Xenarthrans in French Guiana: a brief overview of their distribution and conservation status

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Abstract Nine species of Xenarthra are found in French Guiana, a French overseas region that lies between Suriname and Amapá (Brazil) in the Guianan Shield. Most species seem to occur throughout this *ca.* 83,000 km^2 region, as deduced from distribution data extracted from a database of 470 visual or vouchered observations. *Cabassous unicinctus* and *Cyclopes didactylus* have been mostly observed in the northern part of the country, but additional field surveys are necessary before concluding that they have a restricted distribution. Five species (*Cabassous unicinctus*, *Cyclopes didactylus*, *Myrmecophaga tridactyla*, *Priodontes maximus*, and *Tamandua tetradactyla*) are fully protected by national or regional laws. Subsistence hunting is allowed for the two species of sloths, and there is no restriction on hunting *Dasypus novemcinctus* and *D. kappleri*. Documented threats include roadkills, which are rather common along the few concrete roads (*Tamandua tetradactyla* is the most common victim), and deforestation, which is fortunately still very limited at the regional scale. Few studies have been devoted to xenarthrans in French Guiana, except at the Petit-Saut hydroelectric dam, where scientists had the opportunity to handle several hundred sloths that were translocated to a non-flooded nearby area.

Keywords: *Bradypus tridactylus*, *Choloepus didactylus*, distribution, French Guiana, Xenarthra

Los xenartros en Guayana Francesa: una breve actualización de su distribución y estado de conservación

Resumen Nueve especies de xenartros se encuentran en la Guayana Francesa, una región de ultramar francesa que se ubica entre Surinam y Amapá (Brasil) en el Escudo Guayanés. La mayoría de las especies parecen encontrarse a lo largo de toda esta región (*ca.* 83.000 km^2), según se deduce de los registros de distribución extraídos de una base de datos de 470 observaciones visuales o con colecta de ejemplares. *Cabassous unicinctus* y *Cyclopes didactylus* han sido en su mayoría observados en la parte norte del país, pero estudios de campo adicionales son necesarios antes de concluir que tienen esta distribución restringida. Cinco especies (*Cabassous unicinctus*, *Cyclopes didactylus*, *Myrmecophaga tridactyla*, *Priodontes maximus* y *Tamandua tetradactyla*) están plenamente protegidos por las leyes nacionales o regionales. La caza de subsistencia está permitida para las dos especies de perezosos, y no hay ninguna restricción para la caza de *Dasypus novemcinctus* y *D. kappleri*. Las amenazas documentadas incluyen muertes por atropellamiento, que son bastante comunes a lo largo de los pocos caminos asfaltados (*Tamandua tetradactyla* es la víctima más común), y la deforestación, que afortunadamente está aún muy limitada a una escala regional. Pocos estudios se han dedicado a los xenartros en la Guayana Francesa, excepto en la represa hidroeléctrica de Petit-Saut, donde los científicos tuvieron la oportunidad de manipular varios cientos de perezosos que fueron trasladados a una zona no inundada cercana.

Palabras clave: *Bradypus tridactylus*, *Choloepus didactylus*, distribución, Guayana Francesa, Xenarthra

Basic information on French Guiana

French Guiana (officially "Département de la Guyane") is an overseas region of France, consisting of a single department located on the northern Atlantic coast of South America. French Guiana has borders with two nations: Brazil (state of Amapá) to the east and south, and Suriname to the west. Its 83,534 km² have a very low human population density of less than three inhabitants per square kilometre, with almost half of its *ca.* 230,000 people (census in January 2010: see <http://www.insee.fr/fr/themes/tableau.asp?reg_id=25&ref_id=poptc02104>) living in the urban area of Cayenne, its capital, and in the northern small cities of Saint-Laurent du Maroni, Kourou, and Saint-Georges de l'Oyapock. French Guiana is also populated by 10,000 Amerindian people, of several ethnic groups (Palikur, Wayãpi, Wayana, Kaliña, etc.), and by 22,000 Maroons, also organised in various ethnic groups (Aluku, Ndjuka, Saramaccans, etc.) (Barret, 2002).

French Guiana lies between latitudes 2º and 6º N, and longitudes 51º and 53º W. It consists of two main geographical regions: a coastal strip where the majority of the people live, and dense, near-inaccessible rainforest which gradually rises to the modest peaks of the Tumac-Humac mountains along the Brazilian frontier. French Guiana's highest peak is Bellevue de l'Inini near Maripasoula (851 m asl). Other mountains include Mont Machalou (782 m asl), Pic Coudreau (711 m asl), and Mont St Marcel (635 m asl).

