SOUTHERN THREE-BANDED ARMADILLO

Tolypeutes matacus (Desmarest, 1804)

FIGURE 1 - Adult, Madrejón, Departamento Boquerón (Sjeff Ollers October 2009).

TAXONOMY: Class Mammalia; Subclass Theria; Infraclass Eutheria; Order Cingulata; Family Dasypodidae; Subfamily Tolypeutinae (Myers et al 2006). The genus *Tolypeutes* was defined by Iliger in 1811. There are two known species according to the latest revision (Gardner 2007) only one of which is present in Paraguay. Desmarest´s (1804) description was based on de Azara´s (1801) "Le Tatou Mataco". Larrañaga´s (1923) description was based on de Azara´s (1802) "Mataco". The species is monotypic (Gardner 2007). Synonyms adapted from (Gardner 2007):
Dasypus octodecimcinctus GI Molina 1782:305. Type locality "Nel Cujo" Chile, identified as Provincia Mendoza, Argentina by Tamayo (1968). Name preoccupied by *Dasypus octodecimcinctus* Erxleben (1777) =*Cabassous unicinctus* (Linnaeus 1758).

Lor[*icatus*], *matacus* Desmarest 1804:28. No locality mentioned. Based on de Azara (1801). Sanborn (1930) restricted the type locality to Tucumán, Argentina.
[*Dasypus*] *brachyurus* G.Fischer 1814:130. Type localities "Tecumanis et Circa Buenos-Ayres".
Tolypeutes globules Illiger 1815:108. Nomen nudum.
T[*olypeutis*] *octodecimcinctus* Olfers 1818:221. Name combination.
Dasypus apar Desmarest 1822:367. Type localities "Le Tecuman et les campagnes découverts dans les environs de Buenos-Ayres, à partir du 36º. degré et gagnant vers le sud".
Tatusia apar Lesson 1827:310. Name combination.
Tolypeutes conurus I. Geoffroy St.Hilaire 1847:137. Type localities "Tecuman et des pampas de Buenos-Ayres (Argentina), et de la province de Santa Cruz de la Sierra (Bolivia).
Dasypus [(*Tolypeutes*)] *conurus* Burmeister 1861:436. Name combination.
Dasypus aparoides P.Gervais 1869:132. Nomen nudum.
Tolypeutes muriei Garrod 1878:223. Type locality unknown. Sanborn (1930) restricted the type locality to Bahía Blanca, Buenos Aires, Argentina.
Tolypoides bicinctus Grandidier & Neveu-Lemaire 1905:370. Type locality "l´Amérique du Sud" restricted to "environs de Tarija" Bolivia by Grandidier & Neveu-Lemaire (1908).
Tolypeutes matacus Osgood 1919:33. First use of current name.
D[*asypus*]. *globulosus* Larrañaga 1923:343. Type locality "Australem plagam bonaerensem" Based on de Azara (1802).
Tolypeutes matacos Yepes 1928:478. Incorrect spelling.
Tolypeutes tricinctus matacus Sanborn 1930:66. Name combination.
Tolypeutes tricinctus muriei Sanborn 1930:66. Name combination.
Tolypeutes mataco Nava et al 2007:260. Incorrect spelling.

ENGLISH COMMON NAMES: Southern Three-banded Armadillo (Wilson & Cole 2000, Gardner 2007), Three-banded Armadillo (Neris et al 2002, Parera 2002), La Plata Three-banded Armadillo (Merritt 1976), Southern Domed Armadillo (Gardner 2007), Azara´s Domed Armadillo (Cetica et al 2007).

SPANISH COMMON NAMES: Tatu bolito (Villalba & Yanosky 2000), Quirquincho bola (Redford & Eisenberg 1992, Neris et al 2002), Tatú bola (Parera 2002), Mataco (Parera 2002), Corechi (Cuéllar 2002), Taturapua (Cuéllar 2002), Armadillo de tres bandas (Orozco 2012).

GUARANÍ COMMON NAMES: Tatu bolita (Neris et al 2002), Tatu ai **MPA** (Villalba & Yanosky 2000), Chachu kuyú **Ac** (Villalba & Yanosky 2000), Tatu apepú (Parera 2002), Taturapua (Cuéllar & Noss 2004), Auco Ay (Cuéllar & Noss 2004). "Bolita" and its variations which feature in the Guaraní and Spanish names refer to the species defensive behaviour of curling up into a ball.

