THERYA NOTES 2024, Vol. 5 : 288-293 DOI: 10.12933/therya_notes-24-188 ISSN 2954-3614

Nesting of the variegated squirrel, *Echinosciurus variegatoides rigidus,* on a power line pole using plastic ropes and a weedy plant in Cañas, Costa Rica

Anidación de la ardilla variegada, *Echinosciurus variegatoides rigidus,* en un poste de línea eléctrica usando cuerdas plásticas y una maleza en Cañas, Costa Rica

José Manuel Mora[1,2]*, and Juan de Dios Astorga[3,4]

[1]Carrera de Gestión Ecoturística, Sede Central, Universidad Técnica Nacional (UTN), C. P. 1902-4050. Alajuela, Costa Rica. E-mail: josemora07@gmail.com (JMM).
[2]Department of Biology and Museum of Vertebrate Biology, Portland State University, C. P. 97207, Portland. Oregon, U.S.A.
[3]Ingeniería en Manejo Forestal y Vida Silvestre, Universidad Técnica Nacional, 7-4013. Atenas, Costa Rica. E-mail: spizaetus072@gmail.com (JdDA).
[4]Sistema Nacional de Áreas de Conservación, Área de Conservación Arenal-Tempisque, C. P. 50601. Guanacaste, Costa Rica.
*Corresponding author

Arboreal squirrels construct dreys using twigs, often cut from living trees. Some species use plant material to fill out the structure, but anthropogenic materials are occasionally incorporated as well. In Costa Rica, there are 5 squirrel species, the variegated squirrel, *Echinosciurus variegatoides*, being the largest and most common. This species builds nests of leaves and twigs high in the trees. On November 6, 2021, while traveling from our base to a protected area for wildlife monitoring, we stopped in Cañas, Guanacaste, in northwestern Costa Rica. At 15:00 hr, we observed a variegated squirrel nesting on a power line pole. We monitored the squirrel's behavior for approximately 10 min and recorded the observations with photographs and 2 videos. The squirrel was observed nesting on the platform between a power line pole and an electrical transformer. The nest was constructed using a combination of green leaves, twigs, and plastic ropes of at least 3 different colors, indicating they might be of different types. The plant material used in the nest construction was identified as *Commelina* sp., a problematic weedy plant. This finding is novel, as there are no previous reports of this species nesting on such infrastructure, which has not been documented as a nesting site for squirrels. Furthermore, there are few known instances of squirrels using anthropogenic materials for nesting. We discuss this case in the context of squirrel nesting behavior in Costa Rica and the implications of current urban development.

Key words: *Commelina*; Costa Rica; dreys; electrical infrastructure; plant material; Sciuridae.

Las ardillas arbóreas construyen nidos usando ramitas, a menudo cortadas de árboles vivos. Algunas especies utilizan material vegetal para completar la estructura, pero ocasionalmente también se incorporan materiales antropogénicos. En Costa Rica, hay 5 especies de ardillas, la ardilla variegada, *Echinosciurus variegatoides* es la más grande y común. Esta especie construye nidos de hojas y ramitas en lo alto de los árboles. El 6 de noviembre de 2021, mientras viajábamos hacia un área protegida para el monitoreo de fauna silvestre, hicimos una parada en Cañas, Guanacaste, Costa Rica. A las 15:00 hr, observamos a una ardilla variegada anidando en un poste de línea eléctrica. Observamos el comportamiento de la ardilla durante aproximadamente 10 min y registramos las observaciones con fotografías y 2 videos. La ardilla fue observada anidando en la plataforma entre un poste y un transformador eléctrico. El nido fue construido utilizando una combinación de hojas verdes, ramitas y cuerdas de plástico de al menos 3 colores diferentes, lo que sugiere que podrían ser de diferentes tipos. El material vegetal utilizado en la construcción del nido fue identificado como *Commelina* sp., una maleza problemática. Este hallazgo es novedoso, ya que no existen informes previos de esta especie anidando en infraestructura como esta, que no ha sido documentada como sitio de anidación para ardillas. Además, hay pocos casos conocidos de ardillas utilizando materiales antropogénicos para anidar. Discutimos este caso en el contexto del comportamiento de anidación de las ardillas en Costa Rica y el desarrollo urbano.

Palabras clave: *Commelina*; Costa Rica; infraestructura eléctrica; material vegetal; nido de ardilla; Sciuridae.