French Guiana is home to many important ecosystems: tropical rainforests, coastal mangroves, savannahs, inselbergs, and several types of wetlands (Gond *et al.*, 2011). French Guiana has one of the highest levels of biodiversity in the world, in terms of both flora and fauna. This is due to the presence of old-growth forests (*i.e.*, ancient/primary forests) of various kinds from well-drained to swampy forests, which are biodiversity hotspots. The rainforests of French Guiana and neighboring regions are hypothesized to have provided shelter for many species during dry periods related to terrestrial glaciations (Anhuf *et al.*, 2006). These forests are partially protected by the Guiana Amazonian Park ("Parc Amazonien de la Guyane"), which was established in 2007 and covers some 33,900 km² in the municipalities of Camopi, Maripasoula, Papaïchton, Saint-Élie, and Saül. Additionally, six nature reserves in various parts of north and central French Guiana were established from 1992 to 2006 and cover almost 3,000 km² (**Fig. 1**).
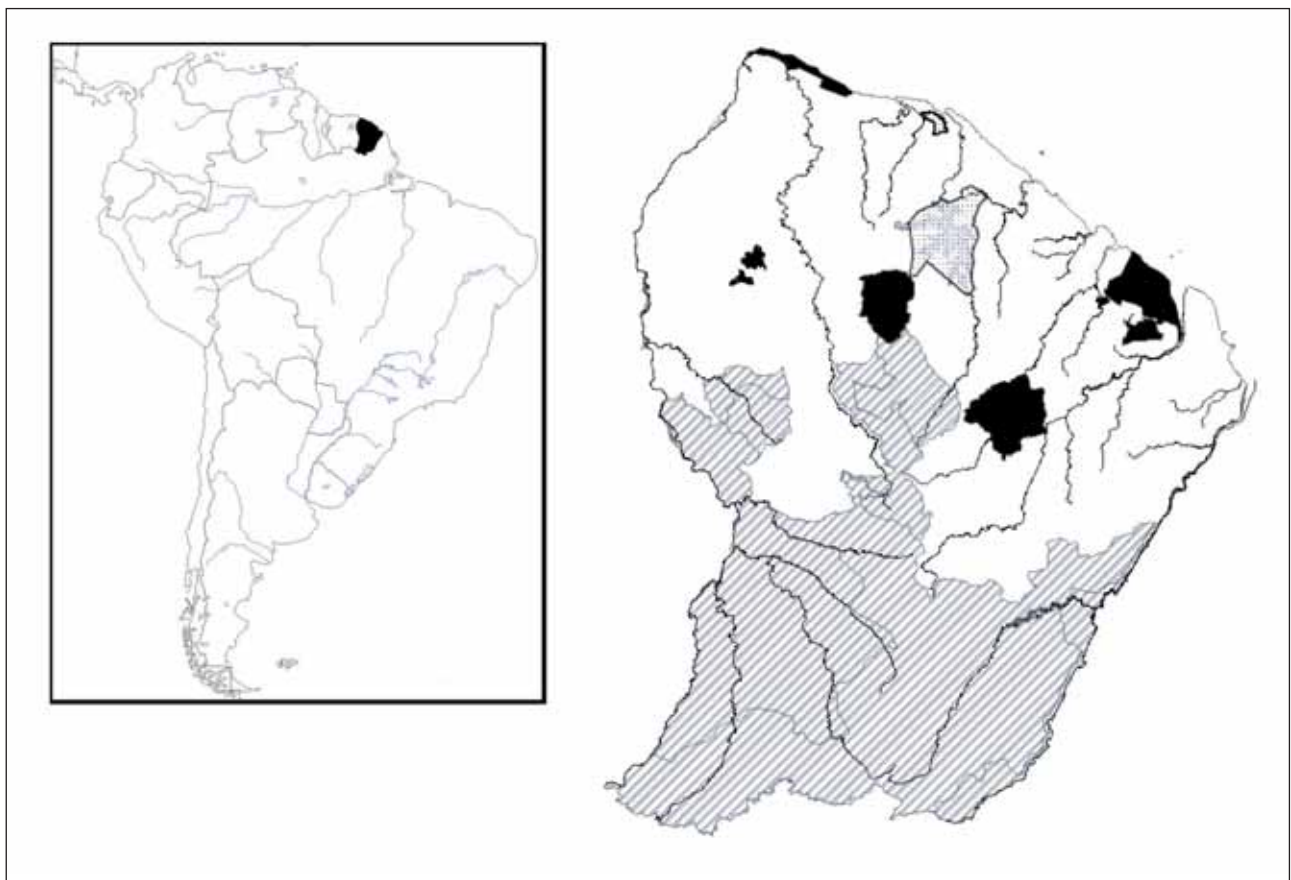

Figure 1. *Left:* map of South America with the location of French Guiana in black. *Right:* map of French Guiana with the large protected areas. In black the major natural reserves ("Reserve Naturelle"); in dashed lines the Guiana Amazonian Park ("Parc Amazonien de la Guyane"), small dots for the no-hunting area of Petit-Saut hydroelectric dam.

