

Confirmation of the presence of Abert's squirrel (*Sciurus aberti*) after a century in Sonora, México

Confirmación de la presencia de la ardilla de Abert (*Sciurus aberti*) después de un siglo en Sonora, México

JUAN PABLO GALLO-REYNOSO^{1*}, LUCILA ARMENTA-MÉNDEZ¹, SAMUEL MACÍAS-SÁNCHEZ², THOMAS R. VAN DEVENDER³, GLORIA PONCE-GARCÍA¹, AND VÍCTOR HUGO CABRERA-HERNÁNDEZ⁴

¹Centro de Investigación en Alimentación y Desarrollo, A. C., Unidad Guaymas. Carretera al Varadero Nacional km 6.6, Colonia Las Playitas, C. P. 85480. Guaymas, Sonora, México. E-mail: jpgallo@ciad.mx (JPG-R); lucila.armenta@gmail.com (LA-M); gloria.ponce.garcia@gmail.com (GP-G).

²Instituto de Biotecnología y Ecología Aplicada, Universidad Veracruzana. Avenida de las Culturas Universitarias No. 101, Col. Emiliano Zapata, C. P. 91090. Xalapa de Enríquez, Veracruz, México. E-mail: macsanch@yahoo.com (SM-S).

³Greater Good Charities, 6262 N. Swan Rd., Suite 165. Tucson, Arizona 85718, U. S. A. E-mail: yecora4@comcast.net (TRVD).

⁴Calle 38 y 39 Ave. 29, Col. Armando López Nogales, Agua Prieta, C. P. 84267. Sonora, México. E-mail: victorhugocabrera89@gmail.com (VHC-H).

*Corresponding author

According to several authors, Abert's squirrel (*Sciurus aberti*) is typically found in ponderosa pine (*Pinus ponderosa*) forest, which provides both shelter and food. *Pinus ponderosa* generally occurs between 1,800 and 3,000 m elevation in Wyoming, Colorado, New Mexico, Arizona, and Utah in the United States. In México, *Pinus arizonica* was formerly considered a variety of *P. ponderosa* in northern Sonora. Conifer forests in the Sierra Madre Occidental from southern Durango north to Sonora and Chihuahua are not monospecific but very diverse. Pine-oak forest is dominated by various species of pines and oaks, and mixed conifer forest by Douglas fir (*Pseudotsuga* spp.), spruce (*Picea* sp.), and southwestern white pine (*Pinus strobiformis*). There is a previously confirmed record of Abert's squirrel from the Upper Bavispe River, Sonora, collected by the Lumholtz Archeological Expedition 1890-92, and another unconfirmed record of a likely *Sciurus aberti* in 1938 in northern Sonora. While conducting mammal surveys on foot (recording tracks of different mammals) and setting up camera traps, we observed the presence of *S. aberti* in the study area. We obtained two photographic records of *S. aberti*, in pine-oak forest in the Sierra Madre Occidental at the town limit of Mesa Tres Ríos, and at 9.4 km southwest of Mesa Tres Ríos, Sonora. *Sciurus aberti* were found on areas with pine-oak and mixed-conifer forests, presumably used for food and cover by Abert's squirrels, demonstrating that these squirrels are not strictly dependent on ponderosa pine (*P. ponderosa*) as previously reported, instead they rely on oak, Arizona (*P. arizonica*) and Apache (*P. engelmannii*) pines, that are widespread in the Madrenal Archipelago (Sky Islands Region) and the northern Sierra Madre Occidental (SMO). These observations confirm the predictions of the presence of *S. aberti* and are an important addition to the mammal fauna of Sonora.

Key words: Mesa Tres Ríos; presence; Sciuridae; Sonora.

