EDENTATA

After a long period of inactivity, SSC Commission Chairman Dr. George B. Rabb asked Dr. Kent H. Redford and myself to reorganize the Edentate Specialist Group, having as its main task the assessment of the conservation status of edentate species and their habitats. On the long term, we are looking for the development of an Action Plan containing the conservation priorities and the main tools to implement the plan.

The first difficulty we ran into in order to achieve the above mentioned goals was the rather small composition of the original group and the fragmented knowledge we detain on current projects being developed focusing on edentates. Therefore, we drew on the successful concept of the Neotropical Primates Newsletter, published by the Neotropical section of the SSC Primate Specialist Group, under the leadership of Drs. Anthony Rylands, Ernesto Rodriguez Luna and Russell Mittermeier, and decided to initiate our own Newsletter, Edentata. The newsletter is a joint initiative of IUCN/SSC Edentate Specialist Group, Conservation International and Fundação Biodiversitas.

Edentata will begin with two issues per year and serve as a forum for scientists and conservationists working with all aspects related to the ecology and conservation of edentates, as well as their native habitats. We also hope that Edentata will serve as a networking vehicle for the activities of the Edentate Specialist Group, leading to the development of the first Action Plan.

Given that the Edentate Specialist Group has lacked coordination for such a long period of time, we are also welcoming nominations of new potential members who are likely to contribute to the activities of the group.

We invite everyone working with these fascinating animals, several of which are now threatened or endangered, to submit information, ideas, news and articles to our future issues and welcome suggestions on how to make our common work a dynamic one. Contributions to Edentata will be accepted in English, Portuguese or Spanish.

We count on all of you!

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The Edentates of the Cerrado

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Introduction

The edentates (=xenarthrans) are an important part of the mammalian fauna of the cerrado. Three of the four edentate families are represented: anteaters (Myrmecophagidae), three-toed sloths (Bradypodidae), and armadillos (Dasyopodidae) with a total of 12 species. The cerrado has been poorly explored biologically and in the future more edentate species may be added to this list. Part of the difficulty in compiling a list of edentates of the cerrado is the inexactness of the cerrado (sensu lato) boundaries. Inclusion of the species listed below is based on my personal experience, Wetzel (1982) and Redford and Fonseca (unpubl.).

Myrmecophagidae

Myrmecophaga tridactyla: giant anteater, tamaodua-bandeira.

This anteater is unmistakable because of its large size, long flag-like tail, and its distinctive coloration. The dorsum and tail are dark brown or black, the forelegs are mostly white with black bands at the wrist and above the claws, a thin white band passes from just below the ears back and up to well above the shoulders, descending to where the forelegs meet the body. This white line encloses a broad band of black. The tail which can be nearly as long as the body is uniformly brown with very coarse hair. Giant anteaters have very poor eyesight and fairly poor hearing. Their sense of smell is very acute and the world of a giant anteater is a world of smells. Smell is used to locate the anteaters diet of ants and termites. The nature of the social insect fauna available to a foraging anteater dictates to what extent it feeds on ants versus termites. The most frequent consumed genus of ants is Camponotus; termit genera commonly consumed include Coptitermes, Syntermes and Velocitermes. Insects are obtained either by rooting with the nose or digging into nests or mounds with the large front claws. Feeding only takes place for a very short time at each location, apparently limited by the response of the prey. Interestingly, captive giant anteaters avidly consume nesting mice indicating that this might be a prey type consumed in the wild. Dead, adult rats are not eaten by captive animals because they are too large to fit into the mouth. Giant anteaters can be active throughout the day and night, depending on the temperature. Low temperatures and rain are associated with diurnal feeding. In central Brazil anteaters seem to be dependent on gallery forests, entering them either to drink or sleep. Anteaters sleep in the forest or out in the grassland. In both case a rough declivity is scraped out and the animal lies down, covering itself completely with its tail. Myrmecophaga is found in many different habitat types, from tropical forest to grasslands but probably reaches its greatest densities in cerrado and grassland vegetation; population density probably varies with social insect abundance. In Parque Nacional Serra da Canastra Shaw et al. calculated a Myrmecophaga density of between 1.3 and two per square kilometer. Adults are solitary and except during breeding season ignore each other. Young have been seen throughout the year. A single young is born after a gestation period of 190 days and is carried on its mother’s back for about the first six to nine months though it can be left in a “nest” while the female feed (T. Carter and J. Shaw, pers. comm.). After an undetermined period of time it will begin to take solid food, feeding alongside its mother. Adult giant anteaters probably have no serious predators. The major source of mortality seems to be fire, as the long coarse hair is highly inflammable. As many as six giant anteaters have been found burned to death after a hot grassland fire. Anteaters are also killed by people, though usually not eaten.

References: Montgomery and Lubin, 1977; Redford, 1983, 1985a, 1987a; Shaw et al., in press.
**Tamandua tetradactyla**: southern tamandua, tamandua-mirim, mixila, meleta.

The tamandua anteater is easily separated from the giant anteater by size, coloration and shape of the tail. Most tamanduas in the cerrado region are golden brown with a black vest covering the dorsum and venter, crossing the shoulders in a black band; however on some individuals the vest may be greatly reduced or even absent. These anteaters are scansorial, and have a very well developed prehensile tail which is only sparsely haired. Though apparently preferring areas with trees, it is possible to find tamanduas foraging in open grassland. They sleep in hollows in trees or abandoned holes such as those made by armadillos. This medium sized anteater feeds on both ants and termites depending on the available prey. Montgomery and Lubin (1977) have shown that there is extensive individual variation in prey choice. The young, feeding with its mother learns her food preference; a fact that may account for the observed individual variation. Tamanduas give birth to a single young which the female leaves in a nest while foraging. When old enough, the young accompanies its mother. Tamanduas have been reported as prey for ocelots and jaguars and as young are probably vulnerable to foxes and other felines. With their ability to escape down armadillo burrows, tamanduas are probably much less susceptible than giant anteaters to fire. They are killed and eaten by humans but are disliked by some because of their strong smell.


