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WHO EATS THE ARMADILLOS? NEOTAPHONOMY OF ACCUMULATIONS PRODUCED BY THE CROWNED EAGLE (*BUTEOGALLUS CORONATUS*)

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Abstract. Neotaphonomic studies of vertebrates provide information about the mechanisms and processes that can modify the original characteristics of skeletal elements and can be used as analogues for interpretations on the origin of archeological and paleontological assemblages. The neotaphonomic evaluation of non-ingested bones (leftover prey remains) and modified digested bones by the crowned eagle (*Buteogallus coronatus*, Accipitriformes, Accipitridae) is presented. Bones were recovered from the nests located in the central–west La Pampa Province, Argentina. Leftover prey remains include representatives of Aves, Iguania, Ophidia, Cingulata, Lagomorpha, and Carnivora. Bones from pellets correspond to Ophidia, Rodentia, and osteoderms of two armadillos Chlamyphoridae (Xenarthra, Cingulata). Some of the latter correspond to pichi (*Zaedyus pichiy* Euphractinae), a common species that is usually located in the diet of *B. coronatus*. *Zaedyus pichiy* osteoderms, recovered from pellets, present modifications in the original ornamentation, as well as a reduction in their thickness. Various pellets also contained remains of the pink fairy armadillo (*Chlamyphorus truncatus*, Chlamyphorinae), a small paradigmatic, nocturnal and fossorial species, endemic to central-western Argentina, which is recorded for the first time as part of this raptor diet. This first mention of *Chl. truncatus* being captured by the crowned eagle is relevant because it involves two little–known and sympatric species, in an area where this armadillo is endemic. Osteoderms of *Chl. truncatus* show an extreme degree of modification, and it is interpreted that its potential of preservation in the fossil record is very low.

Key words. Actualistic taphonomy. Accipitridae. Chlamyphoridae. Digested osteoderms. Central–western Argentina.

Resumen. ¿QUIÉN SE COME A LOS ARMADILLOS? NEOTAFONOMÍA DE ACUMULACIONES PRODUCIDAS POR EL ÁGUILA CORONADA (*BUTEOGALLUS CORONATUS*). Los estudios neotafonómicos de vertebrados proveen información sobre los mecanismos y procesos que pueden modificar las características originales de los elementos esqueléticos de vertebrados actuales, y pueden usarse como análogos para interpretar el origen de asociaciones arqueológicas y paleontológicas. Se presenta la evaluación tafonómica de restos óseos no ingeridos (restos de presa) y huesos digeridos modificados, procedentes de egagrópilas del águila coronada (*Buteogallus coronatus*, Accipitriformes, Accipitridae). Los materiales proceden de nidos ubicados en el centro-oeste de la provincia de La Pampa, Argentina. Los restos de presa incluyen representantes de Aves, Iguania, Ophidia, Cingulata, Lagomorpha y Carnivora. Los huesos contenidos en las egagrópilas corresponden a Ophidia, Rodentia y osteodermos de dos armadillos Chlamyphoridae (Xenarthra, Cingulata). Parte de los osteodermos recuperados se asignaron a *Zaedyus pichiy* (Euphractinae), una especie común que habitualmente está presente en la dieta de *B. coronatus*. Los osteodermos de *Zaedyus pichiy*, recuperados de egagrópilas, presentan modificaciones en la ornamentación original y una reducción de su espesor. Varias egagrópilas también contenían osteodermos del pichiciego *Chlamyphorus truncatus* (Chlamyphorinae), un pequeño y paradigmático armadillo nocturno y fosorial, endémico del centro–oeste de la Argentina, que se registra por primera vez como parte de la dieta de esta ave rapaz. Esta primera mención de *Chl. truncatus* como parte de la dieta del águila coronada es relevante porque involucra dos especies simpátricas y poco conocidas, en un área donde este armadillo es endémico. El grado de modificación de los osteodermos de *Chl. truncatus* es extremo, por lo que se interpreta que su potencial de preservación en el registro fósil es muy bajo.

Palabras clave. Tafonomía actualística. Accipitridae. Chlamyphoridae. Osteodermos digeridos. Centro-oeste de Argentina.

Actualistic taphonomy or neotaphonomy (Tedford, 1970; Lyman, 1994) of vertebrates is becoming frequent, particularly those studies focused on the predator–prey interaction (Lyman, 2018), as they provide valuable information about the mechanisms and processes that can modify the original characteristics of skeletal elements (Lyman, 1994). These kinds of studies can be used as analogues for interpretations on the origin of both archeological and paleontological assemblages (Fernández–Jalvo & Andrews, 1992; Fernández *et al.*, 2017; Montalvo & Fernández, 2019).

In this contribution, we perform a neotaphonomic study on a central arid and semi-arid region of Argentina, which corresponds to the southern portion of the Central or Subandean Zoogeographic Domain (Ringuelet, 1961). This region is known for hosting fossiliferous deposits from the Late Miocene–Holocene lapse (*e.g.*, Verzi *et al.*, 2008; Montalvo *et al.*, 2017, 2023) and for developing naturalistic taphonomic studies, mainly focused on predators, and conducted at a wide spatial scale (Montalvo *et al.*, 2007, 2008, 2011, 2012, 2014, 2016, 2020; Montalvo & Tallade, 2009; Fernández *et al.*, 2017, 2025; Montalvo & Fernández, 2019). In this case, we analyzed the prey–remains of the crowned eagle *Buteogallus coronatus* (Vieillot, 1817) (Accipitriformes, Accipitridae), also called chaco eagle, from a neotaphonomic point of view. This eagle is one of the largest raptor birds in South America (body mass between 3 and 3.7 kg). It mainly inhabits open woodlands in xerophytic and humid forests typical of southern Brazil, Paraguay, eastern Bolivia, and Argentina, with its austral limit of distribution reaching northern Patagonia (Sarasola *et al.*, 2022). This raptor is mostly solitary and crepuscular, and its hunting techniques include perching and waiting for prey, as well as performing circular low-altitude flights approximately 100 m above the ground (Pereyra Lobos *et al.*, 2011). Nests are constituted by large platforms placed on top of trees composed of sticks (Maceda, 2007). *Buteogallus coronatus* has opportunistic and generalist habits. It accumulates large amounts of leftover prey remains (mainly skins, bones, and osteoderms) around the nest in open landscapes and, on some occasions, several pellets can also be recorded in the nesting area (Montalvo *et al.*, 2016; Guardia *et al.*, 2024). In particular, the diet of this raptor primarily includes mammals, mainly Chlamyphoridae (Xenarthra, Cingulata), as well as Mephitidae and Mustelidae (Carnivora), Leporidae (Lagomorpha), Caviidae, Cricetidae, and Ctenomyidae (Rodentia), but it also consumes other vertebrates such as snakes (Elapidae, Viperidae, and Dipsadidae), tortoises (Testudinidae), lizards (Teiidae, Iguanidae), fishes, and birds (*i.e.*, Tinamidae, Psittacidae, Cracidae, and Rheidae) (Maceda *et al.*, 2003; Maceda, 2007; Chebez *et al.*, 2008; Pereyra Lobos *et al.*, 2011; Galmes *et al.*, 2018). Sarasola *et al.* (2010) also recorded the consumption of diverse insects and arachnids. There are no known fossil remains of the crowned eagle, and those of Accipitridae are scarce in Argentina.

Neotaphonomic analyses of the modifications produced by *Buteogallus coronatus* on prey remains (both digested and non–ingested) are scarce. The modifications generated by this raptor during capture and handling of diurnal Chlamyphoridae armadillos (including the Euphractinae *Zaedyus pichiy* Desmarest, 1804, *Chaetophractus villosus* Desmarest, 1804, and *Chaetophractus vellerosus* (Gray, 1865), recovered from several accumulations of prey remains in La Pampa Province (central Argentina), were studied by Montalvo *et al.* (2016). Recently, Guardia *et al.* (2024) analyzed non-ingested vertebrate leftover prey remains accumulated by the crowned eagle in the Ñancuñán Biosphere Reserve in Mendoza Province (central-western Argentina). Montalvo *et al.* (2016) and Guardia *et al.* (2024) suggested that neotaphonomic observations can be used in subsequent studies of armadillo bone accumulations from open–air archeological or paleontological sites from central Argentina and other parts of South America inhabited by this eagle, as well as in future revisions of samples.

The IUCN listed the crowned eagle as a vulnerable species until 2004, when it was declared endangered (BirdLife International, 2024). Many aspects of its biology and ecology are still unknown, including habitat use and dispersal behavior (Sarasola *et al.*, 2022). Considering this situation, all the information obtained from the study of the ingested or handling remains during its feeding is considered of particular interest.

Chlamyphoridae (Cingulata) representatives are noteworthy among the prey of *Buteogallus coronatus*. This group of 'armored' xenarthran mammals are characterized by

having a protective carapace composed of ossified dermal tissues known as osteoderms (Gaudin & McDonald, 2008). Recent phylogenetic data strongly support the monophyly of four armadillo subfamilies gathered into two families: Dasypodinae (long–nosed armadillos) within Dasypodidae and Euphractinae (hairy, six–banded, and pichi armadillos), Tolypeutinae (three-banded, naked-tailed, and giant armadillos), and Chlamyphorinae (pink fairy armadillos) within Chlamyphoridae (Delsuc *et al.*, 2012, 2016; Gibb *et al.*, 2016; Barasoain *et al.*, 2020).

