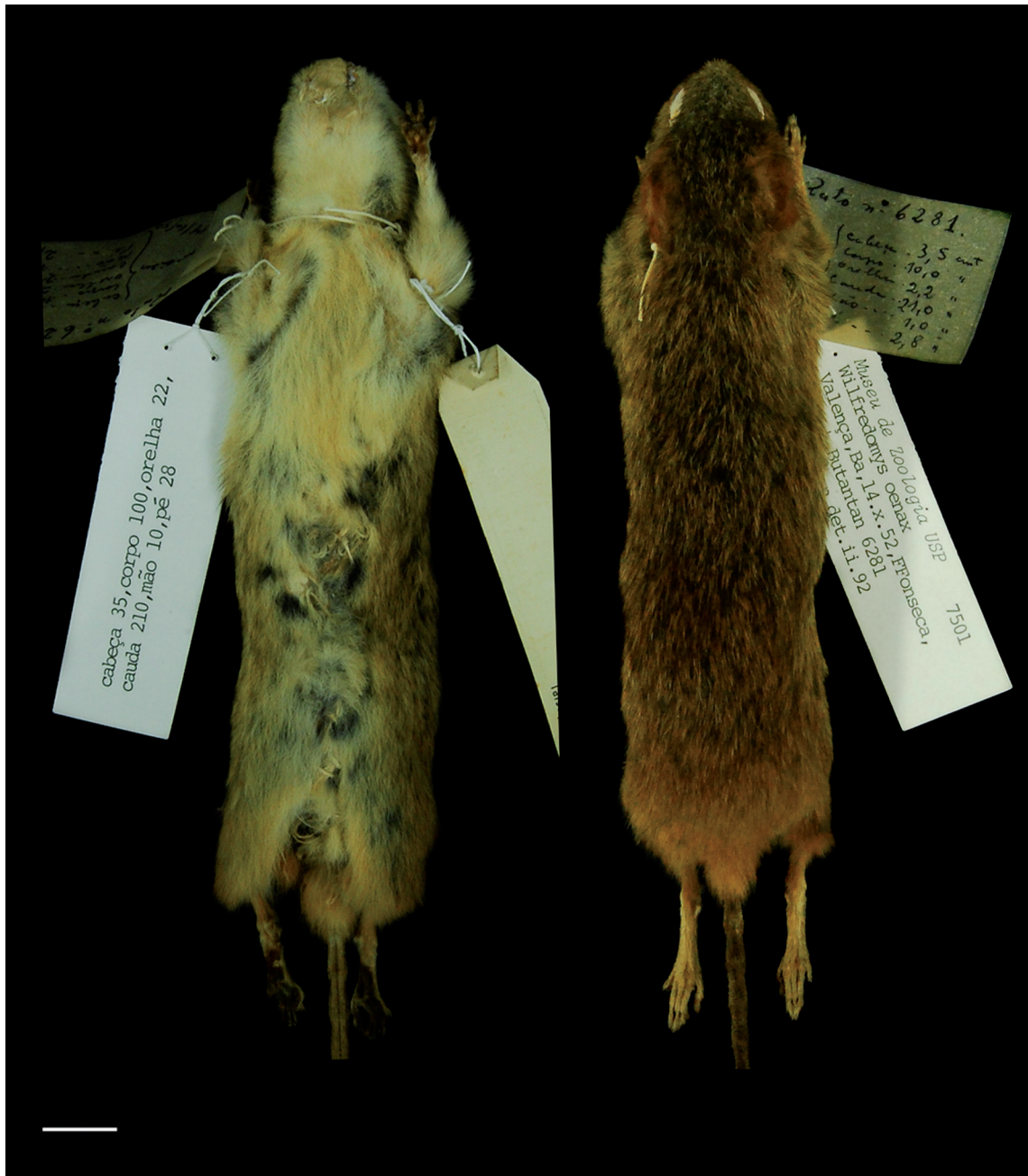


FIGURE 2: Dorsal and ventral views of the skin of *Wilfredomys oenax* (MZUSP 6281) from Ubatuba, São Paulo. This skin was erroneously given a tag with the number MZUSP 7501, but note a second tag with 6281 on it, which corresponds to the skull MZUSP 6281. Scale 15 mm.