Species of Xenarthra present in French Guiana

French Guiana harbours nine species of xenarthrans: four armadillos, two sloths, and three anteaters (Voss *et al.*, 2001; Catzeflis, 2010), which are listed in **Table 1**. These represent 75% of the xenarthran fauna of the whole Guianan Shield, with only three additional species not found in French Guiana: *Bradypus variegatus* (in the Venezuelan states of Amazonas and Bolivar), *Dasypus sabanicola* (in Bolivar, Venezuela), and *Euphractus sexcinctus* (in southern Suriname and in Brazilian Amapá; Lim *et al.*, 2005).

Protection and legal status

Four species (*Cyclopes didactylus*, *Myrmecophaga tridactyla*, *Tamandua tetradactyla*, *Priodontes maximus*) are fully protected by national law (Ministerial Decree of 15 May 1986, updated on 24 July 2006). Similarly, *Cabassous unicinctus* is fully protected by a regional law ("Arrêté Prefectoral") since 31 January 1975. The Ministerial Decree allows hunting for subsistence but forbids any kind of trade for the two sloths (*Bradypus tridactylus*, *Choloepus didactylus*).

Hunting or any destructive action is forbidden for all xenarthran species in all nature reserves (*ca.* 3,000 km^2) and in two other designed areas covering *ca.* 400 km^2 (**Fig. 1**); hunting activities in the Guiana Amazonian Park have not yet been defined by the administration, and it is expected that hunting by non-permanent inhabitants will not be allowed in the central core (*ca.* 20,300 km^2) of the Park.

Abundance

No comprehensive population assessment has yet been done for any xenarthran in French Guiana, but there are indirect estimates of relative abundance, such as those derived from the rescue operation organized by Electricité de France, the company that built the hydroelectric dam at Petit-Saut.

Between January 1994 and July 1995, 365 km^2 of primary forest were inundated by the filling of the Petit-Saut hydroelectric dam on the Sinnamary River, during which time veterinarians and technical staff captured 3,202 non-volant mammals on dozens of islands spread over the inundated area (Vié, 1999). Mammals were caught manually by climbing trees and with various kinds of traps as well as snares, ground-nets, and noose-poles, with an emphasis on animals larger than *ca.* 0.3 kg. Captures were done opportunistically, covering *ca.* 125 km^2 in an environment of old-growth primary forests, including both well-drained and swampy forests.

Xenarthrans caught (and released in a non-flooded nearby area) during that inventory amounted to 1,251 individuals belonging to five species: 638 *Bradypus tridactylus*, 317 *Choloepus didactylus*, 188 *Dasypus novemcinctus*, 63 *Dasypus kappleri*, and 45 *Tamandua tetradactyla* (Taube *et al.*, 1999; Vié, 1999). Clearly, the three-toed sloths were the commonest species (51% of all xenarthrans), as was the case in a similar environment in Suriname during the filling of Brokopondo Lake (Walsh & Gannon, 1967). At both sites (Petit-Saut in French Guiana, Afobakka in Suriname), it appears that three-toed sloths were about twice as abundant as two-toed sloths (638 three-toed and 317 two-toed individuals in French Guiana; 2,104 and 840 in Suriname, respectively). Nine-banded armadillos seemed to be much more abundant (75% from a total of 251 *Dasypus* spp.)

TABLE 1. The nine species of xenarthrans found in French Guiana: scientific, French, and English names.

Bradypodidae & Megalonychidae	Paresseux	Sloths
Bradypus tridactylus Linné, 1758	aï, paresseux à trois doigts	pale-throated three-toed sloth
Choloepus didactylus (Linné, 1758)	unau, paresseux à deux doigts	southern two-toed sloth
Dasypodidae	Tatous	Armadillos
Cabassous unicinctus (Linné, 1758)	petit cabassou	southern naked-tailed armadillo
Dasypus kappleri Krauss, 1862	tatou de Kappler	great long-nosed armadillo
Dasypus novemcinctus Linné, 1758	tatou à neuf bandes	nine-banded long-nosed armadillo
Priodontes maximus (Kerr, 1792)	tatou géant	giant armadillo
Myrmecophagidae	Fourmiliers	Anteaters
Cyclopes didactylus (Linné, 1758)	fourmilier myrmidon, myrmidon	silky or pygmy anteater
Myrmecophaga tridactyla Linné, 1758	grand tamanoir, grand fourmilier	giant anteater
Tamandua tetradactyla (Linné, 1758)	fourmilier tamanoir, tamandua tetradactyle	collared or southern tamandua

than great long-nosed armadillos at Petit-Saut, but no comparison is possible with Brokopondo Lake because the two species were not distinguished among the 1,051 *Dasypus* spp. reported by Walsh & Gannon (1967).

