SIX-BANDED ARMADILLO
Euphractus sexcinctus Linnaeus, 1758

FIGURE 1 - Adult, Bolivia (Paul Smith April 2009).

TAXONOMY: Class Mammalia; Subclass Theria; Infraclass Eutheria; Order Cingulata; Family Dasypodidae; Subfamily Euphractinae (Myers et al 2006, Möller-Krull et al 2007). The genus *Euphractus* was defined by Wagler in 1830 and contains a single species. The genus name *Euphractus* was taken from the Greek meaning "true or good shell" and the species name *sexcinctus* means "six bands". Five subspecies were tentatively recognised by Gardner (2007), two of which are present in Paraguay - *Euphractus sexcinctus flavimanus* (Desmarest 1804) in the east and *E.s.boliviae* in the Chaco (O.Thomas 1907). Desmarest´s description of the subspecies *E.s.flavimanus* was based on de Azara´s (1801) "Le Tatou Poyou" and "L´´Encoubert" of Buffon (1763). Synonyms adapted from Gardner (2007):
Dasypus sexcinctus Linnaeus 1758:51. Type locality "America Meridionali" restricted to Pará, Brazil by O.Thomas (1907).
lor[*icatus*]. *flavimanus* Desmarest 1804:28. Type locality "Paraguay", based on de Azara (1801) and Buffon (1763).

Dasypus flavipes G.Fischer 1814:122. Type locality "Paráguay".
Dasypus gilvipes Illiger 1815:108. Nomen nudum.
Das[*ypus*]. *gilvipes* Lichtenstein 1818:215. Renaming of *Dasypus gilvipes* Illiger (1815).
T[*atus*]. *gilvipes* Olfers 1818:220. Type locality "Paraguay, Brasilien, Guiana"
Dasypus pilosus Olfers 1818:220. Nomen nudum.
Dasypus encoubert Desmarest 1822:370. Type locality "Le Paraguay".
Tatus sexcinctus Schinz 1824:pl.113. Name combination.
D[*asypus*]. *setosus* Wied-Neuwied 1826:520. Type locality "in den Grossen Campos Geraes und den Angrän zenden Gegenden des Sertong" restricted to Bahía, Brazil by Ávila-Pires (1965).
Euphractus musetlinus Fitzinger 1871:259. In part. Type locality "Sud-und-Mittel-Amerika".
Scleropleura bruneti Milne-Edwards 1872:1. Type locality "San Antonio … Ceará", Brazil based on deformed specimen.
[*Dasypus* (*Dasypus*)] *sexcinctus* Trouessart 1898:1145. Name combination.
[*Scleropleura*] *Bruneti* Trouessart 1898:1141. Name combination.
[*Dasypus*] *poyú* Larrañaga 1923:243. Type locality implied as Uruguay. Based on *Dasypus sexcinctus* Gmelin (1788) (=*Dasypus sexcinctus* Linnaeus 1758) and de Azara (1802).
Euphrachtus sexcictus Vizcaino et al 1999: 311. Incorrect spelling.
Euphractes sexcictus Nava et al 2007: 260. Incorrect spelling.

ENGLISH COMMON NAMES: Six-banded Armadillo (Wilson & Cole 2000, Gardner 2007), Yellow Armadillo (Parera 2002), White-bristled Hairy Armadillo (Long 2003), Pig Armadillo (Merritt 2008).

SPANISH COMMON NAMES: Armadillo de seis bandas (Neris et al 2002), Armadillo amarillo (Emmons 1999), Peludo (Emmons 1999), Gualacate (Parera 2002), Peji (Cuéllar & Noss 2004), Quirquincho de seis bandas (Anderson 1997), Peji grande (Anderson 1997).

GUARANÍ COMMON NAMES: Tatu poju **M** (Villalba & Yanosky 2000), Poju **AP** (Villalba & Yanosky 2000), Krypurá **Ac** (Villalba & Yanosky 2000), Kry´y pura **Ac** (Esquivel 2001), Tatuguasu (Cuéllar & Noss 2004), Gatodejai **Ay** (Cuéllar & Noss 2004), Tatú poyú (Parera 2002), Tatú-podyu (Emmons 1999). "Poju" and its variations which feature in the Guaraní names refers to the needle-like claws of the forefeet.

DESCRIPTION: Predominately yellowish to reddish-brown in armour colour (usually yellowish), darker and somewhat blackish-brown on skin. The head plate is triangular with a straight posterior margin, coming to a blunt point just before the nose and is distinctly flattened on the upper part. It is relatively narrow, the width about 70-80% of its length. It extends as a spur behind the eye and there may be traces of scales in a semi-circle below the eye. Scales of the head plate are large and arranged in a well-defined pattern. Ears are medium-length, extending backwards to the second or third line of the scapular plate. They are well-separated by a distance greater than the ear-length across the top of the head. The carapace consists of two fixed plates, the scapular and pelvic plates, with 6 to 8 movable bands separating them (typically 6 and rarely 8). There is a single "nuchal" band between the head and scapular the plate. A sparse covering of long, stiff yellowish-tan hairs sprout from the skin between the bands. The tail is cylindrical and well-armoured with 2 to 4 bands of scales at the base. Two to four holes in the plates above the tail base are glandular openings responsible for the animals distinctive odour - this character is found only in *Euphractus* and *Chaetophractus*. The forefoot possesses five toes with robust claws, the third of which is the longest. Females have two pectoral nipples. Body temperature is 34ºC.