De acuerdo con algunos autores, la ardilla de Abert (*Sciurus aberti*) se encuentra típicamente en los bosques de pino blanco (*Pinus ponderosa*), árbol que les proporciona refugio y alimento. Estos pinos generalmente se distribuyen entre 1,800 y 3,000 m en Wyoming, Colorado, Nuevo México, Arizona y Utah en los Estados Unidos. *Pinus arizonica* era formalmente considerada una variedad de *P. ponderosa* en el norte de Sonora, México. Los bosques de la Sierra Madre Occidental no son monoespecíficos, los bosques de pino-encino son muy diversos desde Sonora y Chihuahua hasta el sur de Durango en México. Existen también bosques de coníferas mixtos dominados por abetos (*Pseudotsuga* spp.), pinabetes (*Picea* spp.) y piñón (*Pinus strobiformis*). Solo hay un registro previo confirmado de la presencia de la ardilla de Abert obtenido en el Alto Río Bavispe, Sonora, colectada por la Expedición Arqueológica de Lumholtz 1890-92, y otro registro sin confirmar de un probable *S. aberti* en 1938 al norte de Sonora. Mientras se monitoreaban rastros de mamíferos a pie (registros de huellas) y se ponían cámaras-trampa para su registro, se observó la presencia de *S. aberti* en la zona de estudio. Obtuvimos dos registros ocasionales de *S. aberti*, ambos en un bosque de pino-encino en la Sierra Madre Occidental en Sonora en el límite del pueblo de Mesa Tres Ríos, Sonora y a 9.4 km al suroeste de Mesa Tres Ríos, Sonora. Se encontró a *Sciurus aberti* en áreas de pino-encino y bosques mixtos de coníferas, presuntamente usadas por las ardillas de Abert para su alimentación y cobertura, demostrando que estas ardillas no dependen estrictamente del pino ponderosa (*P. ponderosa*) como se ha reportado, sino que dependen del encino y los pinos Arizona (*P. arizonica*) y Apache (*P. engelmannii*), que se encuentran ampliamente distribuidos en el Archipiélago Madrenal (Región de las Islas del Cielo) y en la porción norte de la Sierra Madre Occidental (SMO). Estas observaciones confirman la predicción de la presencia de *S. aberti*, y son una importante adición a la fauna de mamíferos de Sonora.

Palabras clave: Mesa Tres Ríos; presencia; Sciuridae; Sonora.

Abert's squirrel (*Sciurus aberti*) is a high-elevation species inhabiting conifer forests in the western United States and the Sierra Madre Occidental (SMO) in Chihuahua and Durango, México. There are 6 subspecies of *S. aberti* in the southwestern United States and 3 in México (Thorington and Hoffman 2005). *Sciurus aberti barberi* (J. A. Allen 1904) occurs in northwestern Chihuahua and now in eastern Sonora. There is a large gap (345 km in a straight line) in the species distribution between *S. a. barberi* in the SMO, and *S. a. aberti* in the Santa Catalina Mountains in Arizona (Hoffmeister 1986).

The only previous specimen of Abert's squirrel from the state of Sonora was from the Upper Bavispe (*sic*) River by the Lumholtz Archeological Expedition of 1890-92, "one skin, in the gray phase, and an additional skull and skeleton" (Allen 1893). Burt (1938) reported another observation of Abert's squirrel in Sonora: "Mountains of northeastern Sonora. Recorded as being seen in oak-covered mountains about Santa Cruz". Burt remarked, "No specimens have been taken in Sonora, but the sight records recorded above probably were of this race". Based on Burt's observation, Nash and Seaman (1977) and Cassola (2017) took the presence of Abert's squirrel in Sonora for granted. Caire (2019) doubted the presence of the species in the Municipality of Santa Cruz, suggesting that Burt probably observed an Arizona squirrel (*S. arizonensis*) instead. Sandoval et al. (2020) reported Abert's squirrels presence in the State of Chihuahua at Campo Verde Natural Protected Area east of Mesa Tres Ríos.

In the Madrean Archipelago between the northern SMO and the Mogollon Rim in central Arizona, there are 55 Sky Island (SI) mountain ranges, 32 of them in Sonora (Deyo et al. 2013; Van Devender et al. 2013). These Sky Islands are isolated mountain ranges with crowns of oak woodland and pine-oak forests (Van Devender et al. 2013) that support a mixture of species typical of the Madrean Tropical sub-province of the SMO, as well species from the southwestern United States (Reina-Guerrero and Van Devender 2005; Van Devender and Reina-Guerrero 2016; Haire et al. 2021). The pine-oak forests on the higher Sky Islands are potential Abert's squirrel habitat. Here we report two new records of Abert's squirrel, confirming its presence in Sonora. *Sciurus aberti* is listed under special protection (Pr) by Mexican Official Norm NOM-059-SEMARNAT-2010 (SEMARNAT 2010).

