



Research note

The northern naked-tailed armadillo in the Lacandona rainforest, Mexico: new records and potential threats

Armadillo de cola desnuda en la selva lacandona, México: nuevos registros y amenazas potenciales

Arturo González-Zamora^{1,2}, Víctor Arroyo-Rodríguez², Ana María González-Di Pierro², Rafael Lombera⁴, Erika de la Peña-Cuéllar², Juan Luis Peña-Mondragón², Omar Hernández-Ordoñez², Carlos Muench², Adriana Garmendia² and Kathryn E. Stoner^{2,3✉}

¹División de Posgrado, Instituto de Ecología A.C. Km. 2.5 Carretera antigua a Coatepec No.351. Congregación El Haya, 91070 Xalapa, Veracruz, México.

²Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México, Antigua Carretera a Pátzcuaro No. 8701, Ex Hacienda de San José de la Huerta, 58190 Morelia, Michoacán, México.

³Department of Biological and Health Sciences, Texas A&M University-Kingsville, MSC 158, 700 University Blvd., Kingsville, TX 78363-8202, USA.

⁴Ecoturism center 'Arca de Noé'. 3ª calle norte s/n Boca de Chajul, Municipio de Marqués de Comillas, Chiapas.

✉ kathryn.stoner@tamuk.edu

Abstract. We review historic occurrences in Mexico of one of the least known Xenarthra of Mesoamerica – the northern naked-tailed armadillo (*Cabassous centralis* Miller, 1899). We document 6 new records in the Lacandona rainforest, southern Mexico, and through interviews with local people, we assess potential threats for this species in the region. In addition to being locally rare, our results show that hunting and death by road-kill may be major threats to this species in the region.

Key words: *Cabassous centralis*, Cingulata, Dasypodidae, xenarthra, human perception.

Resumen. Se revisaron los registros históricos en México de uno de los xenartros menos conocidos de Mesoamérica – el armadillo de cola desnuda (*Cabassous centralis* Miller, 1899). Se documentan 6 nuevos registros en la selva lacandona, sur de México. A través de entrevistas con pobladores locales, se evaluaron las amenazas potenciales para esta especie en la región. Además de ser localmente rara, nuestros resultados muestran que la cacería y las muertes por atropellamiento pueden ser las principales amenazas para esta especie en la región.

Palabras clave: *Cabassous centralis*, Cingulata, Dasypodidae, xenartros, percepción humana.

Cabassous centralis (Miller, 1899) represents one of the least known Xenarthra of Mesoamerica. It is currently classified as Data Deficient by the IUCN due to the limited knowledge on the current status of wild populations, and a lack of available data on the threats that could affect this species (Lara-Ruiz et al., 2008; Superina and Abba, 2009). It is under this scenario that information about new records and an assessment of potential threats become highly valuable for their conservation. Here, we review historic occurrences of this species in Mexico, and document 6 new records of *C. centralis* in the Lacandona rainforest, southern Mexico. We also assess potential threats and provide additional information on human knowledge about this species in the region using interviews with local people.

The northernmost distribution of *C. centralis* occurs in the eastern region of Chiapas, Mexico, and it is found throughout Central America, to northern Colombia and northwestern Venezuela (Fig. 1). It occurs from sea level to around 3 000 m a.s.l. (McCarthy, 1982; Wetzel, 1985; Cuarón et al., 1989; Genoways and Timm, 2003; Díaz-N and Sánchez-Giraldo, 2008).

In Belize and Nicaragua *C. centralis* has been reported to inhabit open savannah dominated by grasses. In Costa Rica it is a rare species everywhere in the country, although it has been observed more frequently in lowland forest than in cloud forest above 1 500 m a.s.l. (Genoways and Timm, 2003). In Chiapas, Mexico, it has been found in areas associated with tropical evergreen forest, grasslands, and transformed areas of secondary forest located below 500 m a.s.l. (Cuarón, 2005). The northern naked-tailed armadillo is nocturnal, solitary,

and fossorial, spending most of its time underground in large excavated tunnels (Carrillo et al., 2002). Its diet consists of termites, ants, and other invertebrates (Carrillo et al., 2002; Cuarón, 2005).

