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Rhyncholestes raphanurus.

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Rhyncholestes Osgood, 1924

Rhyncholestes Osgood, 1924:169. Type species *Rhyncholestes raphanurus* Osgood, 1924, by original designation.

CONTEXT AND CONTENT. Order Marsupialia, Superfamily Caenolestoidea (Marshall, 1980), Family Caenolestidae, Subfamily Caenolestinae, Tribe Caenolestini. The genus *Rhyncholestes* contains a single Recent species, *Rhyncholestes raphanurus*.

Rhyncholestes raphanurus Osgood, 1924

Chilean Shrew-opossum

Rhyncholestes raphanurus Osgood, 1924:170. Type locality at mouth of Río Inío, south end of Chiloé Island, Prov. Chiloé, Chile.

CONTEXT AND CONTENT. Context same as in generic summary. Both the genus and species are monotypic.

DIAGNOSIS. Inasmuch as the genus is monotypic, the diagnosis applies to both genus and species. Skull (Fig. 1) narrow and elongated, the ratio of zygomatic breadth to cranial length is only 42% (Osgood, 1924); second, third, and fourth upper incisors bifid and subequal, with a broad leading blade and a blunt, curved posterior cusp; canine single-rooted and caniniform in male, but double-rooted and premolariform in female; posterior palatal vacuities without median bony partition; antorbital vacuities as in *Caenolestes*; median lower incisor highly procumbent, projecting from alveolus a distance equal to m1 to m3. Skeletal characters as in *Caenolestes*, except humerus relatively shorter, with deltoid ridge extending half its length; metapodials relatively short; 22 (in contrast to 27 in *Caenolestes*) caudal vertebrae (Osgood, 1924). Pelage silky and uniform, without counter-shading (Fig. 2); no external pouch or marsupium; upper and lower lips bearing "loose, fleshy lateral flaps of skin" possibly diagnostic of the family (Pine et al., 1979:343, fig. 3); tail seasonally incrassated with fat (Fig. 4).

GENERAL CHARACTERS. *Rhyncholestes* is a mouse-sized opossum of uniform dark grayish brown coloration. The ear pinnae are short and rounded, and the tail is dark, not furred for most of its length. Upper and lower lip-flaps on a greatly elongated head are the most salient external characters. The sexes are similar except dentally: males have a conical, single-rooted upper canine like that of *Caenolestes*, whereas females have a premolariform, double-rooted canine resembling *Lestoros* (Osgood, 1924). Both sexes have distinctly bifid upper incisors, unique among living marsupials.

External and cranial measurements of adult male and female specimens from Isla Chiloé and an adult male specimen from the Chilean mainland, respectively, were provided by Osgood (1924: 170 [emended in his 1943 account] and 1943:52-53) as follows: total length, 204, 175, 215; length of tail vertebrae, 78, 65, 87; length of hind foot, 21, 19.5, 23.5; ear from notch, 11, 11, (no data); diameter of tail at base, 7, 5, (no data); greatest length of skull, 34, 30.3, 34.8; basal length, 33.3, 29.6, 34.8; zygomatic breadth, 14.7, 12.5, 15; mastoid breadth, 11.1, 10.2, 11.8; length of nasals, 18, 15.8, 19.1; greatest breadth of nasals, 3, 2, 3.7; least interorbital breadth, 6.9, 7, 6.8; length of palate from gnathion, 20.3, 17.5, 20.7; length of anterior palatal foramina, 8.7, 7.3, 7.9; length of palatal vacuities, 6, 5.8, 6.6; front of upper canine to back of last molar, 13.4, 11.9, 13.4; combined length of four upper molars, 5.4, 5.2, 5.5; combined length of three lateral incisors, 3.9, 3.5, 3.8; length of bone of mandible from condyle, 20, 18, 21.5; exposed length of median lower incisor, 6.8, 6.1, 6.8.

