

*Podomys floridanus*. By Cheri A. Jones and James N. Layne

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*Podomys* W. H. Osgood, 1909

*Peromyscus* (*Podomys*) W. H. Osgood, 1909:226. Type species *Hesperomys floridanus* F. M. Chapman.

**CONTEXT AND CONTENT.** Order Rodentia, Family Muridae, Subfamily Sigmodontinae. *Podomys* is a monotypic genus known only from Florida.

*Podomys floridanus* (Chapman)

Florida Mouse

*Hesperomys floridanus* Chapman, 1889:117. Type locality Gainesville, Alachua County, Florida.

*Hesperomys macropus* Merriam, 1890:53. Type locality Lake Worth, Palm Beach County, Florida.

*Sitomys floridanus* Chapman, 1894:336, name combination.

*Peromyscus floridanus* Bangs, 1896:122, name combination.

*Podomys floridanus* Carleton, 1980:115, first use of current name combination.

**CONTEXT AND CONTENT.** Context as in generic summary above. *P. floridanus* is monotypic (Carleton, 1989).

**DIAGNOSIS.** In general the greater size and distinctive color of *P. floridanus* serve to distinguish it from *Peromyscus gossypinus* and *P. polionotus*, which also occur in Florida. The Florida mouse has relatively large pinnae ( $\geq 16$  mm) and hindfeet ( $\geq 24$  mm), and the tail is approximately 80% of body length (Layne, 1970). In addition to relatively smaller ears, particularly in *P. polionotus*, *P. gossypinus* and *P. polionotus* lack the orange shading on the cheeks, shoulders, and lower sides that characterizes adult *P. floridanus*. Additionally, these *Peromyscus* typically have six well-defined plantar tubercles (occasionally only five in *P. polionotus*, according to Smith, 1968). *Podomys* usually has five small pads, although the number ranges from 3 to 6 (Layne, 1970; Stout and Keim, 1981); the hypothenar pad tends to be absent or reduced (Carleton, 1980). Other diagnostic characters include relatively hypsodont molars with small accessory tubercles (Osgood, 1909), an interorbital shelf, small vesicular glands, large ampullary and bulbourethral glands, and a reduced distribution of spines on the glans penis (Carleton, 1980; Linzey and Layne, 1969).

**GENERAL CHARACTERS.** The Florida mouse is somewhat larger than other southeastern peromyscines. Mean measurements (mm) of 30 adults (10 each from Highlands, Levy, and Putnam counties) are: total length, 194.7 (178-220); length of tail, 87.7 (80-101); length of hind foot, 25.8 (24-28); and length of ear, 18.8 (16-21.5) (Jones, unpubl. data). Mean mass (g) of 60 adults from Levy County is 35.5 (27.0 to 47.0). Populations in north-central Florida in the region of the type locality have relatively smaller body size. For comparison, mean measurements and mass of 60 adults from such a population in Alachua County are: total length, 179.3 (166-199); length of tail, 79.2 (70-87); length of hind foot, 23.5 (21.5-25.0); length of ear from notch, 19.4 (18-23); average body mass, 25.8 g (20.3-31.7) (Layne, unpubl. data).

The Florida mouse is peromyscine in appearance, with large pinnae and eyes (Fig. 1). The pelage is soft and silky (Bangs, 1896). Color varies among populations, but, in general, adults are brownish or brownish-gray along the dorsum and bright ochraceous on the cheeks, shoulders, and lower sides. The feet and underparts are white, although some individuals have a tawny patch on the breast (Chapman, 1894; Layne, 1966). The tail is white below and brown above, but not as sharply bicolored as in *P. gossypinus* or *P. polionotus*. The dorsum of juveniles is a clear gray and the ventral parts grayish to white (Layne, 1966). Florida mice have a distinctive skunk-like odor (Layne, 1990).

**DISTRIBUTION.** This mouse is the only mammalian genus endemic to Florida (Fig. 2). In recent times it occurred from St. Johns, Clay, Putnam, Alachua, Suwannee, and Taylor counties south to Sarasota, Highlands, and Dade counties, with an isolated population in Franklin County (Layne, 1992). Osgood (1909) and L. M. Ehrhart (in litt.) found *P. floridanus* on Merritt Island on the Atlantic coast in Brevard County.