Four xenarthran species were not caught at Petit-Saut dam during the 1994–1995 rescue operation: *Myrmecophaga tridactyla*, *Cyclopes didactylus*, *Priodontes maximus*, and *Cabassous unicinctus*. Three of these (*M. tridactyla*, *C. didactylus*, *C. unicinctus*) had nevertheless been recorded in the soon-to-be-flooded Sinnamary River catchment by bona-fide naturalists, but there is no record of *Priodontes* in the Petit-Saut region. Possibly, these four xenarthrans are less abundant than the remaining five species caught in the primary old-growth forests of north-central French Guiana; alternatively, they are more mobile (*Myrmecophaga*) or more cryptic (*Cabassous*, *Cyclopes*) than the others. Whereas *Cabassous* (3 individuals) and *Priodontes* (7 individuals) were rarely caught during the flooding of Brokopondo Lake in Suriname, it appears that the pigmy anteater was rather common there, as Walsh & Gannon (1967) indicate that 161 individuals were rescued.

For both sloths, a more precise study by Taube *et al*. (1999) estimated densities at 1.7 *B. tridactylus*/km² and 0.9 *Ch. didactylus*/km² for the whole flooded area (365 km²), but those densities might be much higher in some parts of the forest, in particular the marshy areas. Taube *et al*. (1999) wrote that estimated densities "can be corrected upward to 9 *B. tridactylus* and 4.5 *Ch. didactylus*/km² if we consider only the area having indeed yielded captures instead of the total flooded area."

Another indirect estimate of relative abundances can be inferred for the two sloths based on the census of mammals hunted by Wayãpi Amerindians (Ouhoud-Renoux, 1998). Two cohorts of Wayãpi hunters were studied in 1976 (29 hunters) and 1994 (14 hunters) at Trois-Sauts, an isolated locality in the south of French Guiana. During both surveys, *Bradypus* were collected and brought back to camp much more often than *Choloepus*: 34 and 18 individuals, respectively, in 1976; 17 and 3 individuals in 1994. The areas where Wayãpi hunting took place consisted mostly of old-growth terra-firme primary forests, and their surface areas were estimated by Ouhoud-Renoux (1998) as *ca.* 160 and 270 km², respectively.

Finally, in a large fragment of mature secondary forests near Cayenne, Charles-Dominique *et al*. (1981) estimated the density of *Bradypus* at 3 to 6 individuals per hectare.

THREATS: HUNTING

Few xenarthrans are hunted in French Guiana, notwithstanding the fact that five species are strictly protected (see above). A recent survey of six localities where bush meat is regularly sold at markets suggests that even unprotected xenarthrans (*Bradypus*, *Choloepus*, *Dasypus novemcinctus*, and *D. kappleri*) are a very minor component of hunted mammals. Out of a total of 1,626 specimens of hunted mammals, xenarthrans make up less than 1% (or 15 individuals) with 12 *Dasypus* spp., 1 *Choloepus*, and 2 *Bradypus* (Grenand, 2003).

THREATS: ROADKILLS

In the northern part of the country, where all of the major roads are located, automobile traffic is certainly a major threat for various xenarthrans (**FIG. 2**). These highways cross large tracks of open vegetation (savannahs, wet shrublands, agricultural landscapes) alternating with small or large patches of forests (mainly primary forests to the East, mainly secondary forests to the West). The main concrete road connects Saint-Laurent du Maroni (border with Suriname) to Saint-Georges de l'Oyapock (border with Brazil), passing by cities of Sinnamary, Kourou, Cayenne, and Regina.

According to reported observations in our database, all nine species of xenarthrans have been found as roadkills in French Guiana, but there has been no regular survey for quantifying road mortality. Certainly the most commonly found is *Tamandua tetradactyla*, which accounts for 14 out of

FIGURE 2. Roadkills are rather common along the paved roads in the northern part of French Guiana. Photograph by Sebastien Barrioz of a *Tamandua tetradactyla* along national road RN1 between Cayenne and Kourou.

30 reported xenarthran roadkills; surprisingly, the arboreal species *B. tridactylus* is second in roadkill abundance.

Threats: Deforestation

As elsewhere in the Guianan Shield and in Amazonia, deforestation is a major threat to xenarthrans, especially to sloths.

Due to low human population density, habitat loss remains rather limited and mainly occurs in the north of French Guiana. Of the 5,600 km² of natural habitats in the littoral zone, 220 km² have been converted to anthropized landscapes during the last decade (ONF, 2010), which add to an area of 300 km² currently used for agriculture and cattle ranching in the littoral zone (INSEE, 2010). Further to the south is the area dedicated to logging (9,800 km²), which is managed by the National Forest Agency (ONF). The ONF is the agency responsible for assigning logging concessions, carrying out surveillance activities, managing tract openings, controlling wood extraction, implementing low impact practices, and (recently) initiating global double ecocertification (PEFC and FSC). Consequently, illegal deforestation and habitat loss due to extensive logging is very limited in French Guiana. Further, records of xenarthrans are common in logged forests, suggesting that current practises allow the various species to persist.