Nest building is a behavior that has evolved across many taxa but is primarily associated with endothermic animals, which can maintain body temperature above ambient levels (Gedeon *et al.* 2010). While some larger mammals regularly construct nests, this behavior is more common in smaller mammals, typically those weighing less than a kilogram (Deeming 2023). Mammalian nests are often made from fresh plant materials (Deeming 2023). For example, the white-naped squirrel, *Simosciurus nebouxii* (I. Geoffroy St.-Hilaire, 1855), builds nests in treetops, usually using plant material from the supporting tree or nearby trees (Lajo-Salazar *et al.* 2018; Ayala *et al.* 2021).

However, mammals may also use human-origin materials for nest construction. In Poland, hazel dormice, *Muscardinus avellanarius* Linnaeus, 1758, have been observed using artificial threads in nest building (Zaytseva 2006), while in Finland, the European hedgehog, *Erinaceus europaeus* Linnaeus, 1758, has been found incorporating plastic bags or wrapping paper into their nests (Rautio *et al.* 2014). Similarly, European mole, *Talpa europaea* (Linnaeus, 1758), has been known to use paper or plastic sheeting in their nests (Gorman and Stone 1990). In the Americas, 4 mammal species have been reported to use plastic waste for nest or burrow construction (Ayala *et al.* 2023).

Arboreal squirrels (Sciuridae) construct dreys, typically built on a platform of large twigs (10–15 cm in length), often cut from living trees (Deeming 2023). Some species use dead leaves, moss, and bark to fill out the structure, and the nest is often lined with softer materials like moss, thistledown, dried grass, feathers, or wool (Deeming 2023). Occasionally, anthropogenic materials such as paper and wool thread are also used (Bosch and Lurz 2013; Deeming 2023). In Perú, for example, the white-naped squirrel has been documented using single-use plastic bags to construct their nests (Ayala *et al.* 2021). The Indian palm squirrel, *Funambulus palmarum* Linnaeus, 1766, has been observed using plastic, which is abundant in its habitat, to build nests (Mohan and Singh 2018). Although the Indian palm squirrel usually builds nests using natural materials, it appears to be adapting to changes in its habitat (Mohan and Singh 2018).

In Costa Rica, the family Sciuridae is represented by 5 species, 2 of which belong to the genus *Echinosciurus* (Mora and Ruedas 2023). The largest of these is the variegated squirrel, *Echinosciurus variegatoides* (Ogilby, 1839), which is diurnal, arboreal, and territorial (Reid 2009). This species is highly variable in appearance, with long, soft fur that ranges in color depending on its distribution and subspecies (Harris 1937). It is found from southern México to Panamá (Hoffmann and Thorington 2005), at elevations ranging from 0 to 1,800 m, although it can inhabit areas up to 2,600 m (Reid 2009). *Echinosciurus variegatoides rigidus* (Peters, 1863) is found in mountains and valleys of central Costa Rica from Puntarenas east to Juan Viñas, and from Liberia in the north to Cartago in the south (Harris 1937).

The variegated squirrel builds its nests, or dreys, in tree hollows or on branches (Reid 2009). The nests are spherical constructions made of leaves and twigs, placed high in the canopy (Koprowski *et al.* 2016). The materials are arranged in a seemingly disorganized fashion, often located in tree forks (Mora 2000). The nests measure approximately 20 to 30 cm in diameter, and females build them at heights ranging from 6 to 15 m or more above the ground (Medina-Fitoria *et al.* 2018; Mencía 2021).

In contrast to birds, which frequently use electrical infrastructure for nesting worldwide (Moreira *et al.* 2023), reports of squirrels nesting on power lines or other electrical structures are extremely rare or nonexistent (Hamilton *et al.* 1987). In this study, we document, for the first time, a variegated squirrel constructing a nest on a power line post, utilizing both a weedy plant and plastic materials.

On November 6, 2021, while traveling from our base to a protected area to monitor birds, we made a stop at Cañas, Guanacaste, Costa Rica (10° 25' 49" N, 85° 05' 33" W; 80 m; Figure 1). At 15:00 hr we observed a variegated squirrel nesting at a power line pole. We observed the squirrel behavior for about 10 min and took pictures and 2 videos.

Cañas is a small city located in northwestern Costa Rica, within the Tropical Dry Forest Life Zone (*sensu* Holdridge 1967). The Tropical Dry Forest is considered the most heavily utilized and disturbed ecosystem in the world (Janzen 1988). The Tropical Dry Forest is found between 0 and 600 m and has a warm climate year-round. Temperatures range from 25 to 30 °C, with annual rainfall between 1,100 and 1,500 mm. However, there is a pronounced dry season, with no effective rainfall, lasting from 4 to 9 months (Bolaños *et al.* 2005).

