

## A Neotype for *Didelphis marsupialis* Linnaeus, 1758

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### ABSTRACT

*Didelphis marsupialis*, type species of the genus *Didelphis*, is a widely distributed and commonly studied American marsupial. Unfortunately, the previously noncontroversial application of the epithet *marsupialis* Linnaeus, 1758, has recently been called into question, and the lectotype is no longer extant. To preserve long-standing binomial usage for this species and other congeneric taxa, we designate a specimen from Surinam in the Royal Ontario Museum as neotype.

### INTRODUCTION

*Didelphis* Linnaeus, 1758, has the widest distribution of all American marsupial genera, occurring from northern Argentina to southern Canada, and includes six living species (Gardner, 2005). The five Neotropical species are commonly placed in two informally recognized groups that differ in ear coloration (Cerqueira and Lemos, 2000; Lemos and Cerqueira, 2002). The so-called black-eared opossums include *D. marsupialis* (which occurs from southern Mexico to northern Bolivia) and *D. aurita* Wied-Neuwied, 1826 (from eastern Brazil), whereas the so-called white-eared opossums include *D. albiventris* Lund, 1840 (in the tropical and subtropical lowlands of Brazil, Bolivia, Paraguay, Uruguay, and northern Argentina), *D. pernigra* Allen, 1900 (in the Andes), and *D. imperfecta* Mondolfi and Pérez-Hernández, 1984 (in the Guianas and southern Venezuela). The sixth species is *D. virginiana* Kerr, 1792, which can have either all-black or white-tipped ears and occurs from Costa Rica to southern Canada. Diagnostic differences among these species (in addition to ear coloration) include facial markings, length of the furry tail base, relative lengths of the digits of the hind foot, adult cranial and external

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dimensions, qualitative details of craniodental morphology, and molecular sequence characteristics (Gardner, 1973; Mondofi and Pérez-Hernández, 1984; Cerqueira and Lemos, 2000; Patton et al., 2000; Lemos and Cerqueira, 2002; Voss and Jansa, 2009).

*Didelphis marsupialis* is the type species of the genus. Unfortunately, Linnaeus's (1758) original description listed six vernacular names as synonyms and cited 11 sources, among which were accounts of both white-eared opossums (e.g., the carigueya of Marcgraf, 1648) and black-eared animals (e.g., the thlaquatzien of Hernández, 1651) as well as the Virginia opossum of Tyson (1704). Therefore, Linnaeus's concept of *D. marsupialis* was composite, based on specimens of several phenotypically distinct forms from two continents, a problem widely recognized and discussed (inter alia) by Alston (1880), Allen (1897, 1900, 1901, 1902), Rehn (1900, 1901), and Gardner (1973). Because Linnaeus did not specify a unique name-bearing type, all the specimens described by the authors he cited had equal status as syntypes for over 150 years, an interval in which the name *marsupialis* was more or less arbitrarily applied by authors (Gardner, 1973).

To resolve the ambiguous application of *Didelphis marsupialis*, Thomas (1911) designated the animal illustrated by Seba (1734: plate 39)<sup>3</sup> as lectotype. Seba's specimen, an obviously parous adult female (fig. 1), was one of those originally cited by Linnaeus (1758), and Thomas's (1911: 143) statement that it "should be taken as the basis of the name" is formally equivalent to type selection (ICZN, 1999: Article 74.5). Seba thought that his specimen came from "Amboina" (Ambon Island, in Indonesia), but this was an obvious lapsus. As noted by Thomas (1901), most of Seba's South American animals came from "Guiana" (i.e., somewhere along the northeast coast between the Orinoco and Amazon rivers), and although there is no certainty that Seba's specimen actually came from South America, Thomas (1911) suggested that the type locality of *D. marsupialis* was Surinam.