DESCRIPTION: Heavily-armoured with the carapace extending almost to the feet, the Southern Three-banded Armadillo is generally sandy-yellow coloured in Paraguay (blackish individuals being found in some other parts of their range). Typically the aspect of the body is hinge-like, with the back steeply rounded and the two halves of the carapace forming an open V-shape at their lower edge. The triangular head plate is remarkably thick and robust and the main carapace consists of two huge plates (scapular and pelvic) separated by 2 to 4 movable bands (generally three). The individual scales are notable for their hexagonal rosette form. The sides of the body are not attached to the carapace, allowing a certain amount of flexibility of movement within the "shell". Long, thick, pale sandy-coloured bristles sprout along the lower edge of the carapace. The ears are large and somewhat flattened with a roughened edge. The iris is brown. The underbelly is quite heavily furred with dark brownish hair. Bare skin on the sides of the face is similarly dark brown, but the tip of the snout and nose are pinkish. The inflexible tail is covered in scutes, short and thick, triangular in form, and blunt-ended, fitting perfectly alongside the head when the animal rolls into its defensive ball. The legs are short and strong, armoured but with a covering of thick brownish hair. The forefeet bear four toes with greatly elongated claws particularly on the middle toes. The hindfeet also bear five toes, the second, third and fourth almost unified, flattened and hoof-like, the first and fifth with "normal" claws.

SKELETAL CHARACTERISTICS: Occipitonasal length 60mm. Relatively long and tubular rostrum. (Diaz & Barquez 2002).

Vizcaino et al (1999) give the following ulnar dimensions (n=4): Ulnar Length 49.4mm (+/-4.9); Olecranon Length 17mm (+/-1.5). 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 0.53 (+/-0.04).

DENTAL CHARACTERISTICS: Armadillos lack true teeth, but possess a series of "molariform" teeth that do not follow the standard mammal dental formula. 9/9 = 36. All molariforms are located in the maxillar, differentiating *Tolypeutes* from *Chaetophractus* and *Euphractus*.

GENETIC CHARACTERISTICS: 2n=38 This species lacks truly acrocentric autosomes and the diploid number is lower than any other armadillo (Nowak 1991).

TRACKS AND SIGNS: Given the dry areas in which this species lives footprints are usually only encountered in areas of loose soil or after rains. The print of the forefeet is distinctive, leaving marks of three triangular forward-facing toes, the middle one approximately twice the length of the outer two. The unusual structure of the hind print leaves a peculiar "compound" print in soft soil which may appear to be made by two feet. For the most part the armadillo walks on the front part of the foot, with the posterior part, complete with its own pads, leaving its impression only in softer soil. **FP:** 3.7 x 2.7cm **HP:** 3.4 x 2.7cm. **PA:** 22cm. (Villalba & Yanosky 2000).

EXTERNAL MEASUREMENTS: A small armadillo with a steeply-rounded, hinge-like carapace. **TL:** (25-30cm); **HB:** 25.7cm (21.5-27.3cm); **TA:** 6.37cm (5.5-8cm); **FT:** 4.23cm (2.5-4.7cm); **EA:** 2.28cm (1.9-4.1cm); **WT:** 1.1kg (0.8-1.5kg). (Parera 2002, Nowak 2001, Ceresoli et al 2003, Redford & Eisenberg 1992, Diaz & Barquez 2002). The following additional measurements were taken from two individuals at PN Tte Enciso, Departamento Boquerón during July 2006 - ***Head Length:*** - 7.4-7.7cm; **TA:** 5.7-6.3cm; **EA:** 2.62cm; ***Carapace Width:*** 11.5-11.6cm; ***Longest Claw on Forefoot:*** 2.65cm (P. Smith unpubl.).

Cuéllar (2002) gives the following measurements for unsexed individuals in Izozog, Bolivia (n=32 unless stated): **HB:** (rolled up) 391mm (303-417mm); **TA:** 63mm (60-80mm); **FT:** 40mm (35-48mm); **EA:** 26mm (20-30mm); **WT:** 1163g (1000-1500g, n=34). Deem et al (2009) found the following mean weights for 6 males and 10 females in Bolivia: **WT:** male 1.88kg (+/-0.12), female 1.97kg (+/-0.23).