Within Chlamyphorinae, *Chlamyphorus truncatus* Harlan, 1825, commonly named as pink fairy armadillo and '*pichiciego*', represents the smallest armadillo and one of the most bizarre, elusive, and unknown living mammals (Minoprio, 1945; Barasoain *et al.*, 2020). It is a nocturnal and fossorial species with solitary habits, endemic to the Central or Subandean Zoogeographic Domain of Argentina (Borghi *et al.*, 2011). This species inhabits dry grasslands and sandy plains with shrubby vegetation along the following ecoregions: Monte of plains and plateaus, Espinal, arid Chaco, Monte of hills and valleys, and Pampas grassland (Abba *et al.*, 2012). *Chlamyphorus truncatus* has a diet mainly composed of insects (such as ants and beetles), worms, snails, and small amounts of roots and other plant parts (Borghi *et al.*, 2011). However, the biology, ecology, and evolutionary history of *Chl. truncatus* is poorly known, fundamentally due to their lifestyle. In addition, there are no publications on the specific physiological adaptations of this armadillo to inhabiting extreme areas such as the xeric environments (Superina *et al.*, 2014). Representatives of the subfamily Chlamyphorinae were recovered from Late Miocene levels of the Cerro Azul (La Pampa and Buenos Aires provinces) and Loma de las Tapias (San Juan Province) formations (Barasoain *et al.*, 2020). Some specimens described for the Late Pleistocene (Buenos Aires Province) and Holocene (San Luis Province) were discussed by Scillato–Yané (1982). At the moment, there is an absence of fossil chlamyphorines between the Late Miocene to the present.

The pichi, *Zaedyus pichiy*, is an Euphractinae that represents an important item of *Buteogallus coronatus* diet (Sarasola *et al.*, 2022). In Argentina, skeletal elements of this armadillo were recovered as leftover prey remains in different nests from La Pampa and Mendoza provinces with the objective of carrying out neotaphonomic evaluations (Montalvo *et al.*, 2016; Guardia *et al.*, 2024). It is a relatively small (*ca.* 1 kg), solitary and diurnal animal that lives in arid and semi–arid habitats in central and southern Argentina and Chile (Wetzel, 1985), reaching altitudes up to 2,500 m. In Argentina, it inhabits different ecoregions: Patagonian Steppe, Monte of plains and plateaus, Pampas grassland, and Espinal (Abba *et al.*, 2012). This species is currently listed as near threatened by the IUCN Red List of Threatened Species (Superina & Abba, 2014). The present-day diversity of Euphractinae is restricted to three genera, having been considerably greater in the past. With respect to the fossil record, remains assigned to *Zaedyus* were mentioned for the Late Miocene of the Ituzaingó Formation (Entre Ríos Province, Argentina) (Scillato–Yané *et al.*, 2013). However, reliable remains of *Z. pichiy* are known since the Early to Middle Pleistocene in the Pampean region (Soibelzon *et al.*, 2010). Holocene archeological records of this species are known in the Pampean region.

In the context of the neotaphonomic evaluation carried out here on pellets and leftover prey remains produced by *Buteogallus coronatus* in La Pampa Province, digested osteoderms of *Zaedyus pichiy* were recovered from pellets, and non-ingested bones (mainly carapace portions) were recovered from nest, while digested osteoderms of *Chlamyphorus truncatus* were identified only in pellets. We analyze and interpret the modifications generated by digestion on both armadillo osteoderms and different skeletal elements from other vertebrates. This study provides novel information on the trophic interaction between *B. coronatus* and two species of Chlamyphoridae in central Argentina, contributes to improving knowledge about their ecology, and represents the first evidence of *Chl. truncatus* as part of the crowned eagle diet.

PHYTOGEOGRAPHIC, BIOGEOGRAPHIC AND CLIMATIC CHARACTERIZATION

From a phytogeographic viewpoint, the materials evaluated (pellets and leftover prey remains) were recovered from two ecoregions in La Pampa Province, Argentina: the Espinal and the Monte Desert (Cabrera, 1994) (Fig. 1.1). The Espinal, in the central sector of the province, corresponds to the Caldén District, characterized by xeric deciduous

forests, mainly caldén [*Neltuma caldenia* (Burkart, 1939)], as well as clearings covered by very open to park-type grassy savannas, and dunes and salty soils. In the dune areas, scrublands and sammophilous grassland develop (Oyarzabal *et al.*, 2018). In the western sector of the province, the vegetation of the Monte Desert is represented by a high shrub steppe, characterized by communities of *Larrea* spp. with isolated caldén trees. In the area of the Atuel–Salado–Chadileuvú wetlands, a low shrub steppe stands out with halophytic scrub (Oyarzabal *et al.*, 2018).

Both ecoregions share a diverse fauna of terrestrial vertebrates, although their frequency of appearance varies between areas. These vertebrates are usually prey of *Buteogallus coronatus* (Chebez *et al.*, 2008; Sarasola *et al.*, 2010; Pereyra Lobos *et al.*, 2011). Among reptiles, species include Testudinidae, Teiidae, Liolaemidae and Viperidae, Colubridae, Elapidae (Bauni *et al.*, 2021). Birds include the Rheidae, Tinamidae, Columbidae, Tytonidae, and a great diversity of Passeriformes families (Verga *et al.*, 2019). Mammals are represented by Didelphidae; Chlamyphoridae Euphractinae and Chlamyphorinae; rodents such as Octodontidae, Ctenomyidae, Caviidae, Chinchillidae, and Cricetidae; Camelidae, and several Carnivora as Felidae, Mustelidae, Mephitidae, and the Canidae (Soibelzon *et al.*, 2021).

Climate is temperate in both ecoregions, with an average annual temperature ranging from 14°C and 16°C and a marked thermal amplitude (around 16°C), more pronounced towards the west. Maximum summer temperatures range from 40°C to 45°C, while winter minimums range from -17°C to -10°C. The scarce rainfall ranges from 80 to 300 mm per year in the Monte Desert and from 300 to 550 mm per year in the Espinal (Cabrera, 1994).

MATERIALS AND METHODS

We evaluated the vertebrate remains obtained from 43 pellets and non-ingested leftover prey remains produced by *Buteogallus coronatus*, which were recovered from different nests areas located in the Espinal and Monte desert of La Pampa Province (Fig. 1.2–3; Tab. 1). Both pellets and left-over prey remains samples (Tab. 1) were collected during 2012 and 2013. They were found on the surface of the sub-strate, around the bases of the trees where the nests were located; most of the findings correspond to accumulations of leftover prey remains. Details of leftover prey remains were previously evaluated from a taxonomic and neotapho-nomic perspective by Montalvo *et al.* (2016). The materials studied are housed in the Vertebrate Collection from FCEN, UNLPam.

Pellet collection was carried out in the field under conditions as undisturbed as possible. Posteriorly, they were broken down dry and the bones were extracted under laboratory conditions. These remains were classified and examined using a stereo microscope Leica MS5. Photographs were taken with a Nikon d3100 camera and some osteoderms were photographed under a scanning

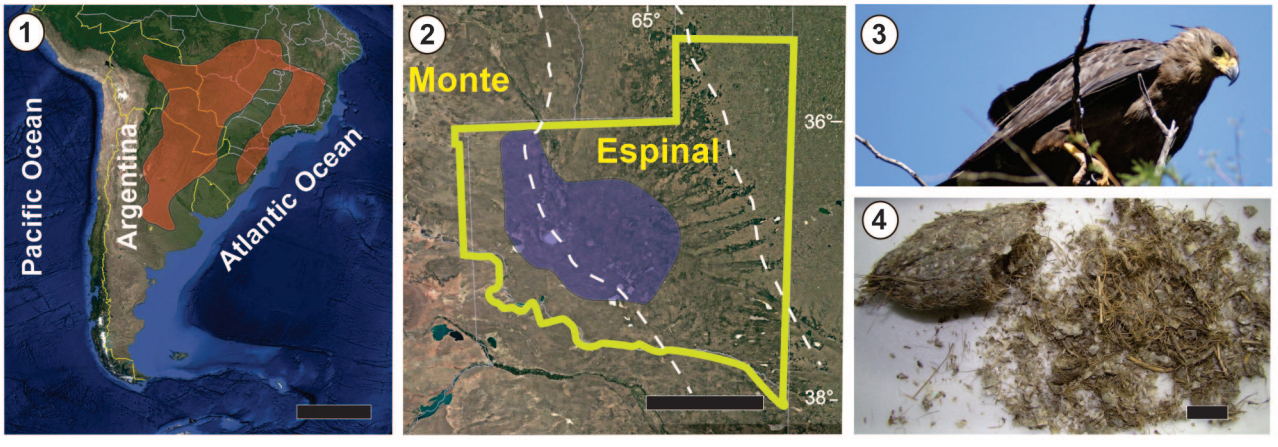

Figure 1. ***Buteogallus coronatus***. **1,** Distribution in South America in red; scale bar= 1000 km; **2,** In blue, area of localities in La Pampa Province (see Tab. 1), and different ecoregions of this province; scale bar= 160 km; **3,** Photograph of ***B. coronatus***; **4,** Portions of complete and disaggregated pellets; scale bar= 10 mm. Images 1–2 from Landsat/Copernicus 2023; Google Earth, accessed December 2023.

electron microscope ZEISS GeminiSEM 360 at Instituto de Ciencias de la Tierra y Ambientales de La Pampa (CONICET–UNLPam).

