

Predation on *Tamandua tetradactyla* (Pilosa: Myrmecophagidae) by *Caiman latirostris* (Crocodylia: Alligatoridae) in a highly seasonal habitat in Central Brazil

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Abstract. *Caiman latirostris* is an opportunistic predator found in rivers, mangroves, and wetlands throughout eastern South America. We report here the predation of *Tamandua tetradactyla* by *Caiman latirostris* in an old cattle dam in the Serra da Bodoquena National Park, Brazil. The adult caiman was accompanied by its hatchlings that fed on the lacerated parts of the Lesser anteater and possibly the insects attracted by the carcass. Although *Caiman latirostris* acts as a fundamental organism for the balance of ecosystems, most of the species' diet records are anecdotal, making this record relevant for understanding the ecology of the species.

Keywords: natural history, diet, parental care, prey, Serra da Bodoquena.

As opportunistic and top predators (Tavaliere et al. 2020), crocodylians are considered generalists (Roberto et al. 2020). Their diet is known to be dependent on the habitat in which they live and varies with age, seasonality, and prey abundance (Ebey 2020, Ortiz et al. 2020). The Broad-snouted caiman (*Caiman latirostris*) is one of six species of alligatorids in Brazil. The species occupies rivers, mangroves, and wetlands throughout eastern South America (Siroski et al. 2020). The Serra da Bodoquena National Park, in Bonito municipality, Brazil houses the westernmost population of the species in Brazil (Zucoloto et al. 2021). In addition to the relevance of *Caiman latirostris* to their ecosystems and the existence of long-term monitoring on some populations of the species (Marques et al. 2020, Mascarenhas-Júnior et al. 2020), most data on its diet consists mainly of insects, snails, shrimps, fishes, birds, and mammals (Melo 2002, Freitas-Filho 2008, Borteiro et al. 2009). Since crocodylian diet affects their behavior and growth (Woodborne et al. 2021), studies bringing new data on the species biology are fundamental for understanding the species ecology and planning conservation strategies (Marioni et al. 2021, Murray et al. 2020). Here, we report on the first record of predation on a Lesser anteater (*Tamandua tetradactyla*) by the Broad-snouted caiman (*Caiman latirostris*) and a review of the dietary items reported for the species.

On 02 September 2005, during the driest and hotter quarter of the dry season, while conducting a faunal survey at Serra da Bodoquena, we found opportunistically an adult *C. latirostris* (about 1.8 m long), which we assume was a female based on its behavior (see below). Along with 14 hatchlings, it was inhabiting an old cattle dam in the Serra da Bodoquena National Park. This dam (21°15'21.3" S, 56°43'32.78" W; datum: WGS84; 490 m a.s.l.) was located on a recently expropriated farm for the creation of the National Park. During the dry season, the dam has a nearly circular form, approximately 30 m in diameter. During the rainy season, the cattle dam receives additional water from a nearby temporary stream, as we observed in a second visit in December 2005. Thus, during the wet season, the dam size doubles, with its margins reaching a nearby (about 50 m) dry forest remnant, providing suitable habitat for *C. latirostris*.

However, this habitat quickly degrades during the dry season, and its margins and water surface lack terrestrial or aquatic vegetation. Much of the farm was still covered with pasture.

During this observation, on 02 September 2005, when we approached, the juveniles that used to be grouped in the shallower parts of the dam, close to the margins, fled in the direction of the adult. Furthermore, we saw that the adult caiman, often located in the middle of the dam, protected the young, placing itself threateningly between us and the hatchlings. Maternal care, including extended parental care by females, has been observed in several Crocodylia (Gans 1996, Whitaker 2007, Carl & Darlington 2017), leading us to consider that the larger caiman was a female.