SIMILAR SPECIES: The most instantly recognisable of the small armadillos due to its hard, inflexible carapace and presence of just three movable bands. Furthermore, contra the stereotypical image that many people have of armadillos rolling into a ball to protect itself, the genus *Tolypeutes* are the only armadillos that do so, making this behaviour diagnostic of the species in Paraguay.

DISTRIBUTION: Occurs from southeastern Bolivia, through the southwestern and western cerrado belt of Brazil, the Paraguayan Chaco to northern and central Argentina. In Bolivia the records are from southern Departamento Santa Cruz and eastern Departamentos Chuquisaca and Tarija (Anderson 1997). In Argentina it occurs in the Provinces of Formosa, Chaco, northern Santa Fé, Santiago del Estero, eastern Salta and Jujuy, Tucúman, Rioja, Catamarca, Córdoba, San Juán, La Pampa, San Luís, extreme northeastern Mendoza and southern Buenos Aires. References to the species presence in Chile probably stem from GI Molina (1782) when Provincia Mendoza formed part of Chile (Gardner 2007). The species is declining rapidly in the southern parts of its Argentinean range.

In Paraguay it is most abundant in the Dry Chaco departments of Boquerón and Alto Paraguay, less common in Presidente Hayes and there are marginal records from extreme western Departamentos Concepción and San Pedro (Neris et al 2002).

Abba & Vizcaíno (2008) list 2 specimens from Paraguay in the Museo Argentino de Ciencia Naturales "Bernadino Rivadavia without precise locality data (MACN13.782 carapace, 1913; MACN27.147 carapace, 1927).

HABITAT: This species is confined to the Chaco where it is most abundant in xerophytic areas, typically thorny Chaco forest and scrub. In the area around the Mennonite colonies of the Central Chaco it may be

found in agricultural land and around rural dwellings provided patches of scrubby forest are maintained nearby. In the Humid Chaco it occurs in palm savanna and gallery forest (Brooks 1995). It chooses to take refuge in forested areas but often forages in more open habitats. At PN Tte Enciso, Departamento Boquerón, the species frequently forages in the area close to the accommodation despite the presence of artificial lights. Parera (2002) states that it does not occur in areas with greater than 700mm annual rainfall.

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 Cerrado and Pantanal biomes in that country.

ALIMENTATION: Three-banded Armadillos are opportunistic insectivores that feed mainly on the surface of the ground, only occasionally digging shallow holes into ant and termite nests. They do not perform extensive digging projects in order to obtain food stuffs, given that in the dry areas in which they live the soil is often so hard as to have the consistency of concrete and requires considerable force even to break the surface with a spade. Considered to be largely myrmecophagous, feeding on *ants* and *termites*, but other soft-bodied invertebrates are also taken and they regularly scratch at tree trunks in search of arthropods (Redford & Eisenberg 1992, Parera 2002). In the Brazilian cerrado three stomachs were found to contain the non-colonial termite *Syntermes molestus,* spiders and ants of the genus *Camponotus.*

During a study in northeastern Santiago del Estero, Argentina, 66 stomachs were analysed by Bolkovic et al (1995) which showed the diet of wild individuals to consist of 70% invertebrate material, 20% fruits and 10% unidentified material, and that the presence of different items in the diet was seasonal. All invertebrates found lived at ground level or below and invertebrate larvae were the most common item in the diet, especially Coleoptera larvae. Termites were shown to be an important item in the diet from July to November but less prominent at other times of year. The following ant species were recorded Ponerinae; Pseudomyrmicinae (*Pseudomyrmex*); Dorylinae (*Crematogaster, Neivamyrmex*, and *Novamyrmex*); Myrmycinae (*Acromyrmex, Pheidole, Elasmopheidole, Solenopsis*, and *Wasmannia*); Dolechoderinae (*Dorymyrmex*); Formicinae (*Camponotus* and *Brachymyrmex*). Lepidopteran larvae and pupae were most prominent during July and August. Of the fleshy fruits present *Zyzyphus mistol* (Rhamnaceae) was the most prominent, being a fruit that stays on the ground for several weeks after falling. Other fruits reflected seasonal abundance, but fruits of *Castela coccinea* (Simaroubaceae) were avoided and the presence of phenols, alkaloids and triterphenoids probably acts to deter the armadillos which seek their food by smell. A considerable quantity of soil was found to be ingested, making of up to 40% volume by weight in some stomachs and an extraordinary 92% volume by weight in one stomach. Items were found intact in the stomach, suggesting that they do not chew their food and local reports suggested that the animals deliberately ingest soil, possibly to assist with digestion. Intact seeds in the stomach suggest that the species may play an important role in seed dispersal of certain plants. Parera (2002) reports that in the Argentinean Chaco the mostly insectivorous diet is also supplemented with fruit.

