

Paca (*Agouti paca*) and Agouti (*Dasyprocta* spp.) - Minilivestock Production in the Amazonas State of Venezuela: 1. Biology

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Summary

*In response to increasing human population pressure in the Amazonas State of Venezuela greater attention is being given to the "minilivestock" production of the wild rodents paca (*Agouti paca*) and agouti (*Dasyprocta* spp.) as sources of food and income and to reduce the risk of their possible extinction.*

In preparation for the increased farming of these rodents, this paper reviews published material on their characteristics, distribution, habitat, conservation status, behaviour, reproductive parameters and nutrition.

It is concluded that the two rodents paca and agouti, have characteristics that justify greater investment in their domestication and farmed production, although and behavioural issues and reproductive limits need further research.

Résumé

Paca (*Agouti paca*) et agouti (*Dasyprocta* spp.) - Mini-élevage dans l'Etat d'Amazonas du Venezuela: 1. Biologie

*En réponse à l'augmentation de la démographie au Venezuela, une grande attention s'est portée sur le "mini-élevage". Des rongeurs sauvages comme le paca (*Agouti paca*) et l'agouti (*Dasyprocta* spp.) peuvent être utilisés comme source de nourriture et de revenu, leur risque d'extinction serait réduit.*

En vue de l'élevage intensif de ces rongeurs, cette revue bibliographique publie des données sur leurs caractéristiques, distribution, habitat, protection, comportement, leurs paramètres de reproduction et leur nutrition.

En conclusion les deux rongeurs, le paca et l'agouti, ont des caractéristiques qui justifient un plus grand investissement concernant leur domestication et leur élevage. Cependant, les problèmes comportementaux et les limites de la reproduction nécessitent une recherche plus approfondie.

Introduction

In many less developed countries ever increasing human population pressure is forcing people to use every possible indigenous food resource. In Venezuela the two forest rodents paca (*Agouti paca*) and agouti (*Dasyprocta* spp.) are examples of such indigenous food resources which are now being increasingly considered for production in captivity. The term "minilivestock", (in French *mini-élevage*) is widely used to describe the utilisation of these and other small animals (8). In some countries there is the potential to develop the traditional minilivestock "production" from hunting to some form of more conventional farming. More intensive forms of production could ease the harvesting pressure on the wild populations and represents a means of preserving wild populations facing the threat of extinction. At present wild populations represent a reservoir of future breeding material and the farmed units could represent a potential reservoir of animals for possible restocking work where minilivestock have been hunted

to extinction.

Paca and agouti are small wild rodents native to Latin America and are well known for their tasty meat, especially the paca. They are prized in many areas including the Amazonas State of Venezuela, one location where these animals are traditionally hunted. In the past hunting by the Amerindians was for home consumption but in recent years the offtake of animals has been increased in order to achieve an income from selling rodent meat in the city markets. Consequently, Venezuela is now seeing severe exploitation of the wild rodent population and the paca, in particular, is believed to be threatened with extinction in spite of the fact that hunting it is technically banned.

In preparation for domestication and increased farming of pacas and agoutis this paper reviews the biology of these rodents with particular reference to their distribution and habitat, conservation status, behaviour, reproduction and nutrition.

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Paca (*Agouti paca*) and agouti (*Dasyprocta spp.*): species characteristics

Pacas and agoutis are rodents of the infraorder *Caviomorpha* and belong to a group of animals which first appeared in South America in the fossil record of the early Oligocene (2). Rodents are a group which occupy a broad variety of ecological niches. The genera *Agouti* and *Dasyprocta* are closely related. They have been defined as the nocturnal and diurnal versions of the same animal (21). However, to hunters, pacas are the most important, probably because of the taste of their meat and high market value.

The paca

Agouti paca (Plate 1) is the second largest rodent in the world after the capybara (*Hydrochaeris hydrochaeris*) (14). In general appearance it is like a giant guinea pig: with a heavy body, short legs (130 mm for the hind legs), a naked and short tail, and weighing 6-14 kg, when mature (13). The males are about 15% larger than the females (4). The sex of pacas is difficult to distinguish externally as the external genital organs are very similar. An important secondary sexual characteristic is the extra width of the head in the male due to the growth of the zygomatic bones (10).



