

# Shrews (Eulipotyphla, Soricidae) of Guatemala

## Musarañas (Eulipotyphla, Soricidae) de Guatemala

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**Abstract.** Shrews (Soricidae) are the only members of the mammalian order Eulipotyphla that occur in Central and South America. In Guatemala, 15 species have been recorded belonging to the genera *Cryptotis* and *Sorex*, 3 of which are new and undescribed. Additionally, 2 species are expected to be discovered in the country based on their known distributions. Most species appear to have limited reproduction throughout the year. We review the taxonomy and natural history of these species.

**Keywords:** *Cryptotis*; natural history; reproductive patterns; *Sorex*; taxonomy.

The family Soricidae or soricids (shrews) is a diverse group of small mammals found throughout much of the world, occurring on every continent except Antarctica and Australia. They can be active at any time of the day, possibly because of a relatively high metabolism that requires an almost constant intake of food. Their diet consists mostly of invertebrates, but may include occasionally small vertebrates, carrion, and vegetation (Churchfield, 1990).

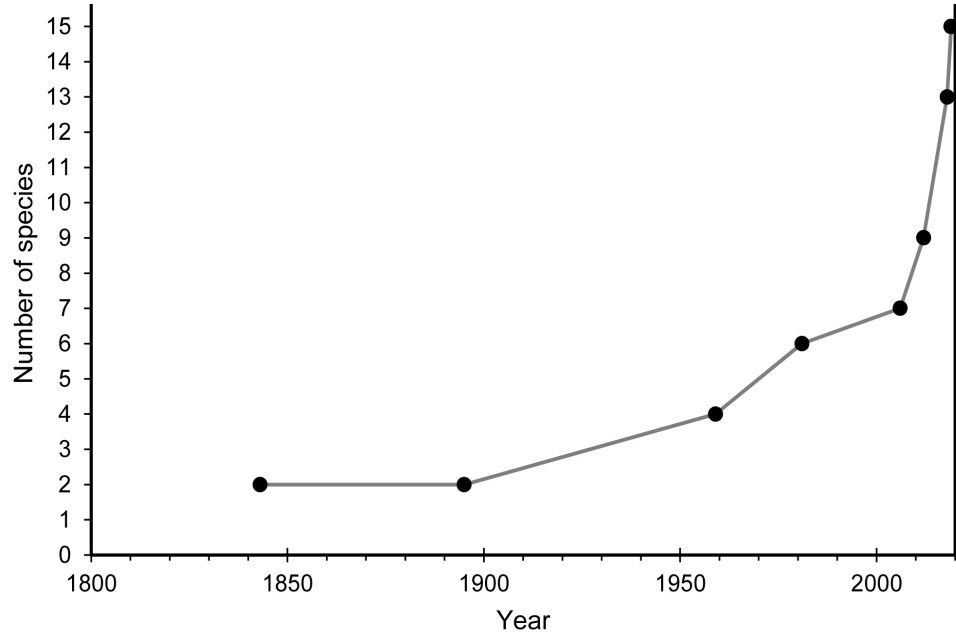
In Guatemala, shrews occur primarily in cool moist montane forests; however, a few are found in lowland forests. In general, shrews of the genus *Sorex* are restricted to montane habitats. Members of the genus *Cryptotis* are more generalist in their distribution, being found in lowland as well as montane forests (Woodman *et al.*, 2012). While they are not arboreal, they can be found on fallen tree trunks, especially if the trees are covered with mosses. Some members of the genus *Cryptotis* are adapted to fossorial life styles (Woodman and Stephens, 2010).

The first shrews recorded from Guatemala were 9 specimens, representing 2 species, reported by Gray (1843). Of these, 7 represent the genus *Cryptotis* and the other 2 represent *Sorex veraepacis* Alston, 1877. All of these early specimens were recorded as being from Cobán, Alta Verapaz. However, the use of Cobán as a locality by early collectors may not be accurate, because many of those specimens actually came from the surrounding region (Matson and McCarthy, 2005; McCarthy and Pérez, 2006; Woodman, 2011a; Matson and Ordóñez-Garza, 2017). The number of known species increased as more data became available (fig. 1).

### Reproductive patterns

Reproductive patterns of Neotropical soricids are based primarily on a few scattered records over the span of decades (Woodman *et al.*, 2012). The most complete data available for a tropical small-eared

**Figure 1.** Number of species of shrews recorded from Guatemala based on data from: Gray (1843), Hall and Kelson (1959), Hall (1981), McCarthy and Pérez (2006), Woodman *et al.* (2012), Woodman (2018, in press) and this chapter.



shrew is for *Cryptotis meridensis* Thomas, 1898 in the Venezuelan Andes. This species appears to have the potential to reproduce throughout the year, as pregnant females were present in all months except July and December. The proportion of pregnant females peaked in April at 23 %. Lactating females were found in all months of the year, with the highest proportion (36 %) in July (Woodman and Díaz de Pascual, 2004).