TABLE 1: External and craniodental measurements (mm) of ten specimens of *Wilfredomys oenax*. See abbreviations of measurements in material and methods. Measurements from MZUSP specimens were obtained in the present work, whereas specimens from American Museum of Natural History (AMNH) and Field Museum of Natural History (FMNH) from Pine (1980). Measurements between brackets were taken from body plus head lengths from field tag; measurements between parentheses represent hind foot plus claw.

Specimen	MZUSP 348 ^a	MZUSP 349 ^a	MZUSP 6281 ^b	MZUSP 35312 ^c	MZUSP 35313 ^c	FMNH 104933 ^a	AMNH 206018 ^d	AMNH 206019 ^d	AMNH 206020 ^d	AMNH 206021 ^d
Age Class	3	3	3	4	4	—	—	—	—	—
Sex	—	—	—	—	—	?	M	M	F	M
TL	—	—	[345]	—	—	—	291	304	280	315
LT	—	—	210	—	—	—	161	185	168	186
E	—	—	22	—	—	—	—	22	—	22
HF	—	—	28	—	—	—	31 (33)	30 (35)	30 (31.5)	28.5 (30.5)
Weight (g)	—	—	—	—	—	—	42	49.4	34.6	61.3
ONL	32.36	—	32.25	33.61	33.4	> 30.4*	30.9	—	29.1	31.3
CIL	30.23	—	29.56	31.09	31.65	28.0	28.2	—	—	28.8
LD	7.41	7.23	7.56	7.75	8.2	7.3	7.3	7.2	7.0	7.3
LR	9.92	—	9.58	10.25	10.1	—	—	—	—	—
LN	11.34	—	11.7	11.61	11.35	—	10.3	10.7	9.7	10.4
BR	5.32	—	5.56	5.88	6	—	—	5.3	5.1	5.4
LIF	7.39	6.69	6.6	7.16	6.8	6.1	6.6	6.2	5.9	5.9
BIF	2.88	2.8	2.6	2.54	2.7	—	—	—	—	—
LPB	4.42	—	4.96	5.6	5.8	—	—	—	—	—
BPB	2.87	2.9	2.75	2.39	2.7	—	—	—	—	—
CLM1-3	5.7	5.35	5.31	5.59	5.54	5.6	5.5	5.3	5.6	5.8
BM1	1.6	1.6	1.5	1.59	1.47	—	—	—	—	—
BM1ant	1.26	1.28	1.47	1.4	1.28	—	—	—	—	—
ZB	—	—	16.95	17.9	18.3	—	—	—	14.7	—
IB	4.1	—	4.05	4.16	4.15	4.1	4.2	—	4.0	4.3
LOF	11.32	—	10.49	12.6	12.1	—	—	—	—	—
BZP	3.27	—	3.06	3.17	3.3	—	—	—	—	—
BRB	13.48	—	14.8	14.46	14.18	—	—	—	—	—
LIP	3.44	—	3.9	4.1	—	—	3.6	3.0	3.9	3.5
BIP	9.65	—	10.3	10.5	—	—	10.3	9.3	9.8	10.6
ZL	14.52	—	13.86	15.48	15.97	—	—	—	—	—

^a São Lourenço, Rio Grande do Sul

^b Ubatuba, São Paulo

^c Cerro Colorado, Depto. de Florida, Uruguay

^d Arroyo del Cordobes, Depto. de Durazno, Uruguay

* see Pine (1980)

pair; anteromedium flexus deep and short, obliquely oriented, with the lingual anteroconule smaller than the labial (barely perceptible in this specimen); anteroloph long; anteroflexus long by the absence of labial anterolophule (Fig. 3G).

Other noteworthy characters mentioned by Pine (1980) and/or González (2000) are an enlarged auditory bulla (Fig. 3E); zygomatic plate broad with moderate sized notch and anterodorsal margin smoothly rounded, notably projected anteriorly to the superior maxillary root of zygozoma (Fig. 3A and B); capsular projection of the dentary little developed (Fig. 3F).