Taxonomic identifications are based on comparison with current specimens from the vertebrate collections of the FCEN, UNLPam (MKUNLPam) and MPHN–ZM. Following Badgley (1986), we calculated the number of identified specimens per taxon, the MNE, and the MNI from each pellet and from the whole sample (including the non-ingested leftover prey remains).

For the neotaphonomic evaluation of the scarce rodent remains, we partly followed the standard methodology of Andrews (1990), Fernández–Jalvo & Andrews (1992), Fernández *et al.* (2017), and Montalvo & Fernández (2019). This methodology allows categorizing predators using several characteristics: the relative abundance of skeletal elements, considering the MNEi as a function of the expected number of that specific skeletal Ei and the MNI, after MNEi/(Ei × MNI) × 100; calculation of indexes of element proportion: [(humerus + femur) / (mandible + maxilla)] x 100] and [(tibia + radius) / (femur + humerus)]; corrosion marks produced by digestive acids on the surfaces of incisors, molars, and postcranial elements; and breakage of skulls, mandibles, and postcranial elements.

Remains of *Zaedyus pichiy* and *Chlamyphorus truncatus* recovered from pellets consist mainly of isolated osteoderms from different portions of the armor. The neotaphonomic methodology used is that proposed by Tomassini *et al.* (2023), who analyzed breakage degree and type of fractures; modifications of articular and broken edges; modifications of the surface (including desquamation or exfoliation of bone layers); and modifications of original ornamentation patterns. In order to evaluate the representativeness of the digested osteoderms of *Z. pichiy*, they were evaluated in relation to the total number of osteoderms present in a complete carapace, using data from Montalvo *et al.* (2016). The total number of osteoderms present in a complete dorsal carapace of *Chl. truncatus* (including scapular and pelvic shields, and mobile rows) and the number of osteoderms in each of them were counted in 11 taxidermied individuals (vertebrate collections of FCEN, UNLPam and MPHN–ZM).

Snake remains recovered from the pellets are mainly represented by several ribs, segments of the vertebral

TABLE 1 – Different nest localities of *Buteogallus coronatus* evaluated in this study (see Fig. 1.2), geographic coordinates, ecoregion (*sensu* Cabrera, 1994), number of pellets and leftover prey remains recovered.

Localities	Latitude (S)	Longitude (W)	Ecoregion	Pellets	MNI* of leftover prey Chlamyphoridae**	MNI* of other vertebrate leftover prey remains
San José	36°37'3.19"	65°42'12.88"	Espinal	2	50	1 *Patagioenas picazuro*
Las Nutrias	36°45'36.52"	65°41'8.43"	Espinal	1	10	-
San Eduardo	36°52'46.42"	65°39'59.69"	Espinal	1	13	-
El Piolín	37°11'25.53"	65°41'54.53"	Espinal	1	-	-
Don Rodrigo	36°45'35.20"	65°50'43.88"	Espinal	4	-	1 *Galictis cuja*
Campomar	36°49'30.53"	65°59'10.47"	Espinal	1	14	1 *Lepus europaeus*
El Odre	36°55'59.22"	66°10'25.47"	Espinal	2	-	-
Torres	36°04'05.50"	66°39'34.10"	Monte Desert	1	19	1 *Conepatus chinga*
Ventrencó	36°37'34.40"	66°53'20.00"	Monte Desert	3	37	2 *Micrurus pyrrhocryptus* 1 *Salvator* sp.
El Tres	36°51'02.20"	66°47'57.00"	Monte Desert	1	22	-
Vicente	36°55'30.00"	66°43'36.43"	Monte Desert	25	20	-

*MNI Minimum number of individuals; **Data from Montalvo *et al.* (2016a) and this work.

column, and isolated vertebrae. In some cases, portions of the skeleton are covered with scales (smooth or keeled) that facilitated their taxonomic assignment. Bird remains are very scarce, both in the pellets and leftover prey remains, which prevented their taxonomic identification, as well as a detailed neotaphonomic evaluation. In each case, the recovered skeletal elements were analyzed considering completeness, type of fractures, and possible marks produced by the predator.

Institutional abbreviations. FCEN, UNLPam, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de La Pampa, La Pampa, Argentina; **MPHN–ZM,** Museo Provincial de Historia Natural–Zoología Mamíferos, La Pampa, Argentina; **MKUNLPam,** Marta Kin collection, Universidad Nacional de La Pampa, La Pampa, Argentina.

Other abbreviations. Ei, element in the individual; **IUCN,** International Union for the Conservation of Nature; **MNE,** minimum number of elements; **MNEi,** representation of each element in the sample; **MNI,** minimum number of individuals.

RESULTS

Pellets and leftover prey remains

The location of prospected nests of *Buteogallus coronatus* is shown in Figure 1.2; the number of pellets and the minimal number of individuals identified as leftover prey remains (both Chlamyphoridae and other vertebrate taxa) from each nest are shown in Table 1. A low number of pellets was generally found, except in the nest of Vicente locality. All the pellets contained very few bones, abundant scales of snakes, hair, feathers, and claws, as well as plant remains (Fig. 1.4). Other vertebrates, recovered as leftover prey remains, include representatives of Iguania, Ophidia, Aves, and Mephitidae, Mustelidae, and Leporidae mammals.

Vicente and Las Nutrias localities. The nest in Vicente locality provided the highest number of pellets (25); 24 with bones and one only with hair. Out of the mentioned 24, four contained bones of the caviomorph *Ctenomys* sp. and the cricetid *Eligmodontia* sp. The MNE is 169 and the MNI is 5 (*Ctenomys* sp., MNI = 2; *Eligmodontia* sp., MNI = 3), and a low average relative abundance of skeletal elements (22.11%) was obtained. However, if we only consider the pellet with the best representation of *Eligmodontia* sp. bones (MNI = 1), the average relative abundance reaches 80.53% (Fig. 2), indicating that this individual was eaten whole.

For Vicente locality, the postcranial/cranial index (= 92.63) reflects a similar representation of elements, while the [(tibia + radius) / (femur + humerus) x 100] index (= 125) shows a higher proportion of proximal elements of the limbs.

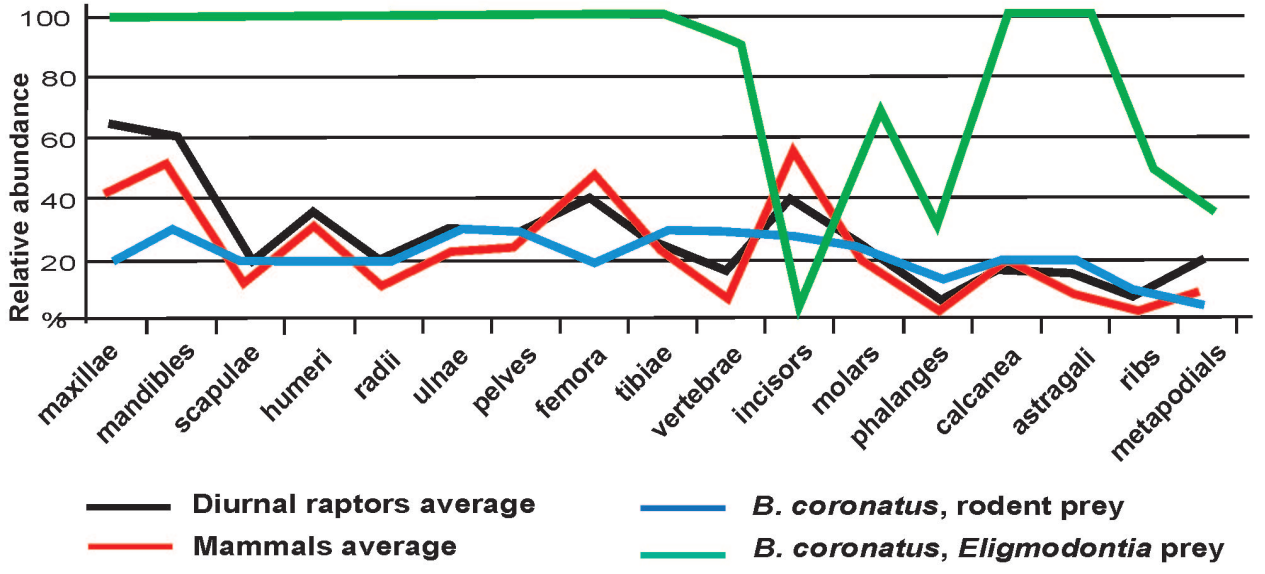

Figure 2. Relative abundance of rodent remains recovered from ***Buteogallus coronatus*** pellets of Vicente nest locality (in blue), compared with data from one pellet with ***Eligmodontia*** (in green), diurnal raptors (in black), and carnivore mammals average (in red) (data for the two latter taken from Montalvo & Fernández, 2019).

In these samples, the majority of postcranial elements (scapulae, radii, ulnae, tibiae, pelves, and vertebrae—four of them articulated) were preserved incomplete. Cranial and mandibular elements were fragmentary, except a partially complete cranium of *Eligmodontia* sp. (Fig. 3.1, 4). Characteristics related to the digestive action were identified in five isolated incisors (three with extreme degree and two with moderate degree) (Fig. 3.2–3); seven molariforms of *Eligmodontia* sp. (Fig. 3.4) with a light digestion degree, and four molariforms of *Ctenomys* sp. (Fig. 3.5–6) with an extreme digestion degree. No evidence of digestion was identified in femora and humeri.