In Central America, data on reproduction remain scarce. The most extensive dataset for Guatemala is for *Sorex ibarraii* Matson and McCarthy, 2005, for which there are data based on 75 females representing 5 months of the year (Woodman *et al.*, 2012). These data indicate that some females are pregnant or lactating in January, April, May, and July, but that a minority of the female population is reproductively active at any given time. The relative numbers of pregnant and lactating females suggest an increased level of reproduction in April through July compared to January and February. Such a pattern is tentatively supported by smaller datasets available from northern Neotropical soricids, which also show reproductively active females present in January, April, July, October, and December (Woodman *et al.*, 2012). As a whole, peak reproductive activity in Neotropical shrews appears to be in April through July, with a tapering off toward October. If this is representative, it suggests that the majority of births and lactation periods are timed to coincide with a rainy season that lasts from mid-May through October. Both ar-

thropod abundance and availability of earthworms are positively associated with rainfall (Fragoso and Lavelle, 1992; Bergallo and Magnusson, 1999), so peak reproduction and lactation may coincide with higher availability of food resources. Litter sizes (based on embryo counts) in Guatemalan and Honduran shrews range from 1 to 2 in *Sorex* and from 1 to 4 in *Cryptotis*, which are low compared to temperate species of these two genera, which can reach as high as 10 young (Woodman *et al.*, 2012; Woodman, 2015).

## Taxonomic Accounts

### Order Eulipotyphla Waddell *et al.*, 1999

The order Eulipotyphla comprises a subset of the mammalian families that formed the traditional, polyphyletic order Insectivora (Waddell *et al.*, 1999). The Eulipotyphla families that are considered to form a natural group include the hedgehogs and gymnures (Erinaceidae), solenodons (Solenodontidae), moles (Talpidae), and shrews (Soricidae). Only 1 of these families, the Soricidae, is present in Guatemala. In Guatemala, 2 genera represent the soricids, the long-tailed shrews of the genus *Sorex*, and the small-eared shrews of the genus *Cryptotis*.

### Family Soricidae Fischer, 1814

The Soricidae comprises at least 25 genera and more than 330 species distributed throughout Eurasia, Africa, North and Central America, and

northern South America (Hutterer, 2005). In external appearance, shrews are small (head and body length 35 – 150 mm, mass 2 – 106 g), mouse-like mammals that are often mistaken for small rodents. Shrews typically have small pinnae that are often concealed by fur, small eyes, and an elongated, pointed snout. They have a long, narrow, flat skull with incomplete zygomatic arches lacking jugals and auditory bullae. The articular condyle of the dentary has a double articulation with the cranium. The teeth of shrews exhibit a unique combination of characteristics. The deciduous dentition is shed in utero.

The Soricidae is partitioned among 3 subfamilies: the Holarctic Soricinae, the Palearctic Crocidurinae, and the African Myosoricinae. Only members of the subfamily Soricinae occur in the New World. The tips of the teeth of most soricines (except *Megasorex* and *Notiosorex*) have a distinctive red pigmentation. The large, curved first upper incisor and long, procumbent first lower incisor form a pincer-like foraging device. Behind the first upper incisor, the anterior upper dentition (incisors, canine, and anterior premolars) is comparatively simple and undifferentiated, and these teeth are often referred to as “unicuspids”. Homologies of the unicuspid have been difficult to determine, and for this reason, dental formulae for individual species often disagree in the relative numbers of incisors, canines, and premolars. Among Guatemalan shrews, there are typically either 4 (*Cryptotis*) or 5 (*Sorex*) unicuspid. The shrew humerus bears a teres tubercle, a bony process mostly unique to shrews and moles. The clavicle is long and slender. The pubic symphysis is open, so that the two halves of the pelvis are not in contact. Shrews are sometimes considered primitive or generalized mammals, but such views ignore the unique suite of cranial, dental, and postcranial specializations possessed by these small animals.

