

Bassaricyon gabbii (Carnivora: Procyonidae)

SUZANNE PRANGE AND TIMOTHY J. PRANGE

Ohio Department of Natural Resources, Division of Wildlife, 360 East State Street, Athens, OH 45701, USA; Suzie.Prange@dnr.state.oh.us

Abstract: *Bassaricyon gabbii* Allen, 1876, is a procyonid called the olingo or bushy-tailed olingo. This species is brown to grayish brown, colored lighter ventrally; is semiarboreal with a long, nonprehensile tail; and is 1 of 5 species in the genus *Bassaricyon*. It occurs in Central America from Nicaragua through Panama, and in South America has been documented in Colombia, Ecuador, Peru, and Venezuela. It prefers multistrata tropical evergreen forests below 1,600–2,000 m. The International Union for Conservation of Nature and Natural Resources classifies *B. gabbii* as Lower Risk/Near Threatened, and it is included in Appendix III of the Convention on International Trade in Endangered Species of Wild Flora and Fauna. DOI: 10.1644/826.1.

Key words: bushy-tailed olingo, frugivore, habitat destruction, olingo, tropical forests

Published 26 February 2009 by the American Society of Mammalogists
Synonymies completed 20 June 2007

www.mammalogy.org



Bassaricyon Allen, 1876

Bassaricyon Allen, 1876:20. Type species *Bassaricyon gabbii* Allen, 1876, by original designation.

CONTEXT AND CONTENT. Order Carnivora, suborder Caniformia, family Procyonidae, subfamily Potosinae. A key to the 5 species (Wozencraft 2005), based on original species descriptions (Enders 1936; Harris 1932; Pocock 1921a; Thomas 1880), follows:

1. Sagittal crest absent 2
Sagittal crest present 4
2. Frontal region elevated and convex *B. gabbii*
Frontal region flattened from crown to nasals 3
3. Bullae more inflated anteriorly; lowest points on bullae are almost immediately below the auditory meatus when viewed in profile *B. beddardi*
Bullae less inflated anteriorly; lowest points on bullae are below the mastoid when viewed in profile
..... *B. alleni*
4. Upper parts grizzled blackish gray; tail edged with hairs of a silvery sheen; ears gray, edged with white *B. lasius*
Upper parts gray-fulvous; tail not edged with hairs of a silvery sheen; ears brown, edged with white *B. pauli*

Bassaricyon gabbii Allen, 1876 Olingo

Bassaricyon gabbii Allen, 1876:21. Type locality “Costa Rica” restricted by Allen (1908) to “Talamanca.”



Fig. 1.—Adult *Bassaricyon gabbii* at Fogden’s Hummingbird Gallery Monteverde, Costa Rica. Used with permission of the photographer J. Cohen.

Bassaricyon gabbi Thomas, 1880:397. Incorrect subsequent spelling of *Bassaricyon gabbii* Allen, 1876.

Bassaricyon richardsoni Allen, 1908:662. Type locality “Rio Grande (altitude below 1000 feet [305 m]), Atlantic slope, Nicaragua.”

Bassaricyon medius Thomas, 1909:232. Type locality “Jimenez, mountains inland of Chocó, W. Colombia. Alt. 2400' [732 m].”

Bassaricyon gabbi orinomus Goldman, 1912:16. Type locality “Cana (altitude 1,800 feet [549 m]), in the mountains of eastern Panama.” Incorrect subsequent spelling of *Bassaricyon gabbii* Allen, 1876.

Bassaricyon medius siccatus Thomas, 1927:80. Type locality “Guaicaramo, on the Llanos of Villavicencio, east of Bogota. Alt. about 1800' [549 m].”

CONTEXT AND CONTENT. Context as for genus. Wilson and Reeder (2005), recognize 3 subspecies of *Bassaricyon gabbii*:

B. g. gabbii Allen, 1876:21. See above.

B. g. medius Thomas, 1909:232. See above.

B. g. richardsoni Allen, 1908:662. See above.

DIAGNOSIS

The frontal region of the skull of *Bassaricyon gabbii* is convex, whereas in *B. beddardi* and *B. alleni* the skull is flattened from the crown to the nasals (Pocock 1921a; Thomas 1880). Viewed from the side, the upper edge of the middle of the zygoma is nearly horizontal in *B. gabbii* but is convex in *B. alleni*; viewed from above, the zygomata are nearly parallel in *B. gabbii*, whereas they diverge slightly posteriorly in *B. alleni* (Thomas 1880). Original differentiation between *B. gabbii* and *B. alleni* also was based on molar characteristics and differences in the shape of the mandibular coronoid process; however, these were subsequently shown to be poor characters (Thomas 1909).

The profile of the braincase of *B. gabbii* is more evenly curved than it is in *B. beddardi*. *B. gabbii* also is distinguished from *B. beddardi* by a less-constricted and less-prominent occiput and a less-curved zygomatic bar posterior to the postorbital angle (Pocock 1921a). *B. gabbii* also has a smaller ventral extension of the pterygoid, a less anteriorly inflated auditory bulla, less-convex inferior border of the mandible, and a more-prominent condyle (Pocock 1921a).