Except for the sphenopalatine vacuities, which were occluded due an inadequately cleaned palatal region, all those characters mentioned above were ob-

served in MZUSP 6281 specimen, leaving no doubt that this specimens refers to *W. oenax*. This specimen seems to be a medium-sized individual (Table 1) which present a moderate tooth wear, especially at lower molars (Fig. 3H). It is worthy to mention that the incisive foramen of the Ubatuba specimen, as well as most of the other specimens, reaches the M1 procingulum. The exception refers to the specimen MZUSP 349, which present a much longer incisive foramen that almost reaches the protoflexus level. However, as already has been reported (see Pine, 1980), this character seems to be much variable among specimens and probably have no taxonomic meaning since I also observed such differences even among specimens from the same locality. Additional specimens are needed in

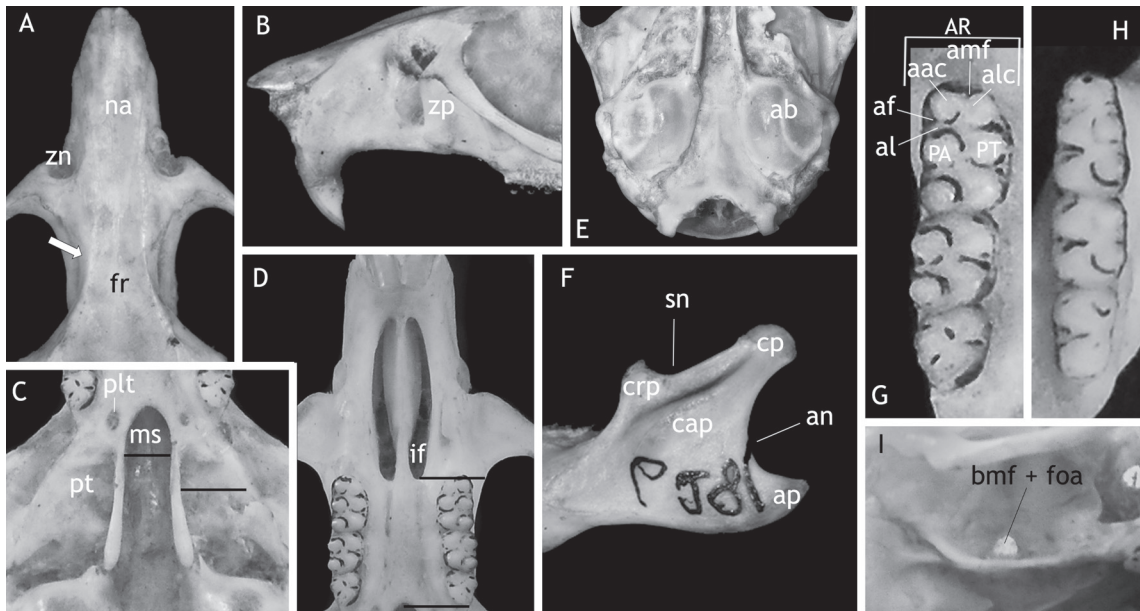


FIGURE 3: Detailed views of morphology of the skull (A-E and I), mandible (F) and upper (G) and lower (H) left molars of *Wilfredomys oenax* (based on MZUSP 6281, from Ubatuba, SP). Labeled structures and region includes: auditory bulla (ab), anteroflexus (af), anteroloph (al), angular notch (an), angular process (ap), anterolabial conule (aac), anterolingual conule (alc), anteromedium flexus (amf), buccinator-masticatory foramen (bmf), condyloid process (cp), capsular process of the lower incisor alveolus (cap), coronoid process (crp), incisive foramina (if), frontal (fr), foramen ovale accessorius (foa), mesopterygoid fossa (ms), nasal (na), parapterygoid fossa (pt), palatal pits (plt), sigmoid notch (sn), zygomatic notch (zn), zygomatic plate (zp), anterocone (AR), paracone (PA), protocone (PT). White arrow indicate shallow depression along the frontals. Black bars indicate comparative width (C) and alignment (D) between structures. Note the confluence between **bmf** and **foa** as a result of the absence of bony strut on the alisphenoid (see Voss, 1991: fig. 12), and that main molar cups are typed in upper case letters with two letter abbreviation.

order to comprehend morphological variation within this taxon.