Six pellets of Vicente locality contained a total of 243 osteoderms belonging to *Chlamyphorus truncatus*, most of them with evidence of digestive corrosion. The assignment to this taxon was based on the morphological characteristics of the osteoderms (see below) and the presence of several typical claws of the forelimbs, which are adapted to the fossorial habit. In these pellets, one broken scapula, 15 broken ribs, 12 articulated and eight isolated vertebrae (one articulated with a rib), and eight complete phalanges were

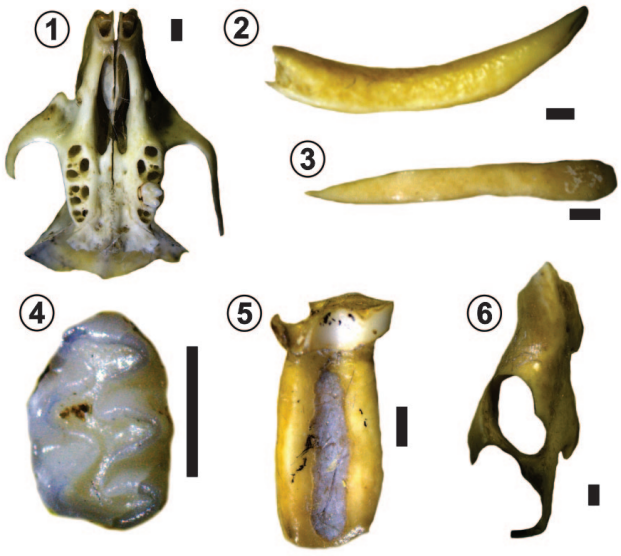

Figure 3. Rodent digested teeth and bones recovered from ***Buteogallus coronatus*** pellets. **1,** ***Eligmodontia*** sp., ventral view of cranium with light digestion molar; **2–3,** cricetid inferior incisors with extreme degree of digestion (lateral and ventral view, respectively); **4,** ***Eligmodontia*** sp., occlusal view of first upper molar without digestion; **5,** ***Ctenomys*** sp., lateral view of molar with extreme degree of digestion; **6,** ***Ctenomys*** sp., occlusal view of portion of mandibular bone. Scale bar= 1 mm.

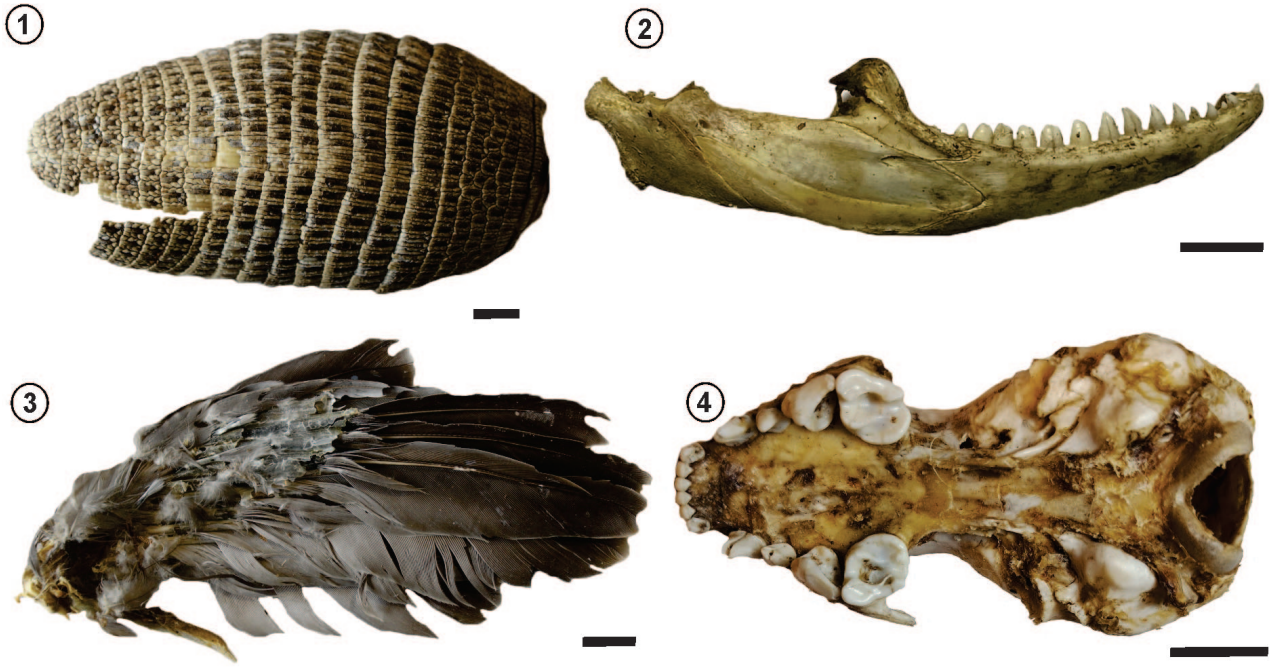

Figure 4. Leftover prey remains from different localities with signs of predation. **1,** ***Zaedyus pichiy***, dorsal view of carapace; **2,** ***Salvator*** sp., lateral view of mandible; **3,** ***Patagioenas picazuro***, dorsal view of wing; **4,** ***Conepatus chinga***, ventral view of cranium. Scale bar= 10 mm.

also recovered. Regarding digestive corrosion, a light degree was recorded in seven vertebrae, two phalanges, and nine undeterminable bone fragments. These skeletal elements could only be assigned to Mammalia indet. From this nest, four pellets contained postcranial elements of *Zaedyus pichiy* (see below), including nine osteoderms. In one pellet, scales of the Patagonia green racer *Philodryas patagoniensis* (Girard, 1858) were recovered. In 10 pellets, there were several undetermined bony remains (10 diaphyses, 16 phalanges, and 26 bone fragments with light digestion).

The single pellet recovered from Las Nutrias locality contained skeletal elements of undetermined rodents, represented by one femur, five ribs, and 10 phalanges, together with six undeterminable bone fragments, all of them without evidence of digestion; and two undetermined phalanges and six vertebrae with heavy digestive corrosion. Besides, this pellet provided 77 digested osteoderms of *Chlamyphorus truncatus* and several keeled scales of the viper *Bothrops* sp.

The leftover prey remains from Vicente and Las Nutrias localities (Tab. 1) included the Euphractinae *Zaedyus pichiy* (Fig. 4.1), *Chaetophractus villosus*, and *Ch. vellerosus* with predation marks (Montalvo *et al.*, 2016).

Don Rodrigo and Ventrencó localities. Four pellets were recovered from Don Rodrigo locality, with a total MNE of 99. Besides, one isolated vertebra, two portions of articulated vertebrae (with four and 56 vertebrae, respectively), and one cranial fragment of Ophidia indet. were recovered. There were also several scales of *Philodryas patagoniensis* and *Bothrops* sp. In one pellet, 24 digested osteoderms from the mobile bands of the dorsal carapace of *Zaedyus pichiy* were identified. A single partial cranium of *Galictis cuja* Molina, 1782 (Mustelidae, Carnivora) was recovered as a leftover prey remain (Tab. 1).

From Ventrencó locality, three pellets with scarce bone remains were recovered, including one diaphysis of Mammalia indet., two phalanges, and the left portion of maxilla with two molariforms of *Zaedyus pichiy*, all of them without evidence of digestion. As leftover prey remains (Tab. 1), two portions of articulated vertebrae and ribs of the snake *Micrurus pyrrhocryptus* (Cope, 1862) and the lizard *Salvator* sp. were recovered (Fig. 4.2). These materials added to the previously mentioned carapaces of the armadillos *Z. pichiy*, *Chaetophractus villosus*, and *Ch. vellerosus* with signs of predation (Montalvo *et al.*, 2016).

Other nest localities. San José, Campomar, San Eduardo, El Tres, Torres, El Odre, and El Piolín localities provided scarce pellets (Tab. 1) with few bony remains. Regarding mammals, materials include one molar of *Ctenomys* sp., with extreme digestion, one diaphysis with light digestion, one astragalus, and 14 phalanges. In San José, Campomar, El Piolín and El Odre localities, identified materials also include scales and vertebrae of *Philodryas patagoniensis* and *Bothrops* sp. Two vertebrae were isolated, while the others were articulated (49 assigned to *P. patagoniensis* from San José nest locality, and 68 assigned to *Bothrops* sp. from El Piolín locality). In San José locality, one pellet provided an undetermined avian bone with light digestion degree and ophidian vertebrae, 49 articulated and two isolated with light digestion degree.

In all these nest localities, portions of carapace of *Zaedyus pichiy*, *Chaetophractus villosus*, and *Ch. vellerosus* were recovered as leftover prey remains, with marks of predation (Montalvo *et al.*, 2016). Other materials recovered as leftover prey remains (Tab. 1) include a wing with several feathers of *Patagioenas picazuro* (Temmink, 1813) (Columbiformes) in San José locality (Fig. 4.3), a cranium of *Lepus europaeus* Pallas, 1778 (Lagomorpha) in Campomar locality, and a cranium of *Conepatus chinga* Molina, 1782 (Carnivora) in Torres locality (Fig. 4.4).

Armadillos as prey

Pink fairy armadillo, *Chlamyphorus truncatus*. The geographic range of this armadillo encloses a relatively large area in central Argentina (Fig. 5.1; Superina, 2006). The carapace morphology of *Chl. truncatus* is unusual among armadillos in general. Silky white hair covers their body beneath the carapace. These characteristics are linked with its lifestyle (Superina & Loughry, 2012).