**FOSSIL RECORD.** The oldest known fossils of *P. floridanus* are from the Haile 21A local fauna (early Irvingtonian) from Alachua County (Morgan, 1991). According to Webb (1974), the species is known from five Rancholabrean assemblages, all in Florida. Recently *Podomys* has been found in two additional Rancholabrean sites, Warm Mineral Springs in Sarasota County and Monkey Jungle in Dade County (Ober, 1978; G. S. Morgan, pers. comm.). A single molar from the presumably early Miocene Thomas Farm local fauna was reported (Baskin, 1978); however, subsequent research indicated that the tooth is part of a Pleistocene assemblage also present at Thomas Farm (G. S. Morgan, pers. comm.). An extinct species, *Peromyscus oklahomensis* from the Illinoian and Sangamonian of Oklahoma and Texas, might be referred to the genus *Podomys* (Dalquest, 1962; Stephens, 1960).

**FORM.** The skull of *Podomys*, compared to that of *Peromyscus*, is large and deep; the supraorbital border is developed into a shelf and the anterior palatine foramina are short and wide (Osgood, 1909; Fig. 3). Dentition is 1/1, 0/0, 0/0, 3/3, total 16. The dental pattern is simplified (Bader, 1959) and varies among populations, with more simplified molars found in populations associated with open woodlands (Wolfe and Layne, 1968).

*Podomys* has a relatively slender, proportionately small baculum with a rounded base compared to *Peromyscus* (Blair, 1942; Burt, 1960). Carleton (1980, 1989), Hooper (1958), and Hooper and Musser (1964) noted similarities in penial structure between this species and *Habromys lophurus*, *H. lepturus*, *Osgoodomys banderanus*, and *Neotomodon alstoni*. The remainder of the male reproductive tract is characterized by enlarged ampullary glands, reduced vesicular and prostate glands, and an expanded deferent duct (possibly for sperm storage), and most closely resembles the reproductive tract of *Habromys* (Linzey and Layne, 1969). The spermatozoon is of the hooked type common to that of *Peromyscus* and numerous other murids (Hirth, 1960; Linzey and Layne, 1974).

**FUNCTION.** *Podomys* has less control of the rate of water turnover than *Peromyscus californicus*, *P. eremicus*, and *P. maniculatus* (Fertig and Layne, 1963; Glenn, 1970). Animals from the field are more dehydrated than those from the laboratory. Under natural conditions, water loss appears controlled primarily by behavioral means (Glenn, 1970; Layne, 1971).



FIG. 1. Photograph of *Podomys floridanus* by J. N. Layne.

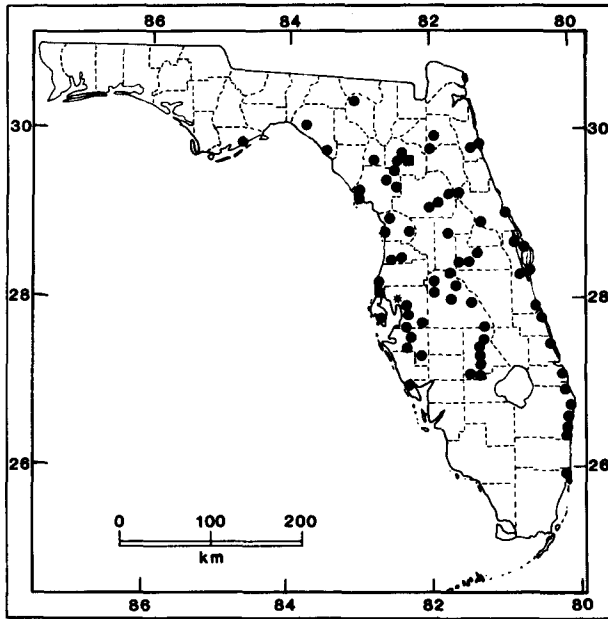


FIG. 2. Distribution of *Podomys floridanus* in Florida. Square represents type locality in Alachua County; dots represent known specimens in collections, literature records, and unpublished records; and the asterisk represents the location of an introduced population.