Cañas is the first district and the head city of the Cañas county, the sixth one of the Guanacaste province (Piedra Quesada 2017). This district covers an area of 193.09 km^2 and has an average elevation of 86 m (Piedra Quesada 2017). Cañas county has a total population of 33,393 inhabitants, with the district of Cañas accounting for the majority, comprising 26,577 inhabitants (Sánchez V. *et al.* 2023).

The variegated squirrel is highly common in the Cañas area, demonstrating its status as a generalist species. It occupies a variety of habitats, from forested zones to disturbed areas like agricultural and urban environments (Mora 2000). Within the city of Cañas, it is less frequently observed but not rare, appearing in areas with trees, such as plazas, or using electrical cables to move between trees and buildings (J. Mora, pers. obs.). This squirrel also uses cables to connect urban areas to the outskirts. Surrounding Cañas city are agricultural zones and riparian vegetation along the Cañas River (Mora 2001).

We observed the variegated squirrel nesting on the platform located between a power line pole and an electrical transformer in the heart of the city, just two blocks from a major highway (Figure 2a). The videos can be viewed on the https://youtu.be/WAB5l35nFoM, and https://youtu.

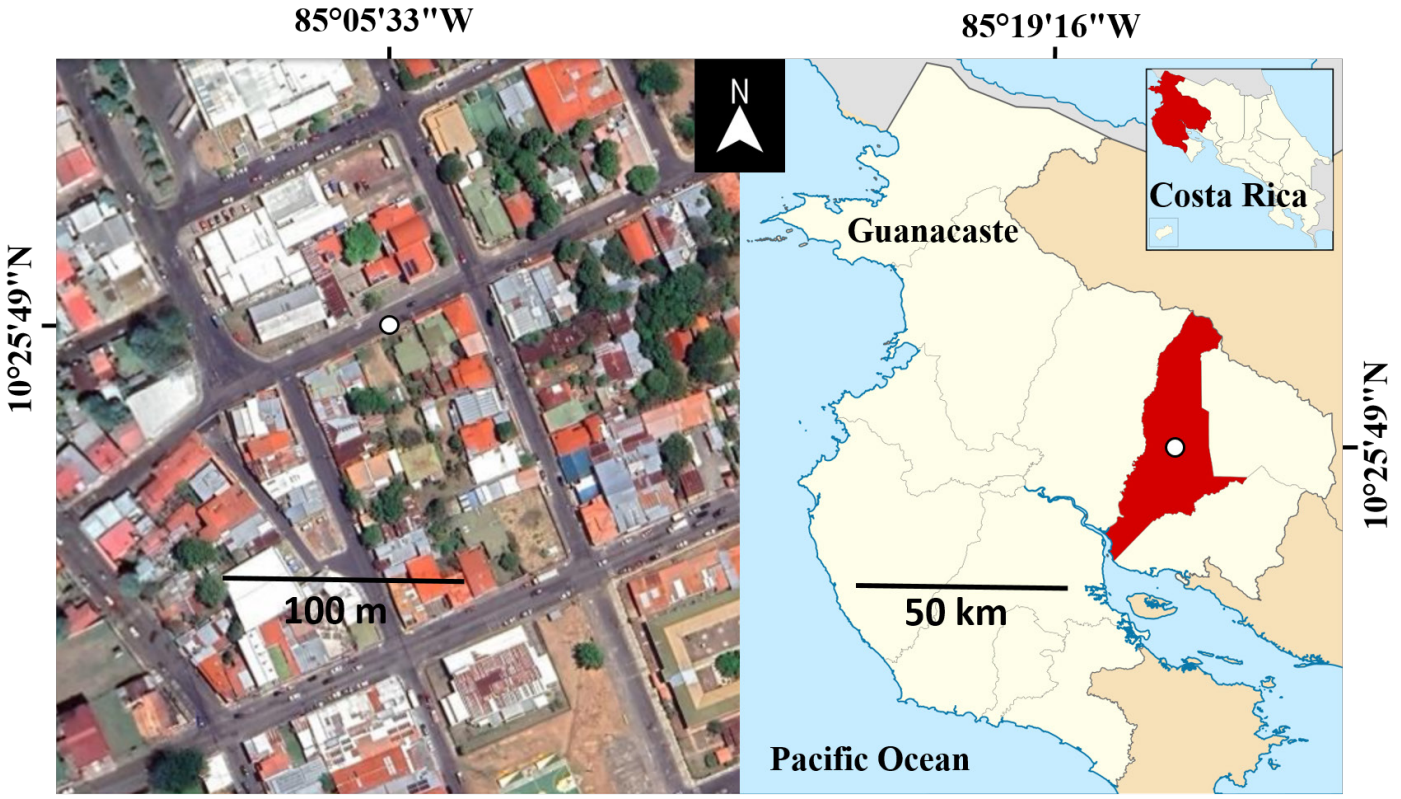

Figure 1. Site (white dot) where a variegated squirrel, *Echinosciurus variegatoides rigidus*, was found nesting on a power line post at Cañas County (highlighted in red), in the Guanacaste Province (outlined in white but shown in red on the map of Costa Rica). Figure based on Google Earth (left section) and Wikipedia under the Creative Commons Attribution-ShareAlike 3.0 license (right section).

be/3EcjMFF13zU. The nest was built using a combination of green leaves, twigs, and plastic ropes (Figure 2b). Notably, the plastic ropes came in at least 3 different colors (black, blue, and white) suggesting they might be of different types (Figure 2). The plant material used for nest construction was identified as *Commelina* sp. (Commelinaceae), a weedy problematic plant (Q. Jiménez, comm. pers.). The plant sections observed were green/living, and it may be thriving without a soil substrate (Figure 2). Plants of the genus *Commellina* are often associated with various agricultural and ecological challenges due to their invasive behavior and adaptability to diverse environments (Isaac *et al.