Seba's collection was broken up and sold at auction in 1752 (Engel, 1961; Boeseman, 1970). Although some of his mammals are known to have survived to the present day, the lectotype of *Didelphis marsupialis* is not among them (see below). Dias et al. (2018) assumed that a specimen in the Museum of Evolution of Uppsala University (fig. 2) is the one illustrated by Seba (1734), but the Uppsala specimen was part of a collection donated to the university's museum by Crown Prince Adolf Frederik in 1745 (Thunberg, 1787; Gentry, 2008), so it cannot have been part of Seba's collection. Additionally, the Uppsala specimen—which the first author has examined—is a juvenile (based on its small size), whereas Seba's was an adult. However, because this specimen is among those known to have been examined by Linnaeus (Linnaeus, 1749), it can be regarded as a paralectotype.

In the absence of an existing lectotype, the application of the name *Didelphis marsupialis* since 1911 has, in effect, been based on Thomas's suggested type locality of Surinam, where only the black-eared species was long assumed to occur (Husson, 1978; but see below). To the best of our knowledge, usage of *D. marsupialis* from 1912 until 2015—including almost 8400 publications indexed by Google Scholar (<https://scholar.google.com/>, accessed in January

<sup>3</sup> Albert Seba (1665–1736) was a wealthy Dutch apothecary who amassed a large collection of animals and plants at his house in Amsterdam, which Linnaeus visited in 1735 (Engel, 1937). Seba (1734) is the first volume of a lavishly illustrated catalog of this historically important collection.