Basal metabolic rates for 10 *Podomys* from Levy County were  $1.68 \pm 0.17 \text{ cm}^3 \text{ O}_2 \text{ g}^{-1} \text{ h}^{-1}$  and for 12 laboratory animals (in captivity for >3 months)  $1.15 \pm 0.09 \text{ cm}^3 \text{ O}_2 \text{ g}^{-1} \text{ h}^{-1}$  (Glenn, 1970). Basal metabolic rates were 1.76 and  $1.70 \text{ cm}^3 \text{ O}_2 \text{ g}^{-1} \text{ h}^{-1}$  for mice from Levy and Alachua counties, respectively (Layne and Dolan, 1975).

Wild populations of *P. floridanus* have a significantly higher proportion of shortened tails than populations of *P. gossypinus*. The integument of the tail is modified to facilitate tail loss, apparently as an anti-predator mechanism (Layne, 1972, 1992).

**ONTOGENY AND REPRODUCTION.** Under natural and laboratory conditions, *P. floridanus* reproduces throughout the year (Dice, 1954; Drickamer and Vestal, 1973; Jones, 1990; Layne, 1966). Layne (1963) stated that breeding is concentrated in late fall and winter. Pregnancies in a sample of 295 adult females captured in Alachua County exhibited a major peak in late summer and fall and a lesser peak in late winter (Layne, 1966). The average number of young in eight wild-conceived litters and of embryos in 57 females from Alachua County was 3.1 (2-4) and 3.4 (1-5), respectively. Average litter size in the laboratory varied from 1.7 to 2.6 (Dice, 1954; Drickamer and Vestal, 1973; Glazier, 1985; Jones, 1990; Layne, 1966; Rood, 1966). Layne (1968b) compared the growth and development of *Podomys* with ten species of *Peromyscus*, and suggested that prolongation of development in *P. floridanus*, *P. truei*, and *P. crinitus* might be in response to limited or dispersed food resources. The gestation period for *Podomys* has not been reported, but judging from *Peromyscus* of comparable size it is probably about 23 or 24 days (Layne, 1968b).

Neonates are hairless except for vibrissae and some tiny hairs distributed on the dorsum and jaws. The pinnae are fused and folded over, and the eyes are closed although the iris is visible through the lids. By the third day darker hairs on the venter and mystacial pads, and sometimes white hairs on the tail, are visible. Pinnae start to unfold at an average age of 3.9 days. Lower incisors erupt at an average of 6.8 days. At 1 week, the dorsum is dark gray and the venter pinkish-white. Hair is apparent on the pinnae and tail, and the longest mystacial vibrissae are 12 mm. Eye movements might be visible at this time. Agouti hairs can be seen on the dorsum at 10 days of age, and the juvenile color pattern is present at 14 days. Other developments during the 2nd week of age include the opening of the external auditory meatus (mean of 12.2 days) and emergence of upper incisors (mean of 9 days). Eyes open at an average of 16.5 days. Young are weaned between 3 and 4 weeks. There were no nursing animals older than 28 days (Layne, 1966).