## Accounts of species

### Genus *Cryptotis* Pomel, 1848

The small-eared shrews of the genus *Cryptotis* include at least 48 species that together constitute a geographical range that extends from the eastern United States and southernmost Canada to north-eastern Venezuela and northern Peru (Hutterer, 2005; Woodman, 2018). Species occupy a variety of habitats from sea-level grasslands and second-growth woodlands in northern North America

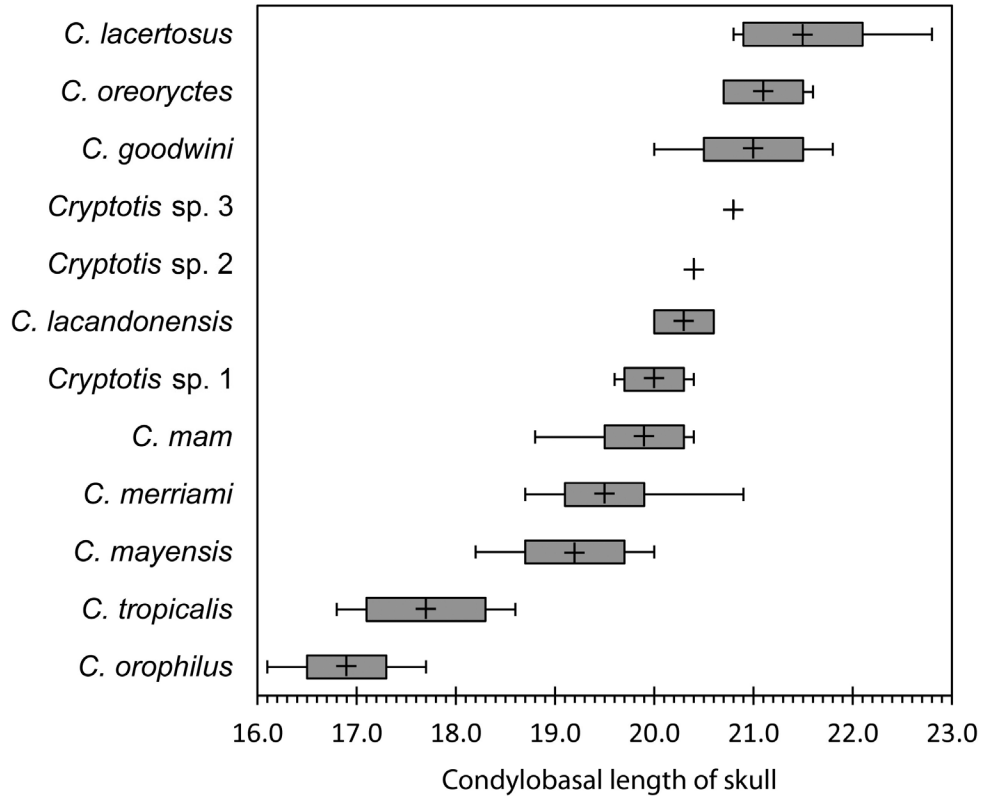
to humid montane forests and paramos in northern South America. Most species in Central America, except *C. lacandonensis* Guevara *et al.*, 2014, *C. mayensis* (Merriam, 1901), and *C. merriami* Choate, 1970, occur above about 1000 m. They typically inhabit lower montane moist forest, lower montane wet forest, montane wet forest, and montane rain forest life zones of Holdridge (1947) and may occur in disturbed cloud forest and secondary forest.

In Guatemala, *Cryptotis* are small to medium-sized shrews (length of head and body 48 – 96 mm, tail 18 – 34 mm, mass 4 – 19 g, condylobasal length of skull or CBL 16.1 – 22.8 mm, fig. 2). These small mammals have medium-gray to nearly black pelage and a short- to medium-length tail that is typically < 50 % of the length of the head and body. The tips of the cusps of the teeth are red-pigmented. There are 4 upper unicuspid that decrease in size posteriorly, the fourth unicuspid always smaller than the third.

The species of *Cryptotis* are often partitioned taxonomically among 5 informal species groups based upon external, cranial, dental, and postcranial characteristics (Choate, 1970; Woodman, 1996, 2002, 2015; Woodman and Timm, 1993, 1999, 2000; Woodman *et al.*, 2003). In Guatemala, only 3 of these groups are present.

The *Cryptotis goldmani*-group occurs from Mexico through Honduras. Species in this group are notable externally by their generally larger body size, longer pelage with little difference in color between dorsum and ventrum, enlarged forefeet, and elongate and broadened fore claws. These species are adapted for greater fossoriality than other members of the genus, and the skeleton of the forelimb is strongly modified. The humerus is relatively short and broad with enlarged processes for the insertion and origin of enlarged fore limb muscles; the olecranon process of the ulna is enlarged; the bones of the forefeet are shortened and broadened, except for the distal phalanges, which are elongated and broadened to support the enlarged claws. In Guatemala, the *C. goldmani*-group includes 4 named species (*C. goodwini* Jackson, 1933, *C. laceratosus* Woodman, 2010, *C. mam* Woodman, 2010, *C. oreoryctes* Woodman, 2011), which are endemic to the country and occur in moist forests above 1100 m elevation. There are 3 populations from Cerro Cucurucho, highlands east of Mataquescuintla, and Cerro Montecristo in the eastern Sierra Madre of Guatemala that remain to be described.