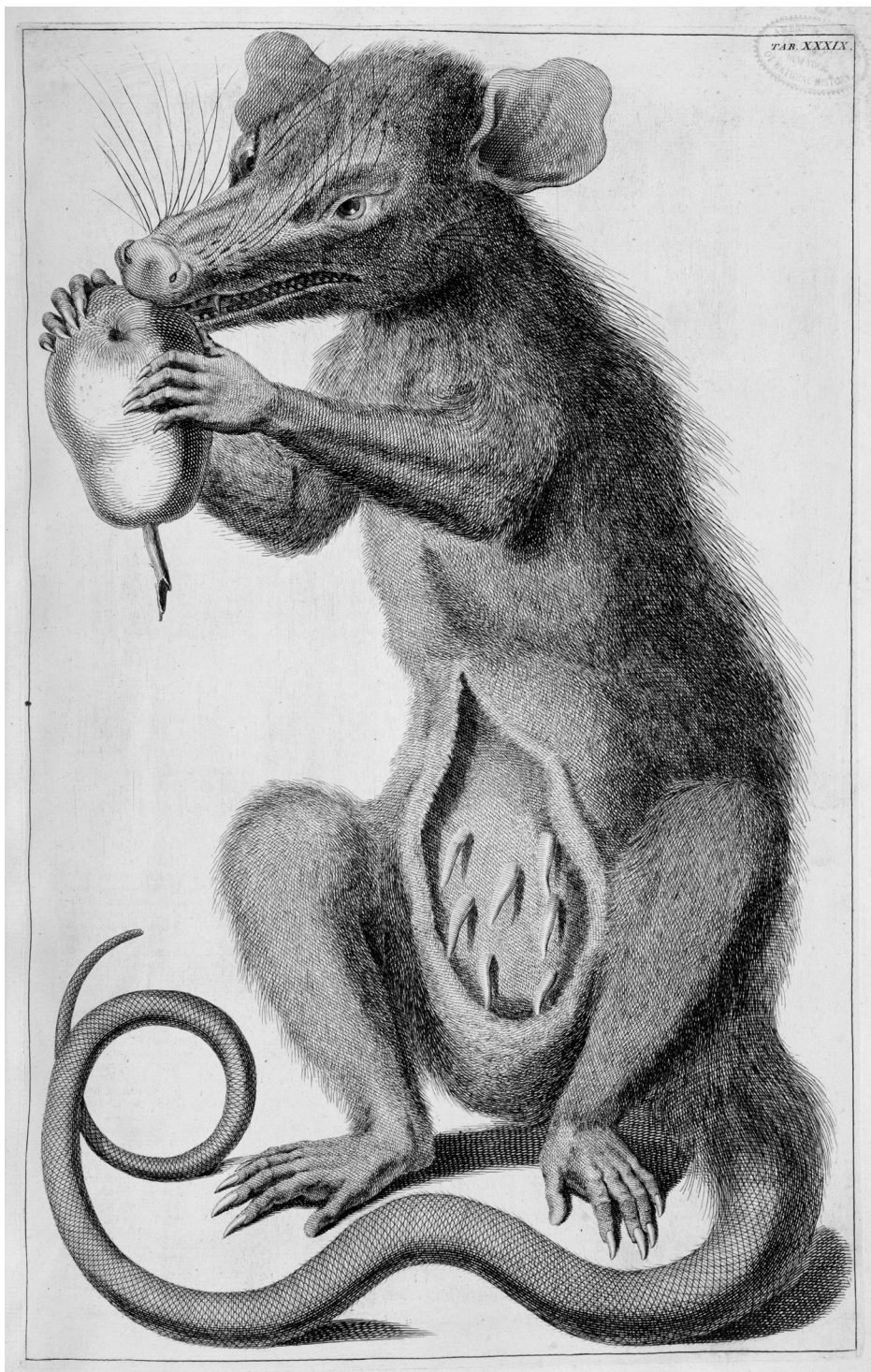


FIGURE 1. The lectotype of *Didelphis marsupialis*, reproduced from an uncolored copy of Seba (1734: pl. 39) in the library of the American Museum of Natural History.





FIGURE 2. Lateral and dorsal view of the paralectotype of *Didelphis marsupialis* in the Museum of Evolution of Uppsala University (UPSZTY 23). The handwritten label on the left was penned by C.P. Thunberg, Linnaeus's pupil and successor as curator of the Uppsala collection.

2019)—was consistent with its basis in the black-eared opossum from Surinam, although other taxa now recognized as valid species (*D. virginiana* and *D. aurita*) were sometimes treated as synonyms or subspecies. Current usage of the name, including a comprehensive synonymy, is summarized by Cerqueira and Tribe (2008), who also cite key references to the literature on this ecologically and epidemiologically important animal.

Despite such long-established and consistent usage, Gurgel-Filho et al. (2015) emphasized Linnaeus's (1758: 54) description of *Didelphis marsupialis* as having white-tipped ears ("Auriculae rotundatae, atrae apicibus albis") and remarked that Seba's (1734) plate 39 also shows an animal with white-tipped ears.<sup>4</sup> As a consequence, they proposed using *D. marsupialis* for the white-eared species currently known as *D. albiventris*, and they suggested that the long-disused epithet *karkinophaga* Zimmermann, 1780, be used for the black-eared species currently known as *D. marsupialis*. Besides disrupting prevailing binomial usage, the nomenclatural changes proposed by Gurgel-Filho et al. (2015) are problematic because they are based exclusively on ear coloration, a character that is known to vary within several species of *Didelphis*, including the Virginia opossum (Gardner, 1973; Cerqueira and Tribe, 2008; Dias et al., 2018).

Thus, the long-undisputed application of *Didelphis marsupialis* is currently in question, and Seba's illustration of the lost lectotype is inadequate to resolve the issue. "Restrictions" of the type locality are sometimes used to justify the application of names, but they have no formal role in constraining binomial usage. By definition, the type locality is simply the place where the name-bearing type was collected (ICZN, 1999: Article 76.1), and the geographic origin of Seba's specimen is unknown even as to continent. The only definitive solution, which is now urgently needed to conserve prevailing usage of at least four names, is to designate a neotype for *D. marsupialis*.

Paralectotypes do not have privileged status as candidate name-bearers (ICZN, 1999: Article 75.1), and the Uppsala specimen is unsuitable for this purpose given its faded pelage, immature morphology, and absence of associated locality data. Furthermore, because of its antiquity (>270 years old), it is an unlikely source of high-quality DNA, an increasingly important basis for taxonomic inference. Lastly, it is quite possible that the paralectotype is not, in fact, an example of *Didelphis marsupialis* as that species is currently recognized, and so would not serve the purpose of conserving prevailing usage. Therefore, we designate a more suitable neotype below.

#### *Didelphis marsupialis* Linnaeus, 1758

NEOTYPE: An adult female specimen in the Royal Ontario Museum (ROM 113908, original number F40983; fig. 3), consisting of a skin, skull, postcranial skeleton, pouch young preserved in alcohol, and frozen tissues. A large (657 bp) fragment of the mitochondrial gene encoding cytochrome oxidase 1 (COI) was amplified and sequenced from this specimen by ROM researchers and has been deposited in GenBank with accession number MG828824.