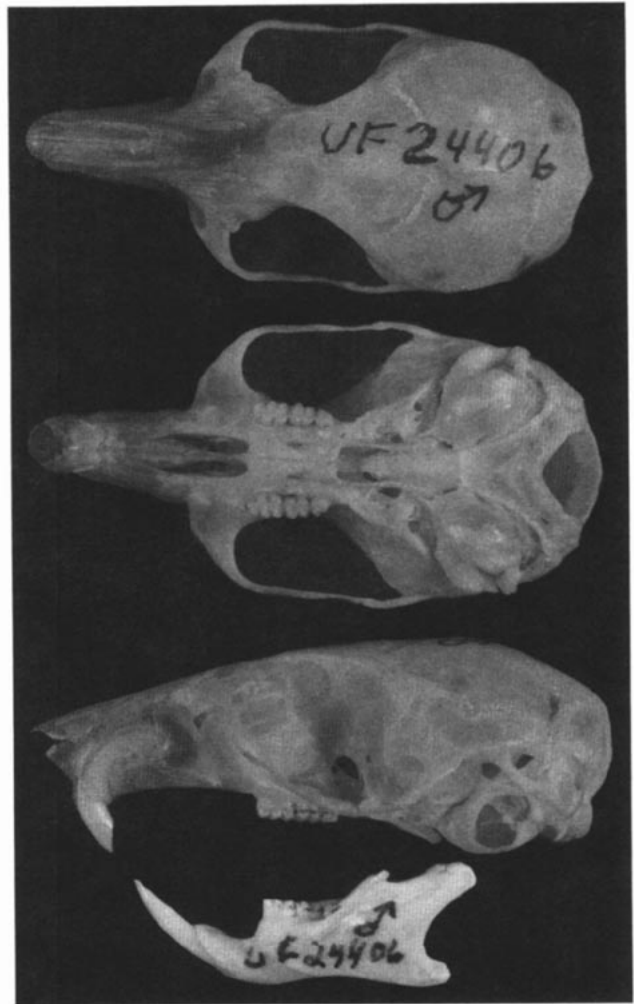


FIG. 3. Dorsal, ventral, and lateral views of the skull, and lateral view of the lower jaw of *Podomys floridanus* (Florida Museum of Natural History 24406). Greatest length of skull, 28.7 mm. Photographs by T. H. Henry.

The post-juvenile molt began between 36 and 42 days in animals from Alachua County. This molt begins on the brachium and shoulders and then extends posteriorly in a band along the sides; occasionally there is a second center on the anterior thigh. A saddle is formed as the molt reaches from the sides to the middorsal line on the shoulders or above the abdomen; then the molt spreads anteriorly and posteriorly. Hair is replaced last on the head and rump. Molt on the venter first appears around the base of the forelimbs, sometimes with a secondary center in the inguinal area. The molt spreads from the arms to fuse at the midline and extends to the throat, breast, and posteriorly. The molt appears to progress in waves rather than at a uniform rate (Layne, 1966).

Maternal care in captivity includes creating nests, plugging entrances to nest boxes, nursing and cleaning the young, and herding juveniles into the nest (Layne, 1966, 1968b). The young are nursed almost continuously for the first 2 weeks; later there appears to be a reciprocal relationship between nursing and the adult activity cycle. Persistent bonds may form between mothers and semi-independent offspring (Eisenberg, 1983; Layne, 1966). Crosses by means of artificial insemination with *P. maniculatus* did not produce viable hybrids (Maddock and Dawson, 1974).

**ECOLOGY.** *Podomys floridanus* is the characteristic mouse of some of the most xeric habitats in Florida. The species is most common in sand pine scrub (*Pinus clausa*) and high pinelands (sandhills dominated by longleaf pine, *P. palustris*, and turkey oak, *Quercus laevis*). It also occurs in slash pine (*P. elliotii*)-turkey oak (southern ridge sandhill), scrubby flatwoods, and coastal scrub associations (Bangs, 1898; Layne, 1992). The soils are sandy and

well-drained, with many patches of bare ground. Populations of *P. floridanus* are reduced or eliminated when habitat conversion occurs as the result of fire exclusion (Jones, 1992; Layne, 1992).

In most areas *Podomys* coexists with *Peromyscus* (Layne, 1990; Packer and Layne, 1991). However, in high pine in Putnam County, Brand (1987) and Jones (1990) found no overlap between *P. floridanus* and *P. gossypinus*, which was associated with lower, wetter microhabitats. Layne (1990) regarded scrub as the ancestral and primary habitat, with high pine a secondary habitat. Based on sampling at more than 50 localities, *Podomys* populations tended to be higher in scrub and scrubby flatwoods (mean of 9.9 and 12.7 mice/100 trapnights, respectively) than in high pineland (mean of 2.5/100 trapnights; Layne, 1990). In addition, home ranges (based on average distance between successive captures) were smaller in scrub (16 m for adults) than in high pine (25 m; Layne, 1990). In high pineland, females had mutually exclusive home ranges that were significantly smaller than those of males; mean home range sizes were 2,601 m<sup>2</sup> for 35 females and 4,042 m<sup>2</sup> for 40 males (Jones, 1990).