Captive individuals took fruit, leaves, boiled rice, bread soaked in milk or tea, ants and their eggs and larvae, and mealworms (Nowak 1991). Additional items fed to captive individuals include boiled egg, grated carrot, honey, lean horsemeat and cod-liver oil (Bolkovic et al 1995). Herrick et al (2002) note that captive individuals at Cinncinnati Zoo were fed dog food, fruit, vegetables and eggs. Merritt (2008) noted that even well-fed captive individuals did not develop significant stores of fat, this possibly being related to the difficulties of a fat individual rolling into a ball to employ its defensive mechanism.

REPRODUCTIVE BIOLOGY: Several males pursue single females in oestrus hoping for the opportunity to mate. Most births happen from October to January, meaning that mating takes place from July to October (Redford & Eisenberg 1992). Neris et al (2002) state that the Paraguayan breeding season is from May to October or November, somewhat earlier than the dates stated by Redford & Eisenberg, but Merritt (1976) concurred with them, quoting November to January as the Paraguayan breeding season. Parera (2002) records breeding in Argentina from September to February. Bernier (2003) states that captive individuals breed year round.

Courting males pursue females from behind until they are walking in unison with his forelegs on the back of the female. (Bernier 2003).

A single young is born after a gestation period of approximately 120 days - though more rarely twins may be born (Adamoli et al 2001, Neris et al 2002). Bernier (2003) states that captive individuals

have a gestation period of 104 to 116 days. Reproductive rate is slow, with an average of 1.5 young per female per annum (Abba et al 2007).

Newborns are miniature versions of adults, with claws fully-developed and hardened. The carapace is flexible and has a leathery texture, but the markings of the individual scutes are apparent from the beginning. From birth newborns are able to walk and roll into a ball. Bernier (2003) states that survival rate of captive newborns is low if the male and female are kept together after birth, but may be as high as 85% if the male is removed before the end of gestation.

Young first open their eyes and ear pinnae at 22 days and are weaned in 10 weeks (72 days). Sexual maturity is reached at 3 to 5 years. Cuéllar (2002) captured juveniles (animals <1kg) in Izozog, Bolivia in June, July and February.

Herrick et al (2002) described a method for electroejaculation of this species, but note that poor sperm recovery and urine contamination was a problem with the procedure. The animals responded to electrostimulation of >2 volts with leg extension and penile erection. Voltages of 3-4 volts caused extension of a bright-red, filiform glans penis (c2 cm in length; c1 mm diameter) from the prepuce of two of three males. Voltages of 5–6 volts) caused the penis to contract and retract in a coiling motion. Sperm concentrations were low (range: 1.3–96.0 x 10^6 sperm/ml) with low numbers of total sperm per ejaculate (overall mean +/- SEM; 2.2 +/- 0.8 x 10^6 sperm/ejaculate). Mean viability was 42.8% (+/-11.9) and motility 24.5% (+/-11.9). Mean pH of ejaculate was 7.8 (+/-0.2) and ejaculate volume 141.1µl (+/-45.3).

GENERAL BEHAVIOUR: Solitary for much of the year, small groups gather only during the breeding season when several males pursue single females in oestrus (Neris et al 2002).

Though sometimes active during the day, animals observed at PN Tte Enciso, Departamento Boquerón during July 2006 were only encountered at night and major activity peaks are likely affected by temperature and rainfall (P. Smith pers. obs., Redford & Eisenberg 1992). Specimens were also found to be active during the first hour of daylight at PN Defensores del Chaco, Departamento Boquerón during September 2006. Neris et al (2002) states that the species becomes more diurnal during the breeding season, whilst Merritt (2008) notes that diurnal activity occurrs on warm winter days, especially involving juveniles. Cuéllar (2000) notes that the species is most active from 6pm to 2am in the Bolivian Chaco, with 83% of 41 captures taking place between 9pm and midnight. In Mato Grosso, Brazil most encounters with the species were between midday and 18.00h.