**Figure 2.** Box-and-whisker plot showing relative sizes of species of Guatemalan *Cryptotis* as measured by condylobasal length of the skull (CBL). Statistics represented are the sample mean (cross),  $\pm$  one standard deviation (gray box), and minimum-maximum (vertical lines). *Cryptotis lacandonensis* and *C. orophilus* are not yet known from Guatemala, and *C. mayensis* is known from only a single modern specimen.



The *Cryptotis nigrescens*-group is known from southern Mexico to Colombia. These are relatively smaller shrews that are adapted for a mostly terrestrial existence under the leaf litter. In addition to their generally smaller body size, they have shorter pelage with little difference in color between dorsum and ventrum, small fore feet, and short, narrow claws. The humerus is relatively long, straight, and narrow with relatively small processes; the olecranon process of the ulna is relatively small; the bones of the forefeet are relatively long and narrow, except for the distal phalanges, which are short and narrow, like the claws they support. In Guatemala, this group includes 2 species, the widespread *C. merriami*, and *C. mayensis*, which occurs from the Yucatán Peninsula into northern Petén. Elevational distribution of the members of the *C. nigrescens*-group in Guatemala is from near sea level to about 1750 m. A third species, *C. lacandonensis*, is known from just over the border in Chiapas, Mexico, and will likely be found in Guatemala.

The *Cryptotis parvus*-group ranges from southeastern Canada and the eastern United States to Costa Rica. Like members of the *C. nigrescens*-group, members of the *C. parvus*-group are smaller shrews that are adapted for a mostly terrestrial existence. Externally, they have shorter pelage with a notably paler ventrum than dorsum, small fore feet, and

short, narrow claws. The humerus, ulna, and bones of the forefeet are generally like those of members of the *C. nigrescens*-group, but are typically smaller. Only 1 species, *C. tropicalis* (Merriam, 1895), is documented as occurring in Guatemala; however, a second species, *C. orophilus* (J.A. Allen, 1895), may be present along the eastern border with El Salvador and Honduras. The potential elevational distribution of species of this group in Guatemala is 975 – 1985 m.

#### 1. *Cryptotis goodwini* Jackson, 1933

Goodwin's broad-clawed shrew was formerly thought to range geographically in highland regions from the Sierra Madre del Sur of southern Chiapas, Mexico, to northern El Salvador and western Honduras (Choate, 1970; Hutterer, 1980; Woodman and Timm, 1999). The species was originally described from a series of specimens near Calel collected in 1895 by the Nelson and Goldman expedition (Goldman, 1951). More recent studies indicate that *C. goodwini* was a complex of several closely related, cryptic species. These species now include *C. lacertosus* and *C. oreoryctes* in Guatemala and *C. celaque* Woodman, 2015, *C. mcCarthyi* Woodman, 2015, and *C. cavatorculus* Woodman, 2015 in Honduras (Woodman, 2010, 2011b, 2015; He *et al.*, 2015; Baird *et al.*, 2017). Pleistocene fossils

reported as *C. goodwini* from near Copán, Honduras (Woodman and Croft, 2005), may represent a distinct modern species.

*Cryptotis goodwini* s. str. is endemic to Guatemala, where it occurs at elevations of 1200 – 3355 m in the western Sierra Madre of Guatemala (Woodman *et al.*, 2012; Woodman, 2015). The species is typically associated with moist areas along streams or in heavily wooded montane cloud forest with deep leaf litter and, commonly, mosses and liverworts (Woodman *et al.*, 2012).

## 2. *Cryptotis lacandonensis* Guevara *et al.*, 2014

*Cryptotis lacandonensis* is 1 of only 2 lowland species of small-eared shrews in the region. The Lacandona shrew is known from lowland tropical rain forest on the floodplains of the Lacantún and Usumacinta rivers in Chiapas, Mexico. This floodplain is about 90 m above sea level here, and dominant forest trees reach > 40 m in height. Although this species has not yet been reported in Guatemala, the Usumacinta forms part of the border between Chiapas and neighboring Petén, so it is likely to be found in Guatemala as well (Guevara *et al.*, 2014).

## 3. *Cryptotis lacertosus* Woodman, 2010

The muscular broad-clawed shrew is endemic to the Sierra de los Cuchumatanes, western Guatemala, where it occurs in subtropical montane wet forest. Its documented elevational distribution is 2680 – 3110 m (Woodman *et al.*, 2012). Individuals have been reported from relatively closed-canopy cloud forest dominated by oaks, pines, and firs and having abundant mosses and downed trees. Reproductive biology of *C. lacertosus* is unknown.