* 2013). Some species can establish dense stands that compete with crops, significantly reducing yields (Webster *et al.* 2005). These plants may release allelopathic compounds that inhibit the growth of neighboring vegetation or act as alternate hosts for nematodes and viruses, posing additional threats to agricultural productivity (Isaac *et al.* 2013). *Commellina* species thrive under a wide range of conditions and exhibit high resistance to environmental stresses, making controlling their spread particularly challenging (Webster *et al.* 2005).

Nests play a vital role in the reproduction and survival of many organisms by providing thermal insulation against the external environment and serving as a refuge from potential predators (Ramos-Lara and Cervantes 2007). The variegated squirrel typically builds nests out of leaves and twigs in tall trees (Ceballos and Valdéz Alarcon 2014; Koprowski *et al.* 2016). On the Nicoya Peninsula of Costa Rica, the trees selected for nesting were leafy, with many branches, and the nests were established at heights over 15 m (Monge 2019). According to one record made by Monge (2019), a squirrel built a nest in a mango tree, *Mangifera indica*, using green leaves from the same tree, which were transported one at a time or in small branches. In Panamá, the variegated squirrel constructs compact nests made of leaves, placed in the tops of tall, slender trees (Best 1995). Similarly, the Mexican red-bellied squirrel, *Sciurus aureogaster* F. Cuvier, 1829 in Michoacán, México, builds nests in the tallest and largest trees, typically close to the main trunk (Ramos-Lara and Cervantes 2007).

In some instances, squirrels have utilized human-made structures for nesting. For example, the gray squirrel, *Sciurus carolinensis* Gmelin, 1788, is known to construct leaf dreys, den in tree cavities, and even use artificial nesting sites such as wooden boxes in North America (Shuttleworth *et al.* 2016, and references therein). Occasionally, they build nests within the eaves or attic spaces of buildings (Shuttleworth *et al.* 2016). However, reports of squirrels nesting on power lines or electrical infrastructure are rare or nonexistent, although these structures are commonly used as travel corridors, rest sites, and dispersal (Hamilton *et al.* 1987). However, such activities can cause power outages and become a nuisance, when squirrels use utility poles and substations (Frazier and Bonham 1996).