The armor (Fig. 5.2–3) is composed of a cephalic shield, continuous with the flexible dorsal carapace with a large number of mobile rows, and very reduced scapular and pelvic shields, both with fixed osteoderms, and a unique posterior structure among mammals called rump plate.

The cephalic shield is composed of five or six rows with thin, quadrangular, and fixed osteoderms covered by cornified scales (Fig. 5.2, 4; Tab. 2).

The whole dorsal carapace, from the beginning of the scapular shield to the rump plate, is connected to the body only by a median thin membrane along the spinal column. It is composed of 24 to 27 rows with a minimum of 381 and a maximum of 501 osteoderms (Fig. 5.3; Tab. 2). The different sections of the dorsal carapace (including scapular and pelvic shields, and mobile rows) are composed of successive and thin imbricated osteoderms covered by cornified scales (Krmpotic *et al.*, 2024). Each mobile osteoderm is rectangular, longer than wide, very thin (<1 mm); it has an unornamented proximal articular portion and a caudal portion ornamented with a barely raised central area surrounded laterally by slight depressions (Fig. 5.5, 7). In areas where two adjacent mobile rows connect, the osteoderms become markedly thinner (Krmpotic *et al.*, 2024, fig. 4b). Osteoderms of the scapular shield have one or two thin glandular dorsal foramina. The osteoderms of some mobile rows from the pelvic shield generally present at its posterior margin only one piliferous foramen (sometimes two), from which a single, almost transparent hair usually emerges (Krmpotic *et al.*, 2024). Fixed osteoderms are shorter and quadrangular. Finally, the rump plate (Fig. 5.6) is composed of osteoderms mainly organized in five rows and with an average of 70 plates (minimum of 66 to a maximum of 95). The osteoderms of this plate are much thicker than those of the rest of the dorsal shield and the covering cornified scale is thin.

The sample studied contains mainly mobile osteoderms from different rows of the dorsal carapace, which show evident modifications of digestion (see below). Most osteoderms are disarticulated and have lost the cornified scale that covered them. We have identified cornified scales only

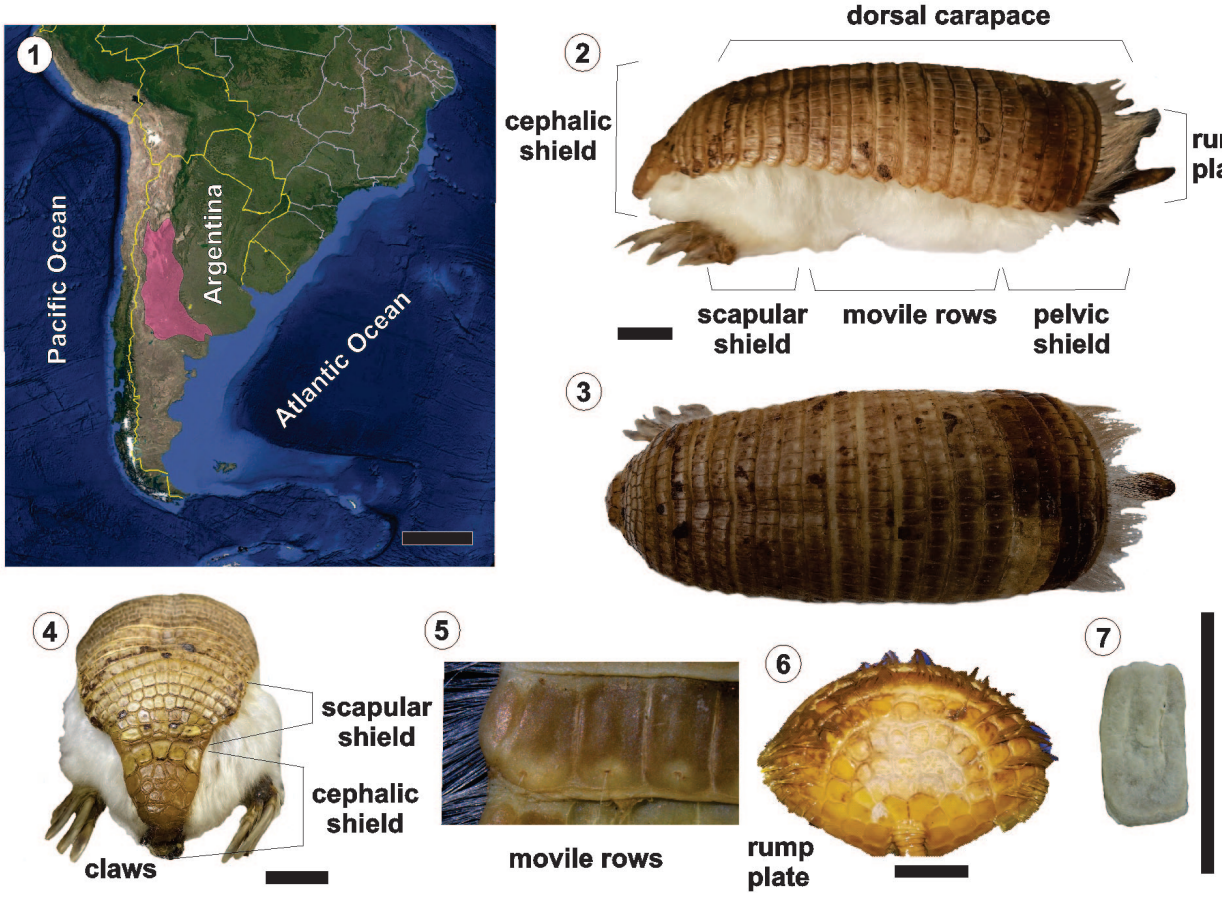

Figure 5. ***Chlamyphorus truncatus***. **1,** Distribution of ***Chl. truncatus*** in Argentina; scale bar= 1000 km; **2,** Lateral view showing the different portions of the armor; **3,** Dorsal view; **4,** Detail of the cephalic and scapular shields in anterodorsal view; **5,** Articulated osteoderms of the mobile row in dorsal shield (no scale); **6,** Rump plate showing fixed osteoderms in external view; **7,** Isolated osteoderm in external view. Scale bar= 10 mm for images 2–7. Image 1 from Landsat/Copernicus 2023; Google Earth, accessed December 2023.

TABLE 2 – Specimens of *Chlamyphorus truncatus* from MKUNLPam and MPHN–ZM collections with details of the different portions of the armor, used for comparison.

Specimen	Rows	Cephalic shield osteoderms	Rows	Dorsal carapace osteoderms	Rows	Rump plate osteoderms	Total osteoderms
MKUNLPam 2110	5	22	26	491	5	74	587
MKUNLPam 1003	5	26	25	381	5	73	480
MKUNLPam 1309	5	30	24	459	5	69	558
MKUNLPam 2111	6	26	26	410	6	95	531
MPHN-ZM 00826	5	27	24	418	5	70	515
MPHN-ZM 00654	6	25	23	450	5	83	558
MPHN-ZM 00824	5	22	24	442	5	67	531
MPHN-ZM 00496	6	24	24	501	5	66	591
MPHN-ZM 00966	6	30	25	425	6	92	547
MPHN-ZM 00003	6	28	27	485	5	75	588
MPHN-ZM 00971	6	29	26	486	5	84	599

in several articulated osteoderms belonging to the posterior area of the scapular shield.

In six pellets from Vicente and one from Las Nutrias localities, the number of evaluated dorsal carapace osteoderms is 317, a low value regarding the total number present in each carapace (Tab. 2). Particularly, the pellets from Vicente locality were recovered in the same date, providing 240 osteoderms. Even though this value is low, it could be reflecting that osteoderms of a single individual were incorporated in several pellets. From Vicente locality, 141 osteoderms (25.49% of the total number in one individual) were recovered from two pellets in August 2013; 37 osteoderms (6.69%) from two pellets in June 2013; and 62 osteoderms (11.21%) from one pellet in July 2012. In Las Nutrias nest locality, 77 osteoderms were recovered from one pellet in February 2012 (13.92% of the total number in one individual). These data confirm a very low representativeness of osteoderms in each pellet with significant loss of these skeletal elements.

It is highlighted that the original ornamentation pattern of mobile osteoderms in *Chlamyphorus truncatus* is very superficial and labile; in fact, it was difficult to recognize and describe it in the reviewed materials (Fig. 6.1). Two superficial depressions are clearly bordering a central higher area, observable in the caudal portion of each osteoderm. In the context of this taphonomic evaluation, it is proposed that the contact with digestive acids accentuated the characteristics of the ornamentation from light to extreme (Fig. 6.2–15), including the increase in depth of the depressions and the decrease and rounding of the central area (Fig. 6.10).

Concerning different taphonomic attributes, irregular fractures are identified in each osteoderm; as result of fracture processes, different portions of osteoderms are present within the total sample. Osteoderm edges and fracture edges are mostly rounded, as a result of digestive corrosion (Fig. 6.11–12).

In the anterior portion of the digested mobile osteoderms (mainly those of the last mobile rows), a pointed area is observed, which gives them a pentagonal appearance (Fig. 6.2, 5, 8, 10). The area of imbrication of the osteoderms is thinner (Krmpotic *et al.*, 2024, fig. 4b, d) whereas the middle zone of each osteoderm is thicker, which is probably the reason why the digestive acids take longer to affect this area. In a more advanced stage of digestion, it is observed that the two superficial depressions that limit the central figure become finer until they disappear (Fig. 6.9–14). Another observed characteristic is

the desquamation of the surface (Fig. 6.14–17), interpreted as a product of digestive action.