On the next day, 03 September, we found an adult Lesser anteater (*Tamandua tetradactyla*) carcass at the water's edge, with the caiman hatchlings feeding on its lacerated parts (and possibly on the insects attracted by the carcass, especially flies). We hypothesize that the carcass was intentionally left on the shore by the mother, accessible to the hatchlings, suggesting a possible case of extended care in the species (Carl & Darlington 2017). The Lesser anteater was missing its left front arm and had deep cuts in its ventral portion (Figure 1). We suppose the Lesser anteater came out of a large remnant of dry forest located near the cattle dam, searching for water; at the time, the dam was the only water body available in the landscape. Likely then, it was attacked by the adult caiman, possibly to provide food for the hatchlings, since caimans are known for providing parental care (Rodrigues et al. 2021, Villamarín et al. 2021), or was waiting until the prey rots to consume this larger item more easily (Westaway et al. 2011).

Although we did not observe the predation event, we are confident that the caiman killed the anteater, based on the following reasoning. The Lesser anteater has crepuscular and nocturnal activity (Laino et al. 2020), coinciding with the Broad-snouted caiman, commonly seen at night (Jesus-Filho et al. 2021). Despite its medium size (about 1 m long and weighing about 4 kg), the Lesser anteater has formidable weaponry for defense, composed of a strong forearm with a large, pointed, and powerful claw at finger III (Taylor 1978,



Figure 1. The preyed adult male Lesser anteater (*Tamandua tetradactyla*), in the Serra da Bodoquena National Park, showing cuts in its belly and the absence of the left arm. Photograph by Reuber Brandão

Lozada-Gallegos et al. 2020). When threatened, the anteater adopts a characteristic erected and threatening posture, facing the potential predator, and keeping their arms wide open (Hayssen 2011, Monroy-Ojeda et al. 2020). If the predator approaches, the anteater can use their claws to produce potentially lethal puncture wounds, in the popularly called “anteater’s hug” in Brazil (Haddad Jr et al. 2014). Thus, few predators in the Serra da Bodoquena can successfully face a Lesser anteater. These potential predators, besides *C. latirostris*, include large canids, medium and large felids, large eagles, and large birds (see Pivatto et al. 2006, Cáceres et al. 2007, Uetanabaro et al. 2007, Souza et al. 2015 for potential predators in Serra da Bodoquena). However, these predators usually move the killed prey to a sheltered place to feed on, avoiding exposed areas such as the dam margins. In the case of snakes, the prey is completely ingested at the location of capture. Furthermore, all these predators often direct their attacks to the cephalic region of the prey, and we did not notice any wounds on the anteater’s head (see Fig. 1). Also, the appearance of the anteater was not suggestive of poor body condition, and we did not observe any signs of skin or fur disease, old scars, trauma, or evident handicaps. It was apparently healthy, suggesting that the caiman did not leave the dam to consume an already dead animal. The wounds on the anteater (Fig. 1) were recent, considering the appearance of the exposed tissues. The anteater’s filiform tongue was also completely protruding, but although it is made up of soft tissue and is prone to rapid desiccation and damage, its natural color, format, and flexibility were retained (Fig. 1). Considering these observations, the most probable predator was the Broad-snouted caiman.

A notable characteristic of the Serra da Bodoquena National Park region is the strong contrast between the dry and rainy periods (Stevaux et al. 2020). We suppose that the limited water bodies in the dry season had forced the caimans to this isolated dam, which explains the presence of the female and her hatchlings in an isolated cattle dam in the last quarter of the dry season since usually the females choose to build their nest near water (Eleutério et al. 2021).

To place our observation in context, we did a literature review on the caiman diet under natural conditions. Based on six publications and our observation, we found that *C. latirostris* consumed 58 prey categories (Table 1). The species’ diet includes insects as the most commonly registered prey category (43%), especially for juveniles (Freitas-Filho 2008, Borteiro et al. 2009). The frequency of insects is similar to that found in other species of the genus (Ortiz et al. 2020). Still, we cannot affirm the percentage consumed according to the stomach volume or if it is related to ontogenetic changes present in the caimans, with young individuals preferring invertebrates and gradually incorporating vertebrates as they grow up (Ortiz et al. 2020). The occurrence of saprozoic flies in the *C. latirostris* diet suggests that the species can feed on carrion or waits until larger prey rots to more easily remove meat chunks.