Plate 1

Paca (spanish, Lapa) (*Agouti paca*) in Cano Gato, Piarao village, Amazonas, Venezuela (Photo G. Govoni) [845]

Distribution and habitat

The paca is distributed throughout most of the Neotropics from east central Mexico to northern Argentina, including Cuba, where it has been relatively recently introduced (13). In Venezuela it is present over the whole country, except Margarita Island (15).

Pacas inhabit different tropical habitats but are most common in forested areas, including both deciduous woodland and rainforest. The presence of water is a constant characteristic of the paca's habitat and it is usually found near streams or rivers (13). When food sources are abundant the activity range of pacas may be very small but during the dry season, which is characterised by a general shortage of food, pacas can be encountered in other environments such as savannah, cultivated crop land or open rocky areas (2). Its range extends from the sea level to an altitude of about 1600 m (15).

Status

The paca is included in CITES Appendix III. Because of the huge geographic range of its distribution the paca is not considered an endangered species, nevertheless in many areas the wild population has been markedly reduced by severe hunting pressure and habitat modification (5, 13). Since the 1970's several countries such as Panama, El Salvador, Nicaragua, Costa Rica, Surinam, Mexico and Venezuela have included the paca among species in danger of extinction, and have tried to protect it by passing various laws aimed at controlling or eliminating hunting (3, 14).

In Venezuela, hunting of pacas has been controlled since 1967, with alternating periods of temporary and total prohibition (14). However, this approach to conservation of the paca population has not achieved any consistent results due in part to a lack of sustained enforcement of the laws (14). In fact, the hunting prohibition of a species traditionally hunted and consumed in Venezuela has generated illegal commercial hunting that supplies paca meat to the urban centres at very high prices.

Behaviour

Pacas show nocturnal activity and rest during the day in burrows, hollow trees or among rocks. It is commonly believed that pacas utilise and modify burrows dug out by other species, especially armadillos (*Dasyopus novemcinctus* and *D. kappleri*) (15). Paca burrows usually have more than one entrance that the occupants may conceal with piles of leaf litter (2).

Pacas are normally active in the early morning and late afternoon (16), although they have a mainly nocturnal habit. It is believed that pacas reduce their activity during moonlight nights but this could not be verified because hunters avoid hunting in such conditions (2). Therefore it is not clear whether unsuccessful hunting during moonlight nights, as claimed by local people, is a consequence of reduced activity by the animals or rather, is due to the easier detection of the human presence by pacas.

Although the paca is a terrestrial animal, the presence of water in the surrounding areas of its territory is a constant finding. Pacas often enter the water and show a good swimming ability. They frequently use streams or rivers as a way of escaping from danger (13).

Pacas show a strong territoriality, protecting their home range with violent fights which sometimes result in the death of one of the combatants (14). The normal total area of paca territories is not well defined but is reportedly larger than for agouti territories which are considered to be 2 - 3 hectares (16). However the area covered by pacas varies according to the availability of food, energy needs (increased during lactation) and season (dry or rain) (14).

Pacas are normally observed alone and only rarely in pairs (2, 16). Aggressiveness is one of the principal characteristics of their behaviour and it probably represents the main constraint to breeding them in captivity (11, 13). Nevertheless, pacas have been raised in captivity by creating small groups rather than couples. The problems usually arise with the introduction of new animals which alter the existing social structure (1, 14, 22). When new pacas come in contact in captivity or they perceive a threat, they exhibit pilo-erection, emit a typi-

cal bark-like sound and show teeth-chattering with grinding (1, 15).

Reproduction

Females reach sexual maturity at approximately 9 months of age, whilst for males it is around 1 year (2). In research on a wild population in Colombia pregnant females were encountered at all times of the year (2). However, a higher birth frequency was recorded in March and September in a population of 47 captive pacas studied in Costa Rica (11). In Panama, a birth peak in a wild population in March-May was reported which coincided with the beginning of the local season of fruit abundance (22).

The gestation period of pacas shows considerable variation. One report indicates a mean gestation period of 155 days with a range of 138 to 173 days (22), whilst another gives a specific figure of 146 days (13). With post-partum mating 2 parturitions per year are therefore possible.

