

# Carrying offspring: An unknown behavior of armadillos

## Acarreo de crías: un comportamiento desconocido en los armadillos

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Armadillos are the only extant mammals characterized by bony shielded regions that protect their head, body, and tail. They have been found exclusively in the Americas. Reproduction is seasonal (from late winter and throughout the entire austral spring and summer, *i.e.*, September to March). During mating season two to four males attempt to mate with a single female, after mating the female raises the offspring alone. Parental care are practically unknown among armadillos. This contribution describes and document for the first time (both by photos and video) the carrying of young offspring by *Chaetophractus villosus* and *Zaedyus pichiy* at different locations of Argentina and Chile, most of them were obtained by citizen science. In all cases the adult catch their pup with its mouth, from its right or left forelimb (one case from the border of the pup scapular shield). Due to all cases are temporally and geographically disconnected, and was observed in different species, this behavior could be part of the usual parental care of armadillos. This results shows the importance of the citizen science for data collection, especially to gain new information about criptic species or uncommon behavior.

**Key words:** *Chaetophractus*; Chlamyphoridae; citizen science; mammal; postnatal care; South America, *Zaedyus*.

Los armadillos son los únicos mamíferos que poseen regiones acorazadas que protegen su cabeza, cuerpo y cola. Se distribuyen exclusivamente en América. La reproducción es estacional y ocurre entre el fin del invierno y durante toda la primavera y verano del hemisferio sur (septiembre a marzo). Durante la época reproductiva es común que dos a cuatro machos persigan una hembra e intenten copular con ella, luego de esto la hembra es la que se encarga de cuidar a las crías. El conocimiento sobre cuidados parentales en armadillos es prácticamente nulo. En esta contribución se describe por primera vez, a través de registros fotográficos y de video, el acarreo de crías por parte de adultos de *Chaetophractus villosus* y *Zaedyus pichiy* en diferentes regiones de Argentina y Chile, obtenidas mayormente a través de ciencia ciudadana. En todos los casos las crías fueron tomadas con la boca del adulto y del brazo derecho o izquierdo (húmero) o del borde del escudo pectoral. El hecho de que estos casos se encuentran separados temporal y geográficamente, sumado a que ha sido observado en diferentes especies, permite suponer que se trata de un comportamiento reproductivo usual en armadillos. Finalmente, es importante realzar la importancia de la ciencia ciudadana como base para la obtención de información biológica, especialmente sobre especies raras o sobre comportamientos desconocidos.

**Palabras clave:** *Chaetophractus*; Chlamyphoridae; ciencia ciudadana; cuidado posnatal; mamíferos; Sudamérica; *Zaedyus*.

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Armadillos have been found exclusively in the Americas, from tropical forest to cold-open grasslands, and comprise approximately 20 extant species (56 % of living xenarthrans, [Kennerley et al. 2018](#)). They are the only extant Cingulata clade (Xenarthra) and are characterized by bony shielded regions that protect their head, body and tail, named cephalic shield, dorsal carapace and caudal sheath, respectively. The body region comprises the scapular and pelvic shield separated by a region of movable bands (see [Soibelzon and León 2017](#)). All extant armadillos have traditionally been included in the family Dasypodidae, but recent studies aim to divide them into two (Dasypodidae and Chlamyphoridae; [Gibb et al. 2016](#); [Mitchell et al. 2016](#)) or four families (Dasypodidae, Chlamyphoridae, Euphractidae, and Tolypeutidae; [Gaudin and Lyon 2017](#)). Following the first proposal, the species included in this study (*Chaetophractus villosus* and *Zaedyus pichiy*) are Euphractinae, Chlamyphoridae. Their physiological characteristics (*e.g.*, low basal rates of metabolism and body temperature, high thermal conductance, and the possibility of entering torpor