TYPE LOCALITY: The neotype was collected at the Brownsberg Nature Park headquarters (4°57' N, 55°11' W, 500 m above sea level), Brokopondo District, Surinam, on 11 April 2002

<sup>4</sup> This is not quite accurate because Seba's (1734) "Thesaurus" was sold in both colored and uncolored versions (Engel, 1937), and the uncolored plates are not informative about ear pigmentation. It is not known whether the colorists who tinted the plates had access to the specimens from which the original drawings were actually made. In fact, it is to be doubted that the opossum in the colored version of plate 39 (reproduced by Dias et al., 2018: fig. 1) was rendered accurately, because its fur is brownish, whereas species of *Didelphis* have grayish or blackish fur. Additionally, the colorized plate does not show the prominent black-and-white caudal marking that is exhibited by all species in the genus (Voss and Jansa, 2009).

by a field crew that included M.D. Engstrom, B.K. Lim, S.L. Peters, F.M. Catzefflis, and M. Djosetro. Local habitats and the mammalian fauna of the Brownsberg Nature Park were described by Lim et al. (2005), who listed eight other specimens of *Didelphis marsupialis* collected in the park, all of which can be considered topotypes.

REMARKS: The neotype skin agrees in all essential morphological details with Husson's (1978) detailed external description of *Didelphis marsupialis*. Salient features include its entirely blackish ears, indistinct facial markings, and a bicolored tail that is furred only near the base (for approximately one-fifth of its length).<sup>5</sup> External measurements (taken in the field) include total length (888 mm), tail length (463 mm), hind foot (including claws, 68 mm), and ear length (from notch, 57 mm); the specimen weighed 1250 grams.

Craniodental traits of the neotype conform to the generic description provided by Voss and Jansa (2009: 116–118). Selected craniodental measurements (taken as described and illustrated by Voss et al., 2018) include condylobasal length (98.1 mm), nasal length (47.0 mm), nasal breadth (12.4 mm), least interorbital breadth (17.0 mm), least postorbital breadth (11.9 mm), zygomatic breadth (47.2 mm), palatal length (59.3 mm), palatal breadth (30.1 mm), maxillary toothrow length (41.7 mm), length of M1–M4 (20.1 mm), length of M1–M3 (16.5 mm), and width of M3 (6.0 mm).

The neotype of *Didelphis marsupialis* is strikingly unlike specimens of *D. imperfecta* (also known to occur in the Brownsberg Nature Park; Lim et al., 2005), which are substantially smaller in both external and craniodental dimensions and have white-tipped ears, more sharply defined facial markings, and longer-furred tail bases (Mondolfi and Pérez-Hernández, 1984).

DUE DILIGENCE: The Code requires that we state why we think that the previous name-bearing specimen of *Didelphis marsupialis* is lost or destroyed (ICZN 1999: Article 75.3.4). Unfortunately, tracking down every possible location where the lectotype might be is a daunting task, because Seba's material was widely dispersed in the centuries following the 1752 auction of his collection. According to Boeseman (1970), who carefully reviewed all of the existing documents pertaining to this event and to subsequent transfers of ownership, Seba's zoological specimens are known to have been acquired by at least 11 European museums, of which one (in Groningen) was destroyed by fire, which only slightly simplifies matters. The remaining 10 museums are those in Amsterdam, Berlin, Bremen, Copenhagen, Leiden, London, Paris, Stockholm, Utrecht, and St. Petersburg.

Because the importance of Seba specimens as potential Linnaean types has long been known to taxonomists, and because all the major museums in these cities are (or were) centers of active zoological research, it seems unlikely that any 18th-century specimen convincingly identifiable as the opossum illustrated by Seba would have remained undetected to the present day; nor, having been identified as such, is it likely that its significance as lectotype would have been overlooked by the European research community. Unfortunately, Seba's mammals were not distinctively labelled, and their identity can only be inferred from original containers (e.g., antique glass jars hermetically sealed with red wax) and particular resemblances to the individuals depicted in Seba's plates (Thomas, 1892). In the absence of such indications (the origi-

<sup>5</sup> The furry tail base (90 mm) was measured in the field by F. Catzefflis (personal commun.).