SKELETAL CHARACTERISTICS: Broad and relatively long rostrum. Interorbital with a marked postorbital constriction. Brain case with obvious lateral markings, somewhat squarish and flattened. Zygomatic arch slender and elongate. Jugal never twice as high as the overlying anterior edge of the squamosal. Tympanic bulla present. External auditory meatus is ossified. *Condylonasal Length:* 114.5mm (109-125.5mm); *Zygomatic Width:* 68.6mm (61.7-75.4mm). (Diaz & Barquez 2002, Redford & Wetzel 1985). Skull illustration based on Chebez (2001) and Smith & Redford (1990).

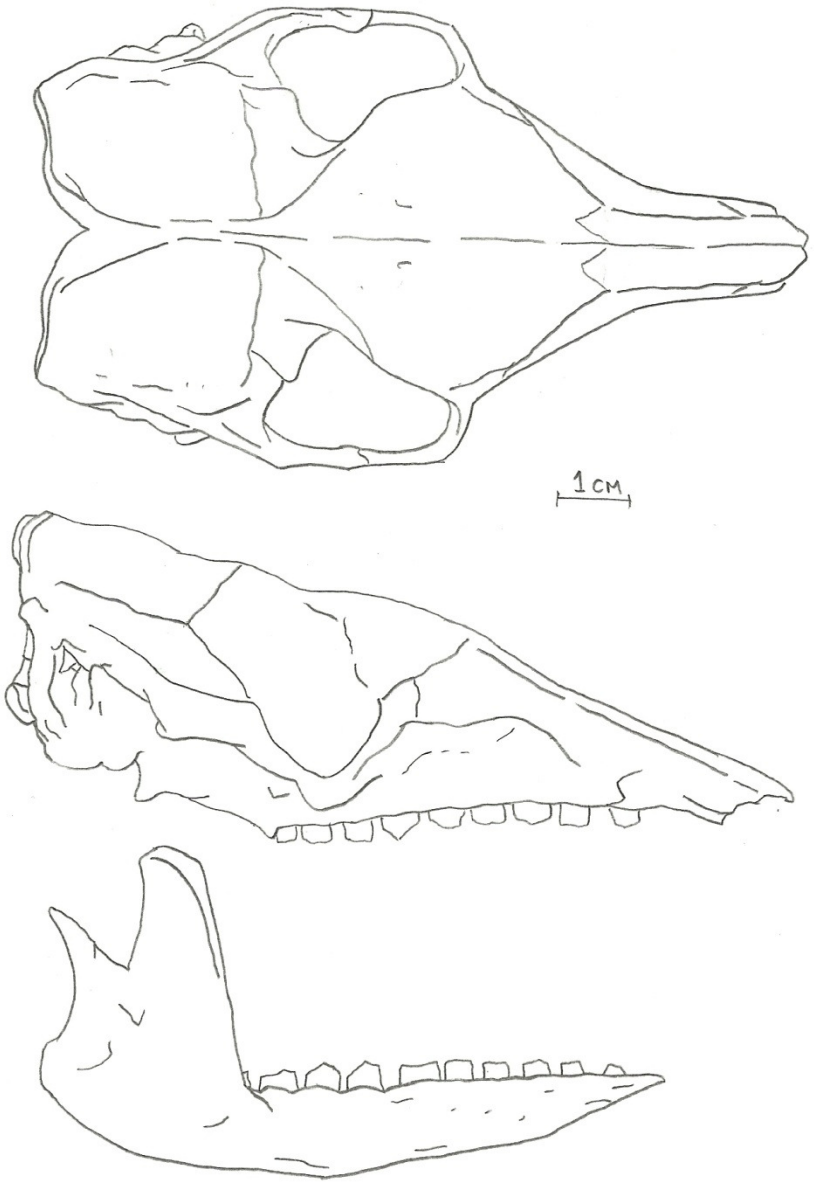
Vizcaino et al (1999) give the following ulnar dimensions (n=14): Ulnar Length 70.3mm (+/-4.3); Olecranon Length 27.9mm (+/-4.0). The trend towards fossoriality is correlated with relative development of the olecranon process, and the ratio of the ulnar length to olecranon length is the Index of Fossorial

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 0.66 (+/-0.07).

The ribs do not imbricate. Rib expansion is more symmetrical than in *Dasypus*, involving both anterior and posterior margins of the rib, and thus resembles the myrmecophagid pattern. (Jenkins 1970).

DENTAL CHARACTERISTICS: Armadillos lack true teeth, but possess a series of "molariform" teeth that do not follow the standard mammal dental formula. They are particularly robust in this species. 9-10/10 = 38-40. First molariform located in the premaxillary as in *Chaetophractus*.

Green (2009) looked for a link between the orthodentine microwear of this species and its diet, but found considerable intertooth variation, possibly related to the uneven distribution of bite force on the dentition of long-faced animals, though food texture and intraspecific variation likely also play a role.



GENETIC CHARACTERISTICS: 2n=58, FN=102. (Gardner 2007). Redi et al (2005) gives the genome size as 4.16pg (+/-0.41) or 4068 Mbp.

