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Abrothrix xanthorhinus. By Mariana Loza, J. Adrian Monjeau, Karin M. Heinemann, Nadia Guthmann, and Elmer C. Birney

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Abrothrix Waterhouse, 1837

Abrothrix Waterhouse, 1837:21 (subgenus; as a genus by Gray, 1843). Type species Mus (Abrothrix) longipilis Waterhouse, by original designation.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciurognathi, Family Muridae, Subfamily Sigmodontinae, Tribe Akodontini, Genus Abrothrix, which we regard as including eight extant species based on the collective results and comments of Gardner and Patton (1976), Reig (1987), and Smith and Patton (1993). Patterson et al. (1984) specifically rejected assignment of xanthorhinus to Abrothrix, retaining it and the closely related species hershkovitzi in Akodon. Reig (1987) and Musser and Carleton (1993) considered Abrothrix as a subgenus of Akodon. Spottorno (1992) argued for generic status for Abrothrix based on a morphological study, as did Brook and Patton (1993) based on molecular data. Given the uncertainty of relationships and classification of species assignable to either Akodon or Abrothrix, we are not presenting herein a key to their identification. The species we tentatively consider to comprise the genus Abrothrix are: andinus, hershkovitzi, illitutea, lanosus, longipilis, olivaceus, sanborni, and xanthorhinus. Akodon markhami described by Pine (1975:423) is generally regarded to be most closely related to olivaceus and, if worthy of recognition at any taxonomic level, almost certainly will be included eventually in the same genus as olivaceus. Similarly, de Santis and Justo (1980:121) named Akodon (Abrothrix) mansoenis, which Smith and Patton (1993) included in the genus Abrothrix. Monjeau et al. (1994) considered mansosenis a synonym of olivaceus.

Abrothrix xanthorhinus (Waterhouse, 1837)

Ratón de Hocico Bayo (Yellow-nosed Mouse)

Mus xanthorhinus Waterhouse, 1837:17. Type locality “Hardy Peninsula, Tierra del Fuego” [actually the southeastern extension of Isla Hoste, ca. 55°30’S, 68°W], Magallanes Province, Region XII, Chile (see Patterson et al., 1984:11).

Mus canescens Waterhouse, 1837:17. Type locality Puerto Deseado, Santa Cruz Province, Argentina (not Santa Cruz, Santa Cruz Province, as given by Patterson et al., 1984). Allen [1905:73] described problems with assignment of the type specimens of both canescens and xanthorhinus, and clarified the type locality of the former as “Port Desire.”


Akodon ilanoi Pine, 1976:63. Type locality Bahía Capitán Canéna (54°51’S, 64°27’W), Isla de los Estados, Tierra del Fuego, Argentina. A synonym of A. x. xanthorhinus according to Patterson et al., 1984:12.

CONTEXT AND CONTENT. Context is as presented for the genus. Relatively complete synonymies of the two recognized subspecies are presented by Patterson et al. (1984). A. hershkovitzi might eventually prove to be only an insular subspecies of A. xanthorhinus. Finally, A. xanthorhinus may eventually be considered conspecific with A. olivaceus, as suggested by Yáñez et al. (1979:202). Recognized subspecies are:

A. x. xanthorhinus (Waterhouse, 1837). See above. Includes A. ilanoi Pine, 1976, as a synonym.

A. x. canescens (Waterhouse, 1837). See above. As arranged by Osgood (1943:180).

DIAGNOSIS. Abrothrix xanthorhinus (Fig. 1) is most similar in size to A. olivaceus, but is slightly smaller, is obviously lighter colored, and has rusty-orange in the fur compared to the darker gray coloration of olivaceus. Cranial measurements of A. xanthorhinus (Fig. 2) average slightly smaller than those of A. olivaceus (e.g., greatest length of skull, 23.86 versus 25.72; zygomatic breadth, 12.07 versus 12.46—Kelt, 1994). The fur of A. xanthorhinus is noticeably shorter than that of A. longipilis and A. sanborni, two appreciably larger and generally darker congeners.

Abrothrix xanthorhinus is narrowly sympatric with Akodon iniscus. The two are quite similar and identifications of them have been confused (see discussion by Patterson et al., 1984). Skulls of A. xanthorhinus differ from those of A. iniscus as follows: anterior surface of the first molar is rarely notched (usually notched in A. iniscus), cranium is flatter in dorsal profile, nasals are more elongated, zygomatic plate is narrower, and the interorbital region is dorsally flatter and more rounded at the orbital margins. Skins of A. xanthorhinus have longer ears (>13 mm), the tail is tricolor rather than bicolored, and the rusty-orange coloration of nose and tail is prominent. Where they occur in sympatry in southern Patagonia (Lago Fagnano, Argentina, and Punta Arenas, Chile), A. xanthorhinus differs on average from A. lanosus in being slightly smaller with longer ears, but the white feet of A. lanosus provide an unequivocal means of distinguishing the two.

