

FIELD NOTE

Some natural history notes on Paraguayan armadillos (*Xenarthra*, *Chlamyphoridae*) *Tolypeutes matacus* and *Euphractus sexcinctus*

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Abstract We report on some novel natural history observations of southern three-banded armadillo *Tolypeutes matacus* and six-banded armadillo *Euphractus sexcinctus* from Paraguay. These are: 1) a new band anomaly for an adult of *T. matacus*; 2) inclusion of the newly described subterranean termite *Heterotermes lauralinearum* Carrijo, 2020 (Rhinotermitidae) and the ant *Atta vollenweideri* (Forel, 1893) (Formicidae) in the Paraguayan diet of *T. matacus*; 3) the first reports of parasitism of *T. matacus* by fleas (*Pulex irritans* and potential lesion of *Tunga perforans*) in Paraguay; 4) identification of tracks of *T. matacus* in the field; and 5) the first documented record for *E. sexcinctus* in Ñeembucú department.

Keywords: band anomaly, diet, Ñeembucú, parasitism

Algunos datos de historia natural sobre los armadillos paraguayos (*Xenarthra*, *Chlamyphoridae*) *Tolypeutes matacus* y *Euphractus sexcinctus*

Resumen Informamos sobre algunas observaciones novedosas de historia natural del tatú bolita *Tolypeutes matacus* y el tatú poju *Euphractus sexcinctus* de Paraguay. Estas son: 1) una nueva anomalía de banda para un adulto de *T. matacus*; 2) inclusión de la termita subterránea recientemente descrita *Heterotermes lauralinearum* Carrijo, 2020 (Rhinotermitidae) y la hormiga *Atta vollenweideri* (Forel, 1893) (Formicidae) en la dieta paraguaya de *T. matacus*; 3) los primeros reportes de parasitismo de *T. matacus* por pulgas (*Pulex irritans* y lesiones atribuibles a *Tunga perforans*) en Paraguay; 4) identificación de huellas de *T. matacus* en campo; y 5) el primer registro documentado de *E. sexcinctus* en el departamento de Ñeembucú.

Palabras clave: anomalía de banda, dieta, Ñeembucú, parasitismo

The southern three-banded armadillo *Tolypeutes matacus* occurs in Chaco, Cerrado, Monte, and Pantanal habitats in southwestern Brazil, southern Bolivia, western Paraguay, and northwestern and central Argentina (Abba & Superina, 2010; Feijó *et al.*, 2015; Ferreira *et al.*, 2022). The six-banded armadillo *Euphractus sexcinctus* is widespread, occurring over most of Brazil, Bolivia, Paraguay, Uruguay and northern Argentina, and is a habitat generalist (Abba & Superina, 2010). In Paraguay, both species are considered to be of Least Concern (Smith, 2012; Abba *et al.*, 2017; Smith & Ríos, 2018). Though these species have been well-studied in Argentina, Brazil,

and Bolivia, very little is known of their ecology in Paraguay. In this Field Note we provide some novel observations on their biology from Paraguay.

BAND ANOMALY: A “TWO-BANDED” THREE-BANDED ARMADILLO

Smith (2024) recently reported the first band anomaly in adults of *T. matacus* based on an individual from Paraguay with an incomplete third movable band. Subsequently, a second individual was captured at Fortín Toledo, Boquerón department (22°21'17"S, 60°20'35"W) with just two movable

