

Diclidurus albus. By Gerardo Ceballos and Rodrigo A. Medellín

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***Diclidurus* Wied, 1820**

Diclidurus Wied, 1820:1629. Type species *Diclidurus albus*, Wied, 1820:1619.

Depanycteris Thomas, 1920:271. Type species *Depanycteris isabella* Thomas, 1920:271.

CONTEXT AND CONTENT. Order Chiroptera, Suborder Microchiroptera, Family Emballonuridae, Subfamily Diclidurinae (including two genera, *Cyttarops* and *Diclidurus*). *Diclidurus* contains two subgenera and four species; *D. albus* (Wied, 1820), *D. scutatus* (Peters, 1869), *D. ingens* (Hernández-Camacho, 1955; subgenus *Diclidurus*), and *D. isabellus* (Thomas, 1903; subgenus *Depanycteris*). The following key is modified from Jones and Hood (in press):

- 1 Color pale brownish, thumb easily distinguishable with a well-developed claw, posterior border of the palate evenly concave and reaching level of anterior cusps of M3 *D. isabellus*
Color generally whitish to grayish white, thumb vestigial, claw nearly absent, posterior border of palate terminating behind M3 and with a medial cleft which in *D. scutatus* is confluent with a large palatine foramina 2
- 2 (1) Length of forearm more than 70 mm, greatest length of skull 20 mm or more *D. ingens*
Length of forearm less than 70 mm, greatest length of skull less than 20 mm 3
- 3 (2) Forearm less than 60 mm, length of maxillary tooththrow less than 7 mm *D. scutatus*
Forearm more than 60 mm, length of maxillary tooththrow more than 7 mm *D. albus*

***Diclidurus albus* Wied, 1820**

Northern Ghost Bat

Diclidurus albus Wied, 1820:1629. Type locality "[Canavieiras], Rio Pardo, [Bahia State], Brazil" (see de Avila-Pires, 1965:5).

Diclidurus freyreisii Wied, 1821:76. Type locality "[Canavieiras], Rio Pardo, [Bahia State], Brazil" (based in the same specimen as *D. albus*; Carter and Dolan, 1978).

Diclidurus virgo Thomas, 1903:377. Type locality "Escazu, [1090 m, San José Province], Costa Rica."

CONTEXT AND CONTENT. Context as for the genus. Some authors (Ojasti and Linares, 1971) regard *D. virgo* as specifically distinct from *D. albus*. Two subspecies are currently recognized (Goodwin, 1969):

- D. a. albus* Wied, 1820:1629, see above.
- D. a. virgo* Thomas, 1903:377, see above.

DIAGNOSIS. *Diclidurus* (Fig. 1) is characterized by the pure white to pale gray pelage (Hall, 1981); in some individuals the basal half of the hairs are dark gray (Ojasti and Linares, 1971; Villa-R., 1967). Unlike other members of the family Emballonuridae, *Diclidurus* has no wing-sacs; instead, it has a large glandular structure in the center of the uropatagium (Fig. 2). This structure has two main lobes that converge at the distal extreme and from there diverge, forming with the uropatagium a sac with a proximal opening. It is larger and better developed in males, and sometimes is enclosed by a horny capsule (Goodwin and Greenhall, 1961; Villa-R., 1967). The skulls of all the members of the genus are strikingly different from those of other bats, but resemble the skull of *Cyttarops* (Miller, 1907; Starrett, 1972). The rostrum bears angular-lateral projections forming two of the salient angles of a deep semihexagonal depression

that compresses the nasal bones and turbinals toward the palate (Fig. 3).

Diclidurus albus is medium-sized for the genus, and can be distinguished from *D. isabellus* by its white to grayish color, the vestigial thumb with a nearly absent claw, and the posterior border of the palate not deeply emarginated. *D. scutatus* is clearly smaller (forearm <60 mm) and *D. ingens* is larger (forearm >70 mm) than *D. albus*.