Bassaricyon gabbii differs from *B. lasius* and *B. pauli* in having shorter and sparser fur and more brownish coloration (Enders 1936; Harris 1932). The skull of *B. gabbii* differs from that of *B. lasius* in that it possesses a lower and less-curved zygomatic arch (Harris 1932). The skull of *B. gabbii* is also generally lighter and smaller than those of *B. lasius* or *B. pauli* (Enders 1936; Harris 1932). *B. gabbii* lacks a sagittal crest, which is present in *B. lasius* and *B. pauli* (Enders 1936;

Harris 1932). In *B. gabbii*, there is a smaller space between P2 and P3 than in *B. lasius*.

Olingos are often confused with the sympatric kinkajou (*Potos flavus*); many native cultures in Central and South America do not distinguish between species of *Bassaricyon* and *P. flavus*, calling all by the same common names (Enders 1936; Goldman 1920; Poglayan-Neuwall and Poglayan-Neuwall 1965). A live specimen collected in Panama and brought to the United States in 1955 was mistaken for a kinkajou (Manville 1956). Olingos and kinkajous are similar in appearance, and both are arboreal and nocturnal. Olingos are lighter (1.1–1.4 kg—Emmons 1990) than kinkajous (1.4–4.6 kg—Nowak 1991). Compared to olingos, kinkajous also have a broader philtrum; digits that are webbed for only one-third rather than two-thirds of their length; and teeth that are larger (except M2), flatter, lower crowned, and less tuberculated (Ford and Hoffmann 1988; Hollister 1916). Most notably, the tail of the olingo is nonprehensile, nontapering, and slightly tufted at the end (Emmons 1990), whereas the kinkajou possesses a muscular, prehensile tail (Ford and Hoffmann 1988).

GENERAL CHARACTERS

The torso of *Bassaricyon gabbii* is slender with moderately short limbs; hind limbs are distinctly longer (Fig. 1). The fur is thick and soft, generally brown to grayish brown dorsally (more rarely paler or golden) and lighter cream to yellow colored ventrally. Pelage is often darker along the dorsal midline and there is a yellowish band that extends across the neck to the base of the ears. The broad face is grayer than body and has a short, pointed muzzle and short rounded ears. The eyes are large and have cinnamon-colored irises and narrow, vertical pupils. Feet are broad with short, curved claws. The posterior one-half of the soles are densely furred, and toes are semipalmate. The tail is slightly longer than the body (tail represents 51–56% of total length—Allen 1908; Goldman 1912; Goodwin 1946; Kays 2000; Thomas 1909, 1927) and may have 11–13 indistinct partial rings of darker fur. The tail is not prehensile or tapered, is somewhat dorsoventrally flattened (Nowak 1991), is lighter in color on the underside, and is bushy at the tip.

The skull of *B. gabbii* is short and broad with a moderately large and well-rounded braincase (Fig. 2). Rostrum is short and depressed. Postorbital processes are well developed from the frontals to the zygomata, and the zygomata are widely expanded. Temporal ridges are well defined but low, and the orbits are large. The palate is flat, with shallow lateral grooves, and extends posteriorly well beyond the toothrows. The vomer is not attached to the palatal bones. Auditory bullae are greatly inflated posteriorly but are low and flat anteriorly. The tube of the external auditory meatus is short (Hollister 1916). The mandible has a long and high ascending ramus. *B. gabbii*, *B. alleni*, and *B.*