**Cyclopes didactylus**: silky anteater, tamanduau.

This is the smallest of the anteaters, weighing only about 250 grams. Its range is centered in the lowland forests of Amazonia and Central America. However, it is probable that *Cyclopes* ranges into the cerrado region, occurring in the forests of the northwest and along gallery forests in the north. This is a small, nocturnal, seldom-collected animal. It has been studied only in Panama where it is strictly arboreal and consumes only ants. A single young is born which stays with its mother until it is half her weight. The young is left in a tree while the female forages.

References: Montgomery, 1983.

**Bradypodidae**

*Bradypus variegatus*: brown-throated two-toed sloth; preguiça-marmota.

The brown-throated two-toed sloth is found throughout Brazil and into northern Argentina wherever suitable forest is to be found. It has been rarely collected in the cerrado region and has never been studied there. As a result the habitat requirements of this species are not understood. Because gallery in the cerrado have been poorly collected the biology of all forest-dwelling mammals is virtually unknown. *B. variegatus* has been studied in Panama where animals were found to occupy home ranges averaging 1.6 ha. They are active both day and night are strictly folivorous and favor some species of trees over others. One of the criteria used in choosing trees is a crown that receives abundant sun; sloths behaviorally thermoregulate while resting by moving in and out of the sun. In their study Montgomery and Sunquist (1978) demonstrated that sloths had different preferred trees and that the species involved changed from individual to individual. Young sloths showed the same tree-species preference as their mothers. A single young is born at a time and is nutritionally dependent on the female for about four weeks. It remains with its mother for about six months after which it occupies a portion of the natal home range.


**Dasypodidae**

*Euphractus sexcinctus*: yellow armadillo, tatupeba, tatu-peludo.

*Euphractus* is the only one of the euphractine or hairy armadillos found in the cerrado region. Hairy armadillos as a group are characterized by stocky builds, broad heads, stout teeth and prominent coarse hair. *E. sexcinctus*, the largest of the hairy armadillos, has long, coarse, white hair sparsely scattered over its dorsum. It is the only armadillo occurring in the cerrado with the characteristics listed above; and is also the only armadillo that may try to bite when handled. *Euphractus* will also often try to escape by running rather than digging. *Euphractus* is largely diurnal though occasionally active at night. It is a good digger and builds burrows with a single entrance that are frequently reused. The female builds a nest and gives birth to one to three young after a gestation of 60-65 days. The young open their eyes after 22-25 days, take solid food at about one month, and reach sexual maturity about nine months. Adult animals possess
three or four holes in the pelvic region of the shell from which it is possible to express a viscous yellow fluid. E. Storrs (pers. comm.) reports captive animals to mark the corners of their cages with this secretion and undoubtedly used in the wild to mark burrows. Yellow armadillos are omnivorous, consuming a broad range of animal and plant food. They have been reported to eat carrion, small vertebrates, insects, particularly ants, bromeliad fruit, tubers and palm nuts. In captivity they will kill and eat large rats. They are inefficient predators, lacking a killing bite, and tear apart the prey by standing on it and ripping off pieces held with the jaws. *Euphractus* are active, alert animals and give one the impression of a small carnivore as they trot along, searching the ground with their noses, frequently stopping to dig shallow foraging holes. In common with other euphractines *Euphractus* can deposit large amounts of subcutaneous fat; captive animals have been weighed at over eight kilos. *Euphractus* appear to prefer higher, dried habitats and I have rarely seen them in marsh habitat. They are hunted for meat, particularly in northeastern Brazil, though some people dislike the meat for its strong flavor.


*Priodontes maximus*: giant armadillo, tatucastra.

The giant armadillo is the most impressive member of the cerrado armadillo fauna. The only armadillos with which *Priodontes* could possibly be confused are those of the genus *Cabassous*. However, unlike these species, *Priodontes* is much larger, has a darker colored shell sharply marked laterally by a buffy border, and has a well armored tail. Like *Cabassous* it possesses a rounded blunt muzzle, a carapace with many narrow bands and large scimitar-shaped foreclaws, the third of which is greatly enlarged. Giant armadillo range over much of South America and are found throughout the cerrado region. They are extremely powerful diggers and highly fossorial. Individuals dig both foraging and sleeping holes which are unmistakable because of their size and usually remain in a burrow for more than 24 hours. Burrows tend to be clumped, are usually found in active or dead termite mounds and rarely occur in gallery forest. *Priodontes* is probably the most myrmecophagous of the armadillos: it has been recorded as eating virtually nothing other than ants and termites. Unlike other armadillos *Priodontes* often destroys a termite mound when feeding. It is largely nocturnal, which combined with its fossorial habits make it difficult to encounter. It is killed for food and for its claws.


*Cabassous tatouay*: greater naked-tailed armadillo, tatu rabo-mole.

Armadillos of the genus *Cabassous* resemble *Priodontes* in having short, blunt muzzles, a carapace with bands and enlarged claws on the forefeet; however, they are much smaller and have pink colored skin. The diagnostic character for this genus is the naked tail: there are either no, or virtually no, scales present. *C. tatouay* is the larger of the two species of *Cabassous* found in the cerrado, weighing up to twice as much as *C. unincinctus*. It is further separable from *C. unincinctus* by the size of its ear: *C. tatouay* has a much larger, funnel-shaped ear that extends well above the top of the head. This species is distributed over the southeastern portion of the cerrado. Very little is known about *C. tatouay* except that it is highly fossorial, digs burrows with single entrances and almost never returns to a burrow. Its diet probably consists of ants and termites like the other species of *Cabassous*.