Field expeditions to Mesa Tres Ríos were conducted to survey the presence of Neotropical otters (*Lontra longicaudis*) from August 24-29, 2015 (Gallo-Reynoso et al. 2015), and for wildlife distributions in June 2018. We visited several places along the Río Bavispe where the first surveys were conducted 15 years ago to confirm the otter's continuous presence. Greater Good Charities' Madrean Discovery Expedition (MDE) to Mesa Tres Ríos was conducted in August 2018, for mammal surveys with wildlife cameras as part of MDE Wildlife Program. The study area included pine-oak forest in the northern SMO in Sonora. Detailed records of our field observations and

our corresponding images of Abert's squirrels and other species of Sciuridae from Sonora are available in the MDE database (<https://madreandiscovery.org>).

We recorded the presence of Abert's squirrel at two localities in two different years (2015 and 2018) in the SMO in eastern Sonora. Individuals of Abert squirrels observed were large, they presented the diagnostic characteristic of long and broad ears with hair tufts at the ear apex, as our observations were carried on summer, the ear hair tufts were shorter than in winter when they are long; both presented dorsal dark gray coloration with white undersides typical of the species (Nash and Seaman 1977). The individuals were observed in pine-oak-cypress forest, in rugged, montane terrain near Mesa Tres Ríos, Municipality of Nacori Chico, Sonora. The first observation was on August 26, 2015 at 10:50 hr, near Mesa Tres Ríos town (29° 50' 54.82" N, 108° 42' 13.28" W) at 1,845 m (Figures 1 and 2). There were two squirrels eating cones of Arizona pine and moving through the canopy (Figure 2a). The second observation was obtained while setting up a camera trap, it was of