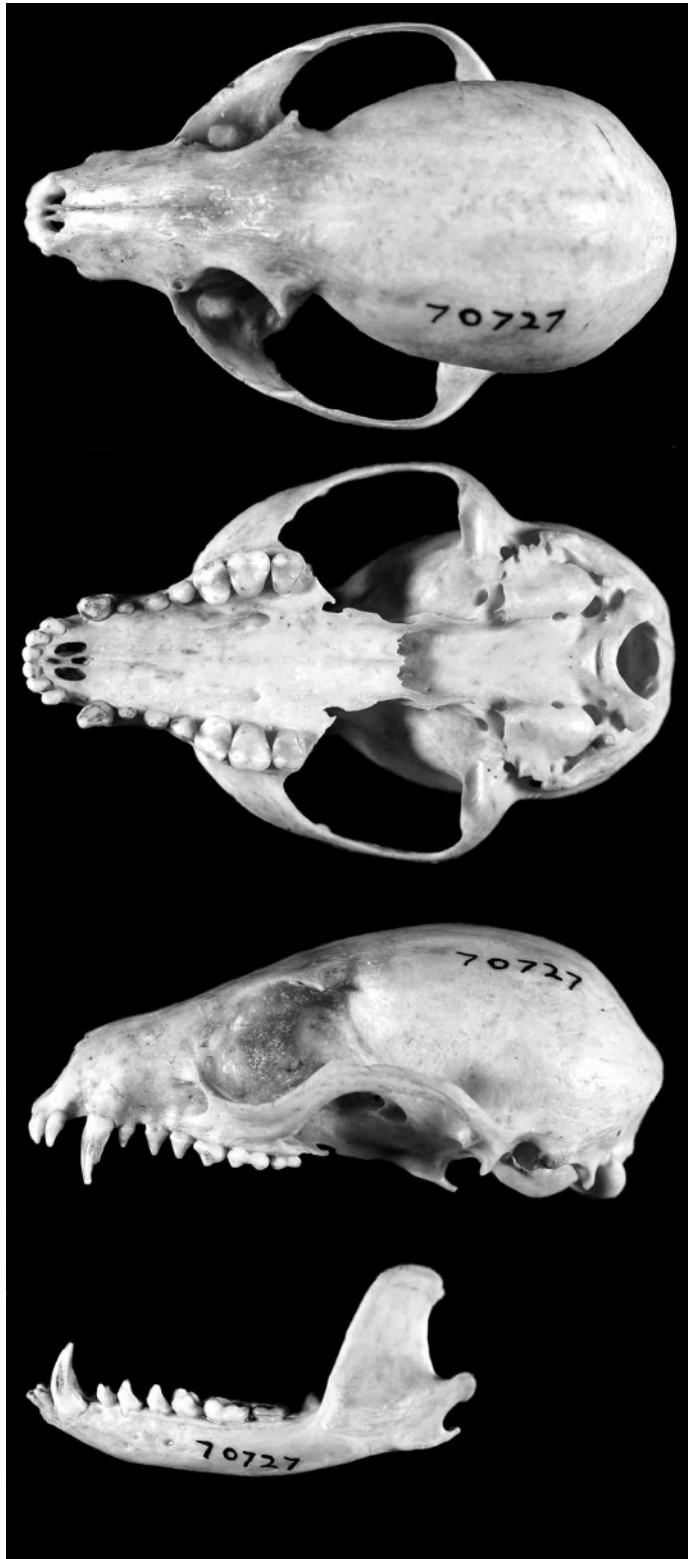


Fig. 2.—Dorsal, ventral, and lateral views of cranium and lateral view of mandible of an adult female *Bassaricyon gabbii* (Field Museum of Natural History collection no. 70727) from Huila, Colombia. Used with permission of the Field Museum of Natural History and photographers B. Patterson and M. Schulenberg. Greatest length of skull is 7.9 cm.

pauli are distinguished from other procyonids by the U-shaped posterior border and parallel lateral edges of the nasals (Decker and Wozencraft 1991).

Cranial measurements (in mm) of the type specimen of *B. gabbii* from the Talamanca region of Costa Rica are: total length of skull, 78.7; zygomatic width, 49.5; mastoid width, 33.8; interorbital width, 15.2; rostrum width, 17.0; and length of maxillary molar series (P1–M2), 23.3 (Allen 1876). Measurements (in mm) of an adult female type specimen of *B. g. richardsoni* from Nicaragua (Rio Grande, Atlantic Slope—Allen 1908), and an adult female specimen of the same subspecies from the province of Alajuela, Costa Rica (Goodwin 1946), respectively, are: condylobasal length, 80.5, 78.7; zygomatic width, 53.0, 53.0; mastoid width, 34.3, 36.5; interorbital width, 17.0, 17.7; rostrum width, 17, 17.3; and length of maxillary toothrow (including C), 28.0, 28.4.

Cranial dimensions (in mm) of an adult male from the mountains inland of Chocó in western Colombia (Thomas 1909) and an adult female from Guaicaramo, Colombia (Thomas 1927), respectively, of *B. g. medius* are: total length, 81.0, 80.0; condylobasal length, 75.0, 75.0; zygomatic width, 51.0, 49.5; braincase width, 35.0, 34.5; interorbital width, 16.8, 17.6; and length of maxillary toothrow (including C), 28.3, 27.5. Dimensions for an adult male *B. g. medius* from Cana in eastern Panama are: total length, 85.0; condylobasal length, 85.0; zygomatic width, 56.2; width across postorbital processes, 35.8; interorbital width, 18.0; length of palatine bone, 46.5; and length of upper molariform toothrow, 23.7 (Goldman 1912).

Body dimensions (in mm) for 3 adult males from Soberania National Park in central Panama are: total length, 770, 775, 785; head–body length, 370, 365, 365; length of tail, 400, 410, 420; length of hind foot, 86, 82, 80; and length of ear, 35, 37, 38. Dimensions for a female from the same location are: total length, 815; head–body length, 355; length of tail, 460; length of hind foot, 85; and length of ear, 38 (Kays 2000). Mean body mass (in kg) for the males referenced above is 1.07, 1.10, and 1.10, and for the female is 1.05 (Kays 2000). Body measurements (in mm) for the Nicaraguan and Costa Rican specimens, respectively, of *B. g. richardsoni* for which cranial measurements were presented previously, are: total length, 950, 850; length of tail, 480, 432; and length of hind foot, 80, 90 (Allen 1908; Goodwin 1946). Additional morphometrics (in mm) for *B. g. medius* including an adult male (Thomas 1909) and female (Thomas 1927) from Colombia, an adult male and female from Cana, Panama (Goldman 1912), and an adult male from Mount Pirri, Panama (Goldman 1912), respectively, are as follows: head–body length, 352, 390, 401, 390, 408; length of tail, 435, 450, 419, 450, 457; length of hind foot, 72, –, 86, 84, 88; and length of ear 34, –, –, –, –.