GENERAL CHARACTERS. Based on the color standards of Ridgway (1912) the color of the dorsal hairs of *D. albus* is usually neutral gray in their basal third, and white otherwise. In some individuals, the distal half is pale buffy brown (Villa-R. and Ramírez-P., 1968), white in others. Ventral fur is white with neutral gray at base. Membranes are unpigmented, but because of numerous blood vessels appear pinkish (Ceballos and Miranda, 1987). The eyes are large, bright, and face is almost naked. The ears are short and yellowish, and tragus is broad and rounded distally (Thomas, 1903; Villa-R., 1967). The glandular structure in the uropatagium is well-developed. It appears triangular in museum study skins. The uropatagium is large and furred to a line between the midpoint of tibiae; calcar is long. Tail is short, reaching about a third of the length of the uropatagium; its distal end protrudes upward through the uropatagium. Propatagium shows little hair through the length of humerus up to the elbow, and the underside of wing bears a line of hair along the posterior edge of humerus and forearm, sometimes extending to the base of the membrane between the fourth and fifth digits. The thumb is minute and almost completely enclosed in a narrow membrane, an elongation of the propatagium. Legs and feet



FIG. 1. *Diclidurus albus* roosting in a palm in Jalisco, Mexico (Photograph by G. Ceballos.)

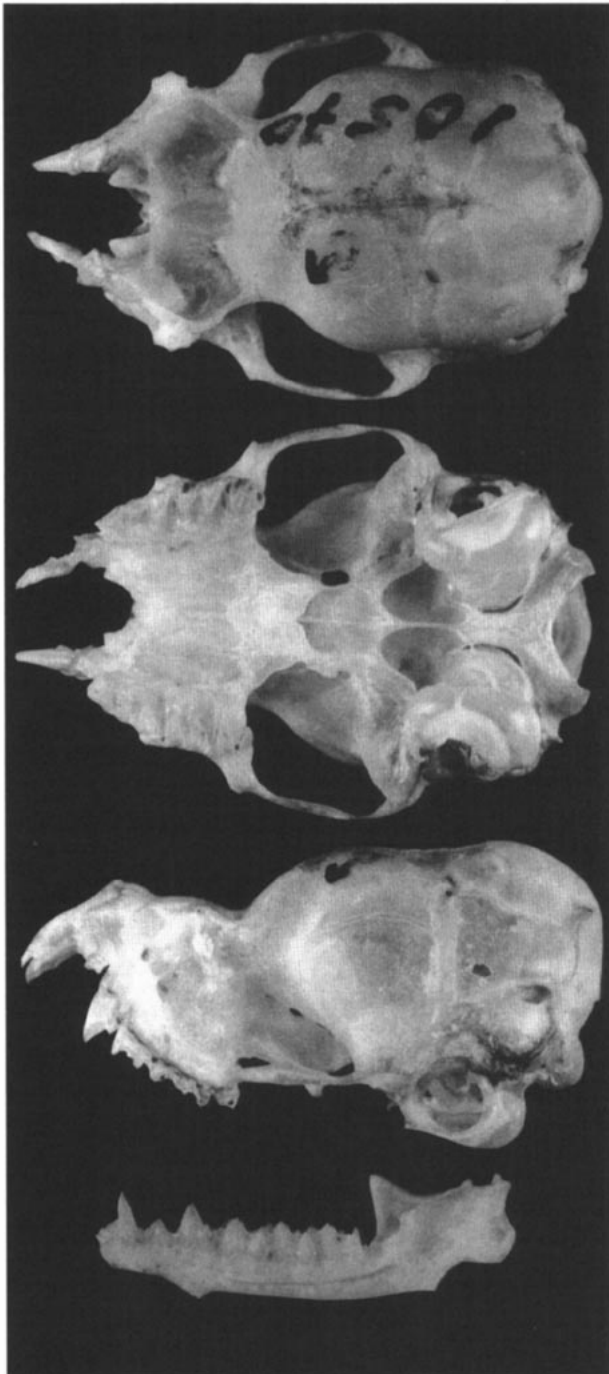


FIG. 3. Skull of *Diclidurus albus*; A) dorsal view, B) ventral view, C) lateral view, and D) lateral view of mandible. Greatest length of skull is 18.5 mm. (Photograph by A. I. Bieler.)

are slender (Ojasti and Linares, 1971; Thomas, 1903; Villa-R. and Ramirez-P., 1968).

The skull of *D. albus* (Fig. 3) has a well-inflated braincase, with the occiput projected posteriorly (Hall, 1981). Zygoma are complete and relatively strong and the auditory bullae are large. The maxillary toothrow is strongly recurved upward, resulting in a diagonal orientation of the canines. Cheek teeth are large, with well-developed W-shaped ectoloph and broad cingula (Miller, 1907; Thomas, 1903). The dental formula is $i\ 1/3, c\ 1/1, p\ 2/2, m\ 3/3$, total 32 (Miller, 1907).

