nocturnal and hide during the daytime in natural burrows such as old termite nests, abandoned dens of other animals, empty fallen tree trunks or between tree roots (Rahm, 1962b). As they do not dig their own burrows, they prefer living along stream beds where cavities eroded out of rocks or tree roots are more common (Kingdom, 1974). Adult animals live in small family groups of up to eight to ten individuals of different age and sex in a network of several dens and resting sites. The mean home area where different feeding spots exist is of 13.4 ha (Emmons, 1983).

Commercial use of porcupine meat

This African porcupine has few natural predators. Leopards, large raptors and snakes (*Bitis gabonica*) are among the most common (Kingdom, 1974), but man is certainly its main predator. In Central and West Africa, the brush-tailed porcupine is consumed in large quantities for its meat. In Nigeria, it is one of the most popular bushmeats together with cane rats (*Thryonomys swinderianus*). In Bendel State it accounted for 19% of the total species sold by the roadside (Martin, 1983). A questionnaire reported brush-tailed porcupine to be the preferred meat of 29% of respondents, and it is the most expensive species per unit of bushmeat sold in that area (Anadu *et al.*, 1988). In urban centres such as Kisangani (Democratic Republic of Congo), rodent meat is also one of the most important animal Orders in terms of consumption (37% of total records), with *A. africanus* representing 10% of this amount (Colyn *et al.*, 1987). In Equatorial Guinea, another survey showed that the bushmeat trade in the continental area relied heavily on the brush-tailed porcupine and the blue duiker (*Cephalophus monticola*). These two species accounted for more than a half of carcasses brought into markets (Fa *et al.*, 1995).

In Gabon, it is also the most popular and abundant of game meat species sold in the markets together with the blue duiker (*C. monticola*). It is also the most expensive meat per kilogram in many African cities (Table 1), reaching 5.5 US$ kg^{-1} in the Libreville market in 1996. According to a WWF evaluation, it accounted for 27% of the recorded game meat in Libreville (Steel, 1994). The same survey gives an estimate of at least 452 099 kg per year in urban areas that could currently generate a minimum yearly value of 2 487 412 US$. These data are certainly much lower than real consumption since only main cities were surveyed and carcasses are not always on view in markets (Table 2).

Subsistence hunting

In the old times, porcupine hunting was practised with dogs that would chase the animals out of their hide; they were then caught in nets and killed with spears. Today, these ancestral practices only remain amongst pygmies and retiring ethnic groups living in deep forest. Hunting and trapping are mainly performed with rifles, cable snares and flashlights for night hunting. The latter is more frequently carried out on moonless nights or when the weather is overcast since animals have fewer chances to see the hunter and are more easily dazzled by torchlights. This activity could have significantly increased the capture of this species which has strict nocturnal habits and is more active on moonless nights (Emmons, 1983). Indeed, porcupines are a species of choice for villagers hunting at night in Gabon. Due to its high popularity and market price, brush-tailed porcupine is more often sold as a source of income, than consumed by the hunter's family. In any case, hunting or trapping is unselective, and there is no tendency to avoid shooting immature animals or pregnant

Table 1. Prices of domestic and wild species in markets in Bendel State (Nigeria) and Libreville (Gabon)

Species	Nigeria, 1997[a] (Naira kg^{-1})	Nigeria, 1982[b] (Naira kg^{-1})	Gabón, 1996[c] (FCFA kg^{-1})
Atherurus africanus	5.50	10.00	2860
Thryonomys swinderianus	5.00	7.55	2825
Tragelaphus spp.	2.00	2.90	1000
Cephalophus spp.	4.25	4.42	1350
Cricetomys spp.	0.86	0.86	1600
Potamochoerus porcus	5.00	0.80	2000
Local beef	2.00		2000
Local pork	2.00		1600
Local lamb	2.00		2500

[a] 1 naira = 1.6 US$ (Martin, 1983).
[b] 1 naira = 1.5 US$ (Anadu *et al.*, 1988).
[c] 100 FCFA = 0.19 US$ (Jori, Pers. obs., 1996).

Table 2. Evaluation of brush-tailed porcupine commerce and consumption in some urban areas from Gabon over a 1 year period (adapted from Steel, 1993)

	Observation days	No. of records	Total per year	Kg per year (Biomass)	Value (FCFA[b])	Value (US$)
Libreville markets	89	1335	5475	16425	46 991 925.00	90 369.09
Libreville restaurants	91	146	586	1757	5 026 242.53	9665.85
Port-Gentill	6	10	608	1825	5 221 325.00	10 041.01
Oyem	18	146	2961	8882	25 410 448.33	48 866.25
Makokou	14	16	417	1251	3 580 337.14	6885.26
Reported total			10 047	30 140	86 230 278.00	165 827.46
Real consumption[a]			150 700	452 099	1 293 454 170.00	2 487 412.00

[a] Real consumption is considered to be at least 15 times greater than known commerce (Steel, 1994).
[b] Common currency in French speaking countries of West and Central Africa. Estimated value: 2860 FCFA kg^{-1}.