In *B. gabbii*, the acromion process on the scapular spine is sharply angled and the trochanteric fossa on the femur is poorly developed (Decker and Wozencraft 1991). The

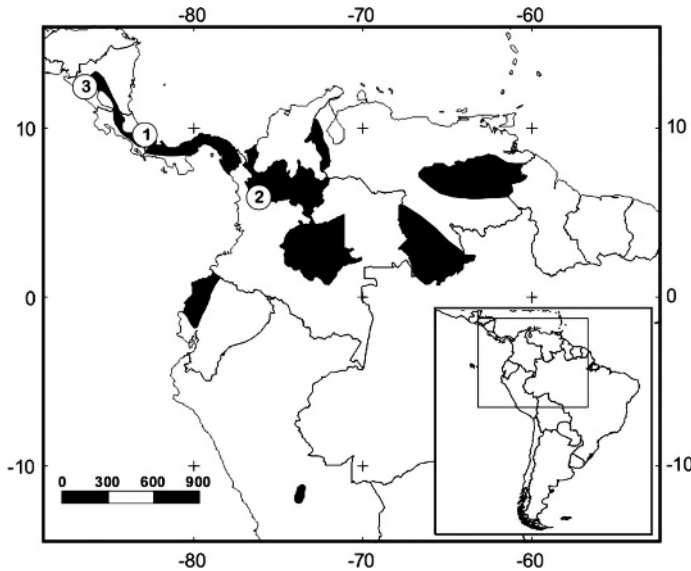


Fig. 3.—Geographic distribution of *Bassaricyon gabbii*. Numbers indicate type localities of subspecies as follows: 1, *B. g. gabbii*; 2, *B. g. medius*; and 3, *B. g. richardsoni*. Delineation of subspecies ranges currently is not possible. Map redrawn from Patterson et al. (2005) with modifications.

trochlear process of *B. gabbii* is intermediate between the broad, gently sloping condition common to *Procyon* and the distinct knoblike projection typical of *Bassariscus* (Stains 1973). *B. gabbii* possesses the smallest calcaneum of all procyonids examined, except *Bassariscus astutus* (Stains 1973). There is only a slight tendency for the posterior articular surface to be sigmoid, the proximal edge of the medial articular surface is folded over the sustentaculum, and the anterior articular surface is poorly developed (Stains 1973).

DISTRIBUTION

Olingos occur in Central America and northern South America (Fig. 3—modified from Patterson et al. 2005). In Central America, *Bassaricyon gabbii* is known from Nicaragua through Costa Rica and Panama (Hall 1981). However, *B. gabbii* also has been reported from near Gualaco, Honduras, and in Guatemala, near the Honduras border (Ordóñez et al. 1999–2000; not shown on map). In South America, *B. gabbii* has been documented in Venezuela (Bisbal 1989), Colombia (Alberico et al. 2000; Glatston 1994), Ecuador (Albuja 1991), and Peru (Emmons et al. 2001). It has also been reported in Bolivia (Redford and Stearman 1993; not shown on map). It may be locally abundant at some sites, but rare in many parts of its range (Emmons 1990; Glatston 1994). There are insufficient data to allow delineation of ranges for subspecies. No fossils are known (Baskin 1982; Koepfli et al. 2007).

FORM AND FUNCTION

In *Bassaricyon gabbii*, cheek teeth are low crowned and only slightly cusped. Incisors contact one another. Canines are large and not excessively laterally flattened; upper canines are nearly straight (Hollister 1916). P1 and P2 have compressed cones. P3 has a posterointernal shelf and P4 has 3 cusps and lacks a hypocone (Hall 1981). M1 is larger than M2 and upper molars have 3 low, round cusps, each with a well-developed outer cingulum (Hollister 1916). Dental formula = $i\ 3/3, c\ 1/1, p\ 4/4, m\ 2/2$, total 40.

Bassaricyon gabbii possesses a multibolular hemophagous organ consisting of a large number of hemophagocytic cells arranged within epithelia (Creed and Biggers 1964). Females have a single pair of inguinal mammae. The baculum is small (32 mm) and slightly bowed (Hollister 1916). Paired anal glands produce a noxious solution that is discharged when *B. gabbii* is antagonized (Poglayen-Neuwall 1990).

ECOLOGY

Gestation in *Bassaricyon gabbii* is about 2.5 months, and typically a single offspring is produced (Wainwright 2002). Young have been seen during the dry season in Costa Rica (Wainwright 2002).

Olingos typically occur in multistrata tropical evergreen forests below 1,600–2,000 m (Emmons 1990; Glatston 1994; Wainwright 2002). They do not seem to frequent disturbed or secondary forests, or plantations and gardens (Emmons 1990). Their exact response to habitat disturbance is unclear (Bisbal 1993); however, Daily et al. (2003) classified *B. gabbii* as highly vulnerable to habitat destruction.

Estimated density of *B. gabbii* at Cocha Cashu Biological Station, Manu National Park, Peru, ranges from $0.03/\text{km}^2$ to $6.8/\text{km}^2$ (Janson and Emmons 1990). *B. gabbii* is typically less common than sympatric *P. flavus*. Using a hoistable trap (Kays 1999), 4 individuals of *B. gabbii* were captured 28 times during 1,292 trap nights and 25 kinkajous 192 times during the same period (Kays 2000).