External and cranial measurements (in mm) provided by Jones (1966), Ojasti and Linares (1971), Starrett and Casebeer (1968), and Villa-R. and Ramirez-P. (1968) are as follows: total length, 86.0 to 103.0; length of tail, 18.0 to 22.0; length of hind foot, 10.0 to 12.0; length of forearm, 63.0 to 69.2; greatest length of skull, 17.0

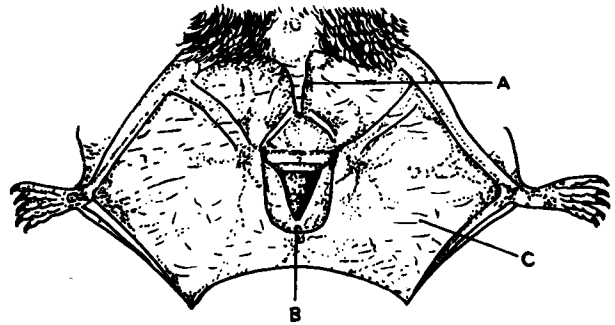


FIG. 2. Uropatagial gland of *Diclidurus albus*; A) tail, B) two-valved chambered gland, and C) uropatagium. Length of hind foot is 12 mm (modified from Villa-R., 1967).

to 19.6; condylobasal length, 16.2 to 19.0; zygomatic breadth, 11.9 to 12.7; least breadth of postorbital constriction, 5.5 to 5.9; braincase breadth, 8.9 to 9.9; length of maxillary toothrow, 7.3 to 8.7; mastoid breadth, 9.8 to 10.2; palatal breadth, 2.4 to 2.7; length of rostrum, 12.2 to 12.7; breadth across canines, 5.6 to 6.2; breadth across third upper molars, 8.0 to 9.0. Adult northern ghost bats weigh from 17 to 24 g (Ceballos and Miranda, 1987). A record of 32.8 (a male) from Veracruz, Mexico (Coates-Estrada and Estrada, 1985) is erroneous (R. C. Vogt, pers. comm.). An analysis of mensural characters, both cranial and external, of five Guatemalan specimens (Jones, 1966) showed that females (three) were larger than males (two) in the following dimensions (mean in mm; females, males): total length (102.3, 92.5), length of forearm (67.7, 63.4), mastoid breadth (10.1, 9.9), and greatest length of skull (19.2, 19.1). Measurements for eight specimens from Mexico (mean in mm; females, males), showed that females (four) were larger in some measurements, for example, zygomatic breadth (12.4, 12.3) and maxillary toothrow (7.8, 7.7), but males were larger in other dimensions, for example, total length (88.0, 89.0) and length of tail (19.0, 21.7; Sánchez, 1978). Examination of larger series of specimens is needed to determine the kind and extent of sexual dimorphism.

DISTRIBUTION. The recent distribution of *D. albus* (Fig. 4) is confined to the Neotropics, and extends from tropical mainland regions from Mexico to South America (Hall, 1981; Koopman, 1982). The northernmost locality for *D. albus* in western Mexico is Playa Novillero, 24 km W Tecuala, Nayarit (Villa-R. and Ramirez-P., 1968). From there it is found along the lowlands of all the states along the Pacific coast (Alvarez del Toro, 1977; Ceballos and Miranda, 1987; Garrido, 1982; Goodwin, 1969; Sánchez, 1978; Sánchez et al., 1985; Villa-R., 1967). In eastern Mexico it is known only from Veracruz (Villa-R., 1967). In Central and South America it has been recorded from Guatemala (Miller, 1907), Belize (Mc-

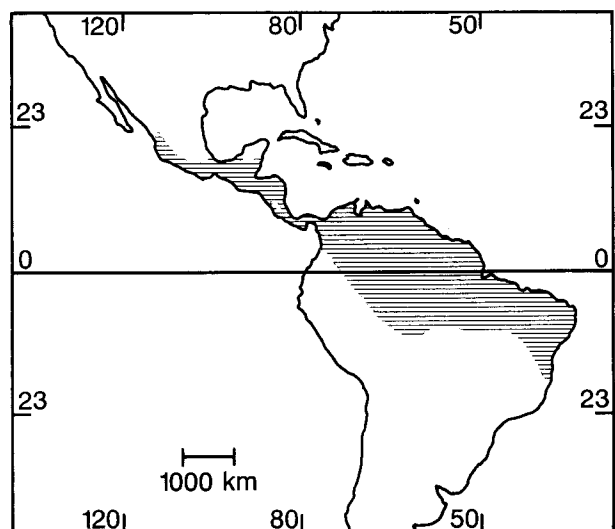


FIG. 4. Distribution of *Diclidurus albus* (modified from Hall, 1981, and Koopman, 1982).