females. In rural areas of Northeastern Gabon, brush-tailed porcupine accounted for 11% of all game caught (Lahm, 1993). In southern Cameroon, *A. africanus* was the second most commonly killed species, representing up top 61% of the bushmeat recovered by village hunters in some areas (Muchaal and Ndjangui, 1995). Infield (1988) reported in north-east Cameroon that this species made up to 12.7% of the total catch in all the villages around Korup National Park. Together with the blue duiker (*C. monticola*) and the bay duiker (*C. dorsalis*), it made up a major proportion (62%) of total hunting and trapping off-take. In Democratic Republic of Congo, *A. africanus* together with *Cricetomys emini* accounts for more that 70% of the species captured and consumed in rural areas (Colyn *et al.* 1987). It

is therefore a favourite meat in most of the rainforest habitats of West and Central Africa. Like the cane rat in West Africa, its consumption does not seem to be associated with any taboo or prohibition (Jori *et al.*, 1995). Almost everything is consumed in this species, except the quills. Initial studies on the dressing-out percentage of *A. africanus* carcasses gave up a carcass yield of more than 65% of the total body weight (Table 3), which is higher than in most domestic and wild species (Table 1). Therefore, an adult animal can produce an average of 2000 g of meat. The Agni people, from Ivory Coast, consider that brush-tailed porcupines have magic properties and use their tail as an amulet to prevent abortions (Rahm, 1956).

Captive rearing results

Its market value, socio-cultural importance and high dressing-out percentage, make the brush-tailed porcupine a good candidate for minilivestock, to produce local animal protein and reduce hunting pressure on other more sensitive wildlife species (Blom *et al.*, 1993). Since 1994, this was one of the goals of a project funded by the French Cooperation Office and the European Union, and run by Vétérinaires Sans Frontières, together with cane rat farming activities (Jori *et al.*, 1995).

The brush-tailed porcupine is easily adapted to captivity and appears rarely affected by stress. Very few deaths have been recorded in newly captured animals. This was also observed in Ivory Coast (Rahm, 1956). Some of the offspring born in captivity appear very sociable and tame and it should be relatively easy to make up a pool of animals readily adapted to captive life. If imprinted since the first weeks of life, they readily follow man and look for human company. Captive animals have already been observed to escape from their pens and to come back after their nightwalks. In Gabon, groups of animals have bred with success in simple facilities made with local materials such as a 3 m^2 pen constructed of bricks and wire, which can hold one male and two females. A hiding place such as an empty trunk is important for the animals to feel secure. Energy requirements are not yet known, but brush-tailed porcupines can be kept on a diet consisting of readily available foodstuffs and by-products such as tubers, bread, palmnuts, peanuts and a variety of forest nuts and roots (Rahm, 1962b). Breeding groups can compose one male and one female although polygamous groups may be possible. They are easy to rear with simple facilities and they can breed well in favourable conditions (Rahm, 1956, 1962a).

An important aspect of captive rearing that needs still to be studied in more depth is the age of sexual maturity. In spite of their apparent precocity at birth, most hystricomorph

Table 3. Live weight, dressing-out percentage and price of the brush-tailed porcupine in Libreville market, Gabon in 1996 (n = 15)

Variable	Mean value ± SE
Live weight (g)	3096.6 ± 529
Dressed carcass weight (g)	2038.5 ± 475
Dressing-out percentage	65.3 ± 7.4
Price (FCFA)	8800 ± 676

1 US$ = 520 FCFA.

rodents take a long time to reach puberty (Weir, 1974). According to several authors *A. africanus* is a species that grows slowly and reaches its definitive weitght at 2 years of age (Rahm, 1962; Crandall, 1974). In our experience in Gabon, young males reached 2000 g at 6 months of age (Houben and Jori, unpubl. obs.), which is considered the adult weight (Rahm, 1962a; Emmons, 1983). Research is needed to verify those observations on a larger population sample. However, by optimizing rearing conditions with proper veterinary care and adequate nutrition, a substantial improvement can be achieved in growth rate. This has been observed in other captive reared hystricomorph rodents such as *Agouti paca* in Panamá (Smythe, 1991).

As other African rodents, the brush-tailed porcupine seems well tailored to small or landless farmers' capabilities, as the initial investment is limited. From that point of view, *A. africanus* seems to be a good candidate for minilivestock in forested areas of Africa. Species considered for minilivestock should also be characterized by a high productivity rate and thus, be able to provide important quantities of animal protein in short periods of time. Nevertheless, this is not a particular characteristic of this species.

Reproductive performances

The brush-tailed porcupine has been considered an interesting species for captive breeding since it was thought to be a polyembryonic species with a rapid growth rate similar to that of other African rodents like the cane rat (*T. swinderianus*) (Adjanohoun, 1992) or the giant rat (*Cricetomys* spp.) (Anizoba, 1982). The choice of a species for game farming is often determined by its biological parameters such as reproduction, growth, behaviour in captivity and energy requirements. Some of these factors can be manipulated in captivity but reproductive parameters have less chance of being improved in short term.

There exist few descriptions of captive breeding of this rodent species. Average lifespan in captivity is 5 years although some individuals have lived up to 15 years (Crandall, 1974). Sexually receptive females invite males to copulate by displaying a distinctive behaviour consisting of presentation of the rump and raising of the tail (Kleinman, 1974). Rahm (1962a) describes the gestation period of this animal as being 100 to 110 days. Therefore two births per female per year can be obtained and three births per female per year are possible (see Table 4). In Europe, this species has been bred with success in London Zoo since 1953 and in Antwerp Zoo (Belgium) since 1978 (Van Puijenbroek, pers. comm.) and a post partum oestrus has been observed. In Gabon, several births have been reported in private households or research projects and females can breed all year round in captivity.

Table 4. Reproductive characteristics of the brush-tailed porcupine in captivity

Reproductive characteristic	Value
Maternal Weight (g)	2500
Newborn weight (g)	150
Number of litters per year[a]	2–3
Average litter size	1
Gestation length (days)[a]	100–110

Source: Weir (1974) except [a] Rahm (1962a).