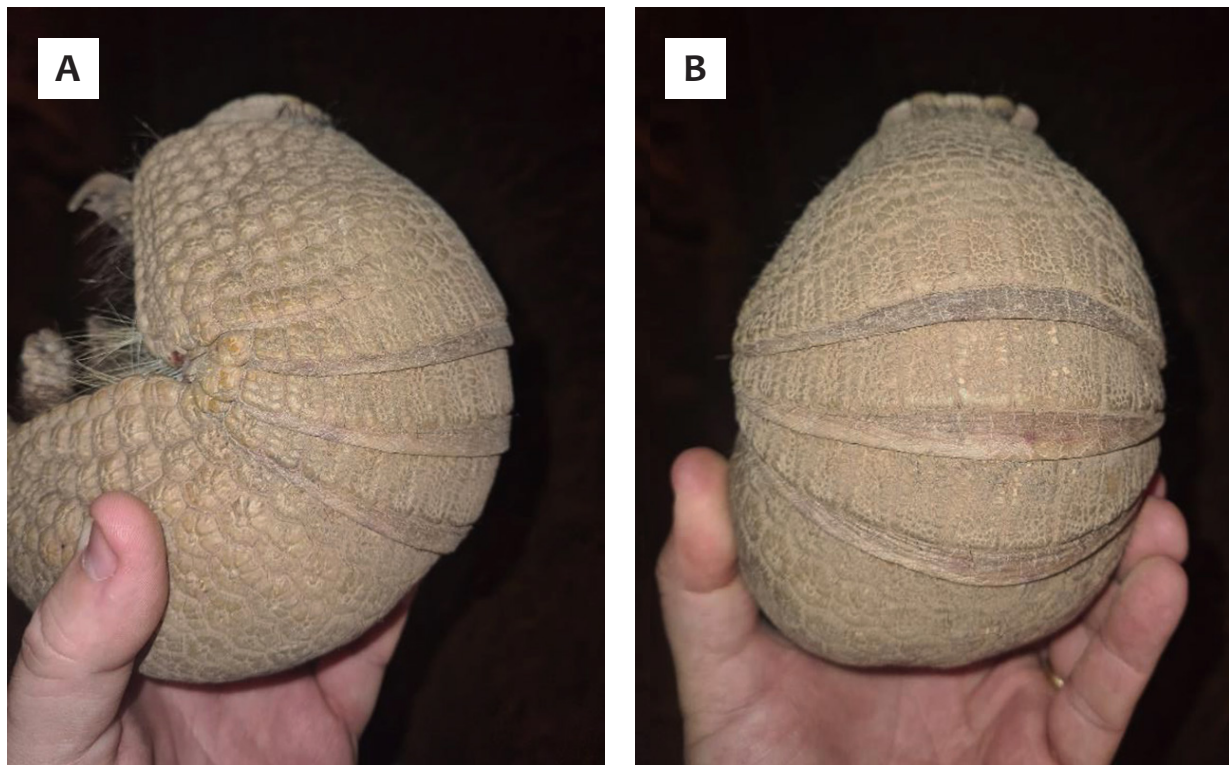


FIGURE 1. **A.** Lateral view of adult *Tolypeutes matacus* showing band anomaly with first movable band fused to the scapular shield. Fortín Toledo, Boquerón department, Paraguay. **B.** Dorsal view of the same individual (Photos: Paul Smith).

bands; the first of the usual three movable bands was present and complete but was completely fused with the scapular shield on the anterior edge (FIG. 1A, B). Nowak (1999) mentions that individuals of the genus *Tolypeutes* may very rarely have two or four bands, but no supporting reference is provided and the species for which this is claimed is not clarified. A review of the literature referring to band anomalies in this species is provided by Smith (2024).

ANT (FORMICIDAE) AND TERMITE (RHINOTERMITIDAE) SPECIES IN THE DIET OF *TOLYPEUTES MATACUS*

Tolypeutes matacus is commonly reported to be largely myrmecophagous, focusing on ants and termites (Redford, 1985b); however, more detailed studies have revealed the diet to be more extensively omnivorous and to show seasonal variation (Bolkovic *et al.*, 1995). Published data on the diet of the three-banded armadillo is available from Argentina (Bolkovic *et al.*, 1995; Gallo *et al.*, 2019) and Bolivia (Bruno & Cuéllar, 2000), but not from Paraguay.