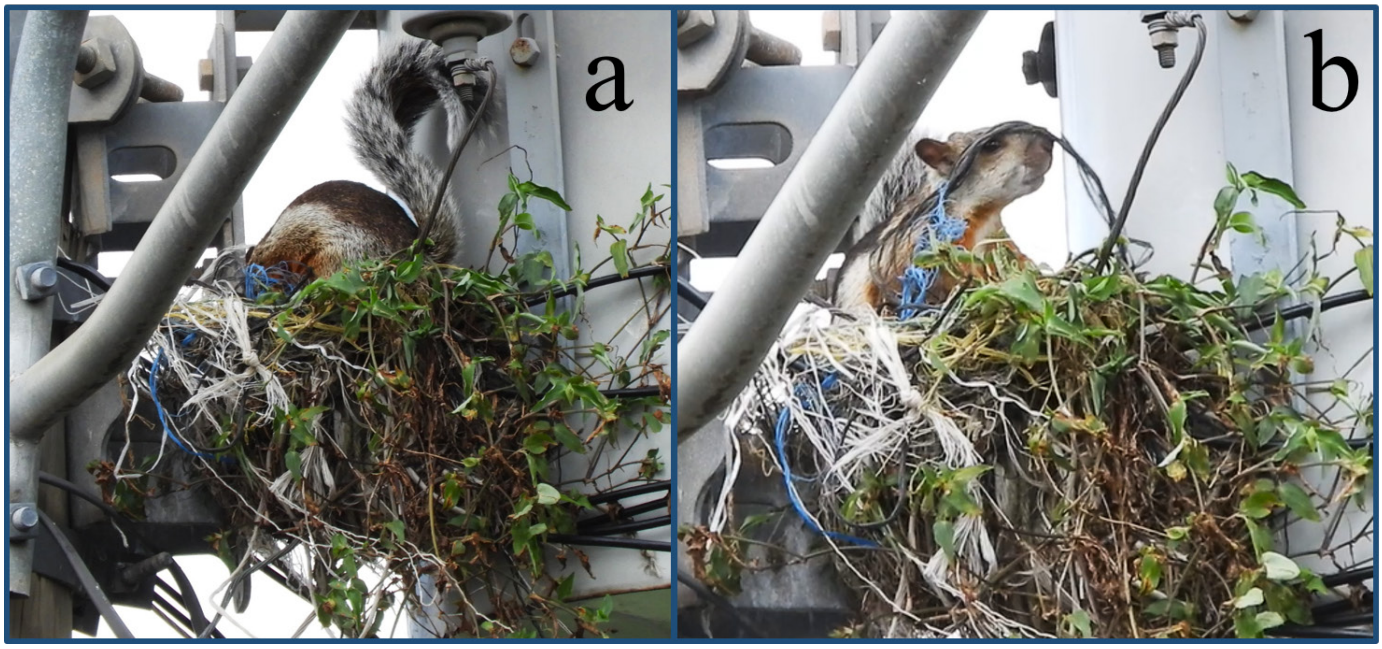

Figure 2. a) A female variegated squirrel, *Echinosciurus variegatoides rigidus*, on a nest constructed between a pole and an electrical transformer; b) the variegated squirrel arranges plastic ropes in its nest. Cañas, Guanacaste, Costa Rica.

In this study, the variegated squirrel nested on a power line pylon, even though 2 trees were located approximately 30 m from the site (Figure 1). Interestingly, birds such as the white stork, *Ciconia ciconia*, are well-known for nesting on power lines, with over 283 bird species documented using such structures in Brazil alone (Moreira *et al.* 2018; Biasotto *et al.* 2022). In addition to birds, power lines are increasingly used by mammal species such as marsupials, edentates, procyonids, and primates, as these structures allow for quick and easy movement between forest patches (Bastidas-Domínguez *et al.* 2021).

However, the use of electrical facilities by wildlife comes at a cost. Between June 2018 and June 2019, 947 cases of non-human primate electrocutions were reported in Costa Rica (Rodríguez *et al.* 2020). This figure only accounts for detected and reported events, as incidents that did not cause power outages were not counted, and not all power companies maintain records of such occurrences (Rodríguez *et al.* 2020). In addition, electrical problems, such as outages and electrocutions can be caused not only by nesting animals but also by their predators, such as snakes, raccoons and others (Frazier and Bonham 1996; James *et al.* 1999).

Plastic materials used in nesting can pose significant risks to wildlife. Plastic ropes, like those documented in this study as used by the variegated squirrel and reported here for the first time, could potentially cause entanglement or asphyxiation (Blettler and Mitchell 2021; Thrift *et al.* 2023). Although no cases of terrestrial mammals being entangled in plastic have been reported to date (Ayala *et al.* 2023), several mammalian species have been observed incorporating plastic waste into their nests. While plastic ropes may offer structural support and insulative benefits, their use likely also reflects their availability in the environment.