GENERAL CHARACTERS. Abrothrix xanthorhinus is a mouse of small size (adults commonly 15–20 g) and is light brown dorsally with characteristic rusty orange on the snout, top of the legs, and sides of the tail. The tail is much shorter (<65%) than the combined length of head and body. Pearson (1995) provided the following list of characteristics: the skull is flat in dorsal profile, the frontal region is inflated, and the rostrum is long with slightly upturned nasals. Width of mesopterygoid fossa is greater than that of parapterygoid fossa. The incisive foramina are rounded posteriorly and reach only to the front of the first molar. The frontal sur-

Fig. 1. Adult Abrothrix xanthorhinus from near Chile Chico, Chile.
faces of the upper incisors lack longitudinal grooves. The upper molar toothrows do not converge.

Of the two recognized subspecies, A. x. xanthorhinus tends to be larger and brownish suffused with rufus, whereas A. x. caecens is more grayish brown and generally smaller. Sexual dimorphism in color and size has not been demonstrated for either subspecies, and appears to be lacking, although means of head and body length of females generally were larger than those of males in the small samples from several southern Patagonian localities reported by Patterson et al. (1984). Comparisons of a large sample (166 females and 194 males, respectively) of A. x. caecens from near Bariloche, Rio Negro, Argentina, by Heinemann (1994) failed to detect significant sexual dimorphism in the following measurements (X ± SD): length of head and body, 81.96 ± 7.59, 80.72 ± 5.15; length of tail, 54.72 ± 6.00, 54.84 ± 5.06; length of hind feet, 19.31 ± 1.11, 19.68 ± 1.12; and length of ear, 11.35 ± 0.84, 11.97 ± 1.08. Additionally, Heinemann et al. (1993) measured body masses of these specimens, and reported no significant dimorphism between reproductive males (X = 17.8 g; n = 30) and reproductive females (X = 16.3 g; n = 44).

In a study of geographic variation of A. xanthorhinus in Tierra del Fuego, where both subspecies occur, it was observed that A. xanthorhinus tends to be slightly larger than A. x. caecens in most dimensions (Patterson et al., 1984). Means of external and cranial measurements (in mm) of female (n = 22) and male (n = 37) A. x. xanthorhinus and female (n = 16) and male (n = 15) A. x. caecens from Tierra del Fuego, respectively, are: length of head and body, 104.8, 100.1, 103.7, 96.7; length of tail, 56.2, 57.3, 54.5, 54.3; length of hind foot, 21.5, 21.8, 20.6, 21.1; condylobasal length, 22.6, 23.0, 22.2, 22.2; basilar length, 18.9, 19.4, 18.5, 18.7; palatal length, 9.9, 10.1, 9.7, 9.8; length of incisive foramina, 5.5, 5.7, 5.4, 5.4; zygomatic breadth, 12.6, 12.7, 12.4, 12.5; cranial depth, 9.6, 9.6, 9.4, 9.3; interorbital breadth, 4.1, 4.1, 4.0, 4.0; length of maxillary diastema, 3.5, 3.6, 3.5, 3.5; and length of maxillary diastema, 6.2, 6.4, 6.1, 6.2. Additional cranial measurements (in mm; X ± SD) reported by Kelt (1994) for 24 specimens (male and female combined) from Aisén, Chile, are: greatest length of skull, 23.86 ± 0.65; length of nasals, 9.04 ± 0.39; breadth of zygoma, 6.60 ± 0.17; breadth of braincase, 11.42 ± 0.22; width of incisors (measured at the alveolus), 2.38 ± 0.62; interorbital breadth, 7.25 ± 0.20; length of mandibular diastema, 2.31 ± 0.13; length of mandibular toothrow, 3.58 ± 0.14; greatest length of mandible, 11.67 ± 0.34; mandibular depth, 3.58 ± 0.19; and length of coronoid process, 1.10 ± 0.20.