Two adult males of *T. matacus* were captured at Fortín Toledo, Boquerón department, on 4 August 2024. The first animal was found to have several large termite soldiers attached to its underbelly

fur, feet, head, and tail. The second individual was encountered feeding at a column of termites, and similarly to have numerous soldier individuals attached to its fur. It should be noted that the feeding armadillo was gleaning termites from the ground, and had not excavated the subterranean nest hole from which the termites were emerging. Samples of the termites were collected (CZPLT-E 11542) both from the fur of the armadillos and from the nest, and were later identified as *Heterotermes lauralinearum* Carrijo, 2020 (Rhinotermitidae), a recently described species that is apparently endemic to the Chaco region (FIG. 2).

Bolkovic *et al.* (1995) noted that termites made up a significant portion of the diet from July to November in Santiago del Estero, Argentina, but were less prominent at other times of year. However, they were unable to identify any of the termite species consumed by the armadillo. Similarly, Bruno & Cuéllar (2000) did not provide identifications for the termites in the diet of the species during a Bolivian study and Gallo *et al.* (2019) assigned termites in an Argentinian study to “Termitidae”.

The precise identification of termites in the diet may be of some relevance to understanding the foraging behavior of *T. matacus*. Perhaps of note is that *H. lauralinearum* is a large (length c. 10 mm), mainly nocturnal, terrestrial termite that digs temporary

outlet holes in the ground away from the main nest, and forms foraging columns, with the outlet holes being sealed once activity is ceased.

An adult *T. matacus* was found at Chaco Lodge, Presidente Hayes department (22°33'06"S, 59°18'05"W), on 28 August 2024. It had excavated a hole (**FIG. 3D**) into a road (the hole being almost as deep as the animal itself) and was feeding on ants (CZPLT-E 11541) that were later identified as the Chaco leaf-cutter ant *Atta vollenweideri* (Forel, 1893) (**FIG. 3A–C**), a widespread species in this ecoregion (Fowler, 1985). Whilst the hole had been dug by the armadillo for the consumption of the ants, we note again that this feeding activity took place away from the main nest (which was within 10 m), possibly targeting an auxiliary entrance typical of colonies of *Atta* ants. We hypothesize that this behavior could be an attempt to maximize the feeding time by

minimizing the amount of ant attacks on the feeding armadillo, through feeding at outposts of the colony where the passing volume of ants is more limited. The same approach may also be true when feeding on termites. Behaviors aimed at avoiding injury by ants and termites while feeding on them are understood to exist in the Myrmecophagidae (Redford, 1985a).

Bolkovic *et al.* (1995) noted the following sub-families and genera of ants in the diet in Santiago del Estero, Argentina: Ponerinae; Pseudomyrmicinae (*Pseudomyrmex*); Dorylinae (*Crematogaster*, *Neivamyrmex*, and *Novamyrmex*); Myrmecinae (*Acromyrmex*, *Pheidole*, *Elasmopheidole*, *Solenopsis*, and *Wasmanina*); Dolechoderinae (*Dorymyrmex*); Formicinae (*Camponotus* and *Brachymyrmex*). Gallo *et al.* (2019) considered ants to be a tertiary item in the diet of the species in Argentina but did not provide any



FIGURE 2. Soldier of *Heterotermes lauralinearum* Carrijo, 2020 (Rhinotermitidae) (CZPLT-E 11542) taken from the fur of a feeding *Tolyteutes matacus*. Fortín Toledo, Boquerón department, Paraguay (Photo: Matthew Owen).