TRACKS AND SIGNS: The slightly rocking gait of this species leads to a distinctive print pattern in which the steps are almost perfectly aligned but the feet are slightly inward pointing towards the medial

line. The tail is carried clear of the floor and does not usually leave an impression in the substrate. Despite the size of the animal the prints are surprisingly small, leaving somewhat rounded impressions, especially towards the tips of the digits. The hindfoot appears to have just three short digits and is similar in basic form to the forefoot, though slightly larger and with more rounded pads. **FP:** 2 x 1.7cm **HP:** 3 x 2.2cm. **PA:** 5cm. (Villalba & Yanosky 2000). Faeces typically with an irregular surface, measure 15 (+/-1.5mm) x 20mm (+/-1.3mm) and contain c62% soil and some plant material (18%). They are of fragile consistency and have a strong odour, presumably due to formic acid and decaying plant material. Weight 2.3g (+/-0.8mm). Typically found near areas of excavation and along trails (Anacleto 2007).

EXTERNAL MEASUREMENTS: The largest of the "hairy armadillos" in Paraguay. **TL:** 61.64cm (40.1-95cm); **HB:** 39.57cm (34.1-49.5cm); **TA:** 22.02cm (11.9-30cm); **FT:** 8.35cm (7.5-9.2cm); **EA:** 3.52cm (2.4-4.7cm); **WT:** 4.32kg (2-6.5kg). Like other "hairy armadillos" they store fat and a captive female individual reached 11kg in weight. **WN:** 95-115g. (Parera 2002, Nowak 2001, Emmons 1999, Ceresoli et al 2003, Redford & Eisenberg 1992, Diaz & Barquez 2002, Redford & Wetzel 1985).

Medri et al (2009) give the following measurements for individuals captured in Nhecolândia, Mato Grosso do Sul, during October 2006 to October 2007. **HB:** adult males 47.72cm (+/-1.59, n=14), juvenile males 30cm (+/-0, n=2), adult females 47.90cm (+/-1.62, n=14), subadult female 40cm (+/-0, n=1); **TA:** adult males 23.51cm (+/-1.21, n=14), juvenile males 17cm (+/-0, n=2), adult females 23.01cm (+/-1.18, n=14), subadult female 20cm (+/-0, n=1); ***Tail Circumference*** adult males 12.85cm (+/-0.56, n=12), juvenile males 7.75cm (+/-0.35, n=2), adult females 13.14cm (+/-0.52, n=14), subadult female 10cm (+/-0, n=1); **FT:** adult males 8.57cm (+/-0.72, n=12), juvenile males 7cm (+/-0, n=2), adult females 8.75cm (+/-0.62, n=13), subadult female 7.80cm (+/-0, n=1); ***Length of Forefoot*** adult males 7.24cm (+/-1.09, n=12), juvenile males 6.15cm (+/-1.21, n=2), adult females 7.32cm (+/-0.78, n=13), subadult female 7cm (+/-0, n=1); **EA:** adult males 4.13cm (+/-0.39, n=12), juvenile males 3.20cm (+/-0, n=2), adult females 3.99cm (+/-0.43, n=13), subadult female 4cm (+/-0, n=1); ***Ear Width*** adult males 2.97cm (+/-0.34, n=12), juvenile males 2.25cm (+/-0.35, n=2), adult females 2.74cm (+/-0.47, n=13), subadult female 2.50cm (+/-0, n=1); ***Head Length*** adult males 13.45cm (+/-0.46, n=14), juvenile males 9.80cm (+/-0.28, n=2), adult females 13.34cm (+/-0.58, n=14), subadult female 12cm (+/-0, n=1); ***Head Width*** adult males 9.26cm (+/-0.84, n=13), juvenile males 7.25cm (+/-0.35, n=2), adult females 9.29cm (+/-0.77, n=13), subadult female 7.50cm (+/-0, n=1); ***Circumference of Thorax*** adult males 46.23cm (+/-3.18, n=13), juvenile males 26.50cm (+/-2.12, n=2), adult females 45.86cm (+/-2.66, n=14), subadult female 7.50cm (+/-0, n=1); ***Number of Movable Bands*** adult males 6 (n=9) 7 (n=3), juvenile males 6 (n=2), adult females 6 (n=11) 7 (n=3), subadult female 6 (n=1); **WT:** adult males 4.38kg (+/-0.60, n=14), juvenile males 1.10kg (+/-0.07, n=2), adult females 4.45cm (+/-0.64, n=14), subadult female 2.55kg (+/-0, n=1).