In central Panama, movements of a single adult male *B. gabbii* of 1.2, 1.4, and 1.7 km were recorded during 3 half-nights of observation, within an estimated home-range size (95% minimum convex polygon) of 23.5 ha (Kays 2000). Home range and movement patterns were similar to those of kinkajous in the area. Four den sites of *B. gabbii* in Panama were all in large (> 50 cm diameter at breast height) trees (Kays 2000). *B. gabbii* also dens in the palm pachiuva (*Socratea exorrhiza*) in Bolivia (Redford and Stearman 1993).

It is widely accepted that olingos are frugivorous (Duke 1967). Olingos are often seen in fruiting trees, especially figs (*Ficus*—Emmons 1990), and stomach contents containing fruit have been reported (Goldman 1920). However, there is some anecdotal evidence for carnivory in *B. gabbii*. One

olingo in Monteverde, Costa Rica, reportedly chased and killed a variegated squirrel (*Sciurus variegatoides*). Another olingo that frequented hummingbird feeders in Monteverde occasionally captured hummingbirds, but whether it consumed them was not stated (Wainwright 2002). Reid (1997) reports an observation of an olingo catching and eating a Mexican deermouse (*Peromyscus mexicanus*).

There is no evidence of carnivory in *B. gabbii* in Panama. Fifteen species of fruiting or flowering trees were recorded in the diet of *B. gabbii*. Nectar of *Ochroma* flowers is especially important in the early dry season, indicated by as many as 5 separate feeding forays by the same olingo to the same *Ochroma* tree during a single night. In Panama, only seeds of *Sponias* were dropped to the ground rather than ingested, suggesting that olingos serve as dispersal agents for most fruits consumed (Kays 2000).

Olingos and kinkajous likely compete for resources (Kays 2000). Kinkajous appeared dominant over *B. gabbii* in the wild, and it has been suggested that the geographic and local distributions of *B. gabbii* might be influenced, in part, by competition with kinkajous (Kays 2000). Kinkajous occur throughout Amazonia, whereas olingos appear to be absent in the less productive eastern forests. It is unknown whether poor habitat alone, or in concert with competition with kinkajous, is responsible for the absence of *B. gabbii* from this region (Emmons 1990).

Potential predators of *B. gabbii*, particularly young, are jaguarundi (*Herpailurus yaguarondi*), ocelots (*Leopardus pardalis*), and large snakes (e.g., boas—Poglayen-Neuwall 1990). Tayra (*Eira barbara*) may hunt them in their dens during the day (Poglayen-Neuwall 1990). Although human hunting activity is likely a minor source of mortality overall, it may be significant in some local areas (Bisbal 1993).

Little is known concerning diseases and parasites of *B. gabbii*. In Panama, 1 of 9 specimens of *B. gabbii* was infected with *Leishmania braziliensis* (Herrer and Christensen 1975). *B. gabbii* is a reservoir for *L. panamensis* (Grimaldi and Tesh 1993). An attempt to infect *B. gabbii* with the primate coccidian *Isoospora arctopitheci* was unsuccessful, although only 1 specimen was exposed (Hendricks 1977). Similarly, 1 specimen of *B. gabbii* was experimentally exposed to *Toxoplasma* in Panama. Although it developed *Toxoplasma* antibody, neither oocysts nor *Toxoplasma* infectivity was demonstrated in fecal concentrates (Jewell et al. 1972).

There are no estimates of longevity or mortality rates for free-ranging olingos. A female specimen of *B. gabbii* lived for 25 years, 3 months in captivity (Poglayen-Neuwall 1989). General husbandry for the genus *Bassaricyon* has been described (Poglayen-Neuwall 1966).

BEHAVIOR

Little is known of the behavior of free-ranging olingos apart from anecdotal evidence of some degree of sociality.

During 5 of 6 nights with > 5 h of observation, individuals of *Bassaricyon gabbii* were observed interacting with other olingos (Kays 2000). On 2 occasions, 2 olingos were seen together, but no details could be observed. During one instance an olingo vocalized in response to another's call (Kays 2000). In Panama, *B. gabbii* was occasionally with conspecifics when shot (Goldman 1920).

Olingos, often observed in trees, are excellent climbers and use their long tail as a balancing organ (Reid 1997). They have been observed foraging in the same fruiting trees at the same time with kinkajous (Goldman 1920; Kays 2000), night monkeys (*Aotus*), and opossums (*Caluromys*—Emmons 1990), and in Peru, *B. gabbii* was found occupying the same large tree cavity as *Aotus* (Aquino and Encarnación 1986). However, in competitive situations, *B. gabbii* appears to be dominated by kinkajous. In small, flowering *Ochroma* trees in Panama, foraging olingos were either aggressively displaced by kinkajous or they left upon kinkajou arrival (Kays 2000). Yet, olingos fed with kinkajous in very large (> 100 cm diameter at breast height) fruiting trees with abundant resources with no apparent aggression (Kays 2000).

Several authors have described a 2-toned call (Emmons 1990; Kays 2000; Reid 1997). Emmons (1990) referred to a 2-toned “wake-up” call or less often a sneezelike sound. Reid (1997) described a 2-note bark, or “whey-chuck” sound that is slower and lower in pitch than similar kinkajou vocalizations. Likely characterizing the same call, Kays (2000) noted the most common call was a “wer-toll.”