To identify all the specimens of *Cabassous centralis* that have been reported in the scientific literature and/ or collected and deposited in scientific collections, we used internet databases (SCOPUS, JSTOR, ISI Web of Science, Google scholar, Google) to locate relevant published works. Scientific collections that were reviewed online include: 1) the Colección Nacional de Mamíferos, Instituto de Biología, Universidad Nacional Autónoma de México (UNAM), Mexico (<http://unibio.unam.mx/>), 2) the Red Mundial de información sobre Biodiversidad (REMIB), CONABIO, Mexico (<http://www.conabio.gob.mx/remib/>), 3) the Smithsonian Institute Museum, USA (<http://vertebrates.si.edu/>), 4) the Fundación Interamericana de Investigación Tropical (FIIT), Guatemala (<http://www.fiitgt.com/>), and 5) the European Distributed Institute of Taxonomy (EDIT), CSIC, Spain (<http://www.e-taxonomy.eu/>).

In general, very few specimens have been reported in the scientific literature or deposited in museums. Wetzel (1980) reports the first naked-tailed armadillo collected in Nicaragua, which was found near Managua and deposited in the Zoologisches Museum, Museum für Naturkunde der Humboldt-Universität in Berlin, Germany (Genoways and Timm, 2003). The Smithsonian Institute Museum holds 14 specimens (4 from Colombia, 1 from Honduras, 6 from Panama, 2 from Venezuela, and 1 from an unknown locality). The European Distributed Institute of Taxonomy reports 38 records of *C. centralis*, but only 8 are georeferenced (4 from Panama, 1 from Ecuador, and 3 from Mexico). The collection of the Fundación Interamericana de Investigación Tropical in Guatemala contains 2 specimens of *C. centralis*. The specimens were collected in October and November 1986 in rubber (*Hevea elastica*) plantations surrounded by agricultural fields and stands of tropical evergreen forest in La Hulera-Mariscos and Pueblo Nuevo, respectively, Departamento de Izabal, Guatemala.

The only 3 specimens of *C. centralis* recorded from Mexico were found in the Lacandona rainforest, in Chiapas, in the area of influence of the Montes Azules Biosphere Reserve (MABR) (Fig. 1). This reserve encompasses one of the largest areas of tropical rain forest in Mesoamerica (> 3 000 km²; Gómez-Pompa and Dirzo, 1995), but human colonization of this region began about 30-40 years ago, and cattle ranching resulted in rapid deforestation and forest fragmentation. The first record was in October 1986. Cuarón et al. (1989) described that in 1986 they received a confiscated live *C. centralis* from the town San Javier, 7.5 km northwest of the Bonampak archaeological site (16°46'18.84" N; 91°05'39.119" W; 400 m a.s.l. Fig. 1).

The predominant vegetation near San Javier is tropical evergreen forest (Rzedowski, 1978). In 1989, 2 additional specimens were collected by Ignacio March outside of the MABR (16°48'20.879" N; 91°07'49.079" W and 16°45'38.159" N; 91°07'49.079" W; Fig. 1). These 3 specimens were deposited in the Colección Nacional de Mamíferos belonging to the Instituto de Biología of the Universidad Nacional Autónoma de México (IBUNAM-CNMA-IB23898; IBUNAM-CNMA-IB26620 and IBUNAM-CNMA-IB26621, respectively). After these records, there have been no additional reports of this species for this region, nor for Mexico.

As part of a long-term research project on the conservation of vertebrates (bats, primates, terrestrial mammals, and reptiles) in MABR, we recorded 6 additional specimens of *C. centralis* in neighboring areas of this reserve between 2007 and 2011 (Fig. 1). In contrast to the 3 previous records, which were all made outside the northern part of MABR, our new sightings were made in the area of influence of MABR belonging to the Municipality of Marqués de Comillas and Ocosingo, Chiapas, Mexico. Deforestation in this region has resulted in the fragmentation of the forest, but several forest fragments (< 1 to > 1 000 ha) still remain in the region.

The first new record was collected on February 15th, 2007. A road-kill adult specimen of *C. centralis* was found on a dirt road 500 m from the town of Loma Bonita, Municipality of Ocosingo (16°05'39.56" N; 91°00'00.45" W; Fig. 1). Because the specimen was in an advanced stage of decomposition, it was immediately buried and excavated 2 months later to recover the skeleton and teeth. It was deposited in the Colección del Museo de Zoología "Alfonso L. Herrera", Facultad de Ciencias, Universidad Nacional Autónoma de México (10095-MZFC). The area near the road-kill consisted of secondary growth vegetation and grasslands. Although located no more than 180 m from MABR, this area is separated from MABR by the Lacantún River (> 100 m wide). The nearest forest fragment (ca. 10 ha) is 650 m away.