As any additional record of *W. oenax* in São Paulo was found, I initially suspected that the record from Ubatuba was a misidentified locality. Therefore, I tried to retrieve field notes made by the collector, Mr. J. Lima, an important taxidermist and naturalist of the MZUSP. Unfortunately, these notes do not exist anymore or were lost. However, Pinto's (1945) historical account of MZUSP's ornithological collection in the late XIX and first half of the XX century, describes J. Lima's itinerary in São Paulo during 1942-1943. This report features the precise period of 15-20 November, 1943, on which J. Lima collected this important specimen at Ubatuba.

DISCUSSION

This record is unexpected for São Paulo, since no recent mammal checklist of the state reports *W. oenax* (e.g., Vivo, 1998; Bressan *et al.*, 2009; Vivo *et al.*, 2011) even though the specimen MZUSP 6281 was collected 71 years ago. Yet, the known distribution of this species has been reported to be more restricted

than formerly thought as a consequence of taxonomic advances since its description, as explained next.

Initially described as *Thomasomys oenax* Thomas, 1928, for several years this species was considered to be related to *Thomasomys pictipes* Osgood, 1933 and *Mus pyrrhorhinos* Wied-Neuwied, 1821, all externally morphologically similar rodents. In the middle of the last century, Hershkovitz (1959) classified *M. pyrrhorhinos* in a new genus (*Wiedomys*) and Ávila-Pires (1960), described *Wilfredomys* to include *T. oenax*. Based on considerations made by Pine (1980) on the three species mentioned in this paragraph, Musser & Carleton (1993) treated *T. pictipes* as closely related to *W. oenax*. Later, González (2000) erected *Juliomys* for *T. pictipes*. Therefore, nowadays, all the mentioned forms are classified into three distinct genera (Musser & Carleton, 2005).

Although the phylogenetic position of these three genera remains unresolved, or at least controversial (see Reig, 1980; Pacheco, 2003; D'Elia *et al.*, 2007; Ventura *et al.*, 2013), some advances on *Wiedomys* and *Juliomys* were obtained, including new species (Oliveira & Bonvicino, 2002; Gonçalves *et al.*, 2005; Costa *et al.*, 2007) and new records (Pavan & Leite, 2011; Fonseca *et al.*, 2013). Conversely, *Wilfredomys*

did not receive any attention since Ávila-Pires (1960) and Pine (1980). The exception are a few specimens of *W. oenax* cited when comparing it to *Juliomys* (González, 2000; Oliveira & Bonvicino, 2002; Pardiñas & Teta, 2011) and *Rhagomys* Thomas, 1917 (Percequillo *et al.*, 2004) – without pointing localities to each *W. oenax* specimen – and in two unpublished thesis, Pacheco (2003) and Queirolo (2009), both mentioning specimens exclusively from Uruguay and Rio Grande do Sul, Brazil.

Interestingly, Bonvicino *et al.* (2008), in a comprehensive identification guide, provides an updated distributional range for rodent species in Brazil, indicating the presence of *W. oenax* in São Paulo state. They based their distribution in a congress abstract authored by González & Oliveira (1997), which I freely translate from Portuguese: “*Wilfredomys oenax* is a species which its distribution range is much wider than known until now. Occurs in central and northwestern Uruguay and in Brazil along the Atlantic Forest up to Bahia state. Probably the material mentioned by Ihering to Costa da Serra (R. G. do Sul) and by Bertoni to Santíssima Trinidad (Paraguay) are referent to this species”.

The authors mentioned above clearly mention that the distribution of *W. oenax* is wider than known to date. About this statement, three assumptions were made here: (1) The record from Paraguay was cited by de la Sancha *et al.* (2009) as a probable reference to *J. pictipes*. These authors mention that no voucher specimen can be associated to Santíssima Trinidad, leaving uncertainty about its real identity. (2) No specific record from São Paulo can be retrieved from González & Oliveira (1997). (3) The only specimen known from Bahia is MZUSP 7501 (skin), which proved to be a mislabeled specimen due the fact that its original number is 6281 observed in an attached tag (Fig. 2), which is the same number as the skull MZUSP 6281 collected by J. Lima in 1943 at Ubatuba.