*Cabassous unincinctus*: southern naked-tailed armadillo, tatu rabo-mole.

This species is easily distinguishable from *C. tatouay* because of its smaller size and much smaller ear. As in *C. tatouay* it has a naked tail, though more scales are present on the tail of this species. It has a blunt muzzle, can fold its ear back when digging and has large front claws. Like its congener, *C. unincinctus* is a very strong digger and can disappear in soft ground in 45 seconds. It digs round holes with a single entrance and rarely returns to its burrow. Little is known of the biology of this species except that it appears to eat only ants and termites. It occurs over virtually the entire cerrado region, is frequently seen during the day and appears to prefer open, dry, grassy areas.


Dasypus novemcinctus: common long-nosed
armadillo, tatu-verdadeiro, tatu-folha, tatu-galinha, tatu-veado.

The genus *Dasypus* is distinguishable from other armadillo genera by having a long, slender skull, a smooth, mostly dark carapace, a long, slender, stoutly armored tail, and long slender ears. Two species of *Dasypus* occur in the cerrado and are easily distinguishable on the basis of size: *D. novemcinctus* is one and a half times as long and twice as heavy as *D. septemcinctus*. *D. novemcinctus* also has more movable bands (mean=8.3; range=8-9) compared to *D. septemcinctus* (mean=6.3; range=6-7). *D. novemcinctus* has a larger range than any other xenarthran species, being found from the southeastern United States to Argentina and throughout the cerrado. It occurs in many different habitats in this range but in the cerrado appears to favor moister areas. It is frequently found near gallery forests, nesting along the water course and foraging in the surrounding open habitats. In areas with high water tables it will construct its nest above ground. The nest consists of leaves and grass and frequently a burrow containing an animal is plugged with this foliage. Species in the genus *Dasypus* exhibit a form of reproduction unique among mammals: monozygotic polyembryony where a single fertilized egg divides to form genetically identical young. *D. novemcinctus* produces quadruplets and in the U.S. is a seasonal breeder. Young are weaned about three months of age and attain full growth between three and four years. Adults are largely solitary though littermates may forage together for a while and there are reports of unrelated adults sharing dens. This species forages primarily at night though cold weather or rain may cause it to emerge during the day. In the southern United States *D. novemcinctus* is larger insectivorous although it consumes fruit, carrion and small vertebrates. It will feed on virtually any food item it can find and ingest. With its small mouth, weak dentition and thin mandibles this species is an ineffective predator of larger mobile prey. In the cerrado, preliminary analysis indicates that ants and termites form a large part of the diet of *D. novemcinctus*. Eyesight is very poor in these armadillos and food is located by smell. Most food items are probably taken from the ground surface or just beneath it. The strong claws are used to dig short feeding holes common in the spread of cattle ranching may have increased the numbers of this armadillo species by increasing the availability of prey: insects attracted to cattle dung and open grassy pastures. Common long-nosed armadillos are heavily hunted in much of Central and South America for their delicate white meat. Unlike most of the other edentate species, *D. novemcinctus*, with its tolerance of human and comparatively large litter size, can probably coexist with humans in rural areas.

References: Galbreath, 1982; Redford, 1987a; Wetzel and Mondolfi, 1979.

*Dasypus septemcinctus*: Brazilian lesser long-nosed armadillo, muleta, tatu-mula.

This species of *Dasypus* is much smaller than *D. novemcinctus* and has a proportionally shorter tail. It shares with *D. novemcinctus* the smooth carapace, elongate snout, long thin tail and long slender ears. It is a small dark *Dasypus* found throughout the cerrado region in open habitats; with the exception of a small portion of the northwestern region. Nothing is known of its natural history and it has probably frequently been confused with *D. novemcinctus*. T. Carter (pers. comm.) reports that *D. septemcinctus* prefers gallery forest and frequently expands burrows dug by other species of armadillos.


*Tolypeutes matacus*: southern three-banded armadillo, tatu-bola.

The southern three-banded armadillo is primarily a species of southern South America and is found only in the southwest and western portions of the cerrado. It does not overlap its congenor *T. tricinctus*, which has a primarily caatinga and southeastern cerrado distribution. The genus *Tolypeutes* is easily distinguishable from all other armadillo genera because of its hard turtle-like shell and its ability to roll into a ball; this is the only armadillo genus capable of doing so. *T. matacus* is distinguishable from *T. tricinctus* by its distribution and the fact that *T. matacus* has three or four toes on the forefeet while *T. tricinctus* has five. Despite the greatly enlarged third claw of *T. matacus* it is not a strong digger and apparently does not dig its own burrows. In fact, unlike most other armadillos except *Euphractus*, it often will run when chased rather than dig. Unlike all other armadillos, *Tolypeutes* will roll into a tight, virtually impenetrable ball when attacked. *T. matacus* seems to feed primarily from the ground surface, occasionally digging shallow foraging holes. It is largely myrmecophagous but will take other softbodied invertebrates. *T. matacus* can be active throughout the day and night though its
major activity peaks are probably dictated by temperature and rainfall. *T. matacus* gives birth to a single young after a gestation of 120 days. The young opens its eyes after about 22 days and suckles for approximately ten weeks. The southern three-banded armadillo, like its congener, is hunted by humans throughout its range. Its habit of rolling up when threatened makes it easy prey for the ever increasing number of humans inhabiting its domain.

References: Meritt, 1971; Redford, 1985b; Schaller, 1983; Wetzel, 1985a.

*Tolepeutes tricinctus*: Brazilian three-banded armadillo, tatu-bola.

