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GREATER HAIRY ARMADILLO *Chaetophractus villosus* (Desmarest, 1808)





FIGURE 1 - (FPMAM59PH) Adult, PN Tte Enciso, Departamento Boquerón (Silvia Centrón October 2009).

TAXONOMY: Class Mammalia; Subclass Theria; Infraclass Eutheria; Order Cingulata; Family Dasypodidae; Subfamily Euphractinae (Myers et al 2006, Möller-Krull et al 2007). Three species are recognised in this genus, two are present in Paraguay. *Chaetophractus* is taken from the Greek meaning "hairy shell", the specific name *villosus* is from the Latin and also means "hairy". The genus *Chaetophractus* was defined by Fitzinger (1871). The genus *Chaetophractus* was defined by Fitzinger in 1871. The species is monotypic.

Poljak et al (2010) performed a phylogeographic study on Argentinean populations that suggested an origin in the Pampean region, expanding south into Patagonia after the Pleistocenic glaciations. The earliest fossil record of this species and indeed of this genus is from Chapadamalal, Provincia Buenos Aires, Argentina dated at 4-3.2 million years ago during the Late Pliocene (Carlini & Scillato-Yané 1996).

The species description is based upon de Azara's (1801) "Le Tatou Velu" Formerly placed in the

Chaetophractinae, Möller-Krull et al (2007) provided DNA evidence that demonstrated their position within the Euphractinae. Synonyms adapted from Gardner (2007):

Dasypus octocinctus Molina 1782:305. Type locality "Nel Cujo" Chile (=Provincia Mendoza, Argentina). Preoccupied by *Dasypus octocinctus* Schreber 1774 (=*Dasypus novemcinctus* Linnaeus 1758).

lor[icatus]. villosus Desmarest 1804:28. Based on de Azara (1801). Type locality "Les Pampas", Buenos Aires, Argentina.

[Dasypus] villosus G.Fischer 1814:125. Name combination.

T[atus]. villosus Olfers 1818:220. Name combination.

Tatusia villosa Lesson 1827:312. Name combination.

Dasypus (Tatusia) villosus Rapp 1852:10. Name combination.

Dasypus [Euphractus] villosus Burmeister 1861:427. Name combination.

Euphractus villosus Gray 1865:376. Name combination.

Chaetophractus villosus Fitzinger 1871:268. First use of current name.

[Dasypus (Choetophractus)] villosus Trouessart 1898:1146. Name combination.

D[asypus]. pilosus Larrañaga 1923:343. Type locality "Campis Bonaerensibus". Preoccupied by *Dasypus* pilosus (Fitzinger 1856).

Euphractus (Chaetophractus) villosus Moeller 1968:514. Name combination.

ENGLISH COMMON NAMES: Greater Hairy Armadillo, Larger Hairy Armadillo (Eisenberg & Redford 1999), Large Hairy Armadillo (Wilson & Cole 2000, Neris et al 2002), Big Hairy Armadillo (Gardner 2007).

SPANISH COMMON NAMES: Pichi peludo (Neris et al 2002), Quirquincho grande (Eisenberg & Redford 1999), Tatu pecho amarillo (Cuéllar & Noss 2003), Tatú peludo (Parera 2002).

GUARANÍ COMMON NAMES: Tatu poju'i (Neris et al 2002). "Poju" refers to the needle-like claws of the forefeet, the addition of "i" meaning small. In other words "little Tatu poju", or small version of *Euphractus sexcinctus*, the species commonly known as Tatu poju in Paraguay. Taturakapeyu (Cuéllar & Noss 2004), Pajotague **Ay** (Cuéllar & Noss 2004).

DESCRIPTION: A medium-large armadillo with conspicuous blackish dorsal hairs and a somewhat flattened carapace. Possesses 7 or 8 movable bands between the scapular and pelvic shields and at least 2 neck bands. Small individuals possess 2 to 4 small openings in the posterior part of the pelvic shield which are glandular openings and produce an odorous secretion. The head shield is large, notably downcurved in profile on the forehead and reaches almost to the point of the snout. It is composed of small disorganised scutes and has a distinct posterior border. There is no spur behind the eye. Head and carapace dark reddish-brown, somewhat paler and more tan coloured on the borders. Ears are medium-sized and dark brown in colour. Sides of head and ventral skin dark brown with long tufts of hair on cheeks, legs and throat, the hairs of the ventral surface being slightly paler than those of the dorsal surface. Legs short but robust with flattened claws on all toes