Interestingly, Cerqueira (2008) at the same year as Bonvicino *et al.* (2008), provides two São Paulo localities for *W. oenax* from literature. Although no precise localities can be retrieved from the references mentioned by Cerqueira (2008), these localities seems to be the one from Ubatuba and other from Bauru (Fig. 4), which probably refers respectively to the specimens MZUSP 6281 mentioned by González (2000) and Oliveira & Bonvicino (2002) and MZUSP 24146 and MZUSP 24147 by González (2000). Therefore these authors should be acknowledged for reporting this species to São Paulo. It's worthy to state that few *W. oenax* specimens from MZUSP were incinerated

by Brazilian federal government authorities, when returning from a loan to other institution. Luckily, this was not the case for the specimens from the mentioned localities.

I personally checked all *Wilfredomys* records at MZUSP register book and stated that the specimens from Bauru (collected by E. Garbe in 1901) were registered as *W. oenax* on February of 1992. Analyzing González (2000) evaluation of MZUSP specimens, all specimens cited here were classified by this author as *Wilfredomys* (Appendix 1). Studying these specimens I observed that most of them refers to really old collections (nearly 100 years ago). For that reason the pelage of some of the fluid-preserved specimens are too faded to observe the vivid color of *W. oenax*. This includes the ones from Bauru, however, securely these specimens don't represent this species since they exhibit characters different from *W. oenax*: MZUSP 24147 (a really young individual) present self-white colored venter (against mostly gray-based in *W. oenax*), MZUSP 24146 (adult individual) present shorter body dimensions especially on its mid-sized tail and ear (HBL: 135, TL: 150, Ear: 17, HF: 28 mm – see Table 1 for comparisons). Yet, according to MZUSP register book, although both specimens are at the same pot labeled as Bauru, São Paulo, the specimen 24147 is actually from Rio Feio. This specimen is very likely to be a *Cerradomys* or a similar *Orizomyini*, but the color is too faded and the inaccessibility to the skull prevented me to furnish a more precise diagnostic.

As a consequence of the progresses on the taxonomy of morphologically similar genera (*Juliomys*, *Wiedomys* and *Wilfredomys*), which led to a reappraisal of their distribution ranges, and to no literature assignments of *W. oenax* specimens to São Paulo state localities, probably misled Vivo (1998) and Vivo *et al.* (2011) to not include this species in their checklists. Therefore, the northernmost published record of *W. oenax* from which a locality can be retrieved were the one from Curitiba (MN 8269) reported by Ávila-Pires (1960).

It is relevant to report that *W. oenax* has not yet been reported to the state of São Paulo and Paraná threatened species lists (Mikich & Bérnils, 2004; Bressan *et al.*, 2009). The scarcity of specimens in museum collections, might not just reflect natural rarity, but it might have deeper implications on this species current conservation status. Other Sigmodontinae also presents similar situation, such as *Juscelinomys candango* and *Gyldenstolpia planaltensis*. Bezerra (2011) consistently discussed the population status of these species based on significant field efforts done since the early 1990 decade near their few known