SIMILAR SPECIES: This is a large armadillo, second only in size to *Priodontes maximus*. Its covering of hair on the dorsum means that it is most likely to be confused with larger individuals of *Chaetophractus villosus*, *C.vellerosus* being considerably smaller and with notably longer ears. The smallest individuals of *Euphractus* are similar in size to the largest individuals of *Chaetophractus villosus*. Note however that *villosus* is generally darker and more reddish and hairier overall, especially ventrally, with conspicuous tufts of hair on the cheeks, legs and throat. Perversely the dark brown hairs of the dorsum of *C.villosus* may be harder to see against the dark carapace than the paler, yellowish-tan hairs of *Euphractus*. The number of bands is variable in this species and whilst *C.villosus* may possess 7 or 8 bands, it never has 6. Another useful character is the flattened head of this species; *C.villosus* shows a more rounded forehead and crown in profile. Behind the eye the head plate descends as a "spur" in *Euphractus* which may also show traces of a plate below the eye, both these features are absent in *C.villosus* which has a smooth and even edge to the plate behind the eye. Examination of the scales on the head plate shows a regular pattern of large scales in this species, that of *C.villosus* is a somewhat less-organised melee of smaller scales, generally with a well-marked posterior "border". Beyond this border *C.villosus* shows at least two distinct nuchal bands prior to the scapular plate, only one is present in *Euphractus*. Note also that *Chaetophractus* armadillos in Paraguay are confined to the Chaco and the cerrado belt of the northern Orient, whilst this species is less conservative in its habitat choice.

DISTRIBUTION: Widely distributed in eastern and central South America east of the Andes and south of Amazonia. In Brazil the distribution was long considered to be in two disjunct populations, one isolated one in Pará State with neighbouring Suriname and extreme southern Guyana and a wider area that is contiguous with its distribution in neighbouring countries further south. However this has more recently been shown to be an artefact of sampling and there are now virtually continuous records from Amapá, Pará, Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Bahia, Tocantins, Goiás, Mato Grosso, Mato Grosso do Sul, Minas Gerais, Espírito Santo, Rio de Janeiro, São Paulo and Rio Grande do Sul (Sousa e Silva Junior et al 2001, Sousa e Silva Junior & Nunes 2001, Goncalves de Andrade et al 2006, Lima et al 2009).

In Bolivia there are records from southern Departamento Beni, Santa Cruz and eastern Departamentos Chuquisaca and Tarija (Anderson 1997). In Uruguay it is found throughout the country though specimen records are available from Departamentos Artigas, Tacuarembó, Rio Negro, Durazno, Cerro Largo, Soriano, Treinta y Tres, Florida, Colonia, San José, Lavalleja y Rocha (Daniel Hernández in litt.). In Argentina it has been recorded from the following Provincias: Misiones, Corrientes, Formosa, Chaco, Salta, Jujuy, Tucumán, northern Santa Fé and Santiago del Estero. The species was introduced into Central Chile, but does not appear to have become established (Long 2003).

In Paraguay the species occurs widely in both eastern Paraguay (*E.s.flavimanus*) and the Chaco (*E.s.boliviae*) and is absent only from extensively forested areas and urban zones. Abba & Vizcaíno (2008) list 2 specimens from Paraguay in the Museo Argentino de Ciencia Naturales "Bernadino Rivadavia mostly without precise locality data (MACN11.24 skull, 1911; MACN45.028 carapace and skull, San Pedro, Puerto Casado 1944).

E.s.flavimanus is distributed through eastern Paraguay, Mato Grosso in Brazil, northeastern Argentina and Uruguay. *E.s.boliviae* occupies the Gran Chaco of Bolivia, western Paraguay and northern Argentina. The remaining subspecies are *E.s.setosus* in southeastern Brazil, *E.s.tucumanus* in the Argentinean Provincias of Tucumán and Catamarca, and *E.s.sexcinctus* occupying the northern part of the range and southern Surinam. The latter intergrades with *flavimanus* in Mato Grosso and *setosus* in southern Brazil. *E.s.boliviae* intergrades with *tucumanus* in the southernmost part of its range.

HABITAT: Typical of open grassy and scrubby habitats, generally in dry areas, but also occurs in gallery forest in the Pantanal area and seasonally-flooded palm savanna in the Humid Chaco. In the Dry Chaco they are less common in densely-forested areas, preferring forest edge and scrub. Merritt (2008) describes the habitat in the Chaco as open thorn scrub and thorn forest in areas that have not been affected by land conversion or human activity, but this species is encountered infrequently in disturbed areas of te Central Chaco such as cattle pastures (P.Smith pers.obs.).

In the cerrado belt they are found in campo limpio, campo sucio and *sensu-stricto* cerrado but are less frequent in cerradón - though Bonato et al (2008) reported that in the cerrado of Brazil they could find no clear preference between the patchwork of cerrado habitats and the species was equally common in grassland and forest. In Piauí, Brazil Goncalves de Andrade et al (2006) found this species in caatinga, mangrove (small pockets of secondary forest and salt marsh), clear cut areas with fragments of secondary forest and clear cut areas between urbanization and mangroves.

In Pará Sousa e Silva Junior & Nunes 2001 found the species in Amazonian savanna and disturbed *sensu-stricto* cerrado with a high density of trees and shrubs. In Maranhão Sousa e Silva Junior et al (2001) found the species in several distinct biomes. 1 "Pré-Amazônia Maranhense" (clearings, the border of primary/secondary forest, and the interior of the unflooded secondary forest). 2 "Zona dos Cocais" (plantations in primary/secondary forest borders, plantations associated with *Orbignya* palm clumps, pasture, copses in different stages of regeneration, and secondary forest). 3 Cerrado (border between the "cerrado" *sensu stricto* and gallery forest). A single animal was captured in an area of cerradón. Use of habitat was apparently generalist and indiscriminate.