DISTRIBUTION. The Chilean shrew-opossum has a narrow distribution, apparently restricted to temperate rain forests in southern Chile and probably adjacent Argentina (Fig. 5; Patterson, in press). The elevational range of records is from sea level (on Isla Chiloé) to 1,135 m (in Osorno Province). Localities are (from south to north)-CHILE: CHILOÉ PROVINCE: Chiloé Island: Mouth of Río Inío, 43°21'S, 74°07'W (type locality); Puerto Carmen, 43°08'S, 73°43'W; 15 km SW Quellon, near mouth of Río Yaldad; Cucao, 42°38'S, 74°07'W; Fundo El Venado, 5 km W Palomar (by road). LLANQUIHUE PROVINCE: south side, Lago Chapo, 41°26'S, 72°35'W; Peulla, 41°06'S, 72°02'W; Refugio, Volcan Osorno, 1,000 m. OSORNO PROVINCE: Valle de La Picada, 425-1,135 m, 41°02'S, 72°30'W; Parque Nacional de Puyehue, 40°39'S, 72°19'W; Maicolpue, 40°33'S, 73°46'W. Despite collecting efforts, the species has not been recorded from islands south of Chiloé (that is, the Guaitecas and Chonos), thus indicating its probable absence there. However, only modest collections have been made in mainland Chile between Puerto Montt and Puerto Aisén, and the species may range more widely than is currently known.

FOSSIL RECORD. Caenolestids have an excellent fossil record that extends to the earliest Eocene (Casamayoran) of Patagonia (Marshall, 1980). By the early Oligocene, three subfamilies were represented: the prototypical Caenolestinae and the more advanced Paleothentinae and Abderitinae. Living caenolestids all are allocated to the most primitive known tribe, the Caenolestini, that

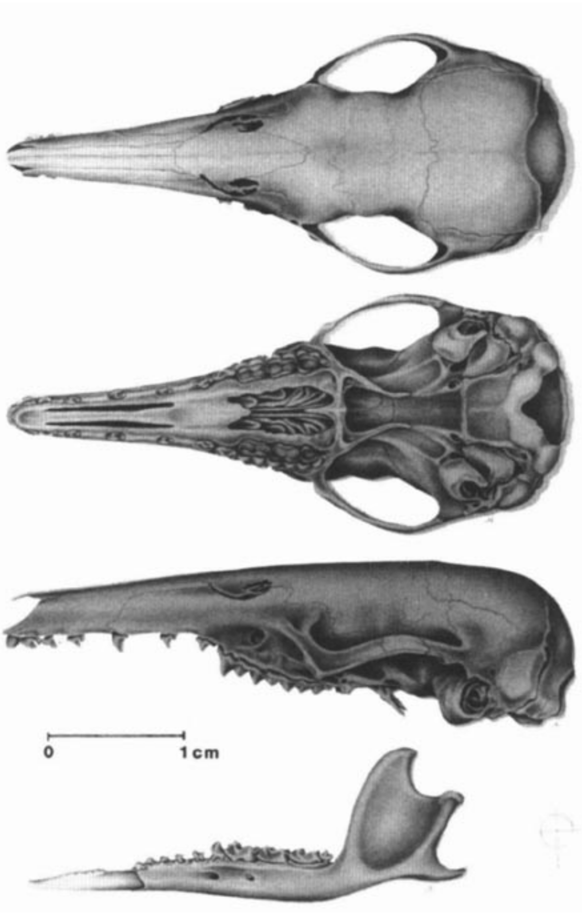

FIG. 1. Dorsal, ventral, and lateral views of skull, and lateral view of mandible of a female *Rhyncholestes raphanurus* from La Picada (FMNH 124003). Illustration by Rosanne Miezio, Field Museum.