## 4. *Cryptotis mam* Woodman, 2010

The Mam shrew, named for a Mayan indigenous group, is endemic to the Sierra de los Cuchumatanes in western Guatemala. *Cryptotis mam* occurs in mixed open conifer forest, especially along streams, and its known elevational distribution is 2895 – 3350 m. Specimens of this shrew were first obtained near Todos Santos Cuchumatán in 1895 by the Nelson and Goldman expedition (Goldman, 1951). This population was formerly identified as Goldman's small-eared shrew, *C. goldmani* and later as Jackson's broad-clawed shrew, *C. griseoventris*. Both of those species are now restricted to Mexico (Choate, 1970; Woodman and Timm, 1999; Woodman and Stephens, 2010).

Reproductive biology of *C. mam* is mostly unknown. A single female captured in July was lactating. Study of gut contents of four females suggests that earthworms (Oligochaeta) may be an important component of its diet, while beetles (Coleoptera) and seeds are also consumed (Woodman *et al.*, 2012). Intestinal parasites include hymenolepid tapeworms (Platyhelminthes, Cestoda) (Woodman *et al.*, 2012).

## 5. *Cryptotis mayensis* (Merriam, 1901)

With the exception of an anomalous record of *C. mayensis* from owl pellets in Guerrero, Mexico (López-Forment and Urbano, 1977; Woodman and Timm, 1993), the Mayan shrew is restricted to the Yucatán Peninsula of Belize, Guatemala, and Mexico (Woodman and Timm, 1993). *Cryptotis mayensis* and the closely related *C. lacandonensis* from Chiapas, Mexico, are the only exclusively lowland small-eared shrews in the northern Central American region.

Only a single female, obtained in 1988 at Biotopo Cerro Cahuí, Petén, currently documents the modern presence of *C. mayensis* in Guatemala. Located along the northeast shore of Lago Petén-Itzá, elevations on and around Cerro Cahuí extend from above 100 m to above 350 m. Cerro Cahuí represents the southwestern limit of the species' known distribution. The only previous record of *C. mayensis* from Guatemala was based on a collection of skeletal remains representing at least 104 individuals of unknown archeological age that were discovered in a Mayan vase in the ruins of Uaxactún (Murie, 1935). Pleistocene fossils of *C. mayensis* are known from several caves in the Yucatán of Mexico (Woodman, 1995).

## 6. *Cryptotis merriami* Choate, 1970

Merriam's shrew is distributed through the northern Central American highlands from the Altiplanicie Central de Chiapas, Mexico, to northern Nicaragua, with disjunct populations in the Tilarán Highlands of northern Costa Rica (Woodman and Timm, 1993; Woodman, 2000). Its known elevational distribution is from 600 m to 1750 m. In Guatemala, the species' distribution includes the Sierra de los Cuchumatanes, Sierra de las Minas, Sierra del Merendón, and Cerro Seja in the Sierra de Santa Cruz. Specimens from Trifinio, near the base of Cerro Montecristo, indicate the species reaches the southeastern mountains of Guatemala as well (Woodman *et al.*, 2012).

Pleistocene fossils of this species were reported from caves near Copán, Honduras (Woodman and Croft, 2005).

Woodman *et al.* (2012) reported capturing individuals in a small patch of secondary forest surrounded by cornfields at Finca Concepción (a former coffee plantation in cultivation since before 1928, Griscom, 1932); in a large patch of disturbed hardwood forest bordering pasture on a hill behind Hotel Country Delights; and in secondary growth in a former coffee plantation at El Limo. These records indicate tolerance for long-term habitat disturbance and an ability to survive in small patches of disturbed and secondary vegetation.

Of 13 females from the months of February, July, October, and December, only 2 showed signs of recent reproductive activity. A pregnant female carrying 3 embryos (Crown-Rump length = 10 mm) was captured on 20 July 2007 at Hotel Country Delights, and a lactating female was recorded 11 July 1994 at Cerro Pozo de Agua (Woodman *et al.*, 2012).

Analysis of the contents of the digestive tract of an individual from El Limo contained tracheal tubes and fragments of a chitinous exoskeleton from a large insect. Intestinal parasites include roundworm (Nematoda) and oocysts of the coccidian *Eimeria hondurensis* Duszynski *et al.*, 2003 (Duszynski *et al.*, 2003).