FIGURE 3. Neotype of *Didelphis marsupialis* (ROM 113908).

nal containers having been discarded, for example, or fluid-preserved specimens having been dissected), it seems unlikely that any material can now be confidently identified as Seba's. Therefore, we assume that the lectotype of *Didelphis marsupialis*, if it does not appear in lists of type material at museums where it might reasonably be expected to have survived on documentary evidence, is either lost or unidentifiable. Of the 10 museums mentioned above, the likeliest to have Seba's mammals based on Thomas's (1892), Engel's (1961), and Boeseman's (1970) narratives are those in London, Leiden, Paris, and St. Petersburg.

The largest single trove of Seba's mammals is preserved in the Natural History Museum in London—formerly the British Museum (Natural History)—which acquired it by purchase in 1867. Thomas (1892) explained the details by which he identified 26 fluid-preserved (“spirit”) specimens that closely correspond to illustrations in Seba (1734). Although these included several opossums (e.g., BMNH 67.4.12.542 [lectotype of *Marmosa murina*] and BMNH 67.4.12.540 [holotype of *Monodelphis brevicaudata*]; Voss et al., 2001), there were no specimens of *Didelphis marsupialis* among them, nor has subsequent curatorial activity at the Natural History Museum turned up any specimen that can now be positively identified as the lectotype (Jenkins and Knutson, 1983).

The Naturalis Biodiversity Center in Leiden includes the collections formerly held by the Rijksmuseum van Natuurlijke Historie (RMNH) and the Zoological Museum Amsterdam (ZMA). Both museums were major recipients of Seba material through multiple purchases and donations (Boeseman, 1970). Although Naturalis currently preserves one of Seba's opossums (RMNH 25421 [lectotype of *Philander opossum*]; Voss et al., 2001), it does not have any type material of *Didelphis* according to collection manager Steven van der Mije (personal commun.), who is currently supervising the publication of a type catalog compiled by Chris Smeenk, the late RMNH mammal curator.

After the 1752 auction a significant part of Seba's collection passed into the zoological cabinet of the Stadholder William V at the Hague, but much of this material was carted off as war booty by French revolutionary troops, who overran Holland in 1795 (Thomas, 1892; Holthuis, 1969; Boeseman, 1970). In Paris, the stolen specimens were integrated into the collections of the Muséum National d'Histoire Naturelle (MNHN), with the result that, decades later, most of them were no longer recognizable as having belonged to the Stadholder; in particular, some mounted specimens had deteriorated and numerous fluid-preserved specimens had been dissected (Pieters, 1980). Although some specimens were subsequently returned to Holland by way of restitution, others are known to have remained in Paris (Holthuis, 1969; Boeseman, 1970). We do not know whether or not any of Seba's mammals still exist in the Muséum National d'Histoire Naturelle, but none of the MNHN specimens mentioned by Geoffroy St.-Hilaire (1803)—whose catalog notably included specimens plundered by French troops from museums in other occupied countries—are certainly identifiable as the lectotype of *Didelphis marsupialis*, nor was any nomenclaturally relevant material of *Didelphis* listed by Beaufort (1966) or Julien-Laferrrière (1994) in their lists of Paris museum marsupial types.

A substantial number of Seba's zoological specimens are thought to have been purchased at the 1752 auction by agents acting for the Russian czar, and at least some of these presumably



ended up at the Zoological Institute of the Russian Academy of Sciences (Boeseman, 1970). However, a catalog of the Zoological Institute's mammalian types (Abramov et al., 1992) included no didelphid material.

We have made reasonable bibliographic and online efforts to find the lectotype of *Didelphis marsupialis* in other European collections, but without success. Although we cannot altogether discount the possibility that it still exists in some obscure museum attic or cellar, Boeseman's (1970) account suggests that much of Seba's material has been lost, destroyed, or rendered unrecognizable over the years. Our unsuccessful efforts to find the lectotype lead us to believe that it has suffered one or another of these melancholy fates.

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