SKELETAL CHARACTERISTICS: Squarcia et al (2006) provide a detailed description of the cranial osteology of this species, noting that the bony components of the skull are typical of most dasypodids. Their findings may be summarised as follows. Paired nasals long and shaped as parallelograms with smooth and slanted rostral and caudal borders. Inner surfaces slightly concave; Frontal bones form an arrowhead shape at the midline of the skull. Only rudiments of postorbital processes present. Inner surface of each frontal with rostral and caudal fossae separated by Y-shaped ridge; Parietal bones parallelogram-shaped. Sagittal crest not developed at interparietal suture. Numerous small foramina present near suture with squamosal. Caudal edge slanted, forming rostral portion of strong lambdoidal crest. Longitudinal ridge along inner parietal face; Paired premaxillae shaped like hemi-cylinders. Palatal premaxillar process caudolaterally supports first tooth and rostromedially an incisive foramen; Zygomatic process of paired maxillae is traversed ventrally by infraorbital canal, completely lateral to the maxillary body. Palatine process of both maxillary bones form more than 50% of the hard palate. Outer border supports eight oval teeth. Beginning of zygomatic arch is between fifth and sixth maxillary tooth. Small septomaxillae are thin, fragile and J-shaped. The retention of these bones is a primitive character related to fossorial habits and helping to protect the naris; Paired lacrimal small and wedge-shaped, contributing to rostral apophysis of the zygoma, characteristic of dasypodids. Large lacrimal foramen is over the orbital

edge; Paired jugal long and laterally-compressed with strong dorsal emargination. Jugal-squamosal suture horizontal and smooth. Postorbital process rudimentary; Horizontal process of paired palatines almost rectangular, perpendicular processes small and fragile; Pterygoids triangular and laminar. Small process extends backwards to contact tympanic bullae. Posteroventral corner with conspicuous hamular process; Pterygoids involved in lateral walls of choanae; Squamosal of paired temporal is valve-shaped and caudoventrally fused to ventral part. Zygomatic apophysis dorsoventrally compressed. Height of zygomatic apophysis at the horizontal suture is lower than jugal height. Glenoid fossa deeply located at the base of the zygoma. Postglenoid process forms the anterolateral face of the external acoustic meatus; Ectotympanic portion of temporal bone completes the tubular external acoustic meatus, which open dorsally and fuse with tympanic bulla. Petrosal part of temporal bone with short, wide and flattened mastoid process; Vomer unpaired, long and thin with two small caudala alae. It represents about 40% of cranial length; Presphenoid absent and orbitosphenoid fuse along midline. Paired orbitosphenoid supports well-developed optic sulcus which open externally by the sphenorbital fissure, located in the junction of the orbitosphenoid and alisphenoid. Foramen ovale entirely in the alisphenoid, a primitive condition in Xenarthra. Foramen rotundum absent; Occipital complex fused to basisphenoid. Unpaired basioccipital portion roughly trapezoidal. Odontoid notch V-shaped. Supraoccipital portion broadly pentagonal with lateral emarginated borders and a V-shaped nuchal crest along the occipitoparietal suture. Outer face with three convexities. Small paired exoccipital portion supports cylindrical condyles, at the base of which open condylar foramina; Dentary solid with narrow tooth-bearing body and broad vertical ramus. Body with 10 oval teeth with maximum rostrocaudal diameter at sixth and seventh alveoli. Coronoid process longer than condyle and "shark fin-shaped". Articular surface of condylar process transversely rectangular and gently concave. Angular process sharp and rugose. Foramen mandibulae in conspicuous large ovoid depression of the inner face.

Squarcia et al (2007) describe the morphology of the tympanic bullae, these being hypertrophied but similar in size to that of *C.vellerosus*, despite the smaller skull of that species. The bullae are well-expanded and swollen, totally ossified in adults and with no indication of the limits between the tympanic and the entotympanic bones. These structures, dome-shaped and obliquely orientated in the basicranium, hide the three middle ear ossicles. The total bullae length was 12.7mm (+/-0.5) and the mean bullar hypertrophy index (bullae length/skull length) was 13.96% (12.61-14.97%).