#### 7. *Cryptotis oreoryctes* Woodman, 2011

The Yalijux shrew is probably endemic to the Sierra de Yalijux, central Guatemala, where it is known from above 2000 m in subtropical montane rain forest (Woodman *et al.*, 2012). Individuals reported from Chelemhá Cloud Forest Reserve were obtained on a steep, moist, north-facing slope with abundant downed trees and mosses in a cloud forest dominated by oaks and pines (Woodman, 2011b). Study of the small mammals inhabiting the Chelemhá cloud forest suggests that *C. oreoryctes* is a relatively uncommon member of a community of at least 15 species of small mammals. Of 175 records, the Yalijux shrew represent < 2 % of captures, whereas, *Sorex veraepacis* comprised > 8 % of captures (Matson *et al.*, 2015). Specimens collected in the nineteenth century “near Cobán” were probably captured in the Sierra de Yalijux and transported to Cobán (Woodman, 2011a).

Reproductive biology is poorly documented. Among 7 females from January, 2 were pregnant, with 2 embryos and 3 embryos. A female taken

on 15 April 1998 was pregnant with 2 embryos (Crown-Rump length = 15 mm). Testes of males captured in January ranged in size from 2.5 x 2 mm to 10 x 6.5 mm (Woodman *et al.*, 2012).

Intestinal parasites include oocysts of the coccidian (Apicomplexa, Coccidia, Eimeriidae) parasites *E. hondurensis* and *E. whitakeri* Upton and McAllister, 1991 (Duszynski *et al.*, 2003). External parasites include the rare tick (Acari, Ixodida, Ixodidae) species *Ixodes guatemalensis* Kohls, 1956 (Keirans and Eckerlin, 2005).

#### 8. *Cryptotis orophilus* (J.A. Allen, 1895)

The Central American least shrew is known to occur from northern El Salvador and western Honduras to the Central Valley of Costa Rica (Choate, 1970; Woodman and Timm, 1993). Its known elevational distribution is ca. 1150 – 1985 m (Woodman and Timm, 1993). Although the species has not yet been reported from Guatemala, it is possible that *C. orophilus* may yet be found in suitable habitats along the eastern borders with El Salvador and Honduras. Elsewhere in Guatemala, *C. orophilus* is probably replaced ecologically by the morphologically similar *C. tropicalis*, but the distributional limits of both species are poorly known. Pleistocene fossils of *C. orophilus* were reported from a cave near Copán, Honduras (Woodman and Croft, 2005).

#### 9. *Cryptotis tropicalis* (Merriam, 1895)

The tropical least shrew has a geographic range from southern Chiapas through Guatemala (Choate, 1970; Woodman and Timm, 1993). Its elevational distribution is poorly known, but specimens have been recorded from ca. 975 – 1580 m.

A female specimen of *C. tropicalis* from 3.5 km north of La Trinidad was captured in an overgrown coffee plantation. The nature of the vegetation at this locality suggests that this species may have a relatively high tolerance for habitat disturbance or early succession plant associations (Woodman *et al.*, 2012).

#### 10. *Cryptotis* sp. from Cerro Cucurucho

Cerro Cucurucho, in Sacatepéquez Department, is part of an isolated highland > 2000 m elevation between Guatemala City to the northeast and Antigua Guatemala to the northwest. Captures of small mammals on Cerro Cucurucho in 2013 and 2015 yielded 8 female and 6 male broad-clawed shrews that have proven to be an undescribed spe-

cies. Based on numbers of captures, this shrew is the second most abundant species in a cloud forest community of at least 10 native small mammals. The habitat at higher elevations on Cerro Cucurucho was reported to be “severely disturbed” cloud forest. Some individuals host an undescribed species of hymenolepid tapeworm (Ordóñez-Garza *et al.*, 2014; Woodman, in press).

#### 11. *Cryptotis* sp. from near Mataquescuintla

In 1947, Charles O. Handley collected a male broad-clawed shrew at 2560 m elevation on an isolated highland in Jalapa Department, about 10 km east of Mataquescuintla. This specimen represents a previously unknown species that is being described (Woodman, in press).

#### 12. *Cryptotis* sp. from Cerro Montecristo

Cerro Montecristo is an isolated mountain comat the junction of the borders of northwestern El Salvador, eastern Guatemala, and western Honduras. A broad-clawed shrew known from specimens collected on at 2150 m in El Salvador and at 2418 m in Guatemala has proven to be a previously unknown species. Among 3 females captured in July 2004 at Trifinio, Guatemala, 1 was lactating, and 2 were pregnant, with 2 embryos (Crown-Rump length = 13 mm) and 3 embryos (Crown-Rump length = 7 mm).