Home Range Cuéllar estimated a density of 1.9 individuals/km^2 in Izozog, Bolivia, which she considered to be lower than expected. Population densities in Mato Grosso, Brazil were estimated at 0.96/km^2 in cerrado, 0.59/km^2 in secondary forest and 0.42/km^2 in deciduous forest. Wetzel (1982) however estimated a much higher population density of 7/km^2.

Refuges Despite well-developed claws on the forefeet, this species does not dig its own burrows, preferring to re-use burrows made by other armadillos and burrowing mammals. Such refuges may be shared during periods of extreme cold with up to six individuals sharing the same nest, though these congregations are only temporary, lasting for 1 to 4 days (Merritt 2008).

Locomotion This species walks on the soles of the hindfeet and only the tips of the claws of the forefeet are in contact with the ground (Vizcaíno & Milne 2002).

Defensive Behaviour The first reaction of this armadillo when faced with a potential predator is to run, the legs moving rapidly like a clockwork toy and the path chosen irregular and zigzagging to avoid vegetation. The eyesight is poor and frequently the animal will almost collide with static objects, pulling up suddenly before changing direction and accelerating again. Unlike many other armadillos they do not dig to escape danger, though they may seek refuge in a nearby hole, and can usually be captured fairly easily by hand after a short pursuit provided their path does not take them into dense thorny scrub. Merritt (2008) states that this species is more elusive and difficult to capture than *Chateophractus vellerosus*, but this does not concur with this author´s experience and I consider it much the easiest armadillo to capture by hand (P.Smith pers.obs.).

Upon capture the armadillo rolls into a ball, the triangular head plate fitting tightly into the extensive scapular plate posteriorly and anteriorly jig-saw-like with the triangular tail so that the soft underbelly of the animal protected by the continuous covering of armour. Frequently the shell remains slightly open and if an attempt is made to touch the underbelly the shell snaps shut with remarkable force

(Nowak 1991). Villalba & Yanosky (2002) state that the force of closing is capable of damaging a human finger and likely acts as a substantial deterrent against predators - the trapdoor closing mechanism acting to dissuade potential predators that stick their nose into the underbelly. If left unmolested the animal begins to unroll slowly, suddenly bursting into a run (Sanborn 1930). Handled animals typically half unroll the shell and begin to defecate. (P. Smith pers. obs.).

Mortality The carapace of this species is especially rigid and it is common to find hollowed-out, dried carapaces in the Dry Chaco, often with the head still attached (P. Smith pers. obs.). The original cause of mortality is not always clear, but the "cleaning" of the remains is probably due to vultures and Southern Crested-Caracaras. The carapace provides an effective defence against foxes and small cats, and it is possibly even enough to dissuade large felines, though Merritt (2008) noted that some carapaces found in the Paraguayan Chaco showed signs of predation by Puma *Puma concolor* and it is also predated by Jaguar *Panthera onca*. Deem et al (2009) performed physical examinations on 162 individuals of this species in the Gran Chaco of Bolivia finding just 2 with minor wounds.

Taber et al (1997) found remains of this species in 2 of 106 scats of Jaguar and 6 of 95 scats of Puma in the Paraguayan Chaco. Interestingly enough remains of this species have been found in the pellets of Burrowing Owls in Santiago del Estero, Argentina.

Longevity The lifespan of this species is 12 to 15 years. Bernier (2003) notes that several captive individuals have survived for more than 30 years.

Parasites Members of this species often have a heavy parasite load and individuals in PN Tte Enciso, Departamento Boquerón frequently carried ticks (Acari) on their underbelly (P.Smith pers. obs.). Nava et al (2007) list the Ixodid ticks *Amblyomma pseudoconcolor, A.auricularium* and *A.parvum* on this species in Paraguay. Guglielomone & Nava (2006) additionally note *A.pseudoparvum* for Argentina and Deem et al (2009) recorded *A.parvum* and *pseudoconcolor* from the Bolivian Chaco.

Mauri & Navone (1993) mention the flea *Malacopsylla grossiventris* (Siphanoptera) on this species in Argentina.