FIG. 2. External view of the Chilean shrew-opossum, *Rhyncholestes raphanurus*, from La Picada, Chile. The ear of this animal is ringed by chiggers.

also contains the Deseadan (Oligocene) genus *Pseudhalmarhiphus* and the Santacrucian (Miocene) form *Stilotherium.* The three living genera of this tribe are known only from Recent specimens (Marhsall, 1980). The enigmatic relationships of caenolestids with other marsupials have been discussed and debated since the group's discovery, but recently by Marshall (1980), Pascual and Herrera (1973, 1975), and Reig (1955). Clemens and Marshall (1976) concluded that Caenolestidae bear no special relationship to Polydolopidae, that had been included within the Caenolestoidea, and allocated them to separate superfamilies.

FORM AND FUNCTION. Virtually nothing has been written on the form and function of *Rhyncholestes* since Osgood's (1924) comments in the generic description. However, the family's peculiar combination of polyprotodont and diprotodont characters sparked a number of character analyses (for example, Broom, 1911; Osgood, 1921; Thomas, 1895), some of which are relevant to *Rhyncholestes.* Caenolestinae exhibit antorbital vacuities, bounded by the nasal, frontal, and maxillary bones and opening into a sinus between the nasoturbinal and maxillary bones (Marshall, 1980). These vacuities are not associated with superficial glands (Osgood, 1921). The functional significance of the "gliriform" lower incisors is unclear, although Kirsch (1977) suggested they may be used in rapier-like fashion to dispatch vertebrate prey. Such trophic habits are not suggested by the few available studies of diet in *Caenolestes* (Barkley and Whitaker, 1984; Osgood, 1921), that indicate chiefly insectivorous food habits. Miller and Rottmann (1977) proposed that *Rhyncholestes* may use their highly procumbent incisors to probe small crevices in search of insects. A. K. Lee and P. Temple-Smith observed *Rhyncholestes* to use the incisors to pull at tissue held in the hands; food is ingested at the corners of the mouth where it is cut and crushed by the cheekteeth. The lip flaps of caenolestids (Fig. 3) also are of undocumented functional significance. They are purported to hold food (Gregory, 1922), convey food inward (Lönnberg, 1921), eject undesirable parts (Kirsch, 1977; Osgood, 1921), or prevent sensory vibrissae and fur from becoming clogged with blood (Kirsch and Waller, 1979).

Studies of the brains of caenolestids show extensive development of the olfactory bulbs and of the higher rhinencephalic centers, but only a "shallow cap" of neopallium on the cerebral hemispheres (Herrick, 1921; Obenchain, 1925). Like didelphids, but unlike phalangeroids (Marshall, 1980), the caenolestids *Caenolestes* and *Lestoros* lack a fasciculus aberrans connecting pallial structures of the two cerebral hemispheres (Obenchain, 1925).

Locomotion in the caenolestids is typically symmetrical, but at higher speeds may include bounding, with fore and hind legs used together (Kirsch and Waller, 1979). Neither *Caenolestes* nor *Lestoros* have been observed to use richochetal progression. In all gaits, the tail is used as a balancing organ, and shows no signs of dorsal or ventral prehensility (cf. Lönnberg, 1921; Thomas, 1895). Relative to other caenolestids, *Rhyncholestes* has a shorter tail with fewer caudal vertebrae, so that it may be less agile. Seasonally, *Rhyncholestes* is known to store fat in its tail (Fig. 4), a trait that distinguishes it from other caenolestids but that it shares with other austral marsupials, including *Lestodelphys, Dromiciops,* and *Marmosa* of South America, and several Australian forms. Osgood's male specimen of *Rhyncholestes,* captured 19 January 1923, had a tail 7 mm across at the base, whereas Sanborn's specimen, captured earlier in the summer (1 December 1939), was not incrassated with fat (Osgood, 1943). Caudal fat storage has been correlated with extended torpor in several small mammals inhabiting temperate regions (Morton, 1980).

