



Short communication

Rediscovery of Enders's small-eared shrew, *Cryptotis endersi* (Insectivora: Soricidae), with a redescription of the species

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Of the 270 or so currently recognized species of mammals of mainland Central America, the least known is Enders's small-eared shrew, *Cryptotis endersi*. SETZER (1950) described this species from a single subadult of unknown sex, obtained by R. K. ENDERS in western Panamá in 1941. For a half century, the holotype has remained the only specimen known, and all literature citations (e.g., MILLER and KELLOGG 1955; HANDLEY 1966; MÉNDEZ 1970; CHOATE and FLEHARTY 1974; CORBET and HILL 1980, 1986, 1991; HONACKI et al. 1982; NOWAK and PARADISO 1983; BURTON 1987; EISENBERG 1989; NOWAK 1991, 1999; HUTTERER 1993; CARLETON and MUSSEY 1995) and redescriptions (e.g., HALL and KELSON 1959; CHOATE 1970; HALL 1981) are based upon it alone. Also, starting with the original description, there have been uncertainties regarding characteristics of the holotype and details of the type locality.

We herein report a second specimen of *C. endersi*, redescribe the species, describe the habitat, and review ambiguous and conflicting accounts of the holotype and type locality. The new specimen is an adult male that extends the known distribution to the

east, and adds to understanding of variation in the species.

During 15 May–10 July 1980, PINE, R. J. IZOR, and J. A. WAGNER conducted field work along and near the Continental Divide of the Cordillera de Chiriquí (or Serranía del Tabasará) in Bocas del Toro and Chiriquí, Panamá. On 18 June, IZOR trapped the *C. endersi* (field no. RHP 8354—now USNM 541048) in a “Museum Special” snap trap baited with peanut butter and rolled oats, on Cerro Bollo (3¹/₂ km E Escopeta), 1800–1856 m, Chiriquí/Bocas del Toro boundary, Panamá, about 70 km east of the type locality. The specimen was prepared as a skin + skull + body skeleton.

The holotype is of unknown sex. Although SETZER (1950) stated that it was an adult, the specimen appears young (subadult as noted by CHOATE 1970). It has but slightly worn dentition and is relatively small. The new specimen (Fig. 1) has more worn dentition, is larger, and has different proportions than the holotype.

Cryptotis endersi is a large *Cryptotis* (Tab. 1), and it has a long tail (49 to 60% of head-and-body-length). In the field, the new specimen was obviously larger and longer

haired than sympatric *C. nigrescens*, although the two species are similar in color. Dorsal pelage is rather long (guard hairs from 7 to 8 mm in length) and dark (Mummy Brown to Fuscous—capitalized color terms from RIDGWAY, 1912); ventral pelage is somewhat paler than the dorsal pelage (Drab Gray to Light Drab). In contrast, SETZER (1950) noted the color of the holotype as “Chaetura Black, no appreciable lightening on sides or belly”.

The forefeet are not notably broad or enlarged. The foreclaws are long, but narrow rather than broadened as in the *C. goldmani* group. There are two large, dorsal foramina on the skull. A vestigial foramen leading to a ventral extension of the sinus canal is present posterior to the dorsal articular facet on at least one side of the skull in the new specimen; there is no foramen dorsal to the dorsal articular facet. The anterior border of zygomatic plate is aligned with the mesostyle-metastyle valley of M^1 ; the posterior border is even with metastyle of M^2 or parastyle of M^3 . Upper toothrows are uncrowded. U^4 is in line with the rest of the unicuspid tooththrow and visible in labial view. The posterior borders of P^4 , M^1 , and M^2 are only very slightly recessed. M^3 is relatively complex, with para-

crista, paracone, precentrocrista, mesostyle, postcentrocrista, and metacone; a well developed protocone is present, but a hypocone is absent or very poorly developed. The mandible is relatively long with low to moderately high coronoid process. The anterior border of coronoid process joins the horizontal ramus of mandible at a relatively low angle. Articular process is tall and narrow. Lower sigmoid notch shallow (but not very shallow). The lower third premolar is relatively long and low-cusped. The posterior border of I_1 extends to posterior edge of P_4 's cusps, but not to its posterior cingulum. Entoconid in the talonid of M_3 vestigial. Dentition bulbous. The new specimen agrees in all non-age-related particulars with CHOATE'S (1970) redescription except that the “anterior element of ectoloph of $M1 (= M^1)$ ” is “reduced relative to posterior element”.