This rare armadillo is known from only a few specimens in collections. As with *T. matacus* it is easily distinguishable from all other armadillos because of its ability to roll into a ball. Unlike *T. matacus*, which has three or four toes on its forefeet, *T. tricinctus* has five. It is primarily an inhabitant of the caatinga region of Brazil. This area has had a long history of human occupation and *T. tricinctus* is apparently very rare or extinct over much of its range, undoubtedly because of human hunting and habitat destruction.

References: Wetzel, 1985a.

Discussion

Edentates are ancient members of the South American fauna. They arose and radiated there, only one species having strayed into North America. The center of contemporary edentate diversity is Paraguay, a fact caused by the high proportion of armadillos species within the order. For armadillos, drier, open vegetation formations were probably ancestral habitat and invasion of wet tropical forests has probably been a recent phenomenon. *Euphractus* is the only one of the euphractine armadillos to make it up onto the Brazilian Shield, but it also ranges north into the savannas of Surinam, where it is undoubtedly a relict of drier Pleistocene periods. *Priodontes* has a huge range and is not confined to the cerrado region. Both species of *Cabassous* are likewise not limited to the cerrado: *C. uncinatus* ranges well into the Amazon basin while *C. tatuay*, a grassland species, is distributed along the eastern portion of mid-South America. *D. novemcinctus* is found from the United States to Argentina while *D. septemcinctus*, another species of the open vegetation formations is found from the caatinga to the chaco. Finally, the two species of *Tolepeutes* are distributed from southern Argentina to the caatinga. Thus, there are no armadillos species autochthonous to the cerrado.

The only sloth that may occur in the cerrado is *Bradypus variegatus*, a species that ranges from northern Argentina into the forests of Central America. If this species does occur in the cerrado, it will probably be in low densities within some of the gallery forests, or perhaps in the forests fringing the north. It will be confined to forests containing a high proportion of non-deciduous tree species.

*Cyclopes*, the silky anteater, if it occurs in the cerrado, would also be limited to the gallery forests. As a vegetation type within the cerrado biome, gallery forests are very poorly collected. The frequent occurrence of thorny palms, dense tangles of bamboos and flooded soils have discouraged exploration of this unique habitat. When such exploration does take place, many species of mammals will undoubtedly be added to the cerrado fauna. But for many of these species, the gallery forest is simply an extension of the Amazonian forest that has allowed huge range extensions into the otherwise inhospitable cerrado.

The other two anteaters, *Myrmecophaga* and *Tamandua*, are similar to some of the species of armadillos in ranging over many vegetation types. Both can be found in open grassland and dense tropical forest. However, both probably reach their highest population densities in vegetation formations like the cerrado which support large and diverse populations of social insects. As with the armadillos and the sloths, the cerrado does not have its own anteater species.

Only recently has work begun on the armadillos and anteaters of the cerrado. Much work remains to be done on these fascinating animals which occupy such a prominent place in central Brazil. When biomass estimates are available, the edentates will undoubtedly be shown to be very important members of the cerrado mammalian fauna.

I am also including a table of morphometric data on edentates of Central Brazil, which contains some unpublished information (Table 1).

Suggestions

As is clear from this paper, there is still a great deal of work to be done on the edentates of the cerrado. The ranges of species like *Tolepeutes matacus* and
Cabassous tatouay are poorly known. Bradypus is totally unstudied, and almost totally uncollected in the cerrado. Work on edentate food habits, reproductive biology, habitat preference, and ranging behavior is needed. Even for species like D. novemcinctus that have been studied in the United States, comparative studies from the cerrado would be of great interest. Tamandua has only been studied in Panama and Venezuela, and there are many questions remaining to be answered. Myrmecophaga has begun to receive some attention from Jim Shaw and collaborators and myself, but these studies have raised more questions than they have answered.

Tracy Carter and associates have done some very interesting studies of some of the cerrado armadillos, but concentrated primarily on mound construction and use. In summary, all aspects of the natural history of all the edentate species need further study and the cerrado, with its open vegetation and ease of observation would be an ideal place to perform such research.

Acknowledgments

I would like to thank R. Wetzel and T. Carter for help in compiling the mensural data and T. Carter, J. Eisenberg, J. Shaw and R. Wetzel for providing comments on the manuscript.

References


Table 1. Morphometric data of edentates of Central Brazil (HB = head and body, T = tail, HF = hind foot, E = ear, W = weight in kg, n = number of animals measured).

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A) Redford, unpublished data, Goiás and Distrito Federal;
B) Wetzel, 1985b;
C) Wetzel & Mondolfi, 1979;
D) Schaller, 1983;
E) Carter, pers. comm., unpublished data;
F) Santos, 1993.
The rediscovery of the Brazilian three banded armadillo and notes on its conservation status

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Abstract

A recent survey in the northern part of Bahia state, Brazil, has revealed the presence of Brazilian three banded armadillos Tolypeutes tricinctus, a species that had not been seen alive by the scientific community for at least 20 years. The factors that led to the decline of the species continue to operate, and three-banded armadillos face an uncertain future. Intensive surveys in the presumed area of distribution of the species are urgently needed so that a management plan for this endemic Brazilian edentate can be developed.

Introduction

The Brazilian three-banded armadillo Tolypeutes tricinctus is the rarest of the edentates, not having been seen by scientists for at least 20 years. The only other species in the genus is T. mactacus, which occurs from Bolivia and the Mato Grosso region of Brazil to southern Argentina (Wetzel, 1981). T. tricinctus is confined to north-eastern Brazil, inhabiting the semi-arid caatingas (communities of drought-adapted plants). It is the only endemic Brazilian armadillo and one of two edentates restricted to Brazil (the other being the maned sloth Bradypus torquatus). T. mactacus is still relatively common, although heavily hunted in some parts of its range (Wetzel, 1981). T. tricinctus, on the other hand, has not been seen, collected or reported for at least 20 years. Carvalho (1969) observed wild individuals and also burned shells in the São Francisco river region of Bahia state. Before this the most recent observations were from Coimbra-Filho and Moojen in 1958 (Coimbra-Filho, 1972), in the Alto Jaguaribe region (state of Ceará) and Barreiras (state of Bahia). As far back as 1964-68 a questionnaire used in the state of Bahia revealed that T. tricinctus was already extremely rare because of overhunting (Paiva, 1972).