Lastly, gold mining activities (Hammond *et al.*, 2007) are responsible for an annual loss of 2,000 hectares of forest habitats.

Habitat destruction and fragmentation occurred during the flooding of *ca.* 360 km² of forests for the Petit-Saut hydroelectric impoundment of the Sinnamary River. Dalecky *et al.* (2002) studied the short-term effects of forest fragmentation on the large mammal fauna, by performing censuses on five medium-sized (11–67 ha) and 33 small-sized (1–10 ha) islands during 1996 to 1999; that is, just after the flooding that occurred from January 1994 until August 1995. During 1993 and 1994 (*i.e.*, before flooding), five xenarthrans were regularly observed on three large blocks of continuous forest through various censuses: *Tamandua tetradactyla*, *Myrmecophaga tridactyla*, *Dasypus* spp. (*D. novemcinctus* and *D. kappleri* were not distinguished), *Bradypus tridactylus*, and *Choloepus didactylus*.

Dalecky *et al.* (2002) found that *Dasypus* was the most resilient taxon, as its presence after flooding was documented on 63% of the 38 surveyed islands. *Tamandua*, *Bradypus*, and *Choloepus* apparently suffered from fragmentation, as they were only found on 6, 7, and 6 islands, respectively. *Myrmecophaga* could not be observed on any island, large or small, among the 38 islands surveyed, indicating that habitat fragmentation is a major threat for the giant anteater.

Geographic distribution of xenarthrans in French Guiana

With the help of numerous naturalists and scientists living permanently or engaged in temporary fieldwork in French Guiana, we compiled a database of *ca.* 470 observations on nine xenarthran species. The database was built by collecting all bonafide observations of non-volant mammals during the years 1993–2012, amounting to *ca.* 3,700 items (as of June 2012). One should keep in mind that such a database built on a voluntary basis includes some biases, the most important being that the data just reflect the localities visited by the *ca.* 50 contributors. This probably explains two facts: i) that the number of different localities is relatively low even for the most common species; ii) that most observations are located in the northern half of the country, where access (presence of roads, tracks, large rivers) is easiest, and where most of fauna surveys have been implemented. For the purpose of quantifying localities per species in the paragraphs that follow, two adjacent sites were considered to represent distinct localities if they were at least 3 km distant from one another. For clarity, however, only those localities separated by about 10–15 km are mapped in **Fig. 3**.

Sample sizes for observations and localities vary among the nine xenarthrans, from a maximum of 98 observations for *Tamandua tetradactyla* (74 localities) to a minimum of 24 observations for *Priodontes maximus* (21 localities). Apparently, all species can be found almost everywhere in French Guiana, from the northern coastal strip to the deep south, but the following comments are hypotheses that warrant testing by additional surveys:

– *Cyclopes didactylus* (44 observations in 32 localities) is mostly found in the northern part of French Guiana, and seems particularly common along the western part of the coastal strip;

– *Myrmecophaga tridactyla* appears evenly distributed throughout French Guiana (64 observations in 56 localities), with many observations along the national roads passing through savannahs and open lands between Saint-Laurent and Cayenne;

– *Tamandua tetradactyla* has not been reported from the center-west or from the south-west, and we do not know if this result is not simply due to the lack of observers in those regions; this species is nevertheless very common elsewhere in French Guiana, with 98 observations in 74 localities;