Total, basal and condylobasal lengths show sexual dimorphism, being longer in females than males. Squarcia et al (2006) give the following cranial measurements for 9 males and 10 females: Nasal Length male 33.7mm (+/-1.7), female 34.8mm (+/-0.9); Nasal Width male 6.3mm (+/-0.4), female 6.5mm (+/-0.4); Frontal Length male 38.8mm (+/-2.2), female 42.1mm (+/-1.2); Frontal Width male 22mm (+/-0.6), female 22.4mm (+/-1.2); *Parietal Length* male 26.3mm (+/-1.0), female 26.9mm (+/-1.0); *Parietal Width* male 18.7mm (+/-0.8), female 19.2mm (+/-0.6); *Premaxillary Length* male 17.3mm (+/-1.1), female 18.4mm (+/-1.0); **Premaxillary Width** male 6.6mm (+/-0.4), female 7.3mm (+/-0.6); **Maxillary** *Length* male 41.8mm (+/-2.7), female 45mm (+/-1.8); *Maxillary Width* male 11.7mm (+/-0.8), female 12.3mm (+/-0.7); Lacrimal Length male 10.2mm (+/-0.9), female 11.3mm (+/-1.2); Lacrimal Height male 6.2mm (+/-0.5), female 6.7mm (+/-0.6); Jugal Length male 24.2mm (+/-1.1), female 24.7mm (+/-1.0); Jugal Height male 8.2mm (+/-0.6), female 8.2mm (+/-0.7); Palatine Length male 20.8mm (+/-0.8), female 22.1mm (+/-1.1); **Palatine Width** male 7.6mm (+/-0.3), female 7.6mm (+/-0.4); **Pterygoid** *Length* male 9.1mm (+/-0.4), female 9.3mm (+/-0.3); *Pterygoid Height* male 5.3mm (+/-0.4), female 5.8mm (+/-0.3); *Temporal Length* male 24.9mm (+/-0.6), female 25.6mm (+/-0.6); *Temporal Height* male 23.8mm (+/-0.7), female 23.8mm (+/-0.7); *Vomer Length* male 35.2mm (+/-1.7), female 37.7mm (+/-1.6); *Vomer Width* male 6.3mm (+/-0.5), female 7mm (+/-0.5); *Occipital Length* male 17mm (+/-0.4), female 16.9mm (+/-0.6); *Occipital Width* male 36.5mm (+/-1.2), female 37.9mm (+/-1.2); *Dentary Length* male 70.1mm (+/-1.3), female 72.5mm (+/-2.0); *Dentary Height* male 38.6mm (+/-1.8), female 40.2mm (+/-1.9).

Squarcia et al (2009) describe sexual dimorphism in mandibular traits for adults of this species. Females have larger mandibles than males independently of their larger cranial size, with total length of mandible and mandibular height at the level of the last tooth being the most important measurements for discrimination of the sexes. They record the following measurements for 37 males and 34 females from

northern Patagonia, Argentina: *Length of Mandible* male 70.5mm (+/-0.2), female 73.2mm (+/-0.3); *Length of Mandibular Toothrow* male 44.2mm (+/-0.1), female 45.5mm (+/-0.2); *Body Length of Mandible* male 50.1mm (+/-0.2), female 51.8mm (+/-0.2); *Height of Mandible* male 39.0mm (+/-0.2), female 40.8mm (+/-0.2); *Condylar Height* male 34.7mm (+/-0.2), female 36.2mm (+/-0.3); *Height at First Tooth* male 4.7mm (+/-0.1), female 5.1mm (+/-0.1); *Height at Last Tooth* male 4.7mm (+/-0.1), female 5.1mm (+/-0.1), female 21.0mm (+/-0.1), female 22.0mm (+/-0.1).

Vizcaino et al (1999) give the following ulnar dimensions (n=6): Ulnar Length 63.4mm (+/-2.8); Olecranon Length 25.2mm (+/-2.7). The trend towards fossoriality is correlated with relative development of the olecranon process, and the ratio of the ulnar length to olecranon length is the Index of Fossorial Ability. An IFE above 0.70 is considered indicative of a highly fossorial species and one below 0.55 of a cursorial species. This species has an IFE of 0.68 (+/-0.16).

DENTAL CHARACTERISTICS: Armadillos lack true teeth, but possess a series of "molariform" teeth that do not follow the standard mammal dental formula. 9/10 = 38. First molariform located in the premaxillary as in *Euphractus*.

GENETIC CHARACTERISTICS: 2n=60. FN=88 or 90. Males have not been karyotyped (Gardner 2007). The SC (synaptonemal complex) karyotype shows 29 autosomal SCs and the XY pair. The X chromosome is submetacentric and the extremely acrocentric Y chromosome is the shortest. The absolute length of the Y axis is 4.1 mm (+/-0.6; n=8). The ratio between the X axis and Y axis is X/Y = 4.5 (n=5) in early pachytene. The length of the XY pair is 3.7 mm (+/-0.8). (Sciurano et al 2006). Redi et al (2005) gives the genome size as 4.18pg (+/-0-14) or 4088 Mbp.

TRACKS AND SIGNS: No information.