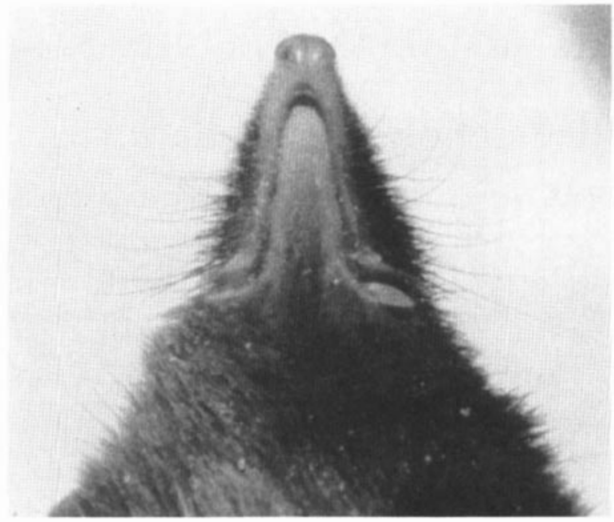

FIG. 3. Ventral view of head of *Rhyncholestes raphanurus,* showing position and shape of dorsal and ventral lip lappets or flaps.

ONTOGENY AND REPRODUCTION. On the basis of a single female specimen, Osgood (1924) claimed that *Rhyncholestes* possesses five mammae, the fifth in a median position slightly anterior to the others; both *Caenolestes* and *Lestoros* have two pairs of mammae (Osgood, 1924; Collins, 1973). Osgood's observation has been echoed, but not confirmed, in subsequent studies. Basing observations on several lactating females, B. D. Patterson, P. L. Meserve, and B. K. Lang determined that there were seven teats, the five described by Osgood plus an anterior pair. Despite Tomes' (1860) initial allusion to a pouch in juvenile *Caenolestes,* there is no trace of a marsupium in *Rhyncholestes* or in other caenolestids (Kirsch and Waller, 1979; Osgood, 1921). Capture of a female caenolestid with young attached to the teats has never been reported; thus, they may utilize a nest, at least during the reproductive season. Maternity nests of these or other American marsupials currently are unknown. Based upon a consistently complete pattern of teat development in lactating females, Kirsch and Waller (1979:394) concluded that litter size in *Caenolestes* may be "as great or greater than the capacity of the mother to suckle."

Meserve et al. (1982) reported that "reproductively active" female *Rhyncholestes* were captured only in summer at La Picada, Osorno Province; none of three females trapped the following May showed perforate vaginae or signs of pregnancy or lactation. Conversely, males were reported to be reproductively active throughout the year. However, reproductive activity in males was assessed by position of the testes, as in rodents; scrotal anatomy in these marsupials apparently precludes an abdominal condition. Most species of small mammals in south temperate rainforest habitats exhibit seasonal patterns of reproductive activity, being generally limited to October–May, and greatest in November–December (Meserve et al., 1982; Pearson, 1983).

The reproductive anatomy of male *Caenolestes* is noteworthy in the extraordinary size of the prostate and Cowper's glands, the deeply cleft glans penis, and the apparent absence of the levator penis muscle (Osgood, 1921; cf. Fig. 4). Spermatozoa of *Caenolestes* represent one of three types found in American marsupials, being "very rectilinear in shape with a niche on one side from which the mid-piece arises" (Biggers and DeLamater, 1965:403). Like other American forms, but unlike Australasian taxa, spermatozoa of *Caenolestes* pair in the epididymis. *Rhyncholestes* is presumably similar in these regards.

ECOLOGY. *Rhyncholestes* appears to be restricted to temperate rain forest habitats. Osgood (1924:172) noted that "The [type] locality was in heavy temperate forests near the mouth of the

FIG. 4. Ventral view of abdomen of *Rhyncholestes raphanurus*, showing freshly everted penis and incrassated tail of male collected 16 February 1984 at La Picada. At 20 mm from its base, the tail measured 8 mm in diameter; tails without significant fat deposits measure about 5 mm diameter.

