

Broadening the distribution of the microendemic shrew *Cryptotis phillipsii* (Eulipotyphla, Soricidae)

Ampliación de la distribución de la musaraña microendémica *Cryptotis phillipsii* (Eulipotyphla, Soricidae)

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The Phillips' small-eared shrew, *Cryptotis phillipsii* (Schaldach, 1966), is geographically restricted to a small patches of montane cloud forests from southern Oaxaca, México. Distributional records and specimens of *C. phillipsii* are relatively scarce, so it still remains as poorly-known species. Here, we provide 2 new localities based on the analyses of specimens that remained unidentified in a museum. We analyzed 5 specimens from the Sierra Madre del Sur biogeographic province, southwestern Oaxaca, which were collected in 1-liter pitfall traps. We determined the taxonomic identity of the specimens using specialized literature and by comparison with other shrew species potentially inhabiting the region. The external and cranial morphology allowed us to determine that these 2 specimens belong to the species *Cryptotis phillipsii*. These records extend the known distribution of *C. phillipsii* by about ca. 60 km west and provide additional information about their habitat preferences. The records presented here extend the range of *C. phillipsii* and corroborate predictions maps of current potential distributions suggesting the existence of suitable conditions for the species in the region. We urge continuing support and funding for fieldwork and the updating of scientific collections in order to accomplish the urgent task of completing the inventory of species and overcome the lack of their distributional information.

Key words: Cloud forests; inventories; México; museum specimens; taxonomy.

La musaraña de orejas pequeñas de Phillips, *Cryptotis phillipsii* (Schaldach, 1966), está geográficamente restringida a pequeños parches de bosques de niebla en el sur de Oaxaca, México. Los registros de distribución y los especímenes de *C. phillipsii* son relativamente escasos, por lo que sigue siendo una especie poco conocida. Proporcionamos 2 nuevas localidades basadas en el análisis de especímenes que permanecieron sin identificar en un museo. Analizamos 5 especímenes de la provincia biogeográfica de Sierra Madre del Sur, en el suroeste de Oaxaca, que fueron recolectados en trampas de caída de 1 litro de capacidad. Determinamos la identidad taxonómica de los especímenes usando literatura especializada y con la comparación con especímenes de otras especies de musarañas que potencialmente habitan la región. La morfología externa y craneal permitió determinar que estos 5 especímenes pertenecen a la especie *Cryptotis phillipsii*. Estos registros extienden la distribución geográfica conocida de *C. phillipsii* unos ca. 60 km al oeste y brindan más información sobre sus preferencias de hábitat. Los registros presentados aquí amplían la distribución de *C. phillipsii* y corroboran las predicciones de mapas de distribuciones potenciales actuales que sugieren la existencia de condiciones adecuadas para la especie en la región. Instamos a continuar el trabajo de campo y la actualización de las colecciones científicas para realizar la tarea urgente de completar el inventario de especies y superar la falta de información de su distribución geográfica.

Palabras clave: Bosques de niebla; especímenes de museos; inventarios; México; taxonomía.

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The lack of geographic information on species distributions (*i.e.*, the Wallacean shortfall; [Whittaker et al. 2005](#)) hinders our ability to adequately manage and conserve the natural resources of the planet. Although the scientific interest in the study of mammals has grown over the time, baseline data on the diversity and distribution of some taxonomic groups are far from well known, because biological explorations are insufficient, especially in tropical mountain regions ([Guevara and Sánchez-Cordero 2018](#); [Mayén-Zaragoza et al. 2019](#)). On the other hand, it has been observed that specimens representing new records (or even new species) have already been obtained but remain unidentified or misiden-

tified in natural history collections ([Kemp 2015](#)). Thus, it is necessary to work from several fronts to achieve a minimal knowledge on the geographical distribution of species, particularly those secretive, elusive or rare species, for which the use of inappropriate collecting methods, poor sampling effort, and problems in taxonomic identification prevent the completeness of inventories ([Carraway 2007](#); [Lobo et al. 2018](#)).

One of these groups are the shrews (Eulipotyphla, Soricidae), which comprise small-sized mammals that occupy various ecological niches and modes of life ([Berman et al. 2007](#)). In México and the United States of America, where



Figure 1. Specimen of the Phillips' small-eared shrew, *Cryptotis phillipsii*, collected in San Miguel Panixtlahuaca, Oaxaca (OAX.MA 4263). Bar indicates 5 mm.

the greatest diversity of shrews in the Americas occurs, the discovery and description of new species, rediscoveries, and range extensions within this family are yet common (Cervantes *et al.* 2008; Lorenzo *et al.* 2019). Of the 5 extant genera of shrews in the Americas, small-eared shrews of the genus *Cryptotis* have the widest distribution extending from eastern North America to the north of South America (Woodman 2019). The genus attains its greatest diversity in the northern tropics of southern México, particularly in the State of Oaxaca, including the presence of sympatric and syntopic species (Guevara and Cervantes 2017). Most of the species of *Cryptotis* in Oaxaca are relatively homogeneous in external and cranial morphology (Choate 1970; Guevara and Cervantes 2017). It is therefore not unusual to find species to be morphologically almost indistinguishable, and for which some specimens could remain unidentified or misidentified in museums (Woodman and Timm 2000; Guevara and Sánchez-Cordero 2018).