Previous records of predation on mammals by *C. latirostris* consist only of Rodentia (Melo 2002, Freitas-Filho 2008). Crocodylians normally eat mammals (Boughton et al. 2020). Still, it is reasonable to imagine that mammals become important prey only for larger individuals, being less accessible for neonates and juveniles (Hedrick et al. 2021, Woodborne et al. 2021). We found that much remains to be learned about the diet of *C. latirostris* and related ontogenetic changes (but see Melo 2002 and Borteiro et al. 2009). Most reports on the species’ diet are anecdotal, and very few studies attempted to quantify the diet, and some of them focus more on its diet in captivity (e.g., Gorza et al. 2020, Hilevski & Siroski 2021). We expect that the record of *Tamandua tetradactyla* predation by *Caiman latirostris* and the review of the dietary items used by the species will contribute to further studies focusing on the role of the Broad-snouted caiman as a top predator in the habitats where it occurs.

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References

- Borteiro, C., Gutiérrez, F., Tedros, M., Kolenc, F. (2009): Food habits of the Broad-snouted Caiman (*Caiman latirostris*: Crocodylia, Alligatoridae) in northwestern Uruguay. *Studies on Neotropical Fauna and Environment* 44: 31-36.
- Boughton, R., Wight, B., Pienaar, E., Main, M.B. (2020): Mammalian Carnivores of Florida. IFAS Extension, University of Florida. Gainesville. <<https://edis.ifas.ufl.edu/publication/UW464>>, accessed on 11 June, 2021.
- Cáceres, N.C., Bornschein, M.R., Lopes, W.H., Percequillo, A.R. (2007): Mammals of the Bodoquena Mountains, southwestern Brazil: An ecological and conservation analysis. *Revista Brasileira de Zoologia* 24: 426-435.

Table 1. Prey items compiled for *Caiman latirostris* from studies carried out in nature in South America. Localities: 1 = Taim Ecological Station, Rio Grande do Sul, Brazil; 2 = Rio Grande do Sul, Brazil; 3 = Rio de Janeiro, Brazil; 4 = Uruguay river basin in the Department of Artigas; 5 = Ilha Solteira, São Paulo, Brazil; 6 = Cananéia, State of São Paulo, Brazil; 7 = Serra da Bodoquena National Park. References used: a = Melo (2002); b = Diefenbach (1979); c = Freitas - Filho (2008); d = Borteiro et al. (2009); e = Freitas-Filho (2008); f = Peixoto-Couto et al. (2020); g = Chupil & Monteiro-Filho (2017).

Prey category (Class)	Order	Family	Species	Locality	References		
Gastropoda	-	-	-	1	a		
	Architaenioglossa	Ampullaridae	<i>Pomacea</i> sp.	2, 3	b,c		
	Architaenioglossa	Ampullaridae	<i>Pomacea canaliculata</i>	4	d		
Malacostraca	Basommatophora	Planorbidae	<i>Biomphalaria straminea</i>	4	d		
	-	-	-	1	a,e		
	Decapoda	-	-	3	e		
		Palaemonidae	<i>Pseudopalaemon bouvieri</i>	4	d		
		Trichodactylidae	<i>Trichodactylus</i> sp.	4	d		
Insecta	Isopoda	-	-	3	e		
	Plecoptera	-	-	3	e		
	Ephemeroptera	-	-	4	d		
	Hemiptera	Belostomatidae	-	<i>Belostoma</i> spp.	1,3,4	a,d,e	
					3	e	
					3,4	d,e	
					3	e	
					3	e	
		Coleoptera	-	-	<i>Megadytes</i> sp.	3	e
						4	d
						3	e
						4	d
						3	e
	Odonata	-	-	<i>Dibolocelus</i> sp.	4	d	
					4	d	
					4	d	
					4	d	
					4	d	
		-	-	-	<i>Hydrobiomorpha</i> sp.	4	d
						4	d
4						d	
3						e	
3						e	
Diptera	-	-	-	3	e		
				3	e		
				3	e		
				3	e		
				3	e		
	-	-	-	-	4	d	
					4	d	
					4	d	
					4	d	
					4	d	
Orthoptera	-	-	-	4	d		
				4	d		
				4	d		
				4	d		
				4	d		
Chelicerata	Araneae	-	-	4	d		
				4	d		
				4	d		
				4	d		
				4	d		
	Actinopterygii	-	-	-	1,2,3	a,b	
					3	e	
					4	d	
					3	e	
					4	d	
Amphibia	Perciformes	Cichlidae	-	4	d		
				4	d		
				4	d		
				4	d		
				4	d		
	Siluriformes	Loricariidae	-	-	4	d	
					4	d	
					4	d	
					4	d	
					4	d	
Characiformes	Characidae	-	<i>Serrasalmus</i> sp.	4	d		
				1,2	a		
				4	d		
				5	f		
				4	d		
Reptilia	Chelonia	-	-	1,4	a,d		
				1,4	a,d		
				3	e		
				4	d		
				4	d		
Aves	-	-	-	1,4	a,d		
				3	e		
				3	e		
				3	e		
				6	g		
Mammalia	-	-	-	4	d		
				1	a		
				3	e		
				3	e		
				7	This study		
Unidentified Tetrapoda	-	-	-	4	d		