Carthy, 1987), Honduras (Goodwin, 1942), Costa Rica (Thomas, 1903), Nicaragua (Ojasti and Linares, 1971), Panama (Handley, 1966; Goldman, 1920), Venezuela, Surinam (Ojasti and Linares, 1971), Colombia (Nicolfo, 1955), Brazil (Cuhna-Vieira, 1942; Wied, 1820), Ecuador (Albuja, 1983) and Trinidad and Tobago (Goodwin and Greenhall, 1961). Altitudinally, it has been recorded from sea level to 800 m in Guatemala (Jones, 1966) and to 1,500 m in Costa Rica (Starrett and Casebeer, 1968).

No fossils are known for the genus *Diclidurus*.

FORM AND FUNCTION. The clavicle of *Diclidurus* bears an anterior process from which a thin sheet of bone extends, increasing the area of origin of the pectoralis muscle and the insertion area of the subclavius muscle, but its functional significance remains unknown (Vaughan, 1970). The scapula is long and slender, with little or no secondary process. The forearm is strongly curved, with the ulna about one fourth the length of radius, and is dorsoventrally flattened and swollen near the elbow. *Diclidurus* has a more or less circular naked area in the forehead hidden in the fur, above the eyes (R. H. Pine, pers. comm.). The bare area is located within the angular depression on the rostrum of the skull. The glandular structure in the uropatagium is larger in males, and it becomes even larger during the breeding season. Its function is unknown, but presumably plays a similar role to that of the wing-sacs of some other emballonurids. Emballonurid wing-sacs enlarge during the breeding season, especially in males, and apparently they function in the attraction of females (Bradbury and Vehrencamp, 1977).

The penis of *D. albus* lacks a baculum, but it has four cartilaginous bodies. It is about 5.5 mm long and 3.1 mm in diameter. The gland penis is hairless, white to cream in color (in some specimens it is pigmented), and about 0.7 mm long and 0.65 mm in diameter. The prepuce is covered by a layer of fine short hair, with scattered longer, thicker hairs. The testes are spindle-shaped, symmetrical, and covered by a black tunica (Villegas, 1983). The ovaries are ovoid, 2.8 mm long and 0.8 mm in diameter. The vaginal aperture is 1.7 mm long, covered by a thick skin fold (Villegas, 1983).

ONTOGENY AND REPRODUCTION. The breeding season of the northern ghost bat apparently extends from January to June (Ceballos and Miranda, 1987). Copulation probably occurs in January and February, when males and females roost close together (Sánchez and Chávez, 1985). Pregnant females have been collected from January to June (Sánchez and Chávez, 1980; Sánchez et al., 1985); females with well-developed embryos (18 to 19 mm) have been collected in May (Villa-R. and Ramírez-P., 1968). Only one embryo has been found per female. Non-pregnant females have been collected in December and February (Jones, 1966; Sánchez and Chávez, 1985). This suggests a monoestry strategy.

No data are available on growth and development.

ECOLOGY AND BEHAVIOR. Little is known about the ecology of *D. albus*. It is a solitary species most of the year; however, early in the breeding season (January and February) up to four individuals, usually a male and several females, may be found roosting within 5 to 10 cm of each other (Ceballos and Miranda, 1987; Sánchez and Chávez, 1985).