Long-term field inventories of small mammals in the Sierra Madre del Sur biogeographic province, southwestern Oaxaca, have yielded various specimens of the genus *Cryptotis* collected in 1-liter capacity pitfall traps (collecting

permit FAUT-0037, SEMARNAT). However, some specimens have remained unidentified. Therefore, we revised five specimens from two localities to clarify their taxonomic status using specialized literature (Carraway 2007; Woodman and Timm 2000) and by comparison with specimens of *C. goldmani machetes*, *C. phillipsii*, and *C. pueblensis*, which correspond to shrew species potentially inhabiting the same region (see Appendix I). The five specimens examined have a broad zygomatic plate and a well-developed lower third molar compared to *C. pueblensis*; they are also relatively smaller in head-and-body length and exhibit narrower foreclaws compared to *C. goldmani machetes*. The external and cranial morphology of the specimens examined allowed us to determine that these belong to the species *Cryptotis phillipsii* (Figure 1).

Two specimens (Mammal Collection of the CIIDIR-Oaxaca, OAX.MA 4268, 4269) were collected along a stream surrounding by montane cloud forest and coffee plantations at 914 m in the municipality of San Agustín Chayuco, whereas other 3 specimens (OAX.MA 4262, 4263, and 4264) were collected in a very wet slope of cloud forests with arborescent ferns at 1,654 m in the municipality of San Miguel Panixtlahuaca (Figure 2). In the same area where *C. phillipsii* was collected in San Agustín Chayuco, some specimens of *Peromyscus aztecus* were also obtained. In San Miguel Panixtlahuaca, also *P. aztecus*, plus *P. melanurus*, *P. mexicanus*, *Oryzomys fulgens*, and *Heteromys pictus* were collected and deposited at the OAX.MA.

The Phillips' small-eared shrew, *Cryptotis phillipsii* (Schalldach, 1966), is one of the less-known species in México. Initially described as *Notiosorex phillipsii*, was later included as a population of *C. mexicana peregrina* (or most recently as *C. peregrinus*); however, a morphological and molecular revision supports its status as species separated from *C. peregrinus*, a similar but not closely related species (Woodman and Timm 2000). The revised specimens of southwestern Oaxaca increase the number of specimens known of *C. phillipsii* available in natural history museums, from 55 to 60 specimens, of which just over half (51.6 %) are housed in Mexi-

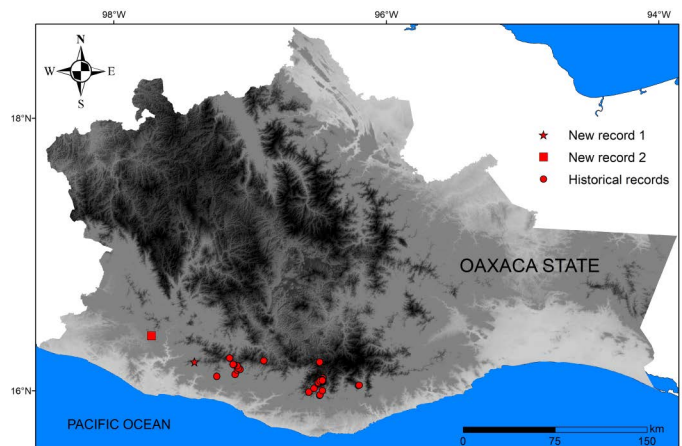


Figure 2. Map showing historical (dots) and new records (star, San Miguel Panixtlahuaca; square, San Agustín Chayuco) of the Phillips' small-eared shrew, *Cryptotis phillipsii*, in Oaxaca, southern México. New records extend its geographic range ca. 60 km to the west.

Table 1. Records of the Phillips' small-eared shrew, *Cryptotis phillipsii*, in Oaxaca, México, indicating the month and year of collecting. American Museum of Natural History, New York, New York (AMNH); California Academy of Sciences, San Francisco, California (CAS); Colección Nacional de Mamíferos, México City (CNMA); Escuela Nacional de Ciencias Biológicas, México City, (ENCB); The University of Kansas Natural History Museum, Lawrence, Kansas (KU); Louisiana State University, Baton Rouge, Louisiana (LSUMZ); University of Michigan, Museum of Zoology, Ann Arbor, Michigan (UMMZ); Colección Mastozoológica del CIIDIR-Oaxaca, IPN (OAXMA).