Pichi, *Zaedyus pichiy.* This species is a small Euphractinae endemic to Argentina and Chile (Fig. 7.1) that can be distinguished from other armadillos by their marginal osteoderms, with sharply pointed apices and a light colored longitudinal dorsal line, extending from the posterior end of the scapular shield or the first mobile row to the posterior end of the pelvic shield (Fig. 7.2). As in other armadillos, all osteoderms are covered by cornified scales. Usually, seven mobile rows (range 6–9) separate the scapular and pelvic shields, and one complete mobile row of nuchal osteoderms is present between the cephalic shield and the scapular shield (Fig. 7.2–6); this nuchal row has a triangular shape in dorsal view (Wetzel, 1985; Superina, 2008). Montalvo *et al.* (2016: tab. 4) totalized 782 osteoderms in a carapace of *Z. pichiy*, including 90 of the cephalic shield, 237 of the scapular shield, 270 of the mobile rows, and 185 of the pelvic shield (Fig. 7.3–6).

The osteoderms of the mobile rows present an articular portion without ornamentation and another portion with an ornamentation including a long and straight central figure,

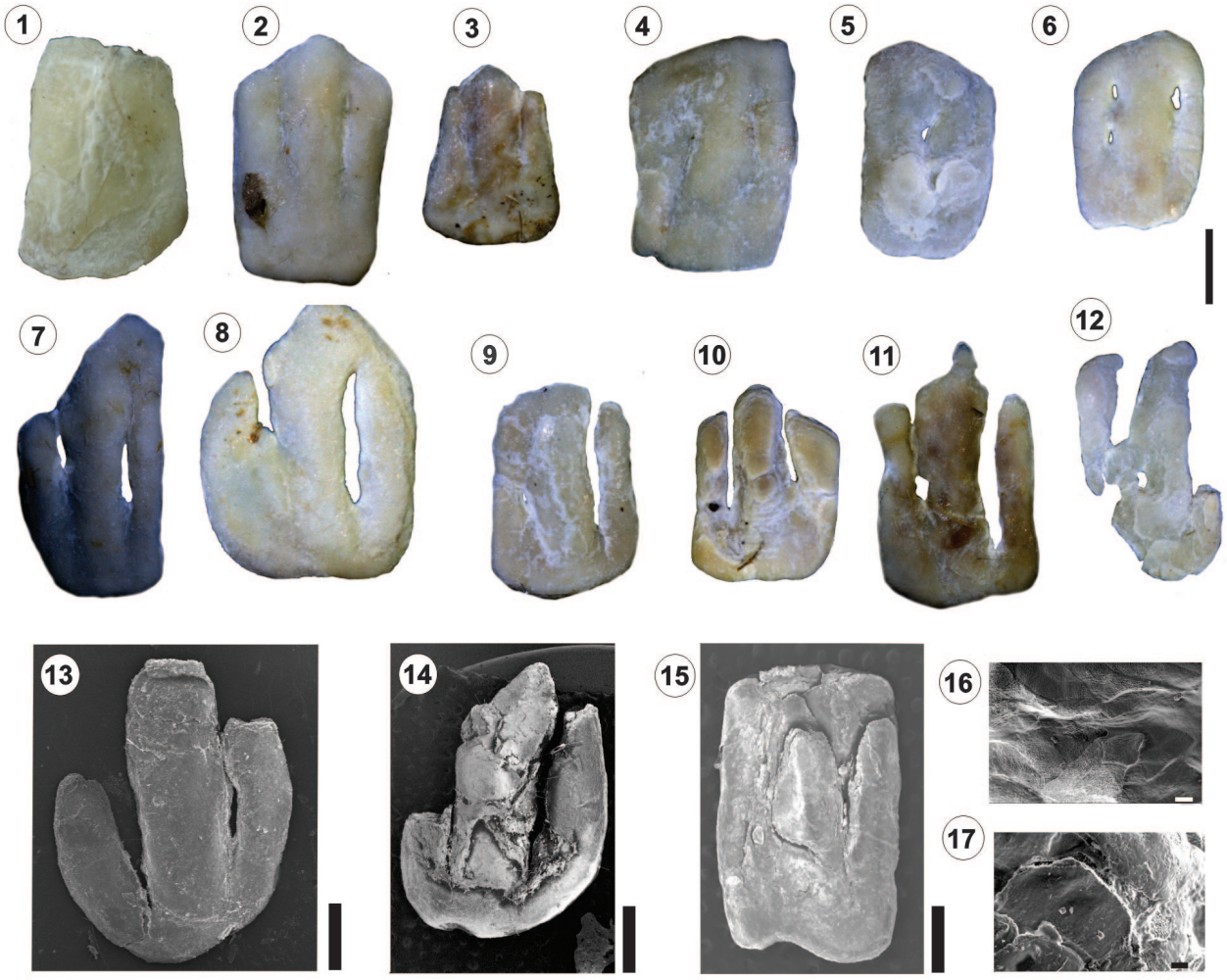

Figure 6. ***Chlamyphorus truncatus*** isolated osteoderms with digestion in external view; **1,** Light modification; **2–6,** Moderate modification; **7–10**, Heavy modification; **11–12,** Extreme modification; **13,** Osteoderm with heavy modification, including breakage in the anterior portion; **14,** Osteoderm with extreme modification, including breakage in the anterior portion and desquamation; **15,** Osteoderm with moderate modification, including desquamation; **16, MEB** image showing heavy modification of the external surface of osteoderm; scale bar= 5 µm; **17, MEB** image showing heavy modification of the external surface of osteoderm; scale bar= 3 µm. Scale bar=1 mm for images 1–15.

laterally surrounded by several peripheral figures (Fig. 7.7). There are small dorsal foramina at the intersection of the sulci that delimitate both central and peripheral figures. The posterior margin of these osteoderms has a single row of piliferous foramina, with the most conspicuous one placed in the middle. The osteoderms of the cephalic shield form a pattern that is unique for each individual (Fig. 7.3); it varies in size and shape, and lacks any figure or foramen (Superina & Abba, 2014). In turn, the fixed osteoderms of the scapular and pelvic shields are sub-square to rectangular, with an ornamentation pattern that includes a central figure that reaches the posterior margin, laterally and anteriorly surrounded by peripheral figures (Fig. 7.4–5).

In Don Rodrigo locality, one pellet contained 24 isolated osteoderms of mobile rows, in which mainly the ornamented portion was preserved due to the breakage at the level of the transitional area with the articular portion. The total osteoderms recovered represent 3% of the average of the total number of osteoderms of a complete carapace of *Zaedyus pichiy*. The majority of these osteoderms showed an intact surface, generally shining. Some of them had the dorsal foramina barely enlarged, located in the sulci, which may indicate a slightly modified ornamentation; in some cases, the foramina were enlarged to such a level that they facilitate the rupture of the osteoderm in the area of the sulci, presenting an intensely modified ornamentation. Thin edges were present in several osteoderms that showed a transverse fracture; and an extreme thinning of the caudal border was observed in the most modified osteoderms (Fig. 8.1–6). Eleven osteoderms were very incomplete, with slightly modified ornamentation, and some of them presented the internal surface with evidence of digestive corrosion (Fig. 8.6). Three pellets from Vicente locality contained portions of the caudal armor whose osteoderms showed light evidence of digestion (only with slight shine) (Fig. 8.7–8). These portions retained articulated vertebrae,