The second new record was a footprint of *C. centralis* found in a sandy riverbank on May 13th, 2007. The footprint of *C. centralis* is easily identifiable, as its shape and size is markedly different from the footprint of the nine-banded armadillo (Aranda, 2000). A plaster mold of the footprint was prepared and deposited in the Laboratorio de Ecología de Paisajes Fragmentados belonging to the Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México. At the observation site (16°14'49.16" N; 90°50'10.17" W; Fig. 1), the stream was surrounded by a strip of second-growth vegetation connecting a large (> 2 000 ha) forest fragment in the Ejido Reforma Agraria to the MABR.

The third new specimen was found in a 1-ha forest fragment (16°05'48.840" N; 91°00'32.759" W; Figs. 1 and 2a-c) on May 18th, 2007 at 23:10 h. The animal was feeding in a termite mound 20 cm above the ground. The individual was foraging with its head inserted into a deep hole (15 cm). The specimen was not sacrificed, but documented with photographs as evidence of the observation (Fig. 2b-c).

The fourth new specimen was another road-kill found on October 15th, 2009 at kilometer 294 (16°05'01.82" N; 90°56'27.63" W; Figs. 1, 2a, 2d) of the carretera transfronteriza (border highway). The individual was in an advanced state of decomposition and for logistical reasons it could not be buried and retrieved at a later date, so it was not collected. Nevertheless, we documented the specimen with photographs (Fig. 2d). The area where the specimen was found was surrounded by agricultural fields and grasslands, and located approximately 3 000 m from MABR and 200 m from the nearest forest fragment (ca.15 ha).

The fifth new record was also a road-kill specimen found on July 24th, 2010 at kilometer 283 (16°04'58.6" N; 90°48'31.5" W) of the carretera transfronteriza (border highway). The individual was a juvenile and it was being devoured by vultures (*Coragyps atratus*). It was deposited in the Colección Nacional de Mamíferos, Instituto de Biología, Universidad Nacional Autónoma de México (registration number in process). The area where the specimen was found was surrounded by agricultural fields and grasslands, approximately 700 m from the town of Santa Rita, and 500 m from the nearest forest fragment (15 ha).

The sixth new record was a footprint of *C. centralis* found in a sandy riverbank on May 18th, 2011 in a 40-ha forest fragment (16°05'07.59" N; 90°58'13.01" W). The footprint was found fresh in the morning (11:00 h). It was easily identified using the figures of Aranda (2000), but we did not prepare a plaster mold of the footprint for logistical reasons. This fragment is mainly surrounded