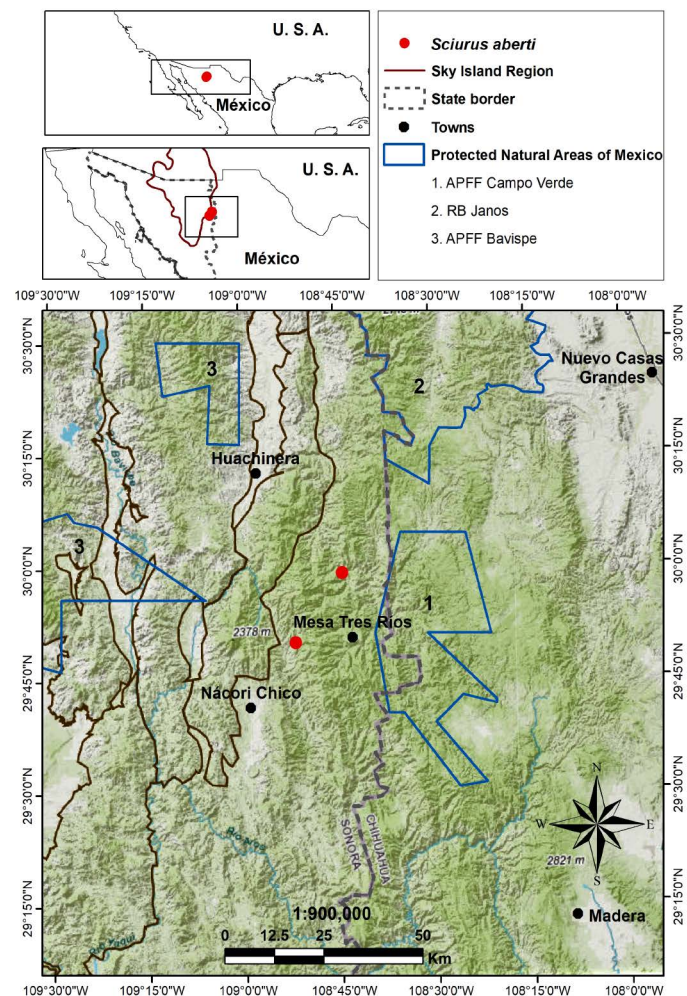


Figure 1. Records location of Abert's squirrels, *Sciurus aberti*, observed near Mesa Tres Ríos, Sonora (red dots). Near Mesa Tres Ríos town (29° 50' 54.82" N, 108° 42' 13.28" W) at 1,845 m and southwest of Mesa Tres Ríos (29° 47' 17.42" N, 108° 47' 27.88" W) at 2,020 m. APFF stands for Área de Protección de Flora y Fauna (Protection Area for Flora and Fauna). RB stands for Reserva de la Biosfera (Biosphere Reserve).



Figure 2. a) Specimen of Abert's squirrel (*Sciurus aberti*) in the canopy of an Arizona pine (*P. arizonica*) in a pine-oak forest near Mesa Tres Ríos, Sonora (29° 50' 54.82" N, 108° 42' 13.28" W), at 1,845 m. August 26, 2015 (Photo J. P. Gallo-Reynoso). b) Specimen of Abert's squirrel on the ground in a pine-oak forest SW of Mesa Tres Ríos, Sonora (29° 47' 17.42" N, 108° 47' 27.88" W), at 2,020 m. June 30, 2018 (Photo V. H. Cabrera-Hernández).

a lone individual at El Aguajito del Macho, 9.4 km (straight line) southwest of Mesa Tres Ríos (29° 47' 17.42" N, 108° 47' 27.88" W) at 2,020 m (Figure 2b). This locality is approximately 11 km (to the South in a straight line) from the first record and 15 km (to the West in a straight line) from the record of [Sandoval et al. \(2020\)](#) of an Abert's squirrel at Campo Verde Natural Protected Area in Chihuahua.

[Valdez-Alarcón and Téllez-Girón \(2005\)](#) and [Castillo-Gómez et al. \(2010\)](#) mentioned the presence of *S. aberti* in Sonora based on [Nash and Seaman \(1977\)](#) and its association with ponderosa pine (*Pinus ponderosa*). However, ponderosa pine only occurs in Sonora in the Sierras de los Ajos and San José close to the Arizona border ([Ferguson et al. 2013](#)). Arizona (*P. arizonica*) and Apache (*P. engelmannii*) pines are similar species that are widespread in the Madrean Archipelago (= the Sky Islands Region) and the northern Sierra Madre Occidental (SMO). In fact, *P. arizonica* was formerly considered a variety of *P. ponderosa*. The use of multiple conifer species for food and cover by Abert's squirrels in pine-oak and mixed-conifer forests demonstrates that Abert's squirrels are not strictly dependent on ponderosa pine as previously reported ([Edelman and Koprowski 2005](#); [Doumas et al. 2015](#)). Pine-oak forest in the SMO near Yécora in eastern Sonora is very diverse with 10 species of pines and 14 species of oaks ([González-Elizondo et al. 2012](#); [Van Devender and Reina-Guerrero 2016](#)). [Sandoval et al. \(2020\)](#) reported Abert's squirrels in a similar habitat at Campo Verde Natural Protected Area (Area de Protección de Flora y Fauna Campo Verde) in the SMO in Chihuahua just east of Mesa Tres Ríos.

After 128 years, these observations confirm the presence of *S. aberti* in the mammal fauna of Sonora and document Abert's squirrels living in pine-oak forest other than areas dominated by ponderosa pine. These observations confirm the predictions of [Sandoval et al. \(2020\)](#) on the probable distribution models of *S. aberti* that includes Sonora. The previous record from the Lumholtz expedition only stated that the upper Bavispe River ([Allen 1893](#)) locality was probably also near Mesa Tres Ríos where this river originates. Additional squirrels seen in the Mesa Tres Ríos area were the Apache fox squirrel (*Sciurus nayaritensis*), the rock squirrel (*Otospermophilus variegatus*), and the cliff chipmunk (*Neotamias dorsalis*). The Apache fox squirrel is the most common tree squirrel in the Mesa Tres Ríos area and the Sierra Huachinera to the west.