Two other species of *Cryptotis* are known from western Panamá, *C. gracilis* and *C. nigrescens*. Reports of *C. parva orophila* from there (CHOATE 1970; HALL 1981; EISENBERG 1989) were based on misidentified specimens of *C. nigrescens* (WOODMAN and TIMM 1993). In western Panamá, *C. endersi*, *C. gracilis*, and *C. nigrescens* are relatively easy to distinguish from each other on ex-



Fig. 1. Skull of adult male Enders's small-eared shrew, *Cryptotis endersi* (USNM 541048).

ternal characteristics. *Cryptotis endersi* and *C. gracilis* have long tails, while *C. nigrescens* has a much shorter tail (Tab. 1). Fully adult *Cryptotis endersi* can also apparently be identified externally by their greater total length. Although dorsal pelage of all three is similar in color (dark brown to blackish), that of *C. nigrescens* is shorter and less "luxurious". Cranially, *C. endersi* differs from *C. gracilis* in its larger braincase, broader rostrum and palate, bulbous dentition, shallower sigmoid notch, and only a vestigial entoconid of the lower third molar. Both species have complex M³s with metacones, but the protocone and metacone typically are more distinct in *C. gracilis*. From the skull of *C. nigrescens*, that of *C. endersi* differs in being larger, with a relatively and absolutely longer, narrower palate, complex M³, a low and long mandible with anterior border of the coronoid process joining the horizontal ramus at a lower angle. Both externally and cranially, *C. endersi* appears to be closely related to *C. gracilis*, as suggested by CHOATE (1970).

Reproductive data for *C. endersi* are essentially nonexistent. The holotype is of a young animal of unknown sex and taken on 24 July. The new specimen is an adult male (testis = 8 mm) trapped on 18 July, and with well-developed lateral glands.

PINE and IZOR's collecting was along a broken, irregular elevational transect with a variety of habitats up Cerro Colorado, from Escopeta, a mining camp [ca. 23 km NNE San Felix, ca. 900 m on the Pacific (south) slope, Chiriquí], to the drainage of Quebrada Alicia and environs (25 km NNE San Felix (Chiriquí), 1425–1525 m) on the Continental Divide, Bocas del Toro. Other nearby sites also were sampled, including Cerro Bollo, also on the Continental Divide. Roads and lodging in this precipitous and extremely windy region were maintained for a planned copper strip-mining operation. Publications dealing with the Cerro Colorado area and its biotas include MYERS (1969), MYERS and DUELLMAN (1982), SAVAGE and DONNELLY (1992), and WOODMAN and TIMM (1993). GJORDING (1981) discussed social impact of the mining

development and provided a map of the area.

Shrews were captured in several different habitats at three trapping localities. Eight *Cryptotis nigrescens* were trapped in what is here called "Pacific Slope Forest" – wet forest distributed on steep slopes from below 1275 m to the crest of Cerro Colorado at ca. 1525 m. Although often foggy, "Pacific Slope Forest" was not wet enough to be, nor had the aspect of, cloud forest (e.g., there were fewer epiphytes), nor had it the height or stratification of rainforest. This habitat seemed relatively undisturbed aside from a number of paths and some signs of past and current logging.

Cryptotis nigrescens (5 specimens) also was trapped in primary cloud forest at Quebrada Alicia and environs [25 km NNE San Felix (Chiriquí), 1425–1525 m, Bocas del Toro]. This site is on the Bocas del Toro (Caribbean Slope) side of the road on a mostly north-facing slope along the crest of Cerro Colorado.

The highest locality trapped was at 1800–1856 m on Cerro Bollo, 3¹/₂ km E Escopeta (Escopeta is at ca. 23 km NNE San Felix), Chiriquí/Bocas del Toro boundary. Both *Cryptotis endersi* (1) and *C. nigrescens* (14) were taken here. OCONNOR et al. (1982) and FAIN and LUKOSCHUS (1984) gave coordinates for this locality as 81°50' W, 8°34' N, but these may actually apply to Escopeta.