in *Zaedyus*; [McNab 1980](#)) determine their distribution, so they are more diverse in tropical regions than temperate ones ([Soibelzon 2019](#)). Among Euphractinae (commonly known as “hairy armadillos”), *C. villosus* has one of the widest distributions in Argentina (excluding only Mesopotamia and the Puna ecoregions) and southern Chile; it was recently introduced by humans in the southernmost province of Argentina (Tierra del Fuego; [Poljak et al. 2007](#); [Gallo et al. 2019](#)). Due to its large distribution [Rossi et al. \(2016\)](#) proposed this species as a sentinel organism for environmental biomonitoring. *Zaedyus pichiy*, for other hand, are widely distributed from central to southern Argentina and some regions of Chile ([Superina et al. 2019](#)). Although different types of studies were carried out in armadillos (which includes evolutionary history, anatomy, histology, parasitology, ecology and fisiology) and the fact that they are easily maintained in zoos, little is known about their reproductive strategies ([Superina and Abba 2018](#)). *Chaetophractus villosus* reaches sexual maturity at one year of age ([Superina and Abba 2018](#)). The breeding season

occurs from late winter and throughout the entire austral spring (Luaces *et al.* 2011) with only one seasonal reproductive behavior which includes two hormonal peaks of females and males testis function only interrupted during May (Ciuccio *et al.* 2011; Luaces *et al.* 2011, 2012). Since the end of April (and continues during the spring) mounting attempts starts to be frequent and two to four males attempt to mate with a single female (E. Soibelzon pers. obs., from monitoring studies with camera traps). After 60 to 75 days of pregnancy, females have one to three pups per litter into their burrow, although juvenile females can have two breeding periods per year (Superina and Abba 2018). The pupping peak occurs during late spring (October to November), and the pups weigh around 80 to 110 gr (Sassaroli 1996). *Zaedyus pichiy* reaches sexual maturity at the age of 9–10 months, the breeding season occurs from spring to early summer, but could vary latitudinally. Births occur into the burrows between October and January and has one offspring per litter, which body mass is 50 gr (Superina and Abba 2018).

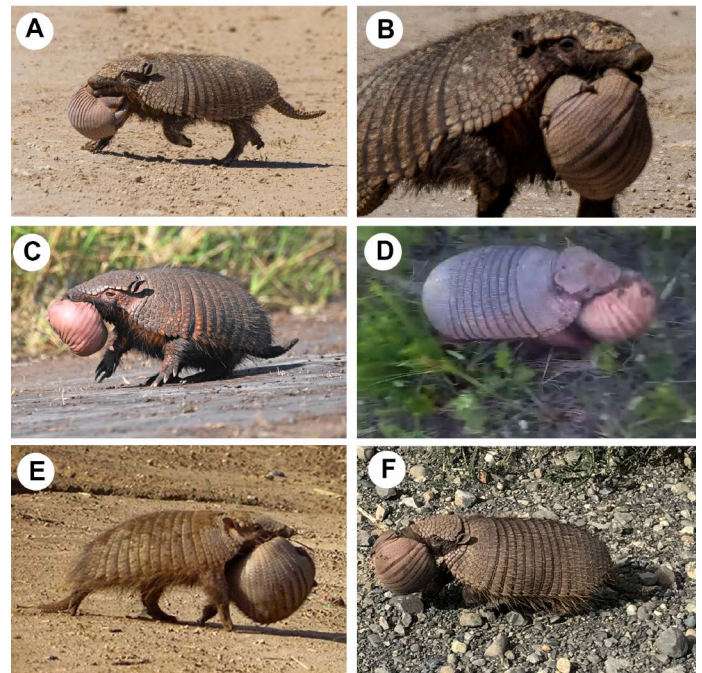
Behavioral aspects linked to parental care are little-known among armadillos. Superina and Abba (2018) suggest that the female raises the offspring alone in Euphractinae, without the collaboration of a male. Poma-Urey and Miserendino-Salazar (2014) observed a female of *Euphractus sexcinctus* carrying a young offspring in Bolivia, but this behavior has never before been more thoroughly documented in the literature. This contribution describes and documents for the first time the carrying of young offspring by *C. villosus* and *Z. pichiy* in Argentina and Chile.

This study was performed by different methods which includes field work and citizen science. Field works were performed in Buenos Aires and La Pampa Provinces (Argentina) as part of vertebrate monitoring studies. During field works, the area was covered by vehicle and on foot looking for armadillos activity. Informal interviews to local farmers were performed in order to gather information about ecological and ethological aspects of armadillos. Regarding to parental care in armadillos, an exhaustive bibliographic research was performed. Due to the scarcity of records and or published information, a survey in social networks were performed (Instagram: @armadillos\_argentina), following the guidelines of citizen science (Tweddle *et al.* 2012). People reporting sightings were further requested to provide photographic evidence of the observed specimens and date of the observation and the exact location.