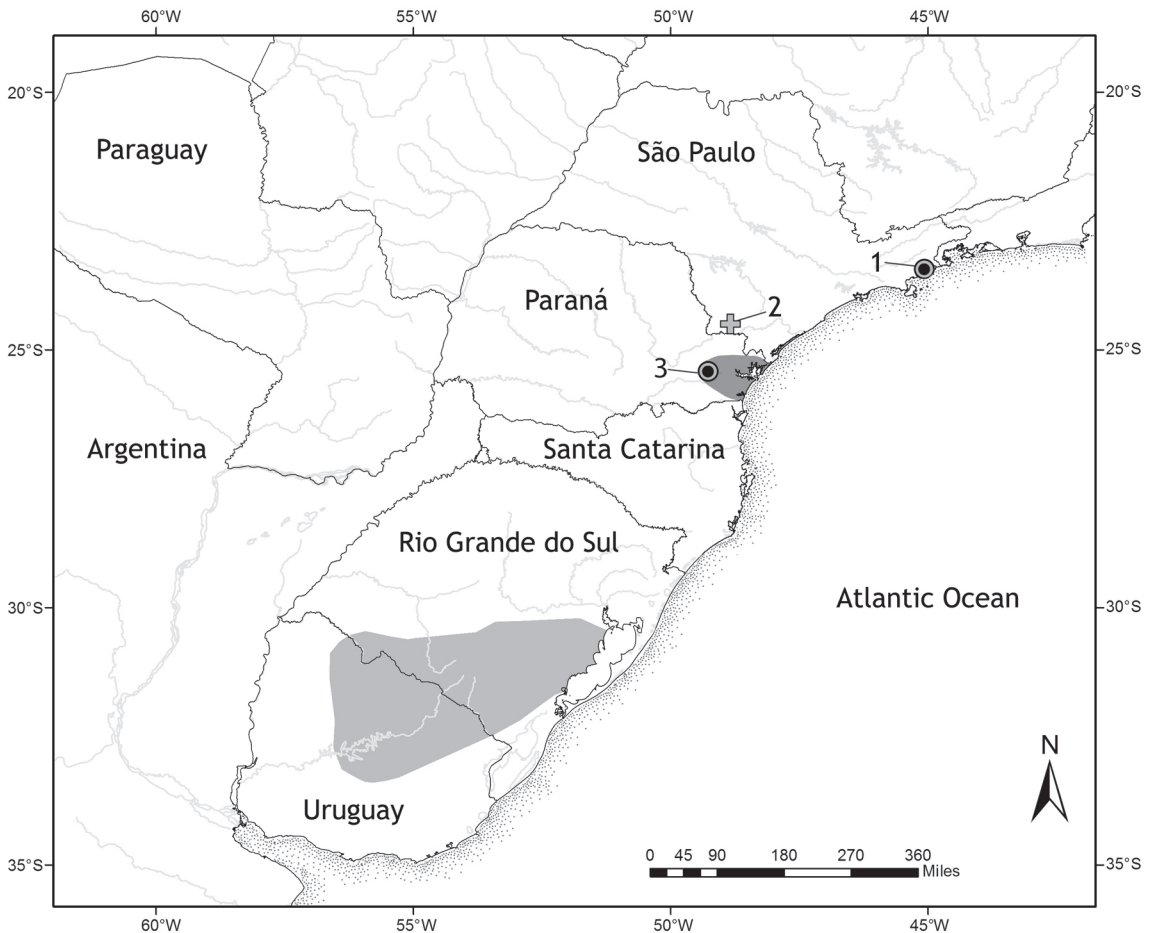


FIGURE 4: Map of the range distribution of *Wilfredomys oenax*. Numbered points correspond to known southeastern records from: (1) Ubatuba, São Paulo (Present work), (2) Abismo Iguatemi, Apiaí city, São Paulo (Castro & Langer, 2011), (3) Curitiba, Paraná (Ávila-Pires, 1960). Dotted circles represent data from live caught specimens and cross represents fossil records. The gray shaded area is the geographic distribution of the species suggested by IUCN (adapted from Vieira & Christoff, 2008), been considered extinct at Curitiba (heavy gray shaded area). Full solid lines indicate Brazilian Federal state boundaries; solid light gray lines indicate major rivers.

localities. Therefore, it was hypothesized that *J. candango* and *G. planaltensis* might extinct or locally extinct, since they have not been recorded since 1960 and 1995 respectively. This also seems to be the fact for *Wilfredomys oenax* from São Paulo state as no other record exists besides the one from Ubatuba in 1943, not even from recent surveys at this locality.