Mating just after parturition is common (11). The existence of post-partum oestrus has been confirmed by a worker who collected 12 wild pacas simultaneously lactating and pregnant (2). Oestrus occurs again at the end of the lactation period when copulation can take place. Lactating females normally refuse approaches by males (16). Unfortunately for potential paca breeders, the oestrus cycle doesn't induce any apparent modification of the external genitalia and heat is therefore difficult for breeders to detect (11). The only useful means of identifying oestrus is by the changed behaviour of the male which is strongly attracted by the female (6). After a successful copulation a large copulatory plug (3 to 13 cm.) is formed and then expelled after 3 or 4 days. It is unusual to see this plug because it is normally eaten by the female. As a result, the only way to detect whether the animal has been mated and is potentially pregnant is to examine the vagina every day to see if the copulatory plug is in place.

Leaving the male together with the pregnant female to reduce the interbirth period can be risky. Aggressive behaviour of males resulting in the newborn being killed soon after parturition has been reported (11). The actual cause of the aggression was unknown and its occurrence was unpredictable.

The lactation period lasts roughly 3 months but offspring commonly start eating solid food after only 3 weeks of life (11). In the wild they are probably weaned at around 6 weeks (2). The newborn are precocious, with an adult appearance, opened eyes, fully furred and with erupted incisors. They are active and able to walk well within a few minutes of birth (15). Pacas usually give birth to one offspring only, although twins have been recorded (2, 11, 22).

The reproductive parameters of pacas, according to the authors cited, are summarised in Table 1.

Table 1: Reproductive parameters of the paca

Puberty	Female: 9 months	Male: 12months
Mating season	Throughout the year	
Gestation period	136 - 173 days	Mean=155 days
Birth peak	March-May and September	
Parturitions/year	1 - 2	
No. offspring	1 rarely 2	
Lactation period	1.5 - 3 months	

Adapted from: 2, 11,13, 22.

Nutrition

The paca is mainly a frugivor. Its diet consists of a great variety of fruits according to seasonal and local availability. In a study in Mexico the preferred fruits in the paca diet were closely related to seasonal abundance rather than the taste of specific fruits (7). The same feeding behaviour has been observed in Colombia where fruits were present in the diet in proportion to their seasonal availability (2). Stomach content examination, direct observation of feeding and the presence of distinctive grooves attributable to the rodent incisors have been used to identify numerous plant species eaten by pacas (2). When fruits are scarce, such as in the dry season, pacas eat leaves and roots (14, 16).

In captive conditions pacas may eat a lot of different kinds of food including rice, beans, potatoes, kitchen scraps, raw meat, insects and concentrated food (13, 14, 22). It is not completely clear what are the nutrient requirements of pacas in captivity or which deficiencies are most likely to develop under such management. In captivity they sometimes eat soil and pieces of cement scraped off the floor. It has not been clarified whether this indicates a mineral deficiency, the need to smooth incisors (6), or a behavioural response to the stress or boredom of captivity. It is recommended that leaves should always be included in the diet of captive pacas to avoid the risk of diarrhoea and to promote coprophagy, an important feeding behaviour of rodents (22). It has not been clarified whether pacas practice coprophagy or caecotrophy or both. The plants normally eaten by pacas have been reported by several workers (2, 6, 7, 12, 13, 14, 22).

The agouti

Agoutis (Plate 2) are very similar to pacas in terms of distribution, behaviour and nutrition. In this section only the features specific to agoutis are reviewed. According to shape and size, the agouti looks like a big rabbit with short ears. Its length ranges from 40 to 60 cm and when mature it weighs up to 5 kg (13).



Plate 2
Agouti (spanish, Picture) (*Dasyprocta leporina*), Piaroa vil-
lage, Amazonas, Venezuela, (Photo G. Govoni) [408]

Distribution and habitat

The agouti's distribution overlaps with that of the paca's. It is also present on many Caribbean islands where in the past it was imported to provide meat for slaves (13). The forest is the preferred habitat for the agouti, although it can also be found in different environments

including swampy areas and cultivated fields (5). The agouti is considered very adaptable and this characteristic has an important role in its survival in disturbed areas. It ranges from sea level to 2500 m of elevation (13).

Status

Agoutis are still common in their distribution range (5). However, because of environmental modifications due to forest clearing and human settlements, many areas once suitable for agoutis are not available anymore (13). As a result there is a gradual reduction in the wild populations in many countries. In some of them, such as Brazil, the agouti is a protected species, although its hunting is still illegally practised (13). Among the different species of the genus *Dasyprocta*, *D. punctata* is the only one included in CITES - Appendix III (5).