Navone (1990) recorded the following endoparasites of this species in the Argentinean Chaco - Nematodes: *Aspidodera scoleciformis* (Aspidoderidae), *Pterygodermatites chaetophracti* (Rictularidae), *Orihelia* (=*Dipetalonema) anticlava* (Onchocercidae), *Mazzia bialata* (Cosmocercidae), *Maciela elongata* and *Moennigia virilis* (Molineidae); Cestode *Mathevotaenia matacus* (Anoplocephalidae); Acanthocephala *Travassosia* sp (Oligacanthorrhinchidae). Smales (2007) describes the first record of *Oligacanthorhynchus carinii* (Oligacanthorrhinchidae) from a Paraguayan specimen. Notarnicola & Navone (2003) noted a prevalence of 3.7% parasitism in this species by the nematode *Orihelia anticlava* in Argentina. Martinez et al (1999) note a prevalence of *Mathevotaenia* (Anoplocephalidae) of 30% in ten specimens tested.

Physiology Chemical immobilisation of this species is difficult because of its unique anatomy. Orozco (2012) describes immobilising specimens with two different anaesthetic protocols, Zelazol (tiletamine and zolazepam) and xylazine-ketamine reverted with yohimbin. For Zelazol a dosage of 3,85 to 11,90 mg/kg (mean: 7,26 mg/kg) was used for males, and 4 to 8,78 mg/kg (mean: 6,51 mg/kg) for females. An initial effect was recorded after 3.4 (+/-1.2) minutes, with recovery beginning after 25.2 (+/-7.7) minutes and complete recuperation by 35.1 (+/-6.7) minutes. The results did not show the deep muscle relaxation that has been recorded in other mammals, and the extent of relaxation varied considerably between individuals.

For xylazine-ketamine a dosage of 0,62 to 1,2 mg/kg (mean: 1 mg/kg) of xylazine combined with 20 to 36,88 mg/kg (mean: 30,9 mg/kg) of ketamin was used for males; and 0,8 to 1,25 mg/kg of xylazine (mean: 1 mg/kg) combined with 24 to 37 mg/kg (mean: 32,1 mg/kg) ketamin in females. An initial effect was recorded after 3.4 (+/-1.5) minutes, with recovery beginning after 32.5 (+/-11.5) minutes and complete recuperation by 36.6 (+/-11.8) minutes. Animals immobilised in this way must be closely monitored for signs of hypothermia.

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 was simple and pear-shaped, and the uterine cervix is long as in all armadillos. Unusually for armadillos a true vagina was observed. The authors recognised three morphological groups

amongst the Dasypodids studied, with *Tolypeutes* armadillos forming their own group amongst the studied genera.

Adamoli et al (2001) described the morphology of the placenta, it being pear-shaped, filling three-quarters 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: A captured individual at PN Tte Enciso, Departamento Boquerón made quiet grunting noises similar to a domestic guinea-pig (P.Smith pers. obs.)

HUMAN IMPACT: This armadillo is confiding and easily captured by hand, making it a popular pet for indigenous groups and the "preferred armadillo for the table" in the Chaco (Hugo del Castillo pers. comm.). It is said to have the best flavour amongst the armadillos, but it is uncertain how much of this is due to its palatability and how much is due to wishful thinking with it being the most abundant and easily captured species in the area. The species is usually "cooked in the shell" and hollowed out carapaces are often found around hunters camp fires (Merritt 2008). In Santiago del Estero, Argentina, it was found to constitute 55% of the wild fauna in the diet of local people. In the Argentine Chaco it made up 18.4% of the diet of local people and was consumed a mean of 16.5 days per year (+/-1.07) (Altrichter 2006). In Bolivia it is the second most hunted armadillo species by the Izoceño indigenous group, contributing 2% of their total diet.

Alves & Rosa (2007a) mention that the tail of the species is used to treat earache in the northeast Brazilian states of Pará and Piauí. In the city of São Luis, Maranhão State, northern Brazil, street traders stated that the fat is consumed as a tea for diahorrea, headaches and asthma, or rubbed onto inflamed areas as an ointment Alves & Rosa (2007b).

Easily maintained in captivity, it is highly desired as a demonstration animal in zoos for education programmes (Merritt 2008). *Tolypeutes* are the only armadillos that roll into a ball to protect themselves, but this atypical behaviour has become associated with a "stereotypical armadillo" in the minds of many people across the globe.

CONSERVATION STATUS: The Southern Three-banded Armadillo is considered Low Risk, near threatened by the IUCN (Abba & Superina 2010), see http://www.iucnredlist.org/search/details.php/21974/all for their latest assessment of the species. Increased population pressure within its range means that an upgrade to vulnerable may be necessary in the near future. 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), but Smith (in press) recommends that the species be considered vulnerable at the national level under IUCN criteria A3ad.