Acknowledgements

This paper is dedicated to the memory of D. E. Brown who identified the second specimen and that has done important work describing the mammals of Sonora. Greater Good Charities has supported the MDE Wildlife camera surveys in Sonora conducting mammal surveys with wildlife cameras and a MDE Scholarship to V. H. Cabrera-Hernández. We are grateful to J. M. Cirett-Galán and N. Villanueva for their assistance in field expeditions and two anonymous reviewers whose comments improved earlier versions of this manuscript.

Literature cited

ALLEN, J. A. 1893. Article III.-List of mammals and birds collected in Northeastern Sonora and Northwestern Chihuahua,

- Mexico, on the Lumholtz Archeological Expedition, 1890-92. *Bulletin of the American Museum of Natural History* 5:27-42.
- BURT, W. H.** 1938. Faunal relationships and geographic distribution of mammals in Sonora, México. *Miscellaneous Publications Museum Zoology, University of Michigan*. Michigan, U.S.A. Available at jggallo@ciad.mx.
- CAIRE, W.** 2019. The distribution of the land mammals of Sonora, Mexico. *Journal of the Arizona-Nevada Academy of Science* 48:40-219.
- CASSOLA, F.** 2017. *Sciurus aberti*. The IUCN Red List of Threatened Species 2017: e.T42461A22245623.
- CASTILLO-GÁMEZ, R. A., J. P. GALLO-REYNOSO, J. ÉGIDO-VILLARREAL, AND W. CAIRE.** 2010. Mamíferos. Pp. 421-436 in *Diversidad Biológica del estado de Sonora* (Molina-Freaner, F. E., and T. R. Van-Devender, eds.). Universidad Nacional Autónoma de México – Comisión Nacional para el Conocimiento y Uso de la Biodiversidad. México City, México.
- DEYO, N. S., A. SMITH, E. GILBERT, AND T. R. VAN DEVENDER.** 2013. Documenting the biodiversity of the Madrean Archipelago: an analysis of a virtual flora and fauna. Pp. 292-299 in *Merging science and management in a rapidly changing world: biodiversity and management of the Madrean Archipelago III and 7th Conference on Research and Resource Management in the Southwestern Deserts* (Gottfried, G. J., P. F. Ffolliott, B. S. Gebow, L. G. Eskew, and L. C. Collins, comps.). May 1-5, 2012. Proceedings RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Tucson, Arizona, U.S.A.
- DOUMAS, S. L., J. L. KOPROWSKI, AND W. O. NOBLE.** 2015. Landscape-level assessment of Abert's squirrel and red squirrel in mixed conifer forest. *The Southwestern Naturalist* 60:240-246.
- EDELMAN, A. J., AND J. L. KOPROWSKI.** 2005. Diet and Tree Use of Abert's Squirrels (*Sciurus aberti*) in a mixed-conifer forest. *The Southwestern Naturalist* 50:461-465.
- FERGUSON, G. M., A. D. FLESCHE, AND T. R. VAN DEVENDER.** 2013. Biogeography and diversity of pines in the Madrean Archipelago. 2012. Pp. 197-203 in *Merging science and management in a rapidly changing world: biodiversity and management of the Madrean Archipelago III and 7th Conference on Research and Resource Management in the Southwestern Deserts* (Gottfried, G. J., P. F. Ffolliott, B. S. Gebow, L. G. Eskew, and L. C. Collins, comps.). May 1-5, 2012. Proceedings RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Tucson, Arizona, U.S.A.
- GALLO-REYNOSO, J. P., S. MACÍAS-SÁNCHEZ, I. D. BARBA-ACUÑA, L. C. ARMENTA-MÉNDEZ, AND G. PONCE-GARCÍA.** 2015. Informe final del proyecto: "Diagnóstico sobre el estado de conservación de la nutria neotropical en el ANP Ajos-Bavispe". Technical Report. Centro de Investigación en Alimentación y Desarrollo, A. C., Unidad Guaymas. Available at jggallo@ciad.mx.