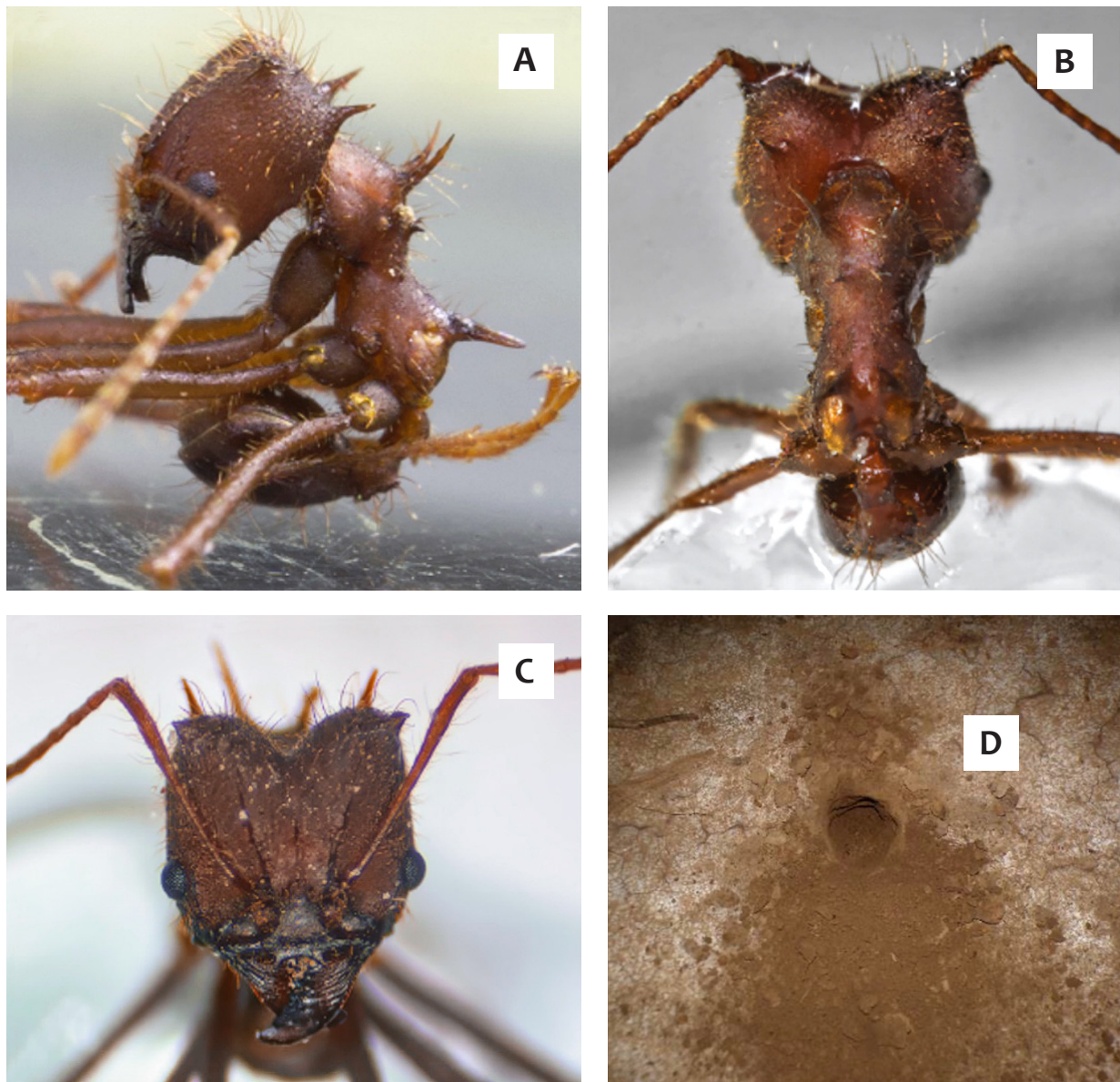


FIGURE 3. A–C. Soldier of *Atta vollenweideri* (Forel, 1893) (Formicidae) collected (CZPLT-E 11541) from a nest at which a *Tolypeutes matacus* was feeding, Chaco Lodge, Presidente Hayes department, Paraguay (Photo: Matthew Owen). D. Foraging hole (approximately 170 mm wide) dug by *T. matacus* feeding on *A. vollenweideri* (Forel, 1893) (Formicidae) at Chaco Lodge, Presidente Hayes department, Paraguay (Photo: Paul Smith).

specific identifications. Thus, we believe this to be the first reference to *Atta vollenweideri* in the diet of *T. matacus*.