Carl, N.J., Darlington, J. (2017): Extended parental care in Broad-snouted caiman *Caiman latirostris* (Daudin, 1801) (Crocodylia, Alligatoridae). Herpetology Notes 10: 127-129.

Chupil, H., Monteiro-Filho, E.L.A. (2017): *Caiman latirostris* (Broad-snouted caiman). Diet and feeding behavior. Herpetological Review 48: 182.

Diefenbach, C.O.C. (1979): Ampullarid gastropod-staple food of *Caiman latirostris*? Copeia 1979: 162-163.

Ebey, K. (2020): Climate change on crocodylians: modeling the effects of variations in rainfall on crocodylians and their ecosystem. New Mexico

Academy of Science Competition Winning Papers 54: 2-27.

Eleutério, B.K.N., Honorato, T.G., Lima, G.C.C., Aguiar, M.T.A., Petelinkar, M.C., Alvarenga, F.P., Rabello, M.F.L.J., Rodrigues, V.H.V. (2021): Aspecto reprodutivo do jacaré-de-papo-amarelo (*Caiman latirostris*). pp. 96-108. In: Rodrigues, V.H.V., Neto, A.M.V., Petelinkar, M.C. (eds), Atualidades e Fundamentos em Reprodução e Desenvolvimento. Editora In Vivo.

Freitas-Filho, R.F.F. (2008): Dieta e avaliação da contaminação mercurial no jacaré-de-papo-amarelo, *Caiman latirostris*, Daudin 1802, (Crocodylia, Alligatoridae) em dois parques naturais no município do Rio de Janeiro,