Plastic pollution is a significant global concern and a recognized driver of environmental change (Ayala *et al.* 2023). The use of plastic waste in nests and burrows by mammals is a relatively new observation, and its potential short- and long-term impacts on their survival remain uncertain (Mohan and Singh 2018; Ayala *et al.* 2023). One related issue is plastic ingestion, which is not confined to marine species; terrestrial mammals like the coyote, *Canis latrans* Say, 1823, and the coati, *Nasua nasua* Linnaeus, 1766, have also been frequently reported ingesting plastic materials (Ayala *et al.* 2023). Furthermore, plastics contain harmful chemicals like bisphenol-A (BPA), which disrupts endocrine systems and has been linked to carcinogenesis in animals (Ayala *et al.* 2023). These combined risks underscore the urgency of addressing plastic pollution for the protection of both wildlife and ecosystems.

The plant material used by the squirrel, *Commelina* sp., also presents challenges, as it is known to be difficult to eradicate (Isaac *et al.* 2013). *Commelina* species are considered invasive in some regions due to their ability to root easily from small fragments, making them particularly troublesome in disturbed habitats (Webster *et al.* 2005; Isaac *et al.* 2013). The squirrel may have found the plant suitable for its nest or may have inadvertently included it as part of the construction.

Nest materials used in nest construction can serve various purposes, such as aiding in temperature regulation, providing comfort for occupants, and reducing ectoparasite loads while repelling moisture (Patterson *et al.* 2007). For instance, shredded bark from eastern white cedar, *Thuja occidentalis*, used by *Glaucomys sabrinus* (Shaw, 1801), and *Tamiasciurus hudsonicus* (Erxleben, 1777), has been shown to offer antiparasitic and thermoregulatory benefits (Pat-

terson *et al.* 2007). Notably, these squirrels did not choose cedar bark solely based on its availability, suggesting a functional preference for its properties (Patterson *et al.* 2007).

Green vegetation used in avian nests suggests that animals may exploit the antiparasitic properties of specific plant species that emit volatile compounds (Patterson *et al.* 2007). Secondary metabolites present in plants serve as natural defenses against herbivory and disease (Clark and Mason 1988). When incorporated into nests, these compounds may reduce ectoparasite loads in the nesting environment (Patterson *et al.* 2007). This is also observed in some mammals, such as dusky-footed woodrat, *Neotoma fuscipes*, which place California bay, *Umbellularia californica*, leaves around their nest sites (Hemmes *et al.* 2002). Laboratory tests showed that flea larva loads were reduced by 74 % when incubated with torn California bay leaves for 72 hr (Hemmes *et al.* 2002). The *Commelina* sp. used by the variegated squirrel may similarly provide some level of ectoparasite control in its nesting environment, potentially offering functional benefits beyond structural purposes.

Our observation of the variegated squirrel nesting on a power line pylon, incorporating plastic waste and a problematic, weedy plant, underscores the global impact of human activities on wildlife. The rapid expansion of urban areas in recent decades has led to significant changes in species behavior, survival, and dispersal (Corrales-Moya and Sandoval 2021). As a result, species adapting to urban environments often modify their behavior to exploit new resources introduced by humans (Caballero *et al.* 2016; Corrales-Moya and Sandoval 2021). Monitoring such behaviors is essential for developing effective wildlife conservation strategies.

Acknowledgements

We appreciate the constructive feedback from 2 anonymous reviewers. Q. Jiménez identified the plant and gave us information about it. J. M. Mora acknowledges E. Rivera, Department Head of Ecotourism Management (GEC) at UTN Central Campus.

Literature cited

Ayala, F., L. Lajo-Salazar, and S. Cárdenas-Alayza. 2021. White-naped squirrels use plastic waste for nest construction in agricultural areas of northern Peru. International Journal of Environmental Studies 79:724-730.

Ayala, F., *et al.* 2023. Terrestrial mammals of the Americas and their interactions with plastic waste. Environmental Science and Pollution Research 30:57759-57770.

Bastidas-Domínguez, M. C., *et al.* 2021. Primeros registros del género *Caluromys* (Didelphimorphia: Didelphidae) para el departamento del Quindío, y aclaraciones sobre los registros de Colombia. Mammalogy Notes 7:218-218.

Best, T. L. 1995. *Sciurus variegatoides*. Mammalian Species 500:1-6.

Blettler, M. C., and C. Mitchell. 2021. Dangerous traps: Macroplastic encounters affecting freshwater and terrestrial wildlife. Science of the Total Environment 798:149317.