Anacleto et al (2006) used the genetic algorithm program GARP to predict the species distribution in Brazil, with results suggesting this species would occur in all the major biomes - Amazonia, Cerrado, Caatinga, Pampas, Pantanal and Atlantic Forest - making it the most habitat generalist species of armadillo to occur in that country.

Habitat choice is apparently unaffected by fire, a study in the cerrado of Mato Grosso, Brazil finding that they utilised burnt areas as frequently as they do unburnt areas when foraging (Prada & Marinho-Filho 2004) - burning is of course a natural occurrence in the cerrado biome. Apparently less common at humid forest edge and probably absent from humid forest interior, but the expansion of the agricultural frontier is probably allowing them to colonise new areas. (Parera 2002, Nowak 2001, Emmons 1999, Neris et al 2002, Redford & Eisenberg 1992).

ALIMENTATION: Omnivorous and able to exploit a wide variety of foodstuffs from fruits and plant matter to meat and even carrion. Eyesight is poor and smell is the primary method used for locating food. Six-banded Armadillos take large insects and exploit seasonally plentiful resources such as palm nuts and bromeliad fruits - at certain times of year plant material can compose a significant part of the diet. Though generally solitary, numbers may gather at large carcasses to feed on carrion and maggots (Nowak 1991). In common with other members of the subfamily Euphractinae they are able to store fat and this may be of assistance during seasonal food shortages (Redford & Wetzel 1985).

In Mato Grosso, Brazil, a study found the diet to consist of 90% plant matter, notably palm fruits (*Acrocomia* sp), pineapple (*Ananas* sp.) and figs (*Ficus* sp.), with the remaining 10% made up of beetles, crickets, ants, spiders, larvae, pupae and one amphibian. A study of stomachs of road kill individuals in São Paulo, Brazil found plant matter to make up just 33% of the diet, whereas insects (principally Formicidae and Scarabaeidae) made up more than 50% of the samples. Vertebrate remains included a Sigmodontid rodent, armadillo plates (likely from scavenging), pig skin, a snake and a small bird (Dalponte & Tavares-Filho 2004).

One female roadkill individual from Goiás, Brazil had four *Calomys* sp. mice in its stomach, two of which were young (Bezerra et al 2001), while in the cerrado of Brazil Bonato (2002) found *Oxymycterus* sp., *Clymomys* sp., remains of a tanager (Thraupidae) and snakes amongst vertebrate remains. Bezerra et al (2001) suggested that predation on rodents during the dry season in the cerrado may be related to the scarcity of plant matter available at this time of year.

Captive individuals have been seen to kill large rats, but their hunting technique was ineffectual and they were incapable of making a quick, clean kill (Redford & Eisenberg 1992). The flesh is removed by standing on the carcass and ripping off pieces with the mouth (Redford & Wetzel 1985). Captive individuals have also been observed attacking a Grey Brocket Deer fawn *Mazama gouazoubira* and a Greater Rhea *Rhea americana* and attempting to drag them into their burrow (Dalponte & Tavares-Filho 2004).

Mercolli & Yanosky (2001) reported wild armadillos of this species predating Rhea nests in the Chaco of Argentina, and suggested that the animals had burrowed under the nest after the laying of the eggs. They recommended that the effect of nest predation by armadillos be assessed as a threat to the conservation of Rheas.

REPRODUCTIVE BIOLOGY: Neris et al (2002) note the breeding season as "spring and summer" but that captive individuals have also engaged in breeding activities during autumn. Pregnant females have been found in central Brazil during September and October, and in Uruguay during January. Bonato et al (2008) considered breeding to be year round in the Brazilian cerrado whilst Cuéllar (in press) states that in the Bolivian Chaco there is a short concentrated breeding season at the end of the dry season with maximum fecundity in the first months of the wet season. Desbiez (2006) detailed chasing behaviour involving up to 8 individuals in a straight line and noted that local people in the Brazilian Pantanal consider this to be a form of mate competition, with several males chasing a female ready to breed. Such chases were seen to last over an hour and covering an area of no more than one hectare, the animals moving in and out of denser vegetation. A female taken in Mato Grosso, Brazil was pregnant with two well-developed young in July. The gestation period is 60 to 64 days. Captive females have been seen to construct nests shortly before giving birth and typical litters contain one to three young and may include both sexes (Redford & Wetzel 1985). Meritt (1976 in Nowak 1991) states that twins frequently consist of one male and one female offspring. Newborns are poorly-developed and have a soft carapace. Females

disturbed with their young may try to move or hide them and/or respond aggressively towards the intruder. Young displaced from the nest are returned by the mother. The eyes open after 22 to 25 days and by the end of the first month they have quadrupled in weight and are able to take solid food. Sexual maturity is reached at 9 months in captivity. (Redford & Eisenberg 1992, Parera 2002, Redford & Wetzel 1985).

GENERAL BEHAVIOUR: Solitary and diurnal or nocturnal, tending to be more nocturnal in areas where human population pressure is higher (Merritt 2008). Bonato et al (2008) reported that the species is nocturnal in the Brazilian cerrado, despite the lack of human predation in the area and suggested that this was because the species maintains body temperatures at a low temperature range. They are active, alert foragers and constantly on the move, maintaining a steady trot with a distinctly rocking motion, stopping occasionally to investigate potential sources of food.