In order to improve the knowledge of breeding pattern of *ChaetophRACTUS villosus*, three Bushnell camera traps were located in an abandoned field stall in Buenos Aires Province. This old stall has remained inhabited by humans almost for the last 70 years and is currently used by several mammals as refuge (during strong storms, hottest summer days), as wildlife and/or livestock passage (it has no doors or windows) and by *C. villosus* which has some burrows.

During field trips, only one photographic record of an adult carrying offspring was obtained (Figure 1 A-B). Interviews to local farmers contributed to increase the knowledge of general aspects of armadillos (Soibelzon *et al.* in press) and concerning to parental care, they state that this activity is unusual. Nine of them confirmed that they have seen armadillos carrying offspring with its mouth (eight for *C. villosus* and only one reported from *Z. pichiy* in La Pampa Province).

Ten records were obtained by social networks (Instagram: @armadillos\_argentina), five of them including photographs (which were share to use from scientific purposes) and corresponds to *C. villosus* (Figure 1 C-F) and *Z. pichiy* (Figure 2). These photographic records correspond to three different ecoregions of Argentina (Pampa, Monte de llanuras y mesetas and Espinal) and the sub-Antarctic ecoregion of Magallanes of Chile (Table 1). In all cases, the adult was running while carrying one offspring by grabbing its right or left forelimb (or the border of its scapular shield) with its mouth (see Figure 1, 2 and supplementary video in the Appendix). Cases identified in Table 1 as A-C and E (also Figures 1 A-D and F) could not be more than a month old, evidenced by the color of the skin and the consistence of the carapace (following Superina and Abba 2018), while case D shows a large offspring, probably three months old (see also Figure 1 E). Case B from Table 1 (Figure 1 C) could take place relatively late or out of the breeding season, because it was recorded in March. Preliminary analyses of the camera traps records shows different kinds of behaviors of *C. villosus* (such as activity and reproduction patterns) but, until now, do not provide new information about the parental care.



**Figure 1.** *ChaetophRACTUS villosus* adult carrying offspring. A-C: Buenos Aires Province. A-B, Near Mechongué city (by the author); C, Near Necochea city (by G. Whitney); D: El Durazno, La Pampa Province (video capture by V. Fernández and F. Bruno); E: Monte Buey city, Córdoba Province (by W. J. Solsona); F: Torres del Paine National Park, Chile (by N. Vargas).



**Table 1.** Geographic location and dates of the records of carrying offspring mentioned in the text. CV: *Chaetophractus villosus*; ZP: *Zaedyus pichiy*. Coordinates in decimal degrees.

Case	Sp.	Location and Figures	Province	Country	Date month/year	Ecorregion	Coordinates	
A	CV	Mechongué (1A-B)	Buenos Aires	Argentina	11/2018	Pampa	-38.166766°	-58.256203°
B	CV	Necochea (1C)	Buenos Aires	Argentina	3/2015	Pampa	-38.554302°	-58.739739°
C	CV	El Durazno (1D)	La Pampa	Argentina	11/2018	Espinal	-36.703018°	-65.287811°
D	CV	Monte Buey (1E)	Córdoba	Argentina	1/2020	Pampa	-32.914764°	-62.452915°
E	CV	Torres del Paine NP (1F)	Magallanes	Chile	11/2017	Magellan	-51.278694°	-72.281654°
F	ZP	La Payunia (2)	Mendoza	Argentina	10/2019	Monte	-35.980271°	-68.749342°

Even though the observations presented here do not permit establish the sex of the adult, it probably corresponds to a female, taking into account that parental care of the offspring in *C. villosus* is carried out only by the females without the participation of the male (Superina and Abba 2018). In agreement, Poma-Urey and Miserendino-Salazar (2014) corroborated that the female carries the young in the yellow armadillo (*Euphractus sexcinctus*). These authors suggest that this behavior could be related to the nearby predator (and this could be the Case mentioned in Tabla 1 as E and C, because *Puma concolor* is abundant in those regions and is known to feed on armadillos, see Soibelzon *et al.* in press). An alternative explanation for this behavior is related to climatic factors that affect the places of refuge and upbringing of the offspring, given that four cases

recorded in Argentina were immediately after a few days of heavy rains that could have flooded the den and forced females to switch between burrows.