GENETICS

Diploid number (2n) is 38 in *Bassaricyon gabbii* (Wurster-Hill and Benirschke 1967). The autosomal complement contains 14 pairs of meta- and submetacentric chromosomes and 4 pairs of acrocentric chromosomes. One pair of small acrocentric chromosomes has satellites on its short arms. The X chromosome is a medium-sized submetacentric, whereas the Y is a small subacrocentric (Wurster-Hill and Benirschke 1968). *B. gabbii* presents a unique cytochrome-*b* gene in that it is 6 base pairs longer than that of most other Carnivora examined thus far (Fulton and Strobeck 2007; Koepfli et al. 2007; Ledje and Arnason 1996). The gene is likewise lengthened in *Nasua nasua* and some individuals of *N. narica* (Koepfli et al. 2007), possibly indicating a close evolutionary relationship between *Bassaricyon* and *Nasua* (Fulton and Strobeck 2007; Koepfli et al. 2007). Nine of 11 microsatellite loci developed for kinkajous also amplified for *B. gabbii* (Kays et al. 2000).

CONSERVATION

The International Union for Conservation of Nature and Natural Resources has classified *Bassaricyon gabbii* as

Lower Risk/Near Threatened (Glatston 1994; International Union for Conservation of Nature and Natural Resources 1994). *B. gabbii* is also included in Appendix III of the Convention on International Trade in Endangered Species of Wild Flora and Fauna by Costa Rica (Glatston 1994). Young may be captured for the pet trade (Glatston 1994). *B. gabbii* is hunted for food by indigenous peoples in some parts of Venezuela (Bisbal 1993). It is also hunted by the Yuqui in Bolivia, although it is not the preferred prey (Redford and Stearman 1993). Habitat destruction and degradation are likely the greatest threats to olingos (Bisbal 1993; Glatston 1994). In the Las Cruces region of Costa Rica, *B. gabbii* was found only in forested habitats, and was classified as highly vulnerable to extinction due to habitat destruction (Daily et al. 2003).

REMARKS

A taxonomic review is needed to clarify the number of legitimate *Bassaricyon* species. Several authors recognize only 1 species, *B. gabbii* (Ewer 1973; Poglayen-Neuwall and Poglayen-Neuwall 1965; Wozencraft 1989); others recognize only 2, *B. alleni* and *B. gabbii* (Eisenberg 1989; Macdonald 1988). Studies of captive *Bassaricyon* provide additional information regarding anatomy (Poglayen-Neuwall and Poglayen-Neuwall 1965), reproduction and physiology (Poglayen-Neuwall 1976), and behavior (Poglayen-Neuwall and Poglayen-Neuwall 1965). Additionally, Pocock (1921b) detailed the external features of a specimen of *Bassaricyon*. Because specimens were not identified specifically as *B. gabbii* in these papers they are not summarized herein. Additional analyses of distributions, densities, natural history, and ecology throughout the range of *Bassaricyon* are necessary if we are to be able to assess the impact of human disturbance (Emmons 1990) and deforestation (Glatston 1994).

Bassar means fox and *cyon* means dog. The specific epithet honors William M. Gabb, who collected the 1st specimen. The name olingo originates from the word oliente, which means foul smelling and alludes to the noxious secretion of anal glands.

ACKNOWLEDGMENTS

We thank B. Patterson and M. Schulenberg of the Field Museum of Natural History for photographing the skull. D. Wilson and C. Wozencraft provided helpful advice on the synonymies and key. Further, we are grateful to D. and J. Cohen for allowing us to use their olingo photograph. Distribution map was reproduced in modified format from data provided by NatureServe in collaboration with B. Patterson, W. Sechrest, M. Tognelli, G. Ceballos, The Nature Conservancy–Migratory Bird Program, Conservation International–Center for Applied Biodiversity Science

(CABS), World Wildlife Fund–US, and Environment Canada–WILDSPACE. Finally, we thank anonymous reviewers whose comments and suggestions improved this manuscript.