*Podomys floridanus* is closely associated with burrows of the gopher tortoise (*Gopherus polyphemus*) in high pinelands (Blair and Kilby, 1936; Brand, 1987; Humphrey et al., 1985; Jones, 1990; Layne, 1992). Use of tortoise burrows in slash pine-turkey oak sandhills in southern Florida also has been reported (Frank and Layne, 1992). A trapping success of 33% was achieved from traps placed in the mouths of tortoise burrows, compared to 0.4% when traps were placed on transect lines (Eisenberg, 1983). In another study, trapping success ranged from 0 to 16% at tortoise burrows and from 0 to 7% on grids (Jones, 1990). Natural ground holes and burrows of other animals, including pocket gophers (*Geomys pinetis*), armadillos (*Dasypus novemcinctus*), and oldfield mice (*P. polionotus*) are also used (Layne, 1990).

Acorns appear to be a major food source when available (Humphrey et al., 1985; Layne, 1970). Generally higher and more consistent annual acorn production in scrub and scrubby flatwoods compared with high pineland correlates with the typically greater abundance of *Podomys* in the former habitats (Layne, 1990). Other foods include insects, seeds, nuts, fungi, and other plant materials, although details of the diet are not well known (Jones, 1989, 1990; Layne, 1992). Milstrey (1987) reported that *Podomys* ate engorged soft-bodied ticks (*Ornithodoros turicata americanus*) that parasitize gopher frogs (*Rana areolata*) and tortoises, raising the possibility that these mice prey on other species utilizing tortoise burrows. In a supplemental feeding experiment in sand pine scrub in Orange County, Young and Stout (1986) observed no response by *P. floridanus* to additional food.

Florida mice are preyed upon by bobcats, *Felis rufus* (Maehr and Brady, 1986; Wassmer et al., 1988); other predators are assumed to include snakes, raptors, foxes, and raccoons (Layne, 1992). Thirty-eight species of parasites of *P. floridanus* include one trematode, four cestodes, 11 nematodes, one pentastomid, four non-chigger mites, three chigger mites, five ticks, five fleas, one louse, and one botfly (*Cuterebra*; L. M. Ehrhart, in litt.; Kinsella, 1991; Layne, 1963, 1967, 1971; Lichtenfels, 1970; Whitaker, 1968). The most common flea, *Polygenis floridanus*, is narrowly host-specific (Johnson and Layne, 1961). The liver-inhabiting nematode *Capillaria hepatica* has a higher incidence in *P. floridanus* than in any other Florida mammal (Layne, 1968a; Kinsella, 1991). Goin (1944) observed a Florida mouse impaled on a cactus (*Opuntia*) spine.

Adult *P. floridanus* had a mean survival time of 4.2 months on high pine grids and 2.0 months on scrub grids (Layne, 1990). Jones (1990) reported that 8.6% of marked animals persisted for 360 days or more on high pine in Putnam County. A male who was approximately 3 weeks old at the time of capture survived for 7 years, 4 months in captivity (Keim and Stout, 1987).

**BEHAVIOR.** Although capable of climbing, *P. floridanus* is primarily a terrestrial species. It is not as active a climber as *P. gossypinus* and other *Peromyscus* (King, 1968; Layne, 1970; Packer and Layne, 1991). Siegel and Van Meter (1973) noted proportional differences in limb bones of *Podomys* and *P. gossypinus*, and concluded that differences in plantar tubercles and tarsal morphology were related to greater prehensile use of the foot in the latter. In laboratory experiments Florida mice were grouped with species that showed relatively high levels of sand digging; results suggested that the tendency to dig sand reflected the habitat of the species (King,

1968). *Podomys* used its forepaws to excavate and to throw substrate backwards, whereas other peromyscines used the hindfeet more frequently to pitch materials back (Layne and Ehrhart, 1970).

*Podomys floridanus* uses small side holes in gopher tortoise burrows (Blair and Kilby, 1936). In Putnam County, the mice constructed small side tunnels, as well as utilized the main tortoise burrow. Areas used by mice occasionally were lined with oak leaves and wiregrass. Additionally, *P. floridanus* used a smaller entrance, a chimney that entered the main tortoise burrow 1–2 m past the entrance, and mice continued to use these chimneys after the main burrow entrance had collapsed (Jones and Franz, 1990). Nests in two tortoise burrows were in side chambers located 1.2–5.5 m from the entrance of the burrow (Layne, 1990). The tendency of *Podomys* to push through a sand-filled tunnel in laboratory digging tests (King et al., 1968) and its emphasis on use of the forelimbs in digging (Layne and Ehrhart, 1970) might be related to modification of gopher tortoise burrows.