– *Cabassous unicinctus* seems globally uncommon or extremely cryptic; the species may be
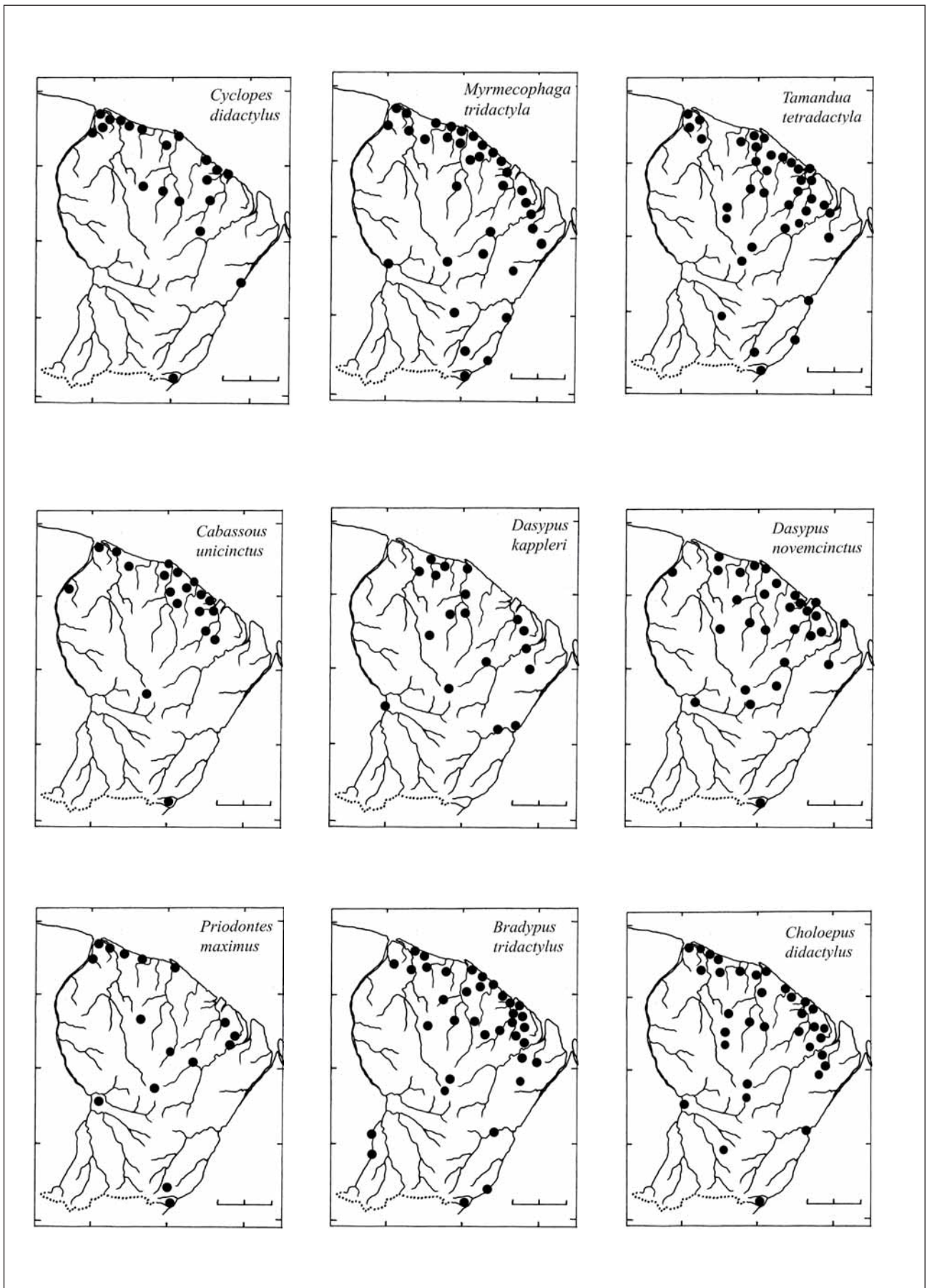
FIGURE 3. Maps of French Guiana with localities of observations for nine species of Xenarthra. The capture data from Petit-Saut have been allocated to a single locality, but they derive from a ca. 125 km² area along the Sinnamary catchment (as explained in Vié, 1999: pp. 120–122). The scale bar on the bottom right of each map represents 80 km. See text for further details.

semifossorial, seldom emerging from its shallow burrows (26 observations in 23 localities, most in the northern part of the country);

– *Dasypus kappleri* is probably distributed all over French Guiana (27 observations for 23 localities), and its apparent absence from the southern-most parts might simply reflect the rarity of surveys in those remote areas, and/or the difficulty at distinguishing the species from its congener *D. novemcinctus*;

– *Dasypus novemcinctus* is distributed all over the country, and is rather common in many places (52 observations in 47 localities);

– *Priodontes maximus* seems uncommon overall (24 observations in 21 localities) but has a wide repartition throughout the country; again, the species might be cryptic, feeding and travelling at night, with its burrows almost always located in treefalls (R.S. Voss, pers. comm.);

– *Bradypus tridactylus* is distributed all over French Guiana, with slightly more localities (73 observations for 52 localities) than the two-toed sloth;

– *Choloepus didactylus* has been observed throughout the country, and seems less common (59 observations for 45 localities) than the three-toed sloth.

Clearly, at the regional scale, all nine xenarthrans are broadly sympatric, at least in the northern half of French Guiana.

Presence in protected areas

All nine xenarthrans have been observed in the "Parc Amazonien de la Guyane" (Guiana Amazonian Park). In other protected areas, up to seven species have been observed, for example: Reserve Naturelle de la Trinité (not recorded species are *Cabassous* and *Cyclopes*), Reserve de l'Amana (both species of *Dasypus* not yet recorded). Based on the distribution maps (**Fig. 3**), we suspect that all nine xenarthrans live in most large protected areas of French Guiana.