- Brasil. PhD, Federal University of Juiz de Fora, Juiz de Fora, Brazil.
- Gorza, L.L., Nóbrega, Y.C., Santos, R.V., Flecher, M.C., Sena, F.P., Neves, D.N.S., Souza, L.M., Paz, J.S., Souza, T.D., Santos, M.R.D. (2020): Combined metabolic bone diseases, medullary aplasia and bacterial pneumonia in Broad-snouted caiman (*Caiman latirostris*). *Aquaculture* 520: 734–780.
- Haddad Jr, V., Reckziegel, G.C., Neto, D.G., Pimentel, F.L. (2014): Human death caused by a giant anteater (*Myrmecophaga tridactyla*) in Brazil. *Wilderness & Environmental Medicine* 25: 446–449.
- Hayssen, V. (2011): *Tamandua tetradactyla* (Pilosa: Myrmecophagidae). *Mammalian Species* 43: 64–74.
- Hedrick, B.P., Schachner, E.R., Dodson, P. (2021): Alligator appendicular architecture across an ontogenetic niche shift. *The Anatomical Record*. DOI: 10.1002/ar.24717.
- Hilevski, S., Siroski, P. (2021): A novel laxative method for crocodylians and digestibility of soybean (*Glycine Max*) in Broad-snouted caiman (*Caiman latirostris*). *Aquaculture* 533: 736137.
- Jesus-Filho, P.R.J., Freitas-Filho, R.F., Nóbrega, Y.C., Barreto-Lima, A.F. (2021): Introdução a métodos de campo para estudos com crocodylianos brasileiros. pp. 95–199. In: Barreto-Lima, A.F., Santos, M.R.D., Nóbrega, Y.C. (eds), *Tratado de Crocodylianos do Brasil*. Instituto Marcos Daniel.
- Laino, R., Musalem, K., Caballero-Gini, A., Bueno-Villafañe, D., González-Maya, J.F., Chaparro, S. (2020): Anteaters on the edge: giant and Lesser anteaters (*Myrmecophaga tridactyla* and *Tamandua tetradactyla*) at their geographic distributional limits in Paraguay. *Iheringia Série Zoologia* 110: e2020007.
- Lozada-Gallegos, A.R., Muñoz-García, C.I., Villanueva-García, C., Rocha-Martínez, N., Ovando-Fuentes, D., Trejo-Salas, M.B., Reyes-Delgado F., Rendón-Franco, E. (2020): Radiographic anatomy of the forelimb in the Northern tamandua (*Tamandua mexicana*). *Journal of Zoo and Wildlife Medicine* 51: 265–274.
- Marioni, B., Barão-Nóbrega, J.A., Botero-Arias, R., Muniz, F., Campos, Z., Silveira, R., Magnusson, W.E., Villamarín, F. (2021): Science and conservation of Amazonian crocodylians: a historical review. *Aquatic Conservation: Marine and Freshwater Ecosystems* 31: 1056–1067.
- Marques, T.S., Bassetti, L.A.B., Lara, N.R.F., Portelinha, T.C.G., Piña, C.I., Verdade, L.M. (2020): Home range and movement pattern of the Broad-snouted caiman (*Caiman latirostris*) in a silviculture dominated landscape. *South American Journal of Herpetology* 16: 16–25.
- Mascarenhas-Júnior, P.B., Santos, E.M., Moura, G.J.B., Diniz, G.T.N., Correia, J.M.S. (2020): Space-time distribution of *Caiman latirostris* (Alligatoridae) in lentic area of Atlantic Forest, northeast of Brazil. *Herpetology Notes* 13: 129–137.
- Melo, M.T.Q. (2002): Dieta do *Caiman latirostris* no Sul do Brasil. pp. 119–125. In: Verdade, L.M., Larriera, A. (eds), *La conservación y el manejo de Caimanes y Cocodrilos de América Latina*. CN Editoria.
- Monroy-Ojeda, A., Arroyo-Gerala, P., Cruz, F.C., Narvaez, R.L., Gómez, L.M., Jiménez Perez, J.L., Jimenez R.L. Alvaro, R.S., Arcos, V.M.V., Perez G.M., Torrez P.R. Cruz Y.L., Díaz C.J., López, F.M. (2020): Observation of a White hawk (*Pseudastur albicollis*) attacking a Northern tamandua (*Tamandua mexicana*) in Chiapas, Mexico. *Journal of Raptor Research* 54: 463–465.
- Murray, C.M., Crother, B.I., Doody, J.S. (2020): The evolution of crocodylian nesting ecology and behavior. *Ecology and Evolution* 10: 131–149.