Biasotto, L. D., *et al.* 2022. Risk of bird electrocution in power lines: a framework for prioritizing species and areas for conservation and impact mitigation. Animal Conservation 25:285-296.

Bolaños, R., V. Watson, and J. Tosi. 2005. Mapa ecológico de Costa Rica (Zonas de Vida), según el sistema de clasificación de zonas de vida del mundo de L. R. Holdridge, Scale 1:750 000. Centro Científico Tropical. San José, Costa Rica.

Bosch, S., and P. W. W. Lurz. 2013. The process of drey construction in red squirrels—nestbox observations based on a hidden camera. Hystrix 24:199-202.

Caballero, I. C., *et al.* 2016. Sex in the city: Breeding behavior of urban peregrine falcons in the Miwestern US. PLoS ONE 11:e0159054.

Ceballos, G., and M. Valdéz Alarcon. 2014. Variegated Squirrel. Pp. 184-185 *in* Mammals of Mexico (Ceballos, G., ed.). Johns Hopkins University Press. Baltimore, U.S.A.

Clark, L., and J. R. Mason. 1988. Effect of biologically active plants used as nest material and the derived benefit to starling nestlings. Oecologia 77:174-180.

Corrales-Moya, J., and L. Sandoval. 2021. Does the distance to forests or buildings influence great kiskadee (*Pitangus sulphuratus*) nesting site selection? Ornitología Neotropical 32:28-33.

Deeming, D. C. 2023. Nest construction in mammals: a review of the patterns of construction and functional roles. Philosophical Transactions of the Royal Society B 378:20220138.

Frazier, S. D., and C. Bonham. 1996. Suggested practices for reducing animal-caused outages. IEEE Industry Applications Magazine 2:25-31.

Gedeon, C. I., *et al.* 2010. Nest material selection affects nest insulation quality for the European ground squirrel (*Spermophilus citellus*). Journal of Mammalogy 91:636-641.

Gorman, M. L., and R. D. Stone. 1990. The natural history of moles. Comstock Publishing Associates. Ithaca, U.S.A.

Hamilton, J. C., *et al.* 1987. Fox squirrels cause power outages: An urban wildlife problem. Pp. 228 *in* The Third Eastern Wildlife Damage Control Conference (Holler, N. R., ed.). Auburn University. Gulf Shores, U.S.A.

Harris, W. B., Jr. 1937. Revision of *Sciurus variegatoides*, a species of Central American squirrel. Miscellaneous Publications Museum of Zoology University of Michigan 38:7-39.

Hemmes, R. B., A. Alvarado, and B. L. Hart. 2002. Use of California bay foliage by wood rats for possible fumigation of nest-borne ectoparasites. Behavioural Ecology 13:381-385.

Hoffmann, R. S., and R. J. Thorington. 2005. Family Sciuridae. Pp. 754-818 *in* Mammal Species of the World (Wilson, D. E., and D. M. Reeder, eds.). John Hopkins University Press. Baltimore, U.S.A.

Holdridge, L. R. 1967. Life Zone Ecology. Tropical Science Center. San José, Costa Rica.

Isaac, W.-A., Z. Gao, and M. Li. 2013. Managing *Commelina* species: prospects and limitations. Pp. 543-562 *in* Herbicides: Current Research and Case Studies in Use (Price, A., and J. Kelton, eds.). IntechOpen. London, United Kingdom.

James, J. B., E. C. Hellgren, and R. E. Masters. 1999. Effects of deterrents on avian abundance and nesting density in electrical substations in Oklahoma. The Journal of Wildlife Management 63:1009-1017.

Janzen, D. H. 1988. Tropical dry forests. Pp. 130-137 *in* Biodiversity (Wilson, E. O., ed.). National Academy Press. Washington, D. C., U.S.A.

Koprowski, J., *et al*. 2016. Family Sciuridae (Tree, flying and ground squirrels, chipmunks, marmots and prairie dogs). Pp. 648-837 *in* Handbook of Mammals of the World: Vol. 6 Lagomorphs and Rodents I (Wilson, D. E., T. E. Lacher Jr., and R. A. Mittermeier, eds.). Lynx Edicions. Barcelona, Spain.

Lajo-Salazar, L., M. Williams León De Castro, and P. Vásquez Ruesta. 2018. Caracterización de la ubicación de madrigueras de *Simosciurus nebouxii* en un área urbana de Lima, Perú. Revista Forestal del Perú 33:147–164.