According to Pinheiro & Geise (2008), the Ubatuba fauna includes 23 small mammals. In addition to specimens surveyed at Ubatuba localities, these authors also cite museum records, including vouchers from MZUSP. Probably a loan was the reason why the noteworthy *W. oenax* specimen from Ubatuba went unnoticed by Pinheiro & Geise (2008) when studying MZUSP specimens. However, other notable records were made by those authors as highlighted by them: “Noteworthy occurrences include an individual of *Rhagomys rufescens* Thomas, 1886 captured in a pit-

fall trap and specimens of an undescribed species of *Rhipidomys* Tschudi, 1845” – which is now referent to *R. itoan* as presents the karyotype $2n = 44$, $FN = 48$ (see Costa *et al.*, 2011).

Interestingly other Sigmodontinae species from the Atlantic Forest, formerly considered very rare, have been recently reported to São Paulo state, such as *Abrawayomys ruschii* Souza Cunha & Cruz, 1979 (Vivo *et al.*, 2011; Ventura *et al.*, 2013) and *R. rufescens* (Steiner-Souza *et al.*, 2008), and other poorly known species such as the recent described *J. ossitenuis* (Costa, *et al.*, 2007), *R. itoan* (Costa *et al.*, 2011) and *Drymoreomys albimaculatus* (Percequillo *et al.*, 2011; Suárez-Villota *et al.*, 2013). Additionally, I found 13 new records of Sigmodontinae based on MZUSP specimens: nine localities of *A. ruschii*, two of *D. albimaculatus*, one of *Phaenomys ferrugineous* Thomas, 1894 and one of *R. rufescens* near the limits of the

city of São Paulo, the biggest metropolis of South America. All those records are currently being studied by other researchers (E. Hingst-Zaher *pers. comm.*; Abreu-Júnior, 2013), therefore no further information can be furnished here.

Most of these recently collected specimens are from the last two decades, when the use of pitfall traps became a much more common method, putting in perspective the question if the species mentioned above are naturally rare or if current methods are just more efficient in capturing them. Recently, long-term studies have helped to answer this question, since the use of pitfall traps at several São Paulo localities, including areas with anthropogenic disturbances, have registered all these rare species (Umetsu *et al.*, 2006; Pardini & Umetsu, 2006; Leiner & Silva, 2012; Ventura *et al.*, 2013) – except *P. ferrugineous*, endemic from Serra da Bocaina region – indicating that those species probably occur in low population densities. However, differently, not a single new record of *W. oenax* has been found for São Paulo state since the one from Ubatuba made 71 years ago, indicating that low population densities might not be the case for this species.

I also searched for other types of records, such as fossil and birds of prey pellets. Interestingly, a fossil record of *W. oenax* from the early Holocene/late Pleistocene approximate period was recently reported to Abismo Iguatemi, located about 5 km to southwest of the municipality of Apiaí, upper Ribeira River (Castro & Langer, 2011). This locality lies between the records from Ubatuba and Curitiba (Fig. 4).

On the other hand, no success was obtained through birds pellets, although studies of this material have proved to be very informative for some rare Sigmodontinae. For instance, before pitfall trapping, the genus *Abrawayaomys* Souza Cunha & Cruz, 1979 remained known for several years from only the type specimen and from few individuals from pellets collected at Argentina (see Massoia *et al.*, 1991). Other species are rarely collected mainly because presents restricted habitats and/or low susceptibility to usual traps, but are known from larger series of individuals in birds' pellets (see Bonvicino & Bezerra, 2003; Scheibler & Christoff, 2007). A recent example is the record of few individuals of the semi-aquatic rodent *Holochilus sciureus* Wagner, 1842 trapped by conventional capture methods, whereas results from owl pellets evidence several individuals at the area – for details compare Rocha *et al.* (2011a, b).

Fortunately, this is also the case for *W. oenax* as two specimens (35312, 35313) were kindly donated to MZUSP by Enrique M. González. According to

him, these specimens are from *Tyto alba* owl pellets from Cerro Colorado, Uruguay, collected at February, 2006 (see González *et al.* 2010). However, despite of the recent success at Uruguay, unfortunately, no record of *W. oenax* from pellets for São Paulo state was found in literature, furnishing another evidence that this species might be locally extinct at this area and others from southeast Brazil, just as it is already considered to Paraná state by the IUCN (Vieira & Christoff, 2008).