LITERATURE CITED

- ALBERICO, M., A. CADENA, J. HERNÁNDEZ-CAMACHO, AND Y. MUÑOZ-SABA. 2000. Mamíferos (Synapsida: Theria) de Colombia. *Biota Colombiana* 1:43–75.
- ALBUJA, L. 1991. Lista de vertebrados del Ecuador. *Escuela Politécnica XVI*:163–203.
- ALLEN, J. A. 1876. Description of a new generic type (*Bassaricyon*) of Procyonidae from Costa Rica. *Proceedings of the Academy of Natural Sciences of Philadelphia* 28:20–23.
- ALLEN, J. A. 1908. Mammals from Nicaragua. *Bulletin of the American Museum of Natural History* 24:647–670.
- AQUINO, R., AND F. ENCARNACIÓN. 1986. Characteristics and use of sleeping sites in *Aotus* (Cebidae: Primates) in the Amazon lowlands of Peru. *American Journal of Primatology* 11:319–331.
- BASKIN, J. A. 1982. Tertiary Procyonidae (Mammalia: Carnivora) of North America. *Journal of Vertebrate Paleontology* 2:71–93.
- BISBAL, F. J. 1989. Distribution and habitat association of the carnivores in Venezuela. Pp. 339–361 in *Advances in Neotropical mammalogy* (K. H. Redford and J. F. Eisenberg, eds.). Sandhill Crane Press, Gainesville, Florida.
- BISBAL, F. J. 1993. Impacto humano sobre los carnívoros de Venezuela. *Studies on Neotropical Fauna and Environment* 28:145–156.
- CREED, R. F. S., AND J. D. BIGGERS. 1964. Placental haemophagous organs in the Procyonidae and Mustelidae. *Journal of Reproduction and Fertility* 8:133–137.
- DAILY, G. C., G. CEBALLOS, J. PACHECO, G. SUZAN, AND A. SÁNCHEZ-AZOFEIFA. 2003. Countryside biogeography of Neotropical mammals: conservation opportunities in agricultural landscapes of Costa Rica. *Conservation Biology* 17:1814–1826.
- DECKER, D. M., AND W. C. WOZENCRAFT. 1991. Phylogenetic analysis of recent procyonid genera. *Journal of Mammalogy* 72:42–55.
- DUKE, J. A. 1967. Mammal dietary bioenvironmental and radiological safety feasibility studies. U.S. Atomic Energy Commission, Columbus, Ohio.
- EISENBERG, J. F. 1989. *Mammals of the Neotropics*. University of Chicago Press, Chicago, Illinois.
- EMMONS, L. H. 1984. Geographic variation in densities and diversities of non-flying mammals in Amazonia. *Biotropica* 16:210–222.
- EMMONS, L. H. 1990. *Neotropical rainforest mammals: a field guide*. 2nd ed. University of Chicago Press, Chicago, Illinois.
- EMMONS, L. H., L. LUNA, AND M. ROMO. 2001. Mammals of the northern Vilcabamba Mountain Range, Peru. Pp. 105–109 in *Rapid Assessment Program (RAP) working paper 12, biological and social assessments of the Cordillera de Vilcabamba, Peru* (L. E. Alonso, A. Alonso, T. S. Schulenberg, and F. Dallmeier, eds.). Conservation International, Washington, D.C.
- ENDERS, R. K. 1936. *Bassaricyon pauli*, a new species from Panama. *Proceedings of the Academy of Natural Sciences of Philadelphia* 88:365–366.
- EWER, R. F. 1973. *The carnivores*. Cornell University Press, Ithaca, New York.
- FORD, L. S., AND R. S. HOFFMANN. 1988. *Potos flavus*. *Mammalian Species* 321:1–9.
- FULTON, T. L., AND C. STROBECK. 2007. Novel phylogeny of the raccoon family (Procyonidae, Carnivora) based on nuclear and mitochondrial DNA evidence. *Molecular Phylogenetics and Evolution* 43:1171–1177.
- GLATSTON, A. R. 1994. The red panda, olingos, coatis, raccoons, and their relatives. Status survey and conservation action plan for procyonids and ailurids. International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.
- GOLDMAN, E. A. 1912. New mammals from eastern Panama. *Smithsonian Miscellaneous Collections* 60:16–17.
- GOLDMAN, E. A. 1920. Mammals of Panama. *Smithsonian Miscellaneous Collections* 69:155–157.