DISTRIBUTION. Abrothrix xanthorhinus is one of the southernmost land mammals in the world, occurring in Patagonian steppe and forests of Argentina and Chile from approximately 37°S southward to nearly 56°S in southern Tierra del Fuego (Fig. 3). Because the most recently published distribution map for this species (Redford and Eisenberg, 1992) includes few records and thus fails to define the northern boundary of distribution, we have included not only published records but also those listed as holdings of several museum collections in Argentina, Chile, and the USA—see Monjeau et al. (1994).] The northern limits of distribution in Argentina follow closely the northern limits of the Patagonian Botanical Province (Cabrera, 1978; Soriano, 1983), which extend farther north on the west and reach the Atlantic coast just south of Peninsula Valdés, Chubut, at approximately 43°S. In the more recent classification of del Valle et al. (1995), the northern limit of the species corresponds to the northern limit of the Central Hills and Mesas Macrobiouzo where it meets the Patagonian Monte Macrobiouzo, both of which are part of the Extra-Andean Oriental Megabiouzo. In Chile, A. xanthorhinus is found from approximately 45°S to Tierra del Fuego (Reise and Venegas, 1974), reaching the southernmost known location of record on Hoste Island (Patterson et al., 1984).

FOSSIL RECORD. Fossils assignable specifically to A. xanthorhinus have not been reported. The oldest known fossil assignable to the Tribe Akodontini (Bolomys bonapartei) is from Early Pliocene (Montehermosoan) deposits in southeastern Buenos Aires Province, Argentina (Reg. 1978). The oldest specimen assignable to the genus Abrothrix are those of A. kemacki, obtained from the Chapadmalal Formation, Late Pliocene-Early Pleiococene, near the present city of Mar del Plata, Buenos Aires Province. This fossil more closely resembles the contemporary form of A. longipilis than
that of either *A. xanthorhinus* or *A. herzhkovitsi*, and is larger even than modern *A. longipilis.* *A. magnus* is known from Early Pleistocene (Vorohuean) deposits from near Mar del Plata (Reig, 1987).

Today the genus *Abrothrix* is distributed primarily in the southern Andean and Patagonian regions from Mendora to Tierra del Fuego, although *A. andinus* reaches southern Peru. This area is roughly 1,000 km west and south of the localities of known Pliocene and Pleistocene fossils, suggesting either a major range shift or a significant reduction in the distribution of the genus, or both. Reig (1987) suggested that perhaps this change was caused by climatic changes during and since the Pleistocene.

**FORM AND FUNCTION.** The dental formula of *A. xanthorhinus* is i 1/1, c 0/0, p 0/0, m 3/3, total 16. Pearson (1995) reported the number of molar roots as 4 (M1), 3 (M2), 3 (M3), 2 or 3 (m1), 3 (m2), and 2 (m3), and noted that M3 is slightly smaller than M2.

Molt patterns of *A. xanthorhinus* (82 males and 80 females)
in southern Tierra del Fuego were studied by Marconi and Kravetz (1991). Juvenile molt begins on the venter, proceeds laterally to the dorsum, and concludes at the head. Three adult molting types were described: regular or massive, when the pigmented area covered from 20 to 40% of the skin; irregular, observed in 22% of adults, in which hair replacement involves large areas but lacks symmetry and appears to be associated with advanced age; and diffuse, characterized by speckled distribution of melanin deposits (also without symmetry) covering more than 5% of the total surface of the skin. Adults undergoing regular molt show a symmetrical pattern commencing on the dorsum and progressing ventrally and anteriorly, terminating in the head and neck region with formation of a "necklace." Regular and irregular moults are observed in spring and autumn whereas diffuse molt most commonly occurs during other times of the year, especially winter and mid-summer. The diffuse molt pattern is associated with reproductive activity; all non-breeding adults show regular or irregular molt whereas most breeding adults manifest a diffuse molt.

Differences in the penis and baculum between Abrothrix and Akodon were described by Spotorno (1986, 1992) and Spotorno et al. (1990). In some Abrothrix, including both A. olivaceus and A. xanthorhinos, the phallic and proximal baculum are elongated and the distal baculum is reduced compared to the barrel-shaped phallus and large (nearly one third of total baculum length) distal baculum in Akodon subrufofasciatus. In the extreme case (abrothrix longipilis and A. sanborni), the phallic and proximal baculum are extremely elongated and the distal baculum is absent.

ONTOGONY AND REPRODUCTION. The annual reproductive period of A. xanthorhinos lasts from 7 to 8 months during spring and summer (Heinemann et al., 1995, Marconi (1988) and Heinemann (1994) reported that 100% of over-wintering individuals were sexually active in spring (September—October). Body mass of reproductive individuals exceeded 12 g. Females produced at least two litters per season. Mean lengths recorded for testes and seminal vesicles were 10.3 and 11.7 mm, respectively, for 32 reproductively active males. Juveniles were captured first in October and represented 29% of the population in March when they reached their peak abundance (Heinemann, 1994). Mean numbers of embryos per female were reported as 5.0 (Heinemann, 1994) and 5.5 (Marconi, 1988).