### Genus *Sorex* Linnaeus, 1758

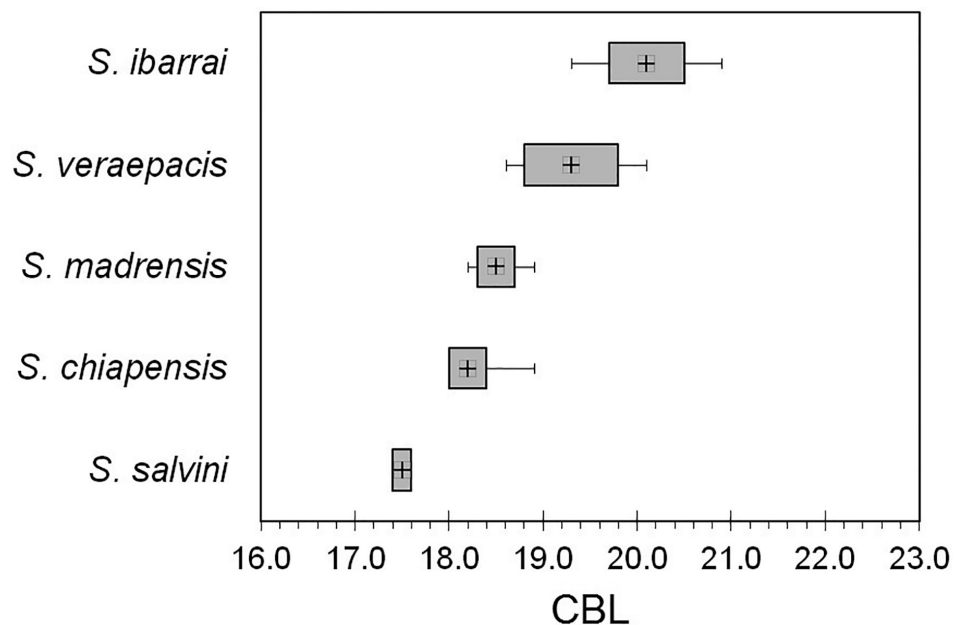
Long-tailed shrews of the genus *Sorex* include at least 80 species that are essentially Holarctic in distribution. Species occupy a variety of habitats from sagebrush scrub to humid montane forests. In Central America they are known to occur only above 1400 m in various montane and cloud forests.

In Guatemala, *Sorex* are small to medium-sized shrews (length of head and body 52 – 79 mm, tail 43 – 66 mm, mass 5 – 13.5 g, condylobasal length of skull or CBL 17.4 – 20.9 mm, fig. 3). These small mammals have medium-gray, brown to nearly black pelage, and tail length is typically > 50 % of the length of the head and body. There are 5 upper unicuspid teeth that decrease in size posteriorly.

Various authors (Diersing and Hoffmeister, 1977; Junge and Hoffmann, 1981; Hutterer, 2005; Carraway, 2007) considered the genus *Sorex*, in the New World, to be composed of 2 subgenera, *Sorex* and *Otisorex*. More recently, Ohdachi *et al.* (2006), Dubey *et al.* (2007), and Esteva *et al.* (2010), based upon molecular data, suggested that only the subgenus *Otisorex* occurs in this region, placing *S. saussurei* Merriam, 1892 into that subgenus rather than into the subgenus *Sorex*. Thus, while several subgenera of *Sorex* are recognized worldwide (Hutterer 2005), only 1 is represented in Guatemala (Esteva *et al.*, 2010; Matson and Ordóñez-Garza, 2017).

Matson and Ordóñez-Garza (2017) recognized 2 species groups based upon the presence or absence of a postmandibular foramen and canal. The *Sorex salvini*-group possesses a postmandibular foramen and canal, and is represented in Guatemala

**Figure 3.** Box-and-whisker plot showing relative sizes of species of Guatemalan *Sorex* as measured by condylobasal length of the skull (CBL). Statistics represented are the sample mean (cross),  $\pm$  one standard deviation (gray box), and minimum-maximum (vertical lines).



by *S. salvini* Merriam, 1897. The *S. veraepacis*-group lacks the postmandibular foramen and canal, and is represented by *S. chiapensis* Jackson, 1925, *S. ibarrai*, *S. madrensis* Matson and Ordóñez-Garza, 2017, and *S. veraepacis*.

### 1. *Sorex chiapensis* Jackson, 1925

The Chiapas shrew, in Guatemala, is known only from El Retiro in the Montañas de Cuilco of Huehuetenango (Matson and Ordóñez-Garza, 2017). The species was reported from the Sierra Madre of Guatemala by Woodman *et al.* (2012); however, those specimens were considered to belong to an undescribed species (Matson and Ordóñez-Garza, 2017). Woodman *et al.* (2012) assigned specimens from El Retiro, Huehuetenango, to *S. v. veraepacis*, but multivariate analyses clearly place that population with *S. chiapensis* (Matson and Ordóñez-Garza, 2017). El Retiro is in the Montañas de Cuilco, which is adjacent to the Chiapan border to the north. El Retiro is also west of the Río Selegua that separates the Sierra de los Cuchumatanes (where *S. veraepacis* is found) from the Montañas de Cuilco. The Río Cuilco separates the Montañas de Cuilco from the Sierra Madre to the west and south. All specimens of *S. chiapensis* were taken at elevations from 3030 to 3160 m.