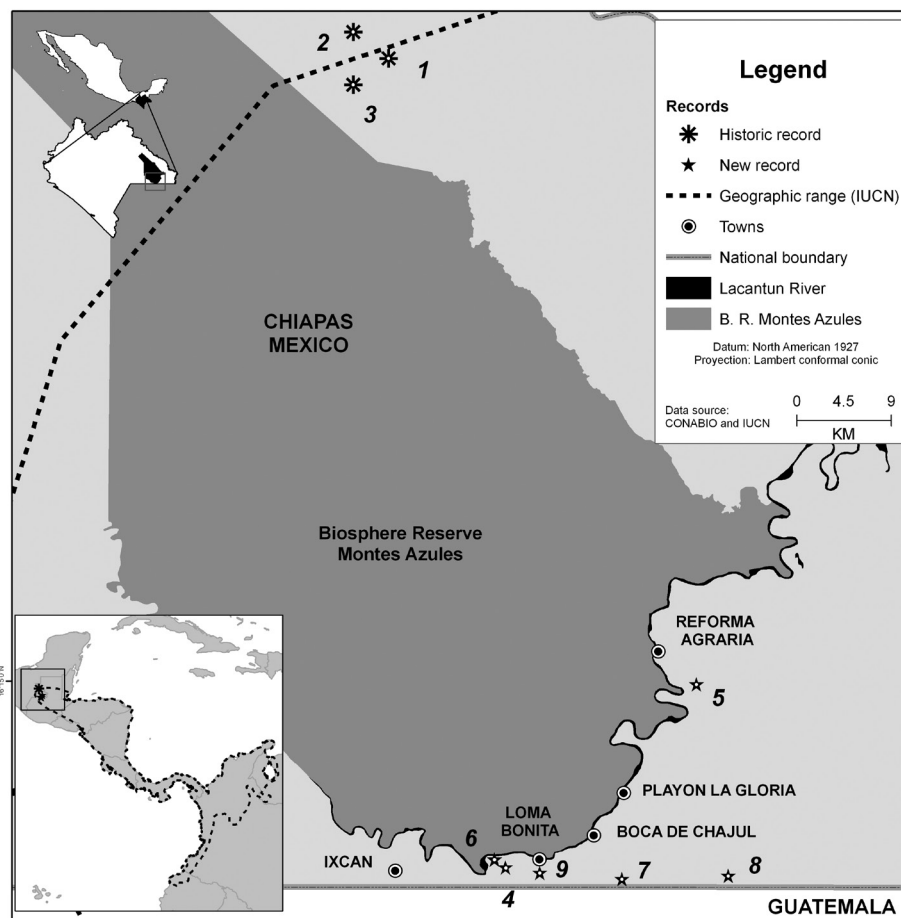


Figure 1. Historical (1-3) and new records of *Cabassous centralis* (4-9) in the Lacandona rainforest, Mexico.