- GOODWIN, G. G. 1946. Mammals of Costa Rica. Bulletin of the American Museum of Natural History 87:275–473.
- GRIMALDI, G., JR., AND R. B. TESH. 1993. Leishmaniasis of the New World: current concepts and implications for future research. *Clinical Microbiology Reviews* 6:230–250.
- HALL, E. R. 1981. The mammals of North America. 2nd ed. John Wiley & Sons, New York 2:601–1181.
- HARRIS, W. P., JR. 1932. Four new mammals from Costa Rica. *Occasional Papers, Museum of Zoology, University of Michigan* 248:1–6.
- HENDRICKS, L. D. 1977. Host range characteristics of the primate coccidian, *Isospora arctopitheci* Rodhain 1933 (Protozoa: Eimeriidae). *Journal of Parasitology* 63:32–35.
- HERRER, A., AND H. A. CHRISTENSEN. 1975. Infrequency of gross skin lesions among Panamanian forest mammals with cutaneous leishmaniasis. *Parasitology* 71:87–92.
- HOLLISTER, N. 1916. The genera and subgenera of raccoons and their allies. *Proceedings of the United States National Museum* 47: 143–150.
- INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES. 1994. 1994 IUCN Red list of threatened animals. www.iucn.redlist.org (21 September 2007).
- JANSON, C. H., AND L. H. EMMONS. 1990. Ecological structure of the nonflying mammal community at Cocha Cashu Biological Station, Manu National Park, Peru. Pp. 314–338 in *Four Neotropical rainforests* (A. H. Gentry, ed.). Yale University Press, New Haven, Connecticut.
- JEWELL, M. L., J. K. FRENKEL, K. M. JOHNSON, V. REED, AND A. RUIZ. 1972. Development of *Toxoplasma* oocysts in Neotropical Felidae. *American Journal of Tropical Medicine and Hygiene* 21:512–517.
- KAYS, R. W. 1999. A hoistable arboreal mammal trap. *Wildlife Society Bulletin* 27:298–300.
- KAYS, R. W. 2000. The behavior and ecology of olingos (*Bassaricyon gabbi*) and their competition with kinkajous (*Potos flavus*) in central Panama. *Mammalia* 64:1–10.
- KAYS, R. W., J. G. GITTLEMAN, AND R. K. WAYNE. 2000. Microsatellite analysis of kinkajou social organization. *Molecular Ecology* 9: 743–751.
- KOEPFLI, K. P., ET AL. 2007. Phylogeny of the Procyonidae (Mammalia: Carnivora): molecules, morphology and the great American interchange. *Molecular Phylogenetics and Evolution* 43:1076–1095.
- LEDJE, C., AND U. ARNASON. 1996. Phylogenetic analyses of complete cytochrome *b* genes of the order Carnivora with particular emphasis on the Caniformia. *Journal of Molecular Evolution* 42: 135–144.
- MACDONALD, L. G. 1988. Land mammals of the great American interchange. *American Scientist* 76:380–388.
- MANVILLE, R. 1956. This “kinkajou” was really the very rare olingo. *Animal Kingdom* 59:109–111.
- NOWAK, R. M. 1991. Walker’s mammals of the world. 5th ed. Johns Hopkins University Press, Baltimore, Maryland.
- ORDÓÑEZ, G., T. J. MCCARTHY, J. MONZÓN, J. O. MATSON, AND R. P. ECKERLIN. 1999–2000. Aplicación del área de distribución de *Bassaricyon gabbi* J. A. Allen, 1876 (Carnivora: Procyonidae) en el Norte de América Central. *Revista Mexicana de Mastozoología* 4:114–116.
- PATTERSON, B. D., ET AL. 2005. Digital distribution maps of the mammals of the Western Hemisphere. Version 2.0. NatureServe, Arlington, Virginia.
- POCOCK, R. I. 1921a. A new species of *Bassaricyon*. *Annals and Magazine of Natural History, Series 9* 7:229–234.
- POCOCK, R. I. 1921b. The external characters and classification of the Procyonidae. *Proceedings of the Zoological Society of London* 1921:389–422.
- POGLAYEN-NEUWALL, I. 1966. Notes on care, display and breeding of olingos *Bassaricyon*. *International Zoo Yearbook* 6:169–171.
- POGLAYEN-NEUWALL, I. 1976. Fortpflanzung, Geburt und Aufzucht, nebst anderen Beobachtungen von Makibären (*Bassaricyon* Allen, 1876). *Zoologische Beiträge* 22:179–233.
- POGLAYEN-NEUWALL, I. 1989. Notes on reproduction, aging and longevity of *Bassaricyon* sp. (Procyonidae). *Zoologische Garten* 59:122–128.
- POGLAYEN-NEUWALL, I. 1990. Procyonids. Pp. 450–468 in *Grzimek’s encyclopedia of mammals* (S. P. Parker, ed.), Vol. 3. McGraw-Hill, New York.
- POGLAYEN-NEUWALL, I., AND I. POGLAYEN-NEUWALL. 1965. Gefangenschaftsbeobachtungen an Makibären (*Bassaricyon* Allen 1876). *Zeitschrift für Säugertierkunde* 30:321–366.
- REDFORD, K. H., AND A. M. C. STEARMAN. 1993. Notas sobre la biología de tres procyonidos simpátricos Bolivianos (Mammalia, Procyonidae). *Ecología en Bolivia* 21:35–44.
- REID, F. A. 1997. A field guide to the mammals of Central America and southeast Mexico. Oxford University Press, New York.
- STAINS, H. J. 1973. Comparative study of the calcanea of members of the Ursidae and Procyonidae. *Bulletin of the Southern California Academy of Sciences* 72:137–148.
- THOMAS, O. 1880. On mammals from Ecuador. *Proceedings of the Zoological Society of London* 1880:393–403.
- THOMAS, O. 1909. Notes on some South American Mammals, with descriptions of new species. *Annals and Magazine of Natural History, Series 8* 4:230–242.
- THOMAS, O. 1927. A new species of *Bassaricyon* from Colombia. *Annals and Magazine of Natural History, Series 9* 20:80.
- WAINWRIGHT, M. 2002. The natural history of Costa Rican mammals. *Distribuidores Zona Tropical, San José, Costa Rica*.
- WOZENCRAFT, W. C. 1989. Classification of the Recent Carnivora. Pp. 569–593 in *Carnivore behavior, ecology and evolution* (J. L. Gittleman, ed.). Cornell University Press, Ithaca, New York.
- WOZENCRAFT, W. C. 2005. Order Carnivora. Pp. 532–628 in *Mammal species of the world: a taxonomic and geographic reference* (D. E. Wilson and D. M. Reeder, eds.). 3rd ed. Johns Hopkins University Press, Baltimore, Maryland.
- WURSTER-HILL, D. H., AND K. BENIRSCHKE. 1967. Chromosome numbers in thirty species of carnivores. *Mammalian Chromosome Newsletter* 8:195–196.
- WURSTER-HILL, D. H., AND K. BENIRSCHKE. 1968. Comparative cytogenetic studies in the order Carnivora. *Chromosoma* 24: 336–382.

Associate editors of this account were RON GETTINGER, KRISTOFER HELGEN, and PAMELA OWEN. Editors were VIRGINIA HAYSSSEN and MEREDITH HAMILTON.