FIRST PARAGUAYAN REPORT OF FLEAS (SIPHONAPTERA) ON *TOLYPEUTES MATACUS*

There are few published reports of fleas (Siphonaptera) parasitizing armadillos (Mauri & Navone, 1993; Superina, 2000; Ezquiaga *et al.*, 2008). A photograph of an individual from Defensores del Chaco National Park, Alto Paraguay department taken during October 2009 by Sjeff Ollers showed two “black spots” on the right side of the pelvic shield similar to the characteristic presence of *Tunga*

perforans (Tungidae) (FIG. 4) (Ezquiaga *et al.*, 2020). However, while we note that these are suggestive of parasitism of the species in Paraguay, we cannot rule out other potential causes of these bore holes and confirmation requires the removal of the flea from the carapace. The genus *Tunga* has previously been reported from Paraguay parasitizing *Euphractus sexcinctus* (Whitaker & Abrell, 1987). Another species of flea was recovered (CZPLT-E 11543) from an individual captured at km 653 of the Ruta Trans Chaco, Boquerón department on 15 March 2023. This was identified as the human flea *Pulex irritans* (Pulicidae) (FIG. 5) and is the first record of that species on a southern three-banded armadillo.

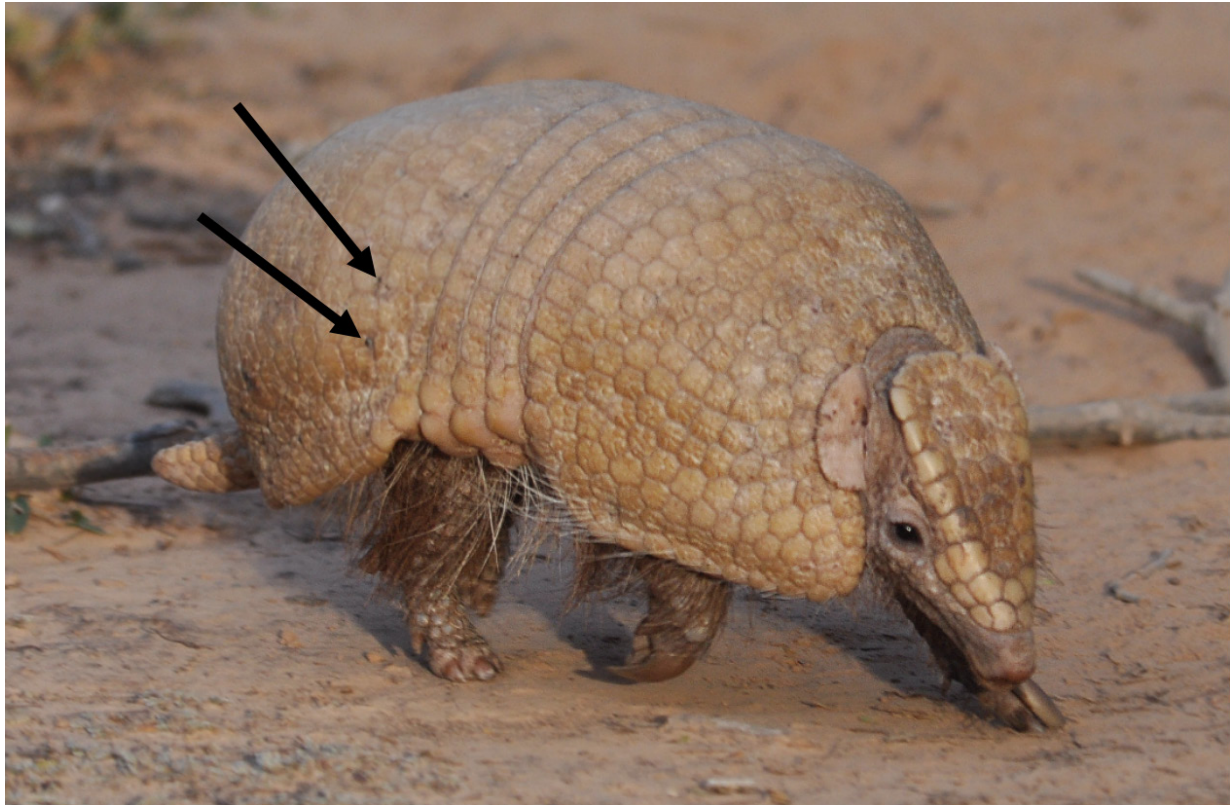


FIGURE 4. Adult *Tolypeutes matacus* showing two lesions in the pelvic shield, potentially caused by fleas of the genus *Tunga* (Tungidae). Defensores del Chaco National Park, Alto Paraguay department, Paraguay (Photo: Sjeff Ollers).