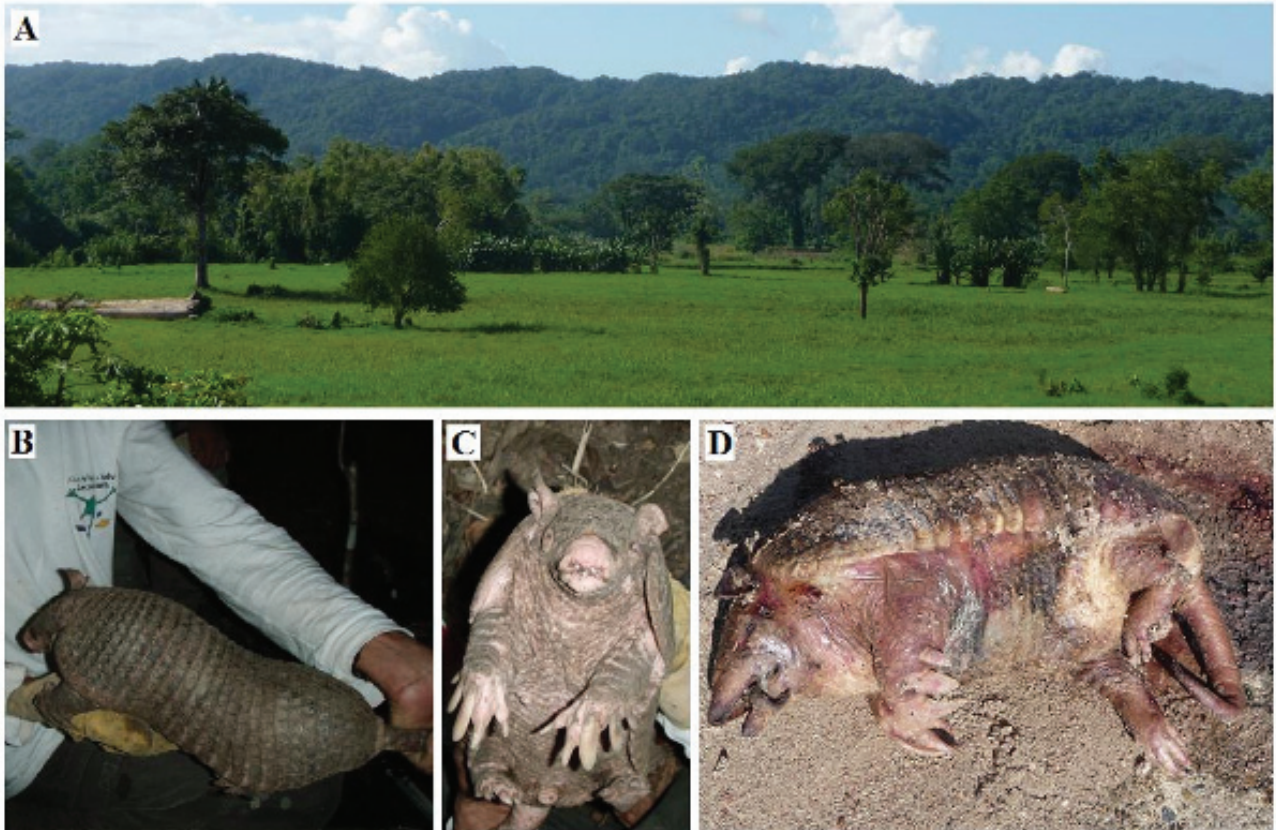


Figure 2. Deforestation and forest fragmentation in the region of Marqués de Comillas, Chiapas, Mexico, has resulted in a heterogeneous landscape dominated by fragments of different sizes within a matrix of agricultural fields and livestock (A). *Cabassous centralis* observed inside a termite mound in a 1-ha forest fragment located in the Ejido Loma Bonita on May 18th, 2008 at 23:10 h (B-C). Road-kill of *C. centralis* at kilometer 294 of the border highway, Municipality of Ocosingo, Chiapas, Mexico (D).

by pasture lands and secondary forests. The nearest town is Loma Bonita (ca. 4 420 m away). The area is located approximately 800 m from the Lacantun River (northern face) and 560 m from the Chajulillo river (eastern face).

To determine the extent to which local people in the region are familiar with this species and to document their knowledge about its ecology, in November 2009 we conducted interviews with 20 residents in communities near the observation sites. In Loma Bonita we did 9 interviews and in Boca de Chajul we did 11 interviews. We restricted our surveys to adult men over 40 years old (range 40 to 103 years) and all with more than 25 years of residency in the region. This group of people represents those who spend the most time working in the field and frequently have more knowledge about native wildlife (Moller et al. 2004).

During the interviews, participants were first shown a photograph of the nine-banded armadillo (*Dasypus novemcinctus*), which is common in the region (Rafael Lombera pers. observ.) and then shown a photograph of *C.*

centralis. All participants readily recognized the 2 species as distinct. The first question we asked was if they had observed *C. centralis* in the region. If their answer was positive we asked how many times they had seen it, approximately how long ago they observed it, and features of the observation site. Finally, we asked if this species is hunted for food or otherwise used by the inhabitants of the region.

Only 8 of the 20 interviewees reported having seen the species in the region, and in all cases they reported seeing the species on only 1 occasion. Two reported seeing it 10 years ago, 4 saw it 15 years ago and 2 saw it 20 years ago. Six of the observations occurred at the edge of a forest fragment near fields, and 2 of the observations were within the interior part of forest fragments (< 20 ha) near fields. Six of the 8 sightings occurred in the daytime and 2 were observed at night. The 6 diurnal observations occurred while the men were using hunting dogs to locate and hunt nine-banded armadillos, which they use as a source of protein. All interviewees claimed to have killed the armadillo immediately because they do not

like the appearance of the animal and they do not use the meat because they believe it is poisonous. None of the interviewed persons observed offspring during their encounters with the armadillo.

Our results concur with those reported by the expert group of the IUCN (Lara-Ruiz et al., 2008; Superina and Abba, 2009), recognizing *C. centralis* as a rare species. In spite of the fact that several academic institutions (e.g., UNAM, ECOSUR) have on-going research projects with vegetation and wildlife in continuous and fragmented habitats within the region (both nocturnal and diurnal research), *C. centralis* rarely has been observed (except for the 6 new cases reported here). The interviews also suggest that this species is very rare, because although we selected people who spend most of their time in the field, most records of this species were made more than 10 years ago.

In addition to being locally rare, there are other characteristics of the species that increase their vulnerability to extinction. In particular, data from the interviews show that in this region this species of armadillo is thought to be poisonous, and it is killed every time it is encountered. Therefore, although it has been suggested that hunting does not seem to be a major threat (Lara-Ruiz et al., 2008; Superina and Abba, 2009), we believe that killing of this species because of fear could be an important threat due to the misconception people have about this animal in the region. Future studies should focus on developing projects of environmental education with the aim of helping to change the perception that people have toward this species.

Because 3 out of 6 records (50%) were road-kill individuals, we cannot exclude death by traffic accident as another major threat to this species. Studies about road-kills have also found that collisions are considered among the major causes of death for amphibians, reptiles, birds and mammals in human-dominated landscapes (Bashore et al., 1985; Groot Bruinderink and Hazebroek, 1996; Trombulak and Frissell, 2000). However, Forman and Alexander (1998) emphasize that the effect of road mortality on wildlife populations may be restricted primarily to a few rare species. Thus, since *C. centralis* is a slow-moving species that seems to inhabit undisturbed forest, as well as secondary forests and agricultural fields around roads, we consider that death by road-kill may be a major threat to this species in the region. We suggest that future studies further evaluate this hypothesis over the entire range of this species.