Carraway (2007) summarized the ecology of the Chiapas shrew in Mexico. There is little information on the reproduction of this species. In our data, 1 female was found to be lactating in July 2008.

### 2. *Sorex ibarrai* Matson and McCarthy 2005

Ibarra's shrew is distributed south and southeast of Cobán in the highlands of the Departments of Alta Verapaz, Baja Verapaz, El Progreso, and Zacapa. Its known altitudinal distribution is from 1475 to 2800 m (Woodman *et al.*, 2012; Matson and Ordóñez-Garza, 2017). It is known only from montane and cloud forests (Matson and McCarthy, 2005; Woodman *et al.*, 2012; Matson and Ordóñez-Garza, 2017).

This shrew is, apparently, the most easily captured and, possibly, the most common shrew in the Sierra de las Minas, representing from 11 % to 19 % of captured animals (Matson and McCarthy, 2005; Woodman *et al.*, 2012). In other localities where it occurs, it was also quite common.

Woodman *et al.* (2012) summarized the reproductive activity of Ibarra's shrew. Although data are limited to January through July, most repro-

duction appears to occur in the wet months of the year April through July (46 % of the females were either pregnant or lactating), but can occur anytime (January 17 % of the females were pregnant or lactating).

Woodman *et al.* (2012) summarized the known diet of *S. ibarrai* based upon analyses of digestive tract contents of four individuals. Their diet consists of insect and plant material. Based upon the same individuals, both nematode and tapeworms were found. *Sorex ibarrai* is host to the flea *Hystrihopsylla guatemalensis* Lewis and Eckerlin, 2004 (Eckerlin, 2006).

### 3. *Sorex madrensis* Matson and Ordóñez-Garza, 2017

Matson and Ordóñez-Garza (2017) found that the specimens of long-tailed shrews in the *S. veraepacis* group from the Sierra Madre of western Guatemala are morphologically distinct from all other populations of the species based upon multivariate analyses, and called this new form *S. madrensis*. The distribution of *S. madrensis* is similar to that of *C. goodwini* (*s. str.* Woodman, 2015; see Species Account). It is found in montane and cloud forests that have a deep layer of leaf litter and mosses (Matson and Ordóñez-Garza, 2017).

As in other species of *Sorex* in Guatemala, reproduction appears to coincide with the wet month's data from July while no reproduction was recorded in the dry month of January (Matson and Ordóñez-Garza, 2017).

### 4. *Sorex salvini* Merriam, 1897

Salvin's shrew is irregularly distributed throughout the highlands of Guatemala and is only known from Guatemala (Woodman *et al.*, 2012; Matson and Ordóñez-Garza, 2017). The known elevational range in Guatemala is from 2040 m to 3100 m (Matson and Ordóñez-Garza, 2017). The species occurs in montane and cloud forest habitats.

*Sorex salvini* occurs in fewer numbers than other species of shrew (Woodman *et al.*, 2012). Nothing is known of its reproduction. The diet appears to be composed of insects; however, data are scarce (Woodman *et al.*, 2012).

### 5. *Sorex veraepacis* Alston, 1877

The Verapaz shrew is restricted to the highlands of Guatemala, in the Sierra de los Cuchumatanes, Huehuetenango, east to the vicinity of Cobán, Alta Verapaz (Matson and Ordóñez-Garza, 2017). The



species is found in montane and cloud forests at elevations ranging from 2680 to 3350 m (Matson *et al.*, 2012; Woodman *et al.*, 2012; Matson and Ordóñez-Garza, 2017).

Reproduction appears to be restricted to the wet months, although only July is recorded for certain (Matson *et al.*, 2012; Woodman *et al.*, 2012). There are no data available on the diet or habits of this shrew.

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**Resumen.** Las musarañas (Soricidae) son los únicos miembros del orden de mamíferos Eulipotyphla que ocurren en el Centro y Sur de América. En Guatemala, se han documentado 15 especies pertenecientes a los géneros *Cryptotis* y *Sorex*, de las cuales 3 no han sido descritas. Con base en las distribuciones conocidas, se espera que 2 especies adicionales sean descubiertas en el país. La mayoría de las especies parecen tener reproducción limitada durante el año. En este trabajo revisamos la taxonomía e historia natural de estas especies.

**Palabras clave:** *Cryptotis*; historia natural; patrones reproductivos; *Sorex*; taxonomía.

# Perspectivas de investigación sobre los mamíferos silvestres de Guatemala

Research  
Perspectives on  
the Wild Mammals  
of Guatemala



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