Only six specimens with complete collecting information are known from the world’s museums and recent studies throughout its distribution range failed to locate wild populations (Mares et al., Wetzel, 1981; A. Langguth, pers. comm.). To our knowledge, only one individual has been recorded in zoological collections (Olney, 1980). T. tricinctus is categorized by the IUCN "indeterminate" (Thornback and Jenkins, 1982). The Brazilian Institute of Environment and Renewable Resources (IBAMA) lists the Brazilian three-banded armadillo as "endangered".

This paper reports on the finding in 1988 that T. tricinctus still lives in the wild in Canudos county, in the northernmost part of the state of Bahia, close to the border of the state of Pernambuco (approximately 10°S 39°W) (see Figure 1).

Description of locality

The range of Tolypeutes tricinctus is confined to the semi-arid vegetation formations, known collectively as caatinga, which extend inland
poorest diggers of the armadillos and roll up when disturbed, making them very vulnerable to hunters. Although T. matacus is frequently seen and hunted in parts of its range (Wetzel, 1981), it was described as being the second most abundant armadillo species in southwestern Mato Grosso, Brazil (Schaller, 1983).

The first indications of the presence of T. tricinctus in the area were given by R. B. Machado and A. Brandt, directors of the Lear’s Macaw Conservation Programme under the auspices of WWF-US and Fundação Biodiversitas. During a survey in late 1988 they discovered two burned shells of the species at houses in the towns of Canudos and Rosário. According to information from local people, these two specimens had been sold at the popular market that serves the whole country and takes place every Sunday in the town of Canudos. Machado and Brandt took the shells to the Federal University of Minas Gerais (Belo Horizonte, Brazil), and an expedition was then sent out to locate live individuals.

Although no individuals were seen in the wild, the authors bought five live adults (three males and two females), and took them to the federal University of Minas Gerais. The three males, which had multiple injuries, died upon arrival, and one of the females gave birth. As is observed with T. matacus (Meritt, 1971), newborn T. tricinctus resemble the adults in general morphology, possessing hardened claws, but with the eyes and car pinnate closed. Attempts are under way to keep the two surviving females in captivity. They are apparently healthy, and at the time of writing have been in captivity for 20 weeks, being fed on a diet of fruit, mealworms, boiled eggs and a special jelly developed for captive armadillos. The individuals purchased at the market were reported to be caught, two days before, in the vicinity of Canudos. According to information from local people, T. tricinctus is relatively common in the market, although the least abundant of the armadillo species sold locally. In addition to the five Tolyptes, we found at the same market, in one single day, 11 common armadillos Dasypus novemcinctus (sold at US$ 3.00 each), eight six-banded armadillos Euphractus sexcinctus (sold at US$ 3.50 each), and one naked-tailed armadillo Cabassous tatouay (sold for US$ 3.00). Euphractus

Figure 1. Map showing the area of Caatinga region in Northeastern Brazil and the location of Canudos in the Bahia state.

diagonally from the north-east corner of Brazil for 800,000 sq km (Figure 1). The vegetation communities of the region we visited can be broadly divided into “arboreal caatinga” and “scrub caatinga” (Hueck, 1972). The locality surveyed in this study dominated by scrub caatinga, characterized by low-growing xerophytic woody plants, cacti and terrestrial bromeliads. Average annual precipitation is usually below 500 mm, and the rainfall can be unpredictable (Hueck, 1972; Sick et al., 1987). The area where T. tricinctus was observed has been termed “Raso da Catarina Ecosystem”(Sick et al., 1987) and one of the most remote and unpopulated sections of north-eastern Brazil. The Raso is characterized by flat terrain cut by canyons carved by seasonal rivers. The central human settlement of this region is the town of Canudos (county of Canudos). The whole county has approximately 13,794 inhabitants, 4,762 of which live in towns.

Observations on Tolyptes tricinctus

T. tricinctus can be distinguished from T. matacus in that the former species has five clawed digits on the forefoot, while the latter has only four (Nowak and Paradiso, 1983). These two species are the
is the species preferred by consumers of the region, followed by Dasyopus. The cheapest species is Tolypeutes (sold for US$ 0.80 each), and apparently the pies are set proportionally to the weight of each species and individual. Individuals of all ages are sold, but immature. T. tricinctus fetch very low prices. Local people say that three-banded armadillos do not thrive in captivity, and therefore cannot be fattened for later consumption. *Euphractus*, *Cabassous* and *Dasyopus*, on the other hand, are said to be suitable for fattening and thrive on a very broad diet. Therefore, even young individuals are sold for a fairly good price.

According to personal observations and information by local people, peccaries, *Tayassu pecari* and *T. tajacu*, brocket deer *Mazama gouazoubira*, lesser anteaters *Tamandua tetradactyla*, mocos or rock cavies *Kerodon rupestris* and cavies *Cavia aperea* are also frequently sold at the Canudos market.

*Tolypeutes* is considered by hunters to be the species that is most easily caught, and this may account for its current rarity. R. Machado has visited three previous markets at Canudos and had reported that the three other armadillo species were present, but that *Tolypeutes* was absent. This may reflect overhunting.