Use (medicine, pets, trade) and local perception

Thanks to the courtesy of Pierre Grenand (pers. comm., January 2012), an ethnobiologist who has 40 years of expertise with the Wayãpi people living at Trois-Sauts (in the headwaters of the River Oyapok), the following can be reported for the relations of native Amerindians with xenarthrans:

Armadillos of the genera *Dasypus* and *Cabassous* are rarely hunted by Wayãpi, probably due to the fact that only elderly people are allowed to eat them. The giant armadillo *Priodontes* benefits from a strict culinary interdict, and consequently is never hunted. The reason invoked by Wayãpis for not consuming Dasypodidae is that armadillos eat earthworms, and that those invertebrates on their turn might have eaten cadavers. Moreover, the blood of armadillos is considered a health-risk for women of childbearing age. On the other hand, armadillos (of all species) are culturally valued for their extraordinary strength: one design of body painting alludes to armadillos, and several names of people (first name, family name) have included the wayãpi word "tatu" (tatu e'e, tatu u, and tatu tawa are the local names for *Dasypus* spp., *Priodontes*, and *Cabassous*, respectively).

The two smaller species of anteaters (*Cyclopes*, *Tamandua*) have no particular role in the Wayãpi culture; neither taxon is hunted, nor do they benefit from any particular belief. To the contrary, the giant anteater (*Myrmecophaga*) is hated by the whole Wayãpi community, who believe that giant anteaters have no magical strength and are intrinsically wicked and malevolent. As a consequence, their belief is that one should kill giant anteaters when encountered.

Sloths, in their turn, benefit from a very positive value assigned to them in Wayãpi culture. If *Bradypus tridactylus* is the commonest game sloth in numbers, the two-toed sloths are even more appreciated. Both taxa are regularly kept as pets (**Fig. 4**),

FIGURE 4. A young *Bradypus tridactylus* kept as a tamed pet by a Wayãpi Amerindian at Trois-Sauts. Photograph by François Catzeflis (November 2010).

which are patiently tamed after being adopted at a young age. Some kinds of boyhood games allude to sloths, with children clinging (entangling) to each other.

Several names of people include the Wayãpi word "aï" (aïkay and aïe'e are the local names for *Bradypus* and *Choloepus*, respectively). There is also a kind of traditional basket named aisoã in Wayãpi, which literally translates to « buttock of sloth », which serves to store cotton fluff and/or cotton fancy-work in progress (with its spindle and cotton ball).

The Wayãpi believe that, in the telluric world (or chthonian world), the regular inhabitants are giant sloths [spelled wo'o] who live and behave like humans.

Armadillos, sloths, and anteaters evoke empathy, if not fondness, from most people living in cities, and there are several children books with xenarthran stories. The main parade of Carnival, an important social gathering at Cayenne and elsewhere, had a giant armadillo prepared by a local band in February 2010 (**Fig. 5**).

Studies on xenarthrans carried out in French Guiana

During and after the flooding of the Petit-Saut hydroelectric dam, abundance, biometry, reproduction, translocation, and post-release ecology of the two sloths have been studied (Richard-Hansen & Taube, 1997; Taube *et al.*, 1999, 2001). Many innovative results were achieved, of which the most salient are:

- For the *ca.* 840 sloths caught in the inundated area, the proportion of young individuals was higher in *Choloepus* than in *Bradypus*;

- Both species are essentially solitary in their natural forest habitat, as more than 95% of sloths

were caught alone with no other conspecific in the immediate vicinity;

- In the surrounding area of primary terra-firme forest where sloths were released after translocation, radiotracking estimated the home range for *Bradypus* at between 1.4 and 3.6 ha, and for *Choloepus* at between 1.2 and 6.5 ha.

- Breeding appears to be continuous, or at least non-seasonal, in *Choloepus* whereas breeding appears to be seasonal in *Bradypus* (births occurring during the long rainy season from April to July), confirming an earlier study (Henry & Dubost, 1994).

Other studies based upon the large biological materials collected at Petit-Saut have addressed veterinary aspects, including biochemistry, hematology, and chemical immobilization (Fournier-Chambrillon *et al.*, 1997; Vogel *et al.*, 1998) and biometry aspects (Richard-Hansen *et al.*, 1999).

References

Anhuf, D., M. P. Ledru, H. Behling, F. W. Da Cruz Jr., R. C. Cordeiro, T. Van der Hammen, I. Karmann, J. A. Marengo, P. E. De Oliveira, L. Pessenda, A. Siffedine, A. L. Albuquerque, & P. L. Da Silva Dias. 2006. Paleo-environmental change in Amazonian and African rainforest during the LGM. Palaeogeography, Palaeoclimatology, Palaeoecology 239: 510–527.

Barret, J. 2002. Atlas illustré de la Guyane. Laboratoire de Cartographie de la Guyane, Cayenne. 219 pp.

Catzeflis, F. 2010. Liste des Mammifères de Guyane française. Arvicola 19: 39–44.