Due to all cases are temporally and geographically disconnected and were observed in different ecoregions and species, this behavior could be widespread and part of the usual repertoire of behaviors of the species rather than rare occurrences. The carrying behavior reported here, along with reports for the yellow armadillo (Poma-Urey and Miserendino-Salazar 2014) and *Tolypeutes matacus* (in captivity at Zooborns, Edinburgh; see Zooborns 2016) constitute strong evidence that parental care in armadillos may be more complex than previously thought and probably extends to at least 3 months of age.

**Figure 2.** *Zaedyus pichiy* adult carrying offspring in La Payunia reserve (Mendoza, Argentina). Photo by A. Castro.

Finally, this results shows the importance of the teamwork between researchers and citizens to gain new information about mammals, especially those concerning to cryptic species, distribution and/or particular or uncommon behavior. This new relationship proves to be positive in different parts of the world (e.g., MammalNet, Mammal Mapper) and deeply enriches scientific knowledge and democratizes its access to the entire population.

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## Literature cited

- CIUCCIO, M., L. F. ROSSI, A. G. FALETTI, P. D. CETICA, E. B. CASANAVE, AND M. S. MERANI. 2011. Seasonal changes in ovarian steroid hormone concentrations in the large hairy armadillo (*Chaetophractus villosus*) and the crying armadillo (*Chaetophractus vellerosus*). *Theriogenology* 75:796-802.
- GALLO, J. A., S. POLJAK, A. M. ABBA, D. E. UDRIZAR SAUTHIER, M. CAMINO, R. M. TORRES, D. M. TAMBURINI, J. DECARRE, E. SOIBELZON, L. B. CASTRO, AND M. SUPERINA. 2019. *Chaetophractus villosus*. In: SAyDS-SAREM (eds.). Categorización 2019 de los mamíferos de Argentina según su riesgo de extinción. Lista Roja de los mamíferos de Argentina, Buenos Aires. DOI: <https://doi.org/10.31687/SaremlR.19.039>.
- GAUDIN, T. J., AND L. M. LYON. 2017. Cranial osteology of the pampathere *Holmesina floridanus* (Xenarthra: Cingulata; Blancan NALMA), including a description of an isolated petrosal bone. *PeerJ*. DOI: <https://doi.org/10.7717/peerj.4022>.
- GIBB, G. C., F. L. CONDAMINE, M. KUCH, J. ENK, N. MORAES-BARROS, M. SUPERINA, H. N. POINAR, AND F. DELSUC. 2016. Shotgun mitogenomics provides a reference phylogenetic framework and timescale for living xenarthrans. *Molecular Biology and Evolution* 33:621-642.
- KENNERLEY, R. J., T. E. LACHER, V. MASON, S. MCCAY, N. ROACH, P. J. STEPHENSON, S. MARIELLA, AND R. YOUNG. 2018. Conservation Priorities and Actions for the orders Cingulata, Pilosa, Afrosoricida, Macroscelidea, Scandentia, Dermoptera, and Eulipotyphla Pp 15-27 in *Handbook of the mammals of the world – volume 8: insectivores, sloths and colugos* (Wilson, D. E., and R. A. Mittermeier, eds.). Lynx Editions. Barcelona, Spain.
- LUACES, J. P., M. CIUCCIO, L. F. ROSSI, A. G. FALETTI, P. D. CETICA, E. B. CASANAVE, AND M. S. MERANI. 2011. Seasonal changes in ovarian steroid hormone concentrations in the large hairy armadillo (*Chaetophractus villosus*) and the crying armadillo (*Chaetophractus vellerosus*). *Theriogenology* 75:796-802.
- LUACES, J. P., L. F. ROSSI, V. MERICO, M. ZUCCOTTI, C. A. REDI, A. J. SOLARI, M. S. MERANI, AND S. GARAGNA. 2012. Spermatogenesis is seasonal in the large hairy armadillo, *Chaetophractus villosus* (Dasypodidae, Xenarthra, Mammalia). *Reproduction, Fertility and Development* 25:547-557.