EXTERNAL MEASUREMENTS: A medium-sized armadillo with a flattened carapace. **TL:** 43.67cm (38.6-55cm); **HB:** 29.11cm (26.1-34.4cm); *Head* 10cm; *Head Width* 11cm; **TA:** 11.2-15.6cm; *Tail Diameter at Base* 8cm; **FT:** 6.17cm (5-7cm); **EA:** 2.4cm (2.2-3.1cm); *Month* 7x4cm; **WT:** 2.37kg (1-3.89kg) They are capable of depositing large amounts of fat and captive individuals may be much heavier than wild individuals; **WN:** 127.29g (108-155g); *Claws of Forefeet:* 1.5-2.5cm. (Parera 2002, Eisenberg & Redford 1999, Neris et al 2002, Redford & Eisenberg 1992, Ceresoli et al 2003, Olocco-Diz & Duggan 2004, Olocco-Diz et al 2006).

SIMILAR SPECIES: This species is easily confused with the larger *Euphractus sexcinctus* with which it overlaps throughout its Paraguayan range - though note that this species is absent from much of the Orient. Typically large individuals of *C.villosus* overlap in size with the smallest individuals of *Euphractus*, but size alone should not be used for specific identification. In general *Euphractus* is more yellowish in colour with pale guard hairs on the carapace, this species somewhat more reddish-tan with dark brownish hairs (though be aware of the effects of soil on "dirty" individuals). *Chaetophractus villosus* is hairier overall (though the dark hairs against the dark shell are not always conspicuous) with more obvious tufts of hair on the cheek, throat and legs. Though the number of movable bands is variable in both species, this species never has less than 7 whilst *Euphractus* may occasionally have 6. Examining the head plate *Euphractus* can be seen to have a "spur" behind the eye and often a line of small scales beneath the eye which are both absent in this species. Note also the rounded forehead in profile of the *Chaetophractus* when compared to the flattened forehead of *Euphractus*. Furthermore the large, well-organised scales on the head shield of *Euphractus* are in contrast to the smaller, disorganised scales of *Chaetophractus* which also usually shows a well-defined posterior border to the head shield. At least two neck bands are present between the head shield and the scapular plate in this species, only one is present in *Euphractus*.

The other member of the genus *Chaetophractus vellerosus* has smaller much longer ears and a greyish base colour to the carapace. There is a notable size difference between the largest *villosus* and the smallest *vellerosus*, but some overlap between the largest *vellerosus* and smallest *villosus*, so size alone should not be relied on for specific identification.

DISTRIBUTION: Widely distributed in the Southern Cone of South America from Brazil and extreme western Brazil to Argentina and eastern Chile south to Magallanes, though its distribution in that country is somewhat disjunct.

In Argentina it is the commonest and most widespread armadillo, being found throughout Patagonia north to Provincias Buenos Aires and Cordóba, and extending further north through the central zone of the country to Provincias Santiago del Estero and Chaco. It was introduced into Isla Grande, Tierra del Fuego in 1982 as a food source for pipeline workers and, following several further reintroductions, is now well established on the island (Poljak et al 2007). Its absence from Uruguay may be related to the water barrier presented by the Rios Uruguay and La Plata rather than climate (Poljak et al 2010), though the species (or one that is extremely similar) was apparently present in that country during the Pleistocene (Perea 1993). In Bolivia it is confined to the extreme southeast of the country in eastern Departamentos Chuquisaca and Tarija (Anderson 1997).

In Paraguay it is present throughout the Chaco, though considerably less common in the humid Chaco. According to Neris et al (2002) they occur in eastern Paraguay in areas of cerrado in the drier



areas of the northern Orient in Departamentos Concepción and Amambay. However this was rejected by the Edentate Specialist Group (2004) who insist that the species is absent from eastern and southern Paraguay and confined to the Dry Chaco. Confusion with the superficially similar *Euphractus sexcinctus* may be responsible for the Oriental records. This is the commonest large armadillo in the most arid areas of the Paraguayan Chaco, but is less common further south towards the central Chaco.

HABITAT: Confined to xerophytic areas of the Chaco where it occurs in matorral, edges of Chaco woodland, ranch land and agricultural areas. Burrows are generally located in bushy areas though they tend to forage in more open habitats, including along roads - they are often seen by the side of the Ruta Trans-Chaco in Departamento Boquerón. Frequently found close to human habitation.

Abba et al (2010) found the species to be present in all habitats in central Patagonia, but commonest in monte-shrub steppes.

The presence of the species as an established introduction on Isla Grande, Tierra del Fuego indicates that climate is not a determining factor for the southerly extent of the range. On the island its distribution is closely related to the oil pipelines and the associated soil disturbance that they have caused (Poljak et al 2007).

ALIMENTATION: A generalist omnivore, their ability to survive on a low water diet is one of the reasons for their success in arid environments where other armadillos are less abundant (Greegor 1975).