The only previous reports of fleas parasitizing *T. matacus* that we are aware of are of *Malacopsylla grossiventris* (Weyenbergh, 1879) (Malacopsyllidae) and *Tunga perforans* Ezquiaga *et al.*, 2015 (Tungidae), both from Argentina (Mauri & Navone, 1993; Ezquiaga *et al.*, 2015, 2020; Boyde *et al.*, 2023).

IDENTIFICATION OF FOOTPRINTS OF TOLYPEUTES MATACUS

We are not aware that the footprint of this species has been previously adequately described and the two illustrations of it in the Paraguayan literature (Villalba & Yanosky, 2000; Weiler *et al.*, 2023) are inconsistent with the most frequently encountered imprint of the species. The track left by the forefoot is in fact very distinctive when the substrate is soft enough to record it, consisting of a near circular imprint of the plantar pad and two anterior imprints of the long claws (**FIG. 6**). The imprint is approximately 30 mm in length and approximately 15 mm wide.

FIRST RECORD OF EUPHRACTUS SEXCINCTUS IN ÑEEMBUCÚ DEPARTMENT

The six-banded armadillo *E. sexcinctus* is widespread in Paraguay, occurring in all of the major

ecoregions in the country. It likely occurs in all the political departments of the country, although documentation is lacking for Caaguazú, Cordillera, Misiones, and Ñeembucú departments (Smith & Ríos, 2018). We document it for the latter department with a photograph of a roadkill specimen taken on Ruta PY-19 approximately 54 km N of Pilar at 26°26'60"S, 58°09'36"W on 15 August 2024 (**FIG. 7**).

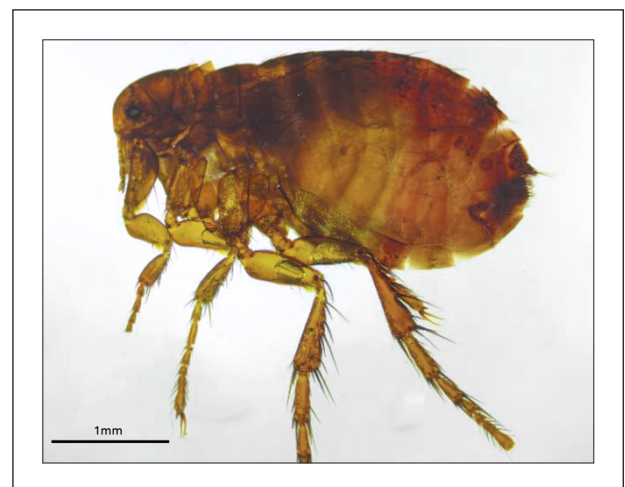


FIGURE 5. Flea *Pulex irritans* Linnaeus, 1758 (CZPLT-E 11543) recovered from *Tolypeutes matacus*. Km 635 Ruta Trans Chaco, Boquerón department, Paraguay (Photo: Matthew Owen).