- MENAB, B. K. 1980. Energetics and the limits to a temperate distribution in armadillos. *Journal of Mammalogy* 61:606-627.
- MITCHELL, K. J., A. SCANFERLA, E. SOIBELZON, R. BONINI, J. OCHOA, AND A. COOPER. 2016. Ancient DNA from the extinct South American giant glyptodont *Doedicurus* sp. (Xenarthra: Glyptodontidae) reveals that glyptodonts evolved from Eocene armadillos. *Molecular Ecology* 25:3499-3508.
- POLJAK, S., J. ESCOBAR, G. DEFERRARI, AND M. LIZARRALDE. 2007. Un nuevo mamífero introducido en la Tierra del Fuego: el peludo *Chaetophractus villosus* (Mammalia, Dasypodidae) en Isla Grande. *Revista Chilena de Historia Natural* 80:285-294.
- POMA-UREY, J. L., AND R. S. MISERENDINO-SALAZAR. 2014. Avistamientos de una peji (*Euphractus sexcinctus* Linnaeus, 1758) llevando su cría. *Edentata* 15:66-68.
- ROSSI, L. F., J. P. LUACES, M. BROWN, M. G. CHIRINO, M. S. MERANI, AND M. D. MUDRY. 2016. *Chaetophractus villosus* as a sentinel organism: baseline values of mitotic index, chromosome aberrations and sister chromatid exchanges. *Mutation Research* 796:40-45.
- SASSAROLI, J. C. 1996. La reproducción de los armadillos. *Isodú* 1:5-7.
- SOIBELZON, E., AND D. C. LEÓN. 2017. Effects of climatic oscillations on the faunas. The Holocene Thermal Maximum and the displacement of armadillos in Argentina: anatomical features and conservation. *Journal of Archaeological Science Reports* 11:90-98.
- SOIBELZON, E. 2019. Using paleoclimate and the fossil record to explain past and present distributions of armadillos (Xenarthra, Dasypodidae). *Journal of Mammalian Evolution* 26:61-70.
- SOIBELZON, E., J. NEGRETE, R. MONTERO, AND H. DELFINO AHUMADA. 2020. In press. ¡No es época de piches! Un intercambio de saberes sobre los mamíferos de la pampa. *Revista Museo*.
- SUPERINA, M., AND A. M. ABBA. 2018. Family Chlamyphoridae (Chlamyphorid armadillos). Pp 48-73 in *Handbook of the mammals of the world – volume 8: insectivores, sloths and colugos* (Wilson, D. E., and R. A. Mittermeier, eds.). Lynx Editions. Barcelona, Spain.
- SUPERINA, M., A. M. ABBA, D. E. UDRIZAR SAUTHIER, J. A. GALLO, E. SOIBELZON, T. A. ROGEL, A. J. AGÜERO, AND C. D. ALBRECHT. 2019. *Zaedyus pichiy*. In SAyDS-SAREM (eds.). Categorización 2019 de los mamíferos de Argentina según su riesgo de extinción. Lista Roja de los mamíferos de Argentina, Buenos Aires. <http://cma.sarem.org.ar/index.php/es/especie-nativa/zaedyus-pichiy>. Downloaded on July 26, 2020.
- TWEDDLE, J. C., L. D. ROBINSON, M. J. O. POCKOCK, AND H. E. ROY. 2012. Guide to citizen science: developing, implementing and evaluating citizen science to study biodiversity and the environment in the UK. Natural History Museum and NERC Centre for Ecology & Hydrology for UK-EOF. Available online: [www.ukEOF.org.uk](http://www.ukEOF.org.uk). Downloaded on October 17, 2020.
- ZOORNS. 2016. Second Armadillo Birth for Edinburgh Zoo. <https://www.zooborns.com/zooborns/2016/05/second-armadillo-birth-for-edinburgh-zoo.html>. Downloaded on November 20, 2020.

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## Appendix

Video record of an adult armadillos *Chaetophractus villosus* carrying young offspring in its mouth in El Durazno, La Pampa, Argentina (video by V. Fernandez and F. Bruno).

[https://drive.google.com/file/d/1xeL58Urp\\_GnX7lVZqr-BuyiuXMmuZbh02/view?usp=sharing](https://drive.google.com/file/d/1xeL58Urp_GnX7lVZqr-BuyiuXMmuZbh02/view?usp=sharing)