Charles-Dominique, P., M. Atramentowicz, M. Charles-Dominique, H. Gérard, A. Hladik, C. M. Hladik & M. F. Prévost. 1981. Les Mammifères frugivores arboricoles nocturnes d'une forêt guyanaise: inter-relations plantes-animaux. Revue Ecologie (Terre Vie) 35: 341–435.

Dalecky, A., S. Chauvet, S. Ringuet, O. Claessens, J. Judas, M. Larue & J.-F. Cosson. 2002. Large

FIGURE 5. A representation of an armadillo at the main Carnival parade in Cayenne, February 2010. Photograph by Association Natural Tribal (Cayenne).

mammals on small islands: short term effects of forest fragmentation on the large mammal fauna in French Guiana. Revue d'Ecologie (Terre et Vie) Suppl. 8: 145–164.

Fournier-Chambrillon, C., P. Fournier & J.-C. Vié. 1997. Immobilization of wild collared anteaters (*Tamandua tetradactyla*) with ketamine- and xylazine-hydrochloride combinations. Journal of Wildlife Diseases 33: 795–800.

Gond, V., V. Freycon, J. Molino, O. Brunaux, F. Ingrassia, P. Joubert, J. Pekel, M. Prevost, V. Thierron, P. Trombe & D. Sabatier. 2011. Broad-scale spatial pattern of forest landscapes types in the Guiana shield. International Journal of Applied Earth Observation and Geoinformation 13: 357–367.

Grenand, P. 2003. La chasse en Guyane aujourd'hui: vers une gestion durable? Unpublished report at IRD (Institut de Recherche pour le Développement), Orléans. 253 pp.

Hammond, D. S., V. Gond, B. de Thoisy, P.-M. Forget & B. DeDijn. 2007. Causes and consequences of a tropical forest gold rush in the Guiana Shield, South America. Ambio 36: 661–670.

Henry, O. & G. Dubost. 1994. Premiers résultats sur la saisonalité de la reproduction des mammifères guyanais. Pp. 161–166 in Gestion de l'écosystème forestier et aménagement de l'espace régional (Congrès SEPANGUY, Cayenne 1990), Cayenne.

INSEE. 2010. Tableaux Economiques Régionaux, Guyane. <http: //www.insee.fr/fr/themes/ document.asp?reg_id=25&ref_id=15938>. Downloaded 25 May 2012.

Lim, B. K., M. D. Engstrom & J. Ochoa. 2005. Mammals. Pp. 77–92 in: Checklist of the terrestrial vertebrates of the Guiana Shield (T. Hollowell & R. P. Reynolds, eds.). Bulletin of the Biological Society of Washington, Washington D.C.

ONF (Office National des Forêts), 2010. Occupation du sol et dynamique foncière: la zone littorale, 2001–2008. Unpublished report.

Ouhoud-Renoux, F. 1998. Se nourrir à Trois Sauts: Analyse diachronique de la prédation chez les Wayapi du Haut-Oyapock (Guyane française). Journal d'Agriculture Traditionnelle et de Botanique Appliquée, Revue d'Ethnobiologie 40: 181–206.

Richard-Hansen, C. & E. Taube. 1997. Note on the reproductive behavior of the three-toed sloth, *Bradypus tridactylus*, in French Guiana. Mammalia 61: 259–263.

Richard-Hansen, C., J.-C. Vié, N. Vidal & J. Kéravec. 1999. Body measurements on 40 species of mammals from French Guiana. Journal of Zoology (London) 247: 419–428.

Taube, E., J. Keravec, J.-C. Vié & J.-M. Duplantier. 2001. Reproductive biology and postnatal development in sloths, *Bradypus* and *Choloepus*: review with original data from the field (French Guiana) and from captivity. Mammal Review 31: 173–188.

Taube, E., J.-C. Vié, P. Fournier, C. Genty & J.-M. Duplantier. 1999. Distribution of two sympatric species of sloths (*Choloepus didactylus* and *Bradypus tridactylus*) along the Sinnamary River, French Guiana. Biotropica 31: 686–691.

Vié, J.-C. 1999. Wildlife rescues - The case of the Petit Saut hydroelectric dam in French Guiana. Oryx 33: 115–126.

Vogel, I., B. de Thoisy & J.-C. Vié. 1998. A comparison of injectable anesthetic combinations in wild two-toed sloths (*Choloepus didactylus*). Journal of Wildlife Diseases 34: 555–566.

Voss, R. S., D. P. Lunde & N. Simmons. 2001. The mammals of Paracou, French Guiana: A Neotropical lowland rainforest fauna. Part 2: Nonvolant species. Bulletin American Museum Natural History 263: 1–236.

Walsh J. & R. Gannon. 1967. Time is short and the water rises: Operation Gwamba: the story of the rescue of 10,000 animals from certain death in a South American rain forest. Thomas Nelson and Sons Ltd., London. 224 pp.