FIGURE 6. Characteristic footprint of *Tolypeutes matacus* consisting of a rounded pad and two claw marks. Laguna Capitán, Presidente Hayes department, Paraguay (Photo: Paul Smith).

Four species of Xenarthrans are now confirmed to occur in this department: *Dasypus novemcinctus*, *Euphractus sexcinctus*, *Myrmecophaga tridactyla*, and *Tamandua tetradactyla* (Smith *et al.*, 2024).

Despite extensive studies in neighboring countries, very few data are available on Paraguayan Xenarthra, many of which are facing imminent conservation challenges. The observations here are published with a view to contributing to a global understanding of the natural history of these fascinating species and thus assisting in the development of more effective management plans to assist in their conservation.



FIGURE 7. Roadkill *Euphractus sexcinctus* at Ruta PY-19 (26°26'60"S, 58°09'36"W), on 15 August 2024, representing first documentation of the species in Neembucú department (Photo: Paul Smith).

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REFERENCES

- Abba, A.M. & M. Superina. 2010. The 2009/2010 armadillo Red List assessment. *Edentata* 11: 135–184. <https://doi.org/10.5537/020.011.0203>
- Abba, A., S.D. Ríos & P. Smith. 2017. Xenarthra: armadillos y osos hormigueros. Pp. 43–51 in: Libro Rojo de mamíferos del Paraguay: especies amenazadas de extinción (Asociación Paraguaya de Mastozoología y Secretaría del Ambiente, eds.). CREATIO, Asunción.
- Bolkovic, M.L., S.M. Caziani & J.J. Protomastro. 1995. Food habits of the three-banded armadillo (Xenarthra: Dasypodidae) in the Dry Chaco, Argentina. *Journal of Mammalogy* 76: 1199–1204. <https://doi.org/10.2307/1382612>
- Boyde, A., D. Mills, A.M. Abba & M.C. Ezquiaga. 2023. Fleas and lesions in armadillo osteoderms. *Journal of Anatomy* 242: 1029–1036. <https://doi.org/10.1111/joa.13842>
- Bruno, N. & E. Cuéllar. 2000. Hábitos alimenticios de cinco armadillos en el Chaco boliviano. Pp. 401–411 in: Manejo de fauna silvestre en Amazonía y Latinoamérica (E. Cabrera, C. Mercolli & R. Resquín, eds.). Ricor Grafic, Asunción.
- Carrijo, T.F., M. Pontes-Noguera, R.G. Santos, A.C. Morales, E.M. Cancellero & R.H. Scheffrahn. 2020. New World *Heterotermes* (Isoptera, Rhinotermitidae): molecular phylogeny, biogeography and description of a new species. *Systematic Entomology* 45: 527–539. <https://doi.org/10.1111/syen.12412>
- Ezquiaga, M.C., M. Lareschi, A.M. Abba & G.T. Navone. 2008. Nuevos registros de pulgas (Siphonaptera) parásitas de dasipódidos (Mammalia: Xenarthra) en el noreste de la provincia de Buenos Aires, Argentina. *Mastozoología Neotropical* 15: 193–196.
- Ezquiaga, M.C., P.M. Linardi, D.M. de Avelar & M. Lareschi. 2015. A new species of *Tunga* perforating the osteoderms of its armadillo host in Argentina and redescription of the male of *Tunga terasma*. *Medical and Veterinary Entomology* 29: 196–204. <https://doi.org/10.1111/mve.12106>
- Ezquiaga, M.C., T.A. Rios, J.A. Gallo & A.M. Abba. 2020. Evidencias de pulgas en xenartos de Argentina: nuevos registros geográficos de corazas de armadillos perforadas. *Notas sobre Mamíferos Sudamericanos* 2: 1–8. <https://doi.org/10.31687/saremNMS.20.0.04>
- Feijó, A., G.S.T. Garbino, B.A.T.P. Campos, P.A. Rocha, S.F. Ferrari & A. Langguth. 2015. Distribution of *Tolypeutes* Illiger, 1811 (Xenarthra: Cingulata) with comments on its biogeography and conservation. *Zoological Science* 32: 77–87. <https://doi.org/10.2108/zs140186>
- Ferreiro, A.M., E. Soibelzon, J.D. Pinotti, S. Poljak & M.B. Chiappero. 2022. Reconstructing the distribution of Chacoan biota from current and past evidence: the case of the southern three-banded armadillo *Tolypeutes matacus* (Desmarest, 1804). *Journal of Mammalian Evolution* 29: 783–795. <https://doi.org/10.1007/s10914-022-09627-3>