Analysis of stomach contents reported in Cuéllar & Noss (2003) revealed that the species feeds primarily on fruits (60% of diet) in the Bolivian Chaco, especially Guayacán *Caesalpinia paraguariensis*, Algarrobo *Prosopis chilensis*, Mistol *Ziziphus mistol*, Yvyra hû *Sideroxylon obtusifolium* and the cacti *Quiabentia pflanzil*, with the addition of insect material such as beetles, termites and ants. Reports of attacks on lambs in central Patagonia have not been proved (Abba et al 2010).

Neris et al (2002) describe it as principally a scavenging species feeding largely on carrion and roadkill. Parera (2002) notes that the diet may change through the year with invertebrates predominating in winter and vegetable matter in summer. In areas of human habitation they may raid rubbish bins in search of food or chicken coups for eggs, and Fernández & Reboreda (1995) reported predation by this species on wild Greater Rhea *Rhea americana* eggs in Argentina. They may even construct temporary burrows under or even into carcasses to exploit maggots. Rarely they may drive the rostrum into soft soil and turn the body in a circular motion to form a conical hole in order to obtain insects. (Nowak 1991).

In captivity they have adapted to commercial dog and cat foods supplemented with fruit, vegetables, eggs and large amounts of live insects, but as they show a tendency towards obesity should not be fed for at least one day each week. (Ratajszczak & Trzesowska 1997). A pair of captive juveniles were able to take bananas by day 48 and dog food by day 56. During their first month their mean milk consumption was 15.22% of their body weight per day and they increased in weight by 11.52g daily. During the second month their milk consumption fell to 8.48% of body weight and they gained 18.54g per

day. In the final fortnight prior to weaning consumption was 4.05% of body weight and they gained 13.56g per day. (Olocco-Diz & Duggan 2004).

Hernández et al (2001) revealed the presence of k-Casein (k-Cn) polymers in the milk of this species, in the forms of dimers, trimers and higher molecular weight polypeptides of which k-Cn was always a constituent. Theses polymers disappeared when samples were treated with reducing agents.

REPRODUCTIVE BIOLOGY: In the Bolivian Chaco they appear to reproduce from November to May with the majority of lactating females being found in December and April (Cuéllar & Noss 2003). Breeding occurs in September in Provincia Santa Fé, Argentina. If conditions allow a second litter may be attempted in a single season.

Prior to mating males follow females sniffing the genital area before mounting (Ratajszczak & Trzesowska 1997). Captive males were seen to attempt mountings throughout the year with the birthing season from February to December (Redford & Eisenberg 1992). Pregnant females are easily recognised due to a visible flattening of the carapace so that the sides barely cover the flanks, the "armour" returning to its natural position after birth (Ratajszczak & Trzesowska 1997).

Litters usually consist of 2 or more rarely 3 offspring (Adamoli et al 2001) born after a gestation of 60 to 75 days. At Pozán Zoo, Poland all births took place at night with females preparing a shallow depression in the substrate using the forelegs and nose. Births were rapid with two offspring typically being born within a 10 minute period and following birth the female immediately proceeding to add more material to the "nest" so that the juveniles were concealed, eventually entering and accompanying the offspring as soon as building is complete (Ratajszczak & Trzesowska 1997). Twins often consist of one male and one female (Nowak 1991).

New-borns have soft leathery skin which gradually hardens with age, the pinnae are not yet formed and the mouth is closed except for the terminal portion. The nails are soft but they are able to crawl in search of milk. (Olocco-Diz & Duggan 2004). Lactation lasts 50-60 days with females often feeding young whilst lying on the back, and the eyes open after 16-30 days. Juveniles begin to move outside the nest at 30 days and take solid food from 35 days onwards Ratajszczak & Trzesowska (1997). Sexual maturity is reached at 9 months. (Redford & Eisenberg 1992).

Ratajszczak & Trzesowska (1997) noted that interbirth intervals of captive individuals were often short, as little as 72 to 74 days in some females, and that such short periods followed successful rearings not unsuccessful breeding attempts. There was no need to remove males from the enclosure during breeding, but females were sensitive to nest disturbance by humans which frequently resulted in nest failure. During failed breedings the young were consumed by the mother leaving no trace of their existence.

GENERAL BEHAVIOUR: Active by day and by night, though apparently primarily diurnal in Paraguay. Neris et al (2002) state that the species is diurnal in winter and nocturnal in summer, though this does not concur with the authors experience. Individuals of this species were observed to be active by day from at least July to early October in the area around PN Tte Enciso, Departamento Boquerón during 2006 and 2007 (P. Smith pers. obs.) and despite significant effort at night, no individuals of this species have been encountered by the author after dark. Merritt (2008) also states that he encountered the species only by day in the Central Chaco area during 20 years of periodic fieldwork. Cuéllar & Noss (2003) describe the species as diurnal in the Bolivian Chaco and note that it is active during the hottest hours of the day with peaks of activity from 10am to 4pm. Abba et al (2009) captured this species mainly at dusk.