The summit of Cerro Bollo, a rounded peak, was originally all cloud forest and elfin forest, the latter on slopes facing N or NW into the very strong prevailing wind. Much of Cerro Bollo still had its original vegetation. There had been a good deal of clearing to make a line-of-sight to a surveyor's marker at the summit on the Continental Divide, however. Trapping was along a pre-existing path and paths cut by the collectors. One of the *C. nigrescens* may have been trapped in the elfin forest, but the rest of the shrews caught here, including the *C. endersi*, were in cloud forest. At least one *C. nigrescens* was caught in disturbed cloud forest. Other mammals taken on Cerro Bollo were *Oligoryzomys vegetus*, *Oryzomys devius*, *Reithrodontomys mexicanus*,

Table 1. Measurements (in mm) of *Cryptotis* from the Chiriquí Cordillera, Panamá. (*C. gracilis* includes ones from interconnected Talamanca Cordillera, Costa Rica). Measurements as in WOODMAN and TIMM (1993) – terminology not the same in all cases, but abbreviations (CBL, CB, etc.) are the same.

	<i>C. endersi</i> (subadult ANSP holotype; USNM 541048)	<i>C. gracilis</i> (n = 31)	<i>C. nigrescens</i> (Panamá) (n = 23)
head-and-body length	73; 81	67 ± 7 57–77	73 ± 6 60–83
tail length	36; 49	36 ± 3 29–42	31 ± 4 19–37
tail as % of head-and-body length	49; 60	55 ± 7 45–68	43 ± 5 28–51
condylobasal length (CBL)	20.4; 21.3	19.4 ± 0.6 18.0–20.4	19.1 ± 0.5 18.2–20.2
breadth of braincase (CB)	9.8; 10.5	9.7 ± 0.4 9.0–10.3 (n = 30)	9.6 ± 0.3 8.7–10.3
breadth of zygomatic plate (ZP)	2.0; 1.9	1.7 ± 0.1 1.5–2.0	2.0 ± 0.2 1.5–2.5
postorbital breadth (IO)	4.6; 4.9	4.6 ± 0.2 4.1–4.6	4.6 ± 0.2 4.3–4.9
breadth across upper first unicuspid (UIB)	2.7; 2.6	2.3 ± 0.2 2.0–2.6	2.6 ± 0.1 2.4–2.8
breadth across upper second molars (M2B)	5.8; 5.8	5.2 ± 0.2 4.9–5.6	5.7 ± 0.2 5.3–6.0
palatal length (PL)	8.6; 9.3	8.7 ± 0.4 7.8–9.3	8.1 ± 0.3 7.5–8.8
length of maxillary tooththrow (TR)	7.9; 8.3	7.5 ± 0.3 6.9–8.0	7.3 ± 0.3 6.9–7.8
length of upper unicuspid tooththrow (UTR)	2.7; 2.9	2.5 ± 0.2 2.3–2.9	2.4 ± 0.1 2.2–2.6
length of molariform tooththrow (MTR)	5.6; 5.6	5.2 ± 0.2 4.8–5.4	5.3 ± 0.2 4.8–5.7
posterior width of upper first molar (WM1)	1.8; 1.8	1.6 ± 0.1 1.4–1.8	1.8 ± 0.1 1.7–1.9
length of mandible from lower sigmoid notch to mental foramen (ML)	6.3; 7.2	6.3 ± 0.3 5.7–6.8	6.4 ± 0.3 5.6–6.9
height of coronoid process (HCP)	4.8; 4.6	4.0 ± 0.2 3.3–4.4	4.7 ± 0.2 4.2–5.0
height of coronoid valley (HCV)	2.9; 2.8	2.7 ± 0.1 2.3–2.8	2.8 ± 0.1 2.5–3.0
height of articular condyle (HAC)	3.8; 4.0	3.7 ± 0.2 3.3–4.0	3.8 ± 0.2 3.5–4.1
breadth of articular condyle (BAC)	3.0; 3.4	2.9 ± 0.1 2.7–3.2	3.0 ± 0.1 2.9–3.2
articular condyle to posterior edge of lower third molar (AC3)	4.8; 5.5	5.1 ± 0.2 4.4–5.5	4.6 ± 0.3 3.8–5.1
length of mandibular tooththrow (TRD)	6.0; 6.5	5.9 ± 0.2 5.5–6.3	5.8 ± 0.2 5.3–6.2
length of lower first molar (m1L)	1.9; 1.8	1.6 ± 0.1 1.5–1.8	1.7 ± 0.1 1.6–1.9

R. creper, and *Scotinomys xerampelinus*. The last two species and the toad *Bufo peripatetes* were taken only at this locality. *Peromyscus nudipes*, trapped in cloud forest in and around Quebrada Alicia, was not taken here.