Medina-Fitoria A., *et al*. 2018. Las ardillas de Nicaragua (Rodentia, Sciuridae): una actualización basada en análisis fenotipíco. Revista Mexicana de Mastozoología, nueva época 8:48-80.

Mencía, D. M. 2021. Las ardillas mis vecinas ¿cómo se han adaptado a las ciudades? Desde el Herbario CICY 13:91-95.

Mohan, K., and M. Singh. 2018. Altered habitats, altered behaviours: use of plastic in nest building by Indian palm squirrel. Current Science 114:963.

Monge, J. 2019. Ciclo reproductivo de la ardilla *Sciurus variegatoides* (Rodentia: Sciuridae) en Costa Rica. Cuadernos de Investigación UNED 11:105-111.

Mora, J. M. 2000. Mamíferos silvestres de Costa Rica. Editorial UNED. San José, Costa Rica.

Mora, J. M. 2001. Diagnóstico ambiental para la elaboración de un plan regulador del cantón de Cañas, Guanacaste. Informe de consultoría. ProAmbiente, San José. Costa Rica. Available at josemora07@gmail.com.

Mora, J. M., and L. A. Ruedas. 2023. Updated list of the mammals of Costa Rica, with notes on recent taxonomic changes. Zootaxa 5357:451-501.

Moreira, F., *et al*. 2018. Drivers of power line use by white storks: A case study of birds nesting on anthropogenic structures. Journal of Applied Ecology 55:2263-2273.

Moreira, F., *et al*. 2023. Long-term management practices successfully reduce bird-related electrical faults in a transmission grid increasingly used by white storks for nesting. Journal of Environmental Management 327:116897.

Patterson, J. E., S. J. Patterson, and R. J. Malcolm. 2007. Cavity nest materials of northern flying squirrels, *Glaucomys sabrinus*, and North American red squirrels, *Tamiasciurus hudsonicus*, in a secondary hardwood forest of southern Ontario. The Canadian Field-Naturalist 121:303-307.

Piedra Quesada, V. (ed.). 2017. División territorial administrativa de la república de Costa Rica. Sección de Publicaciones de la Dirección General de Estadística y Censos. San José, Costa Rica.

Ramos-Lara, N., and F. A. Cervantes. 2007. Nest-site selection by the Mexican red-bellied squirrel (*Sciurus aureogaster*) in Michoacán, Mexico. Journal of Mammalogy 88:495-501.

Rautio A, *et al*. 2014. Nesting patterns of European hedgehogs (*Erinaceus europaeus*) under northern conditions. Acta Theriologica 59:173-181.

Reid, F. A. 2009. A field guide to the mammals of Central America and Southeast Mexico. Second edition. Oxford University Press. New York, U.S.A.

Rodríguez, K., *et al*. 2020. Guía para la prevención y mitigación de la electrocución de la fauna silvestre por tendidos eléctricos en Costa Rica. Second edition. Ministerio de Ambiente y Energía. San José, Costa Rica.

Sánchez V., J. L., *et al*. 2023. Análisis de Situación de Salud del Cantón de Cañas. Ministerio de Salud, Gobierno de Costa Rica. San José, Costa Rica.

Shuttleworth, C., V. E. S. A. Selonen, and J. L. Koprowski. 2016. Grey squirrel nesting ecology and the use of nest sites in european population management. Pp. 349-367 *in* Grey Squirrel: Ecology And Management Of An Invasive Species in Europe. European Squirrel Initiative (Shuttleworth, C., P. Lurz, and J. Gurnell, eds.). European Squirrel Initiative. Stoneleigh Park, Warwickshire, United Kingdom.

Thrift, E., P. Nouvellet, and F. Mathews. 2023. Plastic entanglement poses a potential hazard to European hedgehogs erinaceus europaeus in Great Britain. Animals 13:2448.

Webster, T. M., *et al*. 2005. Tropical spiderwort (*Commelina benghalensis*): a tropical invader threatens agroecosystems of the southern United States. Weed technology 19:501-508.

Zaytseva, H. 2006. Nest material of the common dormouse (*Muscardinus avellanarius* L.) used in nestboxes, Podilla (West Ukraine). Polish Journal of Ecology 54:397-401.

Associated editor: Beatríz Bolívar Cimé.
Submitted: October 2, 2024; Reviewed: December 11, 2024.
Accepted: December 12, 2024; Published on line: December 19, 2024.