No difference in activity levels between seasons was noted by Bonato et al (2008) but there is some evidence to suggest that activity patterns are closely tied to rainfall and ambient temperature (Brooks 1995, Parera 2002). Rocha et al (2006) noted a significant difference in the abundance indexes of this species between the dry season (April to September) 0.50 (+/-0.49) and the wet season (October to March) 1.54 (+/-0.61) in Mato Grosso, Brazil in a study based on footprints. They speculated that this may be due to a greater availability of resources during the wet season.

This species has a characteristic odour which is released from holes in the plates above the base of the tail (Nowak 1991). Their swimming ability has enabled them to colonise offshore islands in Maranhao State, Brazil (Hass et al 2003).

Home Range Minimum home range in Brazil was found to average 93.3ha (Nowak 1991, Parera 2002). Captive animals mark their cages with secretions from their pelvic scent gland and it would seems likely that burrows were marked by the same means in the wild state. (Emmons 1999, Redford & Eisenberg 2002).

Biomass in the Brazilian Pantanal was estimated at18.8kg/km^2 about two-thirds of the overall armadillo biomass in the area (Redford & Wetzel 1985). In Mato Grosso, Brazil, the density was estimated in varying types of habitat with the following results 0.48/km^2 in cerrado, 2/km^2 in gallery forest, 0.59/km^2 in secondary forest and 2.9/km^2 in deciduous forest (Parera 2002). In the Brazilian cerrado the density was calculated at 0.14 individuals/ha (Bonato 2002, Bonato et al 2008) whereas in the Bolivian Chaco it was as low as 0.012 individuals/ha (Cuéllar in press).

Refuges Adept diggers, they scratch the earth with the forefeet and uses the hindfeet to kick it clear of the burrow entrance (Nowak 1991). Caves typically have a single semi-circular entrance with the U-shaped roof corresponding to the convex dorsum of the animal being almost as high as they are wide - approximate dimensions being 20-22cm wide by 19-20cm high (Emmons 1999, Parera 2002). Carter & Encarnaçao (1983) found the mean dimensions of the burrow to be 21cm wide x 19 cm high at the entrance, narrowing to 20cm x 16cm 10cm inside the burrow, and the mean burrow angle to be 32.4º. Many burrows may be dug in a relatively small area and unlike many other armadillos burrows are frequently re-used, one male using a single burrow for 18 consecutive days (Carter & Encarnaçao 1983). In general burrows are only 1 or 2m deep, but open into a chamber that is wide enough for the animal to turn around (Nowak 1991). They are frequently constructed between tree roots (Parera 2002) and are dug in a direction so that the prevailing wind blows away from the entrance (Carter & Encarnaçao 1983). Defecation always takes place away from the burrow.

Aggressive Behaviour Female aggression is generally associated with lactation. Chases involving several individuals may have an aggressive function (Desbiez 2006).

Defensive Behaviour Merritt (2008) notes that individuals encountered in a wild state stand nearly erect on their hind legs, sniffing the air whilst moving the head from side to side. They may then either resume foraging or bolt to safety.

Unlike other armadillos this species is reported to bite when handled (Emmons 1999, Redford & Eisenberg 2002). Merritt (2008) added that they may urinate and defecate on a captor, while scratching out with the foreclaws and will "not hesitate to attack or bite during capture". Despite handling numerous wild individuals of this species I have yet to encounter an individual which has behaved aggressively or attempted to bite when captured (P.Smith pers.obs.), whilst defecation appears to be a normal stress

reaction of all captured armadillos regardless of species. Captured *x5r < fasa7yu6qwa* do try to scratch at the floor, but this seems to be associated with attempts to escape rather then aggression, and attacks on captors of the sort frequently reported in the literature seem to be a very infrequent occurrence.

Its main defence is to run for its burrow and if captured en route it will attempt to burrow rapidly into the ground even when held by the tail. Burrowing animals show remarkable strength and stubbornness and an animal which has begun to burrow can rarely be dislodged from its work unless it is in extremely soft soil. The animal will stop burrowing when pulling pressure is applied, digging in its feet and holding firm, but will immediately continue to burrow as soon as the pressure desists (P.Smith pers. obs.).

Mortality In São Paulo State this species made up 37% of all road kills during a highway survey and it is a common victim of roadkill on Paraguayan highways, especially in the Chaco. Thomas & Sabine Vinke (in litt.) note that in the Chaco this species is the most frequent armadillo roadkill because of its dirunal behaviour, pale colouration similar to the colour of the Chaco soils and its habit of fleeing in an unpredictable zig-zagging run that makes it difficult to avoid.

It does not appear to be unduly affected by burning within its habitat, Prada & Marinho-Filho (2004) considering direct mortality caused by fire to be negligible in the cerrado of Brazil.