Behaviour

The agouti is a diurnal animal, particularly active in the early morning and late afternoon (5). In areas where agoutis are highly hunted they may increase their nighttime activity (4).

Agoutis often live in pairs and young may be tolerated within the parents' home range (4). However, living in pairs may only be the result of high population density when the ranges of females and males overlap (17). Males defend their territory by fighting, often inflicting severe wounds on each other (19). The delimitation of the home range is based on scent-marking utilising anal glands. Habitual trails, feeding and sleeping spots, are also marked by dragging the perineum across the place to be marked (19). Although pacas possess anal glands, they do not use olfactory communications as much as agoutis and never mark their range in the same way as agoutis (19). Anal gland secretions are strong smelling and this is considered a problem in agouti farming especially where animals are kept near houses. Furthermore the meat can be contaminated with the smell if the animals are not carefully handled (13). The strong odour and the habit of agoutis to run in circles when hunted by predators are thought to be two factors that have contributed to elimination of local populations (19). As with pacas a characteristic sound is produced by agoutis when they perceive a danger. In these cases a bark-like warning call alerts family members of the potential danger and the long rump hair is erected (4). A peculiar behaviour has been observed when the agouti is threatened; in front of a predator, such as a snake, it drums its hind feet loudly - with the aim presumably of frightening off the enemy (4, 17).

Reproduction

Like pacas, agoutis reach puberty around 9 months of age (13, 23), although pregnancy has never been observed in females less than 1 year old. However, sexual activity may start at around 6 months of age (9). Although the reproductive cycle of the agouti occurs throughout the year, specific birth peaks have been observed. Analogously to the paca birth clusters have been recorded during the season of fruit abundance (9, 24).

The oestrus cycle is 34 days (13, 23) and its detection

by humans is possible through examination of the vagina, which appears swollen and with the presence of mucus (24). During courtship the male sprays the female with urine before mating (17), as has been recorded for pacas. The gestation period is 100-120 days and twins births are usual (4, 13, 23). However, single births and triplets are also encountered (9, 17). Parturition normally occurs twice each year (13).

The offspring, just after birth, are hidden in a nest site, usually a hole in a tree or a small burrow inaccessible to potential predators and to the parents as well. The mother calls the offspring which come up from the nest to be fed twice a day (17). The offspring at birth are fully developed, furred and with opened eyes (4, 13). In a few days they can eat solid food although lactation normally lasts for about 2 months (23).

The main reproductive parameters of the agouti according to the literature cited are reported in Table 2.

Table 2
Reproductive parameters of the agouti

Puberty	Female: 6-9 months	Male 9 -12 months
Mating season	Throughout the year	
Gestation period	100-120 days	
Birth peak	March-May and December	
Parturitions/year	2	
No. offspring	1-3 usually 2	
Lactation period	2 months	

Adapted from: 9, 17, 23, 24.

Nutrition

The agouti, like the paca, is mainly a frugivore. Its diet includes a considerable variety of seeds, fruits, stalks, leaves and roots. Occasionally it also eats insects and fungi (13). Investigations with an agouti wild population on Barro Colorado Island in Panama have shown that at least 36 different species of wild fruits are eaten by the rodent. Among these *Dipteryx*, *Astrocaryum* and *Scheelea* seeds were the most common (19). Agoutis often feed on cultivated fields and damage crops and they are therefore considered as a pest in some countries. In captivity the agouti will eat a wide range of foods which favours its managed production (24).

A peculiarity of agoutis' feeding behaviour includes its ability to manipulate hard seeds with its forepaws, whilst sitting on its haunches. In this way it can gnaw through the coats of the hardest seeds, consuming fruits that are too hard for the paca (20). The agouti buries seeds in periods of abundance for future retrieval in scarcity periods. As a result, since it must bury a surplus because of uncertain retrieval, it plays an important role as a seed disperser and promoter of reforestation (4, 5, 19).

Conclusions

The wide range of foods that are eaten, and can be eaten, by pacas and agoutis favour their domestication and intensive farming as does the wide acceptability of their meat. Their gestation periods are acceptably short but their prolificacy is relatively low. Behavioural issues remain a serious constraint for large-scale production and further research on reproduction and behavioural issues is required.

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