**Conservation status and prospects for action**

The survey described in the present study is preliminary and a larger project on the conservation and biology of *T. tricinctus* is being developed. The ease with which *T. matacus* is observed in areas where it is not hunted, associated with the fact the previous attempts failed to locate *T. tricinctus* in the caatinga region, indicate that the species is under severe hunting pressure. Anecdotal information obtained locally seems to suggest that the species was much more common in the past, sharply declining during the past 10 years. Local people gave the impression that three-banded armadillos were once so abundant that armadillo hunting dogs were trained not to pursue them. Nonetheless, the area is important in that it is the only site where *T. tricinctus* has been described alive during the past 20 years. The low human population density may account for the persistence of the species, but the threat is certainly increasing.

The standard of living of Brazilian northeastern populations is among the lowest in Brazil. Long and unpredictable droughts make agriculture and the keeping of livestock highly risky. Agriculture is mostly limited to the production of sisl. It is probable that a large fraction of the human population relies on bush meat for its protein requirements. Game in the area under study has been progressively declining, and it is reported that an area of a few kilometers radius around the town of Canudos is now almost free of game species. Because living conditions are below the poverty level, and domestic sources of protein are anyway not easily available, the demand for bush meat is not likely to decrease. Education campaigns designed to curb hunting are therefore unlikely to succeed in the short term.

The only protected area in the Canudos region is the Raso da Catarina Ecological Station (997 sq km), established in January 1984, which now belongs to the IBAMA. The reserve protects a fairly large portion of pristine caatinga habitat. A major problem with the reserve is its loosely defined boundaries, and the fact that local people generally ignore its reserve status. *T. tricinctus* has been reported in the Raso da Catarina Ecological Station, but the "reserve" status does not guarantee protection; hunters have been seen frequently within its boundaries. Since the area has only two permanent guards, law enforcement is highly unlikely to improve in the short term.

Within the distribution range of *T. tricinctus*, there are other established protected areas that belong to IBAMA, such as, Aiuba Ecological Station, National Park of Ubaíjara, and National Forest of Araripe-Apodi (state of Ceará), National Park of Serra da Capivara and Sete Cidades, and Urucu-Uba Ecological Station (state of Piauí), National Park of Chapada Diamantina (state of Bahia), Itabaianas Ecological Station (state of Sergipe), Serra Negra Ecological Station (state of Pernambuco), Ecological Station of Serrinha (state of Rio Grande do Norte). The total area currently under protection in the presumed original geographical range of the Brazilian three-banded armadillo is approximately 558,433 ha. None of these protected areas has been surveyed for the species.

Given these conditions, and anticipating that in the short term the Brazilian federal and state wildlife agencies will still continue to be financially and politically weak, we see only a limited number of options that could succeed in improving the conservation status of *T. tricinctus*. We have listed below some of the most obvious suggestions that we feel have a fair probability of success.
1. At the international level, we suggest that the IUCN transfers the species from the “indeterminate” category to, at least, “vulnerable”. It is our belief, however, that *T. tricinctus* merits “endangered” status, for the following reasons: (a) this is the first report of live individuals in the least 20 years; (b) a number of intensive field studies conducted within its distribution range (Mares *et al.*, 1981; A. Langguth, pers comm.; see also Wetzel, 1981) failed to detect the species; (c) the species is endemic to the poorest region of Brazil. The population reported in this study, in spite of inhabiting a fairly remote area, is under heavy hunting pressure, which is likely to be kept constant or increase in subsequent years. Evidence (a) and (b) suggest that most other populations within the range of the distribution of the species are likely to have disappeared or fallen below critical density. Furthermore, it may be possible that the original distribution of *T. tricinctus* was more restricted or less uniform than previously suspected. The existence of only a limited number of museum specimens with known locality makes the determination of the geographical range of the species difficult (see Wetzel, 1981 for distribution map); (d) the only reserve in the region (Raso da Catarina) lacks any formal protection, and hunters use it freely. Furthermore, previous owners of the land now covered by the reserve have not yet been compensated for their properties, which makes the reserve’s future uncertain; (e) highway BR116, which is soon to be completed, will control access to the region, thus increasing hunting pressure on game species (Sick *et al.*, 1987). Furthermore, international conservation organizations should promote fund-raising to support field studies, to improve established reserves and to secure additional protected areas.

2. At the national, state and local levels, efforts should be channelled towards funding the project for the study of the biology of the species in the region. General surveys should be made in order to search for other potential populations of *T. tricinctus*, especially within the protected areas already established by IBAMA. The government agencies should try to secure better protection for the Raso da Catarina Ecological Station, and conduct or fund education and public awareness campaigns to inform local people of the presence and importance of this protected area. With its relatively large area, the Raso da Catarina Ecological Station represents an important conservation unit within the caatinga ecosystem, and may be crucial to the survival of endangered species such as Lear’s macaw *Anodorhynchus leari*, Spix’s macaw *Cyanospitta spixii* and the Brazilian three-banded armadillo.

3. With information on the general biology of *T. tricinctus*, especially diet and reproductive behaviour, funds should be made available for the development of captive-breeding programmes. Although three-banded armadillos are known to be keep in captivity, there is no information available demonstrating the impossibility of such a programme. Coimbra-Filho (1972) states that both *T. matuscus* and *T. tricinctus* were kept in captivity with good results, although no breeding was attempted. The experience of keeping *T. tricinctus* at the Federal University of Minas Gerais suggests that captive breeding may constitute a viable method of improving the conservation status of the species.

Acknowledgments

Kent Redford stimulated us in writing this note and developing a larger project. Ana Maria P. Fonseca obtained demographic and socioeconomic data on Canudos. World Wildlife Fund-US financed this work. The Fundação Biodiversitas and the Department of Zoology of the Federal University of Minas Gerais provided technical and logistical support.