Six-banded Armadillos figure in the diet of big cats such as Jaguar *Panthera onca* and Puma *Puma concolor*, but are probably also at risk from smaller cats and foxes. Taber et al (1997) found remains of this species in 1 of 106 scats of Jaguar and 1 of 95 scats of Puma in the Paraguayan Chaco. Garla et al (2001) found this species to make up 1.4% of the diet of Jaguar in the Atlantic Forest of Southeastern Brazil. Martins et al (2008) found this species 1 of 14 (7%) scats of Ocelot *Leopardus pardalis* in São Paulo, Brazil but not present in 12 scats of Puma *Puma concolor*. Rodrigues et al (2007) found remains of this species in 0.3% of Maned Wolf *Chrysocyon brachyurus* scats in Brasilia, representing an estimated 1.69% of the total biomass consumed.

Juveniles may be taken by Lesser Grison which are small enough to enter burrows. One individual was seen to flee from a burrow shortly after a Molina´s Hog-nosed Skunk *Conepatus chinga* entered it at Fortín Toledo, Departamento Boquerón during September 2010 (P.Smith pers.obs.).

Longevity A captive individual lived for 18 years and 10 months (Jones 1982).

Parasites Fujita et al (1995) reported the following nematodes from two specimens in Paraguay: *Ascaris dasypodina, Aspidodera fasciata, A.esperanzae* (described as a new species in the same paper - but later proposed as a junior synonym of *A.binansata* by Jimenez-Ruiz & Gardner 2003), *A.scoleciformis, Cruzia tentaculata, Mazzia mazzia, Moeniggia complexus, Spirura guianensis, Trichohelix tuberculata* and an unidentified species of Heterakinae. The two specimens were infected with 1504 specimens of six species and 97 specimens of four species respectively. Hoppe et al (2009) noted five intestinal helminths in specimens from Paraíba State, Brazil: *Ancylostoma caninum* (Ancylostomatidae), *Trichohelix tuberculata* and *Hadrostrongylus ransomi* (Molineidae), *Aspidodera fasciata* and *A.scoleciformis* (Aspidoderidae).

Jimenez-Ruiz & Gardner (2003) reported Aspidoderid nematodes *Aspidodera binansata* (n=32) and *Lauroia bolivari* sp. nov (n=5) from a specimen in Santa Cruz, Bolivia. Moulin (1858) described the nematode now known as *Orihelia anticlava* (Onchocercidae) from this species in Minas Gerais, Brazil, and it has since been found in Sao Paulo (Lent & Freitas 1942), Jujuy, Argentina (Mazza & Anderson 1925) and Concepción, Paraguay (Masi Pallares 1970).

Vicente et al (1997) list the following nematodes for this species from Brazil in their catalogue: *Aspidodera fasciata* (Schneider, 1866) Railliet & Henry, 1913; *Aspidodera scoleciformis* (Diesing, 1851) Railliet & Henry, 1912; *Aspidodera* sp. Travassos, 1941; *Delicata similis* Travassos, 1935; *Dipetalonema anticlava* (Molin, 1858) Lent & Freitas, 1942; *Macielia macieli* (Travassos, 1915) Travassos, 1935; *Lauroia travassosi* Proença, 1938; *Moennigia complexus* (Travassos, 1935) Durette-Desset & Chabaud, 1981; *Moennigiafilamentosus* (Travassos, 1935); *Trichoelix tllberculata* (Parona & Stossich, 1901) Ortlepp, 1922.

Nava et al (2007) listed the Ixodid ticks *Amblyomma pseudoconcolor* and *A.auricularum* on this species in Paraguay and Becharra et al (2002) recorded *Amblyomma pseudoconcolor* and *A.nodosum* in PN Emas, Goiás, Brazil. Guglielmone & Nava (2006) list *Amblyomma cajennense* and *A.pseudoconcolor* for this species in Argentina.

Linardi & Guimarães 2000 report the Tungid flea *Tunga terasma* (Siphanaptera) on this species in Brazil. Mauri & Navone (1993) mention the flea *Malacopsylla grossiventris* (Siphanoptera) on this species in central Argentina.

Physiology Serafim et al (2010) describe the characteristics of semen of this species. Semen was white-translucent and viscose. Mean values obtained where 353µl (+/-86) for volume, 9 for pH, $45\pm14\times10^6$ sperm/ml for concentration, 61% (+/-7) motile sperm with 2 (+/-0.2) for vigor, 55% (+/-7) live sperm, 86% (+/-2) morphologic normal sperm, and 46% (+/-6) functional membrane integrity. Electroejaculation was successful in every attempt.

VOCALISATIONS: Generally quiet apart from the usual grunting noises produced by foraging armadillos. Juveniles are able to produce soft clicks and squeaks. (Redford & Wetzel 1985).

HUMAN IMPACT: This species is frequently hunted for food by indigenous groups and rural populations on account of its large size and abundance (Cartés 2007, Emmons 1999). However it is not the preferred armadillo species for the table, in some areas having a reputation for being "unclean" on account of its habit of consuming carrion and it is even said to spread leprosy in some areas (Neris et al 2002). The meat is said to have a strong flavour (Redford 1994). In the Argentine Chaco it made up 3.3% of the diet of local people and was consumed a mean of 3 days per year (+/-0.15) (Altrichter 2006).