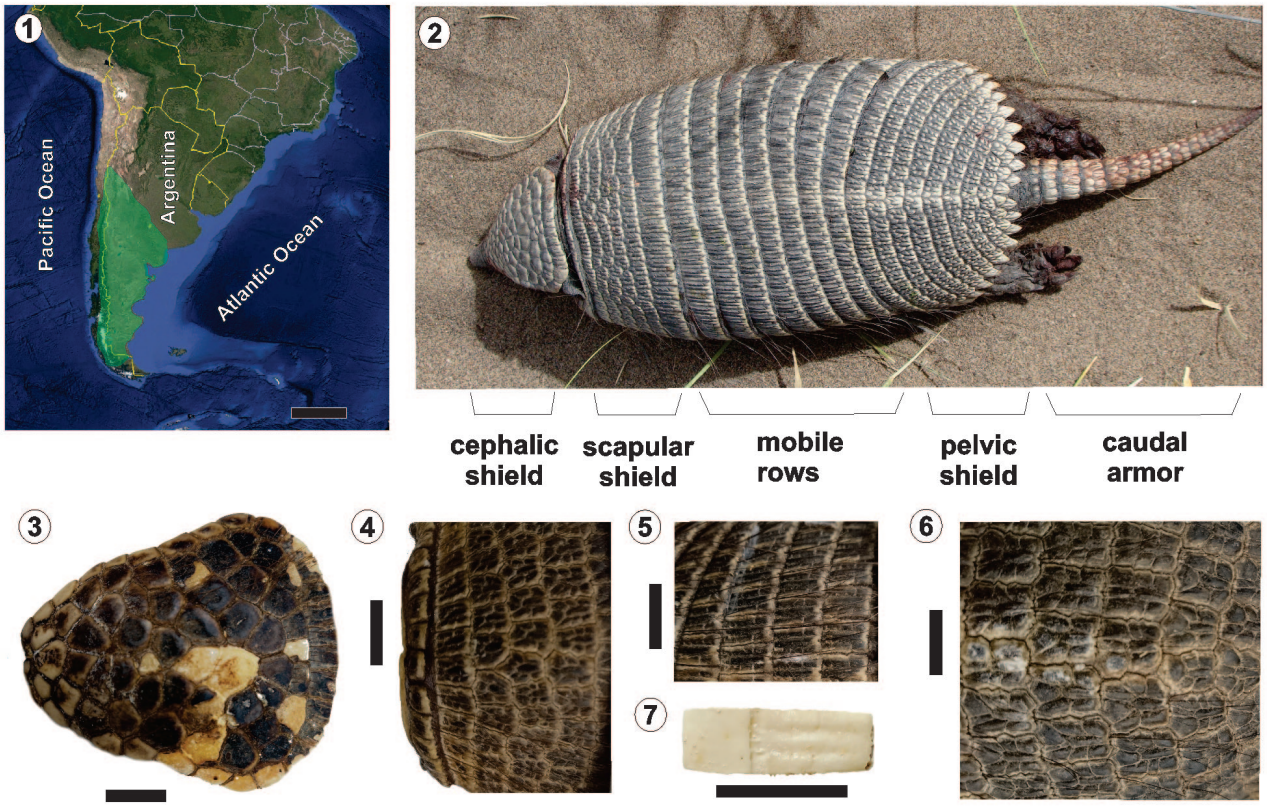

Figure 7. ***Zaedyus pichiy***. **1,** Distribution of ***Z. pichiy*** in Argentina and Chile; scale bar= 1000 km; **2,** Dorsal view showing the different portions of the armor; **3,** Cephalic shield in dorsal view; **4,** Scapular shield in dorsal view; **5,** Articulated osteoderms of the dorsal shield; **6,** Pelvic shield in dorsal view; **7,** Isolated osteoderm in external view. Scale bar= 10 mm for images 2–7. Image 1 from Landsat/Copernicus 2023; Google Earth, accessed December 2023.

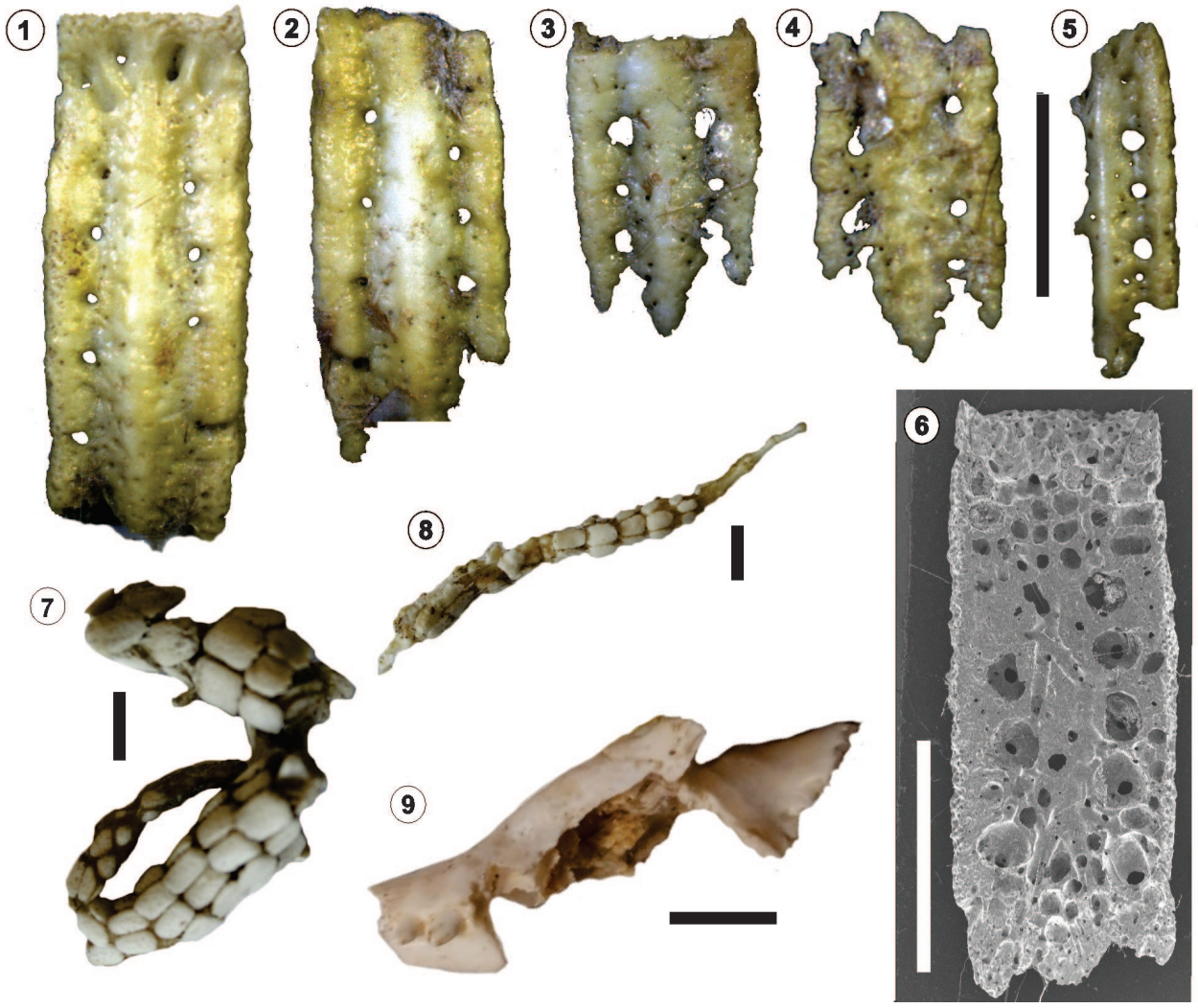

Figure 8. ***Zaedyus pichiy***. **1–5,** External view of isolated osteoderms from mobile rows with different degree of modifications (light to extreme) produced by digestion; **6,** Internal view of isolated osteoderms from mobile rows with extreme modifications produced by digestion; **7–8,** Caudal armors with articulated vertebrae and osteoderms in lateral view; **9,** Cranial fragment with two molars without signs of digestion in ventral view. Scale bar= 5 mm.

one of which with light evidence of digestion. A pellet from Ventrencó locality contained a portion of armadillo cranial fragment with two molars without evidence of digestion (Fig. 8.9). Also, nine articulated vertebrae, two metapodials, and 12 undetermined bone remains were recovered from these pellets.

DISCUSSION

In Argentina, neotaphonomic studies of pellets, scats, and prey remains produced by different predators are frequent (*e.g.*, Montalvo & Tallade, 2009; Montalvo *et al.*, 2011, 2016; Montalvo & Fernández, 2019; Guardia *et al.*, 2024), as they provide information to categorizing the producer, which can be used to interpret accumulations in the archeological and paleontological record. In some opportunities, this type of evaluation has also been helpful to recognize problems related to taxonomic misidentifications (*e.g.*, Tomassini *et al.*, 2023), as well as to make biological and ecological interpretations of past organisms and faunal assemblages (Montalvo & Fernández, 2019).

Although leftover prey remains and occasionally pellets of *Buteogallus coronatus* have been extensively studied in

order to evaluate diet issues (*e.g.*, Maceda *et al.*, 2003; Sarasola *et al.* 2010, 2022; Pereyra Lobos *et al.*, 2011), our evaluation constitutes the first taphonomic analysis of modifications produced on ingested prey remains. This new evaluation is compared with other previous taphonomic studies on this raptor bird, particularly focused on accumulations of leftover prey remains (Montalvo *et al.*, 2016; Guardia *et al.*, 2024). The sample evaluated herein includes remains of snakes, lizards, birds, and mammals (mainly armadillos) as both leftover prey remains and pellet content.

The studied pellets have provided abundant scales of snakes, hair remains, feathers, claws, and scarce bone remains, as well as plant remains, similar to the material commented by Guardia *et al.* (2024). These authors indicated that several prey remains recovered in the Ñancuñán area (Mendoza Province), with modifications attributed to weathering (mainly wind), correspond to old disaggregated pellets. The pellets recovered in La Pampa localities include Ophidia, one incomplete Avian bone, and remains of rodents and armadillos Euphractinae and Chlamyphorinae. These results are consistent with previous recognition of these taxa as an important part of *Buteogallus coronatus* diet (Pereyra Lobos *et al.*, 2011; Guardia *et al.*, 2024).

Only scarce rodent bones from Vicente nest locality could be analyzed following the traditional taphonomic methodology proposed by Andrews (1990). This nest provided 25 pellets (Tab. 1), four of which contained rodent remains of *Ctenomys* sp. and *Eligmodontia* sp., with low values of MNE, MNI, and relative abundance. The curve of relative abundance of rodents is similar to the averages obtained from samples originated by diurnal raptors and carnivore mammals (Fig. 2). Data from bone representation indexes, relative abundance, degree of breakage, and modifications by digestion on rodent bones recovered from *Buteogallus coronatus* pellets of Vicente locality indicate extreme degree of change related to digestion, and allows locating this predator in the category of extreme modification. However, Figure 2 reflects the representation of rodent skeletal elements recovered from one pellet from this locality that are assumed to belong to a single individual that was completely eaten, whose degree of digestion is light.