- GONZÁLEZ-ELIZONDO, M. S., M. GONZÁLEZ-ELIZONDO, J. A. TENA-FLORES, L. RUACHO-GONZÁLEZ, AND I. L. LÓPEZ-ENRÍQUEZ.** 2012. Vegetación de la Sierra Madre Occidental, México: una síntesis. *Acta Botánica Mexicana* 100:351-403.
- HAIRE, S. L., M. VILLARREAL, C. CORTÉS-MONTAÑO, A. FLESCHE, J. INIGUEZ, J. R. ROMO-LEÓN, AND J. SANDERLIN.** 2021. Climate refugia for *Pinus* spp. In topographic and bioclimatic environments of the Madrean Sky islands of México and the United States. Research Square (accepted preview) <https://doi.org/10.21203/rs.3.rs-391708/v1>
- HOFFMEISTER, D. E.** 1986. *Mammals of Arizona*. University of Arizona Press. Tucson, Arizona, U.S.A.
- NASH, D. J., AND R. N. SEAMAN.** 1977. *Sciurus aberti*. *Mammalian Species* 80:1-5.
- REINA-GUERRERO, A. L., AND T. R. VAN DEVENDER.** 2005. Floristic comparison of an Arizona 'sky island' and the Sierra Madre Occidental in eastern Sonora: the Huachuca Mountains and the Yécora area. Pp. 154-157 in *Connecting Mountain Islands and Desert Seas: Biodiversity and Management of the Madrean Archipelago II* (Gottfried, G. J., B. S. Gebow, L. G. Eskew, and C. B. Edminster, comps.). Proceedings RMRS-P-36. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Tucson, Arizona, U.S.A.
- SANDOVAL, S., C. LÓPEZ-GONZÁLEZ, J. G. ESCOBAR-FLORES, AND R. O. MARTÍNEZ-RINCÓN.** 2020. Effect of spatial resolution, algorithm and variable set on the estimated distribution of a mammal of concern: the squirrel *Sciurus aberti*. *Écoscience* 27:195-207.
- SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES (SEMARNAT).** 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010. Protección ambiental, especies de flora y fauna silvestres de México, categorías de riesgo y especificaciones para su inclusión, exclusión o cambio, y lista de especies en riesgo. Diario Oficial de la Federación México. Accessed in August 31, 2020.
- THORINGTON, R. W., AND R. S. HOFFMAN.** 2005. Family Sciuridae. Pp. 754-818 in *Mammal Species of the World: A Taxonomic and Geographic Reference* (Wilson, D. E., and D. M. Reeder, eds.). 3rd Ed. (vol. 2). Johns Hopkins University Press. Baltimore, U.S.A.
- VALDEZ-ALARCÓN, M., AND G. TÉLLEZ-GIRÓN.** 2005. *Sciurus aberti* Woodhouse, 1853. Pp. 542-543 in *Los mamíferos silvestres de México* (Ceballos, G., and G. Oliva, eds.). Comisión Nacional para el Conocimiento y Uso de la Biodiversidad-Fondo de Cultura Económica. México City, México.
- VAN DEVENDER, T. R., AND A. L. REINA-GUERRERO.** 2016. The tropical Madrean flora of Yécora, Sonora, Mexico. *Phytoneuron* 7:1-23.
- VAN DEVENDER, T. R., S. AVILA-VILLEGAS, M. EMERSON, D. TURNER, A. D. FLESCHE, AND N. S. DEYO.** 2013. Biodiversity in the Madrean Archipelago of Sonora, Mexico. Pp. 10-16 in *Merging science and management in a rapidly changing world: biodiversity and management of the Madrean Archipelago III and 7th Conference on Research and Resource Management in the Southwestern Deserts* (Gottfried, G. J., P. F. Ffolliott, B. S. Gebow, L. G. Eskew, and L. C. Collins, comps.). May 1-5, 2012. Proceedings RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Tucson, Arizona, U.S.A.

Associated editor: Nicté Ordóñez-Garza

Submitted: June 22, 2021; Reviewed: October 15, 2021.

Accepted: November 3, 2021; Published on line: November 9, 2021.