Refuges Abba et al (2007) considered this species to be generalist in its choice of burrow location in Provincia Buenos Aires, Argentina, though most burrows were found in grassland areas. Burrow location does not appear to be affected unduly by human presence provided the species is not hunted, and one burrow system was located close to the asphalt on the Ruta Trans-Chaco in October 2009 (P. Smith pers. obs.).

Burrow architecture in the Argentinean Pampas was described in detail by Abba et al (2005). They found burrows typically to consist of a steeply declining entrance tunnel that levelled out to a horizontal gallery. The single entrance was approximately circular (19-20cm wide x 15-20cm high) and faced away from the prevailing wind direction. In soft terrain they descend to a mean depth of 30cm, but may be as

deep as 1m if an obstacle is in the way. Fifty-seven percent of the burrows examined were found to be branched.

Two burrow types were identified: longer, deeper burrows (complex) were built in harder soil and shorter, shallower burrows (simple) in soft soil. Simple burrows had a mean length of 70cm and mean depth of 50cm and were found only in soil with a high organic content. These were likely associated with feeding (60% of those examined ended in a tunnel excavated by Scarabaeid larvae (Coleoptera)) or temporary refuges from potential predators. These burrows are frequently clustered to some degree.

Complex burrows were located in hard, calcareous soil with little moisture and reached 485cm in length and 100cm in depth. Seven of the 34 complex burrows found had chambers near the mouth or at the end, and mean chamber dimensions were 20 x 30 x 50cm. These likely represent permanent, home burrows and were always located in areas that were not subject to flooding. Burrows may be shared by a mated pair but lack nesting material.

Abandoned burrows may be utilised by Burrowing Owls Athene cunicularia. In Provincia La Pampa, Argentina Machicote et al (2004) found owls in 3 of 28 (10.7%) of abandoned burrow systems of this species, compared to 14 of 38 (36.8%) abandoned burrows of Plains Vizcacha Lagostomus maximus, a species which clears all vegetation surrounding its colonies. The fact that armadillos do not clear surrounding vegetation means that fire is possibly an important factor in their selection by these owls in areas where vizcachas do not occur.

The dominant sleep posture of this species is in dorsal or lateral decubitus (Affanni et al 2001). They recorded periods of uninterrupted sleep lasting 6 hours or more under laboratory conditions. Tremors of all four limbs are seen during the initial stages of slow wave sleep, but these disappear a few minutes after this phase begins and if the ambient temperature is greater than 28°C. Over a period of 24 hours five individuals spent a mean of 14.94% of their time awake, 66.4% in slow wave sleep and 18.66% in paradoxical sleep.

Defensive Behaviour Merritt (2008) notes a reduced flight reaction in this species when compared to *Chaetophractus vellerosus*. He notes that individuals may pause and raise onto their hind legs, sniffing the air, when approached, finally taking evasive action by running away. When pursued this species runs rapidly towards its burrow, frequently adopting a zigzagging course and heading through dense, and often thorny vegetation in an attempt to shake its pursuer (P. Smith pers. obs.).

Nowak (1991) states that they may give a snarling noise when pursued and that if overtaken they draw the legs under the body so that the carapace is in contact with the ground. Upon entering a burrow they may spread the feet and arch the body so that the claws and edges of the movable bands anchor the animal in place, making it impossible to remove them by force. If surprised at great distance from their home burrow they may immediately try to dig (Parera 2002). Vigilant individuals can rise up onto the hind legs using the tail for support (Parera 2002).

Sociability Usually seen alone or in pairs in the wild (P.Smith pers.obs.). Ratajszczak & Trzesowska (1997) noted that as many as eight individuals were kept together at Pozán Zoo, Poland without any aggression being shown even when two females simultaneously raised young in the same enclosure. They became quickly tame and enjoyed petting and scratching.

Mortality In Argentina the principal predator is Puma *Puma concolor* and the species is also undoubtedly taken by Jaguar *Panthera onca* in the Paraguayan Chaco. Foxes probably take young animals. In Provincia La Pampa, Argentina, Pessino et al (2001) found that the prevalence of this species in the diet of Puma, jointly with another similar armadillo *Zaedyus pichiy*, rose from 10-12% in the mid 1990s to a high of 58.1% in 1997 and 31% in 2000. They correlated this increase in preference with a decline in the population of Plains Vizcacha *Lagostomus maximus*, which had previously been the preferred prey of the species.