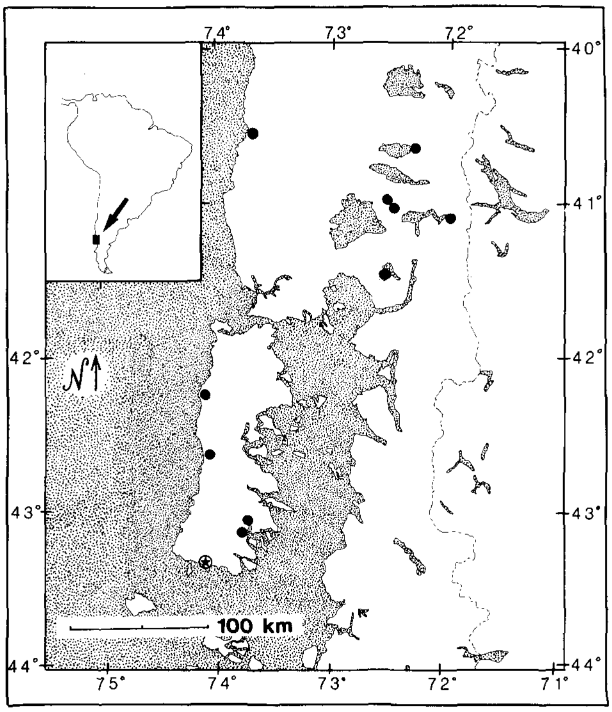

FIG. 5. Geographic distribution of *Rhyncholestes raphanurus* in southern South America, including all known capture localities. Primary sources are provided by Patterson (in press). Presence of *Rhyncholestes* at all but three of these localities has been discovered since 1983.

Rio Inio at the extreme southern end of Chiloe Island. Here it was only after much trapping that the first specimen, the female, was taken." In his field notes for 14 January 1923, he wrote "Set more traps last night in *Caenolestes* territory but had a poor catch. The one specimen was caught in a dry runway under a log at edge of bamboo thicket." The following day he observed, "Mouse traps in the woods which I baited with bacon and meat failed to get more *Caenolestes*, but caught a couple of the short-tailed shrew-mice . . . [*Geoxus valdivianus*] showing their preference for that kind of bait" (Patterson, 1983:11). Osgood later (1943:52) recorded *Rhyncholestes* from 900 m elevation near Refugio de La Picada, "under deep growth in a cool and very moist location." Pine et al. (1979: 343) reported a specimen taken near the type locality (at 15 km SW Quellon near mouth of Río Yaldad, <30 m) that was "trapped on top of a log in a dense and humid Valdivian forest adjacent to a recently logged area."

Meserve et al. (1982) reported capturing 11 *Rhyncholestes* at La Picada in forests dominated by *coihue* (*Nothofagus dombeyi*). These forests included other emergents such as *Eucryphia cordifolia*, *Caldcluvia paniculata*, and *Laurelia philippiana*, and understory trees, such as *Lomatia ferruginea*, *Drimys winteri*, *Weinmannia trichosperma*, and *Amomyrtus luma*; however, bamboo (*Chusquea* cf. *montana*) is a minor floristic component. Shrubby and herbaceous plants in this habitat include *Gaultheria phillyreifolia*, *Gunnera* sp., *Amomyrtus meli*, *Berberis pearcei*, *Griselinia racemosa*, and *Plantago* sp. (Meserve et al., 1982:315). This vegetation is classified as the "*Coihue-Ulmo* subassociation" of the Andean Valdivian forest, distributed between 100 and 850 m elevation. Even within this habitat, all individual *Rhyncholestes* were "live-trapped near burrow entrances at the base of trees or under fallen logs in dense forest" (Meserve et al., 1982:316).

In more extensive work at La Picada, involving an elevational transect of habitats from the foot of the forest to tree-line (425 to 1,135 m), B. D. Patterson, P. L. Meserve, and B. K. Lang captured *Rhyncholestes* in habitats throughout the sampled ecological range that included portions of "Valdivian," "North Patagonian," and "Subantarctic" rain forest associations (Patterson, 1985; terminology of Heusser, 1974). Specimens were taken most frequently on the ground, alongside logs, and in dense cover; fewer were taken in drier microhabitats.