SETZER (1950) stated that the holotype was taken at "Cylindro" in the "Province of Chiriquí". MILLER and KELLOGG (1955) and HALL and KELSON (1959) accepted placement of Cylindro in Chiriquí, but FAIRCHILD and HANDLEY (1966), HANDLEY (1966), and CHOATE (1970) unequivocally placed Cylindro in Bocas del Toro Province. FAIRCHILD and HANDLEY (1966) wrote "Cylindro (NE of Boquete on upper Caribbean slope, near Boquete ... above 4000 feet", Bocas del Toro. They gave Boquete as in Chiriquí at "2000–7500 feet" and at 8°47' N, 82°25' W. CHOATE (1970) placed Cylindro at "Approximately" 8°49' N, 82°24' W. There seems to be no reason not to accept Cylindro's placement as given by FAIRCHILD and HANDLEY (1966), HANDLEY (1966), and CHOATE (1970). However, confusion has persisted. BURTON (1987) wrote "Only known from Bocas del Toro, Chiriqui, Panama". BURTON presumably followed HALL (1981), who stated "type from Bocas del Toro, Chiriquí, Panamá"—omitting the actual type locality, Cylindro, and treating Bocas del Toro as a specific locality rather than a province. HONACKI et al. (1982) gave "Panama, Chiriqui Bocas del Toro (sic), Cylindro". EISENBERG (1989) wrote *C. endersi* "is known only from the area of Bocas del Torro (sic) in northeastern (sic) Panama". HUTTERER (1993) placed the type locality in quotes, as follows, "Cylindro, above 4000 ft., Bocas del Toro, Panamá", presumably quoting CHOATE (1970).

SETZER (1950) wrote that the holotype was "taken in heavy forest near a rotting log". "The northern [Caribbean] slope supports much more luxuriant vegetation than the southern [Pacific] slope because it receives substantially more rainfall ... Much of the area thus is covered with relatively undisturbed rainforest, and is characterized by almost inaccessible terrain and a paucity of human habitation. Within the rainforest,

however, are isolated barrens with stunted trees and sparse ground cover. According to the collector, R. K. ENDERS, the holotype of *endersi* was caught in such a barren" (CHOATE 1970). CHOATE (1970) also stated that *C. endersi* "probably occurs in isolated barrens on upper Caribbean slopes of the Cordillera de Talamanca in western Panamá and southeastern Costa Rica" and "is known only from a soggy barren with stunted trees and sparse ground cover on the upper northern slope of the Cordillera de Talamanca". HANDLEY (1966) gave the type locality as in "fog forest" (= cloud forest). This, along with the new specimen's habitat, suggests that *C. endersi* is, indeed, a cloud forest species. CARLETON and MUSSER (1995) listed *C. endersi* as one of 17 terrestrial mammals endemic to the highlands of western Panamá and/or of Costa Rica, and supposed that it might occur in the Cordillera de Talamanca of the latter country.

Cryptotis endersi remains one of the most poorly known species of Recent mammals, and as deforestation continues in high-elevation forests of Costa Rica and Panamá, it poses a serious threat to *C. endersi* and other cloud forest specialists. It is listed as Endangered by the IUCN (IUCN 1999) under the spelling *Cryptotis ender*.