References


better understanding of their diet (including seasonal variation), and also investigate the possible effects of fires on their foraging behavior (Drumond, 1992). Quantitative data were obtained on dietary items, time spent attacking each nest, and food availability, and these parameters were compared for anteaters foraging in unburnt and recently burnt areas. Censuses were carried out to investigate possible effects of burning on the anteater’s foraging. The giant anteater’s diet showed seasonal variation in prey selection, and was also evidently determined by different defense mechanisms of the ants (notably Solenopsis, Camponotus and Crematogaster) and termites (mainly Apicotermitinae, Nasutitermitinae and Termitinae) predated. The seasonal effect showed that although Shaw et al. (1985) recorded a diet of 88% ants and 12% termites during two months at the end of the wet season (February and March), at other times of the year (for example, April, August and October) termites can make up the majority of their diet. Attacks on nests and galleries were always of very short duration, very rarely lasting more than a minute.

Short term effects of fires were investigated by censuses and observations of foraging behavior in burnt and unburnt areas. They did not avoid recently burnt areas, and there was no evident difference in diet nor prey availability from that observed for intact grassland. The short term effects of, at least light, grass fires would appear to be negligible, probably due to the nests acting as refuges. The anteaters had no problem in finding refuges for themselves during a fire, in swampy areas or forest patches. The effect of fires on the termite and ant communities is undoubtedly, however, complex and significant, and one important factor is the amount of dry biomass available. One would predict that infrequent burns of a larger accumulated biomass may be more damaging than the frequent and light fires typical of most years in the Park.

The study formed part of a Master’s degree for the course in Ecology, Conservation and Wildlife Management of the Biological Sciences Institute of the Federal University of Minas Gerais (UFMG), Belo Horizonte. It was supervised by Anthony B.Rylands, Zoology Department, UFMG, supported by the Brazilian Institute for the Environment (Ibama) responsible for the administration of the Park, and financed by Conservation International (CI) - Brazil Program, Belo Horizonte; U.S.Fish and Wildlife Service, Washington, D.C., Fundação Biodiversitas, Belo Horizonte, and the Higher
Education Department (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - CAPES) of the Ministry of Education, Brazil.

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References


CONSERVATION ECOLOGY OF ARMADILLOS IN THE CHACO REGION OF ARGENTINA

Applied conservation knowledge and basic ecological research are urgently needed to establish sustainable management programs for South American threatened armadillos, particularly for the giant armadillo (Priodontes maximus). In July 1993, we started a long-term, inter-institutional project to (1) analyze population viability of species at risk in subtropical dry forests of the Argentinean Chaco, and (2) propose recommendations for reserve design accordingly. The region harbours the continent’s highest diversity of armadillos (10 species out of 20), which includes the giant armadillo and the larger pichi ciego (Chlamyphorus retusus) both listed as at risk by IUCN. In the short term, we will establish or verify the species’ conservation status. We are currently calibrating line transects of burrows and signs to perform field surveys on a geographical scale, to determine each species’ current distribution, relative abundance, and habitat use. As a result, Action Plan-like reports for armadillos will be produced. Additionally, we are estimating the impact of subsistence hunting by rural and native communities.

Preliminary results indicate that (1) the giant armadillo’s distribution is diminishing to at least 60% of its historical range in Argentina; (2) armadillo diversity by Chacoan ecoregion does not support the expected diversity according to habitat requirements previously recorded; (3) species are hunted mainly in the winter season, and (4) related to their availability rather than selectively; (5) armadillos rank first or second in the list of the most hunted wildlife species for subsistence throughout the region; and (6) quirquinchos (Tolypeutes matacus) and larger mulitas (Dasypus spp.) account for the bulk (approx. 95%) of captured armadillos.

During 1995-1997, we will monitor selected armadillo species to analyze population viability by estimating demographic (population size, reproductive success, survival rate), and genetic variables (heterozygosity, relatedness). A conservation education program will also be performed in cooperation with regional and federal wildlife management authorities, local NGOs, and the media. Some of these programs have already been initiated.

Institutions/Sponsors: National Council of Scientific Research (CONICET), Buenos Aires (Argentina); Universities of Buenos Aires, San Luis, and Salta (Argentina); Wildlife Boards: Federal (Buenos Aires) and Provincial (Santiago del Estero, Chaco, Formosa) agencies (Argentina); National Park Service (Chaco, Formosa, Buenos Aires, Argentina); State University of New York, Stony Brook (USA); The Fauna and Flora Preservation Society, London (UK).

Project personnel: Main researchers, Gustavo Zuleta (project leader) and María Luísa Bolkovic (Ph.D candidate). Institutional Address: INEUCI-CONICET, Ciudad Universitaria, Pabellón II, 4º Piso, Buenos Aires, 1428, Argentina. Tel: (54-1)
DISTRIBUTION AND CONSERVATION STATUS OF THE THREE-BANDED ARMADILLO

Ilmar Santos recently completed his thesis on the distribution and conservation status of the three banded armadillo *Tolypeutes tricinctus* in partial fulfillment of the requirements for the Master's course in Ecology, Conservation and Wildlife Management of the Federal University of Minas Gerais (UFMG), Brazil. The study was supervised by Dr Gustavo A. B. da Fonseca (UFMG). It was supported by the U. S. Fish and Wildlife Service (USFWS), World Wildlife Fund (WWF), Conservation International (CI), The John D. and Catherine T. MacArthur Foundation, and Fundação Biodiversitas.