- Ortiz, G.J.S., Charruau, P., Reynoso, V. (2020): Variation in diet of hatchlings, juveniles, and subadults of *Caiman crocodylus chiapasius* in La Encrucijada, Chiapas, Mexico. *Revista Mexicana de Biodiversidad* 91: e91852.
- Peixoto-Couto, R.M., Cabrera-Miguel, M., Ortega, Z. (2020): First record of predation on *Rhinella diptycha* (Anura, Bufonidae) by *Caiman latirostris* (Crocodylia, Alligatoridae). *Actualidades Biológicas* 42: 1–5.
- Pivatto, M.A.C., Manço, D.D.G., Straube, F.C., Urben-Filho, A., Milano, M. (2006): Aves do Planalto da Bodoquena, estado do Mato Grosso do Sul (Brasil). *Atualidades Ornitológicas* 129: 1–26.
- Roberto, I.J., Bittencourt, P.S., Muniz, F.L., Hernández-Rangel, S.M., Nóbrega, Y.C., Ávila, R.W., Souza, B.C., Alvarez, G., Miranda-Chumacero, G., Campos, Z., Farias, I.P., Hrbek, T. (2020): Unexpected but unsurprising lineage diversity within the most widespread Neotropical crocodylian genus *Caiman* (Crocodylia, Alligatoridae). *Systematics and Biodiversity* 18: 377–395.
- Rodrigues, C.F.S.N., Barboza, R.S.L., Santos, E.M., Correia, J.M.S. (2021): Communal nesting of Broad-snouted caiman, *Caiman latirostris* (Daudin, 1802), in a protected area of Atlantic Forest in northeastern Brazil. *Herpetology Notes* 14: 677–680.
- Siroski, P., Bassetti, L., Piña, C., Larriera, A. (2020): *Caiman latirostris*, The IUCN Red List of Threatened Species 2020. <https://www.iucnredlist.org/species/46585/3009813#bibliography/> accessed on 11 June 2021.
- Souza, E.O., Godoi, M.N., Aoki, C. (2015): Avifauna do município de Bodoquena, Mato Grosso do Sul. *Atualidades Ornitológicas* 184: 43–54.
- Stevaux, J.C., Macedo, H.A., Assine, M.L., Silva, A. (2020): Changing fluvial styles and backwater flooding along the Upper Paraguay River plains in the Brazilian Pantanal wetland. *Geomorphology* 350: 106906.
- Tavaliéri, Y.E., Galoppo, G.H., Canesini, G., Luque, E.H., Muñoz-de-Toro, M.M. (2020): Effects of agricultural pesticides on the reproductive system of aquatic wildlife species, with crocodylians as sentinel species. *Molecular and Cellular Endocrinology* 518: 110918.
- Taylor, B. K. (1978): The anatomy of the forelimb in the anteater (*Tamandua*) and its functional implications. *Journal of Morphology* 157: 347–367.
- Uetanabaro, M., Souza, F.L., Landgraf-Filho, P., Beda, A.F., Brandão, R.A. (2007): Amphibians and reptiles of the Serra da Bodoquena National Park, Mato Grosso do Sul, central Brazil. *Biota Neotropica* 7: 279–289.
- Villamarín, F., Escobedo-Galván, A.H., Siroski, P., Magnusson, W.E. (2021): Geographic distribution, habitat, reproduction, and conservation status of Crocodylians in the Americas. pp. 1–30. In: Zucoloto, R.B., Amavet, P.S., Verdade, L.M., Farias, I.P. (eds), *Conservation Genetics of New World Crocodylians*. Springer.
- Westaway, M.C., Thompson, J.C., Wood, W.B., Njau, J. (2011): Crocodile ecology and the taphonomy of early Australasian sites. *Environmental Archaeology* 16: 124–136.
- Whitaker, N. (2007): Extended parental care in the Siamese crocodile (*Crocodylus siamensis*). *Russian Journal of Herpetology* 14(3): 203–206.
- Woodborne, S., Botha, H., Huchzermeyer, D., Myburgh, J., Hall, G., Myburgh, A. (2021): Ontogenetic dependence of Nile crocodile (*Crocodylus niloticus*) isotope diet-to-tissue discrimination factors. *Rapid Communications in Mass Spectrometry* 35: e9159.
- Zucoloto, R.B., Bomfim, G.C., Fernandes, F.M.C., Schnadelbach, A.S., Piña, C.I., Verdade, L.M. (2021): Effective population size of Broad-snouted caiman (*Caiman latirostris*) in Brazil: A historical and spatial perspective. *Global Ecology and Conservation* 28: e01673.