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References

- BURTON, J. A. (1987): The Collins Guide to the Rare Mammals of the World. Lexington, Massachusetts: Stephen Greene Press.
- CARLETON, M. D.; MUSSER, G. G. (1995): Systematic studies of oryzomyine rodents (Muridae: Sigmodontinae): definition and distribution of *Oligoryzomys vegetus* (Bangs, 1902). Proc. Biol. Soc. Wash. **108**, 338–369.
- CHOATE, J. R. (1970): Systematics and zoogeography of Middle American shrews of the genus *Cryptotis*. Univ. Kans. Publ., Mus Nat. Hist. **19**, 195–317.
- CHOATE, J. R.; FLEHARTY, E. D. (1974): *Cryptotis goodwini*. Mammal. Species **44**, 1–3.
- CORBET, G. B.; HILL, J. E. (1980, 1986, 1991): A World List of Mammalian Species. London: British Mus. (Nat. Hist.).
- EISENBERG, J. F. (1989): Mammals of the Neotropics. The Northern Neotropics: Vol. I: Panama, Colombia, Venezuela, Guyana, Suriname, French Guiana. Chicago: Univ. Chicago Press.
- FAIN, A.; LUKOSCHUS, F. S. (1984): New observations on the genus *Prolistrophorus* Fain, 1970 (Acari: Astigmata: Listerophoridae). Syst. Parasitol. **6**, 161–185.
- FAIRCHILD, G. B.; HANDLEY, C. O., JR. (1966): Gazetteer of collecting localities in Panama. In: Ectoparasites of Panama. Ed. by R. L. WENZEL and V. J. TIPTON. Chicago: Field Mus. Nat. Hist. Pp. 9–20.
- GIJORDING, C. N. (1981): The Cerro Colorado Project and the Guaymí Indians of Panama. Cultural Survival Occas. Pap. **3**, 1–45.
- HALL, E. R. (1981): The Mammals of North America. Vol. I. New York: John Wiley and Sons.
- HALL, E. R.; KELSON, K. R. (1959): The Mammals of North America. Vol. I. New York: Ronald Press.
- HANDLEY, C. O., JR. (1966): Checklist of the mammals of Panama. In: Ectoparasites of Panama. Ed. by R. L. WENZEL and V. J. TIPTON. Chicago: Field Mus. Nat. Hist. Pp. 753–795.
- HONACKI, J. H.; KINMAN, K. E.; KOEPL, J. W. (Eds.) (1982): Mammal Species of the World. Lawrence, Kansas: Allen Press and Association of Systematics Collections.
- HUTTERER, R. (1993): Order Insectivora. In: Mammal Species of the World: a Taxonomic and Geographic Reference. Ed. by D. E. WILSON and D. M. REEDER. Washington, D.C.: Smithsonian Institution Press. Pp. 69–130.
- IUCN (1999): Red Data Book. Mammalia. Gland, Switzerland: IUCN publ.
- MÉNDEZ, E. (1970): Los Principales Mamíferos Silvestres de Panamá. "Panamá": Published privately by the author.
- MILLER, G. S., JR.; KELLOGG, R. (1955): List of North American Recent mammals. U.S. Nat. Mus. Bull. **205**, 1–954.
- MYERS, C. W. (1969): The ecological geography of cloud forest in Panama. Am. Mus. Novit. **2396**, 1–52.
- MYERS, C. W.; DUELLMAN, W. E. (1982): A new species of *Hyla* from Cerro Colorado, and other tree frog records and geographical notes from western Panama. Am. Mus. Novit. **2752**, 1–32.
- NOWAK, R. M. (1991, 1999): Walker's Mammals of the World. Vol. I. Baltimore: Johns Hopkins Univ. Press.
- NOWAK, R. M.; PARADISO, J. L. (1983): Walker's Mammals of the World. Vol. I. Baltimore: Johns Hopkins Univ. Press.
- O'CONNOR, B. M.; LUKOSCHUS, F. S.; GIESEN, K. T. M. (1982): Two new species of *Marmosopus* (Acari: Astigmata) from rodents of the genus *Scotinomys* (Cricetidae) in Central America. Occas. Pap. Mus. Zool. Univ. Mich. **703**, 1–22.
- RIDGWAY, R. (1912): Color Standards and Color Nomenclature. Washington, D.C.: Published privately by the author.
- SAVAGE, J. M.; DONNELLY, M. A. (1992): The second collection of, and variation in, the rare Neotropical toad *Bufo peripatetes*. J. Herpetol. **26**, 72–74.
- SETZER, H. W. (1950): Two new shrews of the genus *Cryptotis* from Panama. J. Wash. Acad. Sci. **40**, 299–300.
- WOODMAN, N.; TIMM, R. M. (1993): Intraspecific and interspecific variation in the *Cryptotis nigrescens* species complex of small-eared shrews (Insectivora: Soricidae), with the description of a new species from Colombia. Fieldiana: Zool. (New Series) **74**, 1–30.
- WOODMAN, N.; TIMM, R. M. (1999): Geographic variation and evolutionary relationships among broad-clawed shrews of the *Cryptotis goldmani*-group (Insectivora: Soricidae). Fieldiana: Zool. (New Series) **91**, 1–35.

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