The Atlantic Forest of southern and southeastern Brazil has a particular and worrying status regarding Sigmodontinae diversity. For instance, while a genus might be locally extinct (*Wilfredomys*), a new one was recently described (*Drymoreomys*). Yet, just as *Wilfredomys*, several genera that are restricted to this area, such as *Abrawayaomys*, *Delomys* Thomas, 1917, *Juliomys* and *Phaenomys* Thomas, 1917, are not readily classifiable into the recognized tribes due to their unknown phylogenetic relationships. This might be an important issue to solve in order to reinforce biogeographical discussions.

The comprehension of phylogenetic position of *Wilfredomys* and the other *incertae sedis* genera mentioned here is essential to comprehend Sigmodontinae biogeographical history. Therefore, in order to help this issue, direct efforts should be done to capture *W. oenax*, since it remains a poorly collected species without tissue samples yet available.

CONCLUSIONS

Despite of being classified as endangered by the IUCN and critically endangered at Brazil (Bresnan *et al.*, 2009), none of the current Brazilian states lists describes *W. oenax* as threatened species, including São Paulo and Paraná lists, where it might be extinct. We cannot discard the possibility that *W. oenax* is highly restricted to the forest canopy and, therefore, common sampling methods are probably inefficient to capture it. But what if this species is really extinct from the areas mentioned here? What are the conservation policies for that? *Ex situ* conservation for reintroduction purposes seems to be a far away reality for small mammals all over the world. Rodents are rarely included in conservation programs, even though for decades some are known to be restricted to a single or just a few localities. Almost nothing is known about natural history of *W. oenax* and recently collected specimens of this species will be essential to conservation efforts and appraisal of Sigmodontinae evolutionary knowledge.

RESUMO

O Rato-do-Mato Wilfredomys oenax é um raro roedor Sigmodontinae conhecido a partir de escassos registros do norte do Uruguai e sul e sudeste do Brasil. Esta espécie é conhecida de poucos espécimes em coleções científicas e está atualmente classificada como ameaçada, sendo considerada extinta em Curitiba, Paraná, o único local confirmado da espécie para o sudeste do Brasil. No entanto, embora espécimes de São Paulo já tenham sido reportados, a presença desta espécie neste estado parece ter passada despercebida na literatura. Através de análise morfológica detalhada de espécimes citados na literatura, o presente trabalho confirma e discute a presença desta espécie para o estado de São Paulo a partir de espécimes coletados há mais de 70 anos atrás. Recentemente, outros raros roedores Sigmodontinae, como Abrawayaomys ruschii, Phenomys ferrugineus e Rhagomys rufescens, tem sido registrados em localidades de São Paulo através da utilização de métodos modernos de amostragem. Entretanto, nenhum espécime de Wilfredomys oenax foi relatado até o momento, indicando que esta espécie pode estar localmente extinta. Este registro adiciona mais uma espécie para a diversidade de mamíferos do estado de São Paulo e reforça a urgência no estudo de Wilfredomys oenax.

PALAVRAS-CHAVES: Mata Atlântica; Coleção científica; Espécie ameaçada.

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APPENDIX I

All known specimens of *Wilfredomys oenax* from MZUSP. States are listed in bold letters, followed by municipalities in *underlined* letters. Specimens followed by * were not examined due specimen lost.

Brazil

Rio Grande do Sul: São Lourenço – MZUSP 104 (skin), 105*, 328 (fluid), 348 (skin and skull), 349 (skin and skull), 352 (skin), 1002 (skin), 1436 (skin and skull), 25721 (fluid). Itaqui – MZUSP 3181 (skin).

One of the specimens (MZUSP 25688 – fluid and skull) cited by Oliveira & Bonvicino (2002) as *W. oenax* refers to a *Oligoryzomys* sp. specimen from São Lourenço.

São Paulo: Ubatuba – MZUSP 6281 (= MZUSP 7501) (skin and skull).

Two specimens from Bauru (MZUSP 24146, 24147 – fluid) cited by González (2000) as *W. oenax* refers to other Sigmodontinae rather than this species.

Uruguay

Florida: Cerro Colorado – MZUSP 35312 (skull), 35313 (skull).