ECOLOGY AND BEHAVIOR. Abrothrix xanthorhinos occupies habitats ranging from the cold, humid forested region of southernmost Patagonia (Marconi, 1988; Patterson et al., 1984) to the open, upland-steppe in eastern and northern Patagonia (Monjeau, 1989; Pearson and Pearson, 1982). Freezing temperatures are common on winter nights over most of the range and not rare even on summer nights in more southerly areas. Snow sometimes covers the ground for several days in northern areas and is common even in the southern part of the range. The snow cover in southern Patagonia is relatively unstable compared to that in similar northern hemisphere latitudes owing to the narrow landmass and strong maritime influence from both the Pacific and Atlantic. Snow cover can melt suddenly during mid-winter causing severe flooding followed by extreme cold resulting in frozen, waterlogged soils that provide little or no protection for mice (Marconi and Kravetz, 1991). Marconi (1988) demonstrated that these conditions result in high mortality, and Marconi and Kravetz (1991) reported a positive relationship between survivorship of A. xanthorhinos and duration of snow cover in this region.

Habitats used by A. xanthorhinos in the northern portions of the range are restricted to arid environments devoid of trees, but the species is not found in the Monte desert, which is warmer with higher rates of evapotranspiration than the Patagonian steppe (Soriano, 1983). South of approximately 45°S the species can be found in both steppe and forest, but it was not captured during extensive trapping (>90 trapnights—each set for an average of approximately 100 trapnights) in the southern beech (Nothofagus) temperate forest farther north in Neuquen, Rio Negro, and northern Chubut (Christie et al., 1983; Monjeau, 1989; Pearson and Pearson, 1982).

Where A. xanthorhinos does occur in the forest, the bambou (Chusquea colorata) understory characteristic of more northerly forests is absent. In general, A. x. xanthorhinos is found in the southmost forests with Nothofagus and Drimys (canelo), whereas A. x. canescens occurs in steppe habitats (Mann, 1978; Osgood, 1943; Patterson et al., 1964; Pine et al., 1978, 1979; Reise and Venegas, 1974).

In Tierra del Fuego, A. xanthorhinos makes use of all available terrestrial habitats (Marconi and Kravetz, 1991), Osgood (1943), Patterson et al. (1984), and Marconi (1988) noted the numerical dominance of A. x. xanthorhinos within the mammalian communities of this region. In small mammal communities in the Nahuel Huapi National Park, Río Negro and Neuquén provinces, Argentina, and adjacent areas of westernmost Patagonia, A. xanthorhinos was numerically dominant only in bunch grass and bushy steppe, two habitats occupied also by Eligmodontia morgani and Reithrodontomys auritus (Monjeau, 1989). A. xanthorhinos occurs also in shrubby steppe (captured in 96.4% of 56 trapnights), bunchgrass steppe habitats (76.9% of 13 trapnights), shrubs (17.5% of 63 trapnights), stony steppe (16.5% of 6 trapnights), rocky habitats (12.5% of 24 trapnights), and meadows in steppe (5.55% of 18 trapnights). If meadows surrounded by steppe are disturbed by overgrazing, then A. xanthorhinos can invade in the absence of the two species that dominate ungrazed meadows, A. longipilis and Leptodactylus myopus. However, A. xanthorhinos seems unable to invade meadows in forest habitat at this latitude (none in 11 trapnights). A significant positive relationship between the trap success of A. xanthorhinos and the abundance of herbaceous cover and spiny shrub cover also was demonstrated. Finally, Monjeau (1989) found that in this forest-steppe ecotone A. xanthorhinos showed a relatively low measure of habitat breadth as compared to 12 species of small forest and steppe mammals.

Abrothrix xanthorhinos is omnivorous, including insects, seeds, and grasses in its diet (Marconi and Kravetz, 1991; Monjeau, 1989). Individuals kept in captivity (N. Guthmann, pers. obs.), including lactating females, fed only apple and sunflower seeds for extended periods appear to remain in good health. Both intact sunflower seeds and husked kernels were cached routinely. Burrowing behavior was not observed for captive A. xanthorhinos, although it is commonly observed in captive A. longipilis. Cannibalism was observed on occasion, including among adults trapped together in Sherman traps and occasionally of litters in the laboratory (N. Guthmann, pers. obs.).

Abrothrix xanthorhinos has been trapped syntopically with other closely related Akodontini, including A. longipilis in the Nahuel Huapi area of Argentina (Monjeau, 1989) and with A. olivaceus near Coihueco Alto in the Aisén Region of Chile (Kelt, 1994). Patterson et al. (1984) earlier reported the latter species pair in sympathy near the Río Negrego and Río Aisén in southern Chile. A. xanthorhinos and Akodon isincatus, morphologically and ecologically similar species of the Patagonian and Monte vegetative regions, respectively, are known to occur in sympathy within a narrow zone that includes Meseta de Somuncura, in the Río Negro Prov. (Bell Museum #15860, A. fuscus), . and Rawson, El Maitén, Pico Salamanca, Lago Blanco, and Chollina, in Chubut Province, Argentina (Patterson et al., 1984).

Density peaks of A. xanthorhinos in a steppe habitat in Río Negro, Argentina (41°S), were consistently observed in March during 4 consecutive years, with lows each September (Heinemann, 1994). The maximum individual longevity reported was 12 months, which was observed for both males and females. The maximum density in Heinemann's study was 40 individuals/ha; that reported by Marconi (1988) for a population in Tierra del Fuego was 63. No significant differences were detected by Heinemann et al. (1995) for average home range sizes of males (n = 39, X = 598 m²) and females (n = 23, X = 548 m²) during the non-reproductive season. Males in reproductive condition showed significantly larger home range sizes (n = 30, X = 1307 m²), but reproductive females (n = 44, X = 610 m²) showed no significant difference when compared to the pooled samples of males and females from the non-reproductive season. Little overlap was detected between female home ranges during the breeding season, but home ranges of adult males broadly overlapped those of females and other males, suggesting a promiscuous mating system for this population.

Fewer females than males have been reported in unconfined populations of A. xanthorhinos. Proportions of females captured were 43% in northern Patagonia (Heinemann, 1994); 46% (Marconi, 1988) and 42% (Patterson et al., 1984) for separate studies in Tierra del Fuego; and 37% in the Aisén Region of Chile (Kelt, 1994). However, when graphs of only reproductive individuals during the breeding season are compared in the reports by Heinemann.
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(1994) and Kelt (1994), the number of females in both studies is greater than that of males, as would be predicted for a species with promiscuous mating.

No published reports of predation on A. xanthorhinus are available. However, A. Trejo (pers. comm.) found remains of the muss in pellets from the great owl horned (Bubo virginianus). Remains also have been discovered in pellets of the barn owl (Tyto alba) and in feces of the Colorado fox (Vulpes velox), all from near Patagonia (Monjeque, unpublished).

The only parasite reported from A. xanthorhinus is the louse, Hoplopleura andina (Castro, 1981, 1982), Reig (1987) reported this parasite from several other species of the "Andean clade" (Smith and Patton, 1993) of akodontine rodents, including A. longipilis, A. olivaceus, A. sabornii, Chromomys jekeldi, and Chelemyx macronyx. Both Reig (1987) and Smith and Patton (1993) interpreted this taxonomic distribution of louse parasitism as a persistence of an early host-parasite relationship among hosts sharing a common ancestry.

GENETICS. The karyotype of Abrithrix xanthorhinus (Bianchi et al., 1971; Gallardo, 1982, Patterson et al., 1984; Spotorno, 1986; Spotorno et al., 1990) is similar in many respects to that of A. longipilis (the type species of Abrithrix). All authors report the 2n = 52, but the FN is equivocal. 56 reported by Gardner and Patton (1976, 1978), although Bianchi et al., 1971; 58 reported by Gallardo (1982) and Patterson et al. (1984), and 59 according to Spotorno (1986) and Spotorno et al. (1990). We count 56 autosomal arms in all published karyotypes in which the quality of the presentation allows us to make such a count, and we consider this to be the FN for this species.

The karyotype of A. xanthorhinus is indistinguishable from those of A. olivaceus (Spotorno and Fernandez, 1976) and A. sabornii (Gallardo, 1982). In addition, Spotorno (1986) and Spotorno et al. (1990) noted that xanthorhinus shares two chromosomal characters with other presumed members of the "Andean group." These are a pair of telocentric chromosomes not larger than 6.6% of the total karyotype length and two medium-sized metacentric pairs. Thus, karyotypic data support the concept of the "Andean clade" proposed by Smith and Patton (1993). The karyotype of these species of Abrithrix differs appreciably from that of Agodon boliviensis (2n = 40, FN = 40), the type species of Agodon (Gardner and Patton, 1976; see also Patterson et al., 1984).

Allozyme genetic distances for species of akodontine rodents (the genera Agodon, Bolomys, and Ozmymycterix) were estimated by Apfeldaum and Reig (1989). They observed that A. xanthorhinus is not closely related to eight species of the genus Agodon, including A. boliviensis, thus providing additional evidence that xanthorhinus should not be included in Agodon.

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