The three-banded armadillo is endemic to the northeastern region of Brazil and is categorized as "indeterminate" by IUCN. During the study, Santos gave emphasis to the diet, home range, geographical distribution, and conservation status of the species. The field work was carried out in the period of November, 1990 to March, 1991. The food habits of the species was examined through the analysis of feces collected in the study area. The data on home range and activity patterns were obtained by radiotracking four individuals equipped with a transmitter. Information on the present geographic distribution was collected through interviews made with local people in 338 localities. With regard to the home range, the data suggest that the species uses an area comparable to that of other bigger Dasypodidae. *T. tricinctus* behaved as a nocturnal species, and its diet was composed of insects, fruits and small vertebrates. Results obtained indicate that *T. tricinctus*, formerly abundant in the surveyed region, is now found in restricted populations in regions of low human density that still have significant areas of natural habitat. Short and long term measures for protection and management of the species in its habitat and in captivity were also outlined.

Reference


**LIVRO VERMELHO DOS MAMÍFEROS BRASILEIROS AMEAÇADOS**


**WORKSHOP: PRIORITY AREAS FOR THE CONSERVATION OF THE NORTHEASTERN ATLANTIC FOREST**

Organized by Conservation International, Fundação Biodiversitas and the Sociedade Nordestina de Ecologia (SNE), the "Workshop for the Definition of Priority Areas for the Conservation of the Northeastern Atlantic Forest" was held on the Island of Itamaracá, Recife, Pernambuco, during the period of December 6th to 10th, 1993.

Experts of many areas, including mammals, birds, reptiles, amphibians, fish, invertebrates, plants and socio-economics, met to define the areas of relevant interest for the bioma’s conservation. Each expert received a set of previously compiled maps and documents, concerning the existing forest fragments, protected areas, vegetation, scientific understanding and species’ richness for the groups involved, as well as social and economic data such as demographic density, population growth and land use. Besides these data, the participants were able to use a data center set up at the workshop. Four PC compatible computers (486 DX2) were operating together with the Geographic
Information System developed by CI (CISIG) that handle the majority of the information generated. In a second phase, the various proposals were combined for the elaboration of a final map of the priority areas.

As follow up to the workshop, the magnetic format data base will be published in the near future. This will comprise basic thematic maps, applied bibliography, a technical report on the event and the data base on the species of interest for conservation.

Recent Publications

The Environmental Impact of Burrowing Animals and Animal Burrows, edited by Peter S. Meadows and Azra Meadows, 1992. Symposia of the Zoological Society of London, no. 63, 386 pages, halftones, figures, tables, Clarendon Press/ The Zoological Society of London. Hdbk £45. This volume examines the impact of burrowing animals on the environment, over a wide range of taxa paying equal attention to terrestrial and aquatic habitats. The scale and importance of animal burrowing are made clearer than ever before by the contributions to this symposium. Available from Jane Pennington, SMJ Marketing, OUP Walton Street, Oxford OX2 6DP, UK. Fax: +44-865-56767


Creative Conservation: Interactive Management of Wild and Captive Animals, edited by G. Mace, P. J. Olney, and A. Feistner, Chapman and Hall, London, November 1993, 400 pp. Hdbk c. £ 45.00 + postage £ 3.50 in UK and surface mail overseas, air mail £ 9.50. The relationship between breeding endangered species in captivity and the support needed to ensure the survival of the species in the wild is crucial to the long term success of conservation programs. This book discusses how the captive breeding community relates to work in the field, what is being done to help species and their habitats survive, and how to contribute in the future. The book is the result of the deliberations and presentations of the 6th World Conference on Breeding Endangered Species in Captivity: The Role of Zoos in Global Conservation, hosted by the Jersey Wildlife Preservation Trust, Jersey, in May 1992, and presents a full review of the biological, logistical, political and economic concerns that affect all efforts to manage populations. Future objectives are presented, and pertinent case studies illustrate the successes and frustrations encountered - a major contribution to the debate on the interactive management of threatened species. In five parts: 1) Introduction. Past progress and future challenges - R. J. Wheater; 2) General Issues; 3) Reintroduction and Captive Breeding; 4) Species Examples; 5) Regional Approaches and; 6) Concluding Remarks - G. Rabb. Available from: Antonia Sharpe, Chapman and Hall, 2-6 Boundary Row, London SE1 8HN, UK. Fax: (071) 522-9623.

Meetings


4th International Congress of Vertebrate Morphology, 31 July-4 August 1994, Chicago. Contact: Dr Susan Herring, Chair, ICVM Organizing Committee, Department of Orthodontics SM-46, University of Washington, Seattle, Washington 98195, USA, Tel: (206) 543-3203, Fax: (206) 685-8163.

Contributions

We would be most grateful if you could send us information on projects, research groups, events (congresses, symposia, and workshops), recent publications, news items or opinions of recent events and suchlike, either in the form of manuscripts (double-spaced) or in diskettes for PC compatible text-editors (MS-Word, Wordperfect, Wordstar). Articles, not exceeding six pages, can include small black-and-white photographs, figures, maps, tables and references, but please keep them to a minimum.

Please send contributions to the editors: Gustavo A. B. da Fonseca, Conservation International, Avenida Antônio Abrahão Caram 820/302, Pampulha, 31275-000 Belo Horizonte, MG, Brazil, Fax: (031)441-2582 or Yuri L. R. Leite / Ilmar B. Santos, Fundação Biodiversitas, Rua Maria Vaz de Melo, 71, Dona Clara, 31260-110 Belo Horizonte, Minas Gerais, Brazil, Fax (031)441-7037, email: cdcb@ax.apc.org.

EDENTATA is produced in collaboration with Conservation International, Av. Antônio Abrahão Caram, 820/302. Belo Horizonte, MG 31275-000 Brazil, and Fundação Biodiversitas, Rua Maria Vaz de Melo 71, Dona Clara, Belo Horizonte 31260-110, Minas Gerais, Brazil. Design and Composition: Yuri L. R. Leite and Ricardo B. Machado, Biodiversity Conservation Data Center (CDCB), Fundação Biodiversitas.