This work was supported by grants from the Consejo Nacional de Ciencia y Tecnología, México (CONACyT Grants CB2005-C01-51043 and CB2006-56799). VAR thanks the financial support provided by the Dirección General de Asuntos del Personal Académico, UNAM (Grant IA-203111). We thank CONANP for granting

permits to work in the reserve, and the Centro de Investigaciones en Ecosistemas, UNAM, for providing logistical support. The Colección Zoológica Regional (Mammalia) del Instituto de Historia Natural y Ecología del Estado de Chiapas provided valuable information. We are grateful to all interviewed people for their valuable information. We are grateful for technical support provided by J. M. Lobato García, G. Sánchez Montoya, H. Ferreira, and A. Valencia García.

Literature cited

- Aranda, M. 2000. Huellas y otros rastros de los mamíferos grandes y medianos de México. Instituto de Ecología, A.C. Xalapa, Veracruz, México. 212 pp.
- Bashore, T. L., W. M. Tzilkowski and E. D. Bellis. 1985. Analysis of deer-vehicle collision sites in Pennsylvania. *Journal of Wildlife Management* 49:769-774.
- Carrillo, E., G. Wong and J. C. Sáenz. 2002. *Cabassous centralis*. In Mamíferos de Costa Rica, E. Carrillo, G. Wong, and J. C. Sáenz (eds). Instituto Nacional de Biodiversidad. INBIO, San José, Costa Rica. p. 64-65.
- Cuarón, A. D. 2005. *Cabassous centralis*. In Los Mamíferos Silvestres de México, G. Ceballos and G. Oliva (eds.). CONABIO y Fondo de Cultura Económica, México, D. F. p. 116-117.
- Cuarón, A. D., I. J. March and P. M. Rockstroh. 1989. A second armadillo (*Cabassous centralis*) for the faunas of Guatemala and Mexico. *Journal of Mammalogy* 70: 870-871.
- Díaz, J. F. and C. Sánchez-Giraldo. 2008. Notable altitudinal range extension of the northern naked-tailed armadillo *Cabassous centralis* (Cingulata: Dasypodidae) in Colombia. *Brenesia* 69: 75-76.
- Forman, R. T. T. and L. E. Alexander. 1998. Roads and their major ecological effects. *Annual Review of Ecology and Systematics* 29: 207-231.
- Genoways, H. H. and R. M. Timm. 2003. The Xenarthrans of Nicaragua. *Mastozoología Neotropical* 10: 231-253.
- Gómez-Pompa, A. and R. Dirzo. 1995. Atlas de las áreas naturales protegidas de México CONABIO-INE, México, D.F.
- Groot-Bruinderink, G. W. T. A. and E. Hazebroek. 1996. Ungulate traffic collisions in Europe. *Conservation Biology* 10: 1059-1067.
- Lara-Ruiz, P., R. Samudio and Members of the IUCN SSC Edentate Specialist Group. 2008. *Cabassous centralis*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <www.iucnredlist.org>. Downloaded on 06 January 2010.
- McCarthy, T. J. 1982. *Chironectes*, *Cyclopes*, *Cabassous* and probably *Cebus* in southern Belize. *Mammalia* 46: 397-400.
- Moller, H., F. Berkes, P.O. Lyver and M. Kislaioglu. 2004. Combining science and traditional ecological knowledge: monitoring populations for co-management. *Ecology &*

- Society 9: 2.
- Rzedowski, J. 1978. Vegetación de México. Editorial Limusa, México, 432 pp.
- Superina, M. and A. M. Abba. 2009. *Cabassous centralis*. In IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>.
- Trombulak, S. C. and C. A. Frissell. 2000. Review of ecological effects of roads on terrestrial and aquatic communities. Conservation Biology 14:18-30.
- Wetzel, R. M. 1980. Revision of the naked-tailed armadillos, genus *Cabassous* McMurtrie. Annals of Carnegie Museum 49:323-357.
- Wetzel, R. M. 1985. Taxonomy and distribution of armadillos, Dasypodidae. In The evolution and ecology of armadillos, sloths, and vermilinguas, G. G. Montgomery (ed.). Smithsonian Institution Press, Washington, D.C. p. 23-46.