Northern ghost bats have been collected in tropical rain forests, in tropical-dry deciduous and semideciduous forests, in coconut plantations, and in disturbed vegetation, predominantly in humid habitats (Ceballos and Miranda, 1987; Goodwin, 1946; Jones, 1966; Villa-R., 1967). They are found in natural and disturbed habitats where there are species of palms that are used as day roosts. Day roosts are under the leaves of the palms. On the Pacific coast of Mexico they have been found associated with coconut (*Cocos nucifera*) and native coquito palms (*Orbignya cohune*; Ceballos and Miranda, 1987; Sánchez and Chávez, 1985). In eastern Mexico, they have been collected from roosts in chocho palms (*Astrocaryum mexicanum*; Coates-Estrada and Estrada, 1985). In Central and South America (including Trinidad Island) they roost in coconut palms (Goodwin and Greenhall, 1961; Starrett and Casebeer, 1968). The holotype was shot from a palm tree (de Avila-Pires, 1965). When roosting in a palm, an individual usually occupies a segment of the leaf close to the rachis (Sánchez and Chávez, 1980). Roosting sites in Jalisco ranged from 2 to 25 m high. A northern ghost bat hanging from a palm leaf is inconspicuous, and sometimes resembles the nest of paper wasps (*Polybia* sp.). Of 23 specimens from Venezuela shot in flight, 87% were obtained near banks and other humid habitats,

and the remaining 13%, in drier habitats, including towns and villages (Handley, 1976).

Other species of bats collected with *D. albus* either in the same roosting sites or foraging areas are *Saccopteryx bilineata*, *Pteronotus gymnotus*, *P. parnellii*, *Artibeus phaeotis*, and *A. jamaicensis* (Ceballos and Miranda, 1987; Starrett and Casebeer, 1968).

Northern ghost bats are insectivorous. The stomachs of eight specimens from Jalisco contained moth remains (Lepidoptera; Sánchez and Chávez, 1985). When feeding they fly high above the ground, thus being difficult to catch in mist nets. They fly "relatively high and apparently in straight course, . . . uttering a unique musical twittering not heard in any other Costa Rican bat" (Starrett and Casebeer, 1968:6). In Guatemala, some specimens were collected from a group that was foraging at heights of 3 to 135 m (Jones, 1966), and in Mexico a northern ghost bat was collected while chasing insects close to a street light (Villa-R., 1950). In Jalisco, *D. albus* is only present from late October to May. There are no records from other months, suggesting local or migratory movements (Ceballos and Miranda, 1987; Sánchez and Chávez, 1985).

GENETICS. The northern ghost bat has a diploid chromosome number of 32, and a fundamental number of 60. The X chromosome is metacentric and the Y is acrocentric (Hood and Baker, 1986). The G- and C-banded karyotypes of *D. albus* showed that *Diclidurus* share little chromosomal homology with other emballonurid species, and that C-positive material is restricted to the centromeric regions (Hood and Baker, 1986). An explanation for the extensive chromosomal divergence in the family Emballonuridae is that the extant genera are ancient (Hood and Baker, 1986). The electrophoretic analysis of blood proteins of *D. albus* showed that only one of 22 loci was polymorphic (Robbins and Sarich, 1988). Data on electrophoresis of blood proteins (transferrins and albumins) suggested that *Diclidurus* is closely related to other New World emballonurids like *Balantiopteryx* and *Rhynchonycteris* (Robbins and Sarich, 1988).

REMARKS. On the basis of immunological and morphological characteristics, the Family Emballonuridae recently has been separated in two subfamilies, Emballonurinae and Taphozoinae (Robbins and Sarich, 1988). According to this classification *Diclidurus* and *Cyrtarops* belong to the subfamily Emballonurinae. *Depanycteris* (Thomas, 1920) is regarded as a subgenus of *Diclidurus* (Koopman, 1982). Specimens *D. a. virgo* from Oaxaca, Mexico, compared by Goodwin (1969) did not differ from South American ghost bats; therefore, he concluded that *D. virgo* and *D. albus* were conspecific, and that the names applied to the southern and northern populations represented, at most, different subspecies. Later, Ojasti and Linares (1971) pointed out that South American specimens used by Goodwin were *D. virgo*, so should not appreciably differ from those of Mexico. However, Handley (1976) and Koopman (1982) have followed Goodwin (1969) in regarding *D. virgo* as a synonym of *D. albus*.

Diclidurus is from the Latin *diclid* meaning two-valved or double door and *urus* meaning tail in reference to the two-chambered, sac-like gland in the uropatagium. The word *albus* is Latin for white, and it refers to the white color of the pelage. In Spanish, species of *Diclidurus* are known as "murciélagos blancos" or "murciélagos fantasmas" (Ceballos and Miranda, 1987; Villa-R., 1967).

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