Natural nests were thin, poorly-constructed platforms of dried oak leaves, pine needles, grass stems, inner fibers of Spanish moss (*Tillandsia usneoides*), and a few small feathers (Layne, 1990). In the laboratory, *P. floridanus* constructs small nests that are similar in size to those of the much smaller *P. polionotus* (King et al., 1964). In one experiment, typical nests of *Podomys* were flat platforms or open cups rather than the spherical nests typical of *Peromyscus*, and Florida mice used less nesting material and shredded it less finely than *P. gossypinus* and *P. leucopus* (Layne, 1969). Variations in nesting behavior among these species were attributed to differences in microhabitat (i.e., use of underground burrows) rather than differences in climate (Layne, 1969; Klein and Layne, 1978; Wolfe, 1970).

The copulatory behavior of *P. floridanus* differs from that of most murids in that there is no intravaginal thrusting, the intromission thrust is more intense than the dismount, there is no lock, and ejaculation occurs on a single insertion (Dewsbury, 1975).

Gyrations and tail vibrations are associated with tail autonomy (Layne, 1972). The stronger nocturnality of the Florida mouse than *P. gossypinus* was correlated with the occupation of more xeric, open habitats (Layne, 1971). Swimming, running, gnawing, and vocalizing behavior were studied in the laboratory (King, 1963; King et al., 1968).

**GENETICS.** *P. floridanus* possesses multiple hemoglobins and a diploid chromosome number of 48 (Foreman, 1968; Hsu and Arrighi, 1968). Greenbaum and Baker (1978) confirmed this number and described 8 pairs of biarmed and 15 pairs of acrocentric autosomes, a large subtelocentric X, and a small metacentric Y chromosome. Average individual heterozygosity of 71 specimens from four localities was 5.33%; the average proportion of polymorphic loci was 21.4% per population (Smith et al., 1973). Mice from these four samples were less variable genetically than comparable samples of peninsular *P. polionotus*. Based on allozymic variation at 19 gene loci, *P. floridanus* was the most divergent ( $S = 0.40$ ) of 20 species of *Peromyscus* (Avisé et al., 1979).

**REMARKS.** Blair and Kilby (1936) preferred the name gopher mouse because of the frequent association with gopher tortoise burrows and to avoid confusion with species of *Peromyscus* in Florida. Other vernacular names include big-eared deer mouse and Florida deer mouse.

In Carleton's (1980) analysis of cranial, dental, and reproductive characters, *P. floridanus* was grouped consistently with *Habromys* and *Neotomodon*. Chromosomal banding data also are consistent with the proposed relationship of *P. floridanus*, *Habromys*, and *Neotomodon*, although their removal from the *Peromyscus-Onychomys* clade and their relation to the subgenus *Peromyscus* have been debated (Carleton, 1989; Rogers et al., 1984; Stangl and Baker, 1984). A cladistic analysis of copulatory behavior among neotomine-peromyscine rodents further supported a close affinity of *Podomys* with *Neotomodon* and *Habromys* (Langtimm and Dewsbury, 1991). Chromosomal, morphological, and parasitological evidence (Carleton, 1980; Hooper, 1958, 1968; Johnson and Layne, 1961; Linzey and Layne, 1969) indicates that *P. floridanus* has strong zoogeographic affinities with middle America and that the ancestral stock reached Florida via a xeric woodland corridor formerly extending around the northern Gulf of Mexico (Johnson and Layne, 1961; Layne, 1969).

*Podomys floridanus* is threatened by widespread habitat destruction. It is listed as a Species of Special Concern by the Florida

Game and Fresh Water Fish Commission (1990), as Threatened by the Florida Committee on Rare and Endangered Plants and Animals, and is under review for listing by the U.S. Fish and Wildlife Service (Layne, 1992).

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