From digested osteoderms of *Chlamyphorus truncatus* and *Zaedyus pichiy*, different modification degrees are identified. Carapace fragments of *Z. pichiy* were the most frequent remains in nest localities from La Pampa and Mendoza provinces (Montalvo *et al.*, 2016, Guardia *et al.*, 2024). Characteristics of digested osteoderms of *Z. pichiy* recovered from pellets (scarce number from each pellet; disarticulation; shine in the external surface; modification of digestion more evident in internal surface, indicating that the cornified scale protected the external surface; Fig. 8.1–6) suggest that these elements could have been accidentally ingested.

From six pellets of Vicente locality and one pellet from Las Nutrias locality, digested osteoderms of *Chlamyphorus truncatus* showed different degrees of modifications and breakage, from scarce to high evidence, which resulted in changes of the original ornamentation (*e.g.*, two superficial depressions bordering a central elevated higher area). A total of 319 dorsal carapace osteoderms were recovered from these pellets. This total number is low regarding the total number present in each carapace; it is possible that bone remains of each individual were incorporated in different pellets recovered on the same date from a same locality. In this sense, Raczynski and Ruprecht (1974) observed that the mixing of bones of one individual in two successive pellets is rare, but there are other mentions of consumed prey that were incorporated into different pellets (Laudet *et al.*, 2002; Woodman *et al.*, 2005). Laudet *et al.* (2002) suggested that multiple rejections of prey individuals could be more frequent than usually considered. If this behavior is verified in the case of *Buteogallus coronatus*, it would be a new raptor that generates multiple rejections of its prey.

It is highlighted that the original ornamentation pattern of thin osteoderms in *Chlamyphorus truncatus* is very superficial and labile. Barasoain *et al.* (2020) indicated that the ornamentation in *Chl. truncatus* is only observable in the cornified scale that covers the osteoderm. However, Krmpotic *et al.* (2024) and new observations in this study indicate that each mobile osteoderm has ornamentation in its caudal portion. Digestive action on these thin osteoderms has magnified their ornamentation. Several digested osteoderms showed desquamation of their surface, which can be

interpreted as a product of digestive action. It is interesting to note that, even in the most affected osteoderms, the woven bone described for these skeletal elements (Krmpotic *et al.*, 2024) is never exposed. With respect to the *Chl. truncatus* osteoderms recovered in the pellets studied here, we suggest that these armadillos could have been eaten whole or in parts, which would be linked to their small size and the presence of a thin, flexible, and highly vascularized carapace that facilitates the ingestion. This behavior is also suggested for ingestion of one rodent in Vicente locality (see above).

The typical pattern of integumentary system of armadillos is deeply modified in *Chlamyphorus truncatus* and, in particular, the scarce ornamentation of the thin osteoderms in the dorsal carapace may be related to its way of life (Krmpotic *et al.*, 2024). Barasoain *et al.* (2020) interpreted the presence of very thin osteoderms in the carapace as the result of a deossification process, developed over time as an adaptation to subterranean habits. This process would also have generated the partial loss of the ornamentation, since fossil chlamyphorines of Late Miocene show osteoderms with a marked ornamentation. The thinning and simplification of the osteoderms of *Chl. truncatus* complicate their preservation and identification. This may be a possible reason for their absence as prey of *Buteogallus coronatus*, except for occasional records (Parera, 2018, Barasoain *et al.*, 2020).

Chlamyphorus truncatus has been interpreted as a nocturnal species (Minoprio, 1945; Borghi *et al.*, 2011) and it is rarely observed in the field (Superina, 2011). Some information collected by one of the authors (MSK) from local residents (interpreted as an excellent source of information; Superina, 2006) confirms its presence during daylight hours in the same area of the nest localities studied here. *Buteogallus coronatus* is an early morning and crepuscular raptor, although biological information on this topic is scarce (see Sarasola *et al.*, 2022). The record of several pellets with remains of *Chl. truncatus* suggests that the range of activity of this armadillo outside its burrow would be longer than that indicated until now. The present study evidences that two vulnerable species (*B. coronatus* and *Chl. truncatus*) interact in their common distribution range (Central or Subandean Zoogeographic Domain *sensu* Ringuelet, 1961), increasing our knowledge about them.

Pellets from Vicente and Ventrencó localities contained cranial and postcranial elements of *Zaedyus pichiy*, and digested osteoderms of this armadillo were identified in pellets from Don Rodrigo locality. This armadillo is a common prey of *Buteogallus coronatus* (Maceda, 2007; Pereyra Lobos *et al.*, 2011; Montalvo *et al.*, 2016; Sarasola *et al.*, 2022; Guardia *et al.*, 2024). The recovered digested mobile osteoderms showed different degrees of modification, from light to extreme, features that support classifying of *B. coronatus* as an extreme predator.

Other published cases of armadillos as prey remains correspond to undetermined osteoderms recovered from a sample associated with the catarthid *Coragyps atratus* (Cathartiformes) in the northeast of Patagonia (Argentina) (Ballejo *et al.*, 2012), and osteoderms of *Dasypus* sp. with a heavy (entire surface affected) to extreme (a very thin layer of bone) degree of modification obtained from an accumulation produced by a Cathartidae, in cave deposits from the Early to Late Holocene in southeastern Brazil (Ballejo *et al.*, 2022, fig. 3a, b).

Although armadillo osteoderms are frequently found in paleontological and archeological sites of South America, few studies focused on evaluating the effect of digestive corrosion on their surfaces. This deficiency has led to problems in performing taxonomic assignments and interpreting the primary origin of fossil accumulations (Ballejo *et al.*, 2022; Tomassini *et al.*, 2023). In fact, neotaphonomic studies of endo- and exoskeletal remains consumed by New World vultures have allowed the recognition of this type of raptor action in the Holocene fossil record (including armadillo osteoderms) of the Gruta do Presépio site in southern Brazil (Ballejo *et al.*, 2022).

Tomassini *et al.* (2023) described the modifications produced by *Puma concolor* (Carnivora, Felidae) on *Dasypus novemcinctus* osteoderms. The presence of digested osteoderms from *Zaedyus pichiy* and *Chaetophractus villosus* were mentioned for scats from *Pu. concolor* described by Montalvo *et al.* (2007) and López *et al.* (2023). In the sample evaluated by López *et al.* (2023), osteoderms and several skeletal elements of *Z. pichiy* were the most abundant in the scats, and the authors highlighted the great tolerance to the digestive action and thus, the potential of being preserved in the fossil record. In turn, Montalvo *et al.* (2007) suggested

that the ingestion of osteoderms would be accidental. Osteoderms of *Z. pichiy* digested by *Pu. coronatus* show lesser modifications than those digested by *Buteogallus coronatus*. This shows that different predators located in the same category (*sensu* Andrews, 1990) produce different degrees of modifications in skeletal elements of the same prey.

The armadillos *Zaedyus pichiy* and *Chaetophractus villosus*, as well as *Ch. vellerosus*, were recovered as leftover prey remains produced by *Buteogallus coronatus*. As in previous studies (Montalvo *et al.*, 2016; Guardia *et al.*, 2024), only skulls, mandibles, teeth, and carapaces were recorded. In addition, other recovered material includes reptilian, avian, and other mammalian remains. Absence or scarcity of other postcranial material as leftover prey remains were previously informed by Montalvo *et al.* (2016) and Guardia *et al.* (2024). Although further analysis on *B. coronatus* is necessary, it is not ruled out that the low representation of bone remains may be related to its high degree of digestive corrosion.

CONCLUSIONS

The results of this investigation highlight the importance of neotaphonomic studies, in this case contributing to increasing the ecological knowledge of *Buteogallus coronatus* and its prey, embracing reptiles (ophidians and iguanians), birds, and mammals (caviomorph and cricetid rodents, mustelids, mephitids, lagomorphs, and armadillos), which can be accumulated with little (from leftover prey remains) or extreme (from pellets) modifications in open-air sites located in the central arid and semi-arid region of Argentina.

Digested osteoderms of the pichi *Zaedyus pichiy* and the pichiciego *Chlamyphorus truncatus* present changes of the original ornamentation and thickness reduction. *Z. pichiy* was previously registered in leftover prey remains, but the record of *Chl. truncatus* as part of the *Buteogallus coronatus* diet is a novelty. Osteoderms of both taxa are extremely modified. As previously suggested, this analysis supports that, despite their modifications, osteoderms of *Z. pichiy* would become easily fossilized. In contrast, the characteristics and the degree of digestion of the osteoderms of *Chl. truncatus* would make their preservation difficult. With respect to these osteoderms, present only in the pellets, we suggest that the prey could have been eaten whole or in parts, and the degree of osteoderm modification endorses the categorization of *B. coronatus* as an extreme modifier, a classification previously based on rodent prey.

This study is especially relevant because it involves two little-known and sympatric species, *Buteogallus coronatus* and *Chlamyphorus truncatus* (endangered and data deficient respectively, according to the IUCN), in an area where this armadillo is endemic. As modern analogous, when the predator-prey interaction is known, and the way the predator modifies the prey bones can be identified, the resolution of the agents and processes involved in the formation of the fossil record are improved. This is particularly interesting because *B. coronatus* lives in an area rich in open-air paleontological and archaeological sites, which contain fossil records of armadillos, including fossil fairy armadillos.

As *Chlamyphorus truncatus* inhabits sandy plains and sand dunes in xeric environments of central Argentina, its conservation depends on the persistence of its arid and semiarid habitats. Everything that can contribute to the knowledge of the biology of both susceptible species (*Buteogallus coronatus* and *Chl. truncatus*) will help their conservation. Besides, it has been mentioned that *Chl. truncatus* is preyed upon by wild dogs and cats, but our study confirms that *B. coronatus* is another predator of this armadillo.

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