Records	Month	Year	Locality
AMNH 178739	August	1957	San Andres Lovene, San Juan Ozolotepec
UMMZ 112572	July	1963	Near Campamento Río Molino (Hwy 175), 7300 ft
CNMA 8444-8446, 8447; AMNH 213758-213759; 214152, 214803-214805; KU 114226	December	1964	Río Molino
KU 121661	December	1969	Río Molino
KU 124298-124299	April	1970	Río Molino
LSUMZ 11915	July	1969	Río Molino
KU 98728	July	1964	20 mi S, 5 mi E Sola De Vega
CAS 14940-14941	March	1965	Sinai, 10 km E Nopala
AMNH 214806, 214808	October	1967	San Miguel Suchixtepec
CAS 14069, 14071-14072 CNMA 26552	April	1968	Km 178, Río Jalatengo, Puerto Angel Rd.
CAS 15475	January	1970	Río Jalatengo, Puerto Angel Rd.
ENCB 3413-3414	January	1968	16 km SW San Miguel Suchixtepec
CAS 14068	April	1968	Km 153, Río Molino, Puerto Angel Rd.
KU 124295-124296	November	1969	27.8 Km (By Road) N of San Gabriel Mixtepec
CNMA 27517-27518	June	1970	Puerto Ángel Road, Km 158
CNMA 26551	January	1970	Km 195 Oaxaca-Puerto Ángel Rd.
CAS 15478	January	1970	Lumber Camp, Km 158, Puerto Angel Rd.
CAS 15476	January	1970	Km 195 Puerto Escondido Rd.
CAS 15474	January	1970	Km 193 Puerto Escondido Rd.
CAS 15473	January	1970	La Cima, Km 184-1/2 Puerto Escondido Rd.
KU 124294	May	1970	36 Km (By Road) N San Gabriel Mixtepec
CNMA 44682, 44724-44736	October	2006	Campamento Río Molino, 2 km SSW San Miguel Suchixtepec
CNMA 44723	October	2006	3.25 Km NE San Juan Lachao
CNMA 44699	October	2006	Santa Rosa, 1.5 km NE San Juan Lachao
OAXMA 4262-4264	March	2009	5.08 km S, 3.32 km W San Miguel Panixtlahuaca
OAXMA 4268-4269	February	2009	9 km E San Agustín Chayuco

can museums (Table 1). *Cryptotis phillipsii* inhabits tropical montane cloud forests over an altitudinal range of 900 to 2,500 m, being geographically restricted to only 6,000 km² in the Sierra Madre del Sur biogeographic province, within the state of Oaxaca (Álvarez-Castañeda et al. 2018). The records presented here fall in this habitat and elevational range. Further research is necessary to assess how coffee plantations affect their populations, in particular in San Agustín Chayuco. A search in databases and literature indicates that this species has been collected throughout the year (Table 1; Sánchez-Cordero and Guevara 2016; Woodman and Timm 2000).

The two new localities presented here extend the distribution by ca. 60 km to the west of the nearest localities in the Sierra de Miahuatlán (Figure 2; Woodman and Timm 2000). In particular, the records of San Agustín Chayuco are notables because they are located crossing Río Verde, a large watercourse running in northern-southern direction that break the continuity of the mountains in the Sierra Madre del Sur. Maps of current potential distributions have suggested the existence of suitable conditions for cloud forest

shrews in that region, but so far there were no records that corroborate its presence (Guevara et al. 2015; Guevara and Sánchez-Cordero 2018). Therefore, the records analyzed here contribute to the value of these studies by corroborating their predictions. Due to its estimated area of occupancy and environmental threats within its distribution area, it is cataloged as vulnerable according to the International Union for Conservation of Nature (Álvarez-Castañeda et al. 2018); however, it has not been considered of priority protection by the Mexican government (SEMARNAT 2010, 2019).

It is feasible that the lack of more records of *C. phillipsii* in other predicted regions, such as southern Guerrero, is due to insufficient fieldwork. We then invite the scientific community to continue long-term surveys in under-sampled regions using proper methods for small mammals. In the case of shrews from northern Neotropics, pitfall traps have proven be highly efficient (Umetsu et al. 2006). On the other hand, it is also possible that, as shown in this work, specimens have already been collected but remain forgotten or ignored in the drawers of the collections (Kemp 2015). Therefore, we urge the constant updating of scientific col-

lections, as well as the databases associated with voucher specimens. Collaborative work between curators and specialist taxonomists should be the norm in order to accomplish the task of completing the inventory of species and overcome the lack of distributional information (Johnson 2012). This accumulated knowledge will provide crucial information for a better understanding of the evolutionary history and conservation status of poorly-known species.

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Appendix I

Specimens examined

Cryptotis pueblensis (17). México: Oaxaca; 1.5 km NE Santa Rosa, Santiago Jamiltepec (CNMA 44691, 44693, 44694, 44698, 44701); km 193 Oaxaca-Puerto Escondido Road, 2.25 km NE San Gabriel Mixtepec (CNMA 44704, 44705, 44707–44709, 44711, 44713, 44715–44717); 20 mi S, 5 mi E Sola de Vega (KU 99547); 27 km (by road) S Juchatengo, 1850 m (KU 121662).

Cryptotis goldmani machetes (14). México: Oaxaca; Campamento Río Molino, 2 km SSW San Miguel Suchixtepec (CNMA 44675–44681, 44683–44689).