The species is present and was previously common in several protected areas in the Chaco, but there is no published data on national population levels. In Brazil the species is in widespread decline and populations are estimated to have decreased by 30% over the last decade. Naturalists working in the Chaco have however reported a sudden steep downturn in the population of this species over the last few years that may be associated with recently legalised animal trade (T.Vinke in. litt.). The dangers posed by the lack of recent published data for Paraguayan Xenarthrans is unintentionally illustrated by Abba & Superina (2010) who cite Redford & Eisenberg (1992) that the species is "abundant in most xeric parts of the Paraguayan Chaco". Whilst this may have been the case until relatively recently, it is no longer an abundant species in Paraguay and may in fact appears to be steep and rapid decline.

The major threats to this species appear to be hunting for food, capture as a pet and burning. The species has poor eyesight and a somewhat haphazard way of escaping danger and burning of forest or grassland undoubtedly claims many victims. Exportation of the species occurs across its range and there is a high mortality rate during this process with upwards of 80% of the specimens sent to Europe dying en route.

Incresingly the Dry Chaco of Paraguay is becoming target for cattle ranchers as a result of the low price of land in the area and deforestation rates have increased alarmingly in the last few years. Persistent rumours of undiscovered oil and gas reserves in the Chaco may also make the area vulnerable to prospecting in future. The species is able to tolerate moderate conversion to agriculture but too much

habitat perturbation is likely to have a negative effect on populations, furthermore the slow reproductive rate of this species hinders the ability of populations to recover quickly.

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 value of 45,000Gs (7.41 euros) has been established as payment to landowners for each individual of this species captured on their land.

On 10 February 2011 ABC newspaper reported that permission had been granted by the SEAM to animal trader Patricia Karina Varela for the export of 151 wild individuals of this species, with an estimated market value of US$52,850. The animals had been captured by Ayoreo indigenous groups in Departamentos Alto Paraguay and Boquerón who had been paid between $2 and $6 per animal. A lack of control once permits are granted has resulted in substandard transportation measures and alleged abuses of the system (Vinke & Vinke 2012), though judicial cases brought against permit holders have been unsuccessful. A self-sustaining captive population is present in the USA, notably at the Lincoln Park Zoo in Chicago (Abba et al 2007), but captive individuals often suffer from pathologies and stereotyped behaviours (Parera 2002).

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FIGURE 2 - (FPMAM95PH) **Southern Three-banded Armadillo** *Tolypeutes matacus.*
Adult head detail. PN Tte Enciso, Departamento Boquerón, October 2007.
Photo Marcelo Bombaci.
FIGURE 3 - (FPMAM917PH) **Southern Three-banded Armadillo** *Tolypeutes matacus.*
Defensive posture. Tunokojai Indigenous Reserve, Departamento Boquerón, November 2010.
Photo Paul Smith.

FIGURE 4 - (FPMAM330PH)
Southern Three-banded Armadillo *Tolypeutes matacus.* Melanistic individual. Departamento Presidente Hayes. www.pybio.org, undated.
Photo Ulf Drechsel.

FIGURE 5 - (FPMAM98PH) **Southern Three-banded Armadillo** *Tolypeutes matacus.* Cephalic shield. PN Tte Enciso, Departamento Boquerón, October 2008. Photo Paul Smith.
FIGURE 6 - (FPMAM99PH) **Southern Three-banded Armadillo** *Tolypeutes matacus.* Tail detail. PN Tte Enciso, Departamento Boquerón, October 2008. Photo Paul Smith.

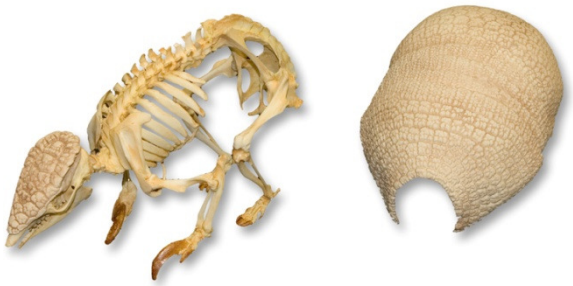

FIGURE 7 - **Southern Three-banded Armadillo** *Tolypeutes matacus.* Skeleton. Courtesy of www.skullsunlimited.com.