In northeastern Buenos Aires Province, Abba et al (2009) found this species to be considerably less abundant in areas where dogs where present than in areas where they were absent. Abba et al (2010) found it to be a frequent victim of roadkill in central Patagonia and a victim of poisoning with substances used to kill foxes. This species is an infrequent victim of roadkill in Paraguay, though principally because its habitat encompasses an area that show very low levels of traffic (P.Smith pers.obs.).

Parasites Navone (1990) recorded the following nematodes in this species in the Argentinean Pampas - Aspidodera fasciata, Aspidodera scoleciformis (Aspidoderidae), Orihelia (=Dipetalonema) anticlava (Onchocercidae), Trichohelix tuberculata (Molineidae), Mazzia bialata (Cosmocercidae) and Ancylostoma caninum (Ancylostomidae) and Pterygodermatites chaetophracti (Rictularidae) in the Espinal region. Notarnicola & Navone (2003) reported a prevalence of 10.8% for infection by Orihelia anticlava in Argentina.

Vicente et al (1997) list the following nematodes for this species from Brazil in their catalogue: Aspidodera scoleciformis (Diesing, 1851) Railliet & Henry, 1912; Aspidodera binansata Railliet & Henry, 1913; Trichoelix tuberculata (Parona & Stossich, 1901) Ortlepp, 1922.

Ezquiaga et al (2008) recorded the flea *Tunga penetrans* (Siphanoptera) on 25% of specimens of this species captured in northeastern Provincia Buenos Aires. Mauri & Navone (1993) listed *Malacopsylla grossiventris* and *Phthiropsylla agenoris* (Siphanoptera) as associated with this species in Argentina.

Nava et al (2007) listed the Ixodid tick *Amblyomma pseudoconcolor* on this species in Paraguay. Guglielmone & Nava (2006) list the *Amblyomma pseudoconcolor*, *A.pseudoparvum* and *A.tigrinum* for this species in Argentina.

Longevity Captive individuals have survived for 20 years (Nowak 1991).

Physiology Aldana Marcos & Affanni (2005) describe the anatomy, histology, histochemistry and fine structure of the Harderian gland of this species. Carmanchahi et al (1999) describe the anatomy, histology and ultrastructure of the vomeronasal gland and Carmanchahi et al (2000) characterise the glycoconjugate sugar residues in the same organ. Estecondo et al (2000) described the sudoriparous acini of the pelvic glands. Ferrari et al (2000) studied the ultrastructure of the olfactory mucosa of this species in comparison with that of *Dasypus hybridus*.

Bermudez et al (2004) studied the platelets of this species. Mean platelet count showed no significant difference between the sexes: male 571.4 (+/-231.9), female 502 (+/-208.8). Responses to proven agonists where the same in both sexes and there was no change in platelet count following a period of captivity. Platelets are circular shaped at rest and emit pseudopodia when activated

Affanni et al (2001) provide a description of the penis of this species. The penis is extremely long penis and retracted within a skin receptacle during wakefulness. Non-erectile penile protrusion together with complex movements occur during short wave sleep and this is the only phase during which erections were observed. Non-erectile penile movements were classified as undulating movements, curving movements and flagellum-like movements. Contrasting with other mammals no erections occurred during paradoxical sleep though the penis remained protruded and flaccid. Arch-like erections were observed during slow wave sleep, beginning spontaneously and lasting no more than 3 seconds before falling flaccid again. Penile erections appeared and disappeared almost instantaneously during mating attempts.

Cetica et al (2005) described the morphology of the female reproductive tract and found it to have ovoid, elongate ovaries with longitudinally polarised cortex and medulla, and several oocytes in each follicle. The uterus is pyramid-shaped and bicornuate, and the uterine cervix is long as in all armadillos. A urogenital sinus is present instead of a true vagina. The authors recognised three morphological groups amongst the Dasypodids studied, with *Chaetophractus* armadillos forming a group with *Cabassous, Chlamyphorus* and *Zaedyus*. Codón & Casanave (2009) describe morphology and histological annual changes of the oviduct. Codón et al (2001) describe the ultrastructure and morphometry of ovarian follicles.

Adamoli et al (2001) described the morphology of the placenta, it being pear-shaped, filling threequarters of the uterine surface and homogeneously villosus across the maternal face but smooth on the fetal face where the umbilical cords inserted. No trace of a yolk sac was present. Histological analysis revealed it to be a hemochorial type placenta.