- Fowler, H.G. 1985. Leaf-cutting ants of the genera *Atta* and *Acromyrmex* of Paraguay (Hymenoptera, Formicidae). *Deutsche Entomologische Zeitschrift* 32: 19–34. <https://doi.org/10.1002/mmnd.19850320105>
- Gallo, J.A., L. Fasola & A.M. Abba. 2019. Armadillos as natural pests control? Food habits of five armadillo species in Argentina. *Mastozoología Neotropical* 26: 117–127. <https://doi.org/10.31687/saremMN.19.26.1.0.03>
- Mauri, R. & G.T. Navone. 1993. Ectoparásitos (Siphonaptera y Acari) más comunes en Dasypodidae (Mammalia: Xenarthra) de la República Argentina. *Revista de la Sociedad Entomológica de Argentina* 52: 121–122.
- Nowak, R. 1999. Walker's mammals of the world. Volume 1. 6th Edition. John Hopkins University Press, Baltimore and London.
- Redford, K.H. 1985a. Feeding and food preferences in captive and wild giant anteaters (*Myrmecophaga tridactyla*). *Journal of Zoology* 205: 559–572. <https://doi.org/10.1111/j.1469-7998.1985.tb03544.x>
- Redford, K.H. 1985b. Food habits of armadillos (Xenarthra: Dasypodidae). Pp. 429–437 in: The evolution and ecology of armadillos, sloths and vermilinguas (G.G. Montgomery, ed.). Smithsonian Institution Press, Washington & London.
- Smith, P. 2012. Assessing the assessment, the relevance of the 2006 Paraguayan mammal Red List to the reality of Xenarthran conservation in 2012. *Edentata* 13: 18–28. <https://doi.org/10.5537/020.013.0101>
- Smith, P. 2024. Structural abnormalities in Paraguayan southern three-banded armadillos *Tolypeutes matacus* (Chlamyphoridae). *Xenarthra* 25: e2502. <https://doi.org/10.2305/GQXT2944>
- Smith, P. et al. 2023. New Paraguayan records of Xenarthra with a review of the species present in Ñem-bucú department. *Xenarthra* 24: e2401. <https://doi.org/10.2305/MMSH5644>
- Smith, P. & S.D. Ríos. 2018. Distribution and status of Paraguayan Xenarthra: towards a better understanding. *Edentata* 19: 1–29. <https://doi.org/10.2305/IUCN.CH.2018.Edentata-19-1.2.en>
- Superina, M. 2000. Biologie und Haltung von Gürteltieren (Dasypodidae). Doctoral thesis, University of Zurich, Zurich. 250 pp.
- Villalba, R. & A. Yanosky. 2000. Guía de huellas y señales: Fauna Paraguaya. Fundación Moisés Bertoni, Asunción, Paraguay. 112 pp.
- Weiler, A. et al. 2023. Guía para la identificación de mamíferos medianos y grandes del Chaco Seco. 2nd Edition. Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Asunción, Asunción, Paraguay. 150 pp.
- Whitaker, J.O., Jr. & D.B. Abrell. 1987. Notes on some ectoparasites from mammals of Paraguay. *Entomological News* 98: 198–204.

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