Though it likely suffers from burning of grasslands to create pasture, the species may actually have benefited from agricultural activities opening up potential new areas for colonisation. However conflict arises when the crops are tubers such as manioc (*mandioca*) or sweet potato (*batata*), favoured foods for the armadillo, resulting in its persecution as a pest species. The presence of a large number of burrows in a small area creates a potential pitfall for horses and their riders (Nowak 1991). Merritt (2008) reports that in the Paraguayan Chaco folklore states that these armadillos will dig up graves to feed on corpses, possibly deriving from observations of amimals feeding on livestock or maybe from the time of the Chaco War when human corpses would have been a plentiful source of protein (P.Smith per.obs.).

The fat of the animal may be used to cure respiratory illnesses and contusions (Neris et al 2002). Commercial price of fat of this species was $1 per 10ml in the city of São Luis, Maranhão, Brazil according to Alves & Rosa (2010) with a price of US$25 per litre paid to the supplier and a monthly trade of 250ml. Alves & Rosa (2007) state additionally that street traders in the city of São Luis, Maranhão and João Pessoa, Paraíba sell the fat for treatment of erysipelas and swelling and in Natal City, Rio Grande do Norte the fat is drunk to ease a sore throat (Oliveira et al 2010). Confessor et al (2009) note the use of fat in ethnoveterinary practice for the treatment of furunculosis.

Alves et al (2009) found it to be the most commonly used wild mammal in the caatinga of Brazil during their surveys of medicinal uses of animals, with the tail being introduced into the ear to combat earache and deafness, whilst in Pernambuco State, Brazil, the belief is that simply scratching the ear with the tail has the same effect (Alves et al 2008). Alves & Rosa (2006) state that the tail is used as an amulet to protect aginst the "evil eye" in Maranhão and Paraíba States, Brazil and the skin drunk in a tea as a treatment for asthma. A tea made from the urine is used to combat urinary infections in Ceará State, Brazil (Ferreira et al 2009b). In the same area fat is rubbed onto burns and inflammations, and the meat is eaten without salt to combat pains in the bones. (Ferreira et al 2009a).

In Argentina the tail may be used by indigenous groups to strike with flint to make sparks, as well as to carry fire-making tools (Redford & Wetzel 1985). In the Brazilian caatinga snuff is inhaled through the hollowed-out tail (Redford & Wetzel 1985).

Chaga´s Disease The causative agent of Chaga´s disease is *Trypanosoma cruzi*, a digenetic kinetoplastid and enzootic parasite of almost 100 mammal species, includign humans. Though typically transmitted to humans via the Reduviid bug *Triatoma infestans*, oral infection with the disease does occur and is oftenm associated with acute forms of the disease. *T.cruzi* has two intraspecific subdivisions, with TCII being most associated with armadillos and associated with less severe human symptoms (Yeo et al 2005). TCII has been isolated from armadillos of this species in Rio Grande do Norte, Brazil (Marcili et al 2009). Barrett & Naiff (1990) described *Trypanosoma peba* from a specimen of this species captured in Bahía, Brazil.

Toxoplasmosis Toxoplasmosis is a widespread zoonosis that affects wild animals and man, caused by the protozoan *Toxoplasma gondii*. Da Silva et al (2006) recorded positive tests for *Toxoplasma* in 2

of 3 specimens of this species tested. Infection of humans via the consumption of undercooked meat is a possibility.

Pulmonary Coccidioidomycosis Endemic to the semi-arid northeast of Brazil, the disease is caused by the inhalation of arthrospores of the fungus *Coccidioides immitis and C.posadasii* (Fisher et al 2002, Cordeiro et al 2006). Cordeiro et al (2006) confirmed the importance of armadillo burrows in the ecology of *Coccidioides* spp. and noted the physiological versatility of the organism. Wanke (1994) associated the arthrospores with burrows of this species.

Moreira (1955) found that when subjected to the cow-pox virus the disease developed normally with an incubation period of five days.

CONSERVATION STATUS: The Six-banded Armadillo is considered Lowest Risk, least concern by the IUCN (Abba & Superina 2010), see http://www.iucnredlist.org/search/details.php/8306/all for the latest assessment of the species. The Centro de Datos de Conservación in Paraguay consider the species to be persecuted by humans in Paraguay and give it the code **N3**. 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.

This is generally one of the most commonly-encountered armadillo species in drier areas of the country and, despite hunting pressure in some places, the population does not appear to be in decline. It occurs in a number of protected areas and its future seems secure.

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FIGURE 2 - (FPMAM924PH) **Six-banded Armadillo** *Euphractus sexcinctus.*
Adult lateral view. Loma Plata, Departamento Presidente Hayes, November 2010. Photo Paul Smith.
FIGURE 3 - **Six-banded Armadillo** *Euphractus sexcinctus.*
Skull. Image courtesy of www.skullsunlimited.com.

FIGURE 4 - (FPMAM47PH)
Six-banded Armadillo *Euphractus sexcinctus.*
Footprints. Laguna Blanca, Departamento San Pedro, November 2005.
Photo Paul Smith.

FIGURE 5 - (FPMAM1003PH) **Six-banded Armadillo** *Euphractus sexcinctus.*
Adult fore foot. near Toro Pampa, Departamento Alto Paraguay, 27 August 2011. Photo Paul Smith.
FIGURE 6 - (FPMAM1004PH) **Six-banded Armadillo** *Euphractus sexcinctus.*
Adult hind foot. near Toro Pampa, Departamento Alto Paraguay, 27 August 2011. Photo Paul Smith.