VOCALISATIONS: Females disturbed at the nest emerge and growl (Redford & Eisenberg 1992). Captured animals can produce a quiet grunting sound by contracting the abdomen (Parera 2002). Suckling young make a noise similar to a cats murmur (*sii*) (Ratajszczak & Trzesowska 1997).

HUMAN IMPACT: The species is consumed by indigenous populations in the Chaco, though it is not the favoured armadillo species for the table. Campesinos tend to avoid eating the species because of its scavenging habits (Neris et al 2002) and in central Patagonia it is viewed as "unclean" (Abba et al 2010). In other areas of Argentina the species is hunted in winter when fat deposits make them heavier. In the

Argentine Chaco it made up <1% of the diet of local people and was consumed a mean of 0.6 days per year (+/-0.07) (Altrichter 2006).

Due to its poor eyesight it is prone to be a victim of roadkill and may also be hunted by domestic dogs. In agricultural areas they may be considered a pest for their habit of burrowing into soft soil causing risk of leg injuries to cattle and horses. (Chiarello et al 2006, Parera 2002). Abba et al (2007) noted that this species is much less common in areas where armadillos are hunted in Provincia Buenos Aires. Abba et al (2010) report that it is considered a pest in central Patagonia, suspected to carry disease and to attack young sheep. They are also found to have a negative effect on both wild and domestic birds in that area because of their propensity for feeding on eggs. Conversely in tourist areas such as Peninsula Valdes they can be popular with visitors because of their boldness and willingness to take food from people's hands.

This species is a carrier of nematode roundworms of the genus *Trichinella* which cause the disease trichinosis (or trichinellosis) (Pozio 2005). The parasite most often enters the human system via the consumption of poorly cooked pork, but the consumption of armadillos in rural areas poses a similar risk. Pigs may become infected by scavenging carcasses of infected animals when they are raised outdoors, and given the scavenging habits of this species it is likely that infection may occur by a similar route. Ribicich et al (2010) found that 3 of 19 armadillos of this species in Provincia Buenos Aires, Argentina tested positive, representing a prevalence of 15.7%. However worm burdens were low (0.04-0.08LPG) making them a poor source of infection for other species.

CONSERVATION STATUS: The Greater Hairy Armadillo is considered Low Risk, least concern by the IUCN (Abba & Superina 2010), see http://www.iucnredlist.org/search/details.php/4369/all for their latest assessment of the species. The species is not listed by CITES. The species is not listed by CITES. The last conservation assessment of the species in Paraguay considered it Least Concern (Morales 2007), and Smith (in press) concurs with that evaluation.

The species was first confirmed to occur in Paraguay as late as 1979 (Myers and Wetzel 1979), reflecting the previous inaccessibility of its habitat rather than the rarity of the species. Due to the wide distribution, isolated nature of its chosen habitat in Paraguay and apparent abundance it appears to be under no imminent threat. Merritt (2008) states that during 20 years of periodic fieldwork the number of encounters with the species has remained essentially constant, suggesting that the species is "holding its own". This armadillo is present in several protected areas. It is able to adapt readily to habitats altered by humans and may even benefit from the association due to its ability to scavenge on refuse. (Chiarello et al 2006).

In 2010 the first permissions were granted establishing quotas for the harvesting of this species by for-profit companies for export abroad under the *Proyecto de Conservación y Utilización de la Vida Silvestre* (Project for the Conservation and Utilisation of Wildlife - henceforth PCUVS), and a monetary value has been established as payment to landowners for each individual of this species captured on their land. The effects of harvesting quotas on populations, especially those in the most accessible areas of the species range, needs to be closely monitored.

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FIGURE 2 - (FPMAM62PH) Greater Hairy Armadillo Chaetophractus villosus. Adult dorsal view. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.

FIGURE 3 - (FPMAM60PH) Greater Hairy Armadillo Chaetophractus villosus. Adult lateral view. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.



FIGURE 4 - (FPMAM61PH) Greater Hairy Armadillo Chaetophractus villosus. Adult head detail. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith. FIGURE 5 - (FPMAM64PH) Greater Hairy Armadillo Chaetophractus villosus. Adult cephalic shield of worn individual. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.



FIGURE 6 - (FPMAM63PH) Greater Hairy Armadillo Chaetophractus villosus.
Adult ventral view. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.
FIGURE 7 - (FPMAM66PH) Greater Hairy Armadillo Chaetophractus villosus.
Adult tail detail. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.



FIGURE 8 - (FPMAM65PH) Greater Hairy Armadillo Chaetophractus villosus. Adult hindfoot. Ruta Trans-Chaco km625, Departamento Boquerón, October 2009. Photo Paul Smith.

FIGURE 9 - Greater Hairy Armadillo Chaetophractus villosus.

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