On Isla Chiloé, Osgood (1943) and colleagues took *Rhyncholestes* in association with the mammals *Histiotus montanus*, *Oryzomys longicaudatus*, *Geoxus valdivianus*, *Akodon olivaceus*, *A. sanborni*, *Auliscomys micropus*, and *Irenomys tarsalis* (Osgood, 1943). During extensive trapping in Valle de La Picada, *Rhyncholestes* was recorded with these same terrestrial species plus *Dromiciops australis* and *Akodon longipilis* (Patterson, 1985). Literature records additionally document the presence of the histricognath rodent *Aconaemys fuscus* in nearby habitats (Pearson, 1984).

Conventionally, *Rhyncholestes* is considered to be scarce because it is so poorly represented in collections (for example, Miller et al., 1983; Tamayo and Frassinetti, 1980). Miller and Rottmann (1977:10) proclaimed it to be "*el mamífero más raro de Chile.*" Yet available data are not unanimous on this point. Meserve et al. (1982:316) suggested that its "apparent rarity might be an artifact of a highly localized distribution (most examples are from near La Picada) and specialized habitat requirements . . . ." However, the species is now known to occupy a large range of microhabitats. Recent trapping records also suggest that there is temporal variation in the abundance of shrew-opossums. Sanborn secured but a single *Rhyncholestes* near the Refugio de La Picada in 1939 (Osgood, 1943), despite attempts to obtain additional specimens, and no subsequent collections were reported from this area until Gallardo's (1978) rediscovery of the species. However, in late summer, February–March 1984, *Rhyncholestes* was more abundant in Valle de La Picada than three syntopic species of sigmodontine rodents (that is, *Irenomys tarsalis*, *Geoxus valdivianus*, and *Auliscomys micropus*; Patterson, 1985).

Unpublished analyses of stomach contents suggest that, although insectivorous, *Rhyncholestes* also consumes significant amounts of plant material (including fungi and seeds) and noninsect animal material, especially earthworms, Lumbricidae.

BEHAVIOR. Meserve et al. (1982) interpreted low recapture frequencies as evidence that *Rhyncholestes* may become "trap-shy" after initial capture. Eleven of their 12 captures of this species occurred over-night, suggesting it is principally nocturnal. In four successive nights at El Venado, Chiloé, M. H. Gallardo captured an adult male, adult female, and two juveniles in a single trap set underneath a log; the trap was not washed between captures. At Puerto Carmen, Chiloé, he collected three animals in the same Sherman trap during successive nights. Whether these capture records signify family groups (with possible ecological or social significance) or instead are merely coincidental remains conjectural.

GENETICS. The standard karyotype of *Rhyncholestes* was reported (Gallardo and Patterson, in press) as a diploid number of 14, apparently primitive for the Marsupialia (Hayman et al., 1971; Reig et al., 1977). Arm length ratios (long arm/short arm) for the chromosomal complement of *Rhyncholestes* were included with the original report, and vary from 1.39 to 1.53 for the six pairs of biarmed autosomes; the sex chromosomes are acrocentric. Like those of other caenolestids, the chromosomes of *Rhyncholestes* exhibit achromatic regions (Gallardo and Patterson, in press; Hayman et al., 1971; Hayman and Martin, 1974).

REMARKS. The family-group name Caenolestidae is based upon the Greek roots *kainos*, "new, recent," and *lestes*, "a robber, pirate," the latter having long been connected to ancient, predaceous fossil marsupials. *Caenolestes* Thomas, 1895 replaced the more descriptive *Hyracodon* Tomes, 1863, which is a junior homonym meaning "shrew-tooth" (Thomas, 1895). The prefix of the generic name of the Chilean shrew-opossum is based on the Greek root *rhynchos*, "snout." The specific epithet is derived from the Greek root, "*raphanos*," meaning "cabbage, radish," an apparent reference to the incrassated tail. The Spanish vernacular name *comadrejita trompuda*, is derived from the diminutive of *comadreja